

The CardioStore by Vetronic Services Ltd

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Introduction

CardioStore is a combined digital ECG recorder and respiratory monitor that can be used for routine monitoring of anaesthetised patients or for obtaining diagnostic quality ECG's in conscious patients.

A clear 6cm x 3cm graphic display provides a real-time ECG trace and information on heart rates and respiratory rates. Designed specifically for the Veterinary market CardioStore can monitor respiratory rates up to 120 per minute and heart rates of over 800 beats per minute. An in-line temperature-sensitive sensor attached to the ET-tube detects patient respiration, whilst ECG monitoring uses the standard four limb attachments of an ECG cable.

ECG's can be saved onto a non-volatile RAM card for later replay or for uploading to a PC for report writing and saving.

CardioStore comes complete with a fully functional Windows software package that will allow uploading of stored ECG's, report generation, faxing and archiving of patient ECG's.

Getting ready for use

To get CardioStore ready for use you will need the following:

CardioStore main unit

4 x AA NimH batteries (supplied)

1 x ECG cable (supplied)

1 x Respiratory cable (supplied)

1 x 2MB PCMCIA RAM card (supplied)



Fit the 4 AA batteries in the battery compartment at the rear of the unit in the positions and polarities indicated by the legends on the floor of the battery compartment.

Plug the respiratory connector in to the socket on the right hand side of the unit at the front.

Plug the ECG connector into the main 25 way D-Type connector. Push until the connector latches into place. The ECG cable is held in place until the side-lever is pushed to release the latch.

Push the PCMCIA card into the slot on the left-hand side of the unit with the front of the card face downward.



The Key Functions

The keypad area has 10 keys on it. Two are used for power ON and OFF and the remaining 8 keys control the functions of the unit. Please note that pressing the OFF key at any time will turn the unit off. You will not be prompted to save any data that has been recorded but not yet saved.



The Keys:

ON A single press turns the unit on You will hear three short beeps which indicate that CardioStore is initialised and ready to run

OFF A single press turns the unit off

The functions on the keys that are in WHITE are active whilst in normal RECORD and REPLAY mode.

RESET. This starts recording data back at the start of any free memory of the PCMCIA card.

↑ GAIN. This increases the size of the ECG seen on the display. It has no effect on the size of the recorded ECG.

SHIFT+. This moves the whole ECG trace up the screen.

REPLAY. This opens a selection screen enabling any recorded ECG to be selected and replayed.

A new screen appears showing the currently selected ECG, the total number of ECG's and the length of the currently selected ECG. For example the following might appear:



*First ECG of 17 held on the RAM CARD.
ECG length is 23 seconds*

This indicates that there are 17 ECG's saved on the PCMCIA card and that the first ECG is selected for REPLAY. The length of the first ECG is 23 seconds.

When the REPLAY screen is showing the following keys are active:

ECG No. + Selects the next saved ECG

ECG No. - Selects the previous saved ECG

RESET. Returns to normal RECORD mode

OK/SETUP Replays the selected ECG

↑GAIN Increases the size of the ECG on screen

↓GAIN Decreases the size of the ECG on screen

SHIFT+ Moves the ECG trace up the screen

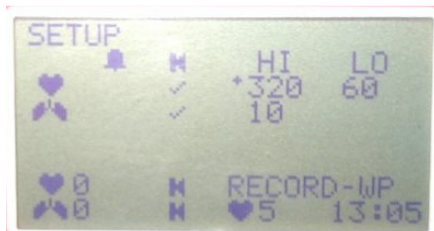
SHIFT- Moves the ECG trace down the screen

SAVE ECG Pressing this button saves all the ECG data recorded on the card since the unit was last RESET. (See: [The difference between RECORDING and SAVING ECG's](#))

↓ GAIN. This decreases the size of the ECG seen on the display. It has no effect on the size of the recorded ECG

SHIFT-. Shifts the whole ECG trace down the screen.

SETUP Enters the SETUP routine and enables the following functions:



ALARM SELECT

Use this to enable or disable alarms for Heart Rate or Respiratory monitoring.

↑ALARM SETTING

Increases the alarm setting of the selected alarm

ERASE CARD

Use this button to wipe all saved ECG's from the PCMCIA card. Once removed the ECG's cannot be recovered. After pressing this button a prompt appears asking if you wish to continue. To erase the card press the OK/SETUP button and hold it down for 2 seconds. Holding it for less than 2 seconds or pressing the REPLAY/NO button will return you to normal RECORD mode. If the OK/SETUP button is held down for 2 seconds a confirmatory long beep is heard indicating that the erase has been completed.

ERASE LAST ECG

This button will erase the last ECG saved ONLY. When pressed a prompt will appear asking if you wish to continue. To erase the last ECG press and hold down the OK/SETUP key for 2 seconds, Holding it for less than 2 seconds or pressing the REPLAY/NO button will return you to normal RECORD mode. If the OK/SETUP button is held down for 2 seconds a confirmatory long beep is heard indicating that the erase has been completed.

BEEP SELECT

Like ALARM SELECT, this button allows enabling/disabling of beeps for either Heart Rate or Respiration monitoring.

↓ALARM SETTING

Decreases the alarm setting of the selected alarm.

SELECT ALARM

This changes the alarm that is selected for change. A small cross next to the appropriate value indicates the selected alarm. Pressing this button moves the cross from HI Heart rate to LO Heart rate and then to Apnoea and then back to HI Heart Rate. Once the alarm is selected use the ↑↓ALARM SETTING keys to change the values.

SETUP

Pressing this key returns the unit to normal RECORD mode.

The difference between Recording and Saving ECG's

The CardioStore unit whilst in RECORD mode (and as long as the PCMCIA card is not full or write-protected) is continuously saving the ECG data to the PCMCIA card. This data as yet is not saved as a named file on the PCMCIA card and will be lost if any of the following occur:

- a) The unit is turned off
- b) The RESET button is pressed
- c) An ECG is replayed
- d) The SETUP functions are accessed.

If any of these occur then the unsaved memory is RESET to zero and data saving begins again as soon as the RECORD mode is re-entered.

What CardioStore is doing is saving the ECG data all the time in case you need it. If it is not needed then it will be written over when the PCMCIA card is full or RESET.

When the SAVE button is pressed all ECG data since the last RESET is saved as a file on the PCMCIA card and the number of ECG's on the card will be seen to increase by one. It is important when saving an ECG to hold the SAVE button down until a double-beep is heard confirming the save.

If the recording time exceeds the remaining time on the PCMCIA card then the data is looped and new data is now saved over any old data that has been recorded but not saved. See: [What happens When the PCMCIA card is full](#)

What happens when the PCMCIA card is full ?

As described in the section '[The difference between Recording and Saving ECG's](#)', the ECG data is continuously being stored in the remaining free memory area of the PCMCIA card. Every time an ECG is Saved the remaining free memory area is updated and the new available free space is shown in the bottom of the right-hand side status screen. When the period of recording exceeds the free remaining time on the PCMCIA card the ECG data is stored back at the beginning of the free memory area overwriting the previous oldest data. This looping has two consequences. Firstly, the PCMCIA card always has the most recent data recorded on it of an amount shown by the free remaining time. And secondly when and if that ECG is saved the PCMCIA card will be full and the remaining time will be shown as 0:00. When this occurs, data can no longer be recorded and so the right-hand status line shows MONITOR to indicate that no ECG is being recorded but that normal monitoring functions are continuing. Any attempt to save data will have no effect.

Connecting to a patient

Respiration Monitoring (Anaesthetised Patients only)

The respiratory monitor is used in patients intubated with an endo-tracheal tube. The respiratory sensor has a standard 15mm connector that pushes into the connector on the end of the ET tube. The other end connects to the anaesthetic circuit in the normal way.

ECG Monitoring

Connect the four ECG leads in the standard manner. Note there are two colour conventions – British and American. The following table shows the proper connections using either convention.

British:

Right Fore	Red,	Left Fore	Yellow
Right Hind	Black	Left Hind	Green

American:

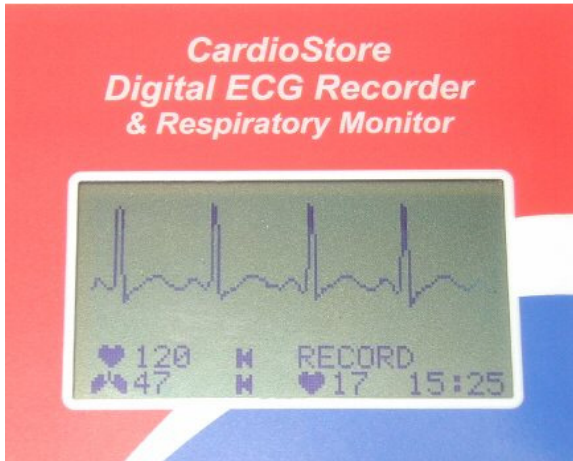
Right Fore	White	Left Fore	Black
Right Hind	Green	Left Hind	Red

You will know which lead convention to follow by the presence or absence of a yellow lead. The British system has a yellow lead whereas the American system does not.

Turn the CardioStore monitor ON by pressing the ON button once.

What the display symbols mean

When CardioStore is turned on you will hear three short beeps whilst the unit is initialising. Then the display appears and the ECG trace is drawn across the screen.



Main screen showing a heart rate of 120, and a respiratory rate of 47.

CardioStore is in RECORD mode, there are 17 ECG's currently stored on the PCMCIA card and there are 15 minutes and 25 seconds of recording time left on the card.

Audible beeps are selected for heart rate and breathing. Both alarms are turned off.

The lower part of the screen is the status screen area and has two parts, a left-hand side part and a right-hand side part.

Left Status Screen

On the left-hand side are a heart symbol and a lung symbol. Any symbol appearing on the same line as the heart symbol on the left-hand side of the screen relates to the ECG monitor. Any symbol appearing on the same line as the lung symbol on the left-hand side of the screen relates to the respiratory monitor.

If no heart rate is detected the value next to the heart will stay at zero. The number next to the lung symbol can have two meanings. When respirations are detected the number displayed is the respiratory rate in breaths per minute. However, if no respiration is detected in a 15-second period then the unit begins an apnoea count and then displays the number of seconds of apnoea. This is useful to indicate the duration and severity of any apnoeic event. After 10 minutes (600 seconds) this counter will return to zero.

To the right of each of these heart and lung symbols there may be two more symbols, a bell symbol and a loudspeaker symbol. If a bell symbol appears on the same line as the heart then this indicates that the heart rate alarms are active. If a bell symbol appears on the same line as the lung then this indicates that the apnoea alarm is active. A loudspeaker symbol indicates that the audible beep is enabled for either heart rate or respiration monitoring.

One further symbol may be seen in this Left Status Screen - an exclamation symbol. An exclamation mark on the same line as the heart symbol means that the alarm has gone off due to the measured heart rate falling outside of the pre-

set alarm limits. An exclamation mark on the same line as the lung symbol means that the alarm has gone off due to the apnoea time exceeding the pre-set apnoea limit. In order for either alarm state to be indicated the bell symbol must be visible next to the appropriate heart or lung symbol.
(To set these limits, see the section on [Setting the display options](#)).

Right Status Screen

The upper line of the right-hand side of the status screen shows the state of the PCMCIA card. If a new empty card is present then the word RECORD appears. Various states of the card are indicated by the following messages:

RECORD	The unit recording data on the PCMCIA card
RECORD – WP	The unit is in recording mode but the PCMCIA card has its write-protect switch set.
REPLAY	The unit is replaying data from the PCMCIA card
CARD BATT	The PCMCIA internal battery is low. Replace immediately.
CARD ERROR	The PCMCIA card inserted in the unit is not recognisable as a formatted ECG data card.
NO CARD	There is no PCMCIA card inserted
MONITOR	The PCMCIA card is full. No more ECG's can be saved but the unit will still carry out all normal monitoring functions.

The lower line of the right hand-side of the status screen shows another heart symbol with a number next to it. This number indicates the number of stored ECG's currently on the inserted PCMCIA card. To the right of this is a time value in minutes and seconds. Whilst in RECORD mode this indicates the remaining unused time on the PCMCIA card. When this shows 0:00 in RECORD mode then no more ECG's can be stored on the PCMCIA card. (To free some memory on the PCMCIA card see Deleting ECG's).
During REPLAY mode the time indicated is the remaining replay time of the ECG. Also, during replay mode the number next to the heart changes to indicate the number of the ECG selected for replay.

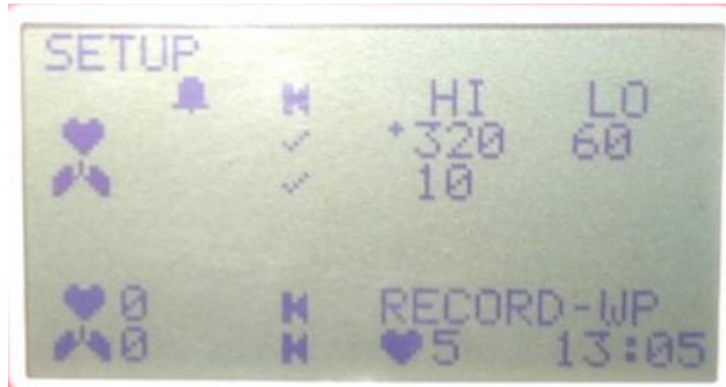
In the event of the battery power running low then a battery symbol appears on the upper line on the extreme right of the PCMCIA status information. This indicates that the rechargeable NimH batteries need recharging. Once this battery symbol appears the integrity of the saved ECG data cannot be guaranteed and the batteries should be charged immediately.

Formatting the card

CARD ERROR – To resolve this message, format the card. Select SETUP, then ERASE CARD, then press and hold down the OK button for 3 seconds until a long beep is heard. The card is now formatted and ready to use.

Setting the display options

To change any of the display options press the SETUP key. A new Setup screen appears.



All the numbers and symbols on the top line relate to the ECG monitor settings and all the symbols and numbers on the second line relate to the respiratory monitor settings. The status screen at the bottom remains unchanged.

Turning the alarms ON/OFF

Press the ALARM SELECT button on the left-hand side of the keypad. Each time this key is pressed ticks appear/disappear under the bell symbol on the left-hand side of the screen. A tick next to the heart symbol enables the alarms for heart rate monitoring and a tick next to the lung symbol enables the apnoea alarm. Repeatedly press this button until you get the combination of alarm settings you require.

Turning the beeps ON/OFF

Press the BEEP SELECT button to set the ticks under the loudspeaker symbol in the same manner as setting the alarms.

Changing the Heart rate Alarm Limits

When the SELECT ALARM button on the keypad is pressed a small cross will move between the HI and LO heart rate settings and the Apnoea time. When the cross is next to a value, pressing the ↑ ALARM SETTING key will increase this value and pressing the ↓ ALARM SETTING key will decrease this value. Adjust the times and rates to suit your alarm requirements.

When all the selections have been made press the SETUP key to return to RECORD mode.

Poor connections and interference

If CardioStore detects that there is excessive interference on the limb leads, particularly mains-borne interference, then the heart rate will be replaced with the word **INT** to indicate this interference. Whilst the screen display itself may not look too bad there is likely to be too much interference to reliably interpret the ECG. Improve the patient connections to remove the interference. Note that the lead II trace is still shown whilst the INT symbol is displayed and that recording & saving of the ECG can still occur. This feature is provided to ensure that good quality ECG recordings can confidently be made each and every time.

Recording and saving an ECG

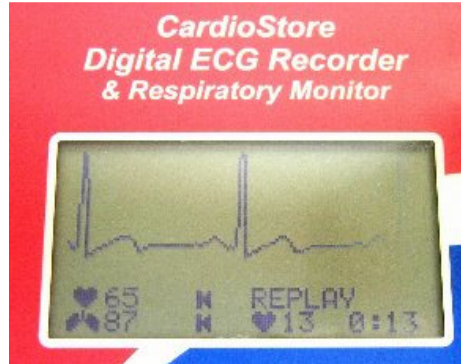
Once the patient leads are connected a lead II trace will appear on the screen. The size and position of this trace can be adjusted by means of the SHIFT and GAIN buttons as described in the section [The Key Functions](#).

Make sure there is a PCMCIA card inserted and that the PCMCIA status line shows RECORD only. If RECORD-WP or MONITOR is showing in the PCMCIA status line then no ECG's can be saved to that PCMCIA card.

During initial set-up and patient adjustment the ECG may have a lot of interference that you do not wish to record. In this instance, press 'RESET' to clear the recorded memory area. Let the ECG trace run for as long as you wish to record for and then press and hold the SAVE button for 2 seconds. The ECG is saved once the long confirmatory beep is heard. The number next to the right-hand heart symbol will increase by 1 and the updated remaining time on the PCMCIA card will be shown in the bottom right-hand corner. ECG monitoring and recording will then continue as normal. To look at the quality of the saved ECG use the REPLAY facility.

Replaying an ECG to check its suitability

To check an ECG after you have saved it, press the REPLAY button and press the ECG No.+ button to select the last ECG on the list. Then press the OK/SETUP button to replay the ECG on the screen.



Replaying ECG number 13. There are 13 seconds left of the ECG to run. The measured heart rate is 65.

The ECG will be re-created exactly as it was recorded and will replay in real-time. The time in the bottom of the right-hand status screen will show how much longer the ECG will replay for.

To interrupt the replay, press either RESET to return to normal RECORD mode, or REPLAY to select another ECG to replay.

Replaying an ECG to any standard ECG machine.

CardioStore can be used to replay an ECG to any standard ECG machine by perfectly reconstructing the ECG and playing back through the limb lead cables. To do this you need to connect the cables lead for lead i.e. connect the Right Fore lead of CardioStore to the Right Fore lead of the other ECG machine, connect the Left Fore lead of CardioStore to the Left Fore lead of the other ECG machine etc. Make sure that the crocodile clips of adjacent limb leads do not touch. When an ECG is replayed on the screen the same ECG will be replayed down the ECG leads and be detected by the other ECG machine.

Use this facility if you do not have the CardioStore Windows™ software and or want to use your existing ECG to produce a paper tracing.

Responding to Alarms

Alarms can be set for both Heart Rates and Apnoea time. (See '[Setting the display Options](#)')

When an alarm condition occurs, the beeper sounds continuously and an exclamation mark appears on either the heart or the lung status line indicating the cause of the alarm.

Apnoea alarm. The selected maximum apnoea-time has been passed. The value next to the lung symbol shows the seconds of Apnoea. As soon as the patient takes a breath the alarm will be silenced and the apnoea time replaced by the respiratory rate. Therefore to silence the alarm it is possible to either compress the chest and artificially create a breath or to enter, and then exit, the SETUP menu, thus clearing the apnoea counter.

Heart Rate alarm. The detected heart rate is either higher than the alarm 'HI' value or lower than the alarm 'LO' value. The alarm will not be silenced until either the heart rate changes to fall within the alarm limits or the limits are changed to accommodate the new rates or the alarm function is disabled. Disabling alarms in response to them going off is NOT RECOMMENDED. It is clinically more astute to adjust the limits, in case the change in heart rate progresses in which case the alarm will sound again.

Installing the CardioStore Windows software.

The CardioStore program is supplied on a single CD ROM. In PC's with the Auto Notify option turned on then inserting the CD will start the installation process. If the installation process does not start, or the Auto Notify option is set to OFF then begin the installation by using *Start* and then *Run* from the Windows Start menu. Then type D:\setup.exe where D is the location of your CD ROM Drive.

The Installation program will then guide you through the setup process. If you are unsure about any of the options offered then accept the defaults. Enter your supplied serial number in the appropriate box when asked. If you are running Windows 2000/NT or XP you will need to have Administrator privileges to install this software -It will also be necessary to restart the computer on these platforms once the installation program has finished. The installation program will install the CardioStore application, some required DLL's, this operating guide and some default templates into the directory and location of your choice. The installation will also create a Desktop icon so that you can start the application directly from your desktop.

Using a parallel-port sharing switch box

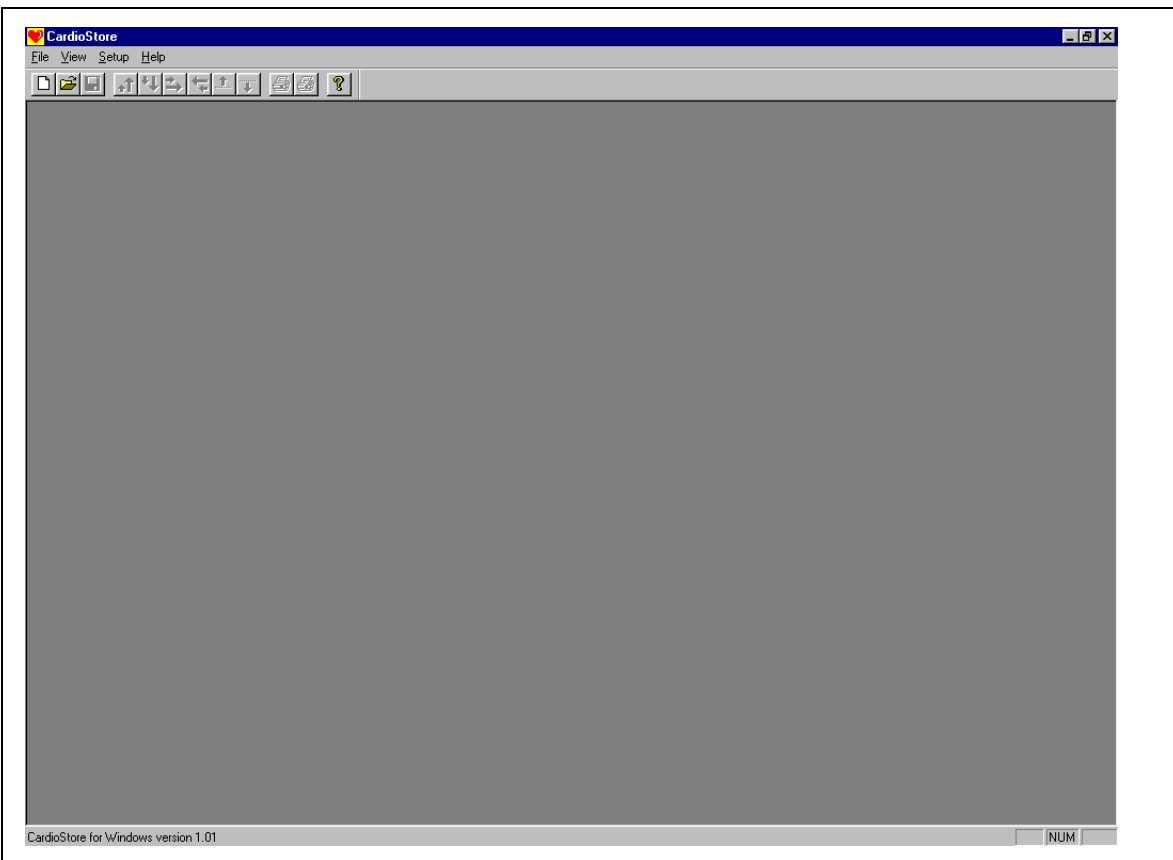
In many instances a PC will not have a spare parallel port and it will be necessary to share the parallel port, often with the printer. The best solution in these circumstances is to use a switch box to switch the computer either to the printer or to CardioStore. A switch box typically has 25-Way D Type connectors, which are all female. The existing printer cable needs to be unplugged from the PC and plugged into one of the switched ports on the switch box, either A or B. CardioStore plugs into the other switched port using a standard 25-Way D-Type male to female cable (supplied). You will need to purchase an extra cable along with the switch box to connect from the computer to the switch box. This additional cable needs to be a 25-Way D-Type Male to Male type. The necessary components i.e. switch box and cables are available from Vetronic Services either when purchasing a CardioStore unit or at a later date.

We DO NOT recommend the use of Auto Switching boxes, as their operation with CardioStore may be unreliable.

Running the software for the first time

Once the Windows software has been installed, the software can be run by choosing, '*Start/Programs/CardioStore*' from the Windows Desktop or by double-clicking on the CardioStore icon on the desktop.

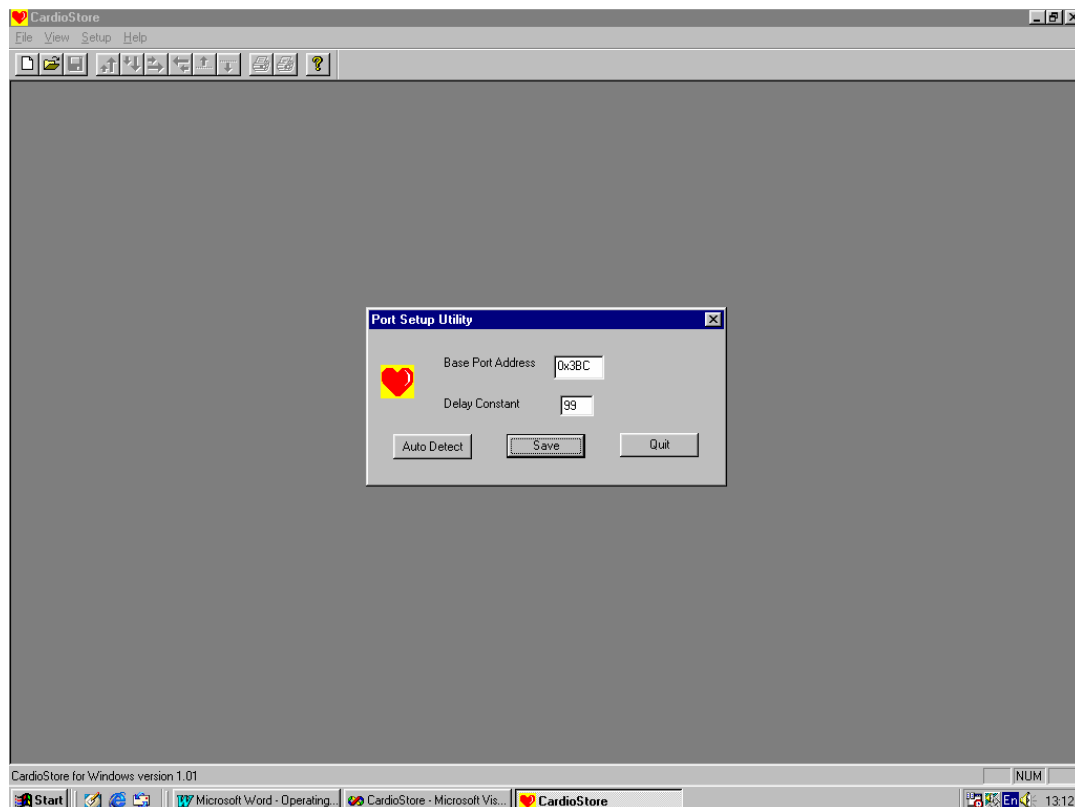
CardioStore will begin and you will be presented with a blank screen with a standard menu bar and the menus, File, View, Setup and Help. Since this is the first time the software has been run there are no existing files to open or view. The first thing in the initial stages is to make sure that the PC is connected and communicating with CardioStore. Choose '*Setup/Port Connection*' from the menu bar and follow the section on '[Using the software to Auto-Detect CardioStore](#)'



Using the software to Auto-Detect CardioStore

When you connect CardioStore to the 25-Way cable from the PC, CardioStore will immediately go into 'PC CONNECT' mode. In this mode none of the buttons on the front of the unit are functional and the words PC CONNECT appear at the top left hand-side of the screen. CardioStore is now ready to send data to the PC. If 'PC CONNECT' does not appear on the screen then check the PC connection and ensure that the 25-Way cable you are using is a one-to-one cable, i.e. every pin is connected end to end. With some PC's it may be necessary to manually turn CardioStore ON after the 25-Way D-type has been connected.

Start the CardioStore Windows software and select *Setup/Port Connection* from the menu of the opening screen.



A dialog box appears with three buttons along the bottom. Ignore the values in the edit boxes for now and select the 'Auto Detect' button. This begins the Auto Detection process and a warning appears advising you to stop any activity that may be going on with any other of the parallel ports on the PC. If you do not need to wait for a printing job to finish press the 'Continue/Detect' button. Within a second or two a dialog box will appear showing the port location of the parallel port that CardioStore is connected to. Change the Delay constant to 50 and then Save and then Quit the dialog box.

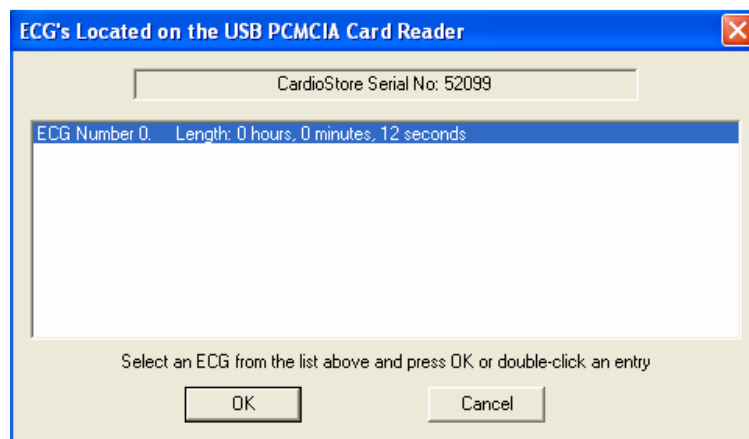
If the PC cannot find CardioStore then a message will appear advising you to make sure that the unit is plugged in and turned ON. Try turning CardioStore OFF and then back ON again before running through the Auto-Detect routine again. If there is still a problem, try another parallel port on the PC and repeat the process.

Now that the parallel port has been set up you can proceed with uploading an ECG to the PC.

Uploading an ECG to the PC

From the menu bar select either '*File/New*' or click on the 'New File' icon on the top left of the menu bar. A dialog box will appear offering the choice of uploading the data via the USB port or via the parallel port. For USB uploads a USB-PCMCIA card reader from Vetronic Services must be used. The PCMCIA card data cannot be read using standard laptop or desktop PCMCIA card slots. For parallel port uploading the CardioStore unit must be connected to the PC by the supplied parallel cable. Once the upload method has been selected click OK to proceed.

A dialog box will appear showing the number and length of the ECG's currently stored on the unit.



Click on the ECG that you wish to upload and then select OK, or double-click on the ECG you require. The file transfer process will begin and a progress bar shows how long the upload is going to take. Once the file has been uploaded a new screen appears showing the uploaded ECG. For more information on what this new screen represents see 'Editing an Uploaded ECG'.

Editing an Uploaded ECG.

Once an ECG has been uploaded a screen similar to the picture below will appear.

The screenshot shows the CardioStore software interface. The title bar reads "CardioStore - [ECGFile2]". The menu bar includes File, Setup, View, ECG, Digital Filter, Window, and Help. Below the menu is a toolbar with various icons. The main window is divided into several sections:

- Practice Information:** Vets Name (No Name), Practice Address (No Address), Telephone/Fax (Not Known).
- Client Information:** Client Name (No Name), Client Address (No address), Telephone/Fax (No number).
- Patient Information:** Patient Name (No Name), Breed (Unknown), Age (Years: ??, Months: ??), Weight (kg) (0.0), Sex (M/F(N)) (?).
- ECG Measurements:** P Amplitude (0.0 mV), P Duration (0.0 mS), P-R Interval (0.0 mS), R Amplitude (0.0 mV), QRS Duration (0.0 mS), QT Interval (0.0 mS), Q Amplitude (0.0 mV), S Amplitude (0.0 mV), T Amplitude (0.0 mV), R-R Interval (0.0 mS).
- Provisional Diagnosis / Comment:** No Provisional Diagnosis.

The bottom section displays the ECG waveform for Lead II and Lead III. The status bar at the bottom indicates "CardioStore for Windows version 1.01" and shows the Windows taskbar with the Start button and several open applications: Microsoft Word - Operating..., CardioStore - Microsoft Vis..., Registry Editor, and CardioStore - [ECGFile2]. The system clock shows 13:50.

Because none of the practice details have yet been entered the values for 'Vets Name', 'Practice Address' and vets 'Telephone/Fax' are unknown. Later we will save the practice defaults that will be used for every ECG file created. See ['Entering the Practice default values'](#). For now type in the Vet, Client and patient details, including the age, weight and sex of the patient. When this has been done select File/Save and save the file with whatever name you choose. It can be useful to save files with names that indicate who and what they refer to. Try using names like "Rover Smith Dec 19 2001.cst". This can make it much easier to find files at a later date. Because this is a Windows™ package you may save your files in any directory and under whatever name you choose. It may be worth creating some directories ready for your ECG files in say the 'My Documents' folder. You may want to create subdirectories that are used for Dogs, Cats etc and you may wish to use directories based on the date or month e.g. C:\My Documents\Dogs\March 2001\. However you choose to organise the files, try and make it easy to find and retrieve files at a later date.

Entering the practice default values.

If the Practice Defaults have not yet been entered then this can be easily done by selecting '*Setup/Practice Defaults*', from the menu bar. A dialog box appears prompting you to put in the Vets Name, Practice Address and Telephone/Fax number. When done press OK. The defaults are stored in the Registry and will be used every time you create a new ECG file. They can be changed at any time but note that changing the defaults will affect ONLY those files created AFTER the change. Files created earlier will be unaltered.

Viewing the ECG for the first time.

Having uploaded the ECG successfully from CardioStore you can now start browsing the ECG and get ready to create your first report. To scroll along the ECG click on the lower scroll bar or drag the scroll button along to the point of the ECG you wish to look at.

On-Screen selection

You will notice that only one ECG trace has a blue background at any time. This is the active trace and is the trace that has changes made to it when selecting the vertical offset or shift of the trace. This feature allows individual ECG traces to be aligned for printing if there has been some wandering of the trace or DC offset due to poor electrode contact. To determine how the ECG trace will look for printing, extra information is provided next to the Lead identifiers above the ECG trace. At one level of ECG trace height (adjusted by the Increase/Decrease size arrow buttons) the text "(Print size)" will appear. It is at this size that the ECG will be printed and the user may now adjust the trace position accordingly if necessary.

There are several ways the ECG view can be changed.

Changing the height of the ECG

Use the '*ECG/Increase Size*' or '*ECG/Decrease Size*' from the main menu or use the quick-buttons on the tool-bar.

To increase the ECG size click on the icon with two arrows pointing upwards, the right arrow being larger than the left.

To decrease the ECG size click on the icon with two arrows pointing downwards, the right arrow being larger than the left.

Changing the Compression of the ECG

Use the '*ECG/Expand*' or the '*ECG/Compress*' menu options from the main menu or use the quick-buttons on the tool-bar.

To expand the ECG, click on the icon with the two arrows pointing to the right.

To compress the ECG, click on the icon with the two arrows pointing to the left.

Changing the baseline position of the ECG

Sometimes the baseline of the ECG may be such that when the ECG is enlarged some of the ECG is clipped by the boundary of the ECG strip. To re-centre the ECG, it is possible to shift the ECG either up or down.

Use the '*ECG/Shift Up*' or '*ECG/Shift Down*' menus option from the menu bar, or use the quick-buttons on the toolbar.

To shift the ECG baseline upward click on the icon showing an arrow pointing upwards and above a dotted line.

To shift the baseline downward click on the icon showing an arrow pointing downwards and below a dotted line.

Choosing which ECG leads to display.

It is possible to view any combination of ECG leads on the screen at any one time. The default view is for leads II & III to be drawn but the view can be changed to whichever lead combination you like.

Select '*View/ECG Lead Selection*' from the main menu and a selection dialog appears with the six leads listed, and a check box next to each lead. Click on the leads you wish to see, which places a tick in the box next to the lead name.

When done click OK.

Selecting an ECG grid.

When the ECG is first uploaded there is no ECG grid and the ECG is drawn onto a plain blue background. It is possible to add or remove the grid to help with ECG assessment. The grid, when shown is marked in horizontal divisions of 200mS or 5 squares per inch as with normal ECG paper. Similarly the vertical divisions are at intervals of 0.5mV.

To display the ECG grid select '*View/ECG Grid*' from the main menu bar. This places a tick next to that menu item. To remove the grid select '*View/ECG Grid*' again and this removes the tick from next to that menu item.

Hiding and showing the Information Toolbar.

Sometimes it is helpful to view some ECG traces side by side. To enable this the information toolbar at the top of the screen can be hidden.

Select '*View/Info Toolbar*' to hide the toolbar. Select '*View/Info Toolbar*' again to show the toolbar.

Using the built-in digital Software filters

CardioStore software version 1.20 has two types of built in filters for use with displayed ECGs. The first type is a Notch Filter and the second type is a Low Pass Filter.

Notch Filter characteristics

The characteristic of a Notch Filter is that it only removes a specific range of frequencies from the signal. Frequencies both above and below the Notch Filter frequency will be left unaffected. In this case the particular frequency of the Notch Filter is mains frequency – 50 Hz (or 60Hz for USA customers). When a Notch Filter is applied to a signal it is possible to virtually eliminate noise caused by mains interference, with little effect on the underlying signal. Typically r-waves will not be reduced in height or character. The exception to this is birds where the r-wave duration is around 20mS, the same duration as one cycle of 50Hz mains. The software allows the application of a Notch Filter at 4 different levels. Each level applies a greater filtering effect so level 4 has a much greater filtering effect than level 1.

Low Pass Filter characteristics

The characteristic of a Low Pass Filter is that it allows frequencies up to a set point to be passed but not frequencies above that. A Low Pass filter can be used to reduce mains interference in the same way that a Notch Filter can but in this case there will be noticeable attenuation of components of the ECG complex, typically the r-wave. There are 2 main reasons for using a Low Pass Filter rather than a Notch Filter

- 1) The interference is not just mains based, for example muscle movement artefact.
- 2) A Notch Filter would remove frequencies that are specifically wanted. This occurs typically when the r-wave duration is of the same order of duration as the mains frequency – 20mS in Europe and 17mS in the United States.

A Low Pass filter can be used quite effectively to remove muscle tremor artefact. In the same way as the Notch Filter can be applied at different levels, so can the Low Pass Filter. There are 20 levels of filtering available for the Low Pass Filter.

Using the filters

To apply a filter to an ECG click on the filter icon



in the main toolbar.

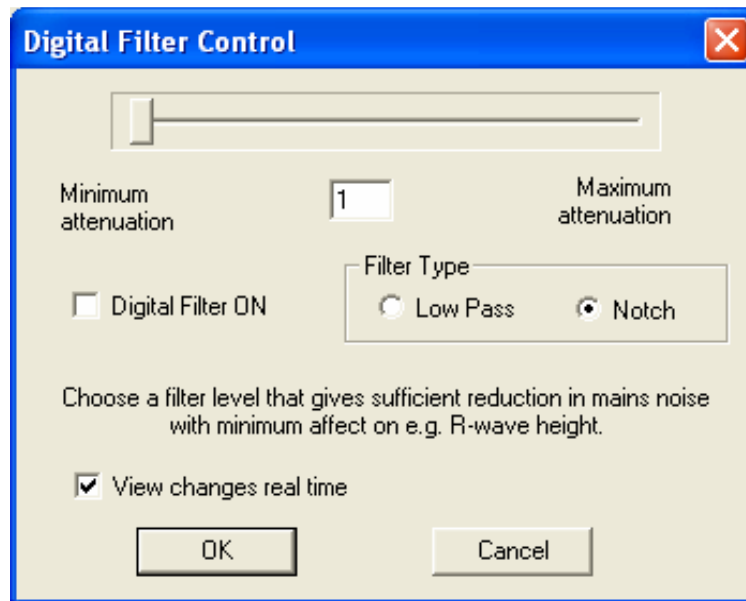
Similarly to stop filtering click on the icon again.

Alternatively use **Filters/Apply Digital Filter** in the main toolbar menu to turn the filter ON and OFF.

Use the **Filters/Set Filter Level** option from the main toolbar menu to configure the filter as required.

If you select this, the following dialog will appear:

The Digital Filter Control Dialog



If the Digital Filter is not already selected it can be turned ON by checking the **Digital Filter ON** box. If the **View Changes real time** box is also checked then any changes you make to the filter setup will immediately be seen on the screen ECG. In this manner it is possible to apply the appropriate filter and view the changes as you make them. The slider at the top of the dialog box may be dragged along to change the attenuation level. Alternatively, type in the required level in the small edit box below the slider. Note that it is not possible to have a Notch Filter level greater than 4 or a Low Pass Filter level greater than 20. The filter level should be applied to reduce the unwanted frequencies to a minimum whilst at the same time maintaining the original ECG signal as much as possible. Some experimentation is normally required initially to get used to the different filter effects.

Care should be exercised when using the filters as they will always have an effect, however minor on the underlying ECG signal.

The selection of the filter will apply to the screen as well as to printing. Therefore a filtered ECG will be printed as a filtered ECG if the filter is ON. Similarly the copy function to clipboard will copy the filtered ECG if the filter is ON.

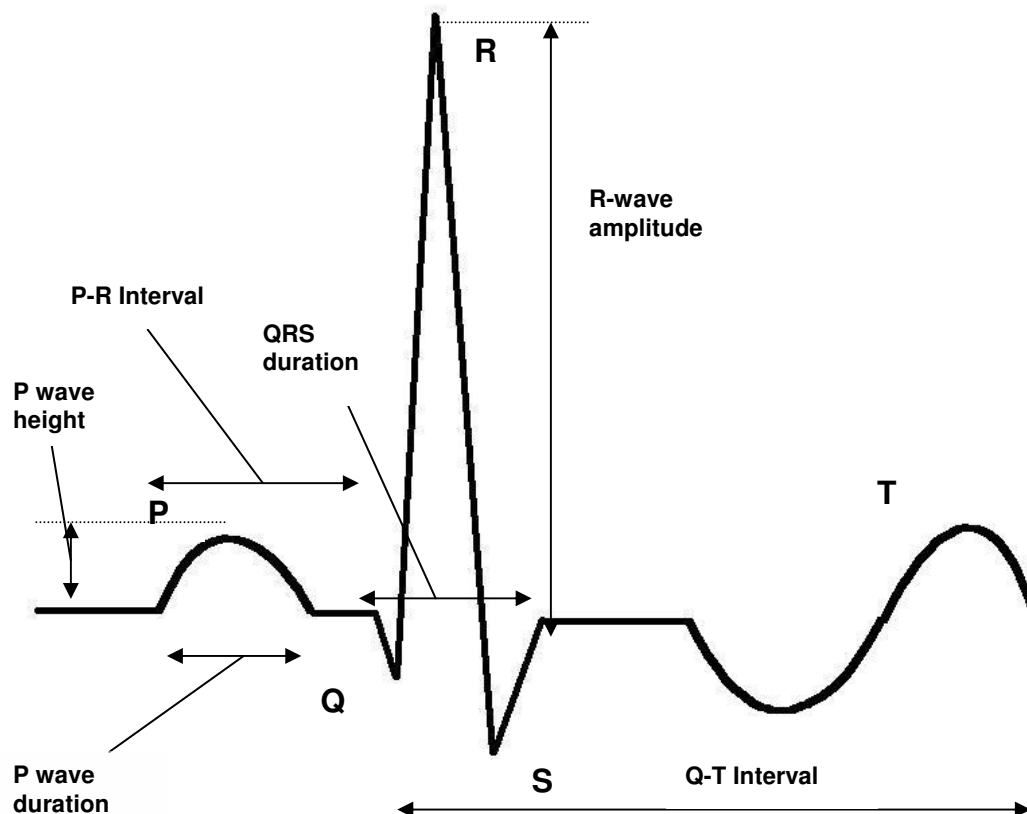
Making the ECG measurements

Ten standard ECG measurements can be made using the mouse and the ECG on screen. The following is a guide to help you in getting the most accurate measurements. For improved accuracy make the time-based measurements with the ECG expanded as much as is possible. Make size-based measurements with the ECG enlarged as much as is possible.

To make a measurement, click on a parameter in the Info Dialog box. Place the cursor head at the start point, click and HOLD DOWN the left mouse button. Move the cross-hair to the end point and then release. The measurement is placed in the box next to the selected parameter.

Use the cursor in the following manner to make these measurements:

P Wave duration. From the beginning of the P-wave to the end of the P-wave
P Wave height. From the base line prior to the P-wave to the crest of the P-wave.
P-R Interval. From the beginning of the P-wave to the beginning of the Q-wave.
R Amplitude. From the base line to the peak of the R-wave.
QRS duration. From the beginning of the Q-wave to the end of the S-wave
QT Interval. From the beginning of the Q-wave to the end of the T-wave.
Q Amplitude. From the baseline to the peak of the Q-wave.
S Amplitude. From the baseline to the peak of the S-wave.
T Amplitude. From the baseline to the peak of the T-wave.
R-R Interval. Between any two neighbouring R waves.



Printing and Print Preview

Before an ECG can be printed the ECG portions required for printing must be selected. If none are selected then only the first page of the ECG report will be printed. At any time the appearance of the final ECG report can be checked by using the Print Preview option in the main 'File' menu or by clicking on the Print Preview icon in the menu toolbar. This icon looks like a printer with a question mark over it. Print Preview shows exactly what the printed report will look like apart from one small difference. In Print Preview the very small 1mm squares of the ECG grid are not shown as they would otherwise obscure the ECG image. Apart from this Print Preview is very much WYSIWYG (What You See Is What You Get).

Using your own headed paper for the first page of the Report

By default CardioStore will print the first page of its report using the Veterinary Surgeon details and the practice address. It will also place a double-line border around the page. If you wish to print the first page of the report onto your own practice headed paper then you can turn off this default header by selecting *Setup/Use headed Paper* from the main menu. Now when you print out the form, only the patient details will be printed.

How to select an ECG strip for printing.

Selecting an ECG for printing is easy. When selecting a trace for printing right-click in the ECG trace that you want to print. A new dialog box will appear with the following selectable items:

Save as Start point: This sets the start position for printing of that lead at the point where the mouse was right-clicked. At the top of the box the selected ECG trace is identified and position in time is also shown. Clicking this button will turn all the selected ECG white. If no end point has yet been selected then only the first 1.0 second of ECG will be selected. The length of the ECG in pages is now displayed in the text box below this button.

Save as End point: This sets the end position for printing of that lead at the point where the mouse was right-clicked. The top of the dialog box shows the Lead that has been selected along with the position in time of the selection. Clicking this button will turn all the selected ECG white. If no start point has been selected then all the ECG from the beginning of the trace is selected. The length of the ECG in pages is now displayed in the text box below this button.

Selected ECG length: This read-only text box shows the length in pages of the currently selected ECG trace. The information displayed is based on the currently selected printer and paper orientation. Changing either of these will result in new

values being displayed in this dialog box next time it is viewed. Page lengths are shown as decimal values. Any fraction over a whole page will mean a new full page will be printed. This feature allows the user to plan the length of a report before printing it out.

Synchronise all Leads with Lead II: This control may be grayed out if the current ECG trace has no Lead II selection. If a Lead II selection has been made then the check box will be visible. Putting a tick in this check box will force all lead selections to be perfectly synchronised with lead II. The synchronisation only occurs when the box is checked and the user exits the dialog box by clicking OK. Selecting this option and exiting by clicking the cross at the top right hand corner will cancel the synchronisation and all leads will remain unchanged. This option allows the user to select a representative portion of the ECG in Lead II and then print all the other leads synchronised to it in one simple command. Unchecking the check box, once the leads have been synchronised will not change the selections but will allow the user to then select individual portions of traces for printing.

Select Printing Lead Options: The user can now select a fixed format for printing. It must be one of the following options:

3-Lead report
6-Lead report
Lead II only

3-Lead report. Only Lead I, Lead II and Lead III will be printed. The number of pages printed will depend on the longest ECG trace of I, II or III selected. If leads are synchronised all leads will begin and end at the same point in time and will be vertically aligned on the paper.

6-Lead report. Leads I, II, III, AvR, avL and avF will be printed with Leads I, II and III on one page and the augmented leads on the following page. If the ECG is to be printed over several pages, then alternating pages of Leads I-III and augmented pages will be printed. If leads are synchronised all leads will begin and end at the same point in time and will be vertically aligned on the paper.

Lead II only. Only Lead II will be printed and the trace will be continuous in a left-to-right, top-to-bottom manner. The minimum amount of lead II printed will be determined by the selection made. If the ECG is long enough the trace will be printed from the selected point to the end of the page in which the selection finishes. This may mean that a selection of Lead II that is for example 10 seconds long will actually be printed over a full page and may cover 25 seconds of ECG trace from start to end.

Select Print Speed: The user may now select the speed at which the ECG trace is printed. Four options are available from 25 mm/S to 200mm/S. The report on

page length is live and will update for any changes made to print speed and printing lead options as well as to paper orientation changes made via the Printer Setup option in the File menu.

Clear This Selection. Clicking this button will remove any selection from the ECG trace named at the top of the dialog box, which is the trace the user clicked in to display the dialog box. The result is instantaneous and occurs without the user having to exit the dialog box.

Clear All Selections. Clicking this button will remove all selections made to all traces of the ECG whether they are visible on screen or not. Because of the destructive and encompassing nature of this action the user is asked to confirm this is what they wish to do by another dialog box before the action is completed. If removing all the selections was not the intent then click NO in response to the "Are you sure?" dialog box. The result of clearing the selections is instantaneous and occurs without the user having to exit the dialog box.

Integrating with Microsoft Word.

CardioStore can integrate with Microsoft Word through the View menu. To activate Word, select *View/Report Editor (MS Word)* from the main menu. CardioStore will then open Word, create a new document based on the file name of the ECG you are currently viewing and use a template that you can select yourself.

Selecting the default template.

If you have not chosen a default template then when you try to open up Microsoft Word you will be asked to select a template to use when creating your reports. You can select any of the ready-made Word templates or a template of your own design. By allowing you, the user, to select your own template you can tailor your ECG reports to appear exactly as you want them. Once the template has been chosen it will be used for all future ECG reports written with Microsoft Word. Once a template has been chosen then you will not be asked to select one again when linking with Microsoft Word. You can change the default template at any time by selecting *Setup/Choose Report Template* from the main menu.

Saving the ECG file

If you have not saved the file that you uploaded from the CardioStore unit then when you open Microsoft Word you will be prompted to give the file a name and save it. Note that you will not be able to use the Microsoft Word feature until the file has been named and saved.

Once the file has been named and a template selected, Microsoft Word will open and place all the patient and client information into the target document. This includes all the parameter measurements as well as the provisional diagnosis text. This information can then be cut and pasted into the document exactly where you would like it.

Special features of the link with Microsoft Word

When CardioStore opens a new document in Microsoft Word it will do so in a new instance of the program even if you are already running Microsoft Word on your desktop. This instance of Microsoft Word is private to, and owned by the CardioStore program. You may open other files and use them to interact with your new document just as you normally would. However, once you close the document linked to CardioStore, the private instance of Microsoft Word will also be closed. Any documents that have been changed during your editing period will automatically be saved when you exit Word. The Word document that was created for the ECG report is linked to the actual ECG in CardioStore so that whenever you open Microsoft Word from an ECG that you have already created a Word document for, that specific Word document will be automatically opened for you. This means that you do not have to keep track of which report belongs to which ECG because CardioStore does it for you.

Copying portions of the ECG to Windows Clipboard

There is now basic support for copying and pasting ECG traces to and from the clipboard. ECG traces are copied as bitmaps with white backgrounds and a black ECG with a surrounding border. To select an area of the ECG for copying, click with the left mouse button just above the ECG trace you wish to copy. If this is not the active ECG trace it will be made active. The cursor will change to a four-pointed arrow and you will be able to drag a rectangle along the ECG to select a portion of the ECG. When the left mouse button is released a popup menu will appear with two options:

Copy selected ECG to clipboard Cancel.

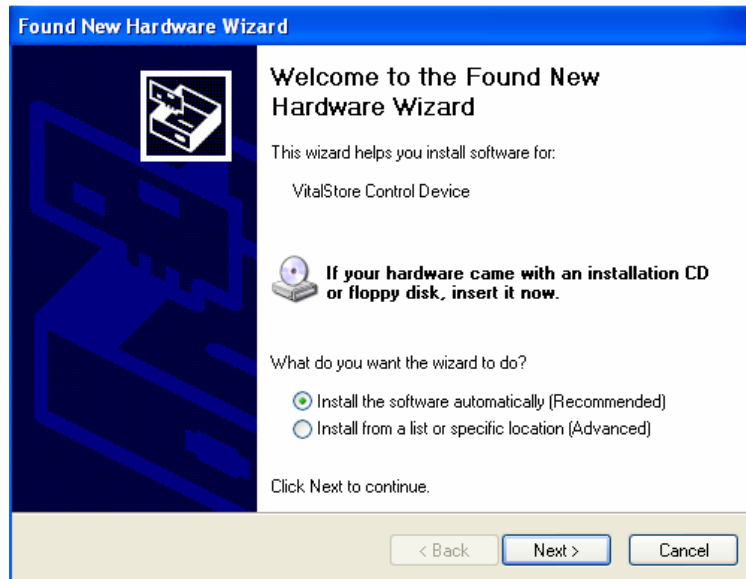
Select the required option and the selection box will automatically disappear. If the user opts not to choose either option but clicks anywhere else on the screen the selection will also disappear.

To use the copied trace the user simply selects Edit/Copy or presses Ctrl-V in the target application such as Word or Excel or desktop publishing package.

If the ECG grid is selected on the screen then this will be copied as well, otherwise the plain ECG will be copied. Note that the copy facility will copy the ECG however it is displayed on the screen, so if a much enlarged portion of an ECG is required this can now be copied.

Installing the Windows drivers for the USB-based PCMCIA card reader

When the USB card reader is first connected to the computer, Windows™ will detect the new USB device and start the Found New Hardware Wizard.



Select, Install the software automatically (Recommended) and click Next. If a new dialog appears prompting a location (Win 98/2000) then select CD Drive or browse to the specific location D:\FTDI Drivers (where D:\ is your CD ROM Drive) and click Next.

A new screen appears and a new dialog appears stating that the software being installed has not passed Windows logo testing compatibility testing. Select 'Continue Anyway' as this is a valid windows driver file. Windows searches for the drivers on the supplied CD ROM and installs them. Driver software installation is now complete. There should be no need to restart the computer following installation.

Extras for your CardioStore

Consumables

Part Number: VSLC220 Description: ECG Electrode Pad 5cm Pack of 30 Price: £5.75	Part Number: VSLM00S50 Description: ECG Electrode Pad 3cm with popper connection Pack of 50 Price: £15.60	Part Number: VSLN00S25 Description: ECG Electrode Pad 3 x 2cm with popper connection Pack of 25 Price: £18.60
 A circular white electrode pad with a blue center and a small label 'C200'. VSLC220	 A circular white electrode pad with a blue center and a small label 'VSLM00S50'. VSLM00S50	 A circular white electrode pad with a blue center and a small label 'VSLN00S25'. VSLN00S25
Part Number: VSLM00A50 Description: ECG Electrode Pad 3cm with socket for 4mm Banana Plug. Pack of 50 Price: £19.95	Part Number: VSLSBPPSA Description: Banana Plug Popper Socket Adaptor. Price: £8.20 each	Part Number: VSLCCMOD Description: Crocodile Clip for 4mm Banana Plug Price: £0.50 each
 A circular white electrode pad with a blue center and a small label 'VSLM00A50'. VSLM00A50	 Two white plastic adaptors, one with a banana plug and one with a socket. VSLSBPPSA	 A small metal crocodile clip with a gold-colored finish. VSLCCMOD

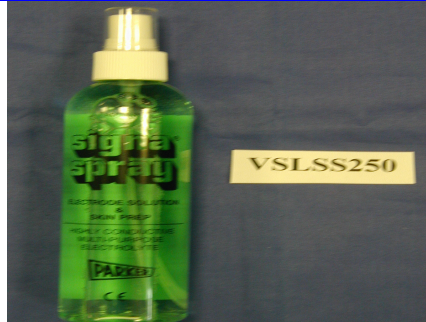
For other products and consumables see our web page:
<http://www.vetronic.co.uk>

Consumables Cont ...

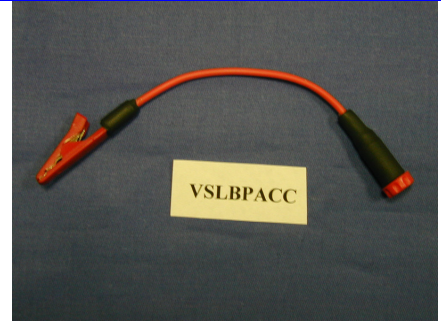
Part Number: VSLECGLPE4
Description: ECG Limb Plate Electrode with Velcro strap and a socket for 4mm banana plug lead connection.
Price: £25.00 for a pack of 4



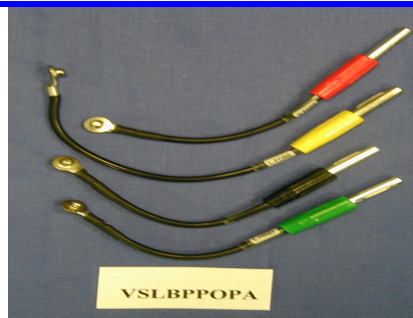
Part Number: VSLSS250
Description: ECG contact electrolyte spray 250ml bottle
Price: £9.95 each



Part Number: VSLBPACC
Description: 4mm Banana Plug to 2mm Atraumatic Crocodile Clip Adapter
Price: £8.00 each



Part Number: VSLBPPOPA
Description: 4mm Banana plug to Popper Male adaptor
Price: £10.00 each



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