

EMC Troubleshooting - Customized EMC Training

Day 1

Session 1 - 2 Hrs.

EMC diagnostic techniques and fixes

Diagnosing equipment(s) required.

How to use the equipment(s)?

Proper fix to resolve the issue.

Approaches for a troubleshooting success! (SIX vital rules)

1. Common phenomenon application
2. Isolation of primary from secondary and tertiary subsystems
3. Focus on the predominating issue
4. Correct implementation of the fixes
5. Comply and then optimize
6. Engineering data reuse (Document & Reference)

Session 2 - 4 Hrs.

Fundamental understanding of EMI/EMC

1. EM Waves, spectrum & propagation, field strength, near & far-field
2. Units and their conversions
3. Interference Coupling - (FOUR Types) Conductive, Inductive, Capacitive & Radiated *
4. BB, NB, DM, CM signals and noises *

Session 3 - 2 Hrs.

Instrumentation - EMI Receiver, Spectrum analyzer, Antenna, Probes, Etc...

Emission - QP / PK & AVG Readings

Immunity - Performance Criteria

*Topics marked with * can be understood deeply with theory background*

Topics marked with # is referring to the options available as per the applicable Industrial domain. The selection of the appropriate topics are required in advance.

Day 2

Session 4 - 2 Hrs.

EMI/EMC/Electrical - Testing, Regulation, Directives & Standards – Specific Domain(s)

GENERIC STANDARDS - EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4

AUTOMOTIVE

ICE & Electrical Vehicles - ESA & Vehicle level compliance #

FMVSS - 49 CFR 571, Title 47 CFR, EMC Directive #

ECE R10 Regulations for vehicles of categories L, M, N O, T, R and S #

ISO 14982:1998 - Agricultural and forestry machinery EMC #

Vehicle & ESA Tests #

CISPR 12 & CISPR 25 #

ISO 16750 Parts, ISO 7637, ISO 21498 #

IEC 11451 / 11452, SAE J standards, JASO & OEM Standards etc. #

RAILWAY

EN 50121 – Railway application – Applicable Parts #

MILITARY & AEROSPACE

MIL STD 461 – CE RE CS RS Tests #

DO-160 – Sections 15 to 23 & Section 25 #

MEDICAL ELECTRONICS

EN 60601-1-2 #

ISM PRODUCTS

EN 55011, EN 55014 & EN 55032 #

HOUSEHOLD APPLIANCES

EN 55014 #

INFORMATION TECHNOLOGY & MULTIMEDIA

EN 55032 & EN 55035 #

MEASURING INSTRUMENTS & LAB EQUIPMENTS

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EN 61326 Parts #

Session 5 - 2 Hrs.

Essential Troubleshooting concepts

Connectors / Interconnections / Cables & Harness

PCB Considerations / Checklist

Session 6 - 2 Hrs.

Conducted Emission related failure modes (LF models)

In-house troubleshooting & Test Lab troubleshooting

Use of LISN & LISN MATE or Directional Couplers for CM & DM Splitting *

CE - Compliance issues & Troubleshooting Examples

1. 25 MHz Inductive device issue *
2. Poor line Filter design *
3. Poor sub-assembly or part selection (Ferrites, Capacitors)

Session 7 - 2 Hrs.

Radiated Emission related failure modes (HF models)

In-house troubleshooting & Test Lab troubleshooting

Current Clamp use to fix the bounds *

RE - Compliance issues & Troubleshooting Examples

1. Ferrite core on cable *
2. Filtering
3. Cables, Harness poor bonding & poor shielding
4. Chassis level poor shielding *
5. Sub-assembly level poor shielding *

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Day 3

Session 8 - 2 Hrs.

Conducted susceptibility related failure modes

In-house troubleshooting & Test Lab troubleshooting

Use of LISN *

CS - Compliance issues & Troubleshooting Examples

1. Harness issue - BCI failure or any current injection scenario
2. Poor filter selection *

Session 9 - 2 Hrs.

Radiated susceptibility related failure modes

In-house troubleshooting & Test Lab troubleshooting

Use of license-free FRS & CB radios, GSM Phones

RS - Compliance issues & Troubleshooting Examples

1. Sub-Assembly level poor shielding *
2. I/O line issue - CM coupling in data line *
3. High Frequency >500 MHz issue - Chassis level Shielding issue *
4. Crosstalk problem *

Session 10 - 3 Hrs.

Electrical Characterization related failure modes (EFT, Surges & ESD)

In-house troubleshooting & Test Lab troubleshooting

Pulse generator, ESD Gun & AM Radio, piezoelectric BBQ igniter

Special components Viz., GDT, MOV, TVS, Cu Plate, Ferrite Choke, Low Pass Filters etc.

Compliance issues & Troubleshooting Examples

1. ESD Failure - Cu-Plate to bend the E-field *
2. Surge failure
3. EFT Failure

Wrap-up with Q&A session - 1 Hr.

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Optional Theory Classes - All the sessions are 4 Hrs. each

Session 11

1. EM Interference theory & Maxwell's Equations (Faraday's Law, Ampere's Law, Gauss's law)
2. Coupling Modes - DM CM & Antenna Mode, Emissions models & Calculations
3. DM & CM Noise reduction techniques
4. DM & CM Splitting technique
5. Transformer Design guidelines

Session 12

6. Line Filter & Data line filter Design, Reactance Paper, and FFT analysis
7. Generation of FCC Limit curves by Current Clamp & EM Field Theory

Session 13

8. Ferrite bead, toroid, chokes selection & non-linear behavior w.r.t frequency
9. Shielding theory & Practice for both near field & far field
10. System level Shielding

Session 14

11. LISN understanding & its use in CE & CS
12. RS Model for Far field phenomena

Session 15

13. RS Model for Near field phenomena - Crosstalk

Session 16

14. RS far field phenomena applied for ESD
15. Bonding
16. Grounding

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