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Application note

Portable appliance testing – Testing surge protected equipment

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Why is surge protection fitted?

Surge Protection Devices (SPDs) are fitted to electrical installations and equipment to help prevent damage from an electrical surge or transient.

A surge or transient on an electrical supply is the presence of an over-voltage condition, usually for a very short duration, of significantly higher voltage than the working voltage, see fig 1. Very short over voltage conditions are also referred to as spikes.

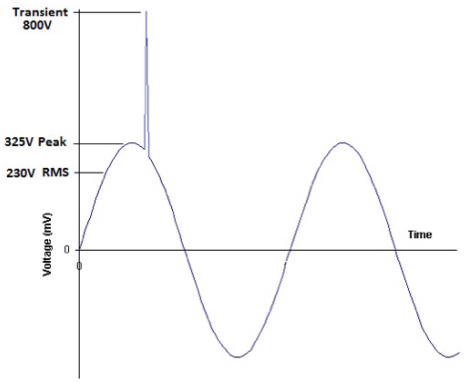

Figure 1.

Surges or transients can be produced by external and internal sources.

External sources include the rare case of a direct lightning strike or more commonly induced by lightning near to an electrical network. Other sources include utility switchgear, tap changing, re-closure operations or even from neighbouring businesses on the same supply.

Internal sources are usually more common and can be generated by machinery, florescent lighting switching on or off, contact arching, static electricity etc.

The surge can be very short duration, often a few microseconds or less.

Single large transients can cause failure of electronic equipment, premature tripping of RCDs etc. Multiple transients can also degrade contacts, damage fluorescent lighting etc.

Surge Protection Devices (SPDs)

These devices are now commonly fitted to various locations in an electrical system. They are designed to operate when a supply voltage exceeds a pre-defined threshold, clamping the maximum voltage on the circuit to safe levels.

Unlike RCDs, MCBs or RCBOs which protect against over-current conditions and respond quite slowly (10s of milliseconds and up to 5 seconds) SPDs respond to an over-voltage condition instantly.

Surge protection levels:

Surge protection is graded by type (or level), depending on the protection it provides and consequently its location in the electrical supply, as below:

Type 1: Fitted to the building main incoming supply.

Type 2: Usually fitted in electrical distribution boards.

Type 3: Fitted close to the devices to be protected, in electrical apparatus or in cables and extension leads

Level 1 and 2 SPDs are not found within the scope of portable appliance testing.

Level 3 devices do present testing issues for portable appliance testing, as the surge protective device (SPD) exist to prevent over voltage conditions. These are the same conditions as when performing an insulation test at 500V.

Most commonly fitted are Metal Oxide Varistors (MOVs) and Gas Discharge tubes. These are placed between the L & Neutral conductors, the Live and Earth conductor and the Neutral and Earth conductor, as shown in figure 2 and 3below:

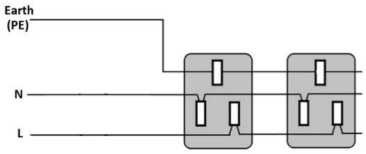

Figure 2.

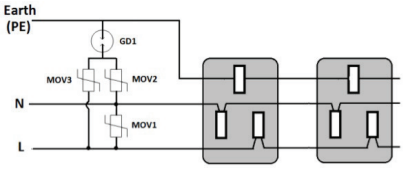

Figure 3

Under normal operating voltages the SPD components appear as an open circuit. However, when a transient appears across the Live to Neutral pair, MOV1 will start to conduct, clamping the voltage to that designed into the MOV. Likewise if the transient appears across the L to E or N to E pairs MOV2 or MOV3 and the Gas Discharge tube will conduct and clamp the voltage.

These devices are designed for short (transient) operation. If the high voltage continues for a long time, the protection components can become hot or even fail.

Testing equipment fitted with SPDs

The portable appliance test that is affected by the presence of SPDs in the insulation test.

The recommended test voltage for an insulation test is 500 V. For this test the PAT will short the Live and Neutral conductors of the "equipment under test" together and apply 500 V between the LN pair and Earth, see figure 4 below. The PAT is looking for any leakage current down to earth.

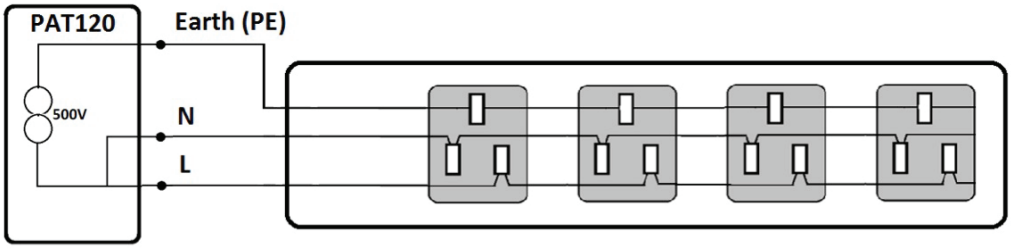

Figure 4.

For the unprotected extension lead in figure 4 above, the result of the insulation test would normally be much greater than 1Mohm and often greater than 99.0 Mohms as there is an open circuit between LN and Earth.

On SPD protected equipment the protection sits across the Live Neutral and Earth circuit as shown in figure 5 below. When 500V is applied, the protection will start to conduct current down to earth and clamping the test voltage. The PAT measures the leakage current to earth and the result is a low insulation test value, typically around 0.2 Mohms.

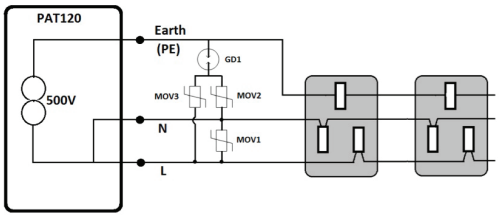

Figure 5.

Although the insulation test runs for several seconds no damage is caused to the SPD components as the insulation test is limited to only 1 to 2 mA.

By selecting a test voltage of 250 V volts, the surge protection devices will appear as an open circuit and do not operate. The PAT tester will not detect any leakage current and would normally return an open circuit measurement of at least 1.o Mohms and often greater than 99.0 Mohms.

Portable appliance testers without the 250V insulation test option cannot determine if a low insulation test result is caused by the presence of SPDs or is a genuinely faulty device.

Note:

Products that have good quality surge protection are usually marked with internationally accepted information describing the surge protection. This typically looks like:

Type 3	= Type of surge protection	(Type 1,2 or 3)
Voc	= Open circuit impulse test voltage	(typically 4kV for type 3)
Vp	= Voltage protection level	(typically 1kV)
Vc	= Maximum continuous voltage of the equipment)	(maximum continuous operating voltage

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