Vet-Tab

Wireless Surgical Monitor
Model VT-1
Operating Manual

vmed technology

Table of Contents

1 Safety

1.1 Safety Notices

BEFORE USING THIS DEVICE PLEASE READ THE ENTIRE MANUAL.

The safety statements presented in this chapter are described below These safety notices appear throughout this manual and your careful attention is required.

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

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

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

1.2 Warnings and Cautions

⚠ **WARNING** ⚠
- **Use of electro-surgical or cauterizing devices may cause injury to the patient and may interfere with monitor performance.**
- **Do not use this device in the presence of flammable anesthetics, explosive substances, vapors or liquids.**

⚠ **CAUTION** ⚠
- **Opening the monitor housing voids the warranty**
- **Users should guarantee the surface of the monitor is dry, clean and prevent the exposure to liquids**
- **Avoid damage caused by dropping, impact, and strong vibrations**
- **Maintenance, service and upgrades should be done only by Vmed or its authorized repair centers.**

NOTE
- **The software was developed per IEC601-1-4. And hazards arising from errors in the software program is minimized.**
- **This monitor complies with the requirements of CISPR 11 (EN55011) class A.**

2 Description of Monitor and Accessories

2.1 VetTab Description

The VetTab is a small, battery operated surgical monitor with internal Bluetooth and integral display that links wirelessly to a Bluetooth equipped Android device for easier viewing. Monitoring parameters include ECG (Electrocardiograph), HR (Heart Rate from ECG or SpO_2), NIBP (Non-Invasive Blood Pressure), SpO_2 (pulse oximetry) and temperature (from the temperature lead on the ECG cable).

2.2 Front panel identification
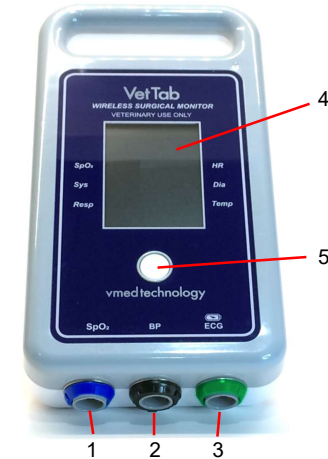
Figure 1 -   VetTab Front Panel

1. **SpO_2 Connector**: (Blue ring) SpO_2 sensor connector
2. **NIBP Connector**: (Black ring) NIBP hose connector
3. **ECG & TEMP Connector**: (Green ring) ECG and Temperature cable connector or USB charging cable connector.
4. **Display**: Color LCD display
5. **Select Button**: Power and function selection

2.3 Accessories

2.3.1 Standard Accessories

- ECG & TEMP cable
- NIBP cuffs and hose
- SpO$_2$ sensor with two tongue clips
- USB AC charging cable
- AC charging plug

2.3.2 Optional Accessories

(contact Vmed for prices or visit vmedtechnology.com for description)

- Esophageal ECG and temperature probes
- Long term ECG monitoring leads
- ECG leg loops
- Exotic needle electrodes
- Tablet wall mount (See Amazon.com: 10" Wall Mounts)

3 Hardware Installation

3.1 Unpacking and checking

Check all materials against the packing list and check for any mechanical damage. Contact the Vmed Customer Service Department at 800 926-9622 to report any problem.

3.2 Connecting animal Sensors and Probes

Connect the necessary animal sensors or probes to the monitor.

SpO$_2$ cable to Blue connector Part VT-SpO2	
Blood pressure air hose to Black connector Part VT-BP	
ECG/Temperature cable to the Green connector Part VT-ECGT	

3.3 Charging the Battery

Plug the USB charging cable into the Green receptacle on the VetTab and the other end of the cable into the USB port on your computer or into the AC plug provided. Full charge is achieved in about 4-5 hours.

> **NOTE**
> The VetTab is designed to operate on battery power only. The battery is charged automatically when the VetTab is connected to AC power using the USB charging cable and AC adapter. During charging the device will be on and able to communicate over Bluetooth, but its LCD may or may not be on.

> **NOTE**
> You will not be able to make use of the ECG or temperature parameters during charging.

The capacity of the internal battery is limited. When the battery capacity is too low, The Battery Indicator will blink. When this occurs, plug the charger into the Green receptacle to charge.

The operating time depends on the parameters being monitored. Measuring NIBP takes more power and will result in a shorter battery life between charges.

4 Operation and Display

4.1 Integral Display Description

Refer to the references below for description on the integral screen:
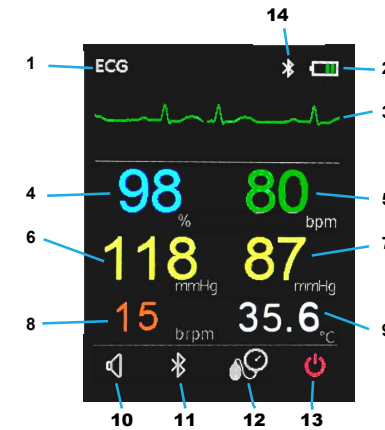
Figure 2 -   Main Screen

1. **Waveform Indicator**: Either ECG or SpO$_2$ waveform
2. **Battery Level Indicator**: Indicates battery power remaining
3. **Waveform**: ECG or SpO$_2$.
4. **SpO$_2$**: Oxygen saturation (%)
5. **HR/PR**: Heart Rate or Pulse Rate (**b**eats **p**er **m**inute)
6. **SYS**: Systolic blood pressure (mmHg)
7. **DIA**: Diastolic blood pressure (mmHg)
8. **RESP**: Respiration Rate (**br**eaths **p**er **m**inute)
9. **TEMP**: Temperature from ECG/temperature probe (˚C)
10. **Audio Select**: Device audio tone ON or OFF
11. **Bluetooth Select**: Bluetooth active or inactive
12. **NIBP Select**: Initiates or cancels BP measurement
13. **Power off Select**: Powers off the monitor
14. **Indicator Icons**: Shows whether audio and/or Bluetooth are enabled

4.2 Interacting directly with the VetTab

Press the button on the VetTab monitor (see Section 2.2, #5) once to turn it on. Once the monitor is powered on, you will see four selections on the bottom of the display (See Figure 3 below) with the left-most icon (Audio) larger than the others. This denotes that it is currently selected.

Figure 3 -   Display selections

Press the button again and the next icon to the right will now increase in size, denoting that it is now selected while the first icon returns to its normal size. Continuing to press the button will select each icon to the right and then cycle back to the first icon on the left.

Once the icon of your choice is selected then press and hold the Select button for at least 1 second to activate your selection.

Each icon performs the following functions when activated.

🔇	**Audio**:	Activating the Audio icon will either enable or disable the audible heart rate tone. If audio is active then a speaker icon similar to this one will appear at the top of the display. It will disappear if disabled.
✳	**Bluetooth**:	Activating the Bluetooth icon will either enable or disable the Bluetooth capability of this monitor. If disabled, no Android device will be able to connect to it. When Bluetooth is enabled a similar Bluetooth icon will flash at the top of the display. It will disappear if disabled.
🩺	**NIBP**:	Activating the NIBP icon will either start a Blood Pressure measurement or cancel one that is in progress. When a BP measurement is in progress a small hourglass icon will appear between the Systolic and Diastolic parameters on the display.
⏻	**Power**:	Activating the Power icon will turn off the VetTab monitor, also disconnecting any Bluetooth connection if active.

4.3 Tablet Display and Interaction

If you purchased your VetTab with a tablet, the tablet monitoring application is pre-installed and ready to connect. If you are using your own tablet you can download the Vmed VetTab monitoring application at no charge from Google Play or from the Vmed Technology support website:

https://www.vmedtechnology.com/downloads_support.htm

NOTE
In order to install the Android app from the Vmed website you will need to follow the instructions provided on our website to enable "sideloading" of apps onto your Android device, which involves disabling some security features within Android.

NOTE
VetTab Application is compatible with Android version 8.1 (Oreo) and above only. For connection procedure see section 4.3.3 below.

4.3.1   VetTab Android App Monitoring Display

The VetTab Android app starts with the monitoring screen, which has parameter and waveform data as presented below. Additionally, the right side of the screen has several icons with which the user can interact. These allow the user to make a connection to a VetTab monitor, initiate a Blood Pressure cycle, toggle the sound or adjust settings in a separate Settings screen. Refer to Figure 4 below for illustration.

The VetTab Android app is designed for live-monitoring only and does not record monitoring data. However, it does provide the ability to see both the waveform and numerical data in a larger context, depending upon the size of the Android device on which it is used. Through this app you can set up and activate a periodic blood pressure measurement cycle and be notified when any of the shown parameters exceed their individual alarm limits. You may also edit these alarm parameters using the Settings screen (described in section 4.3.2).
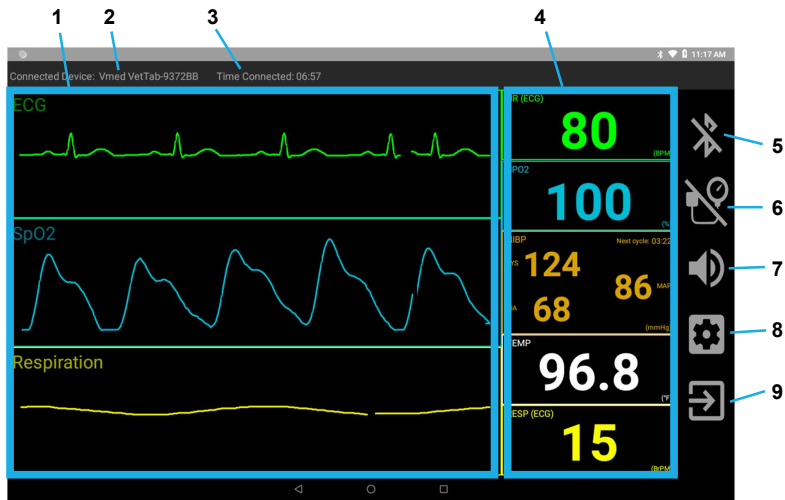
Figure 4 -   Android VetTab App Monitoring Screen

VetTab App Monitoring Screen Elements:

1. Waveform Boxes (ECG, SpO$_2$, Respiration)
2. Currently connected device
3. Elapsed Bluetooth connection time (i.e., monitoring time)
4. Parameter Boxes (HR, SpO$_2$, NIBP, Temp, Resp)
5. Connect Button
6. NIBP Button
7. Audio Button (app only)
8. Settings Button
9. Exit Button

Each icon on the right side of the monitoring screen (items 5-9 above) has the following functionality.

	Connect to VetTab:	Selecting the Connect button while this icon is shown will initiate the Bluetooth connection process to a VetTab monitor (see section 4.3.2). This icon will only appear if a VetTab is not currently Bluetooth connected to this app.
	Disconnect from VetTab:	Selecting the Connect button while this icon is shown will disconnect from the currently Bluetooth connected VetTab monitor. This icon will only appear if a VetTab is currently Bluetooth connected to this app.
	Display Demo Data:	Selecting the Connect button while this icon is shown will begin the display of Demo data. This icon will only appear if "Demo mode" is enabled and Demo data is not currently displayed.
	End Display of Demo Data:	Selecting the Connect button while this icon is shown will end the display of Demo data. This icon will only appear if "Demo mode" is enabled and Demo data is currently displayed.
	Initiate Blood Pressure Measurement:	Selecting the NIBP button while this icon is shown will begin the blood pressure measurement cycle. This icon appears only if blood pressure cycle is inactive.
	Cancel Blood Pressure Measurement:	Selecting the NIBP button while this icon is shown will cancel a blood pressure measurement or its cycle. This icon appears only if a blood pressure measurement cycle is active (either during a measurement or while waiting for a new measurement).
	Disable Audio:	Selecting the Audio button while this icon is shown will disable audio for the app's heart rate tone or alarms. This icon appears only if audio is currently enabled.
	Enable Audio:	Selecting the Audio button while this icon is shown will enable audio for the app's heart rate tone or alarms. This icon appears only if audio is currently disabled.
	Settings:	Selecting this icon will open the Settings screen where the alarm limits and other options can be modified.
	Exit:	Selecting this icon will disconnect any active Bluetooth connection and exit the VetTab Android app.

In addition to the icons on the right of the screen and the waveform and parameter data the app's monitoring screen gives additional information at the top. There you can find the currently connected VetTab device (including its ID number in case you have more than one VetTab device). You can also see the elapsed Bluetooth connection time, which will reset the next time you establish a Bluetooth connection with your VetTab monitor.

4.3.2   VetTab App Settings

The Settings screen allows the user to modify default high and low alarm limits for the Heart Rate, SpO₂, Systolic, Diastolic, MAP, Temperature and Respiration parameters.
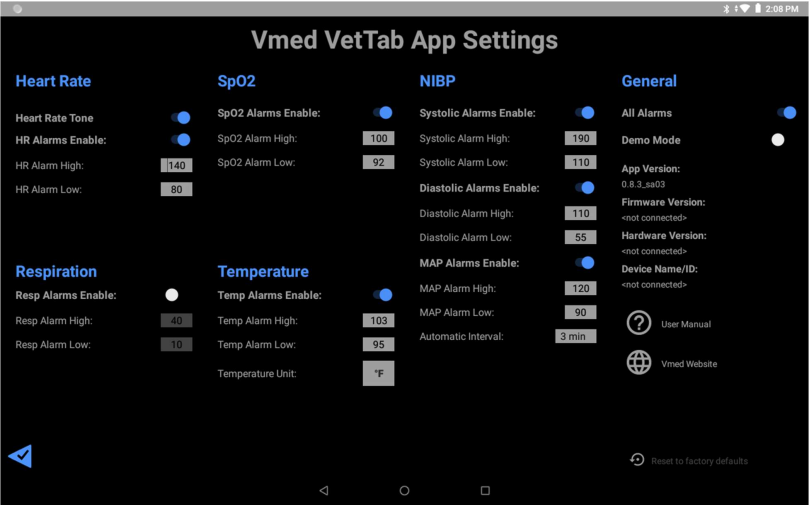
Figure 5 -   Settings Screen

Each category has a blue heading such as "Heart Rate", "Respiration", etc. Each category has its own toggle switch that allows the user to enable or disable the alarms for that category (when the switch is blue then it is on and when it is gray then it is off, disabling alarms for that category). Each parameter type also has both a high alarm limit and a low alarm limit. You may change what is shown by default by tapping its text box and then typing a new number in its place.

Additionally, you may set the temperature unit and the interval that the blood pressure measurement will use between measurements. Demo Mode may also be selected through the toggle switch under "General." Enabling this and then returning to the Monitoring screen will allow you to show pre-recorded vitals data on the screen once the "connect" button is pressed.

If any change is made to a value or switch within the Settings screen you will need to press the "Save Settings" button at the lower left corner of the screen in order to keep these changes and return to the Monitoring screen.

Figure 6 -   Save Settings Button

Instead, you may return to the Monitoring screen without saving any modified settings by tapping the Android Back button at the bottom center of the screen.

Figure 7 -   Android Back Button

4.3.3   Bluetooth Connection to Android Device

The internal Bluetooth on your Android device allows it to link wirelessly to the VetTab communicating its monitoring data for display in the Android app.

Once the *Vmed VetTab* app has been installed on your Android device and you have verified that Bluetooth is enabled on it, you can make use of the app by following these instructions.
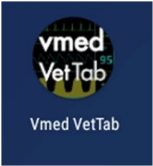
1.   In your list of apps, select the Vmed VetTab app.

Figure 8 -   Vmed VetTab App Icon

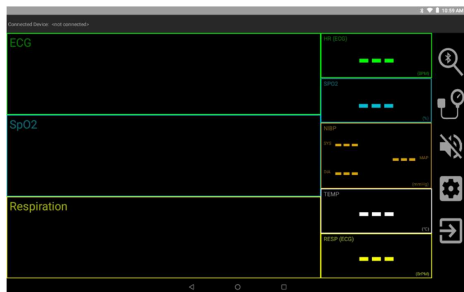2. When it first opens it will show the main monitoring screen (see Figure 9).

Figure 9 -   VetTab App Monitoring Screen

3. Press the Select button on the front of the VetTab to turn it on and make sure that the Bluetooth icon (✳) is blinking at the top of the LCD indicating that Bluetooth is enabled. If it is not blinking, follow the instructions in section 4.2 to enable it.

4. Touch the Connect button (see section 4.3.1) to initiate the Bluetooth connection. Once your VetTab is discovered it will appear in the following list. If other nearby VetTab monitors are also on, they will also be visible. Select your VetTab from the list to initiate pairing.
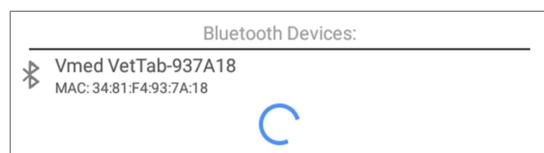

Figure 10 -   Bluetooth Discovery of VetTab

IMPORTANT
The VetTab will appear in this list during Bluetooth discovery with a unique digital ID number corresponding to the VetTab ID number printed on the back label (in Figure 10 it is "937A18"). Pay attention to this ID number if more than one nearby VetTab is turned on to ensure you connect to the right one.

5. If your VetTab has not already been paired with this Android device, you will see the following dialog. Select "Pair" to initiate the pairing. However, if your VetTab has already been paired with this Android device then proceed to step 6.
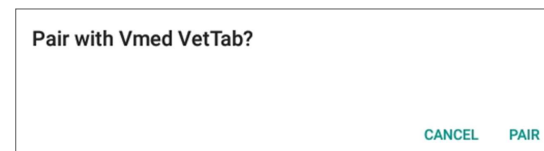

Figure 11 -   Bluetooth Pairing Dialog

6. The screen will now show that you are connected and waveform data will begin traversing each waveform box.

4.3.4   SpO2 Sensor Status Display

Whenever the VetTab is not measuring a certain vital sign parameter from the patient then that vital sign's parameter box will display three hyphens ("---") to indicate that there is no value available. For the SpO_2 parameter there is an additional message at the bottom left corner (see Figure 12) which gives further information about why there is no available SpO_2 parameter value.
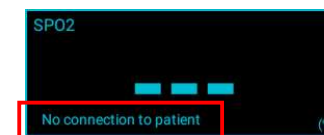
Figure 12 -   SpO$_2$ Status Description

The descriptions indicate such reasons as:

- **Sensor is unplugged** – the SpO_2 sensor cable is not plugged into the VetTab
- **No connection to patient** – the SpO_2 sensor cable is plugged into the VetTab, but the sensor itself is not connected to the patient
- **Searching for pulse signal** – the SpO_2 sensor may be attached to the patient but is unable to detect a pulse to measure (this usually only takes a few moments)
- **Pulse search timed out** – Too much time passed while the SpO_2 sensor was unable to detect a pulse to measure

4.3.5 NIBP Error Message Display

Occasionally when performing a blood pressure measurement, the VetTab may not be able to return a numerical result. In such an instance it should produce an error message in the bottom left corner of the NIBP parameter box describing why this is.

Figure 13 - NIBP Error Message Display

Some of the more common errors are listed below with descriptions of what may have caused them or what you may do to correct them.

- *BP error 3: cuff pressure leak*:
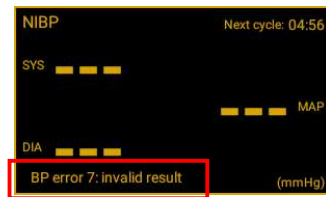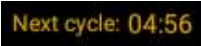 - o Cause: no cuff is attached to the hose
  - o Cause: leak in the cuff so that it cannot inflate completely
  - o **Fix: attach a cuff without any leaks**
- *BP error 5: check cuff position*:
  - o Cause: the cuff is not connected to or improperly positioned on the patient
  - o Cause: the wrong cuff size is used on the patient
  - o **Fix: follow instructions in section 6.3 for proper cuff placement and position**
- *BP error 7: invalid result*:
  - o Cause: hose is kinked or blocked
  - o Cause: cuff not properly connected to patient
  - o Cause: cuff is too large (or loosely wrapped around patient)
  - o **Fix: make sure hose is not kinked or obstructed**
  - o **Fix: follow instructions in section 6.3 for proper cuff placement and position**
- *BP error 8: measurement cancelled*:
  - o Cause: the measurement was cancelled either by the user tapping the BP button on the app or by selecting and activating BP on the VetTab screen. This error would only appear in the middle of a measurement and not during the interval between them.

4.3.6 NIBP Measurement Cycles

When monitoring a patient during a longer procedure you may wish to measure the blood pressure multiple times at regular intervals. The automatic NIBP cycle feature allows you to do so without having to remember to initiate a measurement each time. By selecting one of several choices for "Automatic Interval" under the NIBP section of the App Settings screen (see Figure 5 of section 4.3.2), you may designate the NIBP to automatically initiate a new measurement 1, 3, 5, 10 or 15 minutes after the previous measurement concludes. Or, you may turn off automatic measurement by selecting "Off". When it is off each tap of the BP button will initiate a single measurement.

In the top right of the NIBP parameter box are 3 separate kinds of indicators which show what state you are in for NIBP measurement cycles (see table below).

	BP cycle is off. This 'X' symbol indicates that the BP is neither measuring nor waiting to start a new automatic measurement. To initiate a new cycle, either tap the BP button on the app or select and activate the BP icon on the VetTab remote device.
	BP is measuring. This circular animation where the center periodically grows larger and smaller indicates that a blood pressure measurement is currently active with the cuff at least partially inflated. To cancel a measurement before it is complete simply tap the BP button on the app or select and activate the BP icon on the VetTab remote device.
	BP is in the automatic waiting interval: This text shows a countdown in minutes and seconds from the time interval selected in the App Settings. It appears at the end of each measurement unless "Off" is selected. Once it reaches "00:00" it will automatically initiate a new BP measurement. During this interval if you tap the BP button of the app then it will cancel the BP cycle and return to the *Off* state. Tapping the BP button again will start a new measurement. However, if in the waiting interval and you activate the BP icon on the VetTab remote device then it will begin a new BP measurement directly.

5 Monitoring

5.1 ECG Monitoring

5.1.1   Skin preparation

The quality of ECG information displayed on the monitor is a direct result of the quality of the electrical signal received at the electrode. Proper skin preparation is necessary for good signal quality at the electrode. A good signal at the electrode provides the monitor with valid information for processing the ECG data. Choose flat, non-muscular areas to place electrodes. Suggested guideline for skin preparation:

- Clip thick hair if necessary.
- Gently rub skin surfaces at sites to remove dead skin cells.
- Thoroughly cleanse the site with a mild soap and water solution.
- Wet the location of the patient where the ECG leads will be used with tap water or apply ultrasound gel to the skin clips and attach to each leg.

5.1.2   3-Lead Electrode Placement

Attach the ECG skin clips to the legs as shown in the table below.

The chart below shows the label used to identify each lead wire. Included also is its associated color code per American (AHA) and European (IEC) standards.

American Standard		European Standard	
Label	Color	Label	Color
RF (RA)	White	R	Red
LF (LA)	Black	L	Yellow
LH (LL)	Red	F	Green
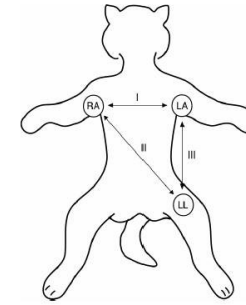
Figure 14 -   Positions of 3-lead wire Electrode Placement giving Lead II display

NOTE: Cable is marked RF (RA), LH (LL) and LF (LA)

5.1.3   Precautions

⚠ WARNING ⚠

- **Use only the specified ECG cable for monitoring.**

- **When applying clips or connecting cables, make sure they are not connected to any conductive part or touching each other or to ground. Verify that all clips, including neutral electrodes, are securely attached to the animal.**

- **Interference from a non-grounded instrument near the animal and ESU interference can cause inaccuracy of the ECG waveform.**

- **Do not touch the animal, bed or instrument during defibrillation.**

5.1.4 Using the optional esophageal probes

Figure 15 - Set of three esophageal probes

⚠ **WARNING** ⚠
Do not use electro-surgical devices near the esophageal probe. Arcing can cause serious burns to the esophagus.

Vmed esophageal probes come in three sizes and have sensors for sensing ECG and temperature. Choose the appropriate probe for the size animal. If the baseline tends to wonder or deviate from a straight line, the electrode spacing is too large and a probe with a shorter spacing should be used. If the ECG signal is intermittent, usually with respiration or double counting occurs, the electrode diameter is too small for the animal and a probe with larger diameter electrodes should be used.
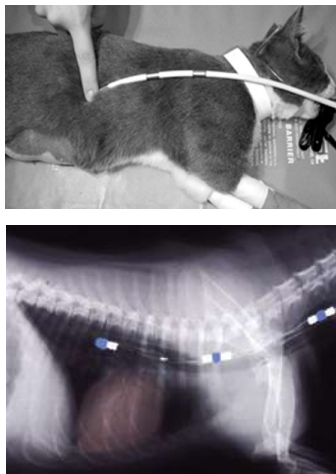

Figure 16 - Position of esophageal probes

1. Lay the probe on the animal simulating it being in the esophagus.
2. Place end of probe one finger width from the last rib.
3. Grasp the probe at the opposite end and hold it there.
4. Lubricate probe contacts with lubricating jelly and slide it into the esophagus until your fingers reach the patient's mouth.
5. Move the probe cranial and caudal and rotate as necessary until the best ECG signal is obtained.

5.1.5 Using the optional long-term monitoring electrodes
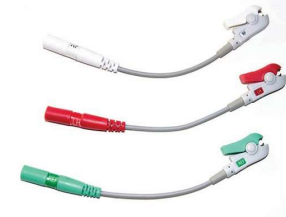
Figure 17 - Long-term Monitoring leads

NOTE
Connect Green clip to the black cable lead of the VetTab ECG cable.

NOTE
The optional, three color clip leads connect to the metal tabs on disposable pre-gelled electrodes. Use 3M 2248-3 infant, long-term monitoring electrodes for small animals or 3M 2270 for large animals. Disposable chest electrodes are best for long term monitoring when the animal is under or recovering from anesthesia.

1. Shave the electrode site
2. Wet area with soapy water and dry.
3. Remove the liner from three electrodes and apply to the chest, over the heart and oriented to the Lead II axis, White on the right chest toward the right front leg, Red in the middle and Black on the left chest toward the left hind leg indicated by the color code on the cable. Electrodes may also be placed on the legs preferably above the hock and elbow.

4. Smooth down the electrodes with circular motion. Avoid pressure on the center of the electrode.
5. Plug the three colored clip leads into the corresponding banana plugs on the ECG cable.

NOTE
Connect Green clip to the black cable lead

6. Connect a clip to each of three electrodes (See step 3).
7. Place a protective wrap over the electrode to prevent the animal from dislodging or chewing off the electrodes or leads.

5.1.6   Using the optional loop electrodes

Figure 18 -   Leg Loop Electrodes

1. Wet each leg with tap water and apply ultrasound gel.
2. Slip loop over each leg and tighten snugly.

⚠ **WARNING** ⚠
Do not cut off circulation of the patient's limb

3. Attach loop lead connectors to the corresponding banana plugs on the ECG cable.

NOTE
Connect the green lead to the black cable lead.

5.1.7   Using the optional exotic needle electrodes
1. Attach needle electrode leads to the banana plugs on the ECG cable.
2. Wipe needles with alcohol and insert subcutaneously to appendage.

5.2 SpO₂ Monitoring

5.2.1   Introduction

SpO$_2$ monitoring is a non-invasive technique used to measure the amount of oxygenated hemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The VetTab processes the electrical signal and displays the waveform and values for oxygenation and pulse rate.

5.2.2   Monitoring Procedure

Use the large clip for large animals; the small clip for smaller animals.

1. Power on the monitor.
2. Attach the lingual clip to the tongue (See Figure 19).

NOTE
Applying a gauze pad to the tongue may improve performance.

3. Plug the SpO$_2$ sensor cable into the Blue connector on the VetTab.
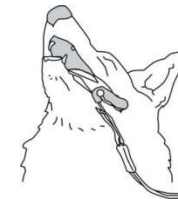
Figure 19 -   Proper site to attach the sensor

5.2.3   Measurement Limitations of SpO₂

If the accuracy of any measurement does not seem reasonable, first check the animal's vital signs by an alternate method. Then check the instrument for proper function. Inaccurate measurements may be caused by:

- Intravascular dye injections
- Excessive animal motion
- Excessive ambient light
- Improper sensor installation or incorrect sensor placement

- Concentration of dysfunctional hemoglobin, such as carboxyhemoglobin and methemoglobin
- Low circular perfusion at the applied part
- Shock, anemia, low temperature and application of vasomotor all reduce the arterial blood flow and may affect the measurement
- Oximeters and oximetry sensors used during magnetic resonance imaging (MRI) scanning. Induced current could potentially cause burns
- High-frequency electrical noise, including noise created by the host system, or noise from external sources, such as electrosurgical apparatus connected to the system

5.2.4 Precautions

⚠ **WARNING** ⚠

- **The SpO₂ cable must not touch an electrosurgery cable. Carefully route animal cabling to reduce the possibility of animal entanglement or strangulation.**

- **Prolonged and continuous monitoring may increase the risk of skin damage at the site of the sensor. It is especially important to check the sensor placement and ensure proper attachment on animals of poor perfusion or skin sensitive to light. Check the sensor location every 2–3 hours and move to another location if the skin deteriorates. More frequent examinations may be required for different animals.**

6 NIBP Monitoring

6.1 Introduction

The Non-invasive Blood Pressure (NIBP) module measures blood pressure using the oscillometric method. This monitor is accurate for large and small animals.

6.2 Monitoring Procedure

1. Power on the VetTab
2. Plug the air hose into the Black NIBP connector on the monitor.
3. Apply a cuff of proper size to the front or rear leg of the animal.
4. Connect the cuff with the air hose.
5. Press the button on the panel to select, then hold down the button to start the NIBP measurement.

When a measurement is performed using the button on the VetTab front panel then it will only perform a single measurement until manually activated again. However, if activated through the Android app, it will perform successive blood pressure measurements based upon the interval specified in the app's settings.

6.3 Cuff Selection and Placement

1. Identify the animal limb circumference.
2. Select appropriate cuff. When the cuff is wrapped around the limb, the index mark on the cuff should fall within the range marked on the cuff.
3. Verify the cuff is completely deflated and wrap cuff around extremity being used and making sure ARTERY mark is over the artery.
4. Verify the cuff is not wrapped too tightly around the limb. Excessive tightness may cause ischemia of the extremities.
5. Make sure that the cuff end falls within the range marked on the cuff, preferably not near the edges of the printed size gauge on the cuff.

Figure 20 -   Ideal Patient Position for Blood Pressure Measurement

6. The limb chosen for taking the measurement should be placed at the same level as the animal's heart. If this is not possible, use the following method to correct the measurement result:

NOTE

If the cuff is placed higher than the heart level, add 0.9 mmHg (0.10kPa) for each centimeter of difference. If the cuff is placed lower than the heart level, deduct 0.9mmHg (0.10kPa) for each centimeter of difference.

6.4 Measurement Limitations

Measurements are impossible with heart rate extremes of less than 40bpm or greater than 240bpm.

The measurement may be inaccurate or impossible:

- If a regular arterial pressure pulse is hard to detect.
- With excessive and continuous animal movement such as shivering.
- With cardiac arrhythmias Rapid blood pressure changes.
- Severe shock or hypothermia that reduces blood flow to the peripheral arteries.
- Obesity, where a thick layer of fat dampens the oscillations.

6.4.1 Precautions

⚠ **CAUTION** ⚠

- **The width of the cuff should be either 40% of the limb circumference as indicated by the cuff gauge. The inflatable part of the cuff should be long enough to circle 50-80% of the limb. The wrong size cuff can cause erroneous readings. If the cuff size is in question, use a larger cuff.**

- **Do not apply the cuff to a limb that has an intravenous infusion or catheter in place. This could cause tissue damage around the catheter when infusion is slowed or blocked during cuff inflation.**

- **Make sure the air hose connecting the blood pressure monitor is not blocked, twisted, or tangled.**

7 Temperature Monitoring

7.1 Measurement Procedure

1. Plug in the ECG/Temp cable to the Green connector.
2. Insert the temperature lead transesophageally or into the anus.
3. Power on the monitor.
4. Wait for the temperature reading to stabilize.

7.2 Precautions

⚠ **CAUTION** ⚠

- **Be careful to avoid damaging the temperature probe and cable. When the ECG/Temperature probe and cable are not in use, coil loosely. If the cable is wound too tightly or bent near its tip, mechanical damage may occur.**

- **If you are in doubt about the accuracy of any reading(s), check the animal's vital signs by an alternative method.**

8 Specifications

8.1 Battery and AC adapter

- Battery type: 3.7V,1800mAh, lithium-ion.
- Time between charges 9-12 hours
- AC adapter: Input: AC 100-240v ~200mA
- Output: DC 5V 1A

8.2 Parameters Specifications

8.2.1   ECG

- Designed for use as Lead II
- Band width: 0.1-25Hz
- Heart rate:
    - Range: 15 bpm to 300 bpm
    - Accuracy: ±1 bpm

8.2.2   SpO$_2$

- Detection range: 35%-100%
- Accuracy: ±1% 90%-100%, ±2% 70%- 89%

8.2.3   NIBP

- Cuff inflation time: <15 seconds
- Initial inflation pressure: 180 mmHg
- Detection range
- Systolic 30mmHg-255mmHg
- Diastolic 15mmHg -220mmHg
- MAP 20mmHg-235mmHg

8.2.4   Respiration

- Chest impedance method
- Range 0 bpm-100 bpm
- Accuracy ±1bmp

8.2.5   Temperature

- Type: Thermistor
- Range: 20C-50C
- Accuracy: ±0.2C

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