What to look for in your next power supply

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Choosing the right power supply design is imperative for an overall successful product. With the ongoing goal of increased density, reliability and efficiencies, power ratings need to be reviewed carefully. Product life, temperature, input voltage, load and cooling are vital considerations as is meeting standards for safety, EMC and regulatory environmental impact compliance. Today's power supplies must meet stringent safety requirements and performance testing adhering to various standards such as,IEC60950 or IEC60601-1 3rd edition for medical devices, as well as meeting various requirements for industrial applications such as EN and IEC standards for EMI/EMC, RoHS compliance and CE mark, among others (Figure 1).

This article will discuss how when selecting an AC or DC power supply – either off the shelf or custom – designers must consider the specific performance criteria suitable for their application when defining IEC61000 EMC requirements.

EMC compliance requirements
EN61000-3-x set limits and measurement methods for low frequency emissions on the AC mains while EN61000-4-xx set limits on susceptibility or immunity of the equipment powered from AC mains. The following are typical emissions and immunity requirements for industrial electronic equipment such as ITE and medical devices.

Limits for Harmonic Current	IEC61000-3-2
Limitation Voltage Fluctuation/Flicker	IEC61000-3-3
High Current Voltage Fluctuation/Flicker	IEC61000-3-5
Electrostatic Discharge Test	IEC61000-4-2
Radiated RFI Immunity	IEC61000-4-3
Electrical Fast Transients/Burst	IEC61000-4-4
Mains Surges	IEC61000-4-5
Conducted RFI	IEC61000-4-6
Harmonics and Inter-Harmonics	IEC61000-4-7
Mains Frequency Magnetic Field	IEC61000-4-8
Pulsed Magnetic Field	IEC61000-4-9
Damped Oscillatory Magnetic Field	IEC61000-4-10
Supply Voltage Dips and Interruptions	IEC61000-4-11
Oscillatory Waves Immunity	IEC61000-4-12

An important requirement to review and specify for your product is to define the performance acceptance criteria. It is not enough to just state the IEC standard. There are four levels for acceptance criteria and you need to be clear on the level that is acceptable for your application.

Acceptance criteria:
1) Normal performance within the specification limits
2) Temporary degradation or loss of function or performance which is self-recoverable
3) Temporary degradation or loss of function or performance which requires operator intervention or system reset, 4) degradation or loss of function which is not recoverable due to damage of equipment or software or loss of data. In all cases, equipment shall not become dangerous or unsafe as a result of the application of the tests. The performance acceptance criteria can be different for the various levels of the test.

In this article we will focus on IEC61000-4-2 Electrostatic discharge.

The IEC 61000-4-2 standard defines four standard levels of ESD protection, using two different testing methodologies. Contact discharge involves discharging an ESD pulse directly from the ESD test gun that is touching the device under test. This is

the preferred method of testing. However, the standard provides for an alternate test methodology known as air discharge for cases where contact discharge testing is not possible. In the air discharge test, the ESD test gun is brought close to the device under test until a discharge occurs. Although this is an alternate method, it is not intended to imply that the test severity is equivalent between the test methods.

Test levels: EN61000-4-2

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Level	Relative Humidity as low as	Antistatic Material	Synthetic Level material	Contact Discharge Test Voltage	Air Discharge Test Voltage
1	35%	X		2kV	2kV
2	10%	X		4kV	4kV
3	50%		X	6kV	8kV
4	10%		X	8kV	15kV

The ESD threat is divided into four threat levels depending on material and ambient humidity. Threat level 1 isconsidered the least severe while threat level 4 is the most severe.

• Levels 1 & 2 are reserved for equipment which is installed in a controlled environment and in the presenceof anti-static materials.

• Level 3 is used for equipment which is sparsely but not continuously handled.

• Level 4 is required for any equipment which is continuously handled.

EN61000-4-2 power-supply considerations
Internal Type power supplies are meant to be handled only during the manufacturing process, as parts are installed in end equipment. Therefore the assumption might be that the power supply is to be designed for and tested to level 3. However, as internal power supplies are increasingly being designed into portable devices such as home healthcare equipment.Power supplies meeting the level 4 test parameters will provide, to the end system designer, a more robust power supply potentially allowing easier system compliance to level 4.
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External power supplies, however, are commonly handled frequently, and therefore it would be beneficial for engineers choosing an external power supply for use with their system to opt for a power supply compliant with level 4 test levels.

From both a technical and marketing (other power supply vendors already advertise level 4 compliance)perspective, it would be recommended that new products be designed and tested to the level 4 requirements.

An engineering analysis should be performed to ensure that there would not be significant unit cost adder in order for the power supply design to be compliant with

the more stringent standard, as well as a review of available test equipment to ensure that a significant capital equipment expenditure is not necessary.

From a power supply design perspective, designing a product to comply with the IEC61000-4-2 ESD requirements can be a challenge at the higher discharge voltages. This becomes even more challenging with a Class II AC input (two wire, no earth ground conductor). When the ESD discharge is applied to the output or signal pin, the voltage is developed across various isolating barriers and capacitors. This occurs because the AC mains arevirtually grounded at some point so applied ESD voltage appears between the point where the charge is applied and earth ground. Without careful consideration of the various discharge paths within the power supply, unexpected arcing and damage to the power supply can occur. Testing to the standard and providing a test report is some assurance that the product will perform well within the confines of the specification.

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