

## Differences between EMC-CS-2009.1 and FMC1278

The following is a brief summary of the major differences between the current specification EMC-CS-2009.1 and FMC1278.

### Forward

- Requirement references changed to align with CPSC related requirements within FSMS. The scope of requirements now includes 24 VDC systems. The specification is limited only to 12 and 24 VDC systems.

### Section 1.2 Vehicle Level Requirements

- References to specific vehicle level ARL requirements have been replaced by general reference.

### Section 1.3 Use of this Specification

- Clear stating of the fact that compliance of component/subsystem requirements are the responsibility of Ford Motor Company. The supplier may not self certify.

### Section 4 Functional Classification/Status

- Functional Classification definitions updated to align with ECE Regulation 10.05. Functional Status definitions to clarify and better differentiate between Status II and Status III.

### Section 5.1 Load Simulator

- Clarification made that Load Simulator is bonded directly to the ground plane

### Section 5.2 Artificial Networks

- Notation that use of artificial networks will deviate from CISPR/ISO standards. In most cases, only one artificial network on power to DUT will be included.

### Section 5.5.2 Tolerances.

- Tolerance on electric/magnetic field strength in addition to power/current changed from  $\pm 10\%$  to  $-0/+1$  dB.

### Section 5.5.4 Power Supply

- Parameter expanded to include 24 VDC power.
- The use of the term "power supply" to, by default be a regulated source. This replaces the previous default to use an automotive battery. For RF emissions testing, a linear regulated power supply must be used to assure test setup ambient requirements are met.

### Section 6.1 EMC Test Plans

- Text clarified to show that the test plan requires both sign-off by the EMC department and inclusion of a valid EMC test plan number before the test plan can be used for sign-off testing.

### Section 6.2 Sample Size

- Still require two test samples. Requirement clarified to state that sample must be of identical design/function.

### Section 6.3 Sequence of Testing.

- RF emissions and immunity are recommended following ESD testing. Damage to either sample requires immediate contact of and direction from FMC EMC. Failure to do so will likely invalidate the test results.

### Section 6.6 Data Reporting

- With respect to immunity testing, the laboratory may not use the terms pass or fail. They may only report Status I, II or III. FMC will make determination of pass/fail based during their review of the formal test report.

### Section 7 Requirement Applicability

- Replace component category P and R with categories D and R. Improved definitions driven by need for better definition of LED functions.
  - Active and passive ignition coils are now included along with fuel injectors. CE 420 is now required for passive ignition coils (i.e. DIM)
- 12 and 24 VDC systems are included.
- Table 7-1 now serves as central point for determining applicability. Redundant applicability references have been removed from individual requirements.

### Section 7.1

- Specification now fully compatible for use ESA type approval per ECE Regulation 10.05. Additional requirements in table (7.1) added to facilitate this.

### Section 8 RE 310

- Level 2 requirements now requires compliance to both PK and AVG limits. Previously either limit was acceptable.
- Long Wave (EU1), Police (EU4), and DAB (EU7) frequency bands have been eliminated.
- Some band designations have been reassigned to continue alignment between Ford and GM. EU4 band reassigned to now include GLONASS band. GPS (G8) band limits reduced by 6 dB to facilitated compatibility for customer installed GPS devices.
- Clarification provided to required FMC review/concurrence before AVG limits are imposed on intermittent use devices.
- Test setup now only uses a single Artificial Network on power. DUT power return connected to ground plane at Load Simulator
- Special test setup for engine control electronics has been eliminated.
- Use of Fast Fourier Transform (FFT) may be used by any receiver that is fully compliant to CISPR 16-1-1(2010). Swept receivers (i.e. spectrum analyzers) may no longer be used.
- Bandwidth reduction for band G1 (AVG limit) may no longer be used unless prior approval attained from FMC EMC. If allowed the reduction can be no lower than 1 kHz. Bandwidth for Bands G8 (GPS) and G9 (GLONASS) may be reduced to 5 kHz to meet ambient requirements for new lower limits.
- Above 1 GHz, DUT shall be tested in 3 orthogonal positions. This aligns with existing requirements for RI 114.

#### Section 9 CE 420

- Applicability further expanded to exclude all electric motors/actuators that operate intermittently with an active duration less than 2 second. This is combined with the existing requirement on electric motors/actuators that operate intermittently AND with direct operator control via depression of a switch. However these exclusions do not apply if the device is expected to be packaged within 300 mm of the vehicle's radio antenna.
- EU1 band eliminated.
- G1 band reduced by 6 dB for better correlation to RE 310 limits.
- Measurement system requirement changes consistent with those for RE 310

#### Section 10 CE 421

- Limits are now in terms of current as opposed to voltage. Current levels based on level required to achieve compliance to EMF guidelines delineated in ICNRP 1998.
- Test setup changed to facilitated direct measurement of current. Measurement receiver must be compliant o CISPR 16.1.1 (2010). Use of FFT is allowed.
- Current probe characteristics included to provide guidance.

#### Section 11 CE 410

- Requirements expanded to include limits for 24 VDC systems. Limits based on those from ECE Regulation 10.05.
- Time base requirement of 0.5usec eliminated to facilitate reduced test time.
- Detail included in the test procedure pertaining to the method to assure that maximum transient magnitudes have been captured.

#### Section 12 RF Immunity

- Notes regarding special requirements for audio removed from Acceptance criteria.
- RI 112, RI 114 and RI 115 all eliminate Artificial Network from power return of DUT. This is consistent with changes for RE 310.
- Thresholding process modified and clarified.
- Alternative test procedures may be allowed (e.g. TEM for key fob), but requires prior approval by FMC EMC. Occurrence is expected to be rare.
- Test frequencies specifically called out. This replaces fixed frequency steps. Frequencies match with test frequencies used for vehicle level testing.

#### Section 12.5 RI 112

- Level 1 and Level 2 limits modified particularly below 15 MHz. Band designations modified
- DBCI now required from 1 – 60 MHz. Previously it was from 1- 30 MHz.
- CBCI required from 20-400 MHz for compatibility to ECE Regulation 10.05
- Test setup now only uses a single Artificial Network on power. DUT power return connected to ground plan at Load Simulator
- Injection probe required to be single turn primary.
- Untested wiring shall remain bundled together with wiring under test except at injection probe. Wiring is wrapped around the outside of the injection probe.
- Monitor probe is not used unless first approved by FMC prior to commencement of testing.

Section 12.6 RI 114

- Band designation modified. Example; Band 4 now become Band 5
- Band 5 frequency band now starts 360 MHz
- Clarification that use of Reverberation is preferred method therefore shall always be used when available.
- Test setup now only uses a single Artificial Network on power. DUT power return connected to ground plane at Load Simulator
- Clarification that that Battery is located directly on dielectric support clarified for MTR method.
- Clarification that MTR calibration shall be accordance with IEC 61000-21. Cal procedure (Annex C) has been removed from specification. Annex C reused for RI 115 test setup characterization.

Section 12.7 RI 115

- Scope of applicability expanded to all modules in vehicle except those packaged in the engine compartment.
- Clarification of conditions for 50mm vs 5 mm antenna-DUT separation.
- Clarification that wrt test setup, the barrel of the antenna shall be perpendicular to the ground plane.
- Specific requirements for test equipment provided. Includes specific requirements for directional coupler characteristics.
- New Characterization procedure presented in Annex C. Requires use of vector or scalar network analyzer.
- Antenna positioning for a test cell clarified. Allowance provided for simultaneous testing of adjacent test cells to reduce overall test time.

Section 13 RI 140

- No changes other than power supply per section 5.5.4

Section 14 RI 130

- Test setup now only uses a single Artificial Network on power. DUT power return connected to ground plane at Load Simulator.
- Clarification that untested wiring shall lie bundled together directly on the ground plane and distance between untested wires and test fixture shall be greater than 200 mm
- Circuit wires with >20 ampere current limitation are excluded from testing.
- Clarification that by default, Slot A is always used for DUT wire placement.

Section 15 RI 150

- Same change as for RI 130

Section 16 CI 210

- Applies to 12 and 24 VDC systems
- Frequency range extended down to 0.01 kHz.
- Level 1 stress level is same as in previous spec with exception of extension to 0.01 kHz
- Level 2 stress added (2 Vp-p from .01 – 100 kHz)
- Stress level setup modified to set level in absence of DUT. Associated signal generator levels recorded. Those value remain constant when DUT connected and operating. Change results in similar setup as for older “-AC” specification.

#### Section 17 CI 220

- Applicable only to 12 VDC systems
- Applies to all power supply circuits. Differentiation between switched and direct battery circuits has been removed.
- Pulses limited to Pulses A1, A2, C1, C2 and ISO Pulse 1
- ISO Pulse 1 formerly referenced as Pulse E. Current limitations for Pulse A1 remain the same.
- Pulses F1, F2, G1 and G2 removed from requirement
- Reference to “input” circuits replaced by “control” circuits. Terminology reverted back to that used in “-AC” specification.
- Test Setup remains the same, but figures updated to improve clarity.

#### Section 18 CI 221

- New requirement applicable to 12 and 24 VDC systems
  - Wrt 12 VDC systems, applicability limited to components required to meet ESA requirements of ECE Regulation 10.05
- ISO pulses used (1, 2a, 2b, 3a, 3b)
- Test setup and test procedures conform to ISO 7637-2

#### Section 19 CI 222

- New Requirement applicable to 12 and 24 VDC systems
- Covers Load Dump using ISO Pulse 5a and 5b
- Replaces Pulse G1 and G2 from CI 220
- Test setup and test procedures conform to what was originally in CI 220

#### Section 20 CI 230

- Applicable only to 12VDC systems
- Number of waveforms reduced from 4 to 2.
  - Waveforms B and D renamed A and B.
- Test procedure changes to require all testing in a thermal chamber @ -40 degrees C

#### Section 21 CI 231

- New Requirement applicable to 12 and 24 VDC systems
  - Wrt 12 VDC systems, applicability limited to components required to meet ESA requirements of ECE Regulation 10.05
- Test performed in accordance with ISO 7637-2. Tests are not performed in a thermal chamber.

#### Section 22 CI 250

- Damped sinusoidal transient characteristics modified to match what has been previously communicated to laboratories over two years ago. No change requirement.
- Figures updated for clarity. Option to place offset at Load Simulator has been eliminated.
- Stress level setup modified to set level in absence of DUT. Associated signal generator levels recorded. Those value remain constant when DUT connected and operating. Change results in similar approach as CI 210.

Section 23 CI 260

- Applicable to 12 and 24 VDC systems
- Waveforms E and F deleted
- Reference to input circuits changed to “control” circuit to align with CI 220

Section 24 CI 270

- Applicable limited to 12 VDC systems
- Tolerances changes for reverse polarity
- Levels increased from 24 to 27 V and with different tolerances.
  - Functional status I eliminated.

Section 25 CI 280

- Parametric testing no longer required immediately after testing. However, parametric testing is recommended after testing on additional test samples.
- ISO 10506 (2001) replaced by ISOP 10605 (2008). Affects ESD simulator verification.
- For handling tests, the DUT is placed on an dielectric support vs a dissipative mat. 200 mm ground still required.
- Figures updated to show that CAN wiring remains co-bundled with other wiring during powered ESD tests.
- ESD stress levels now extended to +/- 15 KV for CAN circuits in diagnostic connector

Annex A Field Calibration for Bands 7 and 8

- No changes other than band reference change

Annex B Modulation and Thresholding

- Thresholding procedure modified to report the level in dB below stress level. This is performed relative to the forward power.

Annex C

Former MTR calibration replaced by new RI 115 characterization procedure. Requires use of a vector network analyzer

Annex D

- Content the same except references are directly to ISO pulses. ISO pulse characteristics have been added to annex.

Annex E (EMC-CS-2009.1)

- Reference to transient pulse application has been removed. This is largely because of decision to apply all transient pulses from CI 220 to all power and control signals. Prior specification would differentiate between switched and direct battery circuits.

Annex E (formally Annex F) Transient Generator

- Capacitor C1 characteristics updated to match what has been communicated to labs. Also matches capacitor characteristics from commercially available generators (i.e. TESEQ, EMTest)

Annex F (formally Annex G) Load Simulator

- Generic schematic update to illustrate design for applying transients through loads within the Load Simulator.
- Clarification that unless specified, an artificial network is not used in the DUT power return circuit

Annex G (formerly Annex H) RI 130/150 Test Fixture

- Figure G-3 updated to show that DUTs with dedicated return has the return circuit in slot C. This now aligns with the text in Sections 14 and 15.
- Provisions for alternative test setups for larger bundles (e.g twisted trios). Requires review and direction by FMC

Annex I (CI 421, EMC-CS-2009.1)

- Annex Eliminated given change in test method.