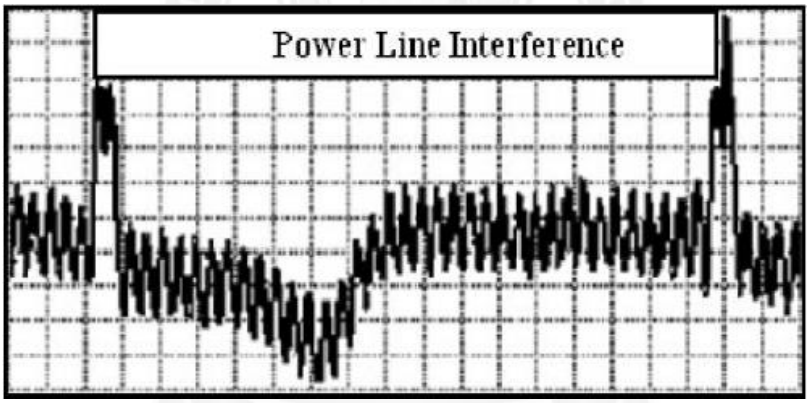
POWER LINE INTERFERENCE

The power line interference of 50160 Hz is the source of interference and it corrupt the recordings of electrocardiogram (ECG) which are extremely important for the diagnosis of patients. The interference is caused by,

- Electromagnetic interference power line.
- Electromagnetic field (EMF) by the machinery which is placed nearby, the signal component holds harmonics with different amplitude and frequency. The harmonics frequency is integral multiple of fundamental frequency such as 50Hz.
- Stray effect of the alternative current fields due to loops in the cables.
- Improper grounding of ECG machine or the patient.
- Electrical equipment's such as air conditioner, elevators and X-ray units draw heavy power line current, which induce 50Hz signals in the input circuits of the ECG machine.



The noise from electric power system is a major source of noise during the recording or monitoring of ECG. Different noises have different frequencies. The noise with low frequency is being problem with ECG signal as well as some time high frequency noises also interference ECG like mobile phone.

If the physical or mathematical variable changes rapidly then it can be high frequency and if it changes slowly then it would be low frequency. If the variable does not change at all then it is said that it has zero frequency. Most of the electronic devices such as ECG, transmitter, receiver, computer etc get power from power line. The 50Hz alternative current (AC) is reduced in voltage, rectified and then filter to obtain low voltage direct current (DC). This is used to give power to those electronic devices.

RIGHT LEG DRIVEN ECG AMPLIFIER

A driven right leg circuit or DRL circuit is an electronic circuit that is often added to biological signal amplifiers to reduce common-mode interference, biological signal amplifiers such as ECG, EEG or EMG circuits measure very small electrical signals emitted by the body, often as small as several micro-volts.

Unfortunately, the patient's body can also act as an antenna which picks up electromagnetic interference, especially 50/60 Hz noise from electrical power lines. This interference can obscure the biological signals, making them very hard to measure. Right leg driver circuitry is used to eliminate interference noise by actively cancelling the interference. Other methods of noise control include:

Faraday cage

Twisting wires

High gain instrumentation amplifier

Filtering

Isolation of the patient preamplifier can also be obtained using an optical isolator. The high common-mode rejection of the amplifier is obtained by proper shielding. The effective capacitance from the input leaded to the earth is made negligible. The preamplifier circuitry should be preferably be shielded in a separate case.

To minimize the common-mode signal between the body of the patient and the floating ground, a right leg driven circuit is used. The common-mode signals after amplification in a preamplifier are inverted and fed back to the right leg electrode, reducing the common mode voltage on the input with respect to the floating ground. Winter and webster examined optimal design parameters for a driven-right-leg circuit.

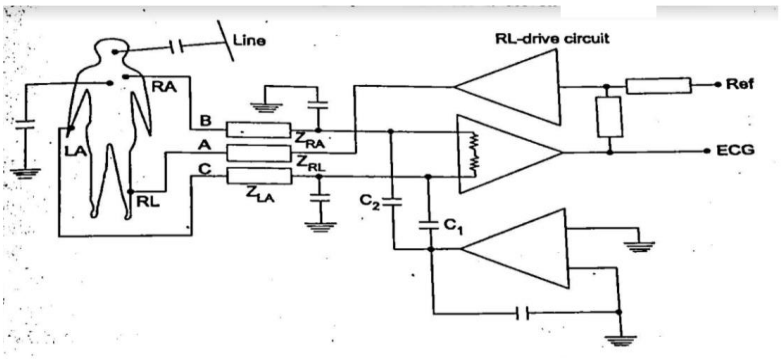


Fig: Improvement in CMRR using right leg driven

The presence of stray capacitance at the input of the preamplifier causes common-mode currents to flow in LA and RA, resulting in a voltage drop at the electrode resistors. An imbalance of the stray capacitance or the electrode resistors causes a difference signal. This difference signal can be almost eliminated, in that the common-mode currents of stray capacitances are not allowed to flow through the electrode resistors but are neutralized by current delivered to stray capacitances from the common-mode rejection amplifier.

In other words, the potentials at A, B and C are equalised through an in-phase component of the common-mode voltage, which the amplifier delivers via C_1 and C_2 are kept equal, independent of the imbalance in the electrode resistors and stray capacitance. The modern ECG machines with their completely shielded patient cable and lead wires and their high common-mode rejection, are sufficiently resistant to mains interference.