

RESOURCES

The Importance of EMI and EMC Testing

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Electromagnetic emissions can affect the functioning of electronic devices, electrical systems, and radio frequency (RF) systems. Since the electricity in a circuit is never entirely contained, all electronic devices emit some level of electromagnetic radiation. This means any device could potentially generate disruptive electromagnetic fields and may be vulnerable to the emissions of other electronics and electrical systems.

Before a final product is brought to market, the manufacturer must prove its compliance with Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) testing requirements. The testing helps ensure that new products under development can function as intended when used alongside current devices and systems in their shared operating environment. So, what is EMI and EMC in regards to the regulatory testing of electronic components and equipment?

Electromagnetic Interference vs. Electromagnetic Capability

The terms electromagnetic interference and electromagnetic capability are often confused when it comes to the regulatory testing of electronic devices. They are commonly used interchangeably. However, it is best to have a basic, general overview of each term and the respective requirements.

Despite being related in many ways, EMI and EMC have different meanings and relevance to the testing process.



What Is EMI?

Electromagnetic interference (EMI) is defined as electromagnetic energy that disrupts the function of an electronic device, electrical system, or radiofrequency system.

Since EMI either can be radiated or conducted, engineers must test power supplies through comprehensive scenarios for both radiation and conduction. Radiated EMI, otherwise known as radio-frequency interference (RFI), travels in the form of radio waves. Meanwhile, conducted EMI comes from the electromagnetic field generated by another source. The current flow is accidentally carried along a cable from this other source to the tested device.

What Are EMI Sources?

The source of EMI sometimes can include electrical storms, solar radiation, and other natural occurrences. However, EMI sources generated by another electronic device or electrical system are much more common. All electronics emit EMI, though specific equipment and peripherals are more likely to produce such disturbances.

The most common EMI sources include:

Electronic devices that function at high frequencies, such as cellphones, radios, computing devices, radar, and sonar equipment.

Power generating or high voltage components and equipment, such as power supplies, switches and relays, generators, solar inverters, battery chargers, and voltage regulators.

Machines operating at high voltage and high frequencies, like motors, ignition systems, LED screens, and welders.

Most electronic devices are engineered to account for the presence of some amount of electromagnetic interference. As each device in an operating environment must function as intended without disrupting one another. It is crucial to ensure that a final product is shielded appropriately from EMI and only produces emissions below the defined limits.

What Is EMC Testing?

Electromagnetic compatibility testing indicates whether a device can exist harmoniously within its expected operating environment. The two facets of EMC testing include:

The device's ability to function as intended in the presence of disruptive EMI sources.

The device's ability to not produce additional EMI that disrupts the functioning of other electronics.

Comprehensive EMC testing scenarios evaluate whether a device will generate or be vulnerable to EMI in its environment. To ensure that a design will function correctly, engineers must protect components and equipment from some amount of electromagnetic radiation. Additionally, the circuits themselves must not generate emissions that can degrade the performance of other electronic devices. EMC testing is necessary to ensure these design specifications are met.

Why Should Power Electronics Always Undergo EMI and EMC Testing?



The EMI and EMC testing processes are essential when bringing a new product to market. Many manufacturers regard these tests as a long-term investment due to the multiple advantages:

Boosts reliability: EMC testing shows that a product is compliant with established requirements and regulations. This compliance increases the product's reliability, strengthening an engineer's confidence in their design and stimulating brand loyalty in consumers.

Improves safety: Historically, failure to correctly anticipate the EMC of a product has led to some disastrous consequences. EMC testing helps prevent safety risks, product failure, data loss, and other adverse events.

Reduces warranty issues: Different regulatory authorities have established compliance standards for electronic devices. Products cannot be recognized or taken to market unless all EMC testing requirements are met. Failing to consider EMC testing can lead to warranty issues.

Highlights potential issues: EMC testing provides early detection of any adverse interaction between the electronic device and the electrical system. Thus, potential problems are easier to correct and can be remedied before the device goes to production.

Reduces service costs: Sophisticated EMC testing equipment can provide long-term service and manufacturing benefits for the product. By increasing reliability and revealing potential issues early, the device will have less risk of unexpected maintenance and lower service costs.

What Does the EMI and EMC Testing Process Look Like?

The typical EMI and EMC testing procedure includes three essential stages — determining what standards apply to the product, performing pre-compliance testing, and choosing an accredited EMC test lab.

1. Determine What Standards Apply to the Product

A specific EMC testing process is determined based on the product type, its intended application, and the compliance standards regulating its use. These standards vary between devices and geography, so manufacturers must develop an EMC test plan based on the correct requirements.

The EMC testing routine may simulate various electromagnetic phenomena, such as the following:

- Magnetic fields, like those radiating from electrical wires
- Radiated and conducted electromagnetic noise
- Voltage drops due to a brownout or other power interruption
- Fast transients caused by arcing from electrical switches
- Electromagnetic surges due to a lightning strike
- Electrostatic discharges associated with static electricity

Because different regulatory bodies have their own specific standards, it can be challenging to define or pin down the requirements of a product. Perform independent research or contact an EMC test lab to determine what standards must be met before sending a product in for formal testing. Avoid a disastrous outcome by considering all necessary EMC standards.

2. Perform Pre-Compliance Testing

The cost incurred from EMI and EMC testing can be relatively high. Should a manufacturer need to investigate failed results and re-test a product, they will have to extend their budget severely. Pre-compliance testing can help avoid these challenges and financial problems by identifying EMC issues as early as possible.

Before a product is formally tested, it should possess excellent EMI immunity and generate no additional EMI emissions than the regulations require. Introduce pre-compliance tests at an earlier stage in the development cycle. This way, the manufacturer will have greater confidence in the product's ability to succeed.

3. Choose an Accredited EMC Test Lab

When bringing products to market, EMC accreditation is crucial for establishing the validity of its testing. Should a problem occur in a device, the manufacturer is responsible for proving compliance with all required regulations. Certification from an ISO/IEC 17025 accredited test lab will help ensure a product meets the necessary standards.

Schedule an appointment well in advance, so you can perform your pre-compliance test with enough time to address any issues before the formal testing.

The 4 Types of EMI and EMC Tests for Power Supplies

Since EMI can affect power supplies through radiation and conduction, comprehensive EMC testing must cover both radiated and conducted interference. Immunity testing for either radiated or conducted EMI is used to gain a reasonable assurance that the device will function as intended in its environment.

Meanwhile, the two types of emissions testing help ensure that any radiated or conducted emissions from the device will not cause harmful interference to other equipment.

Depending on the product being tested, you may want to measure its immunity to EMI and the EMI emissions it generates in both radiation and conduction scenarios.

Immunity Testing

Immunity testing determines a product's susceptibility to EMI — evaluating how it reacts to both continuous and intermittent electromagnetic energy exposure. The device is subjected to electromagnetic noise at various frequencies to simulate a power surge and assess the effectiveness of its power supply.

Radiated immunity: This testing measures how the device will perform when exposed to the level of electromagnetic energy it will encounter in its expected operating environment.

Conducted immunity: This testing measures how the device will react to the electromagnetic energy generated within another source that is accidentally carried via a cable to the tested product.

Emissions Testing

Emissions testing analyzes the amount of EMI generated by the tested product — ensuring that any emissions from the device's internal electrical systems remain below the specified limits. Antennas, amplifiers, and spectrum analyzers help engineers accurately measure how much electromagnetic noise their device generates.

Radiated emissions: This testing measures the amount of EMI a device generates and is used to determine whether its emissions are within the specified limits for its size and power.

Conducted emissions: This testing measures the level of internal electromagnetic energy generated, which may accidentally travel along a cable and cause interference on other systems.

A Look Into EMI and EMC Testing Standards

EMC testing standards define terms, test methods, and rules for electromagnetic compatibility. Manufacturers rely on EMC requirements to specify emission limits and minimum immunity test levels for electronic devices. However, compliance standards are not uniform worldwide.

When it comes to a product's compliance, the responsible regulatory body defines the applicable standards. This body could be a governmental administration, organization, commission, or committee. Different regulatory bodies have established specific regulations for emission and immunity testing. For example, both the United States and European standards offer separate specifications for conducted and radiated EMI.

The specific industry and the end use of the device may also result in [unique EMC testing standards](#). Products developed for particular industries — including the industrial, medical, military, and consumer goods sectors — must meet the applicable standards.

Here are some of the most common EMC testing standards that govern EMI and EMC compliance:

[FCC Part 15](#) includes EMC testing standards for U.S. consumer products.

IEC 60601-1-2 is the standard for medical electrical equipment.

The U.S. military uses stricter EMC testing standards found in MIL-STD 461 and MIL-STD 464.

European standards use specifications from the IEC, ISO, and CISPR, among other agencies.

Industries That Benefit From EMI and EMC Testing



All electronic devices and electrical power supplies require proper EMI and EMC testing before being taken to market and used in the field. Here are a few benefits EMI and EMC testing provides manufacturers for a wide range of industries.

Automotive

Manufacturers throughout the automotive industry use EMC testing for both individual components and automobiles as a whole. Different car companies, including Volkswagen, BMW, and Mercedes, have set strict standards for their products. Whether you produce the engines and radios that go into a vehicle or transform these components into functioning automotive machines, EMI and EMC testing is necessary to ensure the final product's safety, reliability, and market approval.

Industrial

Growing demands for product customization and stringent market requirements continuously impact industrial production. Manufacturers must ensure the end product is [safe and reliable for industrial use](#) while delivering on the market's desire for quality custom equipment. Industrial power supplies that have been appropriately tested to EMC standards provide greater confidence in the final product's ability to shield against interference.

Semiconductors

Nearly all computerized products utilize semiconductors for their compactness, reliability, and efficiency. However, their [higher capacity for electromagnetic emission](#) also leads to necessary EMC testing to assess and protect against EMI risks. This testing is vital for semiconductors intended for operating environments or produced in manufacturing environments that use other sensitive equipment.

Medical

Devices that cannot function in close environments with other electronics and electrical systems may risk patient safety. That's why any equipment used in this demanding and highly regulated industry must be able to work alongside others without EMI compromising their performance. EMC testing is critical for managing the risk of [medical devices and medically approved power supplies](#) requiring the highest control and precision.

The FDA requires EMC testing for all medical devices according to IEC 60601-1-2 standards. Similarly, all medical devices used in European countries must meet specific immunity and emissions testing standards indicated with CE marking.

Military

Manufacturers must subject military equipment to rigorous EMC requirements and [stringent design specifications](#). MIL-STD-461 is a common testing standard for military equipment that could potentially emit or be vulnerable to electromagnetic energy. These military EMC requirements include immunity and emissions testing and are applicable in the army, aviation, aerospace, and marine fields.

Consumer Goods

EMC testing helps support proper functioning and compliance for all electronic devices. Even commonly used [electronics and commercial appliances](#), such as computers, microwaves, washing machines, and television units, must meet EMC requirements. Electronic devices connected to Wi-Fi have a higher risk of emitting far-reaching EMI and have relatively strict regulations for potential interference. FCC standards mandate comprehensive testing standards for all consumer products before they can enter the marketplace.

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