Test Procedures for EMI, EMC and ESD

Course No. 162

APPLICATION This short course will provide the background and details of commercial and military EMI/EMC/ESD standards and review test procedures to gain understanding and proficiency in EMC testing.

FOR WHOM INTENDED This course will be of interest to personnel involved in testing and development of products intended for international markets. It will be of interest to testing and certification engineers and technicians, Quality Assurance personnel such as inspectors and technical auditors, manufacturing engineers, as well as design and development engineers.

BRIEF DESCRIPTION OF COURSE The course provides a review of applicable theory and an explanation of the various terms and definitions encountered. The course proceeds to discuss safety issues and the potential hazards that could be encountered in testing activities.

This is followed with a general discussion of regulatory agencies of the US, European and Japanese authorities and the various standards to be followed such as: ECC, FCC, IEC and MIL-STD.

The test laboratory and open area test site are discussed as well as procedures to be followed for compliance auditing and selecting an anechoic chamber.

The advantages and disadvantages of testing in-house or contracting out are discussed as well as the paperwork requirements for certification testing.

The application of various tests for EMI, EMC and ESD are discussed and recommended procedures for each method are discussed.

A review is made of diagnostic methods for dealing with EMI/EMC/ESD problems. The course closes with a review of the examples of test procedures for various industries.

DIPLOMA PROGRAMS This course is required for TTi's Electronic Design Specialist (EDS), Electronic Telecommunications Specialist (ETS) and Instrumentation Test Specialist (ITS) Diploma programs. It may be used as an optional course for any other TTi specialist diploma program.

PREREQUISITES Students should have completed TTi's Course No. 104-3, "Electronics for Non-Electronic Engineers" or the equivalent. This course is aimed at individuals actively involved in related technical fields. An understanding of basic electrical theory is required.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUs Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

INTERNET COMPLETE COURSE 162 features over 7 hours of video as well as more in-depth reading material. All chapters of course 162 are also available as OnDemand Internet Short Topics. See the on-line course outline for details.

Course Outline

Review of applicable theory: Effects of EMI • Terms and definitions
Introduction to field strength • Safety considerations
European Regulations: CE • European Economic Area • Directives
Technical Construction File • EMC standards • EMI Standards
RF Emissions: Radiated and Conducted Emissions • Standards
Measurement: Transducers • Test setups: Table Top or Floor Mounted
Low Frequency Emissions: Harmonics (IEC 1000-3-2)
Harmonics Evaluation • Test sources • Measurement Equipment
Test Conditions: TV Receiver, VCR/Audio Amplifier/ITE, Lighting, Appliances
Low Frequency Emissions: Voltage Fluctuation and Flicker (IEC 1000-3-3)
Limitations • Three-phase test setup • Flicker and Voltage Deviation
Measuring Flicker Severity • Test conditions
ESD Testing: Severity levels • Generator design
Verification of characteristics • Waveform
Test setups: Table Top, Floor Mounted, In-situ • Test procedures
Radiated Field Immunity Testing: Severity levels • Test Signal
Test Equipment • Field Uniformity Measurements • Anechoic chamber
TEM, GTEM cells • Reverberation chamber • Test Procedure
Fast Transients Immunity Testing
EFT Immunity • Voltage and Frequency levels • Voltage waveform
Test equipment: Burst generator, CDN, Capacitive-Coupling Clamp
Test procedures: Table Top, Floor Mounted • Post-Installation Tests
Power Line Surge Testing
Severity levels • Waveform • Combination or CCITT Wave Generators
Generator Waveform • Coupling/Decoupling Network (CDN): Power, Interconnect • Test Procedures: Power Lines, Shielded Interconnect
Conducted Immunity: Environment Levels • Test equipment: Generator,
Coupling/Decoupling Device • Verification of Common Mode Impedance
Network Analyzer setup • Level setting: CDN, Clamp • CDN Principle
Injection Probe Principle • Test Procedure
Magnetic Field Immunity (Power Frequency): Limits • Typical Levels
Test Equipment: Generator, Induction Coil • Coil Factor • Coil Calibration
Test setups: Table Top or Floor Mounted • Procedures
Immunity to Pulse Magnetic Field • Test levels and Procedure
Immunity to Damped Oscillatory Magnetic Field • Test levels, Procedure
Voltage Dips and Interruptions Immunity
Test Levels: Dips and Interruptions, Variation • Test Equip., Procedures
Considerations in EMC Projects
Test Plan • Pre-Compliance Testing (Emissions) • Pre-Test—Immunity
After Test (Diagnostics) • Selection of Test House • Accreditation Bodies
Auditing (ISO 17025) • Production Sampling • Emissions Immunity
VCCI Method • Production Sampling Immunity • PQAP Items
When Production Changes Affect EMI • Ongoing Compliance • Exercise
Measurement Uncertainties • Estimating Errors • Future Trends
DO-160 (Commercial Avionics): Magnetic Effect
RF Emissions: Conducted, Radiated • AC, DC Inputs
Momentary Power Interruption • Digital Circuits • Voltage Spike Test
Audio Freq. Susceptibility • H-Field and E-Field in Cables, Equipment
RF Susceptibility • Lightning • ESD Detector
MIL-STD-461F: Overview • General Test Setups
Detailed Review of Individual MIL-STD-461F Test Procedures
Grounding Techniques: types of Grounds • Safety • Signal Grounds
Single-point and Multi-point Grounds • Common Impedance Coupling
Separation of Grounds • Ground Loops • Isolation • Shield Grounding
Final Review • Award of Certificates for Successful Completion

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