# Understanding the intrasystem when it comes to EMC

Electromagnetic compatibility (EMC) defines the ability of electrical and electronic equipment to operate acceptably when exposed to external electromagnetic sources and limiting internally generating unwanted electromagnetic energy. EMC covers three areas: limiting emissions generated by the equipment, its susceptibility to external sources and its level of immunity when functioning in its defined environment.

This white paper provides a comprehensive overview of EMC and discusses what electrical engineers need to bear in mind to minimise EMC issues in their applications.

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To begin with, EMC caused a large number of issues across a great number of industries and applications. Back in the early 1990s one of the most severe incidents of interruption of an auto pilot system by passenger electronics was from a portable CD player (1). Anyone who has flown will have been asked to put their mobile phone into flight mode. Rail network operators too have recorded numerous events due to electric trains causing issues with trackside signalling.

Since then, laws and standards have been introduced to address EMC but they vary by country. In the European Union (EU) manufacturers of electronic equipment have to state their compliance by labelling their product with the CE Mark to the EU Directive 2004/108/EC. A series of additional standards applies depending on the end application. For power supplies EN 55011, EN 55032 and EN 61000 are the most widely used standards used, which cover emissions and immunity. These in part refer to the standards of CISPR (International Special Committee on Radio Interference). In the US, FCC Part 15 is used to regulate “unlicensed” radio frequency (RF) transmissions. MIL-STD-461 is the US military standard for subsystems.

From an AC-DC medical power supply perspective, the manufacturer will be concerned about emissions and immunity. With the increasing amount of home healthcare devices operating out of the benign environment of a hospital, the medical standard EN60601-1-2 was recently tightened to reflect the severity of this.

Emissions take the form of conducted and radiated EMI (Electro Magnetic Interference). Conducted EMI is the electrical noise (0.15 to 30MHz) conducted back to the AC source which can affect other devices operating from that source. Radiated EMI is high frequency electrical energy (30MHz to 1GHz) generated by the power supply that can intrude into cables and signal lines, causing other devices to malfunction.

Immunity covers myriad aspects that could interfere with the power supply’s operating parameters. Unlike the emissions standards which have just two levels, Class A and Class B (more severe), the immunity standards have multiple test levels and performance criteria. The criteria for passing can range from

“performance within the specification limits” to “loss of function which is not recoverable”. The latter is not normally acceptable.

ESD testing (electrostatic discharge) ensures that if an operator or patient touches or even approaches a medical device and creates a static spark, the device will continue to perform. With a simple adapter (external) power supply, a failure could result by someone touching the LED indicator on the plastic case of the product. A discharge could pass through the LED and disrupt operation.

Radiated susceptibility tests that the product will not be affected by an external high frequency signal. For home medical devices, such as a dialysis machine, this may be from a nearby mobile phone or Wi-Fi router.

Electrical fast transient bursts could be caused by an air conditioning unit turning off or other devices being plugged in to the same AC outlet. Surge immunity is also tested, which could be caused by electrical storm surges on the AC line. These could be as high as 4kV.

Conducted susceptibility tests immunity to RF signals being injected into the power leads. A magnetic field test will show that the power supply can withstand external magnetic fields. These could even arise from operating a vacuum cleaner in the proximity of the equipment.

The AC supply voltage, although normally continuous, can be affected by outages for a limited amount of time. Voltage dips and interruptions are simulated ranging from 10ms to 5s. Although a typical off-the-shelf power supply is not expected to operate without power for more than a few milliseconds, it is expected to return to normal functionality after the outage occurs. The medical standard now refers to “essential performance”. To clarify, the designer/manufacturer has to determine if a loss of performance or functionality of their medical device product or system will result in an acceptable risk or an unacceptable risk to the patient or operator.

Many power supply products on the market only meet radiated and conducted EMI with external filtering and shielding, which may cause difficulty for the design engineer. This is especially true when the end equipment has to be operated without an earth ground connection (Class II) for applications like home healthcare. To help ease integration, TDK-Lambda recently launched several power supplies that require no external filtering and are certified for both the industrial and medical markets. For example, the 30 to 1500W CUS-M series complies with the most stringent Class B level for both conducted and radiated EMI.

EMC testing using external test facilities can be expensive when factoring in the cost of travelling, overnight lodgings and engineering labour. Many companies will own or rent equipment to make initial tests before going to a certified facility. The most difficult to test in-house is radiated emissions. Certainly one can create an OATS (Open Area Test Site) outside the factory, but unless one has access to a

remote location, with electrical power, surrounding buildings can interfere and create false readings. Local radio masts have been known to cause frequencies that require two sets of results, one with the device under test switched off and one with it powered up. In some circumstances, legislation is now requiring a certified test facility to be used.

To overcome these challenges, TDK-Lambda built its own ALSE (Absorber-Lined Shielded Enclosure) site, which houses a 3m fully automated and fully compliant anechoic test chamber, thus enabling the company to perform EMC test measurements in-house to the EN, CISPR and ANSI standards. Also onsite is a range of equipment to test power supplies to the immunity standards. This allows the company to qualify its power supply products without the need to use a third-party test house.

As technology, like 5G, the Internet of Things and the use of autonomous vehicles continues to advance and propagate into our ordinary lives, ensuring compliance is critical. Failure to fully address and test the end product for EMC may result in extended development times, significant expense, recalls and embarrassment for the manufacturer. Even with a fully compliant power supply, EMC issues with the end system may still occur. TDK-Lambda's Field Application Engineers frequently help OEMs meet the standards. Often the remedy is quite simple. Ensure that system ground points are correctly positioned, and that wiring harnesses do not pick up any pulse or surge energy from the AC input, which is transmitted to sensitive circuitry. Having a full suite of EMC test equipment in-house enables TDK-Lambda to provide OEMs a greater level of support.

For more information about TDK-Lambda, please visit: www.emea.lambda.tdk.com/uk

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**Reference:**

1) Taken from Compliance Engineering Spring 1993, page 92, itself commenting on an article in Time, Feb 22, 1993, www.ce-mag.com.

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Ref: 11/19 LA11733