Use of an Isolation Transformer While Performing Leakage Current or Functional Run Tests

Associated Research strongly recommends the use of an isolation transformer or isolated power source for powering up the Device Under Test (DUT) when performing the Leakage Current or **Functional Run tests**. This white paper covers the various reasons for isolating the DUT power source during these types of tests.

Safety

First and foremost we need to always consider minimizing the operator risk for electrical shock during any safety testing. Using an isolation transformer or an isolated power source can greatly reduce the potential shock hazard for the operator. Some **Leakage Current** standards direct the operator to cycle the power switch of the DUT on and off. Contacting the DUT under an open ground condition could expose the operator to a potential shock hazard as the enclosure of the DUT can have a voltage induced on it that is referenced to earth ground. This could be hazardous since the operator is also grounded. For this reason it is suggested that an isolated power source be used to power the DUT. If the output of the power source is not earth ground referenced then the shock hazard from contacting the case of the DUT and earth ground is eliminated. Figure 1 shows a circuit that incorporates an Isolation Transformer which is the preferred method. The current leakage path to earth ground has been eliminated with the use of the isolation transformer. This effectively eliminates the shock hazard.

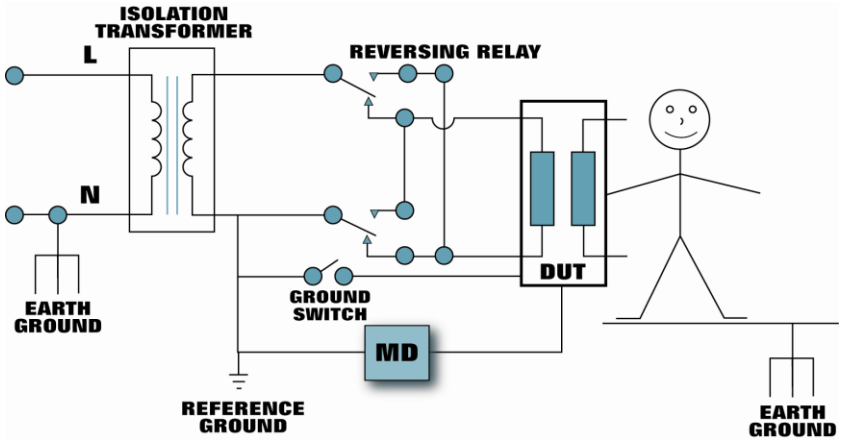

Figure 1

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Ground Leakage

Every DUT that is powered from AC line power is going to have a certain amount of leakage back to earth ground since power distribution systems are ground referenced. Much of the leakage seen during a Leakage Current test can be due to the distributed capacitance of the DUT and the applied voltage. Figure 2, shows a Leakage Current test circuit where the neutral is referenced to earth ground. With this configuration any internal leakage in the test instrument and fixture is added to the leakage of the DUT. Since most Leakage Current testers are powered from the line there will always be some internal leakage in the Measuring Device (MD) circuits. Associated Research has designed our testers to minimize the effect of this ground leakage but it is impossible to reduce this leakage to zero without isolating the DUT power source. Figure 3 shows the same test circuit but incorporates the use of an isolation transformer for DUT power. Performing the test in this manner greatly reduces the internal leakage making this a more accurate test.

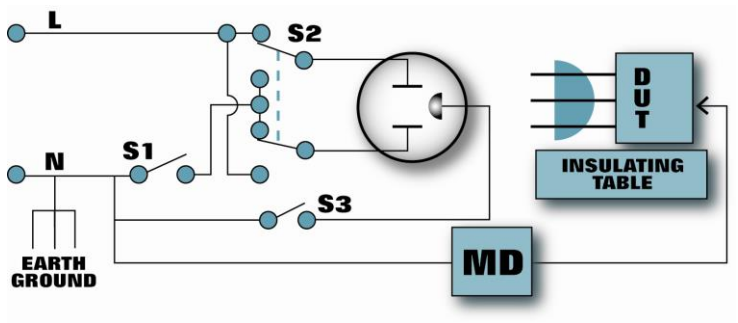

Figure 2: Enclosure Leakage Test Neutral Referenced to Earth Ground

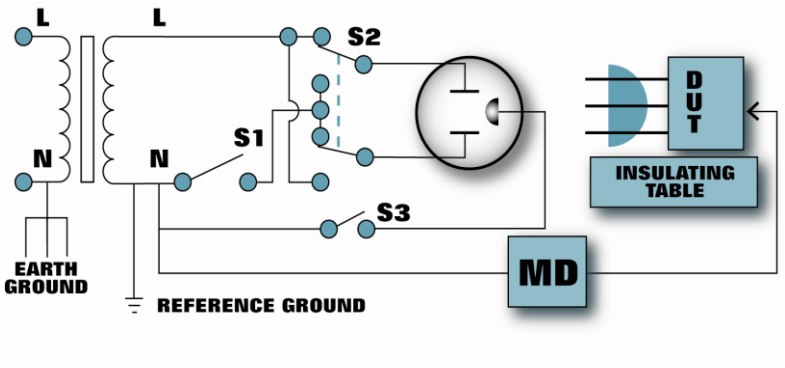

Figure 3: Enclosure Leakage Test Isolated Input, The Output of the Isolation Transformer is not Referenced to Earth Ground

Over-Voltage

When performing a Leakage Current test many product safety standards require manufacturers to apply a test voltage that is equal to 110% of the specified input voltage for the DUT. Obviously if the DUT is simply plugged in to a wall receptacle then the line voltage is not variable and this requirement cannot be met. For this reason in order to meet this requirement of testing at a slight over-voltage the DUT would have to be powered by a power source with a variable input.

NOTE: Many of the diagrams shown in the safety standards show the neutral side of the line as a ground reference point. This does not mean a connection should be made between the neutral and the common earth ground. If you were to connect the neutral of the power source or isolation transformer to earth ground you would in effect be defeating the entire isolation of the circuit. These illustrations in these specifications simply point out that the neutral side of the line is the ground reference point for your leakage measurements for some of the tests that are required, it is not an earth ground reference.

Test Instrument Protection

Finally we are recommending that an isolation transformer or an isolated power source be used as the source of supply for powering up the DUT whenever a Functional Run test or Leakage Current test is being performed at the same test station as the Hipot test. This is a precautionary recommendation

to provide protection for the Hipot tester that may be inadvertently connected to the DUT while line power is applied. It is possible that the return circuit on a Hipot tester can be damaged when left connected to the DUT during a test when a line to ground fault condition exists. The return circuits of a Hipot tester are not designed to carry the high fault currents that can exist when a line to ground fault condition occurs during a line powered test. In many cases the return circuit of the Hipot tester may actually be the low resistance path for the fault current to flow back to ground. Another way to avoid this is to always perform the Hipot test prior to a Functional Run or Leakage Current test. The Functional Run or Leakage Current tests should only be performed after a Hipot test has successfully been completed, as the Hipot test will detect line to ground faults before line voltage is applied to the product. In addition we recommend when using multi-function instruments that include the capability to bypass failures on multi-step tests that this function be de-activated so that the instrument will not advance from a failed Hipot test into a Run or Leakage Current test where a line to ground fault could have caused the Hipot failure. These techniques in addition to the use of an isolated power source will help to avoid blowing fast acting fuses that are built-in to the product design to protect the instrument from the high in-rush current that can result from a line to ground fault.