An Introduction to EMC Testing
(what can be done with scopes)

Vincent Lascoste – EMC Product Manager - RSF
Definition of ElectroMagnetic Compatibility (EMC)

EMC is defined as:

"The ability of devices and systems to operate in their electromagnetic environment without impairing their functions and without faults and vice versa, i.e. to ensure that operation does not influence the electromagnetic environment to the extent that the functions of other devices and systems are adversely affected".

EMC testing is a means of verifying devices and systems abilities to stand up to this principle…
Interference Sources

**INTERFERENCE SOURCE**

**natural sources**
- atmospheric noise
- galactic noise
- electrostatic discharge

**technical sources**

**intentional RF generation**
- telecommunications
  - radiocommunication
  - broadcasting
  - telephone

**unintentional RF generation**
- (broadband, low RF energy)
  - power electronics
  - computers
  - energy distribution
  - ignition systems
  - commutating motors
  - electric arc welding

**non-telecommunications**
- navigation
- diathermy
- microwave ovens
Introduction of ElectroMagnetic Emission

EMI/EMS measurement:

consist to measure un-intended emission of the DUT.

Results are compared to limits, defined by standards

Dut with wanted emission are defined as special cases

The „Working area“ where all devices run in full & relative compatibility

![Graph showing RF Level and Frequency with levels of Emission and Susceptibility.](image-url)
Propagation of Interfering Signals

- **Conducted Interference**
  - coupling via leads and el. components

- **Radiated Interference**
  - near field coupling
    - coupling via inductive and capacitive field
  - far field coupling
    - coupling via electromagnetic waves
Generally speaking, the EMS test methods are adapted to the frequency ranges where different coupling phenomena occur…
Basic Setup – Bulk Current Injection (BCI) Test

Application example for conducted susceptibility measurements according to IEC 61000-4-6

Current Clamp (BCI)

PC with EMC32

NRP-Z91

Signal Generator System Switching Power Amplifier

Shielded Room

6dB Attenuator

Bulk-Injection-Clamp (with calibration fixture) and Monitoring Clamp
Basic Setup – Radiated Test

Application example for radiated susceptibility measurements according to IEC 61000-4-3 up to 6 GHz

Antennas

RF

Anechoic Chamber

Fibre Optic

LAN

PC with EMC32

NRP-Z91

Power Amplifiers

USB

LAN

Signal Generator

RF IN

FWD

REV

RF

Field Probe

Antennas

RF

LAN
Whichever of the discussed methods of testing is used to subject a device to RF Interference, suitable monitoring of the devices performance is needed to check for failures....
Description of standard EMI test setup

**TEST METHOD**

**DUT**

- **Type of TRANSDUCTER**
  - **military (non-military)**
  - **non-military**
  - **non-military (military)**

- **EMI current**
- **EMI power**
- **EMI voltage**

- **Current clamp**
- **Power absorption clamp**
- **Line Impedance Stabilisation Network**

- **EMI test receiver**

- **EMI/RFI fieldstrength**
- **magnetic loop antennas**
- **linear broadband antennas**

- **military & non-military antennas**

**Non-military EMI testing**
- **CISPR band A**: 9 kHz to 150 kHz
  - EMI voltage
  - EMI magnetic field strength

- **CISPR band B**: 150 kHz to 30 MHz
  - EMI voltage
  - EMI magnetic field strength

- **CISPR band C**: 30 MHz to 300 MHz
  - EMI power
  - EMI electric field strength

- **CISPR band D**: 300 MHz to 1000 MHz
  - EMI electric field strength

**Military EMI testing**
- **30 Hz to 40 MHz**
  - Conducted emission

- **30 Hz to 40 GHz**
  - Radiated emission
EMC Applications for Oscilloscopes

EMI
- Radiated Interference: EN55011, EN55012, EN55013, EN55014, EN55015, EN55022, CISPR
- Conducted Interference: EN55011, EN55012, EN55013, EN55014, EN55015, EN55022, CISPR
- Power Quality: EN61000-3-2, EN60555-2, EN61000-3-3, EN60555-3

EMS
- ESD, EFT and Burst Calibration: EN61000-4-2, EN61000-4-4, EN61000-4-5
- EUT Monitoring: EN61000-4-3

Power Harmonics
- LISN (Line Impedance stabilisation network)

Flicker Measurement

RTO: An powerful tool for EMI/EMS debugging and precompl. applications
Thank you for your attention