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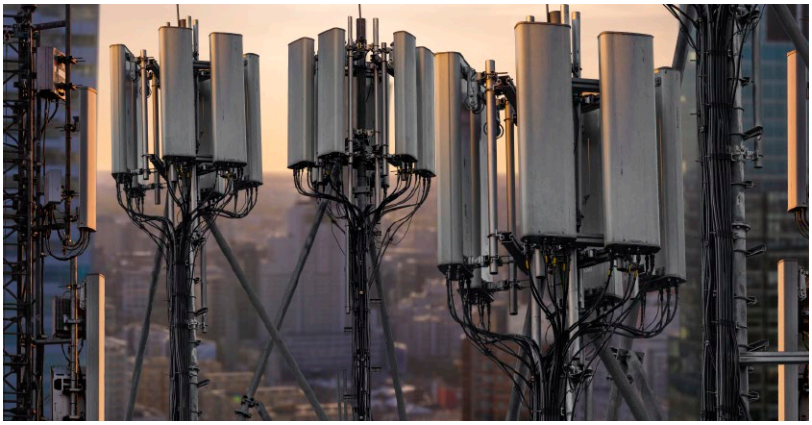
EMC & EMI

Unveiling the importance of power supply conformance to the EMI and EMC standards

TDK·Lambda

EMC & EMI – Unveiling the importance of power supply conformance to the EMI and EMC standards



Meeting the **Electromagnetic compatibility (EMC)** and **Electromagnetic interference (EMI)** standards is a legal requirement in many countries. Understanding the impact of selecting an AC-DC power supply that already conforms will reduce the risk of equipment failure, save cost and avoid product launch delays.

In this article, TDK-Lambda explores what EMI and EMC are and how to ensure compliance.

In today's world, finding any electrical product that does not use semiconductors that are powered by a battery or power supply is becoming more difficult. LED lights have replaced incandescent bulbs in buildings, vehicles, street lighting, and backlights for TVs, monitors and computers. A smartphone has more computing power than the mission used to put the first man on the moon. **With all this technology comes the risk of electrical interference from one product, causing a malfunction in another.**

Electromagnetic compatibility is the ability of an electrical or electronic device to operate acceptably when exposed to electrical noise and magnetic fields from other devices.

The term 'operate acceptably' provides guidance regarding the impact on a product's performance during an exposure. Legislation has been introduced to ensure compliance with EMC standards to avoid the risk of harm, serious injury or malfunctions.

Electromagnetic interference emissions can be either conducted, passing along the AC or DC source, or radiated as high frequency (30MHz to 1GHz) energy, impacting cables or signal lines. Either one of these could cause another device to malfunction.

Immunity is the ability of equipment to withstand external electrical noise and magnetic fields. This can be the discharge of static electricity from clothing, transients from an oven turning on, or even the RF signal from a Wi-Fi router or smartphone. Immunity standards have test methods (see Figure 1), multiple test levels and performance criteria. These levels may be used to determine if a product is 'operating acceptably'. An LED light momentarily turning off and back on again during an electrical storm would probably be acceptable for example.

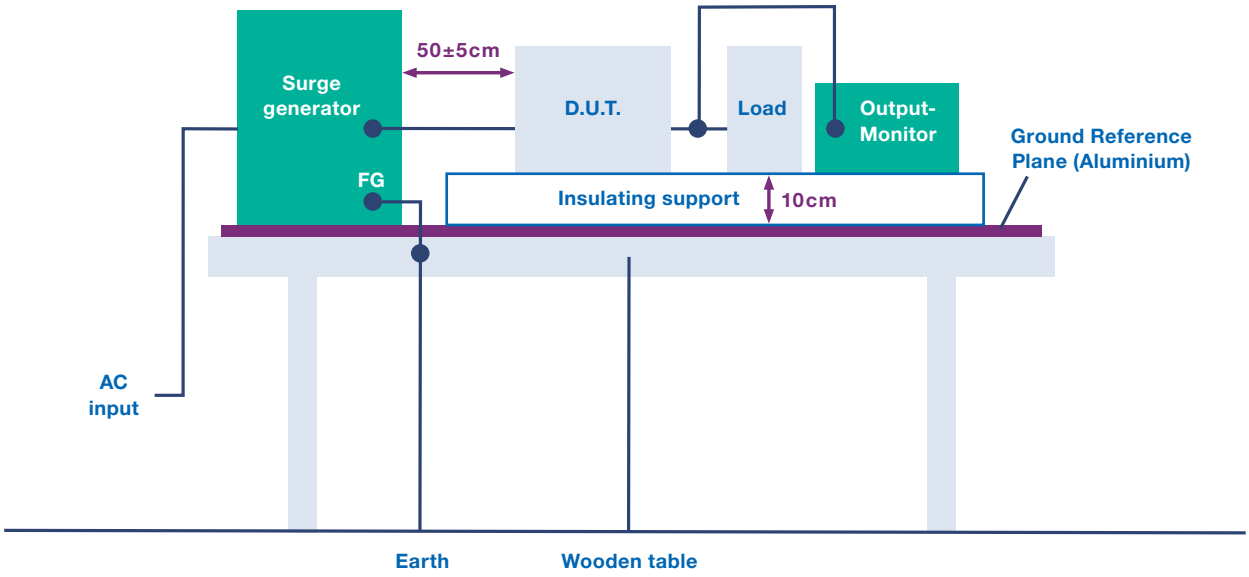
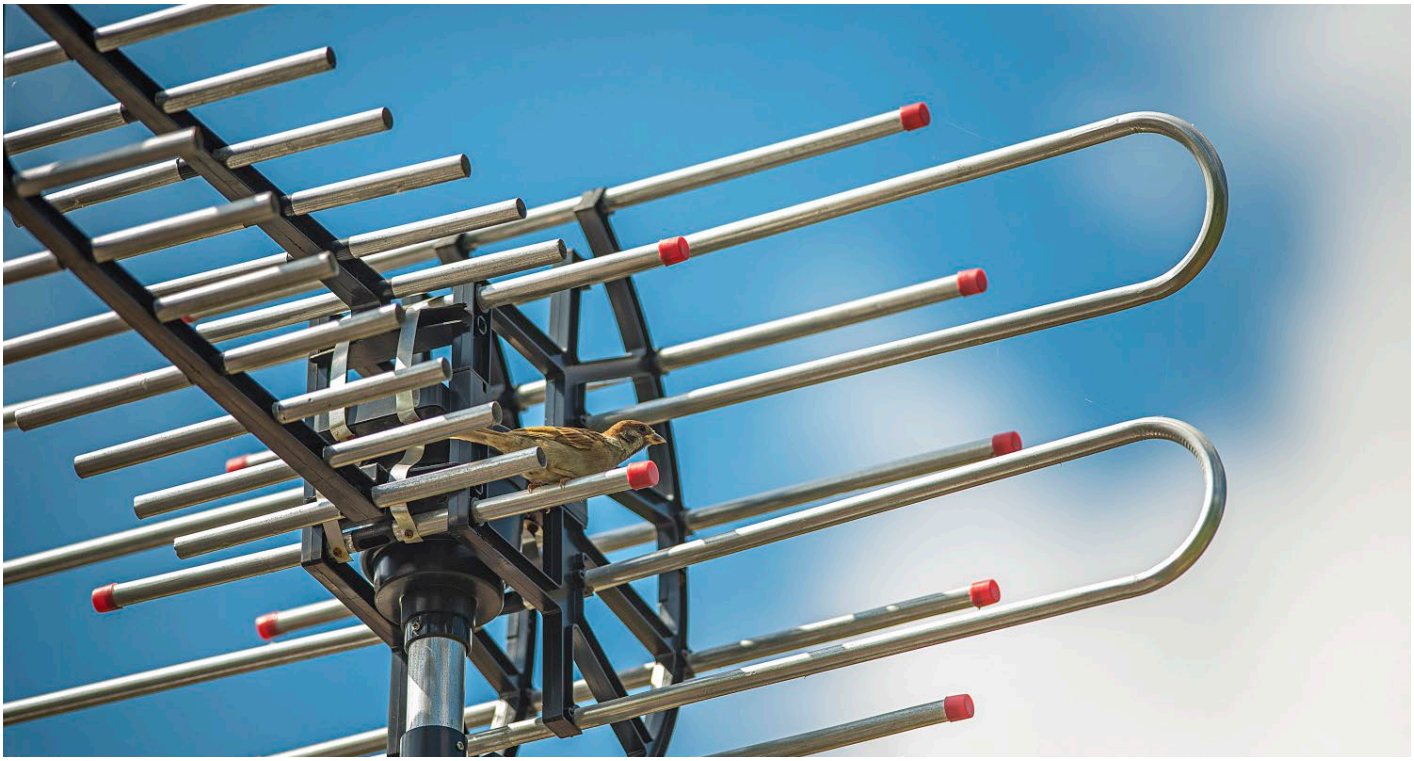


Figure 1: Test method for Surge Immunity Test (IEC61000-4-5)

The compliance and legislations vary between countries but follow common international standards. In the European Union (EU), electronic equipment manufacturers must declare their compliance by labelling their product with the CE Mark to the EU Directive 2004/108/EC. Documentation has to be available to provide proof that testing has been conducted. In the UK, the UKCA mark refers to Electromagnetic Compatibility Regulations (2016). The Federal Communications Commission (FCC) is responsible in the United States.

For power supplies (and many other products), **EN 55011, EN 55032 and EN 61000 are the most widely used standards**, primarily for sale and importing into Europe, which cover emissions and immunity. These refer to the parts of the International Special Committee on Radio Interference (CISPR) standards. In the US, FCC Part 15 regulates 'unlicensed' radio frequency (RF) transmissions, and MIL-STD-461 is the military standard for subsystems.



With the rise in home healthcare treatment, medical devices no longer operate in the benign environment of a hospital, with staff on-hand 24 hours a day. A home dialysis machine, for example, could be subjected to electrical noise and magnetic fields from a range of household appliances and toys. The consequence of this possibility has led to the tightening of the IEC / EN 60601-1-2 medical standard.

Provided an AC-DC power supply has been correctly tested to the immunity standards, there is a minimal risk that a system will fail compliance. Manufacturers should have their test results posted on their website or available upon request. Many of the power supply related 'failures' are due to poor system wiring practices, which leads to electromagnetic coupling. To avoid this, engineers must ensure that the AC input wiring remains as short as possible, routed away from the power supply and separated from the output and any internal signal cables. Multiple earth grounding points in the system enclosure can also generate issues. It is advisable to have just one earth ground point and, again, keep cable lengths at a minimum.

A successful EMI test will rely not just on the power supply meeting the applicable standard, but also on any other high-frequency generating devices in the system. TDK-Lambda EMEA's EMC and Field Application Engineers often assist customers with EMI advice and have seen USB connections cause a significant test failure.

Again, power supply EMI test reports should be available from the manufacturer.

Table 1 shows some of the results for the TDK-Lambda CUS250M power supply.

0.55MHz measurement

Reference data	Limit (dBµV):	Measurement (dBµV):
Quasi Peak	56.00	49.76 (6.24 margin)
Average	46.00	33.01 (13.01 margin)

Table 1: CUS250M EMI margin (>6dBµV)

These figures disclose the amount of margin the power supply is below the limit of the standard, a plot of the noise (Figure 2) and the test set-up (Figure 3).

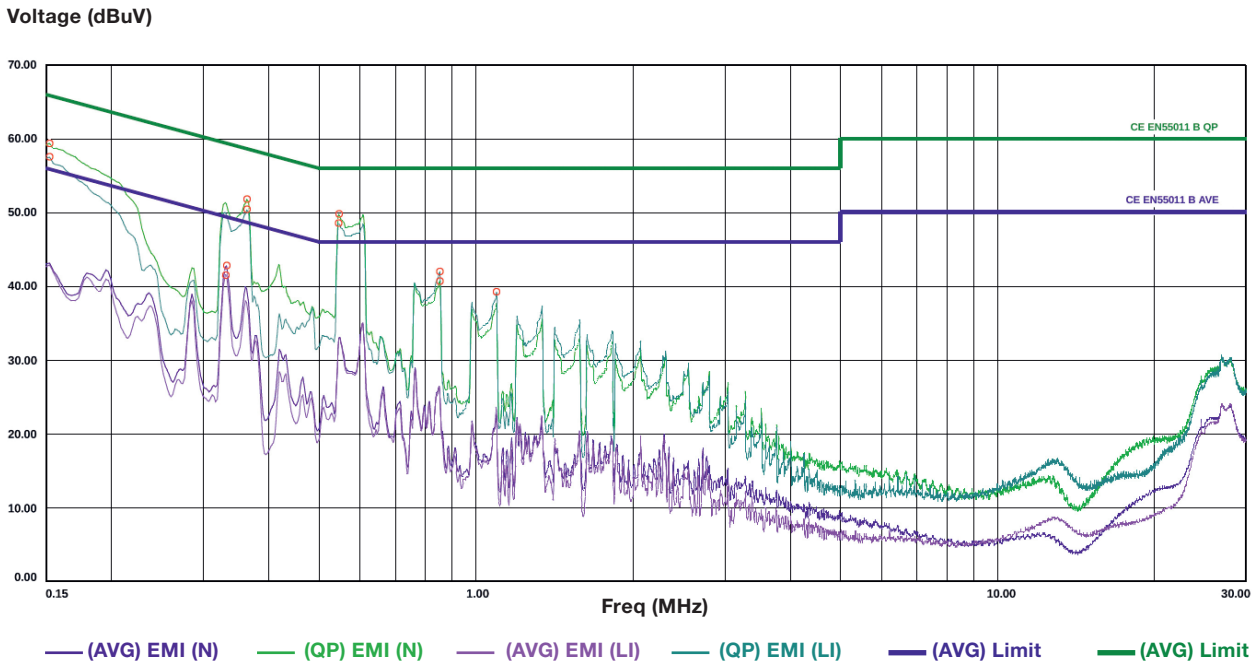


Figure 2: CUS250M EMI plot

A 3dB margin is recommended; a 6dB margin might not sound very much, but on a logarithmic scale that is half the level of electrical noise. The CUS250M achieved the margins due to a patent-pending output terminal/inductor combination to reduce common mode noise. To reduce EMI, a custom ferrite core was designed for the power factor correction (PFC) circuit. Importantly, significant care was taken in the printed circuit board (PCB) layout.

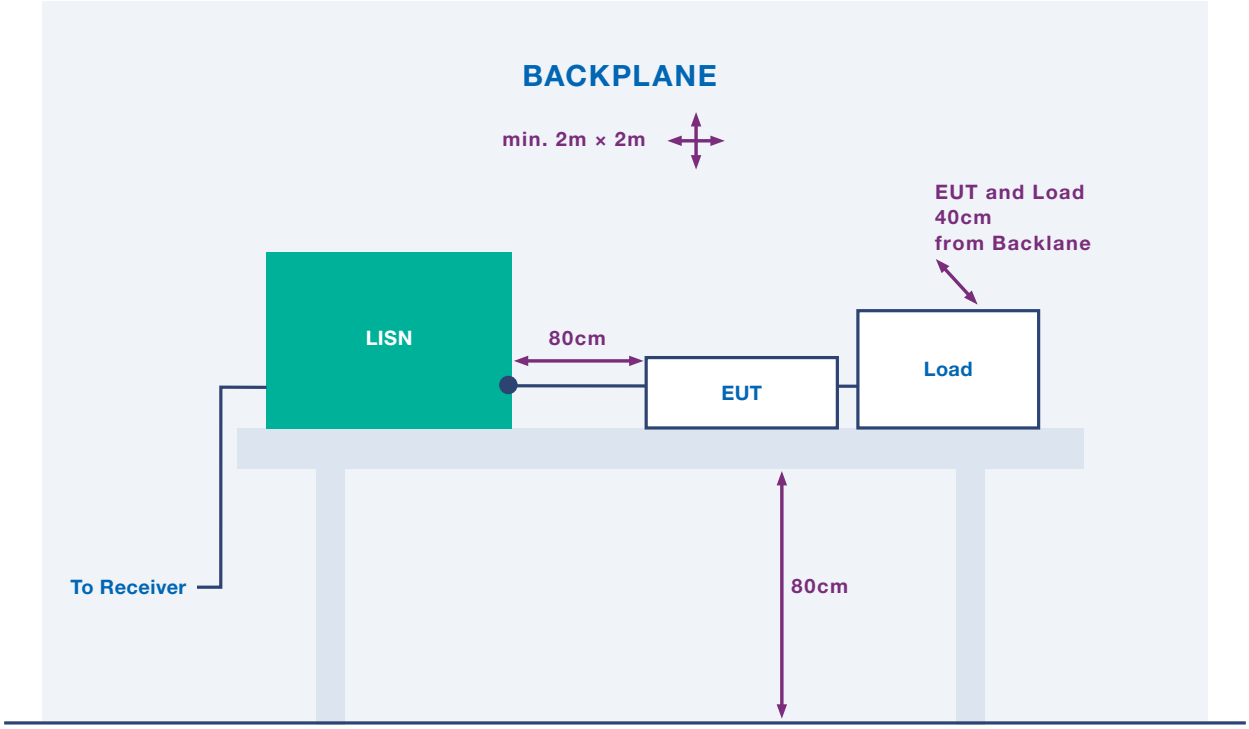


Figure 3: EMI test set-up

Lower cost power supplies often have significantly lower margins or fail to meet the standards as a stand-alone product. An additional external filter or filtering may be required to achieve the legal limit, or ferrite cores may be added to the wiring to suppress the conducted electrical noise. Metal shielding may have to be added around the power supply to meet the radiated noise limitations, potentially causing thermal problems. The extra engineering time required to solve this may delay the product launch, leading to a loss of revenue. Additional shielding also increases the system material cost.

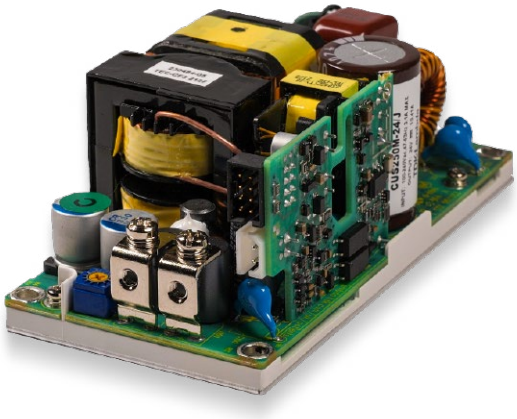


Figure 4: TDK-Lambda CUS250M 250W rated power supply

Companies like TDK-Lambda develop their products to make design engineers' lives easier.

Engineers should evaluate power supplies with good EMC/EMI performance. These wider margins simplify their integration into the end application, leaving additional time to solve issues with other noise-generating components in their application.

TDK-Lambda Corporation

At TDK-Lambda, a “Power Supply” is more than just an electronic device. It is the “heart” of our customers’ systems and the core element of safety and reliability.

Since 1948 as a leading global manufacturer we have been developing and producing innovative and highly reliable power supplies for a wide spectrum of applications. TDK-Lambda offer a broad range of AC-DC power supplies, DC-DC converters, programmable power supplies and EMI / EMC filters.

In addition, with our unique range of activities from research and development through to manufacturing, sales and service, our customers appreciate our experience, know-how and our passion for always wishing to find the best solution for our customers.

More about our complete range of power supplies you can find in our Power Supplies brochure. If you have specific questions about the use of power supplies, please do not hesitate to contact us. Our team of experts will be happy to help you find the best power supply for your application.

Contact

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In any event, we are here to support and assist you.

Author
David Buck, Product Manager

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