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Guide to EMC Standards for Power Supplies

Introduction:

EMC refers to **ElectroMagnetic Compatibility**. Electrical equipment that takes power from a distributed AC or DC source which is connected to other equipment, such as the AC mains in a building, has to have minimal influence on that source. It also has to have minimal influence on other equipment through electromagnetic radiation. A power converter which incorporates switching devices operating at high frequency needs to employ special means to keep the electromagnetic interference within internationally agreed upon limits. In general, electrical equipment has to operate in its environment with minimal disturbance to its environment. The limits to disturbances are defined by the international standards described below.

Types of Standards:

1) Generic Standards:

A top level standard for a type of equipment which encompasses specific basic standards in their references. The current relevant standard for power supplies is **EN61204-3: 2000**. This covers the EMC requirements for power supply units with DC output(s) of up to 200V, at power levels up to 30kW, and operating from AC or DC. source voltages of up to 600V. The **EN** refers to **Euro Norm** or European standard. Europe has led the field in establishing standards for EMC and many other areas which have been adopted worldwide, with some local deviations.

2) Basic Standards List:

The relevant basic standards called up in **EN61204-3** are:

EN55022 and EN55011. Conducted and radiated electromagnetic interference emitted by the power supply. This is also known as CISPR22. The FCC has similar standards in the USA. There are two levels for the emission limits, Class A and Class B. Class B is normally required which puts a lower limit on allowed emissions.

EN61000-4-2. Immunity to electrostatic discharge.

EN61000-4-3. Immunity to radiated radio frequencies.

EN61000-4-4. Immunity to fast transient voltages on the input lines.

EN61000-4-5. Immunity to lightning surges on the input lines.

EN61000-4-6. Immunity to conducted radio frequencies.

EN61000-4-8. Immunity to power frequency magnetic fields.

EN61000-4-11. Immunity to damage from input line voltage reductions.

EN61000-3-2. Limits to the harmonic currents that can be taken from the input line.

EN61000-3-3. Limits to the voltage fluctuations that the power supply can cause to the line input voltage.

3) Performance Criteria:

In immunity testing, there are four classes by which passing or failure are assessed.

Class A. No loss of function or performance due to the testing.

Class B. Temporary loss of function or performance, self recoverable.

Class C. Loss of function or performance which needs intervention to restore.

Class D. Permanent loss of function or performance due to damage. This would always represent a failure.

Basic Emissions Standards

EN55022 (IT equipment), **EN55011** (Industrial equipment), and FCC Class A or B (in the USA):

Conducted and radiated emission limits.

Conducted EMI (electromagnetic interference) is radio frequency energy that the power supply couples into the input power lines. The power supply input incorporates filtering to reduce the conducted emissions as necessary. The radio frequency noise is measured between 150kHz and 30 MHz using a spectrum analyzer or special receiver.

Radiated EMI is radio frequency energy emitted from the enclosure and input and output wiring of the power supply and is measured in the 30MHz to 1,000MHz frequency range. The measurement is usually performed at an "open" site which is an open air location selected to be in a radio frequency quiet zone where television and radio transmissions are weaker. The unit to be tested is placed on a wooden table above a large ground plane 10 meters away from a suitable receiving antenna connected to a spectrum

analyzer.

EN61000-3-2

Puts limits on the harmonic currents that the power supply is allowed to take from the AC mains source. The standard applies to power supplies with rated power between 75W and input line current of up to 16 amps per phase.

A power supply which is not power factor corrected will take a current from the source which is not the same shape as the voltage waveform. This is because the input storage capacitors can only charge when the input voltage is higher than the capacitor voltage. Thus the input current flows for only part of the cycle, and has a high peak value which causes currents which are harmonics of the line frequency. With three phase power distribution the absence of harmonic currents ensures that the neutral current is zero. This was not the case when large numbers of personal computers without power factor correction began to be used in office buildings, and the neutral wire would burn out. Most power supplies now incorporate power factor correction circuitry to ensure that the harmonic currents are low.

EN6100-3-3

Limits voltage changes that the unit under test can impose upon the input power source. This is referred to as the flicker test.

Although this is not normally a problem with power supplies, some types of electrical equipment, especially in process control, can load the power source at regular or semi-random intervals. This can cause voltage changes that can affect the brightness of electric lighting and cause flicker. A survey was performed to determine what rates of flicker were the most disturbing to human subjects, and a curve of maximum percentage voltage variation at various frequencies was established. The most disturbing rate was just over 1,000 changes per minute, and the curve reflects the smallest percentage change at this frequency. Above 1,800 changes per minute the flicker is not noticed.

Basic Immunity Standards

EN61000-4-2

Tests immunity to electrostatic discharge from a simulated human body capacitance of 150pF. By walking across a carpet of artificial fiber in a low humidity condition, a person can build up a charge of several thousand volts. This can be discharged to electrical/electronic equipment, and so it is important that the equipment is immune to these discharges. The test is performed at a voltage of up to 8kV by discharging a probe to the chassis at various locations by direct contact, and at up to 15kV through the air, with the power supply operating. Test levels of 4kV and 8kV are common. Class B performance criterion applies.

EN61000-4-3

Checks immunity to incident radio frequency energy in the frequency range of 80MHz to 1,000MHz, and a separate test at 800 MHz to 960MHz to simulate the effect of digital cellular telephone transmissions. The test is performed in an anechoic chamber which is a shielded room with cone shaped plastic moldings on the inside wall surfaces which absorb radio frequency energy, so there are no echoes. The field strength is 10V/m for the carrier. Class A performance criterion applies.

EN61000-4-4

Tests the effect of a fast voltage transient or burst applied between each input line and ground in turn. The applied voltage has a peak level of 2kV, and rises to maximum in 5 nanoseconds, and falls back to zero in 50 nanoseconds. It is applied at a repetition rate of 5kHz. Class B performance criterion applies.

EN61000-4-5

Simulates the effect of a lightning surge voltage applied to the input power lines. Surge voltages are applied between each line and ground, and also between lines. The line to ground peak voltage is normally twice that applied from line to line. 4kV and 2kV are typical test voltages. The voltage has a rise time of 1.2 microseconds, and a fall time of 50 microseconds. Class B performance criterion applies.

EN61000-4-6

Tests the effect of conducted radio frequency energy which is inductively coupled into the input cables with a ground return. The frequency range is 150kHz to 80MHz at 10Vrms amplitude, and the frequency is increased in 1% steps. The carrier is 80% amplitude modulated at 1 kHz. Class A performance criterion applies.

EN61000-4-8

Electromagnetic compatibility, testing and measurement techniques for power frequency magnetic fields. Criterion A, using Helmholtz coil at 50 Hz, to 30 amps (rms) per meter.

EN6100-4-11

Checks the effect of input voltage dips on A.C. input power supplies only.

There are three different degrees of test severity, a 30% reduction of input voltage for 0.5 period, a 60% reduction for 5 periods and a 95% reduction for 250 periods. For the first test, the unit should continue working with no change of output voltage because most units have a hold-up time of one period, which corresponds to 20 milliseconds at 50Hz. The other two tests will cause reduction or loss of output voltage, and intervention may be needed to restore the output. The unit should not be damaged by the testing. Class B and C performance criteria apply.

Posted by [Power Guy](#)