KNOWLEDGE IN REALITY

EMC SERVICES
From system to component – allocating EMC requirements
Examples from different sectors

- What is the goal?
- Examples
  - Military
  - Railway
  - Marine
  - Vehicle
- What of Forklifts?
- Discussion
What is the goal?

- When installing all components, the complete system shall work within specification
  - Component requirement shall reflect actual environment and installation
  - Adequate requirements – not excessive and not underestimating

System requirement  →  Component requirement
Industrial sector

• Components = apparatus
  • Conform to industrial levels
  • Some 100 standards -> standard chaos
  • Same basic tests, usually same levels

• House = installation
  • Conform to *good engineering practice*
Example: one room with multiple equipment – same electromagnetic environment - Industrial

- Technical rationale: same limit due to local EME
- Multiple product standards
  - Mostly same levels
- Some products do not have industrial environment as level
- Assumption: some space between components
Military sector

• Top level
  • Ships, vehicles, installations
  • E.g. MIL STD 464C: overall environment specification

• Components
  • E.g. MIL STD 461G
  • Tailored limits for each environment (platform)
  • Same basic tests + dedicated tests

• Everything is shielded
  • Assumption: each component = worst case
Military example

• Preconditions:
  • One zone containing multiple components
  • Each component = worst case
  • Same test on each one
  • Assumption: the shield is always continuous
Railway sector

- Specific standard for each environment
- Top level
  - Complete railway emission EN 50121-2
  - Train and complete vehicle EN 50121-3-1
- Components
  - Rolling stock EN 50121-3-2
  - Telecommunication systems EN 50121-4
  - Fixed power installation EN 50121-5
  - Tailored limits for each environment (platform)
  - Same basic tests, EN standard + dedicated tests
Marine sector

- Two environments = 3 zones
  - Bridge and vicinity zone
  - General power distribution zone
  - Accommodation zone
- Ship level
  - IEC 60533 Ships with metallic hull
  - Installation control
- Components
  - Tailored limits for each environment (zone) – IEC 60533
    - Some unique marine requirements
    - Accommodation zone = pick any standard for domestic environment
  - Same basic tests, EN standards
Telecom example: lightning pulse

- Assumption: worst case direct strike 200 kA in tower
  - Low frequency pulse – shielding not very effective
  - Each layer is a shield for the interior
  - Each shield handles 50% of the incident pulse
Vehicle sector – standard car (combustion engine)

- Legal requirements – protecting other cars
- Corporate requirements – protecting your own car
  - Tailored limits in detail, revised periodically
  - Added requirements based on risk assessment
- Each component = one zone
- Hidden car level zones
  - ESD for different placements
  - Portable transmitter test depending on installation
- Component tests
  - Setup simulating the car body
  - Import from MIL setups
Vehicle sector – electric car (hybrids etc)

- Legal requirements – including AC/DC charging
  - Component tests modified
- Several components = one combined zone
- Corporate requirements – protecting your own car
  - What to do?
- Volvo Car solution – tailored testing
  - Identify the worst case component (power inverter)
  - Simulate the impact of that component with RF current injection
  - Worst threat = RF emission
  - Added to the regular emission tests
  - Future development: shielded signal systems
Volvo Car example: shielded system

Risk: Leaking system including cables

Volvo shielding requirement

Problem:
- System leakage generated outside ESA1 and ESA2
- How to discover this prior to vehicle test?
- How to verify ESA1?
- What requirement?

Test volume for ESA2

Filter barrier

System RF leakage

RF generating ESA

Z₀

Z₁

ESA1

ESA2
Volvo Car example: test method

Option 2: Injection on ESA1 during emission measurement

Pros:
- All interfaces, connectors and cables are included
- Measurement is integrated into regular test setup
- No tailored test items (EUT)

Cons:
- How to specify the injection
- The major source must be known
- Pulse generator is complicated
- The laboratory must be prepared!
Forklifts

- EU: one standard – EN 12895:2015
  - Complete forklift
  - Component/system test
  - Same test methods and levels for all
    - LF H-field test (DC, 50 Hz) on component only
  - EN standards as test methods
  - Only external threats considered
  - AC charging handled separately, outside scope
- The 2015 version of the standard
  - Enhanced immunity requirements
  - Buying commercial industrial components off the shelf is harder
  - Why did they choose the EN 61000-4-8 for H-field immunity?
    - Is DC and 50 Hz the only threat?
Forklift test example

- Complete forklift radiated emission
- Component radiated emission
Forklifts – future component requirements

• What do we actually need?
  • Tests relevant to the installation
  • Reuse of existing standards
  • Tests relevant to the real threats
    - External and internal

• What is a forklift?
  • 3/4 wheels
  • Metal body
  • Isolated electrical system 24/48 VDC
  • IoT base unit
Forklifts – component ideas

Regard the forklift as a regular vehicle variant

- Adaptation of existing standards
  - Do not make new method standards!!!
- CISPR25 emission
- ISO immunity
- ISO 16750-2 power quality?
  - Everything is not relevant
Forklifts discussion

Comments?