

REVIEW OF MAIN AUTOMOTIVE EMC TEST REQUIREMENTS RELEVANT TO RTPGE

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802.3bp working group

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Reminder on automotive EMC integration methodology

- Classical V development cycle
- System approach:
 - Requirements on car level
 - Requirements on embedded devices, especially ECUs
 - Requirements on electronic components
- Two families of EMC requirements
 - On-bench tests → validation of individual electronic devices
 - On-vehicle tests

Automotive EMC standards

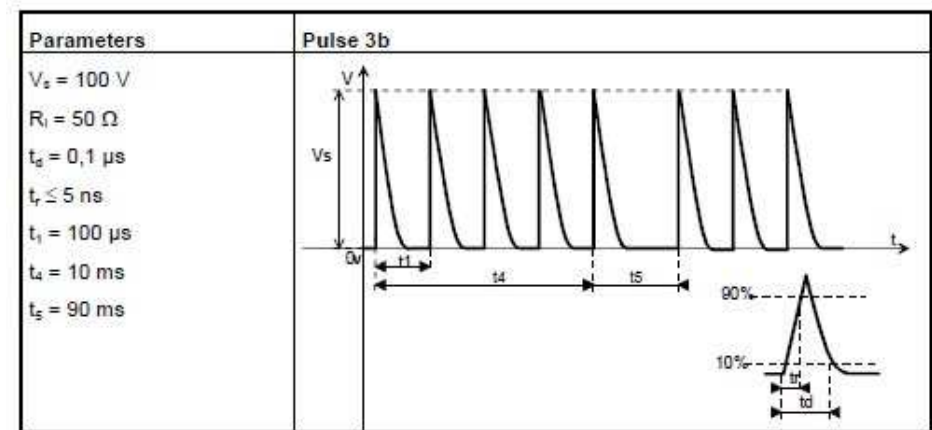
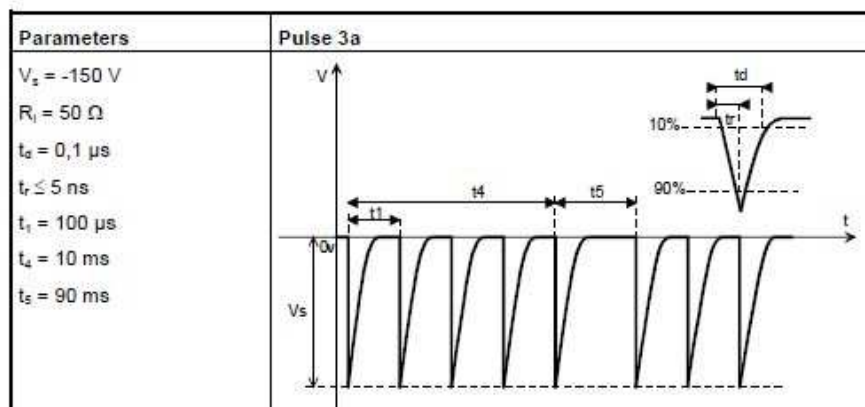
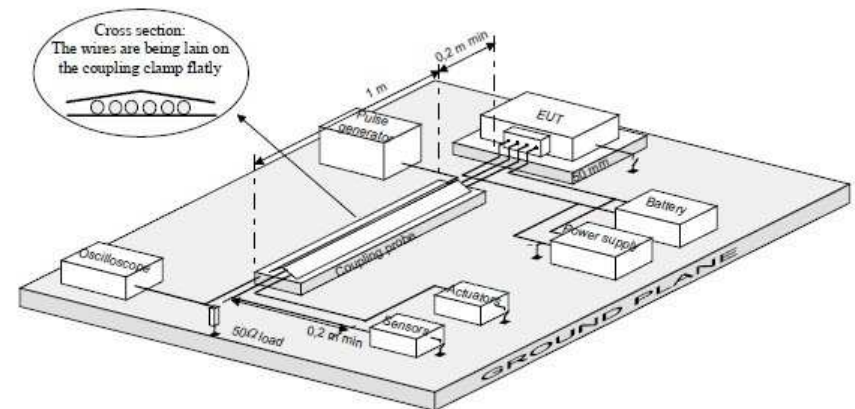
- Test set-ups and limits are derived from EMC automotive standards
 - ISO 7637
 - ISO 10605
 - ISO 11451
 - ISO 11452
 - CISPR 12
 - CISPR 25
- Exact test set-up, conditions and limit values are adapted by each company and to each DUT/System
- Limit levels in following pages are extracted from Renault EMC requirement documents and provided as representative examples

Which tests should we pay attention for?

- One important issue of the task force is choice of twisted pair (shielded or not, and which class)
- Therefore, at first we propose to highlight EMC tests which involve strong contribution of cable harness in the coupling path
- Most relevant tests
 - Coupling of transients by capacitive clamp (ISO 7637-3)
 - Bulk current injection (ISO 11452-4)
 - Radiated immunity (ISO 11452-2)
 - ESD (ISO 10605) (→ rather involves connectors than cables)
 - Radiated emissions (CISPR 25)

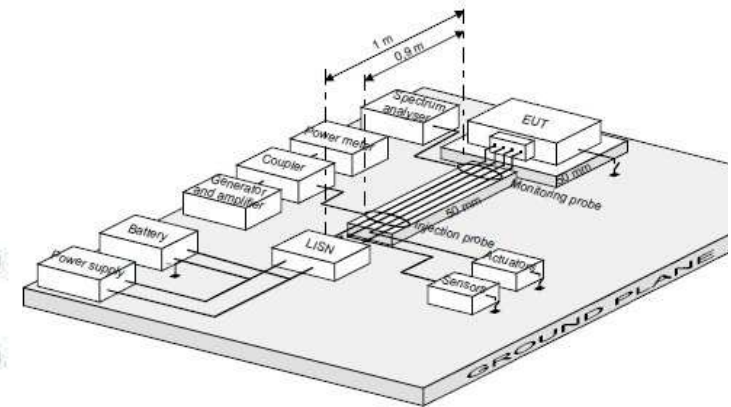
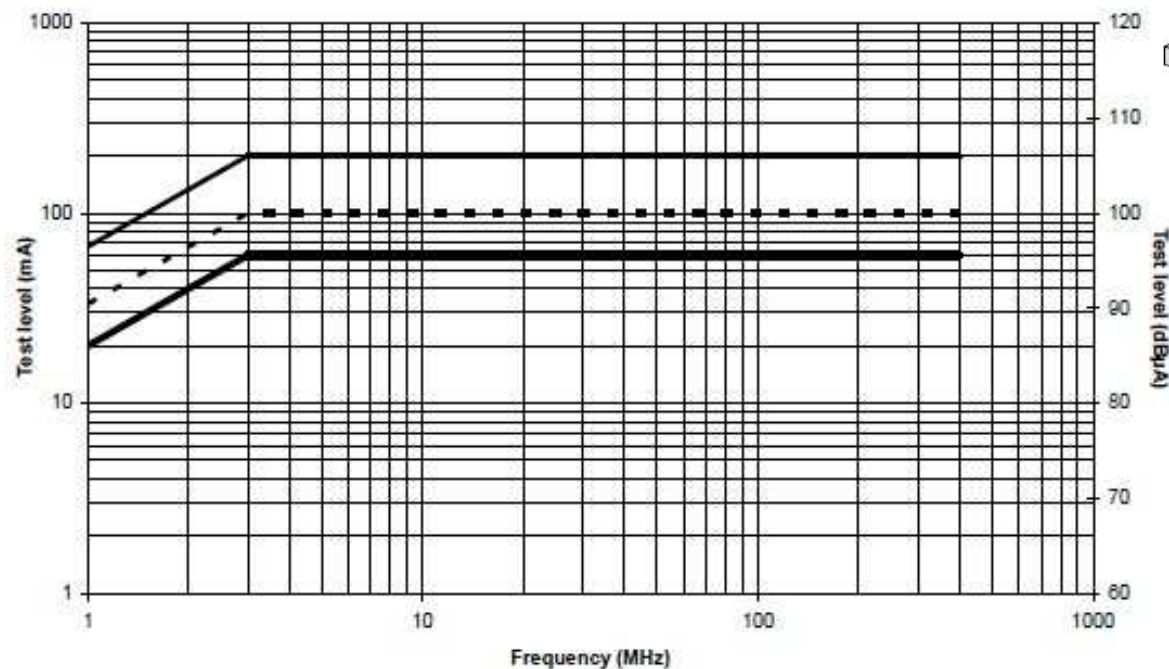
Capacitive clamp coupling (derived from ISO 7637-3)

- Purpose is to create crosstalk coupling to the 1 m length harness of the DUT
- Noise: 3a or 3b impulse noise



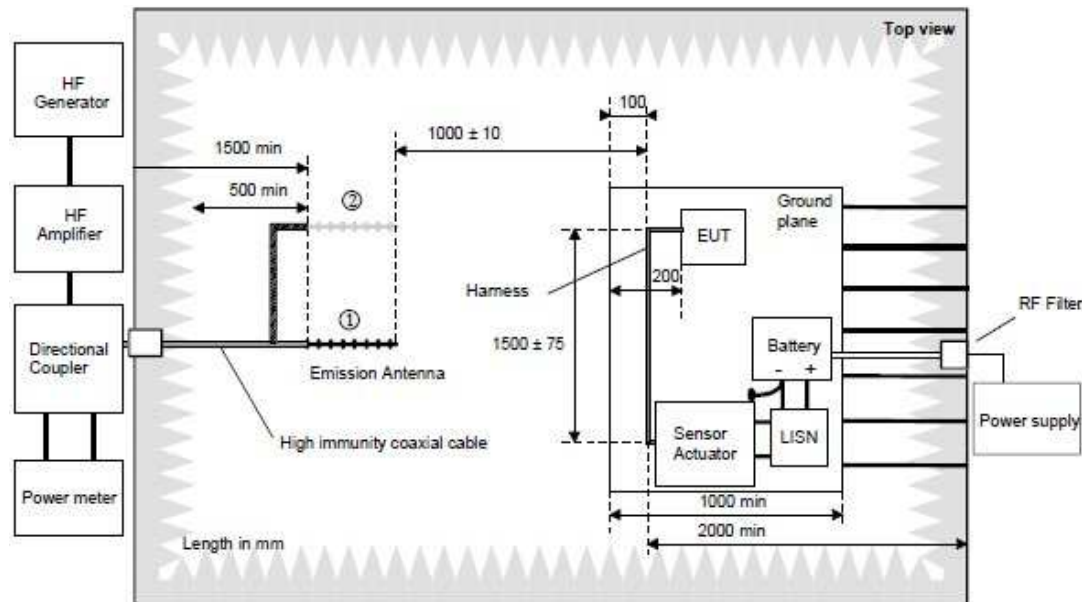
BCI immunity test (derived from ISO 11452-4)

- Current injection by mean of current clamp onto the 1 m length harness of the DUT
- 1 MHz – 400 MHz
- Up to 200 mA from 3 MHz



RF radiated immunity (derived from ISO 11452-2)

- [200 MHz – 2,5 GHz] - [2,7 GHz – 3,2 GHz]
- Antenna reference point at 1 m from the set-up, facing:
 - The middle of the harness of the DUT till 1 GHz
 - The DUT for $F > 1$ GHz
- Harness length < 2 m -- with 1,5 m parallel to the table edge



RF radiated immunity (derived from ISO 11452-2)

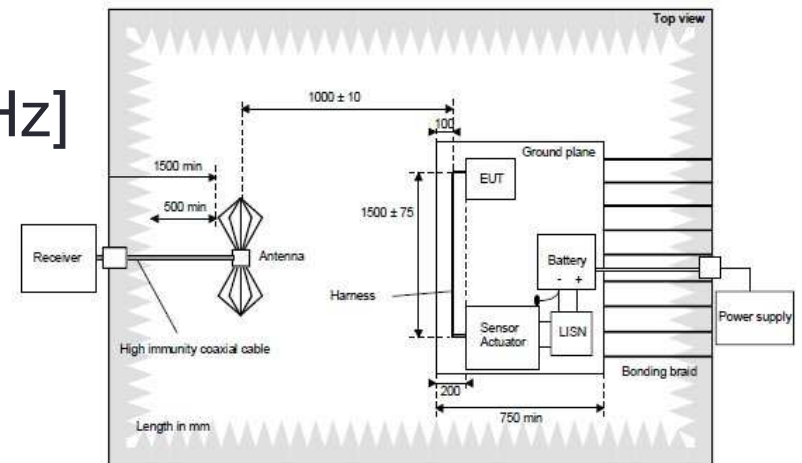
- [200 MHz – 2,5 GHz] - [2,7 GHz – 3,2 GHz]
- Electric field polarization:
 - Vertical over the whole frequency range
 - Horizontal for $F > 400$ MHz
- Modulations
 - CW over [200 MHz – 3,2 GHz]
 - AM over [200 MHz – 800 MHz] (1 kHz, 80%)
 - PM1 over [800 MHz – 1,2 GHz] – [1,4 GHz – 2,5 GHz]
(with repetition frequency 217 Hz, and t_{on} 577 μ s)
 - PM2 over [1,2 GHz – 1,4 GHz] – [2,7 GHz – 3,2 GHz]
(with repetition frequency 300 Hz, and t_{on} 3 μ s)
- Electric field test levels:
 - Up to 200 V/m (RMS)

Resistance to ESD (derived from ISO 10605 & IEC 61000-4-2)

- DUT not supplied
 - 10 contact discharges on pins, up to +/-8 kV, spaced by 1 to 10 s
- DUT supplied
 - Contact discharges up to +/-8 kV, spaced by 1 to 10 s
 - Especially, diagnostic and communication lines shall be tested (as well as ground and power lines)
 - Especially, in case shielded wires are present in the harness of the DUT, ESD shall be applied onto the shielded connector
 - Air discharges up to +/-25 kV, spaced by 1 to 10 s

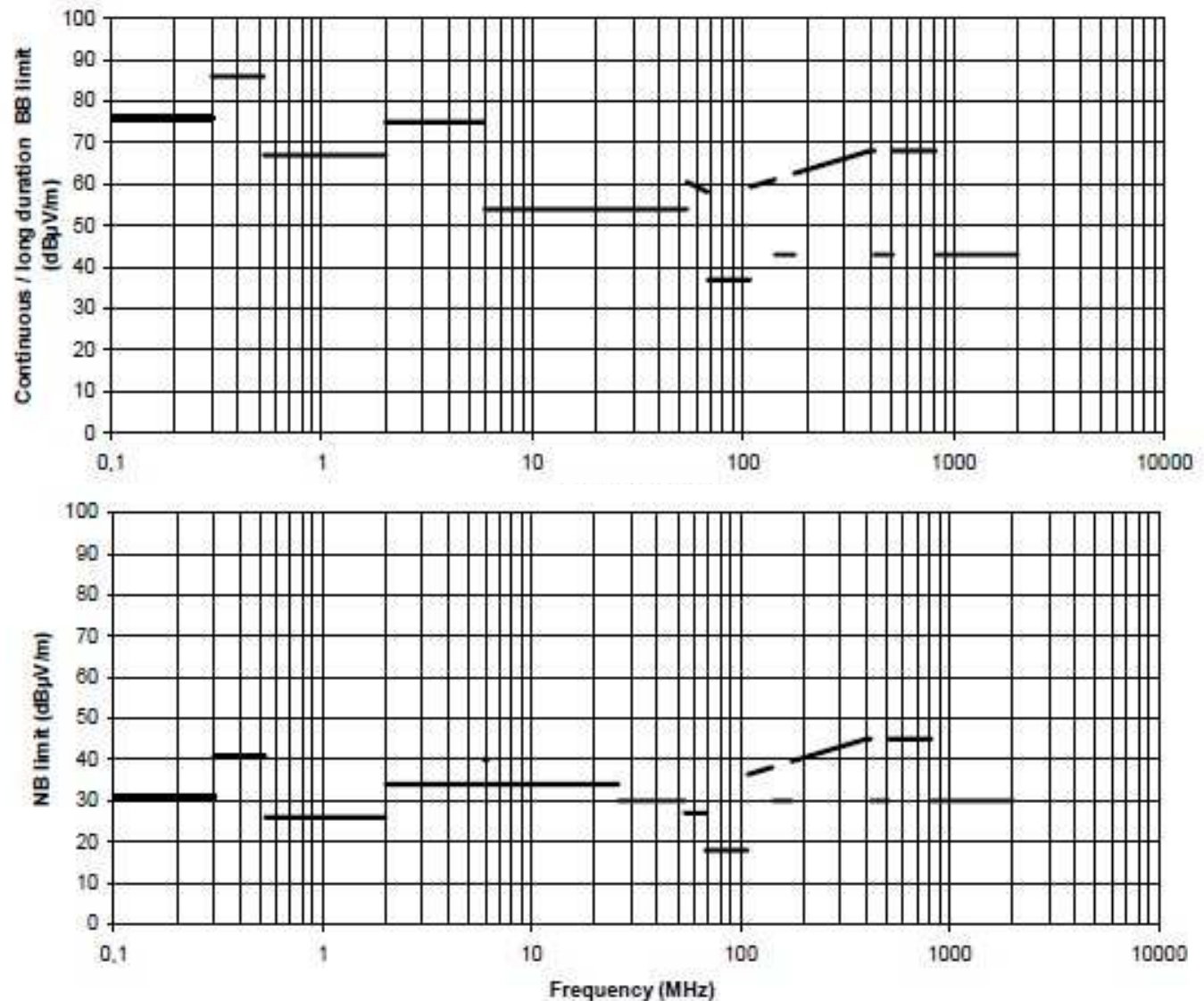
Radiated emissions (derived from CISPR 25 & R10)

- Measurement of electric field at 1m distance from the harness of the DUT, in both V and H polarizations
- Harness length < 2 m -- with 1,5 m parallel to the table edge
- Semi anechoic room
- Frequency range [100 kHz – 2 GHz]
- RBW of the EMI receiver:
 - 9 kHz for $F < 26$ MHz
 - 120 kHz for $F > 26$ MHz
- Antenna position
 - Facing the middle of the harness over [100 kHz – 1 GHz]
 - Facing the DUT over [76 MHz – 2 GHz]
 - (overlapping frequency range is re-performed)



Radiated emissions (derived from CISPR 25 & R10)

- Example of levels (for Europe or North America)
- Limits apply to peak detection
- NB/BB discrimination is done by using average detection value, according to CISPR 25 (ed 2) method



Other on-bench tests

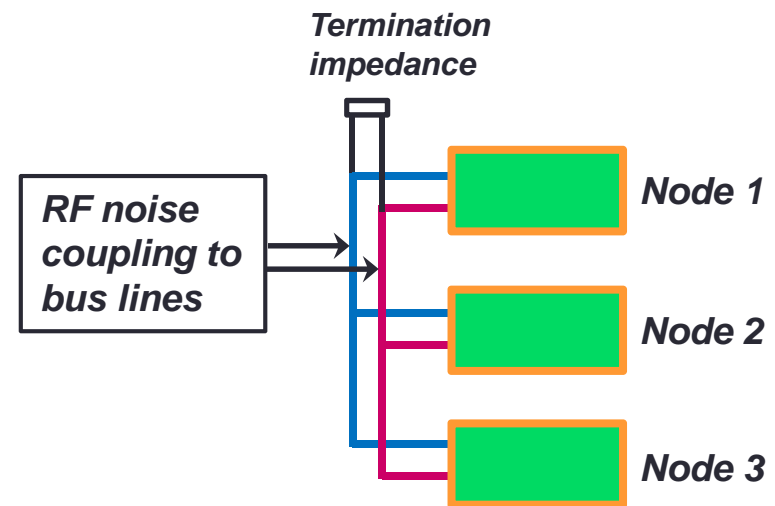
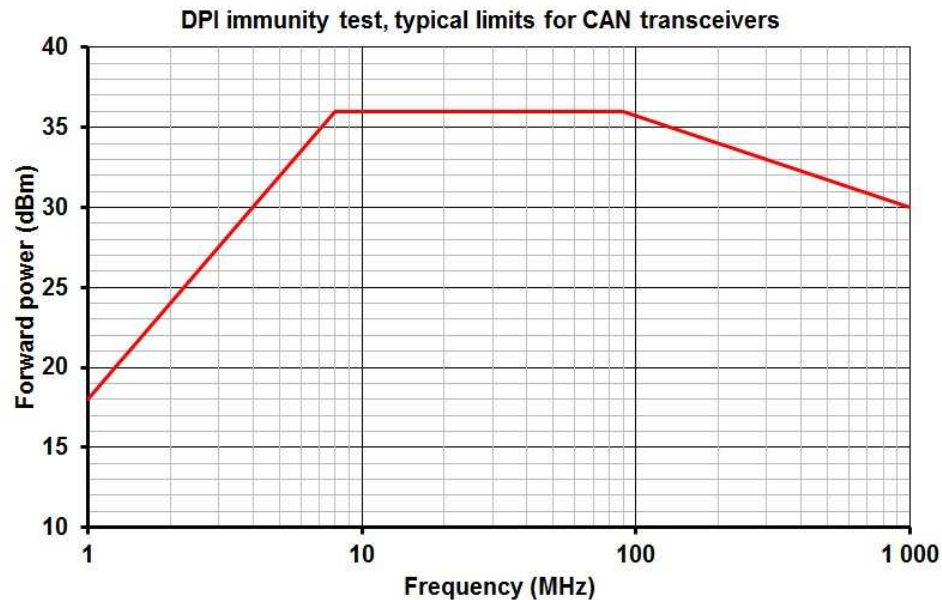
- As stated earlier, we focused on “harness oriented” tests
- Other tests focus on power lines of DUT, for example:
 - Resistance to different transient profiles that can occur on the embedded 12 V powernet:
 - ISO pulses directly coupled to power inputs of the DUT
 - Powernet fluctuations, micro-interruptions, load dump, starting profile...
 - Measurement of transient emissions
 - Measurement of RF conducted emissions
- Also radiated immunity test to handy transmitters
- *All these other tests shall not be put aside when it comes to testing a full ECU including an Ethernet driver, as they will enable to get an insight on the impact of PCB design on internal coupling between Ethernet drivers and voltage regulator unit and powernet (also relevant for PoDL issue)*

Specific requirements for communication dataline transceivers

- Based on IEC 62134 EMC standard series on integrated circuits:
 - Immunity against transients, DPI, ESD, conducted emissions
- Especially DPI:
 - 62134-4 “Integrated circuits – measurement of electromagnetic immunity 150 kHz to 1 GHz – part 4: direct RF power injection method”
- IEC 62228 “Evaluation of CAN transceivers”
 - This product standard refers to above standards
 - There exists derived requirements for LIN and FlexRay transceivers
 - One can expect similar requirements on automotive ethernet transceivers

More on DPI test

- [1 MHz – 1 GHz]
- Up to 36 dBm forward power
- Test is performed on elementary 3-nodes network
- DPI coupling done on each data line through 4,7nF in series with 120 Ω





THANK YOU FOR YOUR ATTENTION
