Ensuring a Successful Visit to the EMC Test Lab

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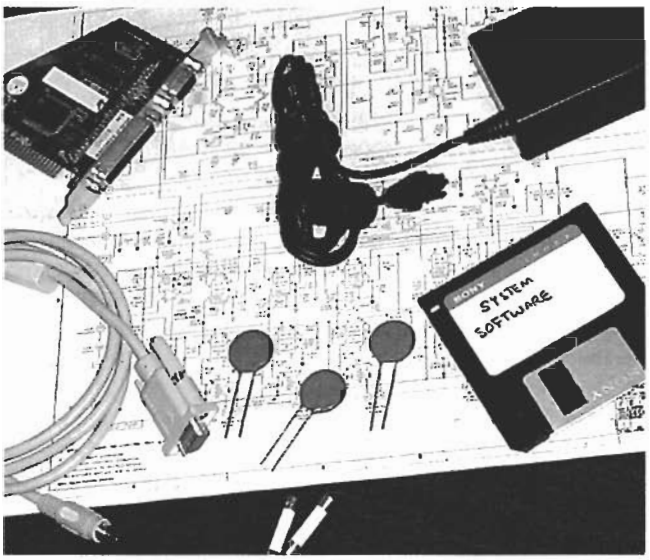
Being prepared is essential to a productive visit to a laboratory for electromagnetic compatibility testing. Working with the lab up front is key.

If you're in the business of making or selling electronic products anywhere in the world, you've likely had your product tested at an EMC test laboratory for radio-frequency (RF) emissions, immunity, or both.

Everyone would like the testing process to be a painless experience, but often problems arise that can delay testing and maybe even the product's schedule. Sometimes equipment fails a portion of a test. Sometimes the product may self-destruct. Sometimes communications get crossed between the manufacturer and the test lab. Proper planning and preparation for each project can prevent such problems and ensure a productive and successful visit. This article presents an overview of how to prepare for the visit. See the checklist in the sidebar "Emissions/Immunity Lab Visit Checklist" on page 39.

When working with an independent test laboratory, manufacturers need to be aware that the lab can do a great deal to help prepare for a successful visit. For example, many labs offer to conduct an early design evaluation prior to testing. At this meeting, test lab engineers review the product for potential design problems related to the tests to be performed. All appropriate tests and test requirements can be identified at this meeting, greatly reducing the likelihood of problems during testing. Some labs do not offer early design evaluation. In such cases, manufacturers should call the test lab before the product is ready to test to discuss the project with one of the lab's applications engineers.



Extra parts and supplies to bring to the test lab include a power supply, unique cable, software, and schematics.

Critical Information

The lab needs to know about a product and its intended market to determine what standards apply and what testing is required. Gone are the simple days of only having to determine whether to test to FCC Class A or Class B. Depending on the product, it can now take hours to determine which standards, or what parts of those standards, apply. For example, to market an RF transmitter in Europe, the R&TTE Directive, the EMC Directive, and the Low Voltage Directive could all apply.

Identifying the appropriate standard can involve examining hundreds of them to determine which are required for a specific product. More research will then be needed to identify which parts of the selected standards apply. The test lab must also determine whether the type of transmitter and its frequency of operation are harmonized within each member state of the European Union. With this information, the test lab can inform the manufacturer—before coming in for the actual testing process—of any special requirements.

Some of the key information that the test lab needs to know includes:

- Power and frequency requirements.
- Clock and processor speeds.
- Input/output (I/O) connections and cables used.
- Number of possible configurations.
- Peripheral equipment needed.
- Support equipment required for proper operation.
- Intended geographic market.
- Size and weight of equipment.

This product information helps the test lab determine not only the tests required, but also the configurations in which the product should be tested. To ensure proper testing, it is imperative that the lab knows what the product is and what

it does. This information enables the lab to determine the time needed for testing and to plan accordingly.

Before scheduling the visit, manufacturers should understand how the product will be tested. If multiple configurations exist for a product, it may need to be tested to identify the worst-case condition. Devices must be tested in the configuration that causes the worst-case condition, and this configuration may not be the same for immunity as it is for emissions. For example, a device such as a computer modem may have an option of using various types of communication ports, but not necessarily at the same time. Two ports could be provided to enable both a dial-up connection and a cable connection. Testing must be done with each port being used separately and in combination to determine the highest risk for emissions or immunity, depending on the test.

Some test labs use a questionnaire to obtain pertinent information from the manufacturer. The answers are used to help determine an appropriate test plan. A test plan will include the test standards that need to be run for that particular device. The plan will also define the specific test conditions. It is usually best to run potentially destructive tests last.

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A test plan should include a list of tests such as the examples shown in Tables I–III. These tables list the applicable tests and requirements for a printer, which falls under the category of information technology equipment. The tables show the tests that would be necessary for CE marking the device for sale in the European Union. In this case, emissions tests would probably be run first, and ESD and surge testing would be done last.

It is beneficial for manufacturers to complete such an information sheet before taking a product to the lab for testing. This information helps the test lab understand the product. Often, pertinent information from this form is used directly in the test report. To avoid errors, it is important to print legibly or type the information on the form.

Along with the test results and parameters, the test report will use information from this form. The test report will include the general information about the product, such as the model number and name, company name, and serial number. Other information might include:

- The operation of the device during the test.
- What constitutes a failure condition for the immunity testing.
- PCB descriptions and revision numbers.
- The power line filter used.
- Other pertinent data.

The client is responsible for providing all necessary information prior to the report being written. Some information should be provided even before the testing is done. Failure to provide this information can delay the testing schedule and the issuing of the report, which would likely result in the product not getting to market in the intended window.

Always provide a model number and not just a product name. Product names often change by the time products are ready to market. If a name does change, the test report could include the wrong model number erroneously. Such an error could cause delays in issuing the report and, therefore, in product launch.

Some manufacturers develop test plans themselves. It is a good idea to have the test lab review such test plans before testing begins. The lab can determine whether the correct tests are included and identify omitted or extraneous tests.

Emissions/Immunity Lab Visit Checklist

- ☑ Supply all required peripheral devices and accessories that comprise a complete system.
- ☑ Bring any auxiliary equipment that may be available as part of the product, including optional equipment, so that it can be used for the test.
- ☑ Supply all cables (supplied or otherwise necessary) required for the operation of the complete EUT system. Cables should be of typical length and construction used for this type of device.
- ☑ If the EUT is small enough, consider sending or bringing a second unit as a backup.
- ☑ Bring any specialty tools and replaceable items (fuses, MOVs, media, etc.) that might be needed.
- ☑ Bring software required for full operation of the EUT. The software should be able to exercise all aspects of the EUT.
- ☑ Supply cables needed for remotely located support equipment.
- ☑ Supply documentation associated with the installation and operation of the EUT. This should include any instructions necessary for the proper operation of the EUT during the test.
- ☑ Supply schematics.
- ☑ Provide information, including a phone number, for a contact person that can provide technical or operational assistance.
- ☑ Provide model number and trade name. For multiple model numbers, define the differences between the model numbers.
- ☑ Provide a list of the clock and processor frequencies for the EUT.

Other Considerations

After providing all necessary information, a few other factors should be considered before testing begins. Before transporting the system to the lab, set it up one last time to

Standard Type	Designation	Test Type	Test Parameters
IEC	61000-4-2	Electrostatic discharge	±8 kV air, ±4 kV contact
IEC	61000-4-3	Radiated susceptibility	3 V/m, 80–1000 MHz
IEC	61000-4-4	Electrical fast transients	±1 kV ac, ±0.5 kV dc I/Os >3 m
IEC	61000-4-5	Surge	±0.5 kV differential mode, ±1 kV common mode ac; ±0.5 kV dc[1] and ±1 kV signal/telecom[1]
IEC	61000-4-6	Conducted RF	3 V rms, 0.15–80 MHz
IEC	61000-4-8	Magnetic susceptibility	1 A/m, 50 Hz
IEC	61000-4-11	Voltage interrupts	>95% interrupt at 5 seconds
IEC	61000-4-11	Voltage dips	30% dip at 0.5 seconds and 95% at 10 milliseconds

1. If connected to the outdoors.

Table I. EN 55024 immunity requirements for ITE.

Frequency Range (MHz)	Class A Devices (dBμV)		Class B Devices (dBμV)	
	Quasi-Peak Detector	Average Detector	Quasi-Peak Detector	Average Detector
0–0.002	—	—	See note 1	See note 1
0.15–0.5	79	66	66 to 56	56 to 46
0.5–5	—	—	56	46
0.5–30	73	60	—	—
5–30	—	—	60	50

1. As specified in the reference standard IEC 61000-3-2 and IEC 61000-3-3. The limit decreases linearly with the logarithm of the frequency in the range of 0.15 to 0.5 MHz. For alternative test site areas, see Annex A of CISPR 22. For discontinuous disturbances, see CISPR 14.

Table II. EN 55022 conducted emissions requirements for ITE.

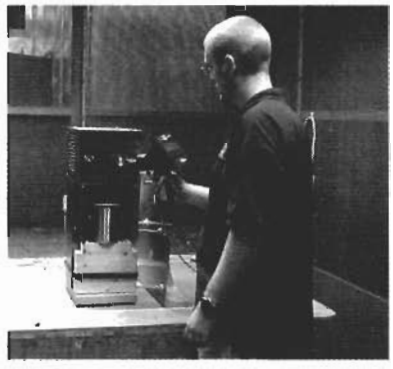
make sure it functions properly. Often a product can be mailed or shipped to a test lab for testing, rather than having someone from the manufacturer available on-site.

When a product is shipped, provide the lab with names and phone numbers of individuals to contact if problems or questions arise. Contacts should be available during working hours to avoid wasted time by having the test engineer waiting for an answer to a question. However, for devices that are complicated or difficult to operate, it is crucial for a person knowledgeable with the product to be present during testing. Whether the manufacturer chooses to be present throughout testing or opts to check in periodically, it is essential that manufacturers talk regularly with the laboratory engineer to ensure that the process runs smoothly.

Certainly, everyone hopes that the equipment under test (EUT) will breeze through the tests without any problems and that no failures or out-of-spec conditions will arise. For manufacturers whose products do not experience problems, congratulations are in order. They can sit back and let the test engineer do all the work. But sometimes, failure conditions do show up during the testing process.

When at the lab to monitor testing, the company's representative should be prepared by having components and supplies available to address the problems. Before scheduling testing, determine what services and supplies the lab makes available. A good lab will have an EMC engineer present. In addition, labs often have common components such as filters, conductive gasketing, capacitors, chokes, fuses, and conductive materials to facilitate necessary changes to a product. Manufacturers can sometimes request that the test engineer or EMC engineer make the change. In these cases, it is essential that a representative from the manufacturer monitor the alteration to ensure that it is replicated in production.

If the product is small and samples are easily available, it is wise to bring an extra one or two samples along. Some tests, specifically in areas related to RF immunity, can be destructive to equipment. For some tests, the product must be subjected to 8 kV of electrostatic discharge. Other tests subject products to voltage interruptions and surges. Power supplies may be subjected to simulated lightning strikes. These tests often cause nonrecoverable failures. Such failures may destroy the test sample, which can set production plans back by days or weeks. It is particularly frustrating if travel time to the lab takes several hours or more. Bringing extra parts and supplies can minimize any downtime.



Mark Rozema tests a product with electrostatic discharge.

Frequency Range (MHz)	Class A Devices (dBμV) Quasi-Peak Detector	Class B Devices (dBμV) Quasi-Peak Detector
30–230	40	30
230–1000	47	37
Note. For alternative test site areas, see Annex A of EN 55022.		

Table III. EN 55022 radiated emissions (at 10 m) requirements for ITE.

Parts and Supplies

Typical extra parts include a power supply, fuses, metal-oxide varistors (MOVs), circuit boards, special or unique cables, and system software. It is important to bring schematics as well. The test engineer must thoroughly understand a product when RF troubleshooting. Schematics provide key product data for the troubleshooting process. Because test standards require that products be tested as complete systems, it is essential to bring all peripherals, cables, tools, and software that the device needs to operate normally.

Everything that can be used with a device in a typical application needs to be part of the test. All I/O cables must be terminated as necessary for the testing to be valid. Power supplies should be available for each voltage required by each country

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intended for market. For instance, if a device is going to be marketed to consumers in both the United States and in the European Union, it must be tested at 110 V/60 Hz and also at 240 V/50 Hz. Before coming to the lab for testing, set up the device for the proper voltage.

Conclusion

Have products tested long before production is planned. Design changes may be required in order for the device to pass the required tests. Be prepared for the visit. Provide as much information as possible to the lab to ensure that the appropriate standards and tests are used. Provide extra parts and supplies to minimize downtime. Understand the test plan, and work with the test lab. As experts in testing and standards, the lab can make the process of bringing a product to market much easier. A good EMC lab has engineers with a broad knowledge of standards and years of hands-on experience in EMC testing and troubleshooting.

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