Reinforced insolation testing on a power supply.

Abstract: With the introduction of the EN60601 3rd edition, some aspects of the creepage and clearance requirements is now open to interpretation. The terminology has now moved away from a series of specific dielectric strength values and spacing distances between parts of the product to a Means of Protection (MOP). As a result of this the Excelsys Technologies Application teams have identified some possible avenues of confusion for our end customer base. This document will assist with the interpretation of the existing specifications, and outline how to best implement this test in a production facility with the end customer's application.

Dielectric Withstand Test:

The Dielectric Withstanding Voltage test is used to determine the ability of the installed equipment to protect against electrical shock. The dielectric withstand voltage test is typically referred to as a hi-pot test. The testing involved is to apply a high voltage between the points being tested and the resultant leakage current is measured.

Fig 1 shows the various isolation levels on a the Xgen series. These levels will typically apply to any generic power supply.

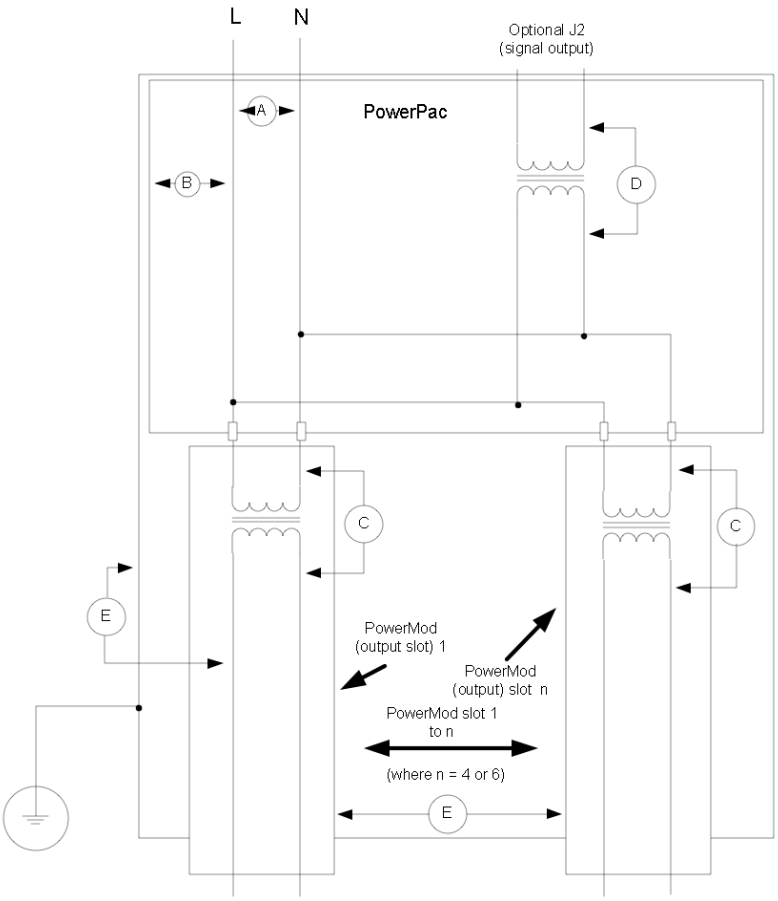

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Fig 2: Note Xgen = PowerPac + PowerMod

When testing from primary to secondary circuits, it is possible to overstress the basic insulation. Basic insulation is defined as the insulation used between primary or secondary circuits and ground. The higher voltages specified for primary to secondary tests will overstress the basic insulation, which is intended to support only 1500 V. This can result in a catastrophic failure of the unit.

Most low-voltage secondary circuits are connected to ground. With the secondary circuits grounded, the hi-pot voltage is unavoidably applied from primary circuits to ground. When the unit is fully assembled, both the PowerPac and PowerMods are earthed to the chassis. On a finished power supply it is not possible to conduct a 4kV AC isolation test from Primary to Secondary. This may lead to a catastrophic failure of the unit. (However Arcing across spacing from primary circuits to ground under these conditions does not constitute a failure of the reinforced insulation.) We also expect that any other power supplies will also face the same issue. This is not limited to the Excelsys designed parts.

How to test:

All safety testing can be categorised into three distinct groups

1. Type Testing.
2. Production testing by Power Supply vendor.
3. Production testing during end customer production.

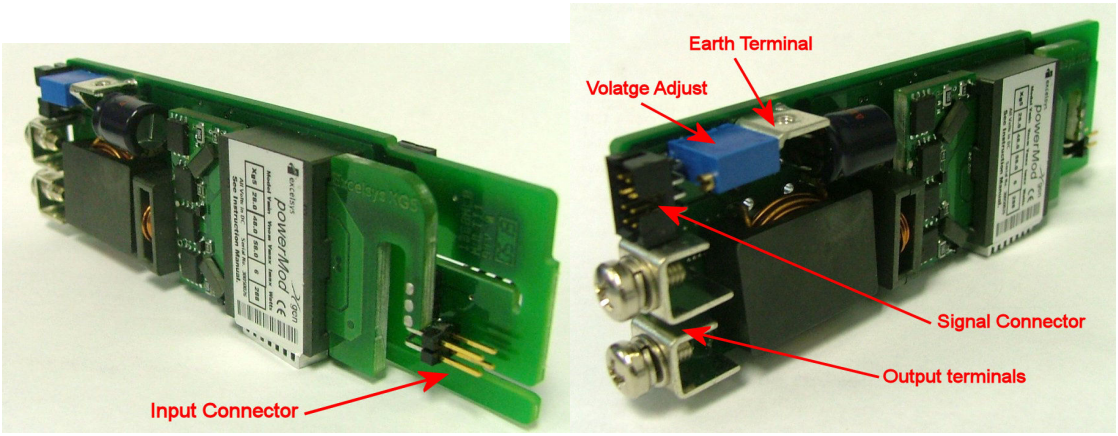
Type Testing:

This is the testing that would typically be carried out by a safety test agency. In doing so, the safety agency is attempting to determine if the construction and design of the power supply meets the relevant safety standard. Here the safety agency can take one of two approaches. A DC equivalent of the peak AC voltage can be used to test the dielectric breakdown in lieu of the 4kV AC. Now, the voltage stress across the capacitor divider chain is removed, and we do not see an electrical overstress occurring during this test, Alternatively since it is a ‘type’ test, you are permitted to remove all components which form a path to chassis ground, in this case the Y capacitors. The PCB would typically be removed from the chassis during this test also.

Production testing by Power Supply vendor:

This will be carried out on a production line during the manufacturing process of the power supply. As previously discussed above, reinforced insulation testing cannot be carried out without overstressing basic insulation in the end product. As a result of this the standard allows for the testing of reinforced insulation separately. Power supply manufacturers are permitted to test the insulation prior to incorporation into the product. Transformers, opto-couplers, PCB’s and so on can be tested independently prior to insertion during the manufacturing process.

As part of our strict quality control, we at Excelsys Technologies undergo a 100% isolation test across the isolation barrier on all PowerMods. Under this process we apply a hi-pot test to across the primary to secondary isolation barrier, which is located on each of the PowerMods.



Safety Tests:

Test Name	**Hi-Pot (Input to Output)**
Settings	Connect all four input pins together. Connect Vout+, Vout- and earth together.
Method	Apply test voltage 4400Vac 50Hz for 1 second between input and output. Measure leakage current Ileak.
Result	Ileak
Pass criteria	Ileak <= 1mA

Production testing during end customer production:

In the event of a customer or safety agency wishing to carry out any isolation testing in their system, in particular from primary to secondary, then further items will need to be considered.

As previously discussed, when testing from primary to secondary circuits, it is possible to overstress the basic insulation. The higher voltages specified for primary to secondary tests will overstress the basic insulation, which is intended to support only 1500 V. This can result in a catastrophic failure of the unit.

Once again, this is covered in the 60601 3rd edition, section 8.8 Insulation / 8.8.3 Dielectric Strength in the Test Conditions paragraph it is stated that

'Alternatively, a d.c. test voltage equivalent to the peak value of the a.c. test voltage may be used.'

Conclusion:

In order to meet this customer demand of being able to verify this as part of the production process, Excelsys is pleased to announce the improved performance of the Xgen series. This improvement has been solely optimized so that a fully configured unit can now withstand the DC peak equivalent of the 4kV AC isolation test from primary to secondary. *(Note: Refer directly to UL60950-1, C5.2.2 or UL60601-1 2nd Edition Section 20.4 or IEC60601-1 3rd Edition Section 8.8.3 for more information.)* In choosing this product range an in-situ DC voltage of 6kV can be applied across the isolation barrier of a fully assembled power supply. This will directly address the growing demand from customers to verify the isolation barrier on their application without causing an electrical stress on internal components. When testing as a complete power supply or system the Customer must use the DC equivalent of 4kV AC, which is 5.6kVDC. (For margin the Xgen series have been designed to withstand a 6kV DC test.)

Excelsys Technologies Ltd. is a modern world-class power supplies design company providing quality products to OEM equipment manufacturers around the world. This is achieved by combining the latest technology, management methods and total customer service philosophy with a 20 year tradition of reliable and innovative switch mode power supply design, manufacture and sales. If there are any further points you wish to discuss from this paper please contact support@excelsys.com.