



Elya Joffe

Electromagnetic Solutions, Ltd

Understanding MIL-STD-461E and MIL-STD-464: A Survival Guide for EMC From Equipment to System

Background

"THE FIRST STEP IN SUCCESSFUL SYSTEM DESIGN IS THE PROPER FORMULATION AND TAILORING OF THE REQUIREMENTS"

"EQUIPMENT EMC IS THE BASIS FOR SYSTEM AND PLATFORM COMPATIBILITY: NEITHER CAN BE COMPROMISED!"

The discipline of Electromagnetic Compatibility (EMC) is concerned with the design of electrical and electronic equipment, systems, platforms and installations, while minimizing electromagnetic coupling and interference from within the system and between systems to their environment.

It therefore covers and requires involvement in a wide range of other fields of engineering, wiring and cabling engineering, electronic engineering, etc.

Achieving EMC, whether within the equipment, within the system or between systems to the platform, require the careful application and implementation of strict EMC standards.

MIL-STD-461 is concerned only with "...technical requirements for controlling electromagnetic interference (EMI) emissions and susceptibility at the subsystem-level and equipment-level".

"...System-level requirements dealing with integration of subsystems and equipment are contained in documents such as MIL-STD-464... The procuring activity and system contractors should review the requirements contained herein for possible tailoring based on system design and expected operational environments".

The above citations highlight the complexity of application of equipment and system-level EMC requirements: The user is highly encouraged to tailor equipment-level EMC requirements based on the system-level electromagnetic environment and requirements.

Regretfully, this is easier said than done. MIL-STD-461 significantly differs from older versions of MIL-STD-461, and is not "backwards compatible" in any way. Furthermore, it encourages tailoring, based on system and installation requirements, which are defined in MIL-STD-464, a complex standard providing a broad spectrum of electromagnetic effects, but – those may or may not apply to the particular system, and might lead to over or under design. In addition, it encourages the use of commercial off the shelf (COTS) equipment and non-development items (NDI) but provides no guidance as to... how to do it.

Application of both standards requires, therefore, a clear understanding of the requirements outlined in them, and the basis for application of tailoring to the needs of the particular system.

Course Objectives

This two-day comprehensive course provides the trainees with the understanding of the equipment and system-level EMC requirements, as outlined in MIL-STD-461 and MIL-STD-464, the inter-relationship between the two and the manner of using those standards for defining the necessary requirements for the particular system.

It is particularly intended to shed some light on the rationale behind the requirements and the manner and basis for tailoring EMC requirements for achieving risk-free yet - cost-effective EMC design.

Mathematical derivations and calculations are kept to the minimum necessary, whereas the practical applications will be extensively discussed.

Practical "real life" case studies are used as examples, and case studies are extensively used along the Course. Sample exercises of requirements specifications will also be discussed and presented.

Bring your particular needs and requirements and return with practical and useful solutions.

Target Trainees

The Course is intended for system and equipment design and development engineers as well as project engineers, who are active in the development of specification, formulation and application of EMC requirements, whether in the equipment or in the system and platform level.

The Course is also intended for qualification or engineering management of electronic and electrical systems and their installation.

Benefit to the Participants

Participants in the Course will:-

- acquire a fundamental knowledge of the problem and interference sources in electrical and electronic systems
- obtain a systematic approach to the concepts of formulation of equipment and system-level requirements and the methods and methodology for tailoring EMC requirements to the equipment and system needs
- understand the importance and application of incorporating Non-development Items (NDI) required to be integrated in systems required to meet severe EMC requirements, as outlined in the Military Standards

A CD-ROM with MIL-STD-461, MIL-STD-464 and other necessary documents will be provided to the Participants.

In addition, participants are encouraged to bring forward actual problems and questions they encountered, which the instructor will attempt to assist in their solution.

Course Outline

Module 1: Introduction – Fundamental concepts

- Nature of an EMI problem

- EMI sources, victims and interactions
- “EMI – The Silent Threat”: A video presentation
- Why design for EMC – motivation and motives?

Module 2: Signals and Coupling Modes

- Spectral contents of signals
- Interference modes – common mode vs. differential mode signals
- Signal coupling and propagation: “path of least impedance”
- Transmission line fundamentals and frequency considerations
- Examples of system and equipment EMI interactions and EMC problems
- The electromagnetic environment

Module 2: MIL-STD-461E: Equipment-Level EMC Standard

- Heritage of MIL-STD-461
- Formulation of EMC requirements by equipment and application
- MIL-STD-461 emission and susceptibility requirements
- MIL-STD-461 emission and susceptibility testing
- Equipment-level data item (documentation) description (DIDS)

Module 3: MIL-STD-464: Integrated System-Level EMC Standard

- Heritage of MIL-STD-464
- Structure and applicability of MIL-STD-464
- Philosophy of MIL-STD-464
- Formulation of system-level EMC requirements by application
- MIL-STD-464 system-level requirements
- System-level data item (documentation) description (DIDS)

Module 4: Equipment to System Interactions: Tailoring EMC requirements

- Supporting documentation and standards
- Analytical methods
- Test and survey data for tailoring
- Other requirements, not in the standard

Module 5: Non-Development Items

- Integration of NDI, COTS and GFE Equipment
- Setting EMC requirements for NDI
- Use of commercial standards
- Avoid performance compromises and remain cost effective?

Module 6: Class Exercise: Specifying EMC requirements for sample equipment

Module 7: EMC requirements consequence in equipment design

- Addressing conducted emissions and susceptibility
- Addressing radiated emissions and susceptibility

Module 8: Summary and Wrap-up

- EMI case studies
- Miscellaneous issues
- Practical EMC protection problems - discussion