HEWLETT PACKARD

Designing for EMC Seminar

Technical Data

HP Education Services: Your Key to Higher Productivity

Course Overview

This course covers major electromagnetic compatibility (EMC) topics and provides a solid understanding of potential electromagnetic interference problems, where they are likely to occur, and approaches to fixing them.

Course Features

- Determine sources and apply fixes to EMC problems
- Understand how common-impedance coupling occurs and how to prevent it
- Identify where radiation is generated in digital circuits and how to minimize it
- Understand differences between cable types
- Recognize good grounding practices for circuits and cables
- Identify different modes of conducted emissions
- Understand differences between cable types
- Recognized good grounding practices for circuits and cables
- Identify different modes of conducted emissions
- Understand radiated susceptibility and conducted susceptibility
- Understand how humans act as electrostatic discharge sources
- Determine the effect of shielding techniques on different sources of emissions
- Identify diagnostic techniques used in investigation and characterizing circuit designs

Specifications

Course Length
2 days

Audience
Digital engineers who want a solid understanding of the problems encountered and considered in designing for EMC.

Prerequisites
A good understanding of fundamental circuit theory

Delivery Method
Classroom, Dedicated

Format
Instruction consists of 90 percent lecture and 10 percent demonstrations by a Hewlett-Packard expert who provides up-to-date information on solving EMC problems.

Ordering Information

To order the Designing for EMC Seminar (HP 11949A) in the U.S. call 1-800-HPCLASS (800-472-5277).

HP's Customer Registration Center can provide you with price and enrollment information about a scheduled class (HP 11949A) or a dedicated class (HP 11950X).

Outside the U.S., contact your nearest local HP sales office.

Classroom Training Benefits

Experienced HP Instructors
Learn from an experienced HP instructor who is an expert in using and applying instrument systems to meet your measurement needs.

Comprehensive Student Materials
Copies of course materials are provided for future reference on the job.

Available at HP Classrooms or Your Site
Take advantage of HP's learning facilities, equipment, and interactive learning environment by attending class at an HP facility. Or, save travel expenses and time by organizing a dedicated class at your location.

Regularly Scheduled Classes
Plan training months in advance.

Course Number: 11949A (scheduled)
11950X (Dedicated)

Detailed Course Agenda:

Introduction
– Electromagnetic compatibility
– Approaches to EMC and fundamental concepts
– Overview of time- and frequency-domain concepts

The section begins through coverage of the many facets of EMC design. You will learn that the various design techniques presented are derived from a basic set of fundamental principles and that the techniques aid each other in achieving compatibility.

Non-conducted coupling
– Electric- and magnetic-field coupling
– The effect of impedance on coupling type
– Mixed coupling

This section examines simple low-frequency models for both capacitive and inductive coupling. In many situations, both types of coupling exist, so the ramifications of mixed coupling are explored.

Common-impedance coupling
– Grounding
– Power-supply distribution

Grounding and power-supply distribution techniques for circuits are discussed in this section. The primary demonstration vehicle will be circuits on PCBs, but the concepts presented apply in other situations. This section includes a detailed discussion of transmission-line models and ground inductance.

Radiation from digital circuits
– Radiation from current loops
– Common-mode radiation and chokes
– Tools for troubleshooting

This critically important section deals with the principle mechanisms for radiated emissions from digital circuits diagnostic techniques and practical ways to minimize emissions. We include a discussion of spectral coherence, spectral effect of ringing, as well as magnetic- and electric-field probes.

Cables
– Twisted pair, ribbon, and shielded cables
– Grounding and radiation
– Diagnosing cable emissions

Our section on cables illustrates methods for minimizing both magnetic- and electric-field coupling to and from cables... including twisted pairs, ribbon cables, and cables with cylindrical shields.

Advanced cables
– Ground-loop and common-mode coupling
– Breaking loops
– Shielding effectiveness of cables

This section will define ground-loop coupling and differentiate it from the closely related phenomenon of common-mode coupling. Methods for reducing or eliminating such coupling will be examined. In addition, the concept of cable transfer impedance will be introduced because this parameter has a major effect on coupling to cables at high frequencies.

Conducted emissions
– Common and differential-mode couplings
– Breaking loops
– Shielding effectiveness of cables
– Conducted emissions
– Common differential mode of interference
– Topology and mounting of power-line filters
– Component placement and mounting
– Susceptibility
– Radiated and conducted susceptibility
– Plane-wave coupling to transmission lines
– Conducted susceptibility

Here we observe the types of conducted emissions and an outline of the design of EMI power-line filters. The ramifications and mounting of a power-line filter are covered because its locations have a significant impact on its effectiveness. In addition, practical fixes for reducing emissions from switching power supplies are given.

Electrostatic discharge
– Humans as ESD sources
– Direct and indirect coupling of ESD
– ESD coupling in cables
– Input protection

In this section we discuss ways to increase the immunity of a piece of equipment to external sources of interference. Areas such as parasitic resonances plane-wave coupling, audio rectification, and power-line- transient suppression will be discussed.

Shielding
– Basics of electronic and magnetic shielding effectiveness
– Discontinuities in the shield
– Cabling to shields
– Shielding low-frequency magnetic shields
– Measurement shielding effectiveness

Included in this section are the basic principles of shielding and conceptual models for handling the effect of discontinuities in the shield. Low-frequency magnetic fields are particularly difficult to shield against and therefore will receive special attention. We'll look at applications of shielding materials, such as gaskets.

Diagnostics
– The use of commonly available tools to diagnose the previously discussed EMI problems

Our final section presents ways to characterize, locate and fix EMI problems from an equipment-level perspective. In doing so, the principal trouble-shooting and design techniques of this course will be integrated.

Printed 4/96

Publication Number 5962-9212EUS

Course Number: 11949A (scheduled)
11950X (Dedicated)