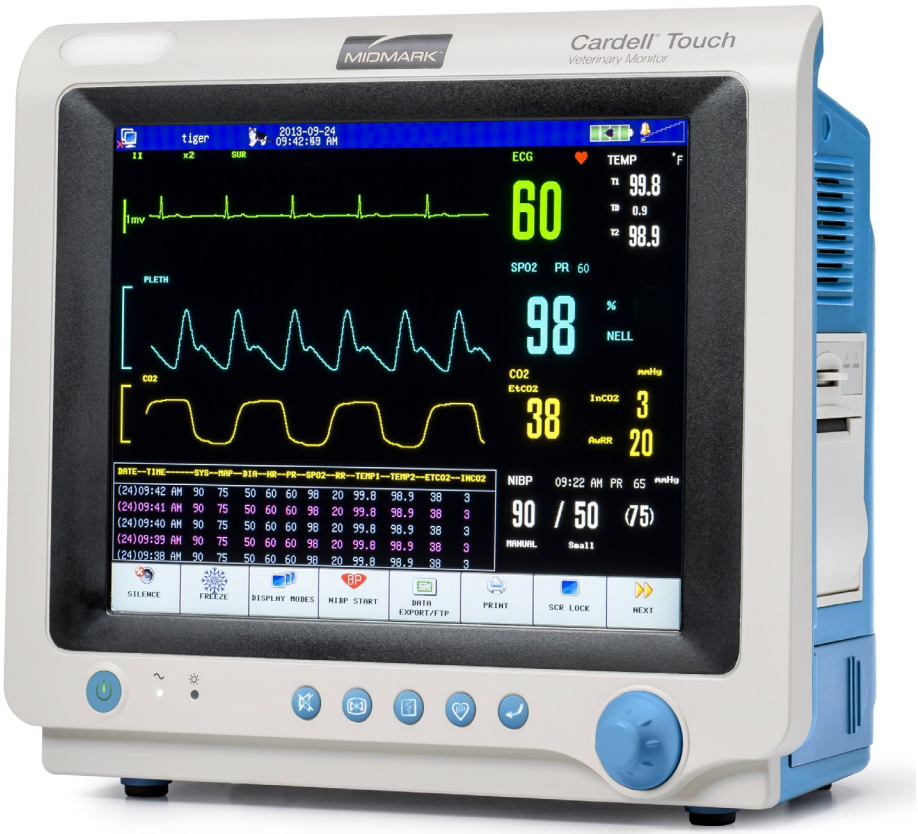
Cardell Touch Veterinary Vital Signs Monitor

For Models:

8013-001
8013-002
8013-003
8013-004



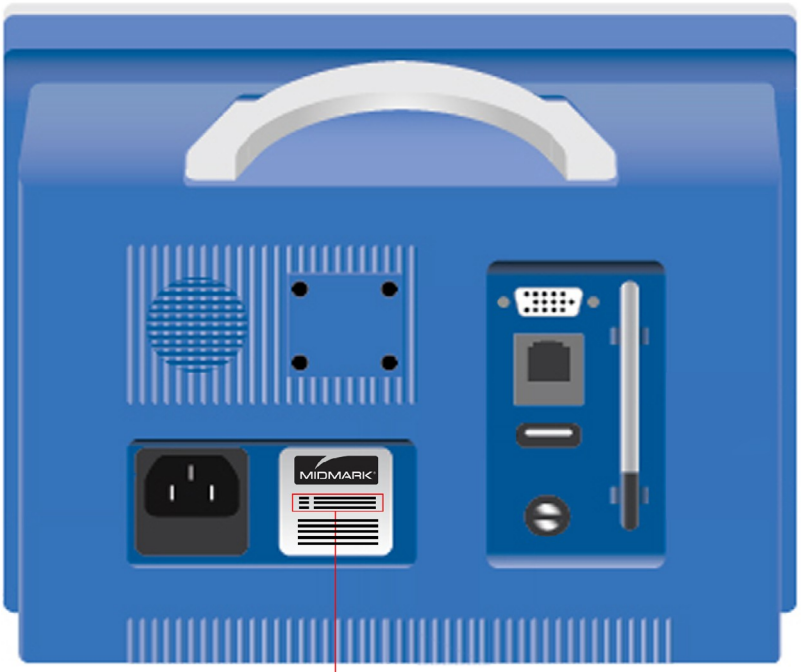
User's Guide

003-2840-00 Rev. AA4 (11/12/19)
Software Version V4.0.X

TP200 Rev. A

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

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SECTION 1 - PREFACE

1.1 General

Welcome and thank you for choosing the Cardell® Touch portable multi-parameter veterinary monitor. The Cardell® Touch continuously monitors and displays the following physiological parameters: ECG waveforms and heart rate, arterial blood oxygen saturation of arterial hemoglobin (SpO2) 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, a built in printer, and export power cords.

This Cardell® Touch can be upgraded to offer CO2 or Multi-gas monitoring at any time. With the addition of a Masimo IRMA™ Mainstream CO2 probe or ISA™ Sidestream analyzer, one can also measure end-tidal CO2 as well as inspired CO2. With the addition of the Masimo IRMA™ Mainstream multi-gas probe or ISA™ Sidestream multi-gas analyzer, one also has the ability 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 Cardell® Touch 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 9001:2008 and ISO 13485:2003 and has the certificate issued by DNV.

SECTION 2 - SAFETY

2.1 Safety Notice

2.1.1 Intended Use

The Cardell® Touch is a portable multi-parameter monitoring device for animals intended to give qualified veterinarians and technicians an efficient and accurate patient vital sign monitoring solution during veterinarian procedures.

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:	14°F (-10°C) to 104°F (40°C)
Humidity:	≤95% (non-condensing)
Atmospheric Pressure:	50kPa to 106kPa

Working Conditions	
Temperature:	41°F (5°C) to 104°F (40°C)
Humidity:	≤80% (non-condensing)
Atmospheric Pressure:	86kPa to 106kPa

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:

- The Cardell® Touch veterinary monitor is not intended to be used as an apnea monitor.
- The Cardell® Touch 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.

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.
- 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.

2.3 Safety Symbols

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

	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.
	Fuse
	Equipotentiality
	Power ON/OFF
	Alternating
	Current Earth Connector
	Caution: U.S. federal law restricts this device to sale by or on the order of a veterinarian.

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:	AC115V/230V
Rated Frequency:	50Hz/60Hz
Rated Input Power:	70VA
Fuses:	T1.6AL, 250V fuse, (2)
Battery:	14.8V 4400mAh Lithium polymer

3.1.3 Shock Protection

The Cardell® Touch multi-parameter 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

The equipotential or grounding cable may be yellow or yellow and green.

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 8. 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:

- Cardell® Touch Multiparameter Veterinary Monitor
- Battery
- Component Package

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

3.2 Before Monitoring

Before monitoring 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.

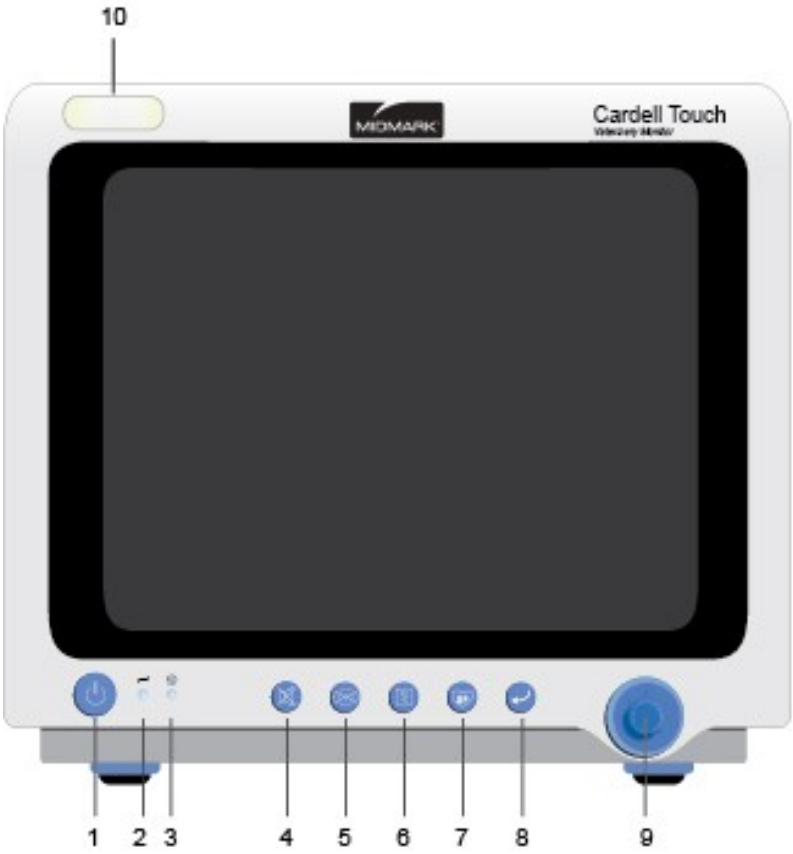
Step 2: Make sure the monitor is connected to the patient with the appropriate accessories.

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 Cardell® Touch veterinary monitor is as shown in Fig.3-1:



The Cardell® Touch veterinary 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 indicator. When the monitor is connected to the wall socket, whether the veterinary monitor is turned on or not, the indicator light will remain on.
	3.	Battery Charging Indicator: When the battery is charging, the indicator light is lit. When the battery is fully charged, the indicator light will not be lit.
	4.	Silence: Press this button to enable /disable the alarm sound.
	5.	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.
	6.	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.

	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.	Return: Press the Return Key to return to the Main Screen from any menu or submenu. If no menus are open, press the Return Key to access the Main Menu.
	9.	Knob: Rotate this knob to navigate the menus. Press the knob to confirm a selection or to enter into an editable field.
	10.	Alarm Indicator: Dual-color (red/yellow alarm indicator). This lights up whenever there is an alarm. 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. 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 Cardell® Touch veterinary monitor is as shown in Fig.3-2:

The Cardell® Touch veterinary monitor rear panel (Fig.3-2)

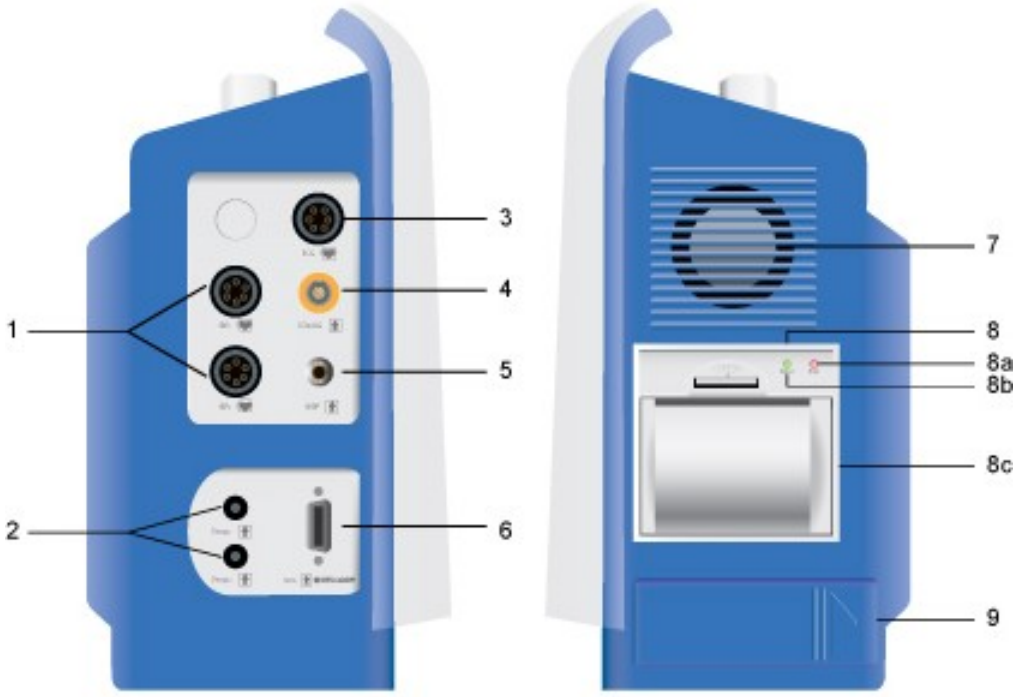
1. Speaker
2. AC Power Connector
3. Label
7. USB Port
8. Grounding (Equipotentiality) Port
9. Stylus Holder

4. Pole Mount Attachment Point
5. VGA Port
6. Ethernet Port
10. Stylus
11. Handle

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 Cardell® Touch veterinary monitor is as shown in Fig.3-3:



The Cardell® Touch veterinary monitor side panel (Fig.3-3)

1. IBP 1/2: Receptacles for IBP cables. (Optional)
2. Temperature 1/2: Receptacles for temperature probes.
3. ECG: Receptacle for ECG cable.
4. CO2 /AG: Receptacle for Mainstream or Sidestream CO2 or AG module accessories.
5. NIBP: Receptacle for NIBP inflation hose.
6. SpO2: Receptacle for SpO2 extension cable.
7. Fan (for heat dissipation)
8. Printer: Internal built in printer. (Optional)

8a. Printer: Error indicator light.
8b. Printer: Power indicator light.
8c. Printer: Paper compartment.

9. Battery 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 Cardell® Touch 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 on the front panel. The system will start a self-diagnostic test which lasts about 15 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 Cardell® Touch monitor can still work using the internal battery. Insert the battery into the monitor label up with arrows pointing in. The battery will click and lock into place when inserted completely. Improper insertion of the battery will damage the battery door. Make certain the battery is inserted completely before closing. Before use, the battery must be charged. Whenever the device is plugged into AC power, the battery will automatically be charged. The battery needs to be charged for at least 8 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 not working, 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 “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “INFO”.

The software loaded on your monitor will be listed next to “SOFTWARE VERSION”. Please refer to the proper manual for operation instructions of your Cardell® Touch monitor.

3.8 Navigation Options

3.8.1 Color TFT Touch Screen

The Cardell® Touch features a color touch screen for ease of navigation. Use your finger or the stylus and press on the screen to access menus and input data. The stylus can be stored away by snapping it into the stylus holder at the back of the monitor.

Touch Screen Quick Access Buttons: These touch screen buttons allow quick access to frequently used menus and functions.

There are 2 rows of Touch Screen Quick Access Buttons. The image below shows the first row, which is the row that appears by default when the monitor is first powered on.

First row Touch Screen Quick Access Buttons (Fig.3-4)

SILENCE	Press this button to silence the alarm. See Section 4.2 for Alarm Silence instructions and explanations.
FREEZE	Press this button to freeze the waveform on the screen for closer observation. Press the BACK button to unfreeze. Press FIRST PAGE to display the waveforms from 240 seconds prior to pressing the freeze button. Press PRE PAGE or NEXT PAGE to move backward or forward in time by 8 second increments, respectively. Press LAST PAGE to move to the 8 second period before freeze was pressed. A yellow FREEZE RECALL depicting point in time will display at the top of the screen. ***NOTE*** When printing from within the Freeze screen, the waveforms will print as frozen on the screen. However, the data values that print are real time.
DISPLAY MODES	Press this button to access the Display Modes Menu. Choose from STANDARD, HISTORICAL DATA, LARGE FONT, and DEMO mode.
NIBP START	Press this button to start taking NIBP manually. Press again to stop.
DATA EXPORT/FTP	Press this button to access the USB Data Export and FTP Remote Server functions.
PRINT	Press this button to start printing manually. Printing will automatically stop after reaching the default time set. Press again to stop printing before the default time limit is reached.
SCR LOCK	Press this button to lock the screen. This will disable the Touch Screen function. To enable the Touch Screen function again, press and hold the “SCR LOCK” button for 3 seconds. Alternatively, the user can use the knob to navigate to the “SCR LOCK” button and then press the knob to unlock the screen.
NEXT	Press this button to access the next row of Touch Screen Quick Access Buttons.

Press the “NEXT” button on the first row to access the next row.

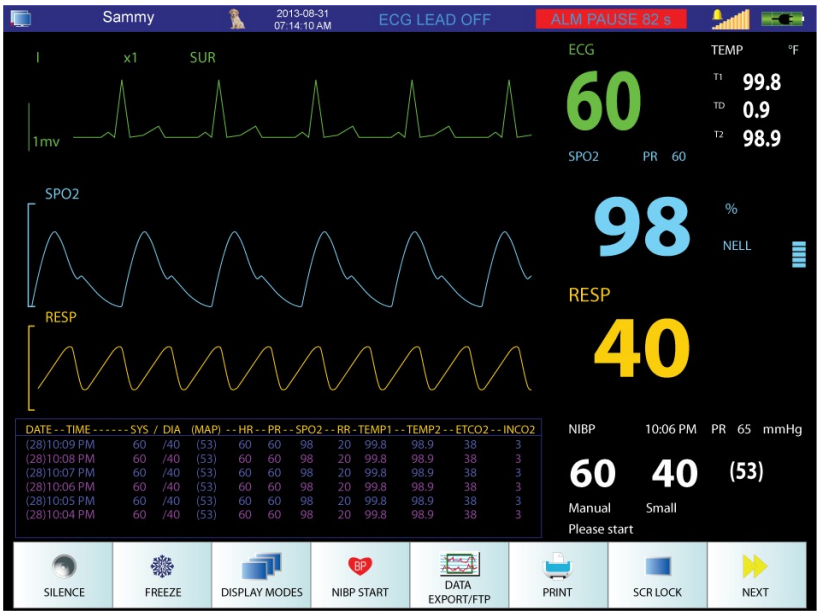
Second row Touch Screen Quick Access Buttons (Fig.3-5)

PATIENT SETUP	Press this button to access the Patient Setup Menu.
ALARM PARA SETUP	Press this button to access the Alarm Parameter Setup Menu. This menu will display all available Alarm Setup submenus for all of the parameters enabled for the monitor.
PRINT SETUP	Press this button to access the Printer Setup Menu.
SUSPEND	Press this button to stop all alarms and recordings until it is pressed again. Intended to be used while entering new patient information and attaching them to the monitor.
MAIN MENU	Press this button to access the Main Menu. Main Menu includes some of the Touch Screen Quick Access Button menus as well as other menus not found among the Touch Screen Quick Access Buttons.
TREND	Press this button to access the Trend Graph and Trend Table functions.
PREV.	Press this button to access the previous row of Touch Screen Quick Access Buttons.

Press “PREV.” on the second row to return to first row.

3.9 Display Screen

3.9.1 Main Screen Display

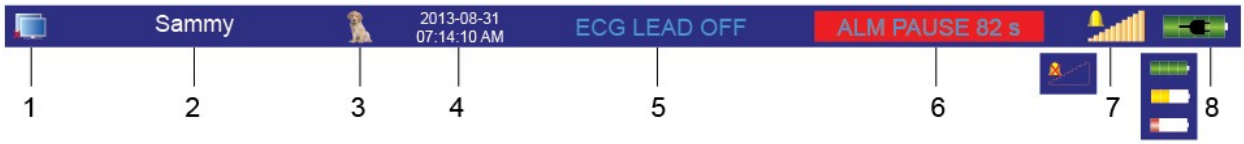


Main Screen Display (Fig.3-7)

Fig.3-7 above displays the Main Screen Display the user will see after turning on the monitor. The following standard parameters are displayed on the Main Screen Display: ECG, SpO2, and RESP waveforms; ECG HR, Temperature, SpO2 %, SpO2 Pulse Rate, RESP, and NIBP data. At the bottom of the Main Screen Display, the Mini Historical Data section displays the following data: Date, Time, SYS, DIA, MAP, HR, PR, SpO2, RR, TEMP1, TEMP2, ETCO2, and INCO2 when NIBP is displayed. The Mini Historical Data section is only visible when 3 or less waveforms are displayed.

> ***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.*

3.9.2 Status Bar



Main Screen Status Bar (Fig.3-8)

The Status Bar is located at the very top of the Main Screen. The Status Bar provides the following information: Network Setting Status, Patient Information, Date and Time, Alarm Messages, Battery Power Status, Battery Charging Status, and Sound Settings. Press on the different icon/section within the Status Bar to access the menu related to that icon/section.

1. This icon displays the Network Setting Status for the monitor. Pressing the screen in this area will open up the menu for Network Settings.

2. This area displays the patient name. Pressing the screen in this area will open up the Patient Setup menu.

3. This area displays the patient species in picture format. The only species available for display in picture format are cats, dogs, and horses. If “Other” is chosen, no picture will be displayed. To change species, press the area associated with the patient name (No. 2 in Fig.3-8 above).

4. This area displays the date in YYYY-MM-DD format and time in HH:MM:SS format. Pressing the screen in this area will open the Date/Time Setup menu.

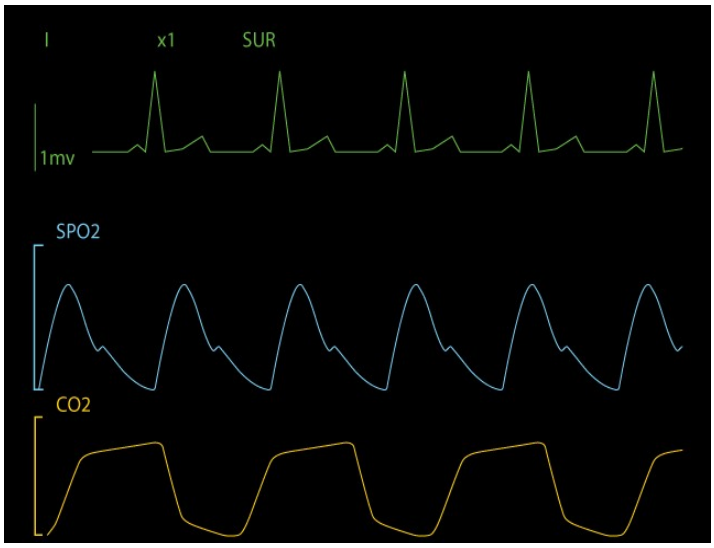
5. This area displays technical alarm messages. If multiple alarm events are occurring simultaneously, this area will rotate through all alarm event messages.

6. This area displays physiological alarm messages. If multiple alarm events are occurring simultaneously, this area will rotate through all alarm event messages.

7. This area displays the alarm volume in 10 increments. The monitor is loudest when all 10 bar increments are lit. The bell icon above the alarm volume bar increments displays sound status. An “X” will appear over the bell icon whenever alarms are silenced. Pressing the screen in this area will open up the Sound Setup menu.

8. This area displays the charge status of the battery as well as AC connection status. The more green segments present within the battery icon, the more power is in the battery. A plug icon will be displayed within the battery icon whenever the monitor is connected to AC power.

3.9.3 Waveform Area



Main Screen Waveform Area (Fig.3-9)

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 (I), RA-LL (II)
- CO2
- IBP: ART1, ART2, PA, CVP, AO, RA, ICP, FA
- AG: CO2, N2O, ISO, DES, HAL, ENF, SEV

3.9.4 Parameter Box

Main Screen Parameter Box (Fig.3-10)

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, 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 Knob can also be used to access all the available options shown on the Main Screen Display. Rotate the Knob to navigate to the desired selection and press the Knob to confirm the selection and access the selected setup menu.

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: Emergency (High) (2 sets of 5 beeps every 5-10 seconds with continuous red flashing visual alarm), Medium: (3 beeps every 10 seconds with yellow flashing visual alarm) and Warning (Low) (1 beep every 10 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:

- LEAD OFF
- PROBE OFF
- SENSOR OFF
- AIR LEAKAGE
- OVER PRESSURE

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

When sensors are unplugged, the screen will display “NO SENSOR”. When probes are not connected to a patient, the screen will display “PROBE 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 Sound ON/OFF and Alarm Level (which will change the tone alarm) may be adjusted within the setup menu of each individual parameter.

4.2 Alarm Silence

To silence the alarm for a pre-determined amount of time, press the Silence Button on the front panel of the veterinary monitor or press the Touch Screen Quick Access Button shown below.

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

To end the silence timer or ALM PAUSE TIME before the pre-determined time frame has elapsed, press the Silence Button or the Touch Screen Quick Access Silence Button again. The alarm will also resume normal alarm functions when the pre-determined alarm silence period expires.

The default ALM PAUSE TIME is 120 seconds.

The ALM PAUSE TIME can be changed by accessing the Alarm Setup Menu as described in Section 4.3.1 below.

Step 1: In the Alarm Setup Menu, selected the ALM PAUSE TIME. This will allow you to choose between Forever, 1min, 2min, 3min, 5min, or 10min.

When the alarm is silenced using the Silence 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.

WARNING
New technical alarms, such as leads off, as well as new physiological alarms, such as exceeding upper limits, will cancel the silence feature. The Asystole and Respiration Apnea alarms cannot be silenced in this manner.

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 Setup

4.3.1 Alarm Setup Menu

Using the Touch Screen or the Knob, follow the steps below to access the Alarm Setup Menu:

Step 1: Select the “MAIN MENU” Touch Screen Quick Access Button.

Step 2: Select the “MONITOR SETUP” Touch Screen Button.

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

Alarm Setup Menu Options:

ALM REC TIME	ALM REC TIME is used for Alarm Triggered Printing. Alarm Record Time can be set up to record 4s, 8s, or 16s during an alarm event.
ALM PAUSE TIME	Alarm pause time is the setting used for the Alarm Silence feature. The Alarm Silence Period can be set to Forever, 1Min, 2Min, 3Min, 5Min, or 10Min.
ALM LIMIT DISPLAY	Turning the ALM LIMIT DISPLAY on will display the upper and lower limits of each parameter next to their parameter values within the Main Screen Parameter Box. User can set this to Off or On.
ALM LATER	ALM LATER allows the user to delay alarms. The user can set this to Disabled, 5s, 10s, 15s, and 20s. 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.

4.3.2 Alarm Parameter Setup Menu

Alarm limits include upper and lower limits that are user adjustable. All parameter limits are available within this menu on the Cardell® Touch veterinary monitor.

Accessing the Alarm Parameter Setup Menu using the Touch Screen or the Knob:

Step 1: Select the “NEXT” Touch Screen Quick Access Button.

Step 2: Select the “ALARM PARA SETUP” Touch Screen Quick Access Button.

Step 3: Select the alarm limits to be adjusted. The following parameter alarm limits are available: ECG, SpO2, Temp1, Temp2, Respiration, IBP1, IBP2, NIBP, Multi-gas, and CO2. Make sure to press the name of the parameter to access the parameter menu (ex.

ECG, TEMP…etc.).

Changing Alarm Limits through the Alarm Parameter Setup Menu:

Step 1: Once inside the Alarm Parameter 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: Press on the upper or lower limit buttons to display a number pad. The default limit number will be displayed initially.

Step 3: Use the "Clear" button to delete the current number and then enter the new number using the number pad.

Step 4: Press the "Enter" button on the number pad once the new number has been entered. This will return the user to the setup menu for that specific parameter. Press the "X" button on the upper right corner to exit the menu. The changes will not be applied without completing the steps below.

Step 5: Press the "Enter" button at the bottom of the Alarm Setup menu to apply the changes and exit.

NOTE
The user can make changes to all the parameters before pressing the "Enter" button located on the bottom right of the Alarm Parameter Setup Menu to apply them.

NOTE
It is very important to press the "Enter" button on number pad menu and the Alarm Setup Menu in order to apply the changes.

Changing Alarm Limits through the Waveform Area:

Press on any waveform within the Waveform Area to access the menu for that particular parameter. Within this menu, the user may also set the upper and lower limits associated to that particular parameter.

Changing Alarm Limits through the Parameter Box:

Press on any data within the Parameter Box to access the menu for that particular parameter. Within this menu, the user may also set the upper and lower limits associated to that particular parameter.

4.3.3 Current and Custom Alarm Settings

There are four total alarm setting accounts available within the Alarm Parameter Setup Menu: Current, User 1, User 2, and User 3. The monitor will come with factory default settings within the Alarm Parameter Setup Menu. When the user first enters the Alarm Parameter 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: Follow the instructions in Section 4.3.2 (Changing Alarm Limits through the Alarm Parameter Setup Menu) to setup all the parameter settings. Make sure to press "Enter" on the Alarm Parameter Setup Menu when all the settings have been entered. This will exit the user from the menu into the Main Screen.

Step 2: Go back into the Alarm Parameter Setup Menu. Check to make sure the parameter settings are as desired.

Step 3: Press the SAVE AS button on the bottom of the menu. This will open the Save As Menu.

Step 4: Choose which account you would like to save this setup in. For this example, we will choose User 1. Press User 1 to display the onscreen key board.

Step 5: Type in the name you wish to use. For example: Cat, Dog, Dr. Smith, Small Surgery…etc. Press enter to apply the name. This will take you back into the Save As Menu. Close the box to return to the Alarm Parameter Settings Menu. The new user name is displayed on the top of the screen next to Alarm Setting Name.

Step 6: Enter the Alarm Parameter Setup menu. Press the "Alarm Setting Name" button. This will display the Alarm Setting Name menu. Choose the user account you would like to use. A pop up window will display the following alert message:

Select YES to return to the USER 1 configuration. The current configuration will be lost!

Step 7: Select YES to load the configuration. The warning message will always display USER 1, USER 2, or USER 3. However, once loaded, the Alarm Parameter Setup menu will show the name the user has entered for this account.

Step 8: Press the ENTER button at the bottom of the menu to apply the changes and exit.

4.3.4 Changes Made to Custom Alarm Settings

> ***CAUTION***
> *It is recommended that before using the monitor on a patient, the desired Alarm Parameter Setting Account is re-loaded onto the monitor using the steps described in Section 4.3.3.*

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.

In order to save an alarm parameter setting change, the user must do a SAVE AS for the intended user and “Enter” on the User menu, and “Enter” on the Save As menu. In order for those changes to also save to the “Current” user, the user must also press “Enter” on the Alarm Setup menu. If a user makes a change to alarm settings outside of the Alarm Parameter Setup Menu, an asterisk (*) will appear next to the Alarm Setting Name. In order for the revised data to be saved as part of that user’s alarm settings, the user must enter the Alarm Parameter Setup Menu, and then enter the user Alarm Setting Name menu to select the Current * user, close out of that menu with the X , select Save As the user if you want those user settings to save and then choose Enter from the Alarm Parameter Setup Menu.

4.3.5 Alarm Volume and Sound Setup

Sound Setup Menu

Press the sound icon  located on the Status Bar to access the Sound Setup Menu.

Select from Sound Setup Menu options below:

ALARM VOL	Choose from Off, 1-10, 10 being the loudest. If ALARM VOL is set to Off, there will not be any audio alarms for either the physiological or technical alarms. However, the visual alarms will still be active.
HR BEAT VOL	Choose from Off, 1-10, 10 being the loudest.
PR BEAT VOL	Choose from Off, 1-10, 10 being the loudest.
KNOB VOL	Choose from Off, 1-10, 10 being the loudest.
TOUCH SOUND	On or Off

Parameter Alarm Sound ON/OFF

The user may choose to turn the alarm sound On or Off for each particular parameter. For this example, we will use the ECG Alarm Sound feature.

To turn the alarm sound off for the ECG function, follow the steps below:

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

Step 2: Select “ALM SOUND”. Choose Off. The physiological out of range audio alarms for the ECG parameter will no longer sound. Alarms relating to the detection of a heart beat (Asystole) will continue to sound, until the Silence Button is pressed .

Repeat Steps 1 – 2 above to set up the ALM SOUND option for each individual parameter.

4.3.6 Default Alarm Limit

The Cardell® Touch includes default alarm limits recommended by members of the American College of Veterinary Anesthesia for general veterinary practice.

Using the Touch Screen or the Knob, follow the steps below to return to the factory alarm setting, i.e., default alarm limits:

Step 1: Select the “NEXT” Touch Screen Quick Access Button.

Step 2: Select the “ALARM PARA SETUP” Touch Screen Quick Access Button.

Step 3: Select the “Alarm Setting Name” Touch Screen Button.

Step 4: Select the “RESTORE DEFAULT” Touch Screen Button.

Step 5: A pop up box will appearing warning the user that the current configuration will be lost if they continue.

Step 6: Select “Yes” to return to the default configuration! The current configuration will be lost!

There are 4 default category of animal sizes to choose from: Cat, Dog, Horse, and Other. The following default alarm limits were set in the factory before delivery for each 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 Parameter Display

The waveform display of each parameter can be changed by pressing on the waveform. This will open the selected waveform's Setup menu. Use the down arrows to scroll through the parameter setup menus. The user may change the Sweep speed, Wave Type, and Wave Color of the waveform.

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

Wave Type is the option to show the waveform in Line or Fill. Fill will make the underside of the waveform solid. This option is not available for ECG or Multi-gas waveforms.

Wave Color is the option to change the color of the waveform to Green, Cyan, Red, Yellow, White, Blue, or Purple. Display Color is also an option for parameters without a waveform.

5.1.2 Display Mode Setup

By default, the Standard Display Mode is chosen. Another display mode may be selected by accessing the Display Modes Menu.

Press the Display Modes Touch Screen Quick Access Button. Select from Standard, Historical Data, Large Font, AG Screen (if AG module is ON) or Demo modes. The Knob can also be used to navigate to the "DISPLAY MODES" Touch Screen Quick Access Button.

5.2 Historical Data Mode

Follow the steps below to enter Historical Data Mode using the Touch Screen Quick Access Buttons:

Step 1: Select the "DISPLAY MODES" Touch Screen Quick Access Button.

Step 2: Select "Historical Data".

Historical Data Mode may be used to review numerical data for the patient. The information is displayed in table format, including the following: Date, Time, SYS, DIA, MAP, HR, PR, SpO2, RR, Temp1, Temp2, Et CO2, In CO2, IBP1, and IBP2.

The system stores up to 2000 sets of history data. The Historical Data screen can display 20 sets of data per page. On the bottom of the screen, there is a set of Touch Screen Buttons that will allow the user to navigate through the Historical Data screen. As always, the Knob can also be used to navigate to these Touch Screen Buttons.

Historical Data will automatically clear itself when clearing patient data. The user may restart the monitor and still retain historical data.

5.3 Large Font Mode

Follow the steps below to enter Large Font Mode using the Touch Screen Quick Access Buttons:

Step 1: Select the "DISPLAY MODES" Touch Screen Quick Access Button.

Step 2: Select "Large Font".

Large Font Mode may be used when observing the screen from a long distance. The Large Font Mode is only visible when 3 or less waveforms are displayed. Large Font Mode will display IBP and AG data values but not IBP or AG waveforms.

5.4 AG Screen Mode

Follow the steps in 12.2.5 to turn on the Multi-gas Screen Display

5.5 Demo Mode

For the purpose of training, the Cardell® Touch provides a Demo Mode function.

CAUTION
Never attempt to use the Demo Mode while monitoring patients.

Follow the steps below to enter the Demo Mode:

Step 1: Press the “DISPLAY MODES” Touch Screen Quick Access Button.

Step 2: Press “Demo” to bring up the password dialogue box for Demo Mode.

Step 3: Use the key pad to input “5188” and press “Enter”.

To confirm that the monitor is in Demo Mode, the word “DEMO” should be displayed at the top of the Waveform Area in yellow.

To exit Demo Mode, simply press the “DISPLAY MODES” Touch Screen Quick Access Button and then press “Exit Demo”.

5.6 Trend Display

5.6.1 Displaying Trend Graph

Follow the steps below to enter the Trend Graph Screen:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

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

Step 3: Press “Trend Graph”.

Trend Display Buttons:

PARAM:	Use the Parameter button on the bottom left corner to choose the parameter to observe. The user may choose from: HR, RR, SpO2, PR, Temp, NIBP, IBP1, IBP2, CO2, InCO2, or AwRR.
RES.:	Use the resolution button to set the resolution for moving the cursor on the graph. Choose from 1s, 5s, 1Min, 5Min, or 10Min.
TIME AXIS	Select the Time Axis to move the range. When Time Axis is selected, use the arrows located below this button to move the X-axis forward in time or backwards in time.
CURSOR	The cursor is a little arrow that is on the very top of the trend graph. When the Cursor is selected, use the arrows located below this button to move the cursor along the X-axis. The date / time stamp on the top of the graph will change depending on where the cursor is pointing to.
Left and Right Arrows	These buttons are used in conjunction with the Time Axis button and the Cursor button to navigate across the X-axis.
Up and Down Arrows	These buttons are found to the right of the trend graph and is used to navigate across the Y-axis.

5.6.2 Displaying Trend Table

Follow the steps below to enter the Trend Table Screen:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

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

Step 3: Press “Trend Table”.

The Trend Table will display the following parameters: AG ETAA. AG FIAA, AG ETN2O, AG FIN2O, AG ETCO2, AG FICO2, AG AWRR, ETCO2, INCO2, AWRR, IBP2, IBP1, NIBP, SpO2, PR, T1, T2, TD, and RR. NOTE: AG data will not display if AG module is OFF.

Trend Table Buttons:

RES.:	Use the resolution button to set the resolution for the graph. Choose from 1Min, 5Min, 10Min, 30Min, or 60Min.
Left and Right Arrows	These buttons are found on the top of the table and is used to navigate to different parameters.

Up and Down Arrows	These buttons are found on the bottom of the table and is used to navigate through the time range displayed on the left side of the table for each parameter.

5.6.3 Deleting Trend Information

To delete the trend information, the user may press Clear Patient Data within the Patient Setup Menu, or restart the monitor.

> ***CAUTION***
> *All trend information and historical data is erased when clearing patient data. All trend information is also erased any time the monitor is turned off. Historical data is retained when the monitor is turned off.*

5.7 Monitor Video Output

The Cardell® Touch provides a VGA (15-pin) output for mirrored display on a computer monitor. For best results, please use a VGA-to-VGA cable and follow the computer monitor's instructions for selecting signal source.

> ***NOTE***
> *Some computer monitors will flash a warning box to ask the user to adjust the refresh rate on the Touch. This is not needed. Ignore the warning and continue using the monitor.*

5.8 Export Trend and ECG Data

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

Step 1: Make sure your USB device is plugged in.

Step 2: Press the "DATA EXPORT/FTP" Touch Screen Quick Access Button.

Step 3: Press "USB DATA EXPORT". The button will highlight and start export. An Exporting In Progress message will appear in the Main Screen Status Bar. Once export has been successful, a message will be displayed: "File export success".

Two excel files will be exported and placed onto the USB device under a folder named CARDELL_DATA_EXPORT. One file will contain up to 24 hours of Trend information. The other file will contain the last 12 minutes of ECG waveform information. Only data from Lead II will be exported. The file name format is as shown below:

Patient name-Trend-Year-MonthDay-HoursMinutesSeconds

Patient name-ECG-Year-MonthDay-HoursMinutesSeconds

For example:

Fluffy-Trend-2014-0318-171838

Fluffy-ECG-2014-0318-171838

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

> ***NOTE***
> *Only data from Lead II will be exported regardless of Lead viewed on screen.*

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 exporting of data is used frequently, please keep the USB storage device plugged into the monitor at all times. Since all data stored on the monitor is purged when power is lost or the monitor is turned off, be sure to download the case data before powering down or if running on battery power and a low-battery status message appears.

5.9 Cardell® Touch Visualizer Tool

The Cardell® Touch comes with a USB device preloaded with the Cardell® Touch Visualizer Tool. This tool will take the exported ECG data and map it into a waveform for easy reference. This tool requires Microsoft Excel 2007, 2010, 2013, or 2016 to work.

NOTE
The Cardell® Touch Visualizer Tool is for use with the ECG data export only. It is not meant to be used with the Trend data export. Please do not load the Trend data into the visualizer.

5.9.1 Importing ECG Data into the Visualizer

To import ECG data into the visualizer, follow the steps below:

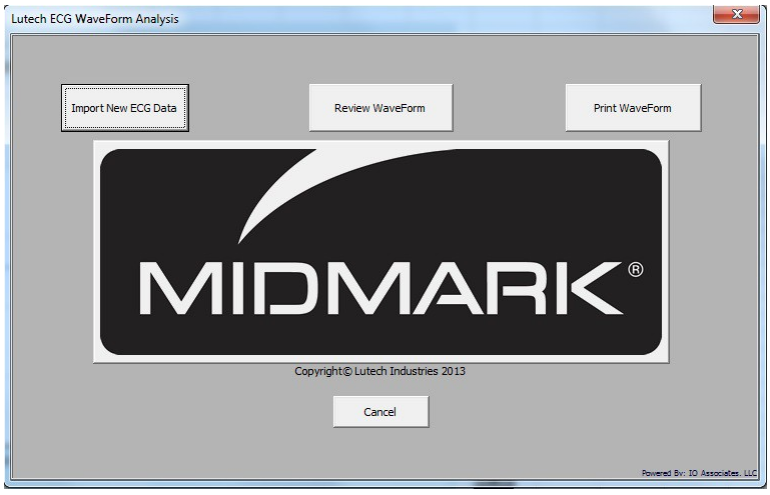
Step 1: Connect the USB device to your computer.

Step 2: Copy the Cardell® Touch Visualizer Tool onto the computer. You only need to do this once.

Step 3: Copy the exported data onto the computer.

Step 4: Double click on the Cardell® Touch Visualizer Tool to open it. If a warning pops up for the macro embedded within the program, please see the Section 5.9.5 on Cardell® Touch Visualizer Troubleshooting.

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



Step 6: Click on the “Import New ECG Data” button. Navigate to the ECG excel file exported from the monitor (see 5.8) and click “Open”.

Step 7: Once the data has been imported, the Start Menu will pop up again. Click on the Review Waveform button. This will close the Start Menu and allow the user to look over the waveform.

5.9.2 Visualizer Data Tabs

The visualizer will look like an excel document. There are 4 worksheet tabs on the bottom.

ECGData	This worksheet stores the ECG Data that was imported. The user does not need to use this worksheet.
NewECGData	This worksheet interprets the ECG data that was imported. The user does not need to use this worksheet.

ECGWave	This worksheet is where the ECG data will be displayed as a waveform. Please see below for a more detailed explanation.
ECGPrintCharts	This worksheet stores the most recently printed waveforms with the exception of current view (print).

5.9.3 Reviewing Waveforms

1.	Menu Button. Allows user to import new ECG data, review ECG data or print ECG data.
2.	Waveform Information. Includes date of export, patient name, patient number, client name, species, ECG lead used, and ECG gain used.
3.	ECG mV
4.	ECG waveform interpreted from the imported data.
5.	Time of data point.
6.	Time frame scroll bar. The ECG visualizer will interpret up to 12 minutes of ECG data. However, this is not enough space on the screen to show all 12 minutes at the same time. Move the scroll bar left and right to show different ranges of time within the 12 minutes.
7.	Sweep speed scroll bar. Click on the arrow keys on the top or bottom of the scroll bar to display the ECG waveform at 25mm/sec, 30mm/sec, 50mm/sec or 100mm/sec, which will be displayed under the waveform. The user may also move the scroll bar with the mouse to increase or decrease the sweep speed outside of the preset sweep speeds noted above. Using this method, a “CUSTOM” message will be displayed under the waveform.

5.9.4 Printing Waveforms

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

Step 1: Click on the “Menu” button.

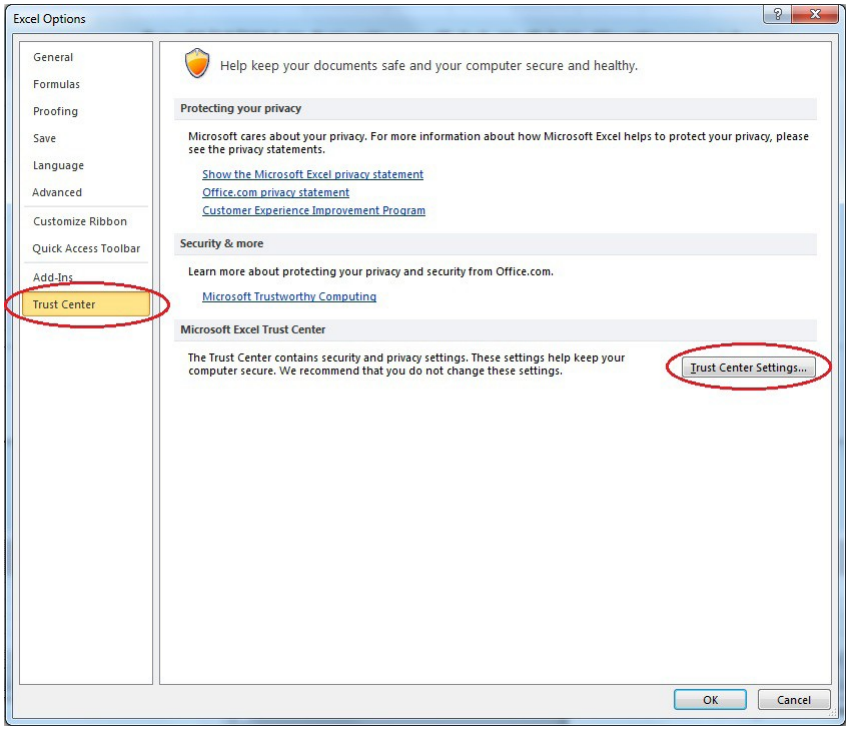
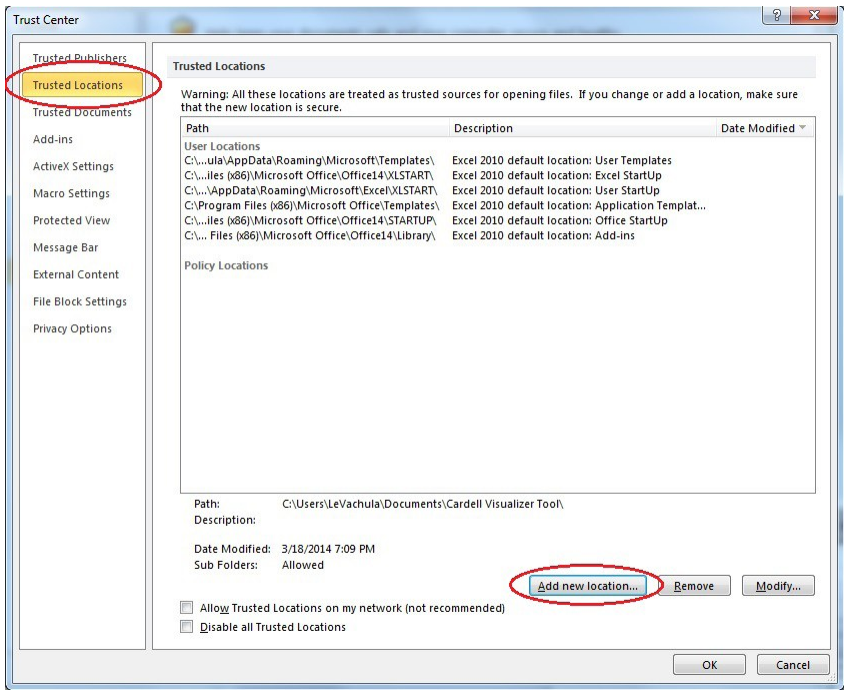
Step 2: Click on the “Print Waveform” button. The print menu will be displayed.

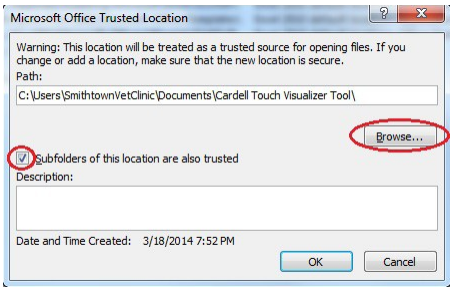
Step 3: Use the drop down buttons to select the range of ECG data you would like to print. Choose from “Current View”, “Entire 12 mins”, or “Specific Time Range”. If “Specific Time Range” is chosen, the Print Range section below will become editable. Choose the desired time range and click on “Print”.

> ***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 before using the Midmark UI “Print Waveform” option.*

> ***NOTE***
> *The ECG waveform chosen to be printed will also be displayed in the ECGPrintCharts tab. Only the most recently printed ECG waveform will be displayed here. Note: Current View (Print) does not display in the ECGPrintCharts tab.*

5.9.5 Cardell® Touch Visualizer Troubleshooting

Error Message	Resolution
Run Time Error (when loading an ECG file)	Make sure the patient's name does not contain any symbols. Use of capital letters, small case letters, and spaces are acceptable. The file name must not be longer than 31 characters; shorten if needed.
Security Warning for Macros and Active X	Macros from an unknown source may cause harm to the computer. However, the Cardell® Touch Visualizer Tool utilizes macros and will not operate without having macros enabled. To do this safely, please follow the steps below: **Step 1:** Create a new folder on the computer and name it Cardell® Touch Visualizer Tool. **Step 2:** Open Microsoft Excel. Click on "File" and then click on "Options". Choose "Trust Center" and then click on "Trust Center Settings" as shown below.  **Step 3:** Click on "Trusted Locations" and then click on "Add new location".  **Step 4:** Use the "Browse" button to navigate to the folder you just made in Step 1 and click "OK". Make sure the check box for "Subfolders of this location are also trusted" is checked. Click "OK".



Step 5: This will add the location of that folder into the list of trusted locations displayed in the window shown in Step 3. Click "OK" to save. If you do not click "OK" here, the added folder will not save.

Step 6: Go to the Midmark USB and save the Cardell® Touch Visualizer Tool into the folder you have just created. You can drag the files from the USB window right into the folder.

Step 7: Go to the folder and double click the Cardell® Touch Visualizer Tool. It should now open without any security warnings.

5.10 Printing Setup (Optional)

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

Step 1: Press the "NEXT" Touch Screen Quick Access Button.

Step 2: Press the "PRINT SETUP" Touch Screen Quick Access Button.

Printer Setup Menu Options:

SCREEN PRIORITY	If set to "ON" the first three waveforms displayed on the monitor will be printed, and REC WAVE printing selection is greyed out.
REC WAVE1	Waveform 1 defaults to ECG. It can be changed.
REC WAVE2	Waveform 2 defaults to SpO2. It can be changed.
REC WAVE 3	Waveform 3 defaults to RESP or CO2 depending on the modules setup with the monitor. It can be changed.
REC RATE:	The user may choose between 12.5mm/s, 25.0mm/s or 50.0mm/s
REC GRID:	The user may choose to turn grid printing ON or OFF.
RT REC TIME:	The user may choose between Continual, 3s, 5s, or 8s of printing time range.
TIMING REC TIME:	The user may choose between Off, 5Min, 10Min, 15Min, 30Min, or 1Hr.
PRINT FORMAT	The user may choose between Wave Data and List Data. Wave data prints the waveforms and parameter values based on parameters selected in the printer setup menu. List data prints parameter values in 8 entry segments. Any blank minutes are skipped.
LIST DATA TIME	Select the end minute of the 8 entry segment to be printed. If no time (or unrecorded time) is selected, the last 8 entries of recorded parameter values will print. This is a 24-hour entry, there is no AM/PM to select.

5.10.1 Recorder

The Cardell® Touch uses a built-in 3-channel thermal recorder.

5.10.2 Manually Controlled Printing

Press the Print Button  or the PRINT Touch Screen Quick Access button 

on the front panel 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 for RT REC TIME in 5.10.4 Interval Printing below.

5.10.3 Alarm Triggered Printing

Alarm triggered printing is available within each individual parameter menu. To turn on the alarm triggered printing for a particular parameter, go into the parameter menu for the parameter you would like to change and select ALM REC. Turn ALM REC to ON to

enable alarm triggered printing for that particular parameter. There is no master switch to turn the alarm triggered printing on for all parameters all at once.

When the alarm triggered printing function is turned ON for a particular parameter, whenever there is an alarm, the recorder will automatically print the data and waveform, if applicable, of the alarm event 2 seconds before the alarm and 8 seconds after the alarm. To change the length of time to print during alarm triggered printing, see Section 4.3 Alarm Setup, ALM REC TIME.

Anytime during printing, the user may press the Print Button or the PRINT Touch Screen Quick Access button to stop printing.

5.10.4 Interval Printing

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

Step 1: Press the “PRINT SETUP” Touch Screen Quick Access Button to display the Printer Setup Menu.

Step 2: In the Printer Setup Menu, selected the TIMING REC TIME. This will allow you to choose between Off, 5min, 10min, 15min, 30min and 1hour. The monitor will automatically print at the chosen interval.

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

Step 1: Press the “PRINT SETUP” Touch Screen Quick Access Button to display the Printer Setup Menu.

Step 2: In the Printer Setup Menu, select RT REC TIME, which is the default recording time frame. This is found on page 2 of the Printer Setup Menu. Choose between Continual, 3s, 5s, and 8s.

5.10.5 Print Header

The printed report header includes name, time, print time setting, date, time, printing speed, and parameter values. Each time a waveform is printed, the above contents will also be printed.

5.10.6 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.

5.10.7 Installing Paper

To install the paper roll in the printer, first press down on the grey-colored latch (with the word “Open” above it) on the printer compartment. Place the roll of paper between the two tabs on the paper holder door with the paper hanging over and off of the bottom of the roll. Pull enough paper from the roll so it hangs over the door when closed. See Fig.3-6 below.

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

Printer paper installation (Fig.3-6)

5.11 Patient Setup

Follow the steps below to enter the Patient Setup Menu:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press “Patient Setup” or the “MAIN MENU” Touch Screen Quick Access Button then press “Patient Setup”.

> ***NOTE***
> *The Patient Menu can also be accessed by pressing on the Patient Setup Area on the Status Bar.*

> ***NOTE***
> *The Status Bar has an area reserved for Patient Information and it 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 Setup Options:

CLEAR PATIENT DATA	Clear current patient data. Please note that all data of the currently monitored patient will be deleted if this option is chosen. Clear patient data should be done before entering the new patient data
PAT NO:	Enter Patient Number here. 10 character limit.
CLIENT NAME:	Enter Client Name here. 12 character limit.
PATIENT NAME:	Enter Patient Name here. 12 character limit. Use of capital letters, small case letters, and spaces are acceptable. Do not use symbols.
SEX:	Enter the Sex of the animal here.
SPECIES:	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.
DOCTOR:	Enter Doctor Name here. 12 character limit .

> ***NOTE***
> *The SUSPEND Quick Access Button can be used in conjunction with adding Patient Information and attaching the patient to the monitor. It prevents the monitor from alarming or recording values during this time.*

5.12 Date and Time Setup

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

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Select “Monitor Setup” to enter the Monitor Setup Menu.

Step 4: Select “Time Setup” to enter the Time Menu.

> ***NOTE***
> *The Date and Time Setup Menu can also be accessed by pressing on the Date and Time area* 
>
> *on the Status Bar.*

Year:	Enter the year.
Month:	Enter the month.
Day:	Enter the day.
Hour:	Enter the hour.
Minute:	Enter the minute.
Time Format:	Choose between 12 hour or 24 hour format.

Set Time

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.

5.13 Sound and Volume Setup

Follow the steps below to enter the Volume Setup Menu using the Touch Screen Quick Access Buttons:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Select “Volume Setup” to enter the Volume Setup Menu.

Step 4: Select from the Volume Setup Menu options listed below.

> ***NOTE***
>
> *The Sound Setup Menu can also be accessed by pressing on the Sound Icon*  *on the Status Bar.*

Alarm Vol:	Choose from Off, 1-10, 10 being the loudest.
HR Beat Vol:	Choose from Off, 1-10, 10 being the loudest.
PR Beat Vol:	Choose from Off, 1-10, 10 being the loudest.
Knob Vol:	Choose from Off, 1-10, 10 being the loudest.
Touch Sound:	Choose between On or Off

5.14 Recall Functions

5.14.1 NIBP Recall

NIBP recall holds 2000 data points.

Follow the steps below to enter the NIBP Recall Screen:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “NIBP RECALL”

The NIBP RECALL Screen shows recorded NIBP measurements and associated pulse rates listed in reverse chronological order. The pressure unit can also be adjusted between mmHg and kPa. Note: If the patient data is cleared, the NIBP RECALL will also be cleared.

5.14.2 Alarm Recall

Follow the steps below to enter the Alarm Recall Settings:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “ALARM RECALL”

Alarm Recall Settings

START DATE:	Adjusts the beginning date for displaying alarms.
START TIME:	Adjusts the beginning time for displaying alarms.
END DATE:	Adjusts the end date for displaying alarms.
END TIME:	Adjusts the end time for displaying alarms.
RECALL EVENT:	Choose from ALL alarms, or one of ECG, SPO2, NIBP, CO2, RESP, or TEMP alarms
ALARM RECALL	Displays the Alarm Recall Screen

The ALARM RECALL Screen shows the alarm events that fell within the time frame dictated by the Alarm Recall Settings, in reverse chronological order. It also includes a snapshot of SPO2 and ECG waveforms that occurred 4 seconds before and following the alarm event. The up and down arrows are used to navigate between each event, and the left and right arrows will navigate through the snapshot of waveforms for each event. Note: If the monitor is turned off or the patient data is cleared, the ALARM RECALL will also be cleared.

5.14.3 Wave Recall

Follow the steps below to enter the Wave Recall Settings:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “WAVE RECALL”

Wave Recall Settings

RECALL DATE:	Adjusts the start date for displaying ECG waveforms.
RECALL TIME:	Adjusts the start time for displaying ECG waveforms.
WAVE RECALL	Displays the Wave Recall Screen

The WAVE RECALL Screen shows 4 lines of ECG waveforms that occurred following the time dictated by the Wave Recall Settings. The up and down arrows are used to navigate 20 seconds forward or backward from the displayed start time. Note: If the monitor is turned off or the patient data is cleared, the WAVE RECALL will also be cleared.

5.15 Revert to Factory Default

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

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “MAINTENANCE”.

Step 4: Use the key pad to input “5188” and press “Enter”.

Step 5: Press “FACTORY DEFAULT”.

> ***CAUTION***
> *Settings and Alarms for all parameters will be affected. If Yes is selected, the current configuration will be lost.*

SECTION 6 - ECG MONITORING

6.1 General Information

The Cardell® Touch 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 electrodes, ECG cable and lead wires recommended by Midmark.

6.3 Animal Preparation and Lead Contact

Accurate electrode 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 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 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

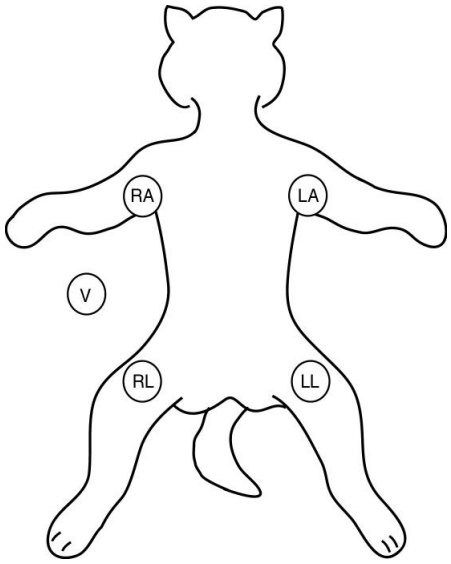


Figure 6-1: 5-Lead Placement

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.

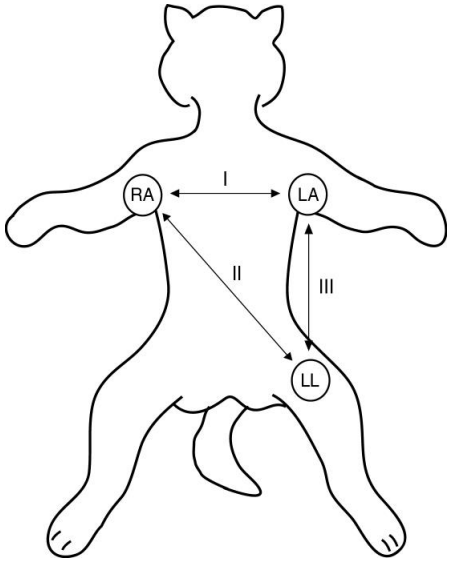


Figure 6-2: 3-Lead Placement

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:

LEAD NAME	Choose from I, II, and III if using 3-lead ECG settings. Choose from I,II, III, aVR, aVL, aVF, or V if using 5-lead ECG settings.
GAIN	Choose from x0.25, x0.5, x1, x2, x4, or Auto.
CASCADE	Choose On to allow the ECG waveform to continue onto a second line for a longer waveform display.
FILTER	Choose from Diagnostic (DIA), Monitoring (Mon), or Surgery (SUR). See definitions in 6.5.2 below.
HR BEAT VOL	Choose from Off, 1-10, 10 being the loudest.
HR UPPER LIMIT	Use the number pad to enter the Upper Limit
HR LOWER LIMIT	Use the number pad to enter the Lower Limit
SWEEP	Choose from 12.5, 25.0, or 50.0
ALM SOUND	Choose from On or Off.
ALM LEV	Choose from High, Medium (MED), or Low.
LEAD TYPE	Choose from 3 Leads or 5 Leads.
HR FROM	Choose from ECG, SpO2 or Auto. Auto will display HR from ECG unless there is not an ECG signal.
HR CHANNEL	Choose from Ch1, Ch2, or Auto. This is the channel the HR will be calculated from.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
ALM REC	Choose from On or Off.
DEFAULT	Allow the monitor to return to factory default settings for the ECG parameter only. No other parameter will be affected. If DEFAULT is selected, the current configuration for this parameter will be lost.

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.

> ***NOTE***
> *Changes to the monitor may be made using the touch screen or the knob, depending on the user's preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.*

6.5.2 Filter Menu

The Surgical/Diagnosis/Monitoring mode gives the user three levels of filters to accommodate different circumstances.

Diagnosis Mode: Displays the original ECG waveform unfiltered.

Monitoring Mode: Filters out low-level interference.

Surgical Mode: When there is a high degree of interference and the ECG waveform is significantly distorted (in an operating room, for example).

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 Alarm Setup.

> ***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)	15-300 bpm

6.6.3 Abnormal Status Alarm

Abnormal Status alarm includes “Asystole” and “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. 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 "lead off" or "no signal received ".

- 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 "no signal received" 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 Cardell® Touch 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 first inflates the cuff to a pressure of around 30 mmHg higher than the systolic pressure, then, slowly deflates the cuff. 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 [BF] below the NIBP receptacle, indicating that the signal input is insulated and defibrillation proof with a type BF applied part. Following exposure to a defibrillation event, NIBP will resume normal operations after 10 seconds.

7.2 Cuff Placement

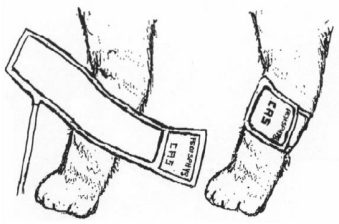
CAUTION
Only accessories recommended by Midmark should be used.

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

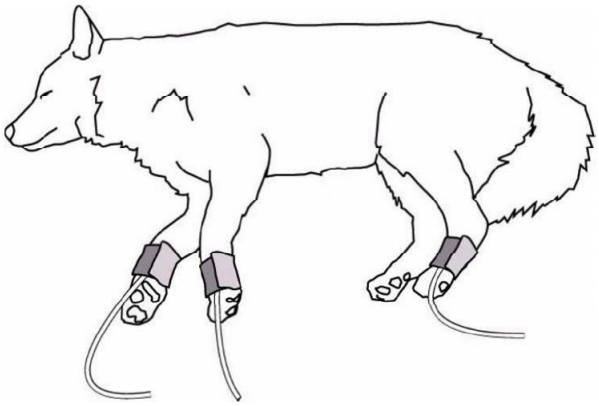
A cat may be left in its owner's lap to keep it calm. Measurements are best done in an area of the hospital away from noise and bright lights. The animal may be held so that the front limbs are free for cuff placement. In conscious patients, the tail may be the most appropriate location for placement 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 turn on (or off) the NIBP module:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “Monitor Setup”.

Step 4: Press “Module Setup”.

Step 5: Press “NIBP” to show the side menu.

Step 6: Press “ON” or “OFF” to turn the NIBP module on or off, respectively. The side menu will automatically close once ON or OFF buttons are pressed.

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:

CUFF SIZE	Large (SV8-SV10) or Small (SV1-SV5)
INTERVAL	Manual, AUTO (1Min, 2Min, 3Min, 4Min, 5Min, 10Min, 15Min, 30Min, 60Min or 90Min).
STAT	5Min/5Sec. Pause. This is the STAT mode.
INFLATION	Enter the inflation value to be used. The default setting is 150
ALM SOUND	Alarm On or Off
ALM LEV	High, Med or Low
SYS UPPER LIMIT	Enter the SYS upper limit to be used.
SYS LOWER LIMIT	Enter the SYS lower limit to be used.
DIA UPPER LIMIT	Enter the DIA upper limit to be used.
DIA LOWER LIMIT	Enter the DIA lower limit to be used.
MAP UPPER LIMIT	Enter the MAP upper limit to be used.
MAP LOWER LIMIT	Enter the MAP lower limit to be used.
PR UPPER LIMIT	The user may set the upper limit using the number pad provided.
PR LOWER LIMIT	The user may set the lower limit using the number pad provided.
UNIT	mmHg or kPa
DISP COLOR	Green, Cyan, Red, Yellow, White, Blue, or Purple.

ALM REC	On or Off
DEFAULT	Allow the monitor to return to factory default settings for the NIBP parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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 under the blood pressure value in the Parameter Box. Choose from Large (SV8-SV10) or Small (SV1-SV5).

> ***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 will display below the numeric data for the NIBP in the Parameter Box on the Main Screen.*

Manual

Press the NIBP Start/Stop button on the front panel and the NIBP measurement will start immediately.

> ***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 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.***

STAT

STAT 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. The mode is mainly used to closely monitor a patient’s blood pressure changes in emergency situations.

During the STAT 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 the STAT pause period (5 seconds) will begin a single NIBP measurement and then continue with STAT mode.

NIBP monitoring provides numerical information only - no waveform.

7.3.4 Alarm Limit Setup

For different patients, different limits may be required. To set up the alarm parameters, reference Section 4.3 Alarm Setup.

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

7.3.5 Alarm for Abnormal Status

The Alarm trigger when the following abnormal events occur and messages will be displayed in the NIBP parameter area: “Loose Cuff”, “Air Leak”, “Meas. (Measurement) error”, or “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

Loose Cuff: If the NIBP status bar displays “Loose Cuff ”, please check the position of the cuff first, and check whether the inflation hose is damaged.

Air Leak: If the NIBP status bar displays “Air Leak”, 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.

Meas. (Measurement) Error: If the NIBP status bar displays “Measurement 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.

Time Out: This may occur if the NIBP is set to STAT or Interval Use. To correct this error, go into the NIBP Setup Menu and change the NIBP back to Manual. Then reset it to STAT 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 sizes.
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 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 (Vivnyl) 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.

SECTION 8 - SpO2 MONITORING

8.1 General Information

The Cardell® Touch 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 Cardell® Touch 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 plethysmographic 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 on the far right of the SpO2 Parameter Box, 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 BF 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.

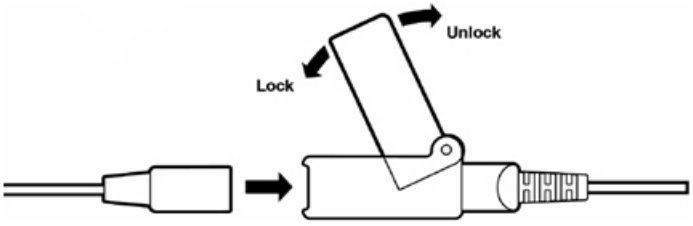
NOTE
If the sensor does not track the pulse reliably, it may be incorrectly positioned, or the sensor site may be too thick, thin, or deeply pigmented to permit appropriate light transmission. If any of these situations occur, reposition the sensor or try another sensor site. If the sensor site is covered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

SPO2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
SPO2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
PR UPPER LIMIT	The user may set the upper limit using the number pad provided.
PR LOWER LIMIT	The user may set the lower limit using the number pad provided.
ALM SOUND	Alarm On or Off
PR BEAT VOL	Choose from Off, 1-10, 10 being the loudest.
ALM LEV	High, Med or Low
SWEEP	12.5 or 25.0mm/s
HR FROM	Choose the source of Pulse Rate value displayed: from SpO2 or from NIBP.
WAVE TYPE	Line or Fill
WAVE COLOR	Green, Cyan, Red, Yellow, White, Blue, or Purple.
ALM REC	On or Off
SatSecond	Disabled, 10, 25, 50, or 100
DEFAULT	Allow the monitor to return to factory default settings for the SpO2 parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user’s preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

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 Alarm Setup.

8.4.1 Alarm Range

Parameter	**Range**
SpO2	0 to 100%
Pulse Rate	20 to 240 bpm

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

Abnormal Status Alarm: “SpO2 PROBE OFF” alarm.

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. Plug the Interface Cable into the SpO2 connector on the side panel of the monitor.
4. 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 pointed items. Normal wear-and-tear caused by patient motion or sensor cleaning will limit the life of the probe. 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 probe is removed from the patient, the message "SpO2 Probe 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 ALM PAUSE TIME (default is 120 seconds) and the message "SpO2 Probe OFF" remains on the display.

8.6 Precautions

> ***CAUTION***
> *Clean the sensor and sensor clip separately before and after each use. See 8.8 Cleaning and Maintenance below.*

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

8.7 Cleaning and Maintenance

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.

8.7.1 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.

8.7.2 Clean the Cable

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

8.8 Troubleshooting

8.8.1 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 “No signal received ” 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.

8.8.2 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 BF 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 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.

If you use a disposable temperature probe, please do not try to disinfect and reuse it. Follow the manufacturer's recommendation for

proper disposal.

9.3 Temperature Setup Menu

Follow the steps below to turn on (or off) the TEMP module:

Step 1: Press the “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “Monitor Setup”.

Step 4: Press “Module Setup”.

Step 5: Press “TEMP” to show the side menu.

Step 6: Press “ON” or “OFF” to turn the TEMP module on or off, respectively. The side menu will automatically close once ON or OFF buttons are pressed.

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:

T1 UPPER LIMIT	The user may set the upper limit using the number pad provided.
T1 LOWER LIMIT	The user may set the lower limit using the number pad provided.
T2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
T2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
ALM SOUND	Choose from On or Off
ALM LEV	Choose from High, Med, or Low
TEMP UNIT	Choose from °F or °C
DISP COLOR	Green, Cyan, Red, Yellow, White, Blue, or Purple.
ALM REC	Alarm record On or Off
DEFAULT	Allow the monitor to return to factory default settings for the Temperature parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user’s preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

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 probes (optional).

1. Place electrodes in proper positions.
2. Select proper respiration lead combination.

3. Set respiration alarm limits.

> ***NOTE***
> *Electrodes 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 the CO2 sample line 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

Follow the steps below to turn on (or off) the RESP module:

Step 1: Press the "NEXT" Touch Screen Quick Access Button.

Step 2: Press the "MAIN MENU" Touch Screen Quick Access Button.

Step 3: Press "Monitor Setup".

Step 4: Press "Module Setup".

Step 5: Press "RESP" to show the side menu.

Step 6: Press "ON" or "OFF" to turn the RESP module on or off, respectively. The side menu will automatically close once ON or OFF buttons are pressed.

> ***NOTE***
> *Only the RESP, CO2, or Multigas waveform can be displayed at one time. Be sure to turn OFF CO2 or Multigas before attempting to turn on RESP.*

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 ALM	Choose from No, 1s, 2s, 5s, 10s, 15s, 20s, 25s, 30s, 35s, or 40s. 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 -- to turn it off, select the NO option.
RR UPPER LIMIT	The user may set the upper limit using the number pad provided.
RR LOWER LIMIT	The user may set the lower limit using the number pad provided
GAIN	x0.25, x0.5, x1, x2, x4
SWEEP	6.25, 12.5, 25.0
WAVE COLOR	Green, Cyan, Red, Yellow, White, Blue, or Purple
WAVE TYPE	Line or Fill
ALM SOUND	Alarm On or Off
ALM LEV	High, Med, or Low
ALM REC	Alarm record On or Off
RESP LEAD	RA-LA(I), RA-LL(II)
ENHANCE FILTER	Used to filter out cardiac interference. ON, OFF

DEFAULT	Allow the monitor to return to factory default settings for the Respiration parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user’s preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

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	0 to 150 rpm
Temperature 1	32 to 122 °F
Temperature 2	32 to 122 °F

Alarm for abnormal status:

Parameter	**Alarm**
Respiration	“ECG LEAD OFF”
Temperature	T”X”, “SENSOR OFF”

To set up the alarm parameters, reference Section 4.3 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 Cardell® Touch 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 Masimo CO2 gas monitoring device, please refer to Section 10.2 as well as the Masimo User's Guide provided with your IRMA™ CO2 probe and ISA™ CO2 analyzer.

IRMA CO2 Probe

ISA CO2 Analyzer

If you have a Respironics CO2 gas monitoring device, please refer to Section 10.3.

10.2 Masimo 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 “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “Monitor Setup”.

Step 4: Press “Module Setup”.

Step 5: Press “CO2” to turn on the module (on page 2 of the menu).

Step 6: Press “ON” to turn the CO2 module on. The side menu will automatically close once ON or OFF buttons are pressed.

> ***NOTE***
> *This will turn off the RESP waveform automatically and replace the RESP waveform on the Main Screen with the CO2 waveform.*

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 ALM	The IRMA™ or ISA™ is programmed to display “0” values after 20 seconds without a detected breath. Choose from No, 1s, 2s, 5s, 10s, 15s, 20s, 25s, 30s, 35s, or 40s. This selected time is the additional delay before the apnea alarm/text will be activated. (E.G. Select 5s for 25 seconds before apnea alarm). The Apnea Alarm is not affected by the Alarm Silence feature -- to turn it off, select the NO option.
WORK MODE	Choose from Standby or Measurement. (See Section 10.2.4).
AWRR UPPER LIMIT	The user may set the upper limit using the number pad provided.
AWRR LOWER LIMIT	The user may set the lower limit using the number pad provided.
EtCO2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
EtCO2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
InCO2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
InCO2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
CO2 ZEROING	For use when manually adjusting the IRMA™ probe - (See Section 10.2.8).
ALM SOUND	Choose from On or Off.
SWEEP	Choose from 6.25, 12.5 or 25.0.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
WAVE TYPE	Choose from Line or Fill.
ALM LEV	Choose from High, Med, or Low.
UNIT	Choose from mmHg or kPa.
ALM REC	Choose from On or Off.
O2 COMPEN	Oxygen compensation, the user can select Low, Med, or High. (Appendix 5).
N2O COMPENSATE	Nitrous Oxide compensation, the user can enable or disable. (Appendix 5).
DEFAULT	Allow the monitor to return to factory default settings for the CO2 parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user's preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

10.2.2 IRMA™ Probe

The following parts are included with your IRMA™ CO2 kit.

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

Connecting the IRMA™ probe to the monitor.

The IRMA™ CO2 analyzer is an external and independent part of the Cardell® Touch patient monitor.

1. With the monitor off, plug the IRMA™ probe into 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™ probe on top of the IRMA™ airway adapter. It will click into place when properly seated.
4. Turn on the monitor.
5. If CO2 is not displayed, turn on the CO2 Module within the Main Menu. Refer to Section 10.2.1 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 10.2.1 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.

6. A green LED indicates that the IRMA™ 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™ probe with the LED pointing upwards.

A HME (Heat Moisture Exchanger) may be connected between the patient's endotracheal tube and the IRMA™ 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™ 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 probe is protected with a HME, always position the IRMA 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.

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

8. To remove the IRMA 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.

10.2.3 ISA™ Analyzer

The following parts are included with your ISA™ CO2 kit.

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

Connecting the ISA™ CO2 analyzer to the monitor.

The ISA™ CO2 analyzer is an external and independent part of the Cardell® Touch patient monitor.

1. Securely mount or place the ISA™ analyzer in a safe location.
2. With the monitor off, plug the ISA™ analyzer into the monitor side panel.
3. Select the correct sampling line to minimize dead space and connect sampling line to the ISA 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).
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 10.2.5 CO2 Exhaust.
5. Turn on the monitor.
6. A green LED indicates that the ISA™ analyzer is ready for use. Perform a pre-use check as described in the Section 10.2.6 Pre-Use Checks.
7. If CO2 is not displayed, turn on the CO2 Module within the Main Menu. Refer to Section 10.2.1 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 10.2.1 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 CO2 ISA™ module at a place higher or at the same level of patient position.

8. To remove the ISA probe, grasp the body portion of the connector and pull to remove.

NOTE
Do not remove by pulling cable.

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

10.2.4 Turn On or Off the CO2 Work Mode

The IRMA probe defaults to Standby mode and will have to be switched to measurement mode before use. A zero will have to be performed manually by selecting “CO2 Zeroing”, please refer to section 10.2.8. For the ISA analyzer, the monitor will begin the zeroing process once connected. Then, the monitor will default to Standby mode and measurement mode will have to be selected before use. To save operational time, the user may elect to turn the monitor to Standby mode when not using the IRMA or ISA 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 and ISA CO2 analyzer, follow the steps below:

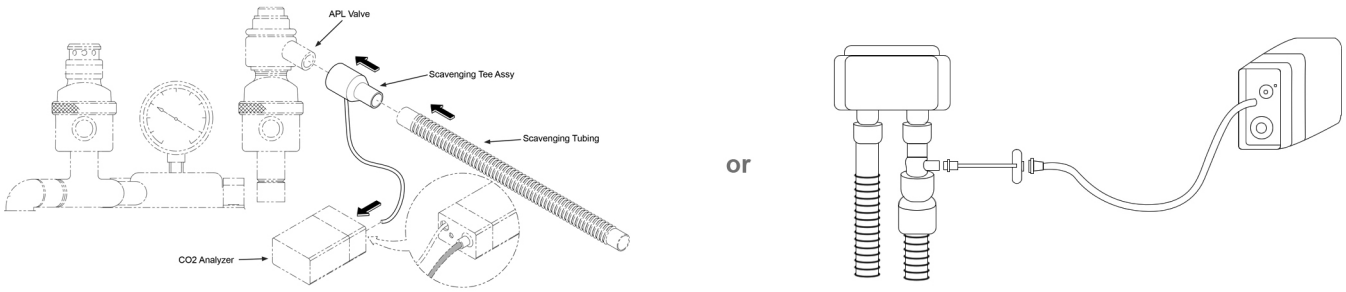
Step 1: Press on the CO2 Waveform Area or Parameter box to open the CO2 Setup Menu.

Step 2: Press the “Work Mode” button.

Step 3: Press the “Measure” or “Standby” button to change the Work Mode.

10.2.5 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.



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

10.2.6 Pre-Use Checks

IRMA™

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™ probe attached.

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

ISA™

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

1. Connect the sampling line to the ISA™ 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 appilcable: 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.

10.2.7 Using CO2

1. Connect the module to the Cardell® Touch and turn the monitor on.
2. If CO2 is not displayed, turn on the CO2 module. Refer to Section 10.2.1 CO2 Setup Menu.
3. The ISA™ analyzer will perform a zeroing procedure automatically. For the IRMA™, when needed, please refer to Section 10.2.8 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 “zeroing”.

WARNING
Incorrect analyzer zeroing will result in false gas readings.

10.2.8 Zeroing

IRMA™

In order to secure high precision of the IRMA™ 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 analyzer, follow the steps below:

Step 1: Snap a new IRMA™ airway adapter onto the IRMA™ 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 “CO2 ZEROING” button (page 2 of menu). The visual technical alarm “CO2 is Zeroing” will appear along with the technical audible alarm. When completed, “CO2 Zero Success” will display.

ISA™

ISA™ Sidestream gas analyzers perform zeroing automatically by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is performed when a steady operating temperature is achieved (typically 30 minutes after startup) and thereafter every 24 hours, taking less than 3 seconds for ISA™ CO2 analyzers.

10.2.9 Alarm Setup

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.

> ***NOTE***
> *Alarm sound can be turned off in the setup menu.*

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, FiCO2 low/high (mmHg) – 0/10, AwRR low/high (rpm)—5/55.

Apnea Alarm

When apnea alarm is on, if no breath is detected for the preset period, 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 Apnea Alarm is not affected by the Alarm Silence feature.*

Abnormal Status

Abnormal status refers to technical alarms such as a sampling line occlusion or an airway adapter error. For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

10.2.10 Cleaning and Maintenance

CO2 Module Cleaning

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

The IRMA™ 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.*

The ISA™ 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™ gas analyzer through its LEGI connector, keep the sampling line connected while cleaning the analyzer.

> ***WARNING***
> ***Never sterilize or immerse the ISA™ Sidestream gas analyzer in liquid.***

ISA™ Maintenance

Once every year, or whenever gas readings are questionable, perform a leakage check according to section 10.2.6 and verify gas readings with a reference instrument or with calibration gas.

Airway Adapters and Sampling Lines

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

10.3 Respironics CO2

10.3.1 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 “NEXT” Touch Screen Quick Access Button.

Step 2: Press the “MAIN MENU” Touch Screen Quick Access Button.

Step 3: Press “Monitor Setup”.

Step 4: Press “Module Setup”.

Step 5: Press “CO2” to turn on the module (on page 2 of the menu).

Step 6: Press “ON” to turn the CO2 module on. The side menu will automatically close once ON or OFF buttons are pressed.

> ***NOTE***
> *This will turn off the RESP waveform automatically and replace the RESP waveform on the Main Screen with the CO2 waveform.*

Follow the steps below to enter the CO2 Setup Menu:

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

CO2 Setup Menu Options:

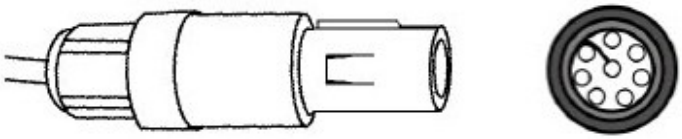
APNEA ALM	Choose from No, 1s, 2s, 5s, 10s, 15s, 20s, 25s, 30s, 35s, or 40s. Within the specified time, if there is no CO2 waveform, apnea alarm will be activated. The Apnea Alarm is not affected by the Alarm Silence feature -- to turn it off, select the NO option.
AWRR UPPER LIMIT	The user may set the upper limit using the number pad provided.
AWRR LOWER LIMIT	The user may set the lower limit using the number pad provided.
EtCO2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
EtCO2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
InCO2 UPPER LIMIT	The user may set the upper limit using the number pad provided.
InCO2 LOWER LIMIT	The user may set the lower limit using the number pad provided.
CO2 ZEROING	Selectable once the module is plugged in and warmed. Note: airway adapter needs to be installed prior to zeroing.
ALM SOUND	Choose from On or Off.
SWEEP	Choose from 6.25, 12.5 or 25.0.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
WAVE TYPE	Choose from Line or Fill.
ALM LEV	Choose from High, Med, or Low.
UNIT	Choose from mmHg or kPa.
ALM REC	Choose from On or Off.
O2 COMPEN	Oxygen compensation, the user can input a number using the number pad. (See appendix 5)
BALAN GAS	Choose from Room Air, N2O, or Helium.
ALTITUDE UNIT	Choose from m (meter) or ft (feet).
ALTITUDE	Use the up and down arrow to adjust altitude then press OK to save. Increments of 250 ft or 76.2 m.
BARO. 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.
DEFAULT	Allow the monitor to return to factory default settings for the CO2 parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

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.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user’s preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

10.3.2 Connecting the CO2 Sensor to the Monitor

1. Insert the CAPNOSTAT 5 CO2 Sensor connector into the CO2/AG receptacle of the Cardell® Touch as shown below.



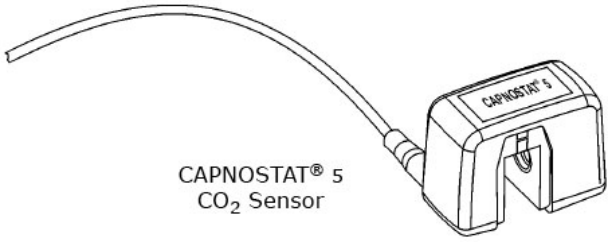
2. Make sure the arrows on the connector are at the top of the connector. Line up the two keys of the connector with the receptacle and insert.

3. To remove the connector, grasp the body portion of the connector, pull in direction of arrow and remove.

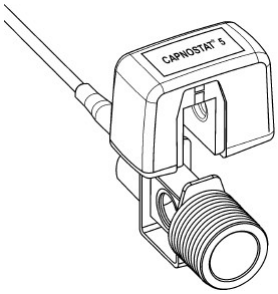
NOTE
Do not remove by pulling cable.

10.3.3 CAPNOSTAT 5 Sensor - Mainstream

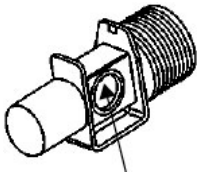
The CAPNOSTAT 5 CO2 Sensor is a rugged, solid-state, Mainstream sensor. It is factory calibrated and does not require further calibration.



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



CAPNOSTAT 5 CO2 Sensor



Window

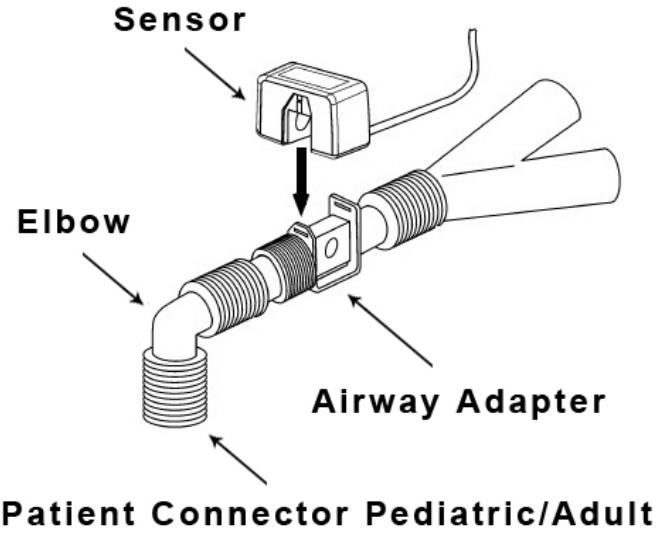
1. Select the correct airway adapter to minimize dead space. Large airway adapter for ET tubes > 4.0 mm (≈ 6 ml dead space). Small airway adapter for ET tubes ≤ 4.0 mm (≤ 1 ml dead space).

2. 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.

3. When initially connected, your C-STAT5 will perform a zeroing procedure automatically. Make sure to successfully Zero your sensor before use. (See section 10.3.5)

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

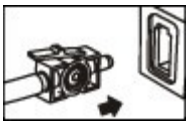
Shown below is the CAPNOSTAT 5 CO2 Sensor with a patient circuit:



10.3.4 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, your LoFlo will perform a zeroing procedure automatically. Make sure to successfully Zero your sensor before use. (See section 10.3.5)

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 mail 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.

10.3.5 Zeroing the CAPNOSTAT 5 and LoFlo CO2 Sensors

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 (page 2 of menu).

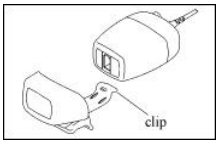
Step 4: Make sure the sensor is not being used or connected to the patient. Press “CO2 ZEROING”.

Step 5: The “CO2 ZEROING” function will now be grayed out on the menu. In addition, the status bar at the very top will display a message: “CO2 IS ZEROING”. A zero in progress message (“Zero In Pro”) will appear at the bottom of the CO2 section in the Parameter Box. The message will also contain a 30 second countdown. Upon successful completion, the top most message will change to “CO2 ZERO SUCCESS” and the countdown will disappear.

10.3.6 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.



10.3.7 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.

10.3.8 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 10 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 Alarm Setup.

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

10.3.9 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. Irreparable damage may occur to the CO2 windows.

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 "NEXT" Touch Screen Quick Access Button.

Step 2: Press the "MAIN MENU" Touch Screen Quick Access Button.

Step 3: Press "Monitor Setup".

Step 4: Press "Module Setup".

Step 5: Press "IBP<1,2>" select ON to turn on the module.

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.

IBP<1,2> Setup Menu Options:

CH Press Setup	This button will allow the user to access Channel 1 and Channel 2 designation options. The user may choose from ART1, ART2, PA, CVP, AO, RA, ICP, FA. ***NOTE*** If both channels are set to the same designation, the scale for both channels will be linked. If you change one, the other will also change to match.
SCALE ADJUST	The user may adjust the maximum and minimum pressure value for Channel 1 and Channel 2
ALARM SETUP	The user may adjust the high and low limits for SYS, DIA, and MAP pressure values in Channel 1 and Channel 2
FILTER	The user may set the waveform filter to Smooth, Normal, or No Filter at all. The monitor will remove interfering signals and background noise at 12.5Hz when set to Smooth. The monitor will remove interfering signals and background noise at 40Hz when set to Normal.
ALM SOUND	Choose from On or Off.
IBP ZEROING	The user may zero the IBP. Please reference Section 11.5 Zeroing the IBP Sensor.
ALM LEV	Choose from High, Med, or Low.

UNIT	Choose from mmHg or kPa.
SWEEP	Choose from 12.5 or 25.0. The sweep speed for Channel 1 and Channel 2 are connected. Therefore, the two channels cannot have different sweep speeds.
WAVE TYPE	Choose from Line or Fill.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
ALM REC	Choose from On or Off.
DEFAULT	Allow the monitor to return to factory default settings for the IBP parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

NOTE
Changes to the monitor may be made using the touch screen or the knob, depending on the user's preference. To use the touch screen, press on the screen with your finger or the stylus. To use the knob, rotate the knob to navigate and press the knob to select/confirm.

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:

Fig. 11-1 IBP Transducer Connection Diagram

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 (page 2 of menu).

Step 2: Press the “IBP ZEROING” button.

Step 3: Press either the “CH1 ZERO” or “CH2 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 “CH1 ZERO” or “CH2 ZERO” button, the button will turn yellow. In addition, the status bar at the very top will display a message: “IBP1 Zeroing” or “IBP2 Zeroing” depending on the channel the user has chosen. 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 Cardell® Touch allows you to label various sites for monitoring pressure. The possible labels consist of: ART1, ART2, PA, CVP, AO, RA, ICP, and FA.

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 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 Cardell® Touch multi-gas module (AG) measures CO2, N2O, and one of the five anesthesia gases (*Halothane, Isoflurane, Enflurane, Sevoflurane, Desflurane*). 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 Sweden IRMA™ and ISA™ gas analyzers.

Please refer to this chapter as well as the Masimo User's Guide provided with your IRMA™ and ISA™ gas 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™ (Sidestream) analyzer or IRMA™ (Mainstream) probe.
- IRMA™ airway adapters (with Mainstream kit).
- ISA sampling lines (with Sidestream kit).
- Multi-gas kit instructions.

12.2.2 IRMA™ Connection Procedures

Connecting the IRMA™ probe to the monitor

1. With the monitor off, plug the IRMA™ 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™ 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.
    - Select AG in the Maintenance Menu.
    - Turn on the Multi-gas Module within the Main 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 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™ 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™ probe with the LED pointing upwards.

A HME (Heat Moisture Exchanger) may be connected between the patient's endotracheal tube and the IRMA™ 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™ 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™ probe is protected with a HME, always position the IRMA™ 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.

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

8. To remove the IRMA 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™ Connection Procedures

Connecting the ISA™ analyzer to the monitor

The ISA™ multi-gas analyzer is an external and independent part of the Cardell® Touch patient monitor.

1. Securely mount or place the ISA™ analyzer in a safe location.
2. With the monitor off, plug the ISA™ probe 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 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™ 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.
    - Select AG in the Maintenance Menu.
    - Turn on the Multi-gas Module within the Main 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™ module at a place higher or at the same level of patient position.

8. To remove the ISA probe, grasp the body portion of the connector and pull to remove.

NOTE
Do not remove by pulling cable.

CAUTION
The ISA™ AG sampling lines are intended for single patient use.

12.2.4 Turn on the Multi-gas Module

Step 1: Press the “Monitor Setup” button within the “Main Menu”.

Step 2: Press the “Module Setup” button.

Step 3: Press “AG” to show the side menu which displays “ON” and “OFF”.

Step 4: Press “ON” to turn the AG module on. The side menu will automatically close once ON or OFF buttons are pressed.

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 Button.

Step 3: Press the “AG Screen” button.

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™ probe, the monitor will automatically detect the sensor and change to Measure mode.

When the monitor is turned on with the multi-gas IRMA™ 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 AA data in the Parameter box to enter the AA Setup Menu.

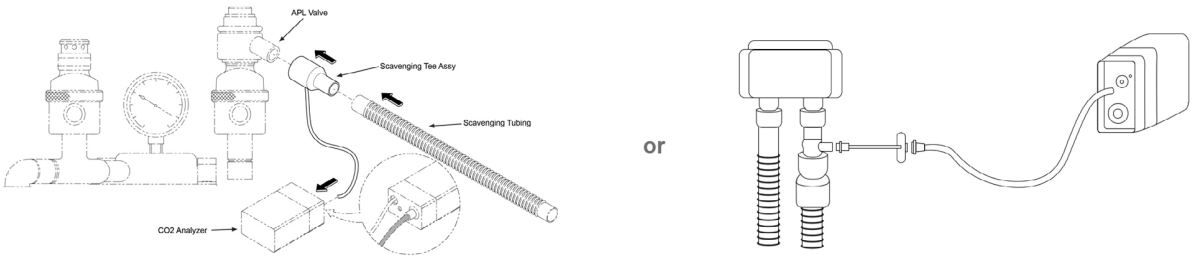
Step 2: Press the “Work Mode” button.

Step 3: Press the “Measure” button.

For the ISA™ 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 the monitor to Standby mode when not using the ISA™ analyzer.

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.



NOTE
The exhaust line is not supplied with the 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 ALM	The IRMA™ or ISA™ is programmed to display “0” values after 20 seconds without a detected breath. Choose from No, 1s, 2s, 5s, 10s, 15s, 20s, 25s, 30s, 35s, or 40s. This selected time is the additional delay before the apnea alarm/text will be activated. (E.G. Select 5s for 25 seconds before apnea alarm). The Apnea Alarm is not affected by the Alarm Silence feature -- to turn it off, select the NO option.
ET ALM HI	The user may set the upper limit using the number pad provided.
ET ALM LO	The user may set the lower limit using the number pad provided.
FI ALM HI	The user may set the upper limit using the number pad provided.
FI ALM LO	The user may set the lower limit using the number pad provided.
AWRR ALM HI	The user may set the upper limit using the number pad provided.
AWRR ALM LO	The user may set the lower limit using the number pad provided.
ALM SOUND	Choose from On or Off.
ALM LEV	Choose from High, Med, or Low.
UNIT	Choose from mmHg or kPa.
SWEEP	Choose from 6.25, 12.5 or 25.0 mm/s.
GAIN	Choose from 1x or 2x.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
WAVE TYPE	Choose from Line or Fill.
O2 COMPENSATE	Oxygen compensation, the user can select Low, Med, or High. (Appendix 5)
N2O COMPENSATE	Nitrous Oxide compensation is disabled when Multi-gas measurement is activated, as the AX+ unit performs this automatically. (Appendix 5)
DEFAULT	Allow the monitor to return to factory default settings for the CO2 parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

12.3.3 N2O Setup Menu Options

ET ALM HI	The user may set the upper limit using the number pad provided.
ET ALM LO	The user may set the lower limit using the number pad provided.
FI ALM HI	The user may set the upper limit using the number pad provided.
FI ALM LO	The user may set the lower limit using the number pad provided.
ALM SOUND	Choose from On or Off.
ALM LEV	Choose from High, Med, or Low.
SWEEP	Choose from 6.25 or 12.5 mm/s.
WAVEFORM DISPLAY	Choose from On or Off.
VALUE DISPLAY	Choose from On or Off.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.

DEFAULT	Allow the monitor to return to factory default settings for the N2O parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

12.3.4 AA Setup Menu Options

WORK MODE	Choose from Standby or Measurement. Please reference Section 12.2.6 Turn On or Off the Multi-gas Work Mode.
ET ALM HI	The user may set the upper limit using the number pad provided.
ET ALM LO	The user may set the lower limit using the number pad provided.
FI ALM HI	The user may set the upper limit using the number pad provided.
FI ALM LO	The user may set the lower limit using the number pad provided.
ALM SOUND	Choose from On or Off.
AG ZEROING	For use when manually adjusting the IRMA™ probe. Please reference Section 12.4.3 Zeroing IRMA™.
ALM LEV	Choose from High, Med, or Low.
SWEEP	Choose from 6.25 or 12.5 mm/s.
WAVE COLOR	Choose from Green, Cyan, Red, Yellow, White, Blue, or Purple.
WAVEFORM DISPLAY	Choose from On or Off.
VALUE DISPLAY	Choose from On or Off.
DEFAULT	Allow the monitor to return to factory default settings for the Anesthetic Gas parameter only. No other parameter will be affected. If used, the current configuration for this parameter will be lost.

12.4 Monitoring

12.4.1 Pre-Use Checks

IRMA™

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

ISA™

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

1. Connect the sampling line to the ISA™ 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 Cardell® Touch 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™ analyzer will perform a zeroing procedure automatically. For the IRMA™, 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™

In order to secure high precision of the IRMA™ 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 has to 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™ AX+ 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™ 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 "AG ZEROING" button (page 2 of menu). The visual technical alarm "AG Start Zeroing" will appear along with the technical audible alarm. When completed, "AG Zero Success" will display.

12.4.4 Zeroing ISA™

ISA™ Sidestream gas analyzers perform zeroing automatically by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is normally performed directly at startup (with or without sampling line attached), when a steady operating temperature is achieved and thereafter every 8 hours from startup, taking less than 10 seconds for ISA™ AG analyzers. A zeroing is also performed when the operating mode is changed from sleep mode to measurement mode. Additional automatic zeroing can however be performed if the analyzer deems it necessary.

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.

NOTE
Alarm sound can be turned off in the setup menu.

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

When apnea alarm is on, if no breath is detected for the preset period, 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 Apnea Alarm is not affected by the Alarm Silence feature.

Abnormal Status

Abnormal status refers to technical alarms such as a sampling line occlusion or an airway adapter error. For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

12.6 Cleaning and Maintenance

Multi-gas Module Cleaning

The IRMA™ 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™ 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™ gas analyzer through its LEGI connector, keep the sampling line connected while cleaning the analyzer.

WARNING
Never sterilize or immerse the ISA™ sidestream gas analyzer in liquid.

ISA™ 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 the appropriate service personnel.

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 Cardell® Touch 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 LEAD OFF	ECG lead cable is not joined well.	Check the connection of all ECG lead cables.
ECG V LEAD OFF	ECG V-lead cable is not joined well.	Check the connection of ECG V-lead cable.
ECG LL LEAD OFF	ECG LL-lead cable is not joined well.	Check the connection of ECG LL-lead cable.
ECG LA LEAD OFF	ECG LA-lead cable is not joined well.	Check the connection of ECG LA-lead cable.
ECG RA LEAD OFF	ECG RA-lead cable is not joined well.	Check the connection of ECG RA-lead cable.
ECG NOISE	ECG measurement signals are heavily disturbed.	Verify that the leads are well connected, the system is properly grounded, and the patient is not moving.
ECG LOST	The patient's ECG signal is too small, so the system can’t do ECG signal analysis.	Verify that the leads/cable are connected correctly, and the current status of the patient.
ECG INIT ERR	Failure in ECG measurement module.	Stop using the ECG measurement function and contact Midmark.
HR ALM LMT ERR	Failure in ECG safety module.	Stop using the ECG measurement function and contact Midmark.
ECG COMM STOP	ECG module can’t communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
ECG COMM ERR	ECG module can’t communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
HR EXCEED	The measured value of the ECG parameter goes out of the range of measurement by the system.	Stop using the ECG measurement function and contact Midmark.

ECG I Over Load	One of the limb leads of Lead I is overloaded.	Check the connections of the limb leads. Verify that each is firmly connected to the patient.
ECG II Over Load	One of the limb leads of Lead II is overloaded.	Check the connections of the limb leads. Verify that each is firmly connected to the patient.
ECG III Over Load	One of the limb leads of Lead III is overloaded.	Check the connections of the limb leads. Verify that each is firmly connected to the patient.
ECG V1 Over Load	The exploring lead is overloaded.	Check the connections of the limb leads. Verify that each is firmly connected to the patient.
RESP		
RR COMM STOP	RR module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
RR COMM ERR	RR module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
RR ALM LMT ERR	Failure in RR safety module.	Stop using the RR measurement function and contact Midmark.
RR EXCEED	RR values are beyond the measurement range.	Stop using the RR measurement function and contact Midmark.
SPO2		
SPO2 NO SENSOR	SPO2 cable has disconnected from the sensor or monitor.	Check the connection of the SPO2 sensor and cable.
SPO2 PROBE OFF	SPO2 sensor has disconnected from the patient.	Check the connection of the SPO2 sensor and cable.
SPO2 COMM STOP	SPO2 module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
SPO2 SENSOR FAULTY	SPO2 Sensor has failed.	Ensure proper connection by disconnecting and reconnecting the sensor. If the error message persists, replace the SPO2 sensor, or cable, or both. If this error continues, contact Midmark.
NELLC ERR, Resetting	Error detected with SPO2. A reset is in progress.	If the error persists, check the connection of the SPO2 sensor and cable.
SPO2 ALM LMT ERR	Failure in SPO2 safety module.	Stop using the SPO2 measurement function and contact Midmark.
PR ALM LMT ERR	Failure in Pulse safety module.	Stop using the Pulse measurement function and contact Midmark.
SEARCH PULSE	SPO2 sensor is finding the pulse of the patient.	Allow time for the pulse and SPO2 to be detected.
NO PULSE	The patient's pulse signal is too small for detection.	Reposition the sensor. If errors persist, contact Midmark.
SPO2 EXCEED	SPO2 values are beyond the measurement range.	Stop using the SPO2 measurement function and contact Midmark.
PR EXCEED	Pulse values are beyond the measurement range.	Stop using the Pulse measurement function and contact Midmark.
TEMP		
T1 SENSOR OFF	TEMP sensor 1 has disconnected from the monitor.	Check the connection of the TEMP sensor.
T2 SENSOR OFF	TEMP sensor 2 has disconnected from the monitor.	Check the connection of the TEMP sensor.
T1 ALM LMT ERR	Failure in TEMP T1 safety module.	Stop using the TEMP measurement function and contact Midmark.
T2 ALM LMT ERR	Failure in TEMP T2 safety module.	Stop using the TEMP measurement function and contact Midmark.

T1 EXCEED	TEMP T1 values are beyond the measurement range.	Stop using the TEMP measurement function and contact Midmark.
T2 EXCEED	TEMP T2 values are beyond the measurement range.	Stop using the TEMP measurement function and contact Midmark.
NIBP		
Reset Failed	NIBP configuration has failed.	Restart the monitor. If errors persist, contact Midmark.
Resetting	NIBP is configuring itself for use.	Allow time for the NIBP to finish configuration.
Pneum Testing	Pump leakage detection in progress.	
Pneum test over	Pneumatic Leakage Test has been halted.	
Calibrating	NIBP Calibration in progress.	
Cal over	Calibration has been halted.	
Please Start	NIBP is waiting for user prompt to begin.	
Auto Measuring	Automatic Measurement mode	
STAT	STAT Measurement mode	
Manual Measure	Manual Measurement mode	
Meas. over	Measurement cycle has been halted.	
NIBP COMM ERR	NIBP module can’t communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
LOOSE CUFF	NIBP cuff isn't properly wrapped around the limb of the patient.	Check position of the cuff and whether the inflation hose is damaged.
AIR LEAK	Air leakage has been detected with the cuff, connectors, or tubing.	Verify that all components are in good condition and connected securely. Try a different cuff and tube set. If errors persist, contact Midmark.
Meas. (Measurement) Error	System Self-Test error, patient trembling or over-excitement, or air leakage.	Calm the patient down and perform the measurement again. If the message persists, contact Midmark.
AIR PRESSURE ERR	NIBP was not able to stabilize the pressure value. The tubing may have kinks.	Verify that all components are in good condition and connected securely. Check for presence of kinks in the tubing. If errors persist, contact Midmark.
WEAK SIGNAL	Cuff is too loose or patient pulse is too weak.	Adjust the cuff and measure again.
RANGE EXCEEDED	NIBP values are beyond the measurement range.	Reset the NIBP measurement module or restart the monitor. If errors persist, contact Midmark.
EXCESSIVE MOTION	Signal interference and/or irregular pulse rate due to limb movement.	Limit motion of the patient.
OVER PRESSURE	Pressure is exceeding the specified upper limit.	Verify that connections are sound and patient is still. If errors persist, contact Midmark.
SIGNAL SATURATED	Significant patient motion detected.	Limit motion of the patient.
PNEUMATIC LEAK	Leakage detected during the Pneumatic Leakage Test.	Verify that all components are in good condition and connected securely. If errors persist, contact Midmark.
NIBP SYSTEM FAILURE	Failure detected in NIBP pump system.	Stop using the NIBP measurement function and contact Midmark.
CUFF TYPE ERR	Selected cuff type not suitable for the patient.	Select proper cuff.
NIBP TIME OUT	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 STAT. If errors persist, contact Midmark.

NIBP RESET ERR	NIBP reset encountered an error.	Reset the NIBP measurement module or restart the monitor. If errors persist, contact Midmark.
MEASURE FAIL	During the measurement process, the system could not execute measurement analysis.	Verify that connections are sound and patient is still. If errors persist, contact Midmark.
NS EXCEED	NIBP systolic values are beyond the measurement range.	Stop using the NIBP measurement function and contact Midmark.
NM EXCEED	NIBP MAP values are beyond the measurement range.	Stop using the NIBP measurement function and contact Midmark.
ND EXCEED	NIBP diastolic values are beyond the measurement range.	Stop using the NIBP measurement function and contact Midmark.
CO2		
CO2 Unauthorized	An unapproved Midmark C-stat or LoFlo has been connected to the monitor.	Please disconnect the accessory and connect one purchased from Midmark.
CO2 COMM STOP	CO2 module or sensor can't communicate with the main system normally.	Reconnect the CO2 sensor with the monitor and restart the monitor, if needed. If errors persist, contact Midmark.
CO2 ALM LMT ERR	Failure in CO2 safety module.	Stop using the CO2 measurement function and contact Midmark.
AWRR ALM LMT ERR	Failure in CO2 Respiration safety module.	Stop using the CO2 Respiration measurement function and contact Midmark.
CO2 Out of Range	CO2 value is outside of the specified accuracy range.	Your CO2 sensor may require a zero or servicing.
CO2 Over Temp	The internal temperature of the probe is outside of the operating range.	Your CO2 sensor should be allowed to cool down or serviced.
Pressure out of range	The ambient pressure is outside of the operating range.	Your CO2 sensor should be serviced.
Zero Required	Zero reference calibration (Zeroing) of IR level is required for accurate measurements.	Zero your CO2 sensor.
Software Error	There's an error with the sensor software.	Restart your CO2 sensor. If errors persist, contact Midmark.
Hardware Error	There's an error with the sensor hardware.	Your CO2 sensor should be serviced.
CO2 speed out of bounds	The analyzer's motor speed is out of bounds.	Restart your CO2 sensor. If errors persist, contact Midmark.
Factory Calibration Lost	The factory calibration is lost or missing.	Your CO2 sensor should be serviced.
Replace Adapter	The IRMA adapter is dirty or damaged.	Replace the IRMA adapter.
Check Airway Adapter	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.
No Sampling Line	There's no sampling line detected.	Insert the sampling line.
CO2 is Sleeping	Changing the Work Mode is required to operate the sensor.	See section 10.2.4 to change the Work Mode.
CO2 Faulty Sensor	CO2 sensor is faulty.	Your CO2 sensor should be serviced.
CO2 Compensation Not Set	Barometric pressure and/or gas compensations have not been set by the monitor.	Restart the monitor. If errors persist, contact Midmark.
CO2 is Zeroing	The CO2 sensor is performing zeroing calibration.	
CO2 Is Warming Up	The CO2 sensor is activating and warming to operational temperatures.	
Pneumatic Error	Pneumatic pressure is outside the expected range. The Sampling Line may be kinked.	Check that the sampling line is not occluded or kinked. If errors persist, contact Midmark.

IBP		
IBP<1,2> COMM STOP	IBP module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
IBP<1,2> COMM ERR	IBP module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
IBP1 SENSOR OFF	IBP1 cable has disconnected from the sensor or monitor.	Check the connection of the IBP1 sensor and cable.
IBP2 SENSOR OFF	IBP2 cable has disconnected from the sensor or monitor.	Check the connection of the IBP1 sensor and cable.
IBP1 ALM LMT ERR	Failure in IBP1 safety module.	Stop using the IBP measurement function and contact Midmark.
IBP2 ALM LMT ERR	Failure in IBP2 safety module.	Stop using the IBP measurement function and contact Midmark.
IBP1 ZEROING	IBP1 Zero Calibration in progress.	
IBP2 ZEROING	IBP2 Zero Calibration in progress.	
IBP1 ZERO FAIL	Significant interference occurred during zeroing process.	Verify that the transducer is open to ambient pressure and all other interference is minimized.
IBP2 ZERO FAIL	Significant interference occurred during zeroing process.	Verify that the transducer is open to ambient pressure and all other interference is minimized.
AG		
AG COMM STOP	AG module or sensor can't communicate with the main system normally.	Reconnect the multi-gas sensor with the monitor and restart the monitor, if needed. If errors persist, contact Midmark.
AG COMM ERR	AG module can't communicate with the main system normally.	Restart the monitor. If errors persist, contact Midmark.
EtCO2 ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
FiCO2 ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
EtN2O ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
FiN2O ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
EtAA ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
FiAA ALM LMT ERR	Failure in AG safety module.	Stop using the multi-gas measurement function and contact Midmark.
AwRR ALM LMT ERR	Failure in AG Respiration safety module.	Stop using the multi-gas Respiration measurement function and contact Midmark.
CO2, N2O, O2 Out of Range	The named gas (CO2, N2O, O2) is outside of the specified accuracy range.	The multi-gas sensor may require a zero or servicing.
AG out of range	At least one anesthetic agent is outside of the specified accuracy range.	The multi-gas sensor may require a zero or servicing.
AG Temp out of range	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 range	The ambient pressure is outside of the operating range.	Your multi-gas sensor should be serviced.
Zero required	Zero reference calibration (Zeroing) of IR level is required for accurate measurements.	Zero your multi-gas sensor.
AG Conc. Unreliable	Agent identification and concentrations are unreliable.	Your multi-gas sensor should be serviced.
Software Error	There's an error with the sensor software.	Your multi-gas sensor should be serviced.

Hardware Error	There's an error with the sensor hardware.	Your multi-gas sensor should be serviced.
AG speed out of bounds	The analyzer's motor speed is out of bounds.	Your multi-gas sensor should be serviced.
Factory Calibration Lost	The factory calibration is lost or missing.	Your multi-gas sensor should be serviced.
Replace Adapter	The IRMA adapter is dirty or damaged.	Replace the IRMA adapter.
Check Airway Adapter	No adapter is detected by the IRMA.	Insert the IRMA adapter.
Check Sampling Line	The sampling line is clogged.	Replace the sampling line.
No Sampling Line	There's no sampling line detected.	Insert the sampling line.
AG IS SLEEPING	Changing the Work Mode is required to operate the sensor.	See section 12.2.6 to change the Work Mode.
Printer		
RECORDER ERR	Printer is not connected or not functioning properly.	Verify that the paper is loaded properly, the door has been closed completely and the Power light is on. If the Error light or Technical Alarm persists, contact Midmark.
Keyboard		
KEYBOARD INIT ERR	Failure in the initialization of the keyboard panel.	Restart the monitor. If errors persist, contact Midmark.
KEYBOARD INIT ERR1	Failure in the initialization of the keyboard panel.	Restart the monitor. If errors persist, contact Midmark.
KEYBOARD INIT ERR2	Failure in the initialization of the keyboard panel.	Restart the monitor. If errors persist, contact Midmark.
KEYBOARD INIT ERR3	Failure in the initialization of the keyboard panel.	Restart the monitor. If errors persist, contact Midmark.
KEYBOARD INIT ERR4	Failure in the initialization of the keyboard panel.	Restart the monitor. If errors persist, contact Midmark.
Power		
PM 5V TOO HIGH	There is an error detected with the 5 volt function of the power supply.	Restart the monitor. If errors persist, contact Midmark.
PM 5V TOO LOW	There is an error detected with the 5 volt function of the power supply.	Restart the monitor. If errors persist, contact Midmark.
PM 3.3V TOO HIGH	There is an error detected with the 3.3 volt function of the power supply.	Restart the monitor. If errors persist, contact Midmark.
PM 3.3V TOO LOW	There is an error detected with the 3.3 volt function of the power supply.	Restart the monitor. If errors persist, contact Midmark.
Button 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

13.3.1 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 Cardell® Touch 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:

• Masimo Mainstream and Sidestream CO2 and Multi-gas Modules	2 years
• Capnostat Mainstream and LoFlo Sidestream CO2 Modules	1 year
• 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 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;
- all sinks, faucets, and plumbing accessories;
- 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 ANYWARRANTIES 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 844-856-1232 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 115V/230V
Rated Frequency:	50Hz/60Hz
Rated Input power:	70VA
Fuses:	T1.6AL, 250V fuse (2)
Battery:	14.8V, 4400 mAh Lithium polymer

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
Heart Rate Average:	8 beats
Connector:	AAMI 6-1 pin
Lead Selection:	I, II, III, V, avR, avL, avF
Lead Off Alarm:	Visual and audible
Input:	3-lead ECG cable or 5-lead ECG cable
QRS Indicator:	Visual and audible
Sweep Speed:	12.5 /25 /50mm/s
Amplitude Selection:	x1/4, x1/2, x1, x2, x4, Auto
Trend:	120hrs max(monitor), 1 hr max (export)
Bandwidth:	Monitoring mode: 0.5 to 35Hz Diagnostic mode: 0.05 to 100Hz Surgical mode: 0.5 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
Unit:	mmHg or kPa
Operation Mode:	Auto, Manual, STAT Measurement
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, 90 (Min)

D. End-tidal CO2

Masimo (Optional)

Method:	Mainstream or Sidestream Capnography
Detection Equipment	Ultra compact multi-channel infrared micro bench and barometric pressure sensor
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)
Rise time:	Less than 90ms at 10 l/min
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

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

E. Temperature (2-channel)

Measurement and Alarm Limit:	0-50°C
Probe:	Skin surface or rectal /esophageal
Unit:	Celsius/Fahrenheit
Accuracy:	+/-0.1°C from 24-45°C, +/-.2°C from -1 to 60°C
Resolution:	0.1°C
Refresh time:	Approx. 1 second

F. Respiration

Measurement Mode:	Thoracic Impedance (indirect) or through Capnography (direct)
Respiration Rate Measurement and Alarm Range:	0-150brpm +/-2brpm
Waveform Display Speed:	6.25, 12.5 and 25mm/s
Refresh time:	2 seconds

G. Multi-gas (Optional)

The measurement range and accuracy of each gas are as follows (all conditions):

CO2:	0~15 Vol. % ± (0.3 kPa + 4 % of reading)
N2O:	0~100 Vol. % ± (2 kPa + 5 % of reading)

Anesthetic Agents:

HAL:	0~8 Vol. % ± (0.2 kPa + 10 % of reading)
ISO:	0~8 Vol. % ± (0.2 kPa + 10 % of reading)
ENF:	0~8 Vol. % ± (0.2 kPa + 10 % of reading)
SEV:	0~10 Vol. % ± (0.2 kPa + 10 % of reading)
DES:	0~22 Vol. % ± (0.2 kPa + 10 % of reading)

The accuracy specification of Agents is not valid if more than two agents are present in the gas mixture. During measurement, only the detected anesthetic agent is displayed.

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:	120 hours max	
Sweep Speed:	12.5/ 25 mm/s	

I. Display

Display type:	Color TFT LCD Touch Screen Size: 10.4 inches
Resolution:	800 (H) x 600 (V) pixels
Display channel:	Minimum of 2. Maximum of 8.

J. Recorder (Optional)

Type:	3-channel thermal recorder
Printing mode:	real-time or alarm triggered printing of text and graphic
Resolution:	Vertical (400dpi), Horizontal (800dpi)
Printing speed:	12.5/25.0/50 mm/s

K. Physical Specifications

Net weight without batteries:	8.1 lbs (3.7kg)
Net weight with batteries:	9.1 lbs (4.1kg)
Dimensions:	11.4in (28.89cm) x 5.6in (14.17cm) x 10in (25.4cm)

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

Marc R. Raffe DVM, MS, DACVA, DACVECC

Pfizer Inc., St. Paul MN

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™ Developer's Manual, and Section 7.8 of ISA™ 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 ISA probes except for in IRMA CO_2 or ISA 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 ISA or IRMA Gas analyzer using the SetN_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 SetN_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	SetN_2O parameter	Cardell® Touch 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 measureing 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 ISA probe using the SetO_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 SetO_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	SetO_2 Parameter	Cardell® Touch 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.
SV-1	Small animal BP cuff for 3-6cm limb circumference	1
SV-2	Small animal BP cuff for 4-8cm limb circumference	2
SV-3	3.5cm BP cuff for 6-11cm limb circumference	3
SV-4	4.0cm BP cuff for 7-13cm limb circumference	3
SV-5	5.0cm BP cuff for 13-20cm limb circumference	2
SV-8	Large animal BP cuff for 13-20cm limb circumference	1
SV-10	Large animal BP cuff for 18-26cm limb circumference	1
01-03-0162	6ft air hose w/ quick disconnect	1
016-1743-00	ECG trunk cable	1
016-1604-00	3-lead ECG wire set	1
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
590004	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
015-3297-00	Battery	1
PL-200	Redux gel for ECG use	1
015-3091-00	Ground wire	1
061-1016-00	Blood pressure cuff selector	1
016-1618-00	Stylus	1
015-3322-00	USB-Cardell® Touch	1

The following are optional accessories for use with the Cardell® Touch 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
1027730	LoFlo module mounting bracket
002-1895-00	Masimo CO2 Mainstream sensor kit
002-1896-00	Masimo CO2 Sidestream sensor kit
002-10171-00	ISA 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
EP-S	Small esophageal ECG
EP-L	Large esophageal ECG
EP-XS	Extra small esophageal ECG
CD-0019	Flat ECG clips (5PK)
016-1603-00	5-lead ECG wire set

ECG-SN	Snap-on ECG clip
01-05-0507	Small pregelled electrode for snap-on wire sets 60/box
015-0363-03	Power cord, UK
015-0363-04	Power cord, Australia
015-0363-00	Power cord, Europe
8008-002	Touch rolling stand w/ basket and mounting plate
8008-004	Monitor mount for Canis Major lift table
9A465002	Monitor mount for VMS Plus anesthesia machine
9A465004	Monitor pole mount
9A465006	Monitor Stud mount
9A465008	Monitor wall mount
002-1684-00	5-lead kit
002-1745-00	Multi-gas Mainstream sensor kit
002-1746-00	Multi-gas Sidestream sensor kit
015-3356-00	Multi-gas to monitor cable
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

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