ECG Study

Technician and teacher sheet

Apparatus

EKG / ECG sensor.

Electrodes (3 per person tested).

Data recording setup.

Default to start.

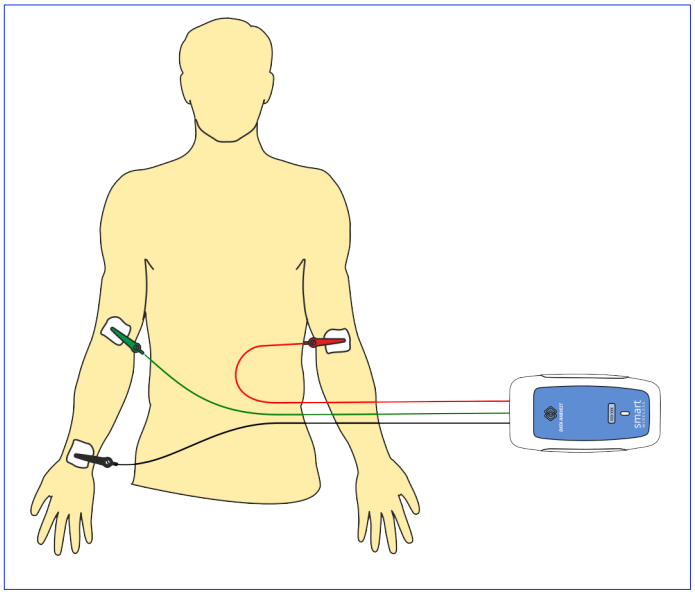
Slowly increasing sample rate.

Introduction

The ECG offers a chance for the student to study the heart and to use non-invasive monitoring to collect limited anatomical information about the heart. The sensor is not a medical grade device and caution should be made when commenting on any of the waveforms that are collected.

This demonstration investigation will help students to be able to:

- Identify the components of the ECG.
- Comment on the relationship of the components of the ECG to the heartbeat.
- Calculate a heart rate from a small sample of data.
- State how the heart rate is changing to respond to exercise i.e. rate increase vs. stroke volume increase.



When used with a BT link to the recording device there should be no interference, excepting muscle activity in the data collected. The wireless connection also means the sensor is electrically isolated.

Recording information

A 10 second recording time will capture on average 12 heart cycles. If the time span is too long it can be altered via the setup. The critical value is the intersample time, this should be 20 ms or faster (when the total logging time is reduced shorter intersample times become available).

With an intersample time of 20 ms the majority of detail of the ECG is captured, but you may find that 1 in 6 beats loses the PQRS complex. At 20 ms there is sufficient detail to measure time intervals between the events of the ECG.

Practical notes

The heartbeat on average lasts for 0.8 second therefore to capture all the heartbeat the intersample period needs to be short. The student will not see the heart beat being generated in real time. The test subjects need to be relaxed and stationary when data is being collected. The movement of all muscle generates electrical energy, which may confuse the recording.

The success of the ECG collection is in making the good contact between the student and the electrode patch. A few moments extra spent in preparation will pay dividends in quality of the results. Using ethanol on a rough paper towel will remove any oils from the skin and gently abrade the surface skin layer. If an abrasive paper is to be used the student subject should be responsible for its use, not their partners who may be a little over zealous in its use! Wherever possible the electrode patches should be placed over areas devoid of large muscle masses. Electrical artefacts caused from the maintenance of muscle tone will add unnecessary noise to the trace.

Students will find that not all ECG's will look alike. They should not be alarmed; the characteristics of the heart like all other aspects of an individual vary within limits of variation. In particular the height of the QRS complex will vary; this has no health implications and is a simple consequence of the individual's skin and body resistance. If the students are able to place electrodes closer to the heart they will find the signal is improved. It should be possible for the electrode patches to be applied "discreetly".

The electrode patches use reduced allergy materials. There should not be any adverse reaction to the patches, but it would be wise to be aware of the possibility. Removal of the patches will take the top layer of skin cells away therefore some reddening of the skin where the patch had been placed is normal.

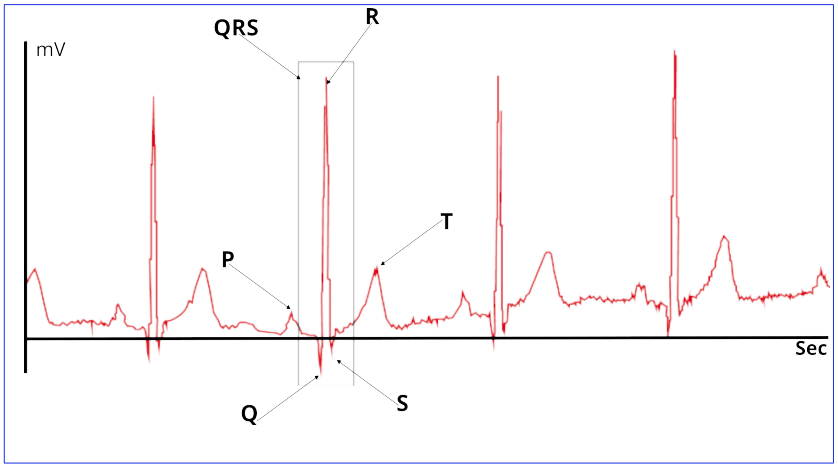
The term ECG is commonly used in the British isles and is slowly being replaced for the more international EKG. In part this is to create clarity between a recording of the heart pattern and recordings of the brains activity.

If any students have had an ECG taken the will notice the apparatus uses considerably fewer patches. In a modern clinical ECG more patches allow addition derived data such as "vector" patterns to be created.

This is ECG is purely for demonstration purposes, it should never be used for clinical purposes.

Example data.

A typical ECG trace of 4 complete heart cycles. The components of the hearts electrical activity have been labelled up. Not that in each cycle the components will be more or less visible - this is normal, it is in part an artifact of the recording method used. The y axis is mV compared to the reference electrode, this will vary with an individuals skin and body resistance



Positioning the electrode patches

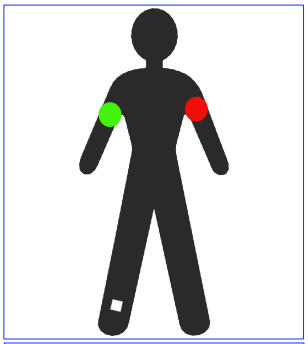
Note: *The test subject can attach both the electrode patch and leads; there is no need for the intervention of a second person. If necessary the electrodes and leads can be connected discreetly under the test subjects clothing.*

There are four suggested positions for the electrode patches – the inside of the upper left arm, the inside of the upper right arm, the area behind the ankle on the left leg and the area behind the ankle on the right leg.

There are three electrode leads from the ECG Sensor each with a different colour crocodile clip connector. The crocodile clip for the positive lead is red, for the negative lead is green and for the reference point (isoelectric line) is black.

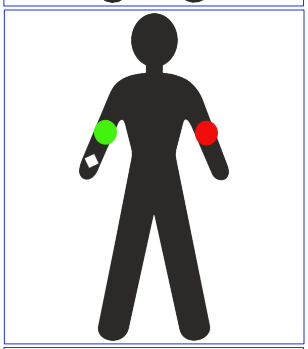
There are three different ways described that the electrode leads can be connected to the electrode patches. Each arrangement of lead and electrode will record a different shape and intensity of waveform and is described as a 'lead type'. For the majority of individuals either the Lead I or II layout will produce the 'typical' ECG trace.

Lead type	**Red (Positive) lead**	**Green (Negative) lead**	**Black (Reference) lead**
Lead I	Left arm	Right arm	Right ankle
Lead II	Left leg	Right arm	Right ankle
Lead II	Left leg	Left arm	Left ankle



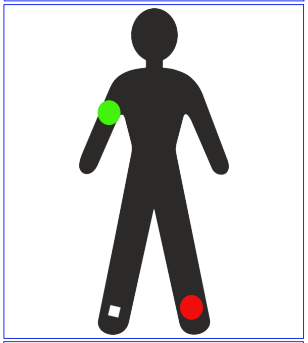
Lead I

1. Rub the area of skin that will be used with the paper towel.
2. Place an electrode patch on the inner part of your right upper arm (RA), your left upper arm (LA) and on the area behind your right ankle (RL).
3. Connect the Green crocodile clip to the electrode tab on your right arm (RA).
4. Connect the Red crocodile clip to the electrode tab on your left upper arm (LA).
5. Connect the Black crocodile clip to electrode tab on your right ankle (RL).



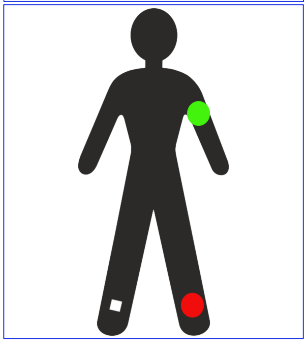
If attaching the lead to the ankle causes a problem, e.g. the test subject is wearing tights, use this alternative Lead I arrangement:

1. Place an electrode patch on the inside of your right elbow, right wrist and left elbow.
2. Connect the Green Crocodile clip to the electrode tab on your right elbow.
3. Connect the Black Crocodile clip to the right wrist.
4. Connect the Red crocodile clip to the left elbow.



Lead II

1. Rub the area of skin that will be used with the paper towel. Place an electrode patch on the inner part of your right upper arm (RA), on the inner area behind your left ankle (LL) and on the inner area behind your right ankle (RL).
2. Connect the Green crocodile clip to the electrode tab on your right arm (RA).
3. Connect the Red crocodile clip to the electrode tab on your left ankle (LL).
4. Connect the Black crocodile clip to the electrode tab on your right ankle (RL).



Lead III

1. Rub the area of skin that will be used with the paper towel. Place an electrode patch on the inner part of your left upper arm (LA), on the inner area behind your left ankle (LL) and on the inner area behind your right ankle (RL).
2. Connect the Green crocodile clip to the electrode tab on your left arm (LA).
3. Connect the Red crocodile clip to the electrode tab on your left ankle (LL).
4. Connect the Black crocodile clip to the electrode tab on your right ankle (RL).

- Good contact between the electrode patches and the skin is the key to getting good results. To ensure good adhesion the area of skin being used should have any moisture, surface oil or dead skin removed by rubbing the area with a paper towel – preferably dampened with alcohol e.g. industrial methylated spirits (IMS).
- It may be useful to demonstrate the method of electrode attachment to new users.
- When the electrodes and leads have all been connected leave a time delay of at least 15 seconds before starting to collect data. This gives time for the reference electrode to stabilise the waveform. The exact time delay required will depend upon the individual and the electrode layout. Recordings taken before this time may show either a flat line or erratic values.
- Coughing, sneezing, laughing, moving and talking will affect the reading. The test subject should be relaxed and motionless.
- When investigating the effect of exercise unclip the crocodile clips from the electrode patches but leave the patches in place. After exercise reconnect the crocodile clips.

Software knowledge required.

1. Connecting the sensor(s) to the software.
2. Use set up to change the intersample period.
3. Change axis limits.
4. Use values, difference and interval to find times between areas of interest
5. Use the runs manager to show individual or multiple runs on the same chart.