POWER ELECTRONICS

What Destroyed the Hindenburg can Ruin your Equipment

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Experts have concluded that Electrostatic discharge (ESD) caused the Hindenburg to ignite leading to the historic explosion. The Hindenburg, filled with hydrogen gas and having gone thru a thunderstorm, had built up static electricity. While the ship was being moored, ESD generated sparks, causing the flammable hydrogen gas to ignite and burn completely in 34 seconds. ESD is the release of charge from one object to another. While not as catastrophic as the Hindenburg, ESD can damage electronic devices. Hence, electronic equipment is tested to withstand ESD to a certain degree. These tests are spelled out in 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

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 is considered 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 presence of 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.

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 are virtually 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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