WHITE PAPER

Get It Right Every Time with Pre-Compliance Testing

We often hear questions regarding the differences between pre-compliance and compliance testing. Verifying your designs on your own is called pre-compliance testing. Pre-compliance testing closely simulates the way compliance tests are run – putting your designs against actual compliance test limits. Then, once you are confident in your design, you can take it to a third-party lab for final compliance testing.

Pre-compliance testing is important because it is a low-risk, cost-effective method to ensure your device under test (DUT) will pass final compliance testing. Waiting until the end of the product development cycle for compliance testing is risky, so if you implement pre-compliance testing during development, it will help minimize surprises. For example, by checking your designs for electromagnetic compatibility (EMC), you can help your device pass compliance testing on the first try. If your device fails compliance testing, a simple design tweak might fix the issue, so the only added cost is more time in the compliance lab. However, this best-case scenario rarely happens. Instead, many devices fail compliance testing two or more times, which results in costly rework and a delayed product ship date - something no one wants.

Compliance testing is a very formal process, based on regional, country and local requirements. Improve your device's chance to pass compliance testing by implementing pre-compliance testing, which is a low-risk, cost-effective method to meet compliance requirements.

KEYSIGHT TECHNOLOGIES

Common Pre-Compliance and Compliance Tests

Pre-compliance measurements give an approximation of the EMI performance of the DUT. The cost of performing pre-compliance tests is a fraction of the cost of full compliance testing using an expensive facility.

Full compliance measurements require the use of a receiver that meets the requirements set forth in CISPR16-1-1, a qualified open area test site or semi anechoic chamber, and an antenna tower and turntable to maximize DUT signals. Great effort is taken to ensure accuracy and repeatability. Compliance test facilities, owned and operated by a third party, are often quite expensive.

An anechoic chamber is a room designed to absorb reflections of electromagnetic waves – which is the perfect environment for performing compliance tests on an electronic device. An anechoic chamber ensures that no external signals interfere with the test. In general, most electronic device manufacturers do not have an in-house anechoic chamber. They usually reserve an anechoic chamber ahead of time through a third-party. The costs associated with the reservation and use of an anechoic chamber is a key differentiator between pre-compliance and compliance testing.

Pre-compliance tests are usually done in-house and can be broken down into two categories: emissions testing and immunity testing. Within each of these categories, you have to perform both radiated and conducted tests.

- Radiated measurements characterize an unintentional electromagnetic energy release from an electronic device via a non-physical medium (signals broadcast from the DUT through air)
- Conducted tests characterize unintentional electromagnetic energy release from an electronic device via a physical medium (cable testing)

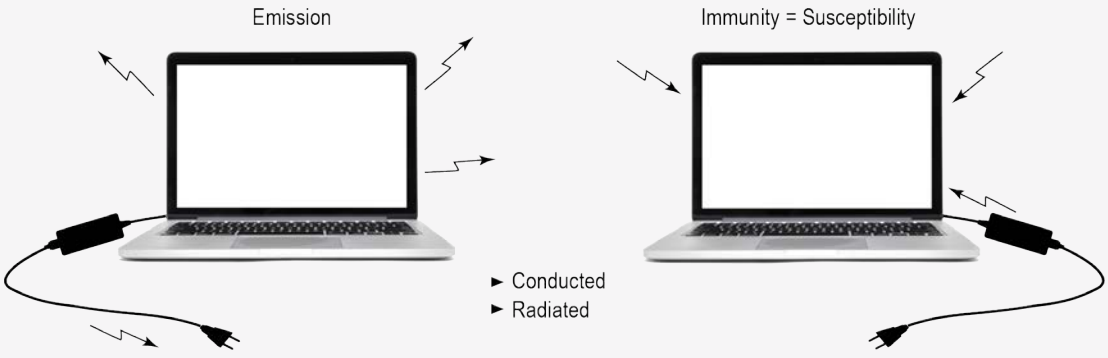

Figure 1: Shows the relationship between radiated emissions vs. radiated immunity.

When you perform pre-compliance testing, you are trying to minimize your device's risk of failing compliance testing. Therefore, it is critical to understand which tests your device is most likely to fail. The most common failures occur during the following tests:

1. Radiated Emissions
2. Radiated Immunity
3. Conducted Emissions
4. Electrostatic Discharge (ESD)

Emissions testing	Immunity testing
• Radiated emissions • Conducted emissions • Electrostatic discharge (ESD)	• Radiated immunity • Conducted Immunity

Let's review what is involved in each of these four tests, so you have a better understanding of where failures may occur during testing.

1. Radiated emission testing

Radiated emission testing measures the radiated electrical fields (E-fields) emanating from the DUT. The radiated emissions test is usually the compliance test most devices fail. All devices will have some emissions, but if these emissions meet the requirements set by your standards body, your device is compliant. A radiated emissions test involves measuring a DUT's radiated emissions using a signal analyzer and an antenna.

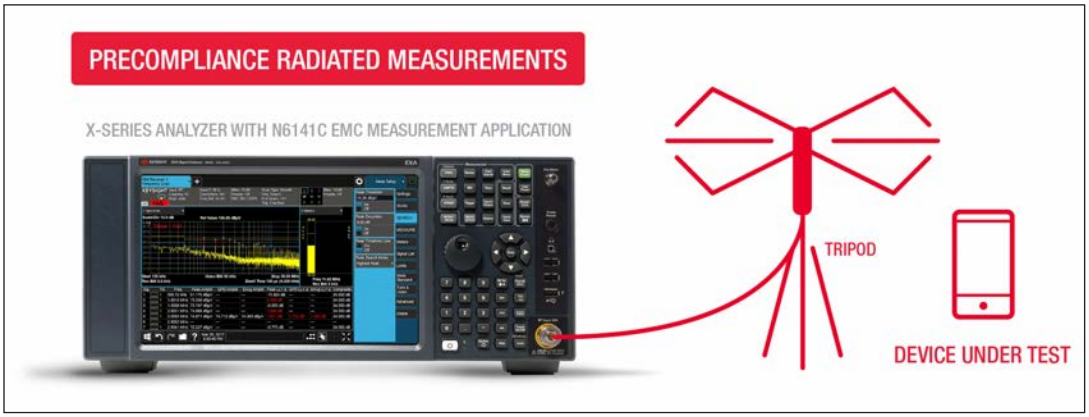

Figure 2: Radiated emissions set-up.

2. **Radiated Immunity**

Radiated immunity is a measure of how resistant or immune your DUT is to electromagnetic interference (EMI) before its performance starts to degrade. This is also a common cause of failure in compliance testing. The set up for radiated immunity test requires three signal generators to cover the entire frequency range, and RF broadband power amplifier, and two or three antennas.

3. **Conducted emissions**

Conducted emissions testing focuses on the unwanted signals the DUT generates on the AC power line. Radiated and conducted testing are very important as your device will now pass compliance testing if it fails either of these tests. For conducted emissions testing, you will need a spectrum analyzer equipped with EMC pre-compliance measurement software, a line impedance stabilization network (LISN), and a limiter.

4. **Electrostatic discharge testing (ESD)**

ESD testing checks how immune the DUT is to static discharges, usually from operators touching the key pads or touchscreens. The set up for an ESD test is a DUT connected to ground plane, and several sheets of metal in various thicknesses. During the test, observe how the DUT interacts with the various planes, thickensses, and materials. If you discover an ESD issue, you need to resolve it before compliance testing.

Standards Bodies

Standards bodies like the Comité International Spécial des Perturbations Radioélectriques (CISPR) establish the requirements for testing.These standards help regulate products and make sure they meet uniform standards for safety and performance. For example, CISPR's regulations stipulate the required equipment and methods for measuring electromagnetic interference (EMI) and the limits and immunity requirements for electronic devices.

Different countries have different organizations to enforce these requirements. In the United States, the Federal Communications Commission (FCC) is the organization that enforces these compliance testings and certifications. Generally, compliance with national or international standards are written into laws passed by individual nations. Therefore, there will be variations from country to country. For example, one main difference between the United States and Europe is that the United States has set immunity limits. There are no immunity limits associated with European EMC certification.

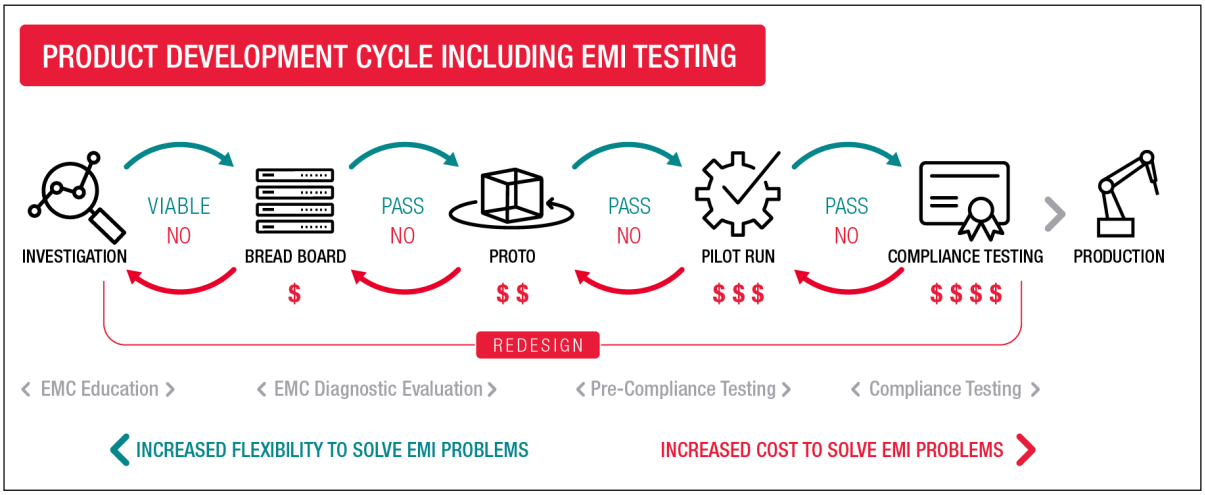

Figure 3: Decrease the cost and speed issue with pre-compliance testing.

Pre-Compliance EMC Tests are Requirements

In summary, here are the key topics we covered:

- Pre–compliance is a low risk, cost effective method to ensure you will pass final compliance tests
- There are four main types of tests covered in pre-compliance – they include:
  - Radiated Emissions
  - Radiated Immunity
  - Conducted Immunity
  - Electrostatic Discharge
- CISPR is one of the main regulatory agencies that determine what measurements need to be performed on your device

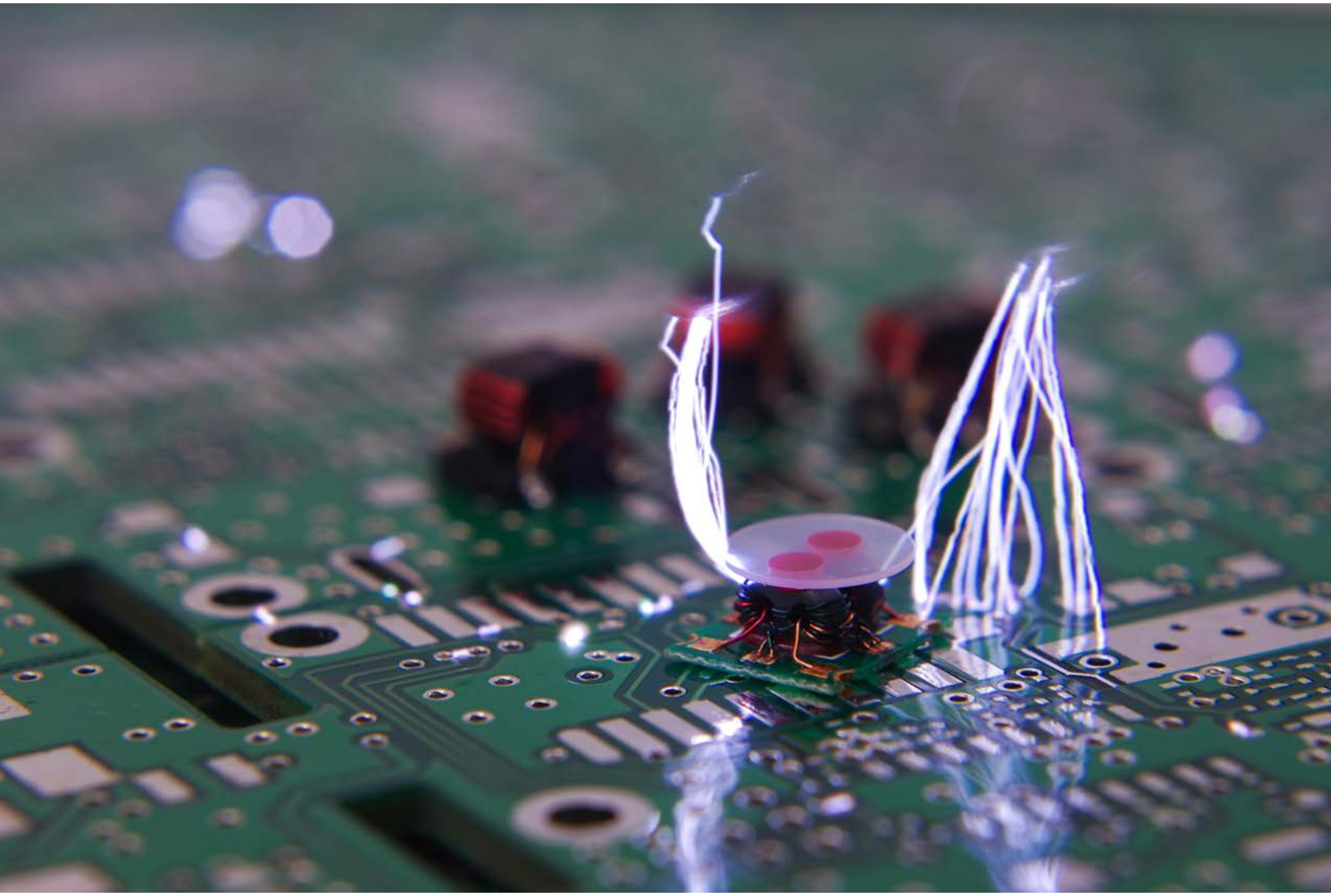

Figure 4: ESD is a major source of problems that can be found through pre-compliance testing.

Conclusion

In conclusion, pre-compliance is a crucial part of your design test process. If you test your product during the product development cycle, you can ensure that it meets the regulations for emissions, immunity and ESD. Precompliance testing actually speeds your product through the development cycle by decreasing the risk of extensive rework. For a better understanding of the importance of pre-compliance testing, watch "**The ABC's of EMC**" video series.

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