

# **User Manual**



**EMC120**  
**EMI Precompliance Test Software**  
**070-9878-01**

Copyright © Tektronix, Inc. All rights reserved. Licensed software products are owned by Tektronix or its suppliers and are protected by United States copyright laws and international treaty provisions.

Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013, or subparagraphs (c)(1) and (2) of the Commercial Computer Software – Restricted Rights clause at FAR 52.227-19, as applicable.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Printed in the U.S.A.

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

## WARRANTY

Tektronix warrants that the media on which this software product is furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If a medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which this software product is furnished, this software product is provided "as is" without warranty of any kind, either express or implied. Tektronix does not warrant that the functions contained in this software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period. If Tektronix is unable to provide a replacement that is free from defects in materials and workmanship within a reasonable time thereafter, Customer may terminate the license for this software product and return this software product and any associated materials for credit or refund.

**THIS WARRANTY IS GIVEN BY TEKTRONIX IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPLACE DEFECTIVE MEDIA OR REFUND CUSTOMER'S PAYMENT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**



# Table of Contents

<b>Preface</b> .....	<b>iii</b>
About This Manual .....	iii
Related Documents .....	iii
<b>Getting Started</b>	
Product Description .....	1-1
Supported Test Equipment .....	1-2
Accessories .....	1-2
System Requirements .....	1-3
Installation .....	1-3
First Time Operation .....	1-8
<b>Operating Basics</b>	
Using the Help Wizard .....	2-1
<b>Reference</b>	
<b>EMI Basics</b> .....	<b>3-1</b>
EMC Concepts .....	3-1
Summary of EMI Standards .....	3-4
Peak Versus Quasi-Peak Detection .....	3-6
Correction Factors .....	3-7
Test Equipment Considerations .....	3-9
Preparations Before Testing .....	3-13
Open-Field Site Testing .....	3-15
Anechoic Chamber Testing .....	3-16
Conducting EMI Tests .....	3-17
<b>Appendices</b>	
<b>Appendix A: File Naming Conventions</b> .....	<b>A-1</b>
<b>Glossary</b>	
<b>Index</b>	

## Table of Contents

---



## Preface

This manual describes the capabilities of the EMC120 EMI Precompliance Test Software and how to access its online Help information. The EMC120 EMI Precompliance Test Software is also referred to as the test software.

To get started, refer to the first section, *Getting Started*. This section shows you how to install and configure the test software. For detailed information about features in the software, refer to the test software online Help. The online Help includes a Wizard mode that leads you through the steps necessary to set up and run a test.

## About This Manual

This manual is composed of the following sections:

- *Getting Started* provides a product description, installation instructions, and GPIB configuration information.
- *Operating Basics* describes the online tutorial available in the test software.
- *Reference* provides a discussion of EMI basics that covers all the elements you should consider when setting up an EMI test.
- *Appendices* provides additional information.

## Related Documents

The following related document is also available:

- The *27120B EMI Measurement System User Manual* (Tektronix part 071-0521-XX) describes a complete EMI test system offered by Tektronix. This test system uses the EMC120

EMI Precompliance Test Software for automated control of  
system equipment.



# Getting Started



## Getting Started

This section presents information you need to install the EMC120 EMI Precompliance Test Software and configure the GPIB card for control of your spectrum analyzer. This section contains the following information:

- Product Description
- Supported Test Equipment
- Accessories
- System Requirements
- Installation
- First Time Operation

## Product Description

The EMC120 EMI Precompliance Test Software is a Windows-based program for performing preliminary EMI testing. The test software works with certain Tektronix spectrum analyzers to automate precertification EMI testing.

Automated tests simplify the testing required by the FCC and CISPR standards. You choose tests to perform and configure them using the standard Windows interface. The online help provides complete descriptions of all software functions.

The test software is also available as part of the 27120B EMI Measurement System.

The test software provides the following functions:

- Performs radiated and magnetic emissions tests
- Performs conducted emissions tests

- Allows configuration of tests and saving of the test setups
- Lets you define and save correction factors for ancillary devices
- Graphs test results using several scaling options
- Provides full online help with topic search capability and a tutorial

## Supported Test Equipment

Aside from the host/controller PC described under *Installation*, the test software supports the following test equipment:

- Tektronix 2712 Spectrum Analyzer with Option 12, provides quasi-peak detection and EMC filters (200 Hz, 9 kHz, 120 kHz).
- Tektronix 2711 and 2712 Spectrum Analyzers without quasi-peak detection. The test software supports firmware versions 01.12.94, 05.20.94, and newer. Instruments with older firmware may be compatible though they have not been tested with the test software.
- Tektronix 2706 RF Preselector.
- Turntable and mast, which are available from Electro-Metrics, Inc.

## Accessories

The test software includes the following standard accessory:  
*EMC120 EMI Precompliance Test Software User manual* (this manual).

For information on a complete EMI test system, ask your Tektronix representative about the 27120B EMI Measurement System. It

provides all the components you need to perform precompliance EMI testing of new or redesigned instruments.

## System Requirements

The test software runs on a PC computer that meets the following minimum requirements:

- Intel 486 DX33
- 8 MB RAM
- 10 MB hard drive space
- A 1.44 MB, 3.5 inch floppy drive to load the test software.
- Super VGA monitor
- Windows 3.1 or Windows 95.
- GPIB card of PCII/IIA or AT-GPIB type.

## Installation

Installation requires loading the test software to your hard disk and configuring your GPIB-compatible test equipment and the software to enable communication.

### Installing the Test Software

To install and use this program, you should be familiar with Windows operations and commands. If necessary, review your Windows User manual before proceeding. For a list of the installed files, refer to Table 1–1 on page 1–7.

Install the test software on your computer as follows:

1. Insert the test software Disk 1 into your 3.5 inch floppy drive.
2. Start Windows if it is not already running. Quit all other Windows applications before beginning installation. If the

installation program accesses a file in use by another application, an installation error will occur.

3. To start the install program on a Windows 3.1 system, follow these steps:
  - a. In the Program Manager, choose FILE at the top of the screen.
  - b. Choose RUN from the drop-down menu.
  - c. In the Run window, enter A:setup. If the install disk is in another drive, use that drive letter.
  - d. Select OK.
4. To start the install program on a Windows 95 system, follow these steps:
  - a. Choose the Start icon at the lower left.
  - b. Choose RUN from the pop-up menu.
  - c. In the Run window, enter A:setup. If the install disk is in another drive, use that drive letter.
  - d. Select OK.
5. The EMC120 Installation window appears while the setup utility copies several initialization files to your hard disk.
6. Choose INSTALL or EXIT.
  - To install the test software, choose INSTALL.
  - If you do not want to install the program, choose EXIT.
7. To install the program in the default directory shown at the lower left, click on the large install icon at the left.

To install the program on a different drive, click on Change Directory and choose a target drive and directory. When done,

select OK. Click on the large installation button at the left to start the installation.

8. The EMC120 begins the installation process. The program checks for system compatibility before installing the program files.

As the program installs each file, it displays the percentage complete for the transfer. Between files, it displays the progress of the total installation.

9. When prompted, remove the disk and insert the next disk in order. Choose OK to resume installation.
10. When installation is complete, the program displays the following message: "EMC120 setup was completed successfully."

On a Windows 3.1 system, the install program creates a Windows group named Tektronix EMC120 and an icon, also named Tektronix EMC120, within the group.

You have completed the software installation procedure.

### **GPIB Configuration**

The test software requires the spectrum analyzer, and other GPIB-controlled test equipment, to have unique GPIB addresses. To set the GPIB addressing, follow these steps:

1. Configure your 2712 Spectrum Analyzer by selecting the UTIL/4/0/0 menu and then setting the following parameters:
  - Status: Online
  - GPIB Address: 1
  - Power On SRA: Off
  - EIO/LF Mode: EOI
  - Talk Only Mode: Off

2. Set unique addresses on the 2706 RF Preselector and any other GPIB equipment on the bus. The address is typically set in a configuration menu or with switches on the rear panel. Refer to your equipment manual. Set the address on the 2706 RF Preselector to 10, unless this address conflicts with another instrument with a preconfigured address of 10.
3. Configure the test software with the addresses you have set for each piece of equipment. Choose Options from the menu bar and select Hardware. Figure 1–1 shows the Hardware Setup window.

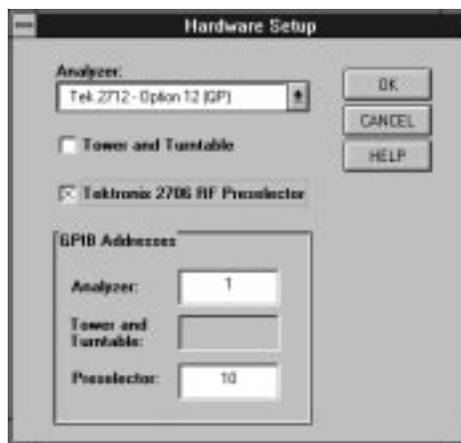


Figure 1–1: Setting GPIB address in the Hardware Setup window

4. Select the type of spectrum analyzer, then set the GPIB address. This address should match the address set on the spectrum analyzer.
5. To configure a tower and turntable or a Tektronix 2706 Preselector, click on the appropriate box and enter the instrument GPIB address.

6. When done, select OK.

**Supported GPIB Cards.** The test software supports the National Instruments GPIB-PCII/IIA and AT-GPIB/TNT IEEE 488 (GPIB) interface cards. You need install only the Windows instrument drivers for the interface cards. Other GPIB interface cards may operate with the test software, but they have not been tested.

#### Installed Files

The install program places a variety of files in your Windows system directory and in the application directory. Table 1-1 lists the files installed in the application directory. For the list of files installed in the windows\system directory, view the file SETUP.LST on disk 1 of the test software installation disks.

Table A-1 in Appendix A describes each of the Limit, Factor, and Test files listed in Table 1-1.

**Table 1-1: Listing of files installed in the application directory**

Files installed in C:\EMC120 (default location)		
EMC120.EXE	FCCA_CND.LIM	SAEJ551Q.LIM
EMC121.HLP	FCCA_CND.TST	55011ARQ.LIM
EMC120.INI	FCCA_RAD.LIM	55022ACA.LIM
DEFAULT.TST	FCCA_RAD.TST	55022ACQ.LIM
HLPWIZ.LIM	FCCB_CND.LIM	55022ARQ.LIM
HLPWIZ.RAD	FCCB_CND.TST	55022BCA.LIM
HLPWIZ.TST	FCCB_RAD.LIM	55022BCQ.LIM
EM_6912A.RAD	FCCB_RAD.TST	55022BCQ.TST
EM_7820.CON	SAEJ551.LIM	55022BRQ.LIM
EM_LPA30.RAD	SAE-J551.TST	55022BRQ.TST

## First Time Operation

This section provides information to get you started using the test software and instructions on using the online help. For information about using the application, refer to the EMC120 online help.

### Starting the Software

Follow these steps to start the test software:

1. If necessary, open the Tektronix EMC120 group window.
2. Double-click on the Tektronix EMC120 icon to start the test software. Figure 1–2 shows the startup dialog box.

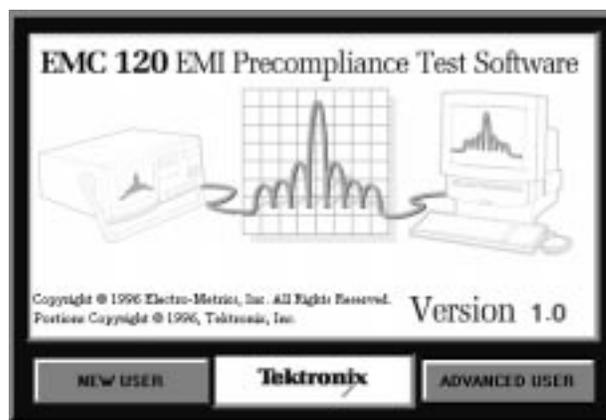


Figure 1–2: Start-up dialog box

3. Choose either NEW USER or ADVANCED USER.

The NEW USER button starts the test software and automatically opens the Help Wizard dialog box for you. For information on using the Help Wizard, refer to page 2–1.

ADVANCED USER starts the test software directly.

**Online Help**

In the EMC120 window, choose Contents from the Help menu. This selection displays the main online help window. To learn how to navigate through the online help, choose How to Use Help from the Help menu.

Illustrations in the online help are optimized for a VGA monitor.

The help buttons function as follows:

- **Contents** returns to the Help Contents page.
- **Search** searches for specific topics.
- **Back** returns to the previously displayed topic.
- **History** goes to any of several previously displayed help topics.
- **Glossary** displays the glossary and allows jumps to glossary topics.
- << and >> move forward and backward through browse topics.

You can print individual help topics to your system printer. Use the File Print command to print the current topic. The print command uses the default system printer.





# Operating Basics



## Operating Basics

This section describes how to use the Help system provided with the EMC120 software. The online Help system consists of the searchable Help reference and a Wizard guide to help you set up and run tests.

### Using the Help Wizard

The Help Wizard is an online aid for learning and using the test software. It will step you through the following tasks:

- Creating a test
- Creating a correction factor file
- Opening an existing test
- Running a test

The Help Wizard automatically starts when you choose NEW USER from the startup dialog box. You can also select the Help Wizard at any time from the EMC120 Help menu. Figure 2-1 shows the initial Wizard Help window.

To begin a Wizard tutorial, click on the topic of interest. For a new user, the first step should be Create a Test. The Wizard tutorials help you create a real test setup and run the test. You can save the setup and test results after completing the Wizard tutorial.

Each of the Wizard tutorials is described following Figure 2-1.

When the light bulb cursor appears, it indicates a glossary word. Click on the word to see its definition.



Figure 2-1: Wizard help selections

### Create a Test

The first Wizard tutorial shows you how to set the parameters necessary to perform a test. In this tutorial you perform the following tasks to set up a test:

1. Open the Test Setup window, which is the main test configuration window.
2. Set the frequency range, test type, resolution bandwidth, and reference level.
3. Select OK to exit the Test Setup window. You are prompted to name and save your test settings in a test file (.tst).

The test software does not send commands to the spectrum analyzer or other controlled equipment until you actually run the test. You can adjust test parameters until they are properly configured for your test.

**Create a Factor File**

This tutorial shows you how to select or create a correction factors file for your test equipment. In this tutorial you perform the following tasks to create a Factor file:

1. In the Test Setup window, click on the FACTORS button. The Factor Selection window appears.
2. To create a new factors file, select the Create button in the Factor Selection window.
3. Enter a frequency value and press the Enter key. Then enter the amplitude value for that frequency and press the Enter key. The new frequency and amplitude become part of the factors table.
4. Continue entering frequency values then amplitude values. New entries are sorted by frequency as they become part of the factors table.
5. To change an entry, click on its row number at the left. Then you can edit the frequency and amplitude values in the top entry boxes. Press Enter to move the new values into the factors table.
6. When you have input all values, select OK.
7. You are asked if you want to save the new correction factor file. Select Yes then enter a filename. Select OK to save the file.

You can create limit line files in the same way, by selecting the LIMITS button in the Test Setup window. Limit lines provide an amplitude line across the results graph so you can see where the measurement exceeded your limit.

**Open a Test**

This tutorial has you select a test file, perhaps the one created in the Create a Test tutorial. You can also select a test file from the supplied library of tests. These include SAE and commercial standards tests. Once a test is loaded, you modify individual settings to meet your test requirements.

**Run a Test** This tutorial shows you how to set the hardware GPIB addresses and run the current test configuration.



# Reference





## EMI Basics

This section contains an overview of electromagnetic interference (EMI) testing with a brief discussion of two important EMI standards. For more information on specific techniques and requirements of EMI testing, refer to the applicable EMI test standards. Refer to page 3–6 for a list of several important standards documents.

## EMC Concepts

Electromagnetic compatibility (EMC) is the ability of electrical or electronic equipment to coexist with other electrical or electronic equipment in its environment. The designer of electronic equipment must consider both EMI emissions from the equipment and the electromagnetic susceptibility (EMS) of the equipment to EMI from outside sources. Ideal equipment neither generates nor is susceptible to electromagnetic energy. The test software measures only EMI emissions.

### EMI Sources

Potential EMI sources exist everywhere. These sources range from nearby ballasts for fluorescent lamps to local radio and TV broadcast stations. Such sources emit electromagnetic energy primarily in well-defined, narrow-frequency bands. This type of interference is called narrow-band EMI. Digital equipment, on the other hand, can emit EMI over a broad frequency range due to the fast transitions required on digital signals. Such interference is called broadband EMI.

### EMI Paths and Modes

There are two ways that radio frequencies (EMI) can travel from a source to another piece of equipment. These are radiation and conduction. Figure 3–1 illustrates the two modes.

EMI radiation consists of electromagnetic waves from source equipment, including its power cord and cables. Low-power EMI radiation may affect local equipment, while high-power emissions can travel throughout a building or for miles around the source. Conducted EMI is radio frequency energy conducted from the source equipment, through the wires of the AC power mains, to other equipment.

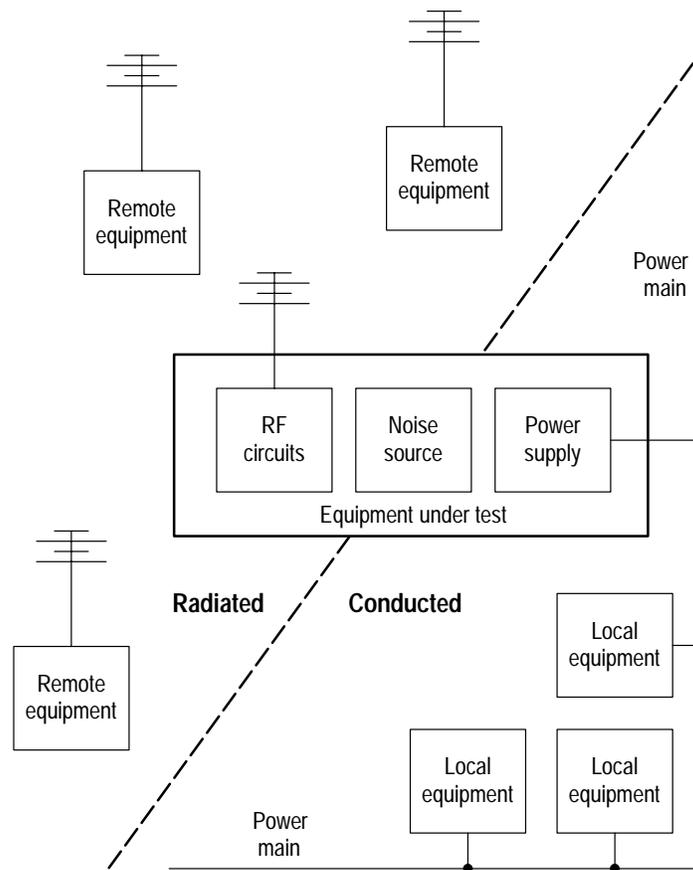


Figure 3-1: EMI propagation and coupling modes

**Narrow Band EMI**

Most electronic equipment is designed for minimum susceptibility to narrow-band EMI, such as FM broadcast signals. In some cases, minimum susceptibility is inherent in the operating range of the equipment. For example, broadcast frequency EMI may be beyond the normal operating frequency or below the sensitivity level of the equipment. More often, the equipment designer achieves EMI immunity by designing the equipment enclosure as a shield against EMI and by employing filtering and decoupling in the power supply.

Narrow-band EMI emissions are of greater concern in speciality applications, such as military communications. As a result, military EMI specifications require narrow-band and broad-band testing for equipment emissions.

Before going to an open site, you should characterize the equipment under test (EUT) to determine emissions at specific frequencies. When you get to the open site, narrow-band EMI from RF broadcast may mask your problem areas, but at least you are aware of the masking. You may require a different site or a qualified anechoic chamber to fully test your EUT.

**Test Site Qualification**

A test site must be qualified for ambient EMI levels, generally before each test session. Test site qualification includes monitoring for the presence of narrow-band EMI. EMI from a local commercial broadcast can easily mask emission problems in the equipment under test.

To better control the affects of ambient EMI, you should perform initial EMI testing in a shielded anechoic chamber. As a useful alternative to an anechoic chamber, you can perform preliminary testing on an engineering bench with the equipment under test enclosed in a grounded, wire-mesh cage.

## Summary of EMI Standards

To reduce the electromagnetic compatibility (EMC) problems experienced by industrial and retail customers, regulatory organizations established EMI standards for most electrical equipment. The standards specify acceptable EMI emissions levels and the associated testing methods. The test software measures EMI emissions to standards for *unintentional radiators*. Unintentional radiators are not designed to be RF transmitters. The software is useful for other EMI measurements, though it is not intended for susceptibility testing.

The following discussion covers the major standards. For more information, refer to the EMI standards documents listed on page 3–6.

### FCC Part 15

The FCC EMI standard applies to equipment sold or used in the United States. Subpart B, which took full effect in 1992, sets limits on radiated and power-line conducted EMI from all equipment using digital techniques and timing, or containing clock signals equal to or exceeding 9 kHz. The FCC standard requires radiated and conducted emissions tests are over specified frequency bands above 450 kHz. Test frequency limits are based on the clock speeds in the equipment under test (EUT).

The latest FCC regulations for unintentional radiators dictate the upper test limits for radiated measurements. The highest frequency generated within the EUT determines the upper limits for testing as follows :

- 30 MHz for frequencies below 1.705 MHz
- 1 GHz for frequencies from 1.705 MHz to 108 MHz
- 2 GHz for frequencies between 108 MHz and 500 MHz
- 5 GHz for frequencies from 500 MHz to 1 GHz
- Lowest of 40 GHz or 5th harmonic for frequencies over 1 GHz

The test type (conducted or radiated emissions) and equipment class determine the specific EMI frequency ranges, limits, and test distances.

**Class A and B Tests and Filing Requirements.** The standard divides equipment into Class A and Class B types. Class A equipment is intended for industrial use. Class B equipment is intended for residential use. Both classes of equipment can be qualified by testing independent of the FCC. The equipment manufacturer may perform these tests. The manufacturer must keep the test results on file. Test results data for Class B equipment must be submitted to the FCC. Test results need only be kept on file for Class A equipment. The FCC has the authority to test samples of Class A and B equipment at random to ensure that the manufacturer is in compliance.

**CISPR** European Union (EU) countries require compliance to the EMC Directive 89/336/EEC. CISPR 22, which is titled *Limits And Methods Of Measurements Of Radio Interference Characteristics And Information Technology Equipment*, is the primary RF emissions standard used to demonstrate compliance to the EMC directive. Manufacturers in the United States wishing to market electronics products in the EU must comply with CISPR 22 requirements.

The Japanese Voluntary Control Council for Interference by Data Processing Equipment has set limits identical to those of CISPR 22.

CISPR 22 divides equipment into two categories denoted as Class A ITE and Class B ITE. Class A equipment is for typical commercial use. Class B equipment is for typical domestic use.

The CISPR standard requires radiated and conducted emissions tests. The lower limit for testing is specified at 150 kHz by the CISPR standard.

**EMI Standards Documents**

Refer to the following standards documents for detailed testing requirements:

*ANSI C63.4–1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*

*CISPR 22, Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment, 1993 (EN 55022, 1995)*

*FCC 47 CFR Part 15, Radio Frequency Devices*

*IEC Specification 714, Expression of the Properties of Spectrum Analyzers*

*CISPR Publication 16, CISPR Specification for Radio Interference Measuring Apparatus and Measurement Methods, 1987*

## Peak Versus Quasi-Peak Detection

Quasi-peak detection is a CISPR method of weighting EMI measurements based on pulse signal repetition rate. Subjectively, pulse repetitions become more annoying to a broadcast listener as their rate or amplitude increases. As a result, frequent low-energy pulses are just as annoying as infrequent high-energy pulses.

To measure annoyance level relative to pulse rate, CISPR EMI receivers use a weighting function based on quasi-peak detection. The quasi-peak detector has defined charge and discharge times. By allowing the detector to discharge between pulses, lower amplitude readings are obtained for lower, repetition-rate pulses. High-repetition pulses give higher amplitude readings, since the detector does not have time to discharge between pulses.

All spectrum analyzers use peak detection, and they typically operate at a higher scan rate than EMI receivers. This higher scan rate allows quicker evaluation of EMI levels. For infrequent

pulses, peak detection from a spectrum analyzer results in a higher (unweighted) EMI reading than with quasi-peak methods. CISPR Publication 16 provides graphs of pulse rate correction factors to correlate the higher spectrum analyzer peak values with the corresponding quasi-peak values. For pulse repetition rates above 10 kHz, and for continuous wave (CW) signals, quasi-peak receivers and peak spectrum analyzers give the same results.

Pulse-rate correction factors are not usually needed, even for low-repetition-rate EMI, when the spectrum analyzer includes a quasi-peak detector, such as the Tektronix 2712 with Option 12.

Peak detection is commonly used for prequalification testing, because any product that passes EMI specification limits in the peak mode will also pass in the less-stringent quasi-peak mode.

## Correction Factors

Because no transducer is ideal, it is necessary to apply correction factors to all EMI measurements to compensate for the real-world characteristics of specific test equipment. Correction factors are applied to antenna bandwidth and gain, preamplifier gain, and cable losses. Equipment manufacturers typically provide correction factors for their transducers, antennas, and probes.

Correction factors are also useful for converting instrument readings to the correct units. For example, adding an EMI meter reading, in  $\text{dB}\mu\text{V}$ , to the antenna factor supplied by the manufacturer, yields a corrected field intensity in  $\text{dB}\mu\text{V}/\text{m}$ , the unit defined in the radiated emissions specifications.

Other corrections may be required to make accurate EMI measurements. Total EMI level calculations should include all identifiable factors including those from components such as connecting cables.

The test software includes tools that make it easy to input and edit correction factors that are then applied to the raw EMI measure-

ments. Correction factors may be entered as one constant value or as multiple values that vary with frequency. Figure 3–2 shows a plot of an antenna factor that varies with frequency.

---

**NOTE.** *The test software provides sample files of typical correction factors. Remember, since correction factors are unique for each device, you must edit the correction factor files to match the specifications of your device.*

---



Figure 3–2: Sample plot of log periodic antenna factors

## Test Equipment Considerations

The two key components of an EMI test system are the sensor for picking up EMI emissions and an RF receiver for measuring EMI emission levels. You may also find an RF Preselector useful to minimize spurious test system radiation or to block narrow-band ambient frequencies in open field testing.

### EMI Receivers

EMI tests require a spectrum analyzer or an EMI receiver to measure detected EMI. Some spectrum analyzers include special functions, such as CISPR-specified filters (200 Hz, 9 kHz, 120 kHz) and quasi-peak detectors, that help with EMI measurements. The spectrum analyzer is more of a general-purpose test instrument, while the EMI receiver is a special-purpose test instrument.

Many developers use only spectrum analyzers for prequalification testing because the spectrum analyzer can perform most EMI receiver functions. The EMI receiver performs only specialized tests and is difficult to configure for troubleshooting or other signal analysis. While the EMI receiver is optimized to perform legal certification, the versatility of the spectrum analyzer makes it effective for preliminary EMI investigations, quick quality verifications, and troubleshooting EMI problems.

The spectrum analyzer has capabilities that are particularly useful for EMI measurements:

- Broad swept-frequency ranges provide a display of wide-frequency bands, which can simplify EMI troubleshooting.
- Portability allows use in the field.
- Digital Storage and Maximum Hold (available on all Tektronix spectrum analyzers) allow unattended broadband monitoring for infrequent or spurious EMI emissions.
- Digitized spectra and a PC control interface simplify EMI data logging. The PC interface also allows automatic equipment set up

and computation on the measurement data, including any correction factors.

### Overview of EMI Sensors

Several types of sensors and EMI pickup devices are required for EMI testing. A sensor receives the EMI signal and couples it to the spectrum analyzer. The spectrum analyzer displays and measures the detected EMI signal.

Many sensors are available to support a variety of EMI measurements. The type of sensor required is determined by the test standard (FCC or CISPR), the type of test (radiated electric field, radiated magnetic field, or conducted), and the tested frequency range. For example, radiated electric field (E) tests use biconical, log periodic, or dipole antennas, while magnetic field (H) tests use a magnetic loop antenna.

### Conducted EMI Sensors

Transducers required for conducted EMI measurements are generally specified by the type of testing. For example, the FCC and CISPR specify the use of a Line Impedance Stabilization Network (LISN) for conducted EMI measurements.

The LISN performs the following two functions:

- Ports the RF energy coming from the equipment under test (EUT) through its power cord.
- Decouples energy from the AC power mains that could affect the measurement.

The LISN provides isolation between the power mains and the EUT. The governing Standards specification gives the circuit diagrams for the LISN required in a given test.



---

**CAUTION.** *Never turn the equipment under test on or off with a LISN RF signal cable connected to the spectrum analyzer. The power cycling causes surge currents that can damage the sensitive input of the spectrum analyzer.*

---

### Radiated EMI Antennas

Radiated EMI measurements require the use of an antenna. Many types of antennas are available. E-field measurements are often made with dipoles, tunable dipoles, or broadband antennas. Broadband antennas, such as the biconical or log periodic antennas, increase the efficiency of EMI measurements. Broadband antennas are typically better than tunable dipoles for automated measurements.

The FCC allows the use of tuned dipoles or broadband antennas for radiated E-field measurements. In addition to the antennas specified in the EMI Standards specifications, near-field probes can help determine the sources and characteristics of EUT radiation. By moving a near-field probe around your EUT, you can distinguish between emissions from sources such as a keyboard and an oscillator.

### RF Preselectors

A preselector is a filter placed on the input of the spectrum analyzer. The preselector passes desirable signal components or frequency bands while stopping others. Preselectors serve three main purposes:

- Control the input signal to minimize spurious responses within the spectrum analyzer. A general purpose preselector prevents spurious responses during mixer conversion. This use permits a wide preselector bandwidth as long as spurious signals, such as the conversion image, are restricted.
- Limit the width of the input spectrum. Limiting the bandwidth of the input spectrum provides an increase in the dynamic range of the measurement, especially when performing quasi-peak

measurements. For information on quasi-peak measurements, refer to page 3–6.

- Block large ambient signals for open site measurement. Preselectors used for EMI applications have more stringent performance specifications than a typical preselector for spectrum analysis.

The primary difference between a general-purpose preselector used for spectrum analysis and a preselector designed for EMI measurement is in the preselector bandwidth. A preselector optimized for EMI measurement must have a narrower bandwidth in order to reduce the input level from large ambient sources. A spectrum analyzer that employs a low-pass, 1 GHz filter may benefit from a separate preselector filter for some EMI measurements.

### Types of Preselectors

The simplest EMI preselection system consists of several individual filters that may be selected as needed. A band-stop filter, for instance, can eliminate a high-level broadcast source that interferes with the measurement. This technique is inexpensive, but is slower and not easy to set up.

High-performance EMI preselectors are typically swept filter types, which provide filter bandwidths between 20% and 5% of the center frequency of the filter. For example, a 20 MHz bandwidth is possible with a 400 MHz center frequency. Narrow bandwidth filtering provides overload protection from large broadcast signals while allowing higher sensitivity measurement of the crucial signal elements.

Another alternative is the Tektronix 2706 RF Preselector. The RF preselector consists of eight stepped bandpass filters. These filters and their associated switches provide manual operation or automated operation using GPIB commands. The typical operating bandwidth is 250 MHz for a 400 MHz center frequency, which is wider than with swept filter preselectors.

The bandpass transmission start and stop frequencies are based on the CISPR band requirements, such as 150 kHz to 30 MHz, and on the expected EMI signal intensity at specific frequencies. For example, broadband EMI signals usually have the highest intensity at the lower frequencies. While it is possible that an EMI signal can overload a spectrum analyzer using the RF preselector, it is not likely given the usual spectral distribution of such signals. The automated signal overload software, provided by Tektronix, can identify possible overload signals and prevent erroneous measurements.

## Preparations Before Testing

There are certain preliminary steps required before beginning EMI testing. Most of the issues discussed here apply equally to open field testing and chamber testing. For all testing, the standards documents from the specific regulating agencies (such as FCC or CISPR) should take precedence for test procedures and methodology over any information presented here.

### **Calibrated Equipment**

All equipment should be calibrated according to the procedures provided by the equipment manufacturer. For spectrum analyzers, the operator calibration procedures are straightforward. In fact, you can calibrate some instruments by simply pressing a button to initiate autocalibration. On other instruments, you follow procedures in the instrument manual to perform necessary checks or adjustment of amplitude, frequency, and sensitivity.

### **Correction Factors**

Determine which correction factor tables are necessary for the EMI probe and receiver you will use to acquire signals. Manufacturers of these devices provide correction factor tables. Correction factor tables are discussed further on page 3–7.

### Detecting Mixer Overload

When an input signal amplitude exceeds the normal operating range of the input mixer of an instrument, it causes front-end overload. When overload occurs, displayed signal amplitudes will not change proportionally with signal input level. Also, frequency components not originally in the input signal are created by the mixer overload. These false components increase in level two to three times faster than the valid input level.

To quickly check for overload, add 10 dB of attenuation to the input signal. If the displayed signal amplitude drops by about 10 dB, then overload is not likely. If the signal amplitude does not drop by 10 dB, overload is likely.

Detector overload most often occurs in the following situations:

- When monitoring line frequency (usually 50 or 60 Hz) and high-frequency switching power supply signals during conducted EMI measurements
- When taking measurements in close proximity to broadcast stations or communication facilities, especially if an external amplifier is used with the antennas

The following techniques can reduce or eliminate the effects of an overload signal:

- Reduce the amplitude of the overload-causing signal. Rearrange the test equipment so the receiving antenna points in a different direction. When possible, move to a different, quieter environment to reduce overload.
- Apply more attenuation to the front end of the spectrum analyzer. This technique reduces the level of the offending signal, but it also reduces the level of all signal elements.
- Reduce or eliminate the effect of overload by using a preselector. Refer to the preselector discussion on page 3–11.

## Open-Field Site Testing

Until recently, all CISPR and FCC standard measurements were specified with open-field test sites. Now both open field test sites and anechoic chambers may be qualified for EMC testing. Figure 3–3 on page 3–18 shows the requirements for an open field test site. The Open-Field Site Testing must meet all the requirements stated in the appropriate standards documentation and be qualified by the FCC before making certification and verification measurements.

Radiated emissions specifications are based on open-field measurements made in a low ambient EMI environment. However, such measurements are often not possible or practical.

One reason is that most industry is located near large cities. Such areas are notorious for broadcast saturation and many other types of intentional and unintentional EMI sources. The concept of a low ambient EMI environment in an open-field situation usually is not practical. Inclement weather further limits the testing possible outside in an open-field environment.

### Qualifying an Open Field Site

The FCC has specified procedures for verifying the proper characteristics of an open-field site used for radiated EMI testing. These procedures include recording ambient EMI levels and measuring the site-path attenuation. Both of these verification tests are also required for qualifying an anechoic chamber as a test site.

Except for reflections from the ground along the propagation path, a test area should be free from reflections. Reflections can cause deep nulls in the frequency response of the site, or large variations in signal level with changes in equipment orientation.

For testing the ambient EMI level, a spectrum analyzer with digital storage is quite effective. The spectrum analyzer can be left in the Max Hold mode, which causes signals above the peak noise level to be stored and displayed. This feature allows the capture of

infrequent signals (for example, police and other emergency communications) that may affect the test site.

The FCC bulletin FCC 47 CFR Part 15 provides details for comparing measured attenuation over the site path with that of a theoretical model. The CISPR requirements are slightly different from those required by the FCC.

## Anechoic Chamber Testing

An anechoic chamber is a special room that is shielded from outside EMI and that is extremely absorbant of internal EMI. The design of anechoic chambers has improved in recent years, prompting the FCC to allow their use for final EMC qualification. The advantage of an anechoic chamber is that it can be sited within a city and still provide excellent immunity from ambient broadcast sources.

The main features of an anechoic chamber are as follows:

- Physical dimensions that allow the specified separation between the equipment under test (EUT) and the antenna and probes. The height of the room must allow movement of the antenna from one to four meters above the floor as the standard requires.
- Walls and ceiling covered with an effective RF absorber to eliminate reflections except from the floor. New ferrite tile materials are very effective as an RF absorber.
- A floor that is very conductive and provides an effective ground plane. The floor produces reflections as the standards require.
- An atmosphere in the chamber that provides attenuation of transmitted signals within  $\pm 4$  dB of the Normalized Site Attenuation (NSA) standard.

- Power filters that prevent external EMI from conducting through the power leads of the equipment under test. The availability of clean power is another advantage of the anechoic chamber over an open site.

All other requirements for an open air test site must be met for the anechoic chamber. Anechoic chambers must be qualified by the FCC.

## Conducting EMI Tests

The most common EMI tests are radiated and conducted emissions tests. Typical setups for these tests are illustrated in Figures 3–3, 3–4, and 3–5. Refer to page 3–4 for summaries of the FCC and CISPR standards. For specific test requirements, refer to the respective EMI standards documents.

### Radiated Emissions Testing

The general test procedure for radiated tests require taking signal level measurements across specified frequency bands with the antenna in a horizontal or vertical plane, relative to the ground. The spectral measurements must then be corrected with the appropriate correction factors. Testing is repeated over the same frequency bands with changes in the antenna orientation as proscribed by the standards documents. For each antenna orientation, antenna height may also need to be varied.

Testing should be repeated for four complete test sequences with the equipment under test (EUT) rotated 90° for each test sequence. In the case of automated testing, the EUT can be rotated 360° on an automated turntable, while worst-case emissions are detected using the Max Hold feature of the spectrum analyzer.

The testing goal is to locate the highest level of emissions from the equipment under test. If these emissions exceed specification limits, then the emission source must be isolated and eliminated, or the equipment must be repackaged to reduce the emissions to acceptable levels.

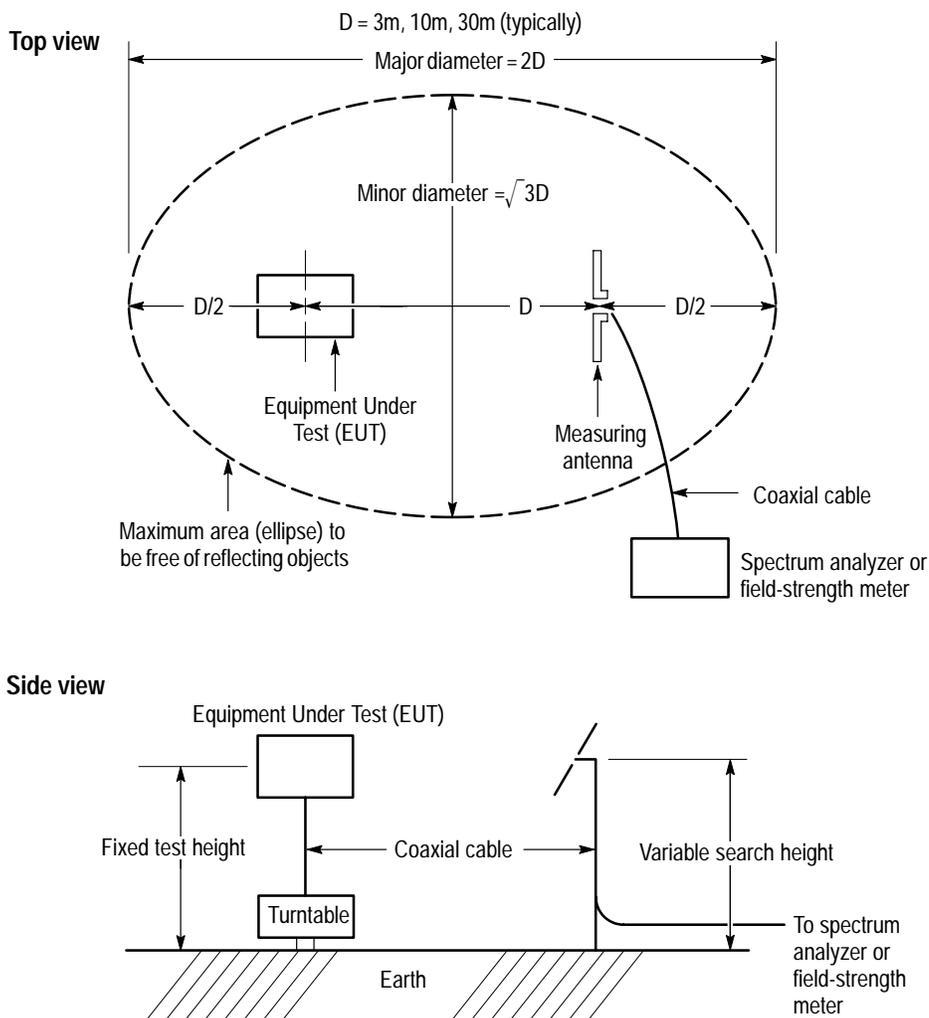


Figure 3-3: Typical configuration for radiated emissions tests

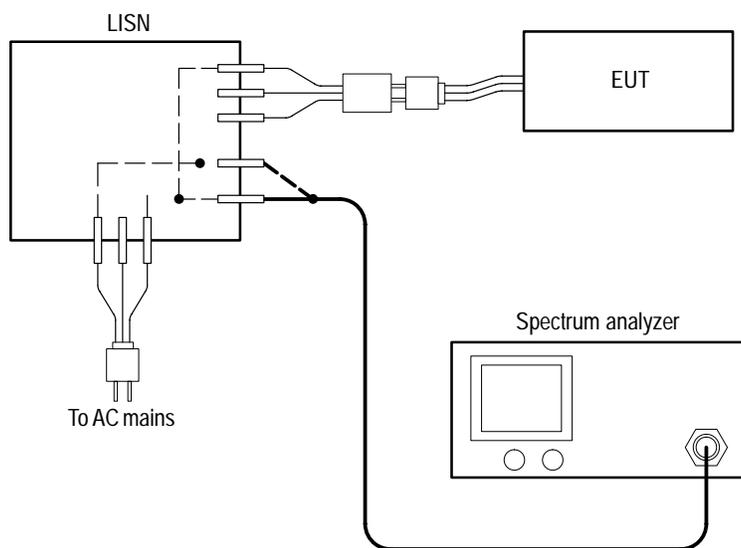


Figure 3-4: Typical configuration for conducted emissions tests

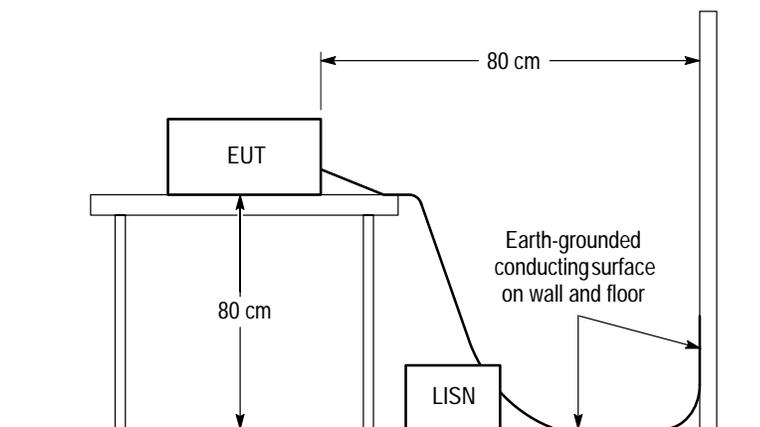


Figure 3-5: Typical configuration for testing in an Anechoic chamber

### **Variations in Test Results**

In addition to the site itself, other factors are responsible for the accuracy of the final measurement. The accuracy of the transducer conversion factors affects the final measurement. The antenna or probe is calibrated at a specified frequency interval, but the measurements may be made at any frequency. If the antenna or LISN is improperly calibrated, or not calibrated over sufficient bandwidth, it could affect the final measurement.

The measurement equipment must be calibrated and certified to be accurate. Amplifiers, in-line attenuators, and cables must all be calibrated before taking the final measurements.

The equipment must be operated properly; use of the wrong bandwidth, or improper attenuator settings can greatly affect EMI measurements. Each of these items may have a great effect on the accuracy of measurements.

### **Automating the Process**

The process of qualifying or auditing EMI compliance can be very time consuming and can accumulate a large amount of data. Additionally, more extensive testing is now required by regulating agencies.

Spectrum analyzers automate measurements in several ways. They provide a broadband look at EMI spectra. Unlike most EMI receivers, spectrum analyzers provide automated tuning plus digital storage and processing of signal spectra. Additionally, display markers with on-screen readout both simplify and speed the determination of spectral levels.

The use of test software run on a PC significantly shortens the testing process. PC control allows programmed instrument setup for various test requirements, transfer of acquired data to the computer, programmed antenna factor correction, and automatic comparison of data to specification limits. Additionally, graphics capability allows the results to be displayed and incorporated into qualification documents.



# Appendices



## Appendix A: File Naming Conventions

This appendix describes the file naming conventions used for the test software files and the purpose of each file. Table A-1 lists the limit (LIM), factor (RAD and CON), and test (TST) files included with the test software.

**Table A-1: Listing of limit, factor, and test files**

Filename	
55011ARQ.LIM	EN55011 Class A – Radiated Emissions, 30 meters (QP)
55022ACA.LIM	EN55011/22 Class A – Conducted Emissions (AV)
55022ACQ.LIM	EN55011/22 Class A – Conducted Emissions (QP)
55022ARQ.LIM	EN55022 Class A – Radiated Emissions, 10 meters (QP)
55022BCA.LIM	EN55011/22 Class B – Conducted Emissions (AV)
55022BCQ.LIM	EN55011/22 Class B – Conducted Emissions (QP)
55022BRQ.LIM	EN55011/22 Class B – Radiated Emissions, 10 meters (QP)
SAEJ551.LIM	SAE Peak, 120 kHz RBW, 10 meters
SAEJ551Q.LIM	SAE QP, 120 kHz RBW, 10 meters
FCCA_CND.LIM	FCC Part 15, Class A – Conducted Emissions
FCCA_RAD.LIM	FCC Part 15, Class A – Radiated Emissions, 10 meters
FCCB_CND.LIM	FCC Part 15, Class B – Conducted Emissions
FCCB_RAD.LIM	FCC Part 15, Class B – Radiated Emissions, 3 meters

**Table A-1: Listing of limit, factor, and test files (cont.)**

Filename	
EM_6912A.RAD	SAMPLE – Electro-Metrics EM-6912A Biconical Antenna, S/N 102 – 3 meters
EM_LPA30.RAD	SAMPLE – Electro-Metrics LPA-30 Log Periodic Antenna
EM_7820.CON	SAMPLE – Electro-Metrics EM-7820 LISN
55022BCQ.TST	EN55011/22 Class B – Conducted Emissions
55022BRQ.TST	EN55011/22 Class B – Radiated Emissions, 10 meters
FCCA_CND.TST	FCC Part 15, Class A – Conducted Emissions
FCCA_RAD.TST	FCC Part 15, Class A – Radiated Emissions, 10 meters
FCCB_CND.TST	FCC Part 15, Class B – Conducted Emissions
FCCB_RAD.TST	FCC Part 15, Class B – Radiated Emissions, 3 meters
SAE_J551.TST	SAE J551 Test, Rev MAR 90



# Glossary



# Glossary

**Acquire**

To capture a waveshape as a series of numeric values, through a process called digitizing. The software uses 500 acquired points in each waveform captured from Tektronix spectrum analyzers. A data set from an EMI test may include more than one waveform.

**Accuracy**

Conformity or degree of conformity to a performance requirement; usually expressed as allowable error, a range of permissible values, or an upper or lower limit.

**Address, primary**

A selectable value that identifies a unique GPIB-configured device and enables a controller to differentiate between devices connected to the bus.

**Amplitude**

The magnitude of an electrical signal, usually expressed in dBm.

**ANSI**

American National Standards Institute.

**ASCII**

American Standard Code for Information Exchange.

**Auto-Acquisition**

A software operating mode that allows the software to automatically acquire a waveform, without operator intervention.

**Average**

A spectrum analyzer operating mode that allows the mean of several acquisitions to be analyzed as a single waveform.

Averaging allows the software to analyze noisy signals, since the random noise is mathematically reduced by the averaging. The software is configured to achieve average detection through the use of video filtering.

**Band**

The basic building block of any EMI test. When performing EMI tests, a band is a range of frequencies to be tested using a single transducer and set of correction factors.

**Bandwidth**

The difference between the limiting frequencies of a continuous frequency band. See also *Resolution Bandwidth*.

**Broadband**

Any pulsed signal having a pulse repetition frequency that is less than the measuring instrument's bandwidth setting. The frequencies in a broadband signal fill its entire occupied bandwidth. Because a broadband signal is widely dispersed spectrally, its power level at one frequency is a function of the measuring bandwidth used. See *broadband Versus Narrow band EMI* in Section 2 of this manual for a discussion of differentiating broadband and narrow band signals. See also *Narrow band*.

**Calibrate**

To compare actual performance against a standard, and adjust into conformity with a standard.

**Compression**

A spectrum analyzer condition caused by an input signal with an amplitude greater than the spectrum analyzer is capable of measuring. Compression is the difference between the measured and actual signal amplitude.

**dB**

Decibel. 10 times the base-10 log of one electrical power to another, or 20 times the base-10 log for voltage or current.

**dB $\mu$ V**

Voltage with reference to 1  $\mu$ V. dB $\mu$ V is the unit of measure for Conducted EMI tests when using a LISN. A dB $\mu$ V value is expressed as 20 times the base-10 log of the result of a voltage divided by 1  $\mu$ V.

**dB $\mu$ V/m**

Voltage converted to field strength by adding antenna factors. dB $\mu$ V/m is the unit of measure for commercial Radiated EMI tests.

**dBm**

A logarithmic unit of power referenced to 1 mW. dBm is the default unit of measure for the spectrum analyzer. A dBm value is expressed as 10 times the base-10 log of the result of a power (in watts) divided by 1 mW.

**Digital Storage**

Waveforms retained in digital form in memory.

**Digitize**

Convert an analog measurement of a physical variable into a numerical value to express the quantity in digital form.

**EMC**

Electromagnetic Compatibility. EMC is the absence of signals that interfere with the intended operation of a particular electronic device.

**EMI**

Electromagnetic Interference. EMI is the presence of signals that may interfere with the intended operation of electronic devices. EMI may prevent a device from meeting compliance standard(s) of a regulatory agency or agencies.

**Factor File**

A file that contains specific settings information for the portion of an EMI test associated with that frequency range.

**Filter Loss**

See *Insertion Loss*.

**Frequency**

The rate at which a signal oscillates, or changes polarity, expressed as Hertz, or number of cycles per second.

**Frequency Drift**

See *Stability*.

**Frequency Range**

The range of frequencies over which the performance of the instrument is specified. Frequency span is expressed in Hertz or Hertz per division.

**Gain Compression**

Maximum input level where the scale linearity error starts increasing.

**GPIB**

General Purpose Interface Bus. A system enabling remote operation between the spectrum analyzer and external equipment, such as controllers, printers, plotters, and display units.

**Insertion Gain**

Any increase in signal amplitude caused by placing a device in the signal path. Insertion gain is typically caused by adding a preamplifier.

**Insertion Loss**

Any decrease in signal amplitude caused by placing a device in the signal path. Insertion loss is typically caused by antennas, cables, attenuators, and preselector filters.

**Limits**

The amount of EMI acceptable by various regulatory agencies and their respective standards, such as FCC, CISPR and VDE.

**LISN**

Line Impedance Stabilization Network. A transducer used for conducted EMI measurements on equipment under test.

**Low-Pass Filter**

A filter that passes all signal frequencies below a nominal cut-off frequency while attenuating all higher frequencies.

**Marker**

An intensified movable cursor indicating a specified frequency point for the purpose of identification, measurement, and comparison.

**Max Hold**

A spectrum analyzer feature that captures the maximum signal amplitude at all displayed frequencies over a series of sweeps.

**Max Span**

The maximum frequency span that can be swept and displayed by the spectrum analyzer. See also *Zero Span*.

**Maximum Input Level**

The maximum input signal amplitude that can be safely handled.

**Maximum Safe Input Power (Without Damage)**

The maximum power applied at the input that will not cause damage to the measuring instrument.

**Narrow Band**

A discrete signal appearing only at particular frequency positions. The indicated power does not change as a function of measurement bandwidth. See also *Broadband*.

**Noise Floor**

The internal noise of an instrument or system that represents the minimum limit at which input signals can be observed. The spectrum analyzer noise floor appears as a baseline in the display even when no signal is present.

**Peak**

The point or points of a waveform having the highest amplitude. Also, the "normal" method of acquiring a signal with a spectrum analyzer.

**Peak Detection**

A detection scheme where the peak amplitude of a signal is measured and displayed.

**Polarization**

The orientation of a signal being propagated through the air. Radiated signals for EMI detection are commonly detected using vertical and horizontal polarizations.

**Preselector**

A tracking filter located ahead of the first mixer that allows only a narrow band of frequencies to pass into the mixer. A preselector prevents out-of-band signals from overloading the spectrum analyzer input.

**Pulse Repetition Rate**

The average number of pulses per unit of time. Often, the measurement is expressed as pulse repetition frequency, and is measured in hertz. For example, a signal with a pulse rate of 1 millisecond has a pulse repetition frequency of 1 kHz.

**Quasi-Peak**

A method of acquiring a signal that yields the effective amount of energy in the signal. Quasi-peak analysis takes into account not only the peak amplitude of the signal, but also its bandwidth characteristics and pulse repetition rate. Refer to *Peak Versus Quasi-Peak Detection*, in the *Reference* section of this manual, for further information.

**Quasi-Peak Detector**

A voltage detector with specified charge and discharge times.

**Reference Level**

The signal level required to deflect the CRT display to the top graticule line.

**Resolution Bandwidth**

The specified bandwidth of the filter in the IF stages of the spectrum analyzer. The resolution bandwidth determines how well the spectrum analyzer can resolve or separate two or more closely spaced signal components.

**Span Per Division (Span/Div)**

The frequency difference represented by each major horizontal division of the graticule.

**Spectrum**

The frequency domain representation of a signal where it is represented by displaying its frequency distribution.

**Spectrum Analysis**

The technique or process for determining the frequency distribution of a signal.

**Spectrum Analyzer**

A device for determining the frequency components of a signal. A spectrum analyzer displays the power distribution of an incoming signal as a function of frequency.

**Start Frequency**

The frequency at the left-hand edge of the spectrum analyzer display.

**Stop Frequency**

The frequency at the right-hand edge of the spectrum analyzer display.

**Sweep Rate**

The speed, expressed in time per horizontal division, at which the spectrum analyzer is tuned.

**Test**

A complete set of measurements made on an EMI source. A test may consist of measurements made at multiple frequencies, distances, and orientations, with multiple transducers and polarizations.

**Total Span**

The total width of the displayed spectrum; the span/div times the number of divisions.

**Transducer**

Any device that collects energy for its measurement. EMI transducers are typically either antennas or LISNs.

**Video Filter**

A post-detection low-pass filter (sometimes referred to as a noise averaging filter) used primarily to smooth the displayed spectrum.



# Index



# Index

## A

- Accessories, 1–2
- Addresses, setting for GPIB, 1–5
- Advanced user selection, 1–8
- Anechoic chamber testing, 3–16

## C

- CISPR EMI standard, 3–5
- Concepts, of EMI measurement, 3–1
- Conducting EMI tests, 3–17
- Correction factors
  - file naming, A–1
  - in EMI testing, 3–7
- Create a factor file, 2–3
- Create a test, 2–2

## D

- Documents, related, iii

## E

- EMI concepts
  - EMI sources, 3–1
  - EMI standards, 3–4
  - narrow band EMI, 3–3
  - paths and modes, 3–1
  - test site qualification, 3–3
- EMI basics, 3–1
- EMI concepts, 3–1
  - anechoic chamber testing, 3–16
  - automating tests, 3–20
  - conducted sensors, 3–10

- conducting EMI tests, 3–17
- correction factors, 3–7
- equipment configuration, 3–18
- open-field site testing, 3–14
- peak versus quasi-peak detection, 3–6
- preparations for testing, 3–13
- qualifying an open-field site, 3–15
- radiated antennas, 3–11
- receivers, 3–9
- RF preselector, 3–11
- RF preselector types, 3–12
- sensors, 3–10
- test equipment, 3–9
  - variations in test results, 3–20
- EMI receivers, 3–9
- Equipment, supported, 1–2

## F

- FCC standards, 3–4
- File naming conventions, A–1
- Files, installed, 1–7
- First time operation, 1–8

## G

- Getting started, 1–1
  - EMI basics discussion, 3–1
  - first time operation, 1–8
  - new user or advanced user, 1–8
  - online help, 1–9
  - online tutorial, 2–1
- GPIB
  - configuration, 1–5
  - supported PC cards, 1–6

## H

- Help
  - online, 1–9
  - online help wizard, 2–1

## I

- IEEE 488. *See* GPIB
- Installation
  - GPIB configuration, 1–5
  - installed file list, 1–7
  - library files, A–1
  - of software, 1–3
  - system requirements, 1–3

## L

- Limit lines, library files, A–1

## M

- Manuals, related, iii

## N

- Narrow band EMI, 3–3
- New user selection, 1–8

## O

- Online help, 1–9
  - using the help wizard, 2–1
- Open a test, 2–3
- Open-field site testing, 3–14
  - qualification, 3–15
- Operating basics, 2–1
- Options. *See* Accessories

## P

- Peak detection, compared to quasi-peak detection, 3–6
- Preparations, before EMI testing, 3–13
- Product description, 1–1

## Q

- Quasi-peak detection, compared to peak detection, 3–6

## R

- Radiated and conducted modes, 3–1
- Related documents, iii
- Requirements, PC system, 1–3
- RF preselector, types, 3–12
- RF preselectors, description, 3–11
- Run a test, 2–4
- Running the software, 1–8

## S

- Sensors
  - antennas, 3–11
  - conducted EMI, 3–10
  - overview, 3–10
- Software
  - file naming conventions, A–1
  - functions offered, 1–1
  - online help, 1–9
  - product description, 1–1
  - running the first time, 1–8
- Sources, of EMI, 3–1
- Standards
  - CISPR, 3–5
  - FCC Part 15, 3–4
  - for EMI testing, 3–4

reference documents, 3–6  
Starting the software, 1–8  
System requirements, 1–3

## T

Test equipment  
for EMI testing, 3–9  
supported, 1–2

typical configuration, 3–18  
Test files, library files, A–1  
Test site qualification, 3–3  
Tutorial  
creating a factor file, 2–3  
creating a test, 2–2  
online, 2–1  
open an existing test file, 2–3  
run a test, 2–4

## Index

---



