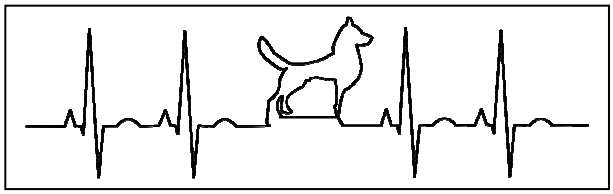
Understanding the terminology used when ECG Monitoring.



Here at Vetronic Services we talk to our customers a lot about ECG monitoring, for instance what the differences are between Single Lead and Six lead ECG monitors.
There does generally seem to be quite a lot of confusion regarding the terminology surrounding ECG work, so we decided to write this document to help clear up that confusion.

What does an Electrocardiograph (ECG Machine) do?

The Electrocardiograph (ECG machine), compares, amplifies and filters the electrical potential differences recorded by electrodes and presents the results as ECG Leads.

Cables

Cable - this refers to the actual physical wires that you connect to the patient.

Leads and Channels

Leads & Channels - these two terms are used interchangeably and they refer to the electrical measurement between two points.

For example: ***a single channel ECG machine with a bipolar Lead II connection to a patient, will have 3 cables and monitor only one channel or lead.***
Which channel or lead is monitored will depend on where you place the two active electrodes.

The above paragraph raises several questions:

1. What is an electrode?
2. What are active electrodes?
3. What is a bipolar lead connection?
4. Why does the electrode placement affect which lead is measured?
5. What is a single channel ECG machine

We'll answer these questions now to help clarify things

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What is an Electrode?

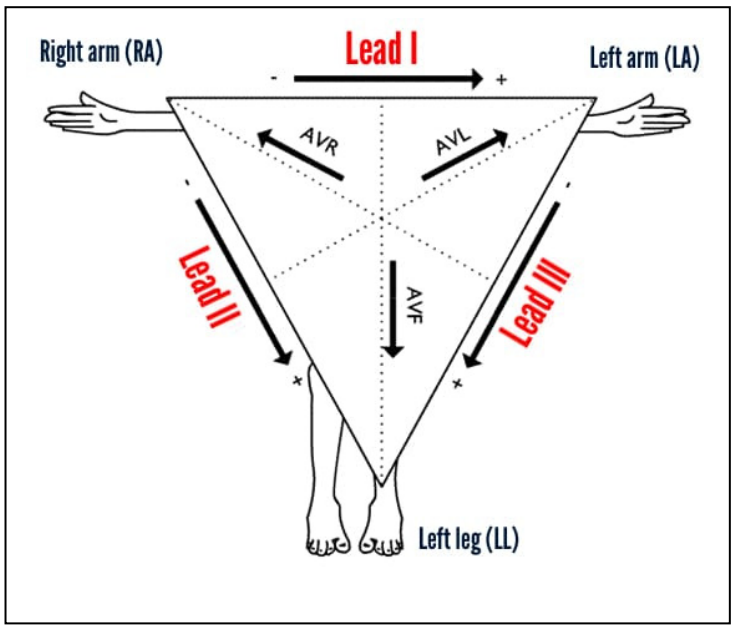
An electrode is an electrical connection, so in ECG terms it is the metal bit at the end of the ECG cable. It may be a crocodile clip, a snap-connector or an ECG pad. These are all electrodes.
The electrical currents of the heart are conducted all the way to the skin. This happens because the tissues and fluids surrounding the heart act as electrical conductors. By placing electrodes on the skin, it is possible to detect these electrical currents.

What are Active Electrodes?

An active electrode is an electrode used in a lead signal measurement.
In the UK the non-active electrode is black and is usually connected to the right-hind. This black electrode is known as the reference electrode and it provides a reference voltage for the ECG machine. This electrode is very important in helping reduce electrical noise and interference but plays no part in the actual signal obtained. You will find that if you have excellent skin contact with your other electrodes, then removing the black reference electrode makes no difference.

What is a bipolar lead connection?

A bipolar lead connection is a connection made up of **two** active electrodes. An example is a lead II connection, which is a connection between the Right Fore electrode and the Left Hind electrode.
There are 3 standard bipolar lead connections and they are derived from Einthoven's Triangle - Lead I, Lead II and Lead III



As you can see from the diagram:
Lead I is a connection between Right Fore and Left Fore

Lead II is a connection between Right Fore and Left Hind

Lead III is a connection between Left Fore and Left Hind.

Notice that the black (Right Hind) is not part of the leads because it is the reference lead only.

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Why does the electrode placement affect which lead is measured?

If you place the red lead on the Right Fore and the green lead on the left hind you will see a Lead II signal on your ECG machine.
However, if you place the red lead on the Right Fore and the green lead on the Left Fore you will see a Lead I signal on your ECG machine because the measurement is between Right Fore and Left Fore, which is Lead I.

What is a single channel ECG machine?

A single channel ECG machine only has two active electrodes and can therefore only measure one lead combination. Which lead combination is measured depends where you place the electrodes.
As we now know, making a single lead measurement takes two active electrodes and a reference electrode, so a single channel ECG machine has 3 cables. Unfortunately there is no standard on the colouring of these 3 cables. Some manufacturers make them as Red, Green and Black whereas others make them as Red, Yellow and Black.
This doesn't really matter. If you want a lead II trace place the Red lead on the Right Fore and the Green or Yellow on the Left Hind. In other words place the active electrodes in the lead II configuration.

Six Lead ECG Machines

As we know a single channel ECG machine can only measure between two points on Einthovens Triangle because there are only two active electrodes. But we only need one more cable to connect to all 3 points on Einthovens Triangle. So, a six lead ECG machine has 3 active electrodes plus the reference electrode meaning it has 4 physical cables.

But why is it called six-lead when we can now only measure 3 leads?

It is true that we can now measure three leads (Lead I, Lead II and Lead III) but with some simple mathematics we can produce 3 more leads, called the ***augmented leads***. This cannot be done with a single lead ECG machine but explains why an ECG machine with 4 cables can produce 6 ECG lead measurements, whereas a machine with 3 cables can only produce a single lead measurement.

We hope that this helps to clear up any confusion you may have regarding ECG terminology. If you ever have any queries, please do call us 01626 365505 or email us at enquiries@vetronic.co.uk and we will always be happy to help.

Thank you

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