

The ERM – 8010 ECG and Respiratory Monitor by Vetronic Services Ltd

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Introduction

The Vetronic Services ERM-8010 is a microprocessor controlled ECG and respiratory monitor designed specifically for veterinary use. The unit is a fully portable battery-powered device suitable for both indoor and outdoor conditions. A clear liquid crystal graphic display shows the real-time ECG of the patient being monitored in addition to displaying the current heart rate and respiration rate. Each detected ECG is accompanied by a beating heart symbol and an optional beep. Similarly each detected breath is indicated by an inflating/deflating lung symbol and an optional beep. Optional ECG and respiratory alarms allow close monitoring of both heart rate and respiration. The ERM-8010 has an in-built memory facility which records the heart rate and respiratory rate continuously. This allows trends of heart rate and respiration rate to be plotted for the last 60 minutes of recorded data. During ECG monitoring the screen can be frozen at any time to allow closer inspection of the ECG trace and the sweep speed of the trace across the screen can be altered to suit the patient being monitored. All the user options such as which beeps are selected, together with the sensitivity level are automatically stored in memory every time they are changed and will be preserved when the unit is turned off or the battery is replaced. At turn-on all these settings are read from memory and loaded into the unit.

The unit is fitted with a socket to allow output to our thermal printer. This is not included as standard but is available as an optional extra.

The ERM-8010 offers complete ECG and respiratory monitoring with graphic display and trend recording in a small pocket-sized reliable instrument.

Functional Specifications

ERM-8010 Facilities

- Real time ecg display
- Continuous monitoring of heart rate
- Clear display of heart rate in beats per minute
- Beating heart symbol with each detected heart beat
- Optional beep with each detected heart beat
- Optional alarms for high and low heart rates
- Variable sensitivity
- Simple Lead II standard ecg connection
- Dual clip size for a range of species
- Variable ecg trace sweep speed
- Ecg freeze facility
- Continuous respiratory monitor
- Clear display of breathing rate in beats per minute
- Inflating/Deflating lung symbol indicates each breath
- Optional beep with each detected breath
- Optional Apnoea alarm
- Respiratory sensor housed in simple standard 15mm ET connector
- Plotting of ecg trends for the last 60 minutes continuous monitoring
- Plotting of respiratory trends for the last 60 minutes continuous monitoring.
- In-built non-volatile memory saves all user settings between uses.
- Very low current consumption extends battery life to over 250 hours
- On-screen low battery warning gives advance information on battery status.
- Pocket sized unit for theatre and field use.

Connecting the ERM – 8010 Ready for use

Before use it is necessary to connect both the battery and the sensor cables to the ERM-8010. The battery (supplied) is a standard 9 volt PP3 battery. We recommend any long life 9 volt PP3 battery suitable for low current use. The unit will also work with rechargeable NiCad batteries with the same PP3 connectors. The battery compartment is located at the back of the unit on the underside. Open the battery cover by sliding it out from the main unit and connect the battery to the battery terminals inside the compartment. Replace the battery cover.

The sensor cable has a 5-pin circular connector that connects to the socket located at the front of the unit. Connect the sensor cable to the unit by pushing the plug into the socket with the indented notch uppermost. Then tighten the knurled retaining ring to hold it in place. Once secured the sensor cable should be left connected unless being returned for servicing or repair.

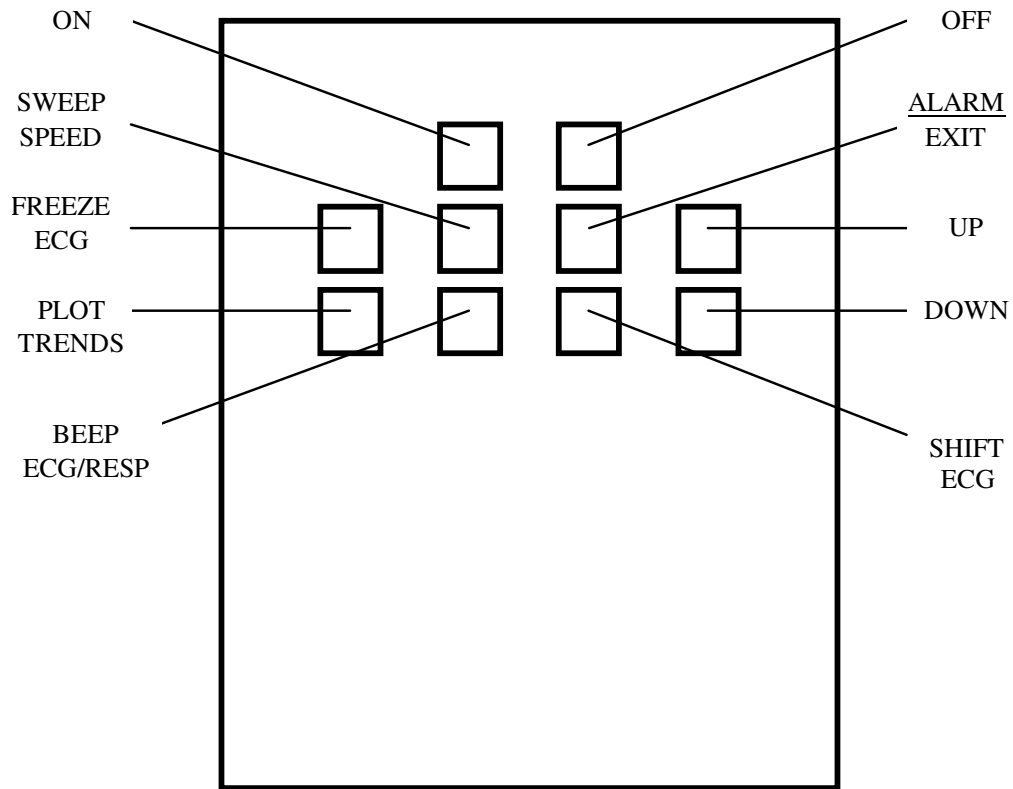
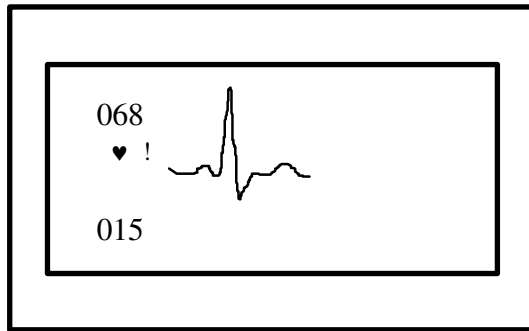
The unit is now ready for immediate use.

DECLARATION OF CONFORMITY



This product conforms to European standards EN 50 081-1 and EN 50 082-1

Year 2000. This product is free from the effects of the millennium bug and is Year 2000 compliant.



ERM - 8010 FRONT PANEL

The Control Buttons

ON button: A single press held for a second turns the unit on.

OFF button: A single press held for a second turns the unit off.

FREEZE ECG button: Freezes the current ECG display waveform. Display remains frozen until the EXIT button is pressed.

SWEEP SPEED button: A single press advances to the next sweep speed in the order 12.5mm/S, 25mm/S and 50mm/S.

ALARM/EXIT button: In normal ECG display mode a single press on this button will take the user to the Alarm set up menu. In any menu this button acts as the exit or escape button.

UP button: In normal ECG display mode this button increases the sensitivity of the ECG detector. Used in menus to select menu options.

PLOT TRENDS button: In normal ECG display mode pressing this button takes the user to the Trend Plotting menu.

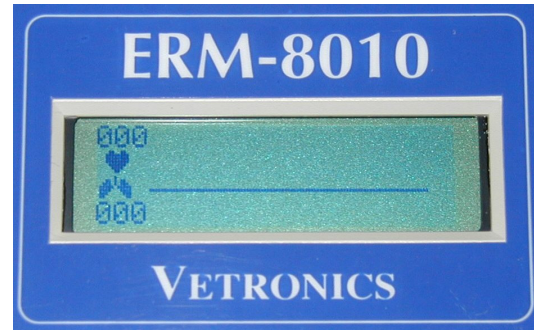
BEEP ECG/RESP button: Pressing this button toggles the beep between ECG and respiratory detection.

SHIFT ECG button: Pressing this button shifts the vertical position of the trace on the screen.

DOWN button: In normal ECG display mode this button decreases the sensitivity of the ECG detector. Used in menus to select menu options.

Using the ECG Rate Monitor

- Turn the unit on by pressing the ON button for 1 second.
- The display will look like this:
(Refer to picture to the right)



- Connect the ECG leads to the patient using the supplied crocodile clips in the following manner.

Red	Right Fore
Green	Left Hind
Black	Right Hind

This is the standard Lead II connection suitable for dogs, cats and most small mammals. For other species see Appendix B.

- Adjust the sensitivity by pressing the UP and DOWN arrow buttons to show a normal ECG pattern on the screen.
- The R-wave needs to reach approximately 2/3 the screen height to register as a beat.
- Base-line wandering of the ECG is caused by poor skin contact on one or all of the electrodes. Reposition or add a contact medium such as Isopropyl Alcohol.
- Repeatedly press the BEEP ECG/RESP button until there is a tick next to the heart symbol.
- The heart symbol will flash with every beat and be accompanied by an audible beep.
- The top left hand corner of the screen shows the heart rate in beats per minute.
- If no heart rate is detected over a period of 10 seconds then the displayed heart rate will return to zero.
- Normal monitoring will continue regardless of whether the tick is next to the heart symbol or not.

Using the Respiratory Monitor

- Connect the in-line monitor to the 15 mm connector at the end of the ET tube.



- Connect the other end to the incoming gas supply as normal.
- A breath is detected by measuring the temperature difference between inspired and expired gas.
- Repeatedly press the BEEP ECG/RESP button until there is a tick next to the heart symbol.
- When the patient exhales the lung symbol will empty and a beep will be heard.
- The respiratory rate is displayed in the bottom left hand corner of the screen.
- If no breaths are detected over a period of 60 seconds then the displayed respiratory rate will return to zero.
- Normal monitoring will continue regardless of whether the tick is next to the lung symbol or not.

Using and Setting the Alarms

- The top line of the display shows the limits of the plot and the time over which the rates have been recorded.
- To leave this screen press the EXIT button again.
- The respiratory rate trend plot can then be selected with the DOWN arrow button or to return to normal display mode press the EXIT button.
- The limits between which the ECG plot is displayed are the same as the heart rate alarm limits. This allows easy recognition of rates reaching the alarm limits and also allows the limits to be changed to view data differently.
- Attempting to plot trends when there is less than one minute of data will produce the error message NO DATA!

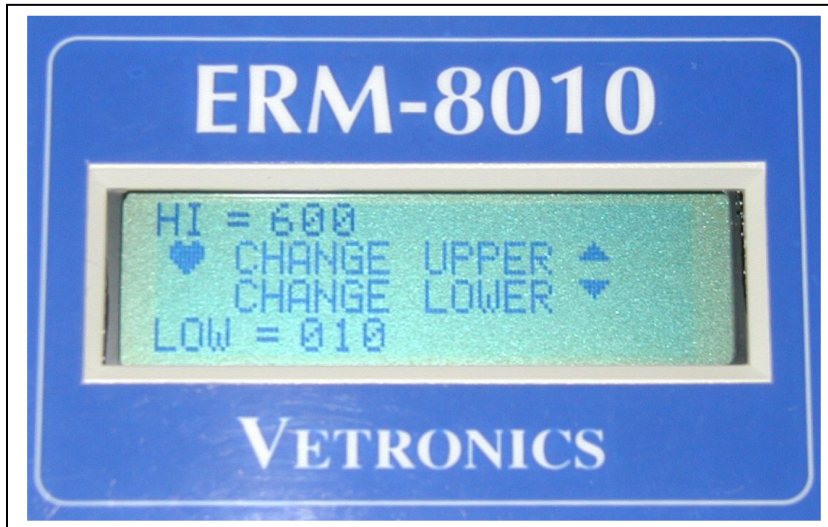
The ERM-8010 has alarms for both heart rates and respiration and either or both or none may be selected at any one time. Each alarm setting is independent of any other alarm setting.

Setting the Heart Rate Alarms

- With the ERM-8010 in normal display mode press the ALARM button once.



- Press the UP arrow button to remove the cross through the bell next to the heart symbol.
- Press the ALARM button again.



- Choose to set either the upper or lower heart rate limit by pressing the UP arrow button or the DOWN arrow button respectively.
- Increase or decrease the limit by using the UP and DOWN arrow buttons.
- The maximum upper limit is 600 and the minimum lower limit is 10.
- Due to error-checking the upper limit cannot be set lower than the lower limit. If this is attempted the numbers will refuse to change.
- When the limit is set correctly press the EXIT button. Set up the other limit if required and press EXIT when done.
- If both alarm limits are set correctly, press EXIT once again. If respiratory alarms are turned on then the set-up screen for this will be shown. If respiratory alarms are off then the display returns to normal display mode.
- The alarm will sound continuously if the displayed heart rate falls outside of the alarm limits. The alarm condition will be identified by an exclamation mark appearing next to the heart symbol.
- Silence the alarm by correcting the condition leading to the change in heart rate or by changing the alarm limits. Do NOT silence the alarm by turning the alarm off (by placing a cross through the bell) as no further alarm conditions will be detected.

Setting the Apnoea Alarm

- With the ERM-8010 in normal display mode press the ALARM button once.



- Press the DOWN arrow button to remove the cross through the bell next to the lung symbol.
- Press the ALARM button again.
- If the heart rate alarms are turned on then the set-up screen for those will appear. To leave the heart rate settings as they are press the EXIT button once and the set-up screen for the Apnoea limit will appear.



- Change the Apnoea limit by pressing the UP and DOWN arrow buttons until the required value is set.
- The maximum upper limit is 60 and the minimum lower limit is 5 seconds.
- When the limit is set correctly then press the EXIT button to return to the normal display mode.
- If a breath is not detected within the time limit then the alarm will sound continuously. The alarm condition will be identified by the exclamation mark appearing next to the lung symbol.
- The alarm will be silenced by the next breath or by entering and quitting the alarm set-up routine. On leaving the set-up routine the full apnoea time must elapse before the alarm will sound again.

Using the ERM – 8010 to Plot Heart Rate and Respiratory Trends

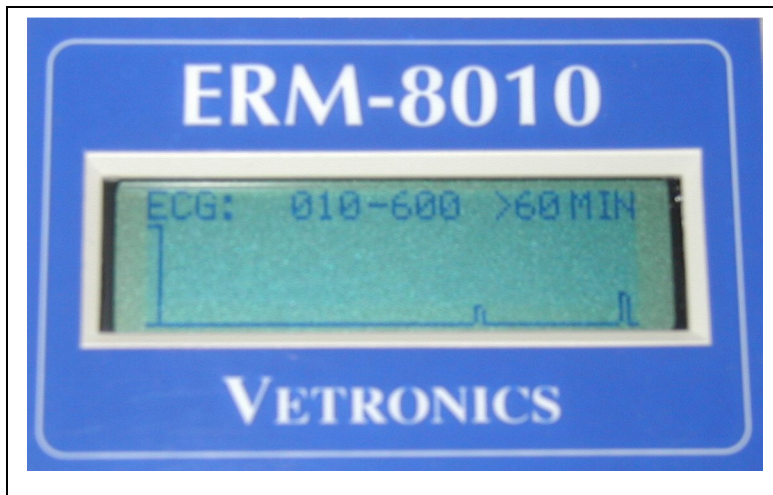
Trends can be plotted for both respiratory rates and heart rates for periods of up to 60 minutes. The heart rate and respiratory rate of a patient are stored every 60 seconds whilst the unit is in normal display mode. If the period of monitoring exceeds 60 minutes then the previous information will be overwritten in such a way that the last 60 minutes of recorded data is always available.

Displaying the Heart Rate Trends

- With the ERM-8010 in normal display mode press the PLOT TRENDS button.



- Press the UP arrow button to select the trend plotting option.
- Press the UP arrow button again to plot the heart rate trends.



- The top line of the display shows the limits of the plot and the time over which the rates have been recorded.
- To leave this screen press the EXIT button again.
- The respiratory rate trend plot can then be selected with the DOWN arrow button or to return to normal display mode press the EXIT button.
- The limits between which the ECG plot is displayed are the same as the heart rate alarm limits. This allows easy recognition of rates reaching the alarm limits and also allows the limits to be changed to view data differently.
- Attempting to plot trends when there is less than one minute of data will produce the error message NO DATA!

Displaying the Respiratory Rate Trends

- With the ERM-8010 in normal display mode press the PLOT TRENDS button.



- Press the UP arrow button to select the trend plotting option.
- Press the DOWN arrow button to plot the respiratory rate trends.



- The top line of the display shows the limits of the plot and the time over which the rates have been recorded.
- The limits of the plot are determined by the maximum and minimum respiratory rates during the displayed time period.
- To leave this screen press the EXIT button once.

- Press the UP arrow button to display heart rate trends or press the EXIT button again to return to normal display mode.
- Attempting to plot trends when there is less than one minute of data will produce the error message NO DATA!

Clearing the Trends of Memory

The ERM-8010 will allow all trend data to be erased and return the recording time to zero to allow the start of a new monitoring period. Once erased the data is non-recoverable.

- From normal display mode press the PLOT TRENDS button.
- Press the DOWN arrow button to clear the trends.
- To exit without clearing the trends answer NO to the question “ARE YOU SURE” by pressing the DOWN arrow button again.
- To clear the trends answer YES by pressing the UP arrow button. All data is then erased.

Freezing the Display

The display can be frozen at any time whilst the ERM-8010 is in normal display mode. Freezing the display stops any further monitoring of heart and respiration rates until the EXIT button is pressed and the unit reverts to normal display mode. Because all monitoring and all timing stops whilst the display is frozen no alarms will be activated or beeps sounded until the unit returns to the normal display mode. Then the timings will resume exactly at the point where they were interrupted by the FREEZE ECG button being pressed. Freezing the display enables closer inspection of an ECG trace.

- Press the FREEZE ECG button to freeze the display
- Press the EXIT button to return to normal display mode.

Changing the Sweep Speed

The rate at which the trace is drawn across the screen can be changed by pressing the SWEEP SPEED button. At turn-on the sweep speed is 25mm per second. Pressing the SWEEP SPEED button when the unit is in normal display mode will increase the sweep speed from 25mm per second to 50mm per second. This has no effect on the displayed heart rate or interval timings but enables the character of very fast ECG's to be more readily seen. Pressing the

SWEEP SPEED button again will change the sweep speed from 50mm per second to 12.5 mm per second.

- Press the SWEEP SPEED button once to increase to the next speed.
- When the sweep speed is 50 mm per second a further press of the SWEEP SPEED button returns the rate to 12.5mm per second.

Because of the slight limitations of the display resolution in displaying the ECG trace there will often be an apparent change in appearance of the ECG complexes when changing sweep speeds. In order to get the most information from a displayed ECG it should be viewed at the highest practical sweep speed since this represents the best resolution.

Changing the Sensitivity

The sensitivity of the ECG amplifier may be changed by pressing either of the UP or DOWN buttons. There are 5 possible sensitivity settings allowing ECG's from horses to rodents to be displayed. Pressing the UP button increases the sensitivity and makes the displayed ECG larger. Conversely pressing the DOWN button decreases the sensitivity. If the DOWN button is pressed sufficiently then the amplifier is turned off and a flat-line trace results. Pressing the UP button will turn the amplifier back on again. The ECG sensitivity setting is stored in non-volatile memory and will remain as set even if the unit is turned off or the battery replaced. If either button is pressed and held down it takes 10 seconds to cover the full range of settings.

- Press the UP arrow button to increase the height of the displayed ECG.
- Press the DOWN arrow button to decrease the height of the displayed ECG.

Non Volatile Memory

The ERM-8010 has on-board non-volatile memory that records and saves all of the user-selected options as well as the alarm limits and length of monitoring. Therefore when the unit is turned off or the battery replaced all the user settings will be preserved. Specifically all of the following data is stored in non-volatile memory

- Upper heart rate alarm limit
- Lower heart rate alarm limit
- Apnoea limit

Heart rate alarm status i.e. on or off
 Respiratory rate alarm status i.e. on or off
 ECG or RESP beep selection
 Duration of monitoring (0-60 minutes or >60 minutes)
 Up to 60 minutes of heart rate data
 Up to 60 minutes of respiratory rate data

Amplifier sensitivity setting

Low Battery Warning

When the battery voltage drops below 6 volts the ERM-8010 can no longer operate correctly and the display will dim. Just before this happens a battery symbol will appear at the top right hand side of the screen. When this symbol appears the battery must be replaced.

Quick Reference Table

Function	Action	Effect
Display Functions		
Freeze display	Press freeze ECG button	Display is halted at point of button press
Un-freeze display	Press exit button	Returns display to normal display mode
Change sweep speed	Press Sweep Speed button	Advances to next sweep speed.
Increase the ECG amplifier sensitivity	Press the UP arrow button	ECG trace appears larger on the screen
Decrease the ECG amplifier sensitivity	Press the DOWN arrow button	ECG trace appears smaller on the screen
Shift ECG	Press the shift ECG button	ECG trace is shifted slightly up the screen
Beep Functions		
Enable ECG beep	Press the BEEP ECG/RESP button until there is a tick next to the heart symbol	An audible beep will be heard every time an ECG complex is detected.
Enable Respiratory beep	Press the BEEP ECG/RESP button until there is a tick next to the lung symbol	An audible beep will be heard every time a breath is detected.
Disable beeps	Press BEEP ECG/RESP until no ticks appear next to either the heart or lung symbols	No beeps will be heard for either ECG or breath detection.
Alarm functions		
Enable the heart rate alarms	Press the ALARM button and then press the UP button to remove the cross through the bell next to the heart symbol	Enables heart rate alarms for both high and low limits
Enable the Apnoea alarm	Press the ALARM button and then press the DOWN button to remove the cross through the bell next to the lung symbol	Enables the Apnoea alarm
Disable Alarms	Press the ALARM button and then press	Disables the alarm for either the heart

	either the UP or DOWN button to cross out the bell next to the appropriate symbol	rate, apnoea alarm or both.
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Function	Action	Effect
Alarm Functions contd.		
Set the heart rate alarm limits	Enable the heart rate alarms and then press ALARM to enter the alarm rate set-up menu.	Allows the user to set both the upper and lower limits of the heart rate alarms
Set the Apnoea time limit	Enable the Apnoea alarm and then press ALARM to enter the Apnoea time set-up menu	Allows the user to set the Apnoea time to any value between 5 and 60 seconds
Trend Plotting Functions		
Plotting the heart rate trends	Press the PLOT TRENDS button and then press the UP arrow twice. When done press the EXIT button twice	Plots the heart rate trend graph for the latest period of monitoring
Plotting the respiratory rate trends	Press the PLOT TRENDS button and then press the UP arrow followed by the DOWN arrow. When done press the EXIT button twice	Plots the respiratory rate trends for the latest period of monitoring
Clearing the trends	Press the PLOT TRENDS button and then press the DOWN arrow followed by the UP arrow.	Resets the recording timer to zero and clears the memory of all previous data

Note: All functions are accessed while the ERM-8010 is in normal display mode.

Appendix A

SPECIFICATIONS FOR THE ERM-8010

Technical

Mechanical

Weight	475g
Width	100mm
Height	55mm
Depth	190mm
Construction	ABS plastic (Grey)
Display area	60.5 x 18.5 mm
Display size	122 x 32 pixels
Pixel size	0.44 x 0.45 mm
Pixel pitch	0.44 x 0.49

Electrical

Power Source	9 Volt PP3 Battery
Power Consumption	25mW
Current	2.5 mA

Amplifiers

ECG

Amplifier Sensitivity range	100uV to 5mV
Heart Rates	10 to 800
Sweep Speed	12.5, 25 & 50 mm/second
Alarm Limits	10 to 600 bpm
Heart Rate alarm increments	10 bpm
Counting method	Lead II R-wave detection
Sensors	Skin electrodes
Input impedance	5M ohms

Respiration

Rates	1 to 150 breaths per minute
Apnoea alarm limits	5 to 60 seconds
Apnoea alarm increments	1 second
Detection method	Thermal
Sensor	NTC thermistor
Placement	In-line

Appendix B

Using the ERM-8010 in other species.

The ERM-8010 cannot distinguish between the P, R and T waves in an ECG complex and will count extra beats if the P and T waves are sufficiently large to trigger the detection circuit. This can lead to false readings in some animals. Usually by employing a different Lead connection a true reading can be obtained. The following sections provide some hints on getting reliable readings in different species.

Connections for equines.

The following connection sites will provide a good ECG complex with a prominent R-wave suitable for monitoring by the ERM-8010.

Red Lead	Attach to skin in jugular furrow
Green Lead	Attach to skin over xiphoid
Black Lead	Attach to skin on lateral chest wall.

Connections for rabbits

The ECG complexes in rabbits can be very small so it is important that there is good skin contact. Either pluck or clip a little hair from the connection sites and use a contact medium. When the electrodes are connected in the standard manner the T-wave may be as large as the R-wave and this will lead to a double beep for every ECG complex. The recorded heart rate will reflect this and appear twice the actual rate. To avoid this it is often useful to connect the leads in a Lead I configuration as follows.

Red Lead	Attach to right fore
Green lead	Attach to left fore
Black lead	Attach to right hind.

Connections for birds.

Due to the nature of birds skin it can be difficult to obtain a good ECG recording from these animals. A good reading can usually be obtained by using transcutaneous needles. The same sites can be used as for mammals in a Lead II configuration. However there is often a large P-wave and a large T-wave with a negative R-wave which will make accurate recording of the heart rate difficult. By using a Lead I connection the T and R waves appear iso-electric and the ERM-8010 can count the prominent positive P-waves. For details of the Lead I connections see the section above on rabbits.

Extras for your ERM - 8010

Consumables

Part Number: VSLC220 Description: ECG Electrode Pad 5cm Pack of 30	Part Number: VSLM00S50 Description: ECG Electrode Pad 3cm with popper connection Pack of 50	Part Number: VSLN00S25 Description: ECG Electrode Pad 3 x 2cm with popper connection Pack of 25
 A circular white electrode pad with a blue center and a small label 'C2000'. VSLC220	 A blue popper connection attached to a white electrode pad. VSLM00S50	 A blue popper connection attached to a white electrode pad. VSLN00S25

Part Number: VSLM00A50 Description: ECG Electrode Pad 3cm with socket for 4mm Banana Plug. Pack of 50	Part Number: VSLSBPPSA Description: Banana Plug Popper Socket Adaptor.	Part Number: VSLCCMOD Description: Crocodile Clip for 4mm Banana Plug
 A blue popper connection attached to a white electrode pad. VSLM00A50	 Two white plastic adaptors, one with a banana plug and one with a popper connection. VSLSBPPSA	 A metal crocodile clip with a banana plug. VSLCCMOD

For other products and consumables see our web page:
<http://www.vetronic.co.uk>

Consumables Cont ...

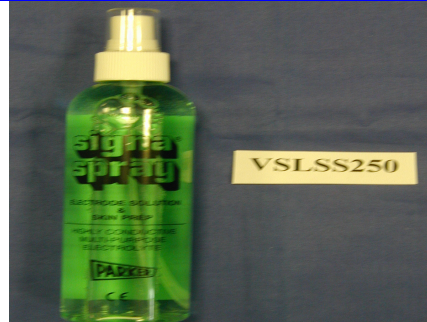
Part Number: VSLECGLPE4

Description: ECG Limb Plate Electrode with Velcro strap and a socket for 4mm banana plug lead connection.



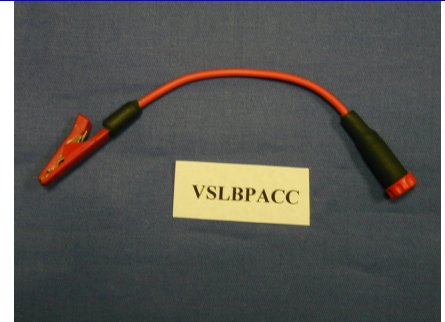
Part Number: VSLSS250

Description: ECG contact electrolyte spray 250ml bottle



Part Number: VSLBPACC

Description: 4mm Banana Plug to 2mm Atraumatic Crocodile Clip Adapter



Part Number: VSLBPPOPA

Description: 4mm Banana plug to Popper Male adaptor



For other products and consumables see our web page:
<http://www.vetronic.co.uk>