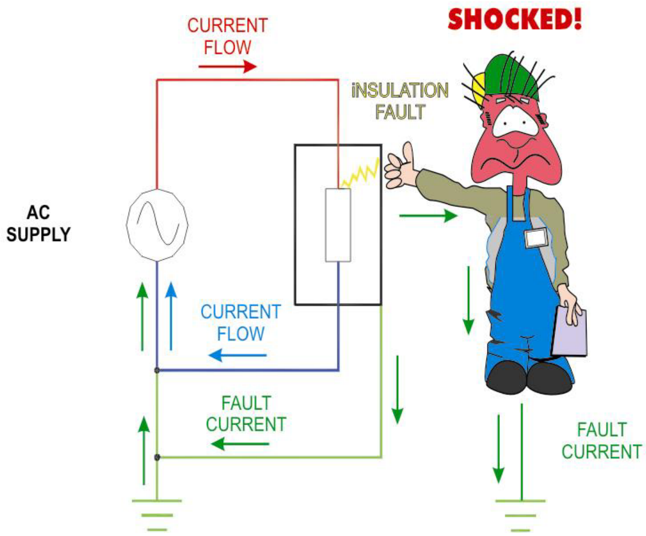
Isolation Transformers

In a situation where there is increased risk of electrical shock or damage to expensive measurement equipment, for example in a test laboratory, the use of an isolation transformer as a source of supply is recommended.

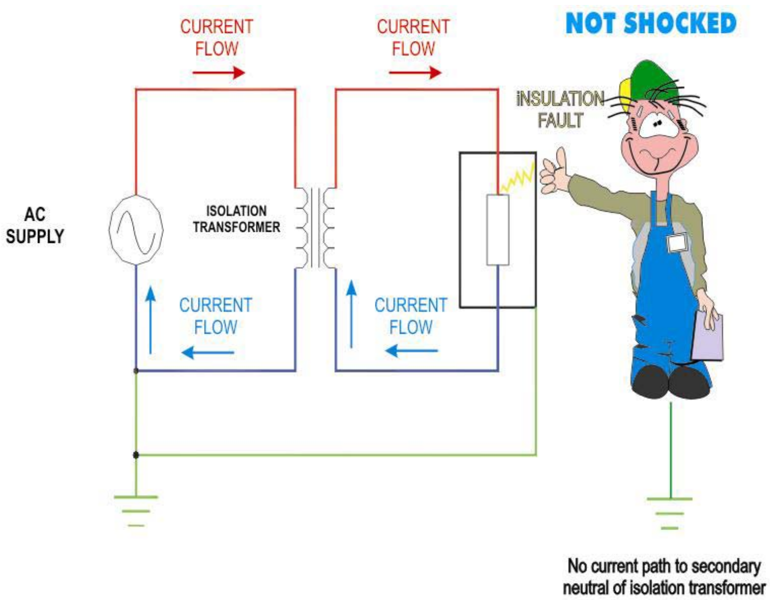
An isolation transformer electrically separates the mains primary input from any equipment connected to the secondary. This is often called galvanic isolation. To fully appreciate the implications of this, it is important to understand that; in a standard UK mains distribution system, the neutral is indirectly connected to the earth – consequently the neutral and the earth conductors are at a different voltage or potential to the live. This means that to complete an electrical circuit, something (or someone) needs to be in contact with the live terminal and the earth (or neutral) at the same time, to create a current path and receive an electric shock



An isolation transformer works by breaking the connection between neutral and earth, so the earth is said to be floating and not at any fixed potential relative to the live and so there is no possibility for current to flow from the live terminal to the earth.

In reality there may be leakage current between live and earth and neutral and earth, which may result in some potential difference existing between live and earth and this may provide a significant shock current, so care must always be taken.

To help understand this, think of the secondary winding of an isolation transformer as being a DC source, like a battery for example. Touch the positive (or live in the case of an AC supply) terminal only and you will not get a shock because there is no path back to the negative (neutral) terminal. However, touch both supply connections and you will receive a shock!



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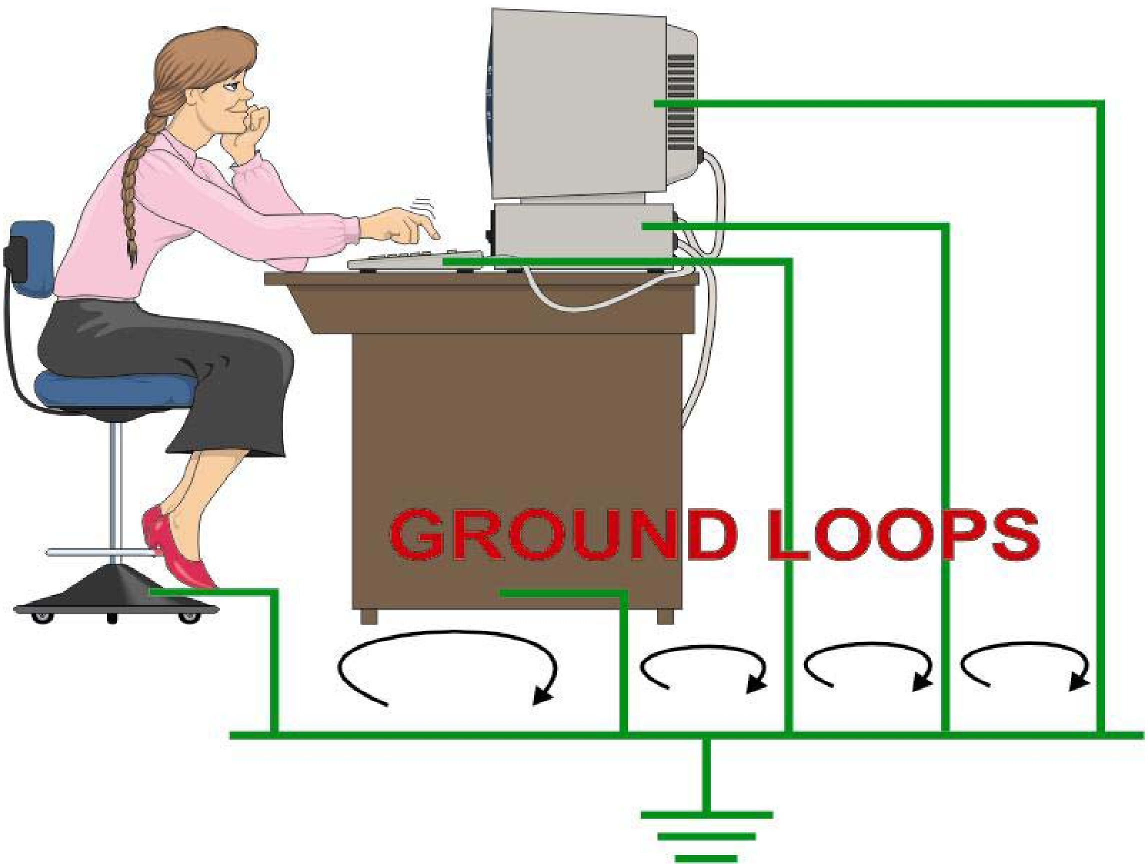
In a standard AC supply environment, all conductive parts are generally earthed to provide a safe, low impedance path for fault currents, allowing automatic supply disconnection devices, like fuses to operate in the event of a problem. For safety purposes there is a large amount of redundancy in an earthing system and as a consequence many earth current paths exist, some intentional and some un-intentional.



The electrical characteristics of these earth paths or ground loops will differ greatly; consequently voltages may be developed in the earth as a result of small leakage currents which tend to exist in electrical/electronic equipment. Coupled with this, these ground loops can act as antennae picking up high frequency interference. Typical problems associated with groundloops are ‘humming’ from audio equipment and vertical bars on CCTV screens.

The use of an isolation transformer provides a floating supply to equipment negating the effects of these earth voltages but it also acts as consolidation point, allowing multiple earth connection at one point, reducing the possibility of earth impedance mismatch.

Special environments, like medical locations require high quality transformers to provide isolation at low mains frequencies but also at high frequencies too, ensuring that potentially lethal leakage currents are kept to a minimum. This is achieved by having an electromagnetic screen between the primary and secondary windings to reduce high frequency capacitive coupling.