

The Sentinel Blood Pressure Monitor by Vetronic Services Ltd

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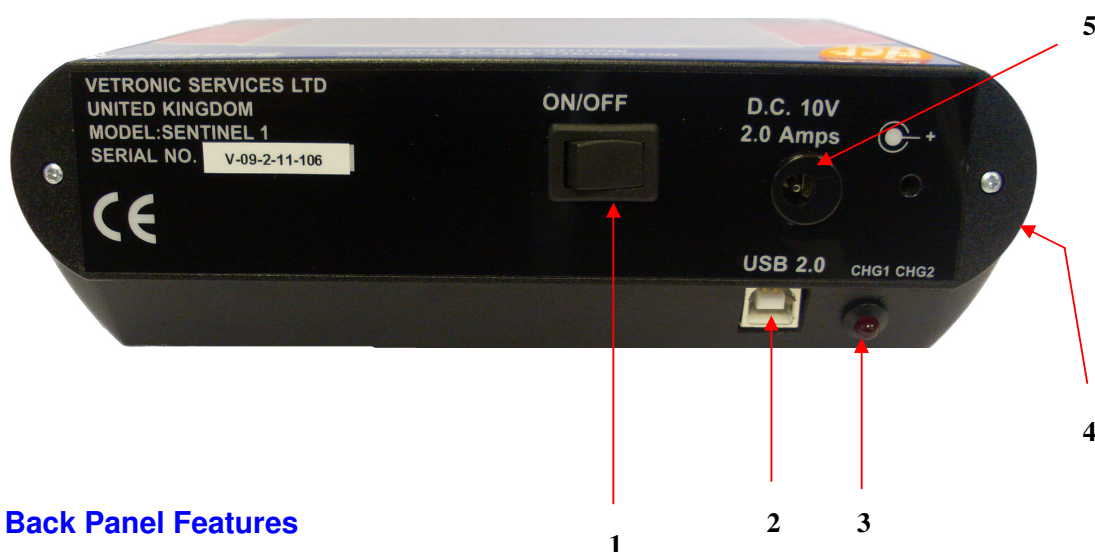
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Section 1: Using the Oscillometric Module - An Introduction

General features of the Oscillometric Module

The Oscillometric module is a Veterinary-specific Non Invasive Blood Pressure module that uses the principle of oscillometry to measure a patient's blood pressure. By means of an inflatable cuff, placed on a limb or tail, the blood pressure is determined by an automatic inflate and deflate process, controlled by the Sentinel unit. The Oscillometric principle requires that the pressure in the cuff be taken to a value greater than the patient's systolic blood pressure to temporarily halt blood flow. The pressure is slowly released and the changes in pulse waveform, associated with the onset of arterial and then venous flow, are detected. An internal algorithm translates the measured points to a Systolic, Diastolic and Mean arterial pressure. These values are then displayed on the NIBP screen along with the patient's heart rate. Readings may be taken automatically at a pre-determined interval or manually when required.

Sentinel Blood Pressure Monitor Back Panel



Back Panel Features

- 1 ON/OFF Switch
- 2 USB Cable Port
- 3 Charging LED Indicator
- 4 Beep Volume control knob (side of unit)
- 5 DC charger input

Turning the Sentinel unit ON and OFF

ON

The Sentinel unit is turned on using the ON/OFF switch located on the rear panel of the monitor.

When the monitor is turned on the display is activated, three beeps are heard and then the unit is ready to use. All user settings are recorded as soon as any changes are made and held in the unit's own non-volatile memory. These values are read in from the non-volatile memory each time the unit is turned on.

OFF

The Sentinel monitor can be turned off at any time by turning the switch at the rear of the unit to OFF.

Mains Power and Charging the Batteries

The Sentinel unit is fitted with 6 internal, high energy Nickel Metal Hydride (NiMH) rechargeable batteries, arranged as a single bank of 6 batteries. These batteries are fixed within the unit and are not removable. The batteries can be re-charged at any time by plugging in the mains charger and power supply provided. Use only the supplied charger as other chargers with different voltages and current capabilities may damage the unit. When the mains charger is plugged in the red LED at the rear of the Sentinel unit will flash about once every second. When charging is complete the LED will go off. To charge the batteries from fully extinguished takes approximately 8 hours. During charging the unit can be used as normal. The unit may be operated without the mains power and with different modules will have a varying operating life as indicated below:

- Fitted with Sentinel unit only 16 hours

The flashing LED on the rear of the unit will be lit in different ways to indicate charge status

Flashing at once per second – Normal Charging

Flashing at 4 times per second – A charging error has occurred. Disconnect the mains charger and try again. If the fault persists, contact your Vetronic Services representative or distributor.

LED off – Unit fully charged or Power unit not connected.

Low Battery indication

When the battery voltage is low and recharging is required a message will appear in the top status line. This will alternate with any other message that may be displayed.

Two battery-related messages may appear:

"BATTERY VOLTAGE LOW" at which point all functions of the unit will remain normal but charging is necessary.

"BATTERY VOLTAGE CRITICAL" if this message appears then the functions of the monitors may be affected and the unit will soon turn off unless the mains charger is plugged in.

The Touch Screen

All operations of the Sentinel unit are accessed using the touch screen. All actions require only a single touch of the screen. Double-touching or “double-clicking” is not required or supported.

If an action is supported when the screen is touched then a single short beep will be heard. If no beep is heard, then touching the screen at that position will not initiate an action.

In normal use the touch screen will respond to fingertip touch or touching with the tip of the nail. Very little force is required to activate the touch screen. If the screen does not appear to be responding normally then see the section “Initialising the touch screen”.

Initialising the Touch Screen

The Touch Screen is set up at the factory and would not normally require initialisation. However if the screen is totally unresponsive or is behaving in an unpredictable manner, or you have been advised by a Vetronic Services technician to reset the touch screen, then follow this guide:

With the unit turned OFF, place your finger in the centre of the screen and press gently. Keeping it pressed, turn ON the Sentinel unit. After the 3 beeps the introduction screen with version number will appear. After that the screen will go blank. Now release your finger.

If the screen does not go blank and the normal Sentinel screen appears then either the screen was not pressed firmly enough or the press was not maintained for the whole of the switch-on period. Turn the unit OFF and repeat the process.

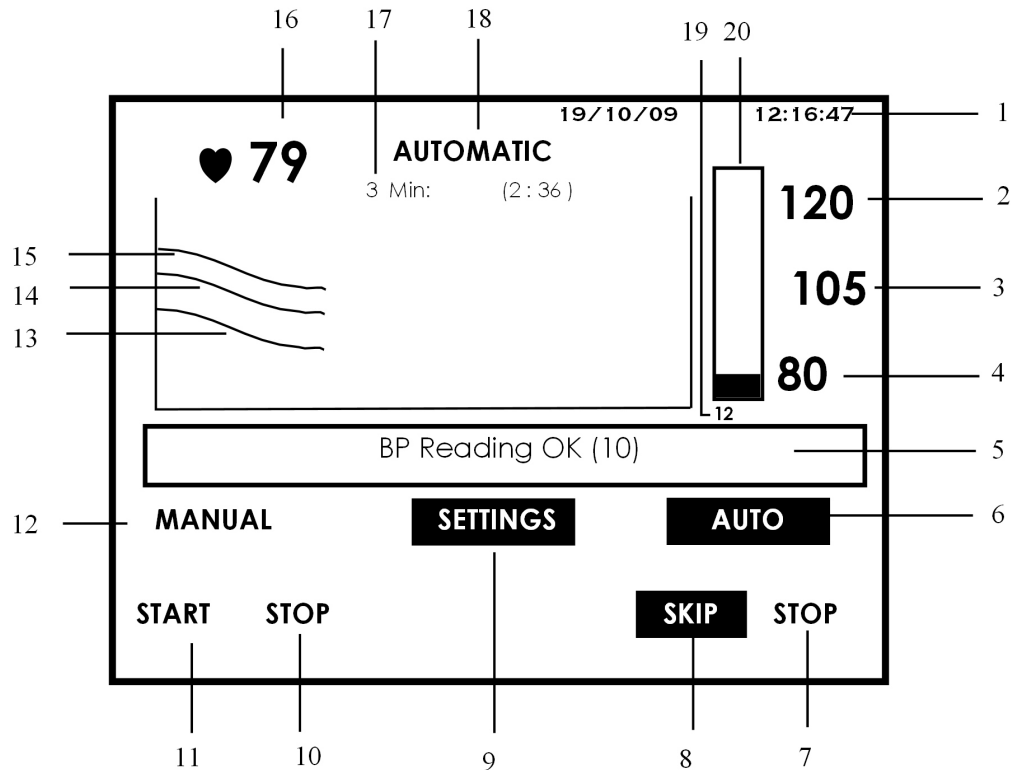
After releasing your finger a long beep will be heard and the text “TOUCH POINT 1 – “appears on the screen. In the top left-hand corner is a small square. Using a blunt stylus or ball-point pen with the nib retracted touch this small square to set the co-ordinates for that corner. The X and Y values will then appear on the screen. Make sure these are constant before releasing that point. After 8 seconds a beep will be heard and the small square will move to the top right-hand corner. Touch this square to record the co-ordinates. Every 5 seconds this process will repeat, with the square moving around the screen in a clockwise manner until all of the corners have been set. Release the last touch point within the 5 seconds to see a summary of the screen co-ordinates. When this is done, the recorded co-ordinates will be listed at the top of the screen like this:

TOUCH POINT 1	X = 16	Y = 229
TOUCH POINT 2	X = 240	Y = 227
TOUCH POINT 3	X = 238	Y = 18
TOUCH POINT 4	X = 15	Y = 18

Note the closeness of the values marked with the same colour. These are typical values. If you do not see values like this, then repeat the process. If that fails to provide normal values contact Vetronic Services LTD, or your local distributor.

Organisation of the NIBP module touch screen

The top portion of the screen is dedicated to the blood pressure trend display, the blood pressure measurement results and the pressure manometer. The main elements of the screen are shown below:



- | | |
|--|---------------------------------------|
| 1 – Time & Date | 12 Manual control button (active) |
| 2 – Systolic pressure from last reading | 13 – Diastolic trend line |
| 3 – Mean arterial pressure from last reading | 14 – MAP trend line |
| 4 – Diastolic pressure from last reading | 15 – Systolic trend line |
| 5 – Status bar | 16 – Heart rate from last BP reading |
| 6 – Automatic control button | 17 – Countdown time (set & remaining) |
| 7 & 8 – Automatic Mode control buttons | 18 – NIBP measurement mode |
| 9 – Settings menu button | 19 – Cuff pressure in mmHg |
| 10 & 11 – Manual Mode control buttons | 20 – Pressure Manometer |

Screen elements in detail

Top elements of the Display

Along the top of the display are 4 areas of information. On the left is a heart symbol with the heart rate measurement from the last Blood Pressure recording (16). Please note that the heart rate can only be taken during a blood pressure measurement and is updated once at the end of a successful BP measurement. In the centre of the display are two items of information. In bold capital lettering, the NIBP mode of operation is shown as either MANUAL or AUTOMATIC (18). In AUTOMATIC mode, a line of text below the word AUTOMATIC shows two points of information (17). The first item is the set interval for the automatic measurement. This value is in minutes and can be set to any value from 1 to 120 minutes. In brackets after this item is a countdown timer showing the time left until the next automated blood pressure measurement.

The final item on the top area of the display is the Time & Date section (1). This displays the date in dd/mm/yy format followed by the time. The time is continually updated every second, so the seconds are seen incrementing on the far top right of the screen. Touching the screen over the Time/Date area will open a new menu allowing you to set/reset the time and date. See "Resetting the Time & Date".

Trend Display

The Trend Display occupies the largest part of the main display and shows the historical data of measured blood pressure values. The Trend Display has 3 graphs drawn in it, one each for Systolic, Diastolic and Mean Arterial pressures (13,14 & 15). The oldest readings are to the left of the screen. The screen can show just over 100 readings from side to side. If more than 100 readings have been taken in a series then the screen will show the last 100 readings with the latest reading being on the far right side of the Trend Display

Manometer & Blood Pressure Values

On the right of the Trend Display area is a vertical box that is a representation of a manometer (20). The manometer shows the actual cuff pressure during inflation and deflation of a measurement. Just below the Manometer is a single value, which is the actual cuff pressure in mmHg (19). During a blood pressure reading the manometer and cuff pressure values give an indication of the progress of the measurement.

The result of the blood pressure reading is shown to the right of the Manometer as 3 integer values. The uppermost reading is the Systolic value, the middle one is the Mean Arterial Pressure (MAP) value and the lower one is the Diastolic value. These values are updated after each successful blood pressure reading.

The Status Bar

Just below the trend display area is a status bar (5). Messages will appear in this status bar relating to the state of a blood pressure measurement, such as "BP reading OK" or in the case of a disconnected hose, "Inflate timeout-Air leak". For a full list of the possible messages and their meanings see the section "Reported screen messages". In the message shown above the

number 10 in the brackets after “BP Reading OK” indicates that this is the 10th measurement in a series since the trends were last cleared.

Control Buttons

Along the bottom of the screen are a row of buttons, labelled MANUAL, SETTINGS and AUTO. The MANUAL and AUTO buttons are the Mode control buttons. Associated with the MANUAL button are two further buttons labelled START and STOP. Associated with the AUTO button are two further buttons, labelled SKIP and STOP.

A button that is highlighted (light on dark background) is active. In the above picture this means that the mode of operation is Automatic and that the SKIP function of the Automatic mode is available. Pressing the SKIP button will skip any countdown time left and immediately begin a blood pressure measurement.

In MANUAL mode, the START button will be active. Once this is touched, the measurement will begin and the STOP button will be active. If for any reason, you wish to stop the measurement, press the STOP button.

The SETTINGS Button

The SETTINGS button allows the setup of the automatic measurement interval, the cuff size range and the alarms. It also allows the Trend Display to be cleared.

AUTO-INTERVAL:	2 Min	UP	DOWN	
CUFF SIZE		1-3		
HI SYS ALARM:	180	UP	DOWN	OFF
LO SYS ALARM:	100	UP	DOWN	OFF
HI MAP ALARM:	120	UP	DOWN	OFF
LO MAP ALARM:	60	UP	DOWN	OFF
CLEAR TRENDS		EXIT		

Auto-Interval

Use the UP DOWN buttons to set the automatic interval between the end of one blood pressure measurement and the start of the next.

Cuff Size

The NIBP module has two veterinary specific algorithms tailored for two ranges of animals. For animals needing a cuff size of between 1 and 3 a more sensitive algorithm is used. To choose the appropriate cuff size range touch the button to the right of the CUFF SIZE text. This will toggle the text in the button between “1-3” and “4+”

Alarms

Alarms can be set for High and Low Systolic pressures and High and Low Mean Arterial Pressures. Setting alarms for High and Low Diastolic pressures is not an available option. Use the UP and DOWN buttons to set the required alarm level. Note that a High alarm level can not be set below a Low alarm level and the menu will prevent you from doing this. To enable an alarm touch the button to the far right of the appropriate alarm to set this to ON. Touch it again to set it back to OFF. Once all of the alarm options have been set, touch the EXIT button to save the settings and return to the main screen.

Clear trends

The CLEAR TRENDS button will erase all the stored data in the unit's memory used for plotting the trends. On touching this button the trend data will be erased, a beep is heard and the unit returns to the main screen.

Using the Sentinel NIBP Module in practice

Cuff Selection and placement

Before a measurement can be taken the cuff size must first be selected. The cuff size is based on the circumference of the patient's limb: The cuff width should be approximately 40% of the limb circumference. Because an animal's leg is roughly a cylinder it is easier to use the relationship that the width of the cuff should be 25% bigger than the width of the limb at the point where the measurement is to be taken. In practice, place the cuff length-ways against the leg or tail. If the cuff covers the full width of the leg with about a quarter left over, that is the correct cuff size. The cuff should never extend over a joint.

Plug the long black hose into the connector at the side of the unit so that it clicks into place. If difficulty is experienced in fitting the connector, make sure that the metal tab on the panel connector is pushed down. Connect the appropriate sized cuff to the push-fit luer connector at the end of the black hose. Wrap the cuff around the limb making sure that the *Artery Marker* is reasonably close to the artery. When wrapped around the patient limb the marker line on the cuff must fall between the range marker. It may be necessary to shave the animal fur if there is trouble obtaining blood pressure measurements. The cuff should be at the level of the heart for proper measurement accuracy. When the cuff is below heart level, measurement results may be higher than comparative results obtained at heart level. When the cuff is above heart level, measurement results may be lower. Use the area just above the hock, carpus or the base of the tail

In the Sentinel NIBP Monitor, there are two measurement methods based on cuff size. For the smaller cuff sizes of 1-3, the inflation rate, maximum pressure and deflation rate are different from those used in the larger cuff sizes of 4 and larger. When changing cuff sizes, be sure to set the correct range in the "SETTINGS" options.

How to ensure best results are achieved

- a. Ensure the correct cuff size has been selected
- b. Ensure the cuff is applied firmly before inflation begins
- c. Ensure the appropriate cuff size selection is made in the SETTINGS menu
- d. Reduce limb/tail movement during the measurement phase
- e. Try wetting the fur, particularly on the smaller animals. In rare cases shaving of the fur may be required.
- f. If problems are experienced, try a different measurement position

Mode Selection - Automatic or Manual

The NIBP module can be run in two modes, manual mode where all blood pressure measurements are initiated by the user, or Automatic mode where blood pressure measurements occur at fixed time intervals. These intervals can be set by the user.

Manual operation

To select manual operation, touch the MANUAL button at the bottom left-hand side of the screen. If this is not already selected it will turn from black text to a black button with white text. The START button below it will also become highlighted. At this point a measurement will only be started when the highlighted START button is touched. Once started, a measurement can be cancelled at any time by pressing the STOP button. Cancelling a measurement will result in the message “BP Reading cancelled” appearing in the status bar until a new measurement is begun.

Automatic operation

To select automatic operation, touch the AUTO button at the bottom right hand side of the screen. If this is not already selected it will turn from black text to a black button with white text. The SKIP button below it may also become highlighted, or if the time since the last measurement has exceeded the automatic interval period, a new measurement will begin. In that case the STOP button will be highlighted. Once started, a measurement can be cancelled at any time by pressing the STOP button. Cancelling a measurement will result in the message “BP Reading cancelled” appearing in the status bar until a new measurement is begun.

Taking a measurement – the process

Once the cuff has been chosen and fitted, the appropriate cuff size selected in the SETTINGS menu and the operating Mode selected a measurement can begin. In manual mode, press the START button and in automatic mode, either press the SKIP button or wait for the interval time to elapse.

Once a measurement has begun, the pump can be heard inflating the cuff and the manometer will show the pressure rise in the cuff. At the same time the cuff pressure value under the manometer will display the actual cuff pressure in mmHg. The cuff will be inflated to a preset maximum pressure. If the unit has been used to take readings from an animal, it will ‘learn’ the appropriate value to inflate the cuff to, based on the previous systolic reading. If the unit has just been turned on then the cuff will be inflated to 160mmHg on the first reading. Thereafter the cuff will be inflated to the previous systolic pressure plus 30mmHg.

Once the target pressure has been reached the deflate process will begin. The pressure is reduced linearly in the cuff at approximately 3mmHg per second, whilst the unit “listens” for pulse signals in the artery and thence the cuff. These signals are strongest at around the systolic pressure and weakest at around the diastolic pressure. Care should therefore be taken not to knock or disturb the connecting hose during a measurement as this will be seen as external noise and may cause the failure of the measurement. The manometer and cuff pressure reading will show the deflation process and the small solenoids inside the Sentinel unit will be heard clicking on and off during the deflate process. At the end of the deflate process the cuff pressure will be released and there will be two long beeps from the Sentinel unit signifying a successful reading. If for any reason a blood pressure measurement could not be taken, the status bar will show the cause of the reading failure. For a full explanation of any reported messages see the section “Reported screen messages” later in this manual.

Resetting the Time & Date

The Time and Date can be reset by touching the screen area over the displayed time. A new menu appears that shows the current settings:

YEAR :	2009	UP	DOWN	
MONTH:	12	UP	DOWN	
DAY:	14	UP	DOWN	DONE
HOURS:	09	UP	DOWN	
MINUTES:	16	UP	DOWN	CANCEL

Touch the UP and DOWN buttons to set the appropriate values and then press the DONE button to save the changes and exit. To abort any changes, press the CANCEL button. Note that when the time is reset the 'seconds' value is automatically reset to zero.

Reported screen messages

There are a number of messages that may be reported on the screen in the status box. The messages and their meanings are listed here:

BP Reading OK (n)

This message appears after a successful measurement has been taken. The number, n, in the parentheses represents the number of readings taken in the current series of readings. This number is set to zero when the trend memory is cleared.

Weak or no signal

The unit has been unable to detect a signal.

Check the following:

That the cuff is in the correct position

The patient

That the cuff is properly tightened

That there is not excessive hair on the limb Try dampening with water if the coat is very thick

That the correct size cuff is being used

Artifact/Erratic signal

There has been too much artifact or noise seen during the measurement. This is normally due to patient movement or an undersized cuff.

Check the following:

That there is not excessive patient movement

That the cuff is in the correct position

That the correct size cuff is being used

Retry count exceeded

The unit has attempted to take a reading but has been unsuccessful despite several attempts at inflate and deflate.

Check the following:

That the cuff is properly tightened

That there is not excessive patient movement

That the cuff is in the correct position

That the correct size cuff is being used

That there is not excessive hair on the limb Try dampening with water if the coat is very thick

Measurement timed out

During an attempt to take a reading the time waiting for a signal has exceeded the maximum expected.

Check the following:

That the cuff is properly tightened

That there is not excessive patient movement

That the cuff is in the correct position

That the correct size cuff is being used

That there is not excessive hair on the limb Try dampening with water if the coat is very thick

Pneumatic Blockage

The unit has detected excessive pressure during inflate which suggests that the hose is blocked.

Check the following:

That the hose has no sharp bends or is pinched

That the patient is not lying on the cuff

That the cuff is in the correct position

BP Reading cancelled

The user has cancelled the blood pressure reading. The unit is now ready to take a reading

Inflate timeout-Air leak

The unit has taken too long to inflate the cuff. Check the following:

That the hose is connected to the system and the cuff

That the cuff is properly tightened

That the cuff is in the correct position

That the correct size cuff is being used

That the cuff is not leaking air

That the hose connections are not damaged or loose

Safety Timeout

The cuff pressure has remained above 10mmHg for more than 180 consecutive seconds. This is a safety feature to prevent limb ischaemia. Remove the cuff and wait at least 60 seconds before re-applying. It is also necessary to reset the unit by turning the power OFF for 10 seconds and then turning the unit back ON
Also check:

That the cuff is in the correct position
That there is not excessive patient movement

Cuff Overpressure

The cuff pressure has exceeded 300mmHg. Check the following before attempting another reading:

That the correct size cuff is being used
That the hose has no sharp bends or is pinched
That the patient is not lying on the cuff
That the cuff is in the correct position

EC91 Call technical support
Transducer out of range
ADC out of range
EEPROM Failure. Try recalibration

All of the above indicate an internal fault. Call your supplier or distributor to report the fault. The unit may need to be returned to the manufacturer for servicing.

Warnings & Precautions

Please read the following information carefully. The information contained below relates to all users of the Sentinel blood pressure module incorporating the NIBP (Oscillometric) unit.

This module is for veterinary use only. DO NOT use on human patients.

DO NOT use this device when Oscillometric pulses may be altered by other devices or techniques.

DO NOT use in the presence of flammable anaesthetics; this could cause an explosion.

DO NOT attach the cuff to a limb being used for IV infusions as the cuff inflation can block the infusion, potentially causing harm to the patient.

If the blood pressure cuff is on the same limb as a pulse-oximeter probe, the oxygen saturation results will be altered when the cuff occludes the artery.

To obtain accurate blood pressure readings, the cuff must be the correct size, and also be correctly fitted to the patient. Incorrect size or incorrect fitting may result in incorrect readings.

When a cuff is to be positioned on a patient for an extended length of time, be sure to occasionally check the limb for proper circulation.