Experiment (2)

ELECTROCARDIOGRAPHY (ECG)

➢ The Objective:

Electrocardiography is the electrical recording of the heart activity and function in order to assist the physician in diagnosis disease, establishing a treatment plan and evaluating the effect of the treatment of patient. The heart produces tiny electrical impulses which spread through the heart muscle to make the heart contract ;these impulses can be detected by the ECG machine.

➢ Theory:

The cells inside the heart muscle conduct electrical current. Some cells in the heart (the pacemaker cells) charge by themselves regularly and they cause the other cells to charge. A current flows through the heart muscle in a particular way. Every time this happens the heart muscle contracts and pumps the blood "heart beat".

➢ The Configuration and Parts of the System:

All electrocardiographys have the following fundamental parts:

- ECG electrodes
- Preamplifier
- Lead selector switch
- Isolation circuit
- Band-pass filter circuit
- 1 mV calibration source
- Means for protecting the amplifier against a high voltage
- Galvanometer
- ECG readout devices
  See Fig. (3)

Fig. (4) ECG System

➢ System Block Diagram

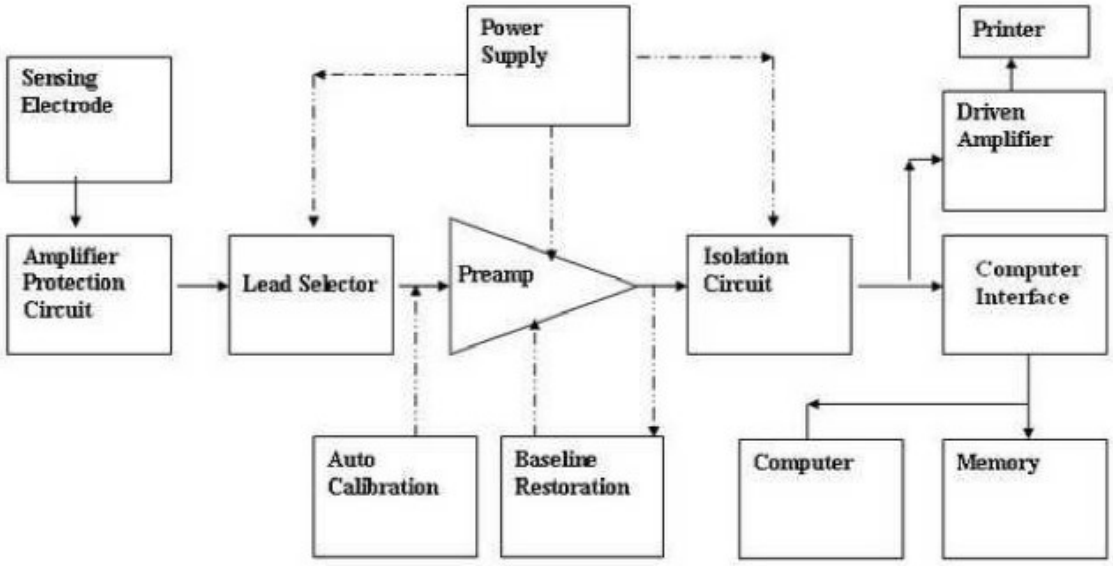


Fig. (5) ECG Block Diagram

➢ The Principle Work of the System

When the heart depolarizes with each heartbeat, the electrodes sense the tiny electrical impulses on the skin that are created as a result. The impulses travel back to the machine where they are amplified and printed on a graph. The tissues in the human body are electrical conductors and when the electrical current flows in the heart we can measure it in the surface of the body. ECG electrodes are made of silver-silver chloride and they are stuck to the skin together with ECG gel. The electrical signals from the heart are picked up by these electrodes and measured and recorded by the ECG machine.

➢ The Procedure of Operation

As the heart undergoes depolarization and repolarization, electrical currents separate throughout the body. The currents are commonly measured by the electrode placed on the body surface and resulting (ECG) waveform. In order to record an ECG waveform, differential recording between two points on the body are made. Traditionally, each differential recording is referred to as a lead; there are two basic types of electrocardiogram leads:

1. Bipolar Limb Leads:

Those designated by Lead I, II, III which form Einthoven Triangle:

1. Lead I = LA connection to noninverting amp. Input And RA connecting to inverting amp. Input
2. Lead II = LL connection to amp. Noninverting input RA connect to inverting input and LA shorted to RL
3. Lead III = LL connected to noninverting input LA connected to inverting input.

*2. Unipolar Limb Leads (*augmented limb leads):

Leads that look at composite potential from 3 limbs simultaneously where signal from 2 limbs are summed in a resistor network and then applied to an inverting amplifier input and the remaining limb electrode is applied to the non-inverting input

1. Lead aVR = RA connected to non-inverting input while LA and LL are summed at inverting input, augmented (amplified) Voltage for Right arm (aVR)
2. Lead aVL = LA connected to non-inverting input while RA and LL are summed at inverting input, augmented (amplified) Voltage for Left arm (aVL)
3. Lead aVF = LL connected to non-inverting input while RA and LA are summed at inverting input augmented (amplified) Voltage for Foot (aVF). See Fig. (6)

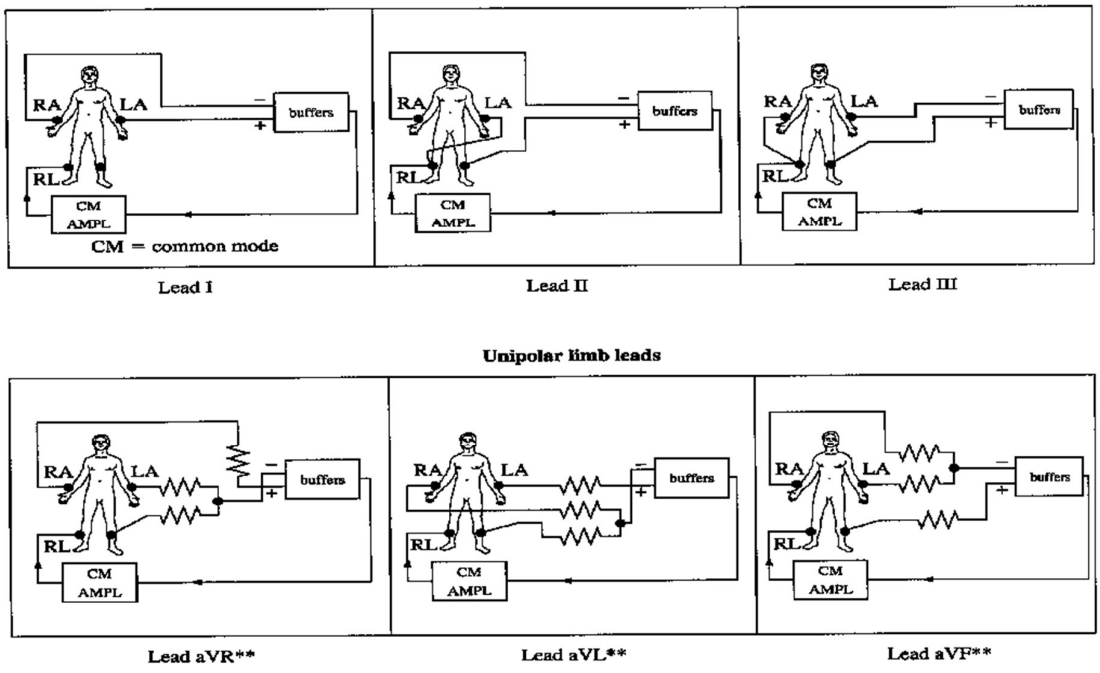
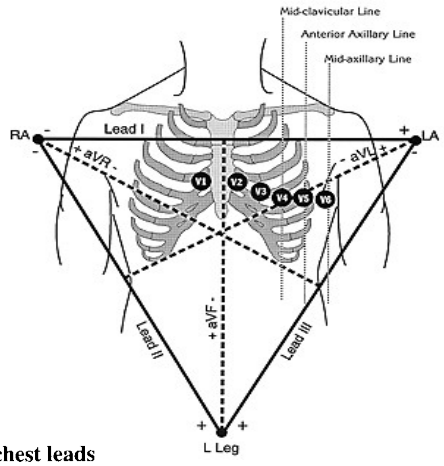


Fig. (6) The position of ECG leads

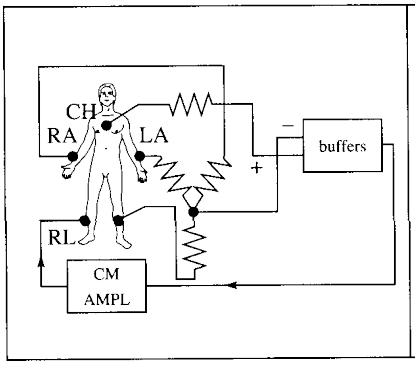
3. ***Unipolar Chest Leads:***

Measured with signals from certain specified locations on the chest applied to amplifiers non-inverting input while RA, LA, and LL are summed in a resistor Wilson network at amplifier inverting inputs. Fig. (7) shows the position of chest leads

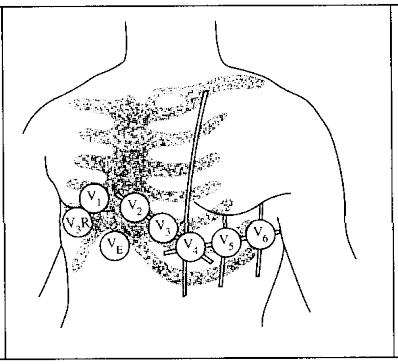
Fig. (7) the position of chest leads



Unipolar chest leads



Lead V**



CH Positions

V_1	Fourth intercostal space, at right sternal margin.
V_2	Fourth intercostal space, at left sternal margin.
V_3	Midway between V_2 and V_4.
V_4	Fifth intercostal space, at mid-clavicular line.
V_5	Same level as V_4, on anterior axillary line.
V_6	Same level as V_4, on mid-axillary line.
E	Ensiform, base of sternum.

CH Positions

The typical ECG signal is as shown in Fig. (8)

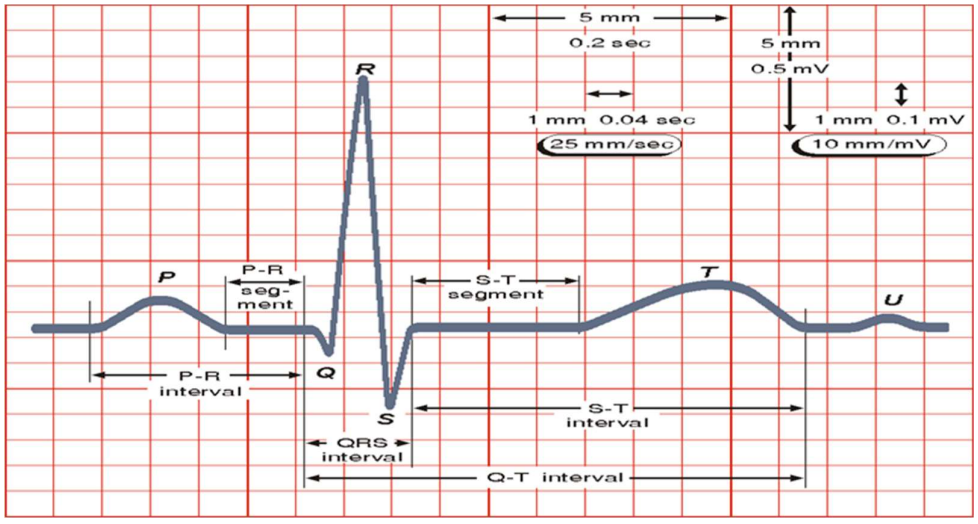


Fig. (9) typical ECG signal