Quality Anaesthetic monitoring and Ventilation equipment

VSL

Vetronic Services Ltd

ECG Monitoring

Keith Simpson BVSc MRCVS MIET(Electronics)

Abbotskerswell, Devon.

Designed by Vets, for Vets

Getting a good clean ECG trace

- The Equipment
- Methods of attachment
- Assessment

Designed by Vets, for Vets

ECG cable selection

- Shielded or unshielded
- Makes a lot of difference to the ability to obtain a good ECG
- Many medical ECG cables are shielded only as far as the split. After that the cable is unshielded
- Susceptibility to mains interference is greatly increased.

Designed
by Vets, for Vets

UK lead convention

- RED – Right Fore
- YELLOW – Left Fore
- GREEN – Left Hind
- BLACK – Right Hind (reference electrode)

Designed
by Vets, for Vets

USA lead convention

- RED – Left Hind
- WHITE – Right Fore
- BLACK – Left Fore
- GREEN – Right Hind (reference electrode)

Designed
by Vets, for Vets

Methods of attachment

- **Primary aims**
  - Maximise the surface area of attachment
  - Minimize the contact resistance
  - Minimize noise pickup

Designed by Vets, for Vets

Maximize the surface area of attachment

- **Options**
  - Crocodile clips
  - Sticky ECG electrodes
  - Limb Plate Electrode
  - Hypodermic needles

Designed by Vets, for Vets

Crocodile Clips

- **Can be painful**
  - Use modified clips
  - ‘Bite’ as much skin as possible
    - Spreads the load
    - Reduces pain
    - Maximises the contact
  - Need a conducting medium
  - Much better with shaved area

Designed by Vets, for Vets

Sticky ECG electrodes

- Variety of sizes but the contact area is essentially the same

- Need well prepared dry skin
  - Clip area larger than ECG pad
  - De-grease with surgical spirit
  - Allow to dry and then apply pad

- Takes time to apply so good for long ops or ambulatory monitoring

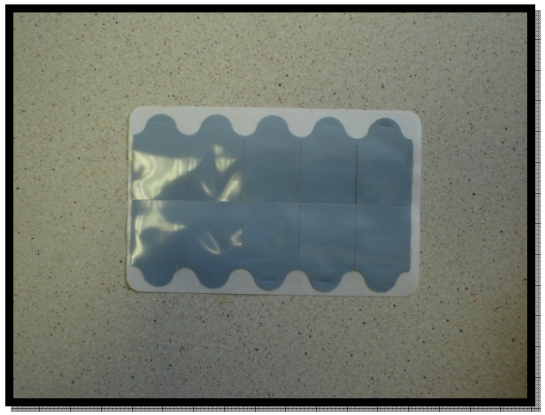
- Can get reasonable results from the pads of the feet but skin resistance is high so subject to noise and movement artefact

- Good preparation is imperative otherwise get mediocre results

Designed
by Vets, for Vets

Vetronic Services Ltd

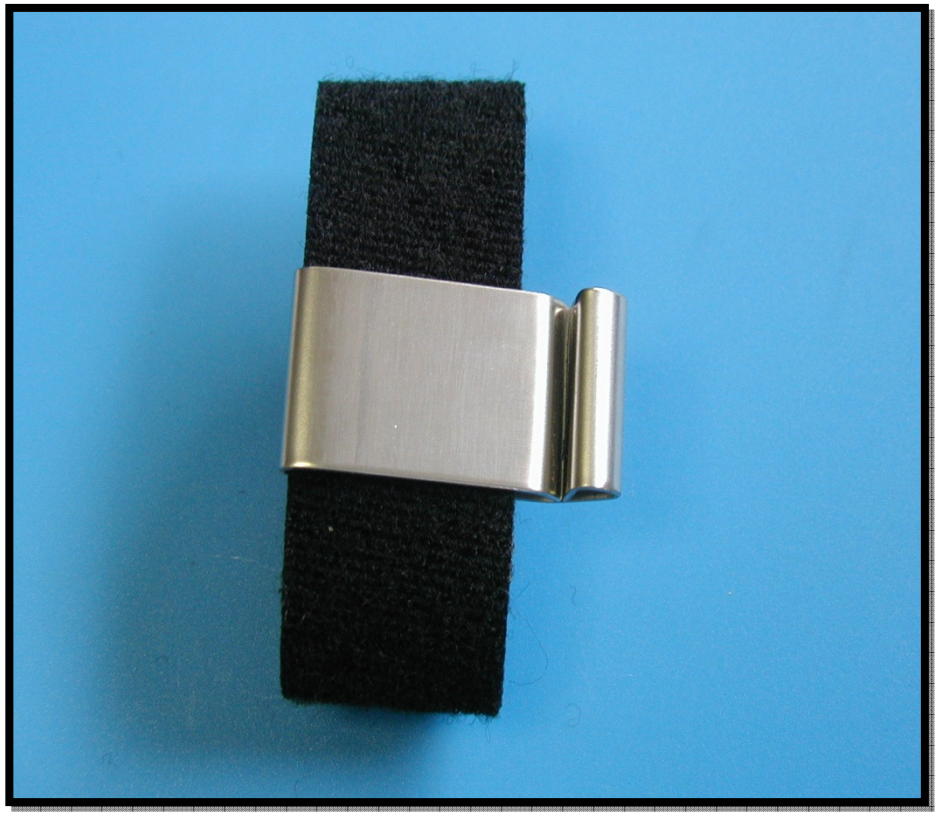
ECG pad types



Designed by Vets, for Vets

Limb plate electrodes

- Very easy to apply
- Non painful
- Large surface area so good signal pickup
- No need to clip hair
- Good long term results (hours)



Designed
by Vets, for Vets

Hypodermic Needles

- Fairly well tolerated – 21g or 23g

- Bypasses skin resistance but small contact area so can produce unreliable results, particularly with movement

- Good for e.g. birds where skin is v fragile and cannot use pads or LPE

- Push needle under skin and out again, then attach crocodile clip to free end – picture…..

Designed
by Vets, for Vets

Minimize contact resistance

- Hair provides distinct barrier to contact, even when soaked in spirit

- Remove hair – pluck or shave
  - Anaesthetised dogs/cats: Pluck hair between pads and use modified crocodile clip for quick connection

- For crocodile clips and LPE apply contact medium *before* attaching electrode

- Use a conducting medium
  - Surgical spirit/isopropyl alcohol
  - Electrolyte solution/Saline
  - Cardiac gel/Ultrasound gel (remove after use)

Designed by Vets, for Vets

Agent	***Pros***	***Cons***	***Contact Time***
Surgical Spirit	Promotes good contact. Cheap. Easily available	Smell. Irritant. Short contact time	10-15 minutes
Isopropyl Alcohol	Promotes good contact. Reasonably cheap	Smell. Irritant	30-40 minutes
Electrolyte Solution, e.g. Signa Spray by Parker	Non-irritant. Good contact. Low/zero odour	Less readily available. Increased cost	1hour+
Cardiac Gel	Good sustained contact	Less easily available. Increased cost. Messy. Clogs up electrodes.	2 hours+
Self adhesive Electrodes	Clean. New contact every time. Simple to use	More expensive Must prepare area. Not re-usable	2 hours+ Up to days in some cases

Minimize contact resistance

Don’t even try with a set of clips like this

Designed by Vets, for Vets

Minimize Noise Pickup

- So now you have a well attached ECG set of cables. Is that all you need for a good ECG?

- **NO!**

  - Must reduce noise pickup as well

Designed by Vets, for Vets

Cable Position

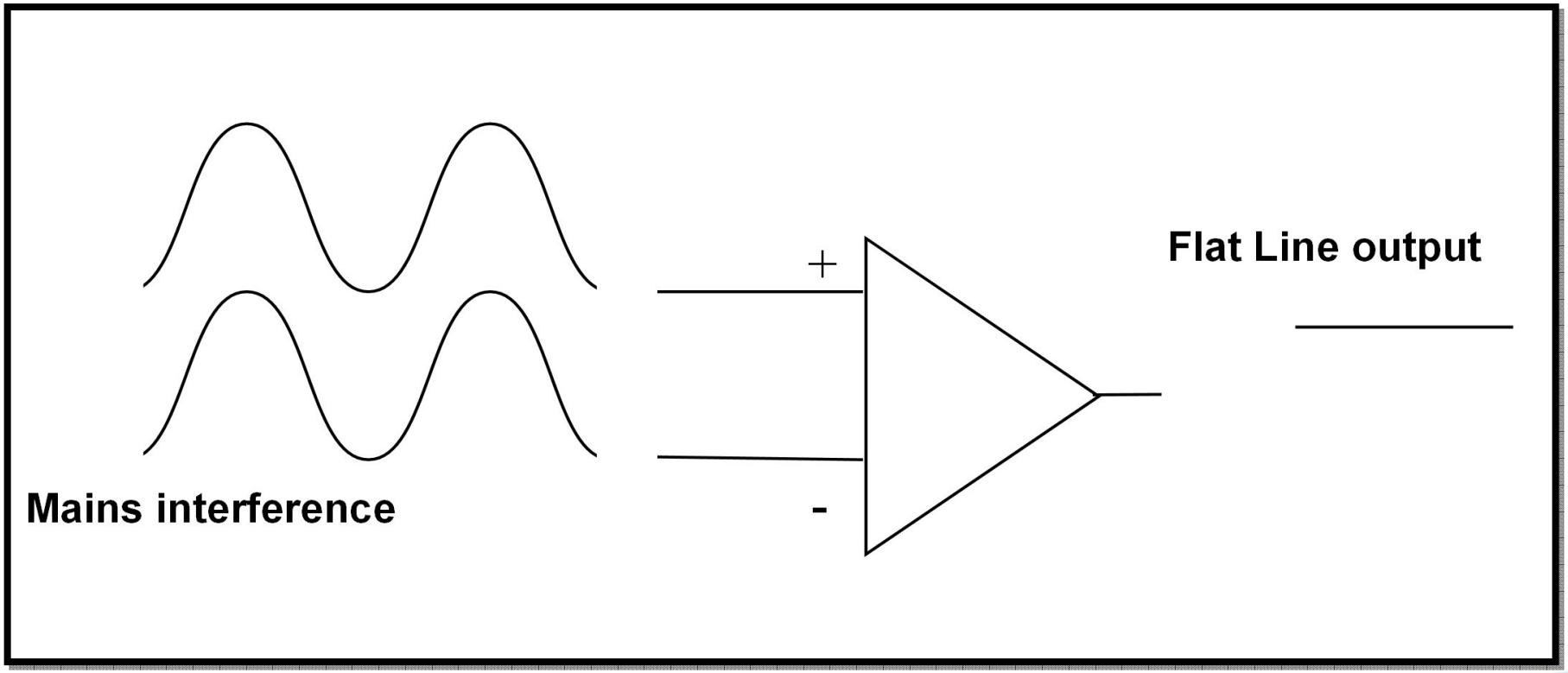
- Cable position is extremely important

- Due to phenomenon of Common Mode Rejection

- Simply put – For best rejection of noise all leads must “see” the same interference and so follow the same path

Designed by Vets, for Vets

Common Mode Rejection



Designed by Vets, for Vets

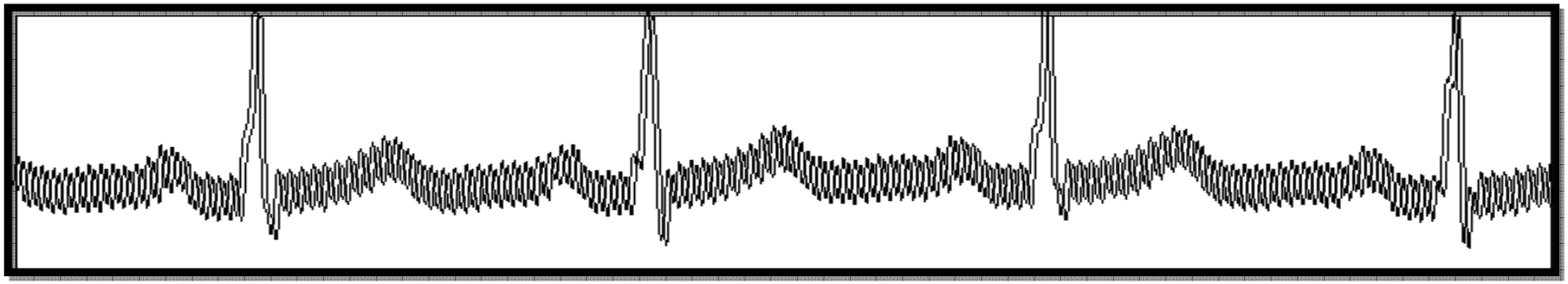
Improving Common Mode Rejection

- Minimise contact resistance
- All leads should be same length especially if unshielded
- All leads should run as close together as possible

Designed by Vets, for Vets

Effect of cable spread

- The two pictures show the ECG of the patient with spread cables and with parallel cables



Demonstration of Effect of Cable Spread

Vetronic Services Ltd

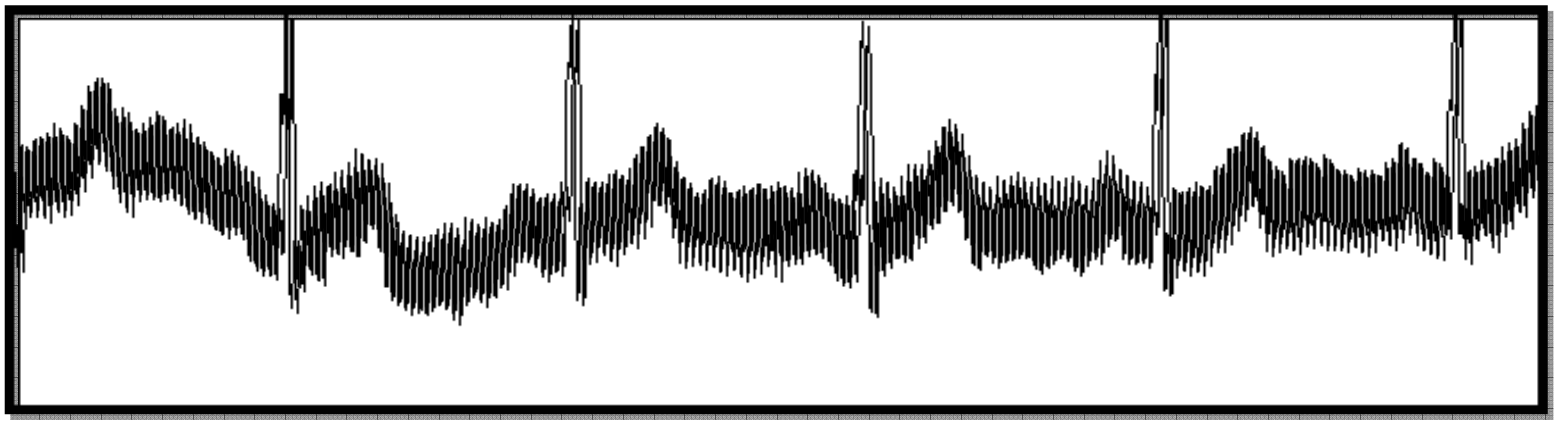
Designed by Vets, for Vets

Vetronic Services Ltd

So you can not get anything but noise

What do you do?

- Test the machine
- Remove Causes of interference



Designed by Vets, for Vets

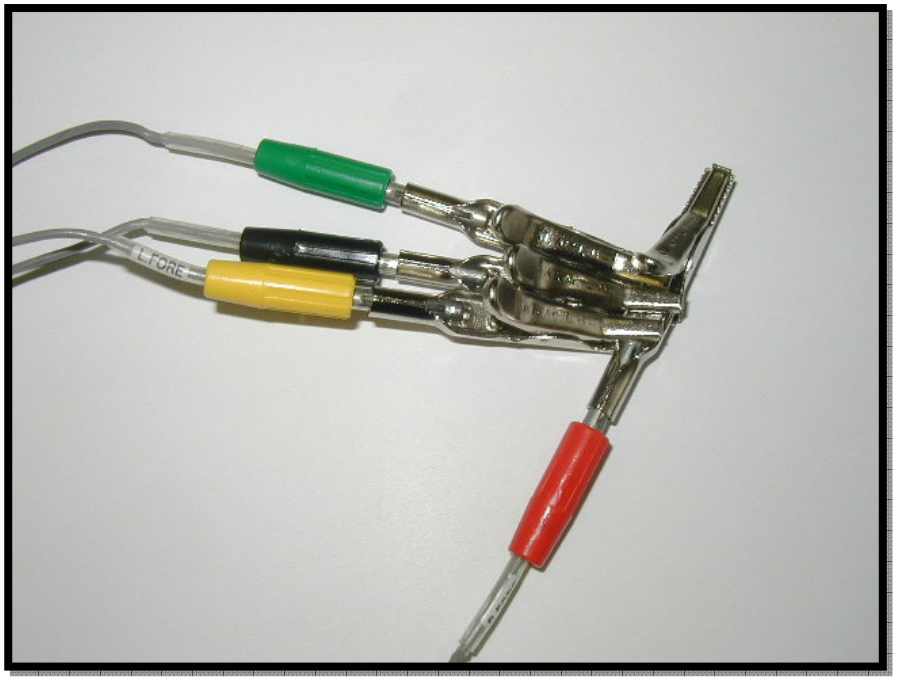
Test the Machine

- Two very simple tests to assess the ECG machine
  - All Leads together
  - Individual Lead test

Designed
by Vets, for Vets

All leads together

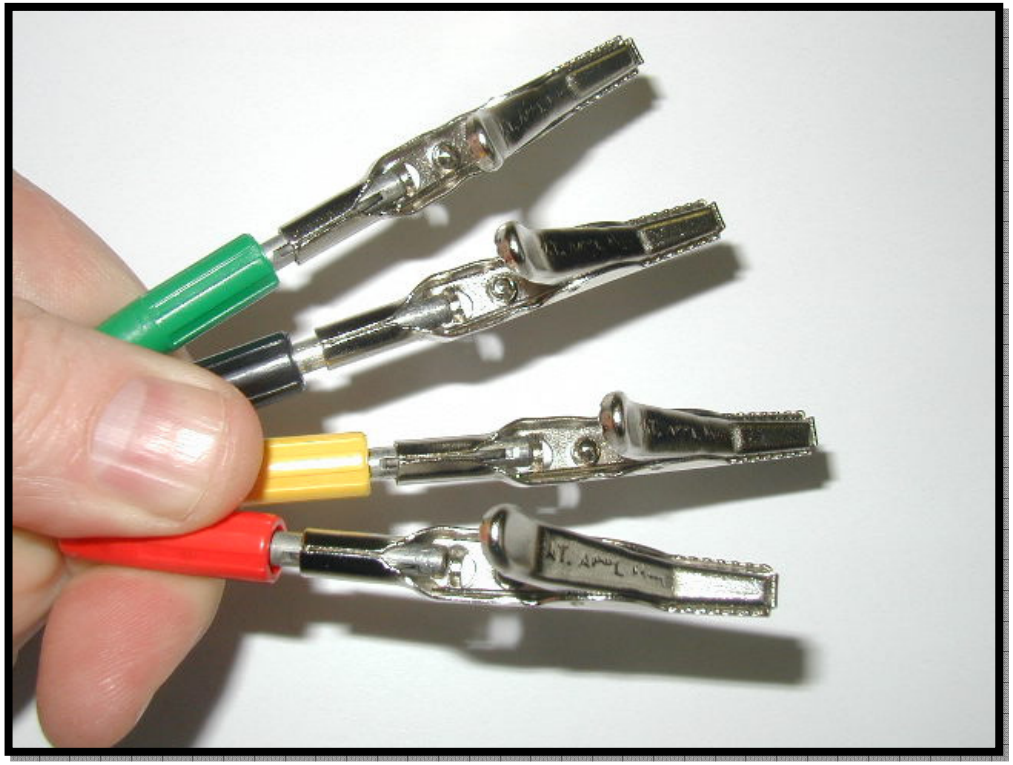
- On all Lead settings of the machine there should be a completely flat line. If not, there is a fault



Designed
by Vets, for Vets

Individual Lead Tests

- Hold all four leads in one hand and fan out the clips



Designed
by Vets, for Vets

Individual Lead Tests

- Touching any one of these leads (except Right Hind) should cause massive stylus movement or screen trace deflection.

- Touch each in turn. A properly functioning machine will have the following response

Designed
by Vets, for Vets

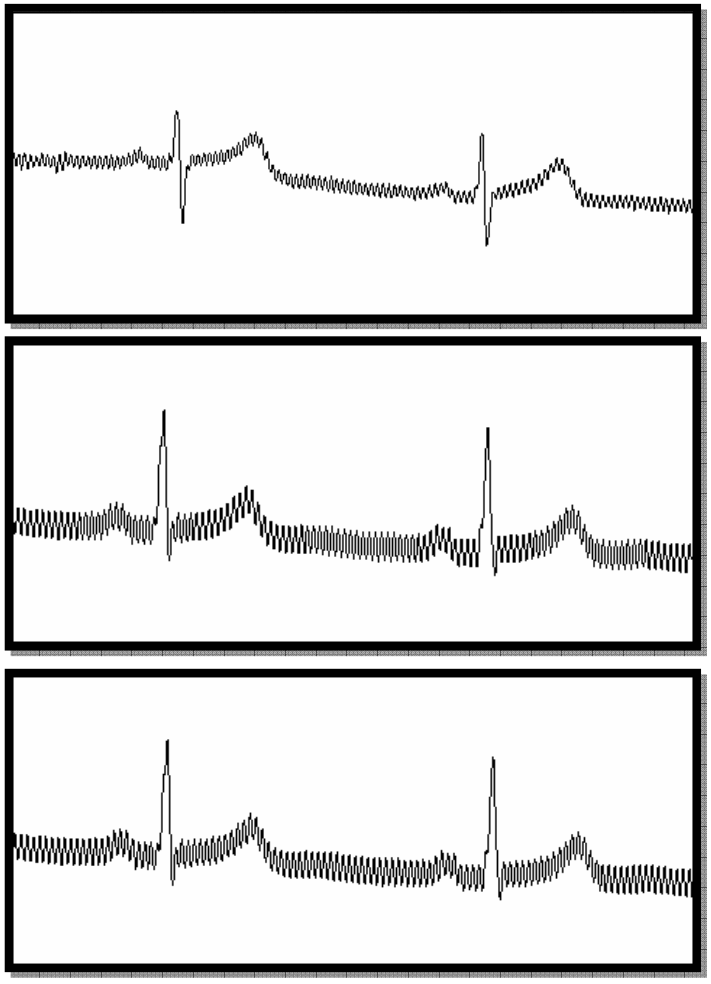
Individual Lead Tests

- **Lead I**
  - Response with Right Fore and Left Fore
  - No response with Left Hind or Right Hind
- **Lead II**
  - Response with Right Fore and Left Hind
  - No response with Left Fore or Right Hind
- **Lead III**
  - Response with Left Fore and Left Hind
  - No response with Right Fore or Right hind

Designed by Vets, for Vets

Deducing a lead problem from the ECG result

Right Hind contact problem



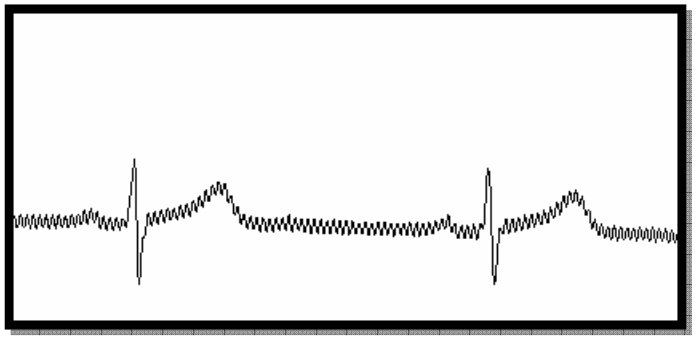
Lead I

Lead II

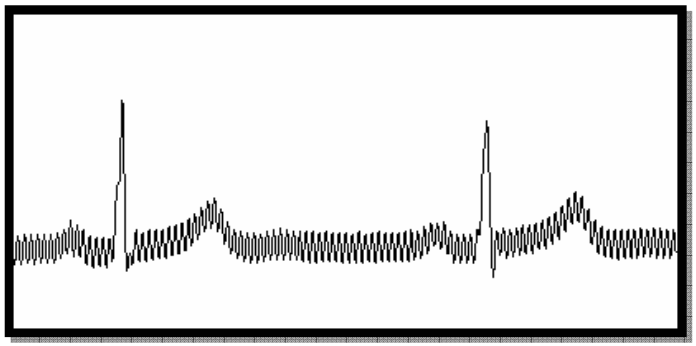
Lead III

Deducing a lead problem from the ECG result

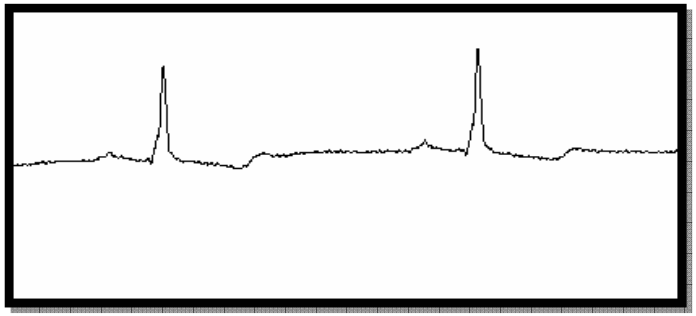
Right Fore contact problem



Lead I



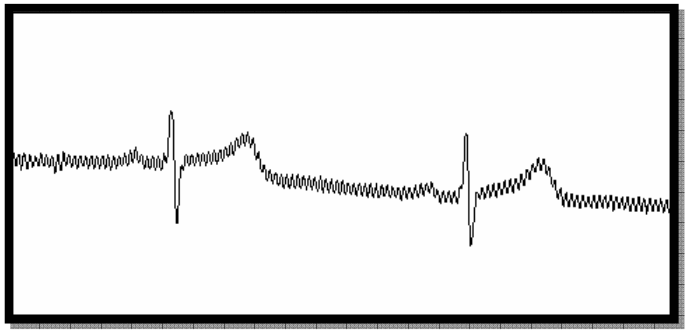
Lead II



Lead III (Does not involve RF)

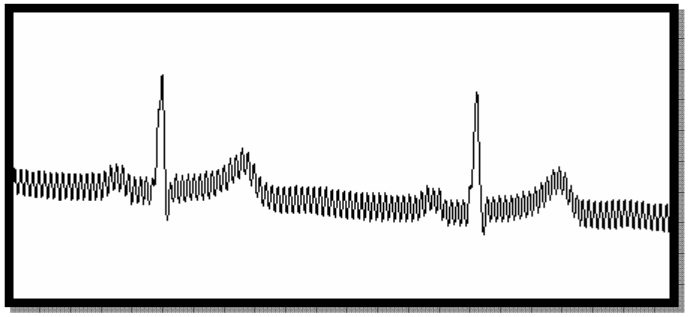
Deducing a lead problem from the ECG result

Left Fore contact problem



Lead I

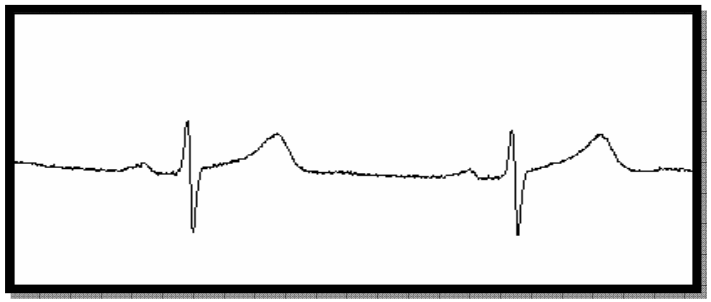
Lead II (Does not involve LF)



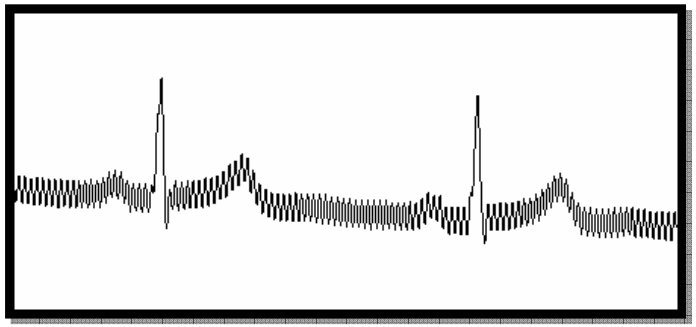
Lead III

Deducing a lead problem from the ECG result

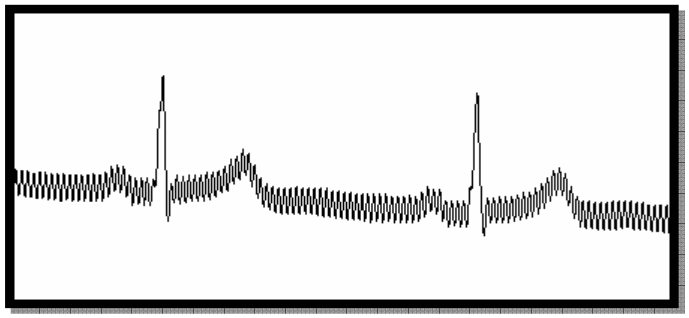
Left Hind contact problem



Lead I (Does not involve LH)



Lead II



Lead III

Sources of Interference

- Mains induced noise
- Movement
- Mobile phones
- Newer digital Cordless phones

Designed by Vets, for Vets

Thank-you for Listening

If you have any further issues or enquiries about Vetronic Services LTD and their products please do not hesitate to contact us on the below contact details:

Tel: 01626 365505

Fax: 0870129 4705

Email: enquiries@vetronic.co.uk

Web: www.vetronic.co.uk

Designed by Vets, for Vets