



# Electromagnetic Compatibility Design, Validation and Acceptance Process for Electrical Components and Subsystems

## Foreword

This engineering process addresses electromagnetic compatibility (EMC) design, validation and acceptance process requirements for electrical and/or electronic (E/E) components & subsystems for Ford Motor Company (FMC). This is a companion document to RQT-002700-000417: Electromagnetic Compatibility Specification for Electrical/Electronic Components and Subsystem (FMC1279). These requirements have been developed to assure common global practices within FMC and with its E/E component & subsystem Suppliers and Approved EMC Test Laboratories. This document replaces EMC-P-2009.

FMC1279 is available for download from the Ford Standards Management System [FSMS](#) under RQT-002700-000417 (Legacy Requirement ARL-0466). Corrections and/or editorial updates to this specification will be made as required and without prior notification to the user. It is recommended that the user verify they have the latest version of the specification prior to application to their E/E component/subsystem.



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## 1.0 Scope

This engineering process applies to the Electromagnetic Compatibility (EMC) design development, design validation and product acceptance of electrical/electronic (E/E) components and subsystems for used by Ford Motor Company (FMC) including its associated vehicle brands.

This is a companion document to the specification titled: **Electromagnetic Compatibility Specification for Electrical/Electronic Components and Subsystem (EMC-CS-2009)**

### 1.1 Purpose of this Process

The purpose of this engineering process is to ensure that all E/E components and subsystems are properly engineered and delivered with a consistent, high level of electromagnetic compatibility (EMC) PRIOR to system integration and vehicle validation.

This process presents EMC control management procedures necessary for the successful specification, design, validation and acceptance of E/E components and sub-systems. It also provides for ongoing assurance that E/E System, Sub-system & Component EMC will be maintained throughout the products' operational life-cycle.

The Supplier may contact the FMC EMC department for details concerning these requirements. Additional component, subsystem, and vehicle level EMC requirements may be imposed by individual vehicle brands reflecting special conditions in their target markets.

### 1.2 Use of this Process

This process applies to all E/E components and subsystems. It shall be used by FMC Design and Release (D&R) group and their sourced Suppliers to manage the EMC design, validation and acceptance of their component or subsystem.

The FMC D&R group shall be responsible for the execution of this process by the Supplier and the management of deliverables. The FMC EMC Engineering Department shall be responsible for technical support and guidance to both the FMC D&R group and the Supplier.

The core elements of this process are:

- EMC Test Requirements and Test Plan Submission.
- EMC Test Reporting and Data Submission.
- EMC Data Reviews and Product Acceptance.
- EMC Change Management and Re-Validation Requirements Analysis.

### 1.3 Additional Information

The process & document requirements delineated herein represent a formal approach to the design, validation and acceptance of E/E components and sub-systems for EMC. It is based on collective experiences within the industry, where these process disciplines and deliverables have achieved high levels of EMI robustness and successful product compliance.

Every attempt has been made to assure that the information contained herein is accurate at the time of document release. Subsequent editorial updates and/or technical clarifications of process requirements may be made without notice. Updates are found at <http://www.fordemc.com> and the [FSMS](#) in the form of a document addendum. It is the responsibility of the user to review this information each time the document is used.

## 2.0 References

**FMC1278** Electromagnetic Compatibility Specification For Electrical/Electronic Components and Subsystems

**GMW3103** General Specification for Electrical/Electronic Components and Subsystems, electromagnetic Compatibility

## 3.0 Abbreviations, Acronyms, Definitions & Symbols

**Annex.** Supplementary material attached to the end of a specification, usually used to supply general information and not requirements.

**CAD.** Computer Aided Design.

**Carry Over.** Term used to describe a production level component designed and qualified to a current or previous EMC specification that is exactly the same component being re-used for a future vehicle program

**Component.** Reference for active electronic modules, electric motors, passive and inductive devices

**Component, subsystem Engineering Specification.** Engineering specification for the component or subsystem documenting all performance requirements (mechanical, thermal, EMC, etc)

**D&R.** Design and Release or Engineer responsible for releasing the component

**DUT.** Device Under Test

**DV.** Design Verification (components not constructed from production tooling)

**E/E.** Electrical and/or Electronic – Includes electrical, electronic and electromechanical components and subsystems

**EMC.** Electromagnetic Compatibility

**EMCTDR.** Electromagnetic Compatibility Technical Design Review

**EMI.** Electromagnetic Interference

**FDJ.** Final Data Judgment (GPDS Milestone)

**FMC.** Ford Motor Company including all affiliate brands

**FMC D&R Group.** The FMC engineering activity responsible for design of the component or subsystem

**FMC EMC Department.** The Ford Motor Company EMC department associated with a specific brand

**FSMS** Ford Standards Management System

**GPDS.** Global Product Development System – Current Product development process adopted by Ford and its affiliate brands

**I/O.** Input/Output

**LR.** Launch Readiness (GPDS Milestone)

**Normative.** Provisions that are necessary (not informative) to meet requirements

**OEM.** Original Equipment Manufacturer – reference to enable wider use of this document by other Brands

**PA.** Program Approval (GPDS Milestone)

**PCB.** Printed Circuit Board

**PCM.** Powertrain Control Module

**PDF.** Portable Document Format

**PTC.** Program Target Compatibility (GPDS Milestone)

**PV.** Production Verification (component constructed from production tooling and manufacturing processes)

**PWB.** Printed Wiring Board

**RE.** Radiated emission

**RI.** Radiated Immunity

**Recognized Laboratory.** An EMC laboratory that meets the requirements for acceptance by Ford Motor Company. Refer to <http://www.fordemc.com> for more details on this program.

**Shall.** Denotes a requirement

**Should.** Denotes a recommendation

**Sign-Off Test.** The process of confirming by testing that the product design meets it's technical requirements. DV/PV test is considered as Sign-Off test for EMC.

**UN.** UnderBody (GPDS Milestone)

**UP.** UpperBody (GPDS Milestone)

**UN V1.** UnderBody (GPDS Milestone)

**UN V2.** UnderBody (GPDS Milestone)

**VP.** Verification Prototype (GPDS Milestone)

**VP MRD.** VP – Material Required Date. This is a GPDS Milestone, by which all representative commodities components should be available for installation on the vehicle.

## 4.0 Test Plan Process

This section describes the procedures necessary to satisfy the Supplier requirement for the preparation, submission and FMC acceptance of an EMC Test Plan for component/sub-system design & production validation testing.

### 4.1 Requirement

The D&R/Supplier shall prepare an EMC Test Plan in the required format. The EMC Test Plan shall be developed during the electrical design progression phases UN/UP <V1-V2>. The Draft test plan shall be submitted for review at the earliest opportunity during UN/UP <V1-V2>. *Early submission of the test plans are recommended.*

The final submission shall be received and accepted by FMC EMC no later than 20 days prior to scheduled UN/UP < V2> deliverable date and at least 20 days prior to scheduled DV EMC Testing at a recognized test facility.

The accepted EMC test plan shall receive a unique Test Plan Number, which must be obtained before commencement of formal testing. Failure to obtain a Test Plan Number prior to the commencement of testing will invalidate the test results.

### 4.2 Roles and Responsibilities

The D&R/Supplier shall be responsible for the development and maintenance of the specific component/sub-system EMC Test Plan in the required format. This responsibility includes, but is not limited to:

- Identification of all Test Modes / Functions applicable to E/E operation.
- Identification of applicable EMC tests and matrix of testing to cover variants / modes within E/E component/sub-system family.
- Component/Subsystem Specific Acceptance Criteria
- Submission of Draft EMC Test Plan for timely review and consultation with FMC EMC Engineer.

### 4.3 EMC Test Plan - Process Steps

The EMC Test Plan review process steps shown in figure 4-1 are described as follows:

- The D&R shall initiate the requirement for an EMC Test Plan and establish program timing to meet the GPDS milestone for the deliverable. D&R shall be responsible for timing and execution of this deliverable with Supplier.
- The D&R Engineer / EMC Engineer may determine the need for an EMCTDR. This would enable more detailed collaboration and understanding on a cost effective validation plan.
  - The Supplier shall submit PCB layout (CAD format), Hardware Schematic (CAD &/or electronic PDF), EMC related analysis and necessary documentation for the EMCTDR.
- The D&R shall initiate the first draft of the commodity EMC test plan. *In many cases, there exist previous or generic commodity EMC test plans. The D&R should consider use of these test plans as a basis of creation of the EMC test plan for their specific commodity.*
- The Supplier may provide the initial draft for comment at any time during commodity development to the FMC EMC Engineer to provide directional test requirements.
- The D&R / Supplier shall develop for test plan content accuracy, particularly:
  - Component/Sub-System Description, including system diagrams
  - Operating Modes / Functional Classifications
  - Special Test Requirements/Test Setups (may require support from test laboratory)
  - Component/Sub-System Acceptance criteria
  - Specification of Interface (I/O) Signal parameters including relevant network communication (e.g. CAN) messages
  - Specification of Interface (I/O) Loads

- The D&R / Supplier to agree on the content of the EMC Test Plan before submission to Responsible FMC EMC Engineer
- The FMC EMC Engineer receives Final EMC Test Plan for review.
- If the EMC Test Plan is not ready for approval the supplier shall update the EMC Test Plan and resubmit the updated test plan to the FMC EMC Engineer.
- If the EMC Test Plan is ready for approval, the D&R shall submit the EMC Test Plan Title Page to FMC EMC Engineer with D&R and Supplier signature(s).
- The FMC EMC Engineer shall sign and issues a Test Plan Tracking Number.
- All accepted plans shall have a Test Plan Tracking Number based on the vehicle application where the component/subsystem is first used. The format of the test plan number is shown below:

**<Region> -EESE-T- <year> - <nnnn>-< x >**

<Region> = the region issuing the tracking number

- F = Ford Europe
- N = Ford North America
- S = Ford South America
- A = Ford Asia Pacific Africa
- O = Ford Otosan

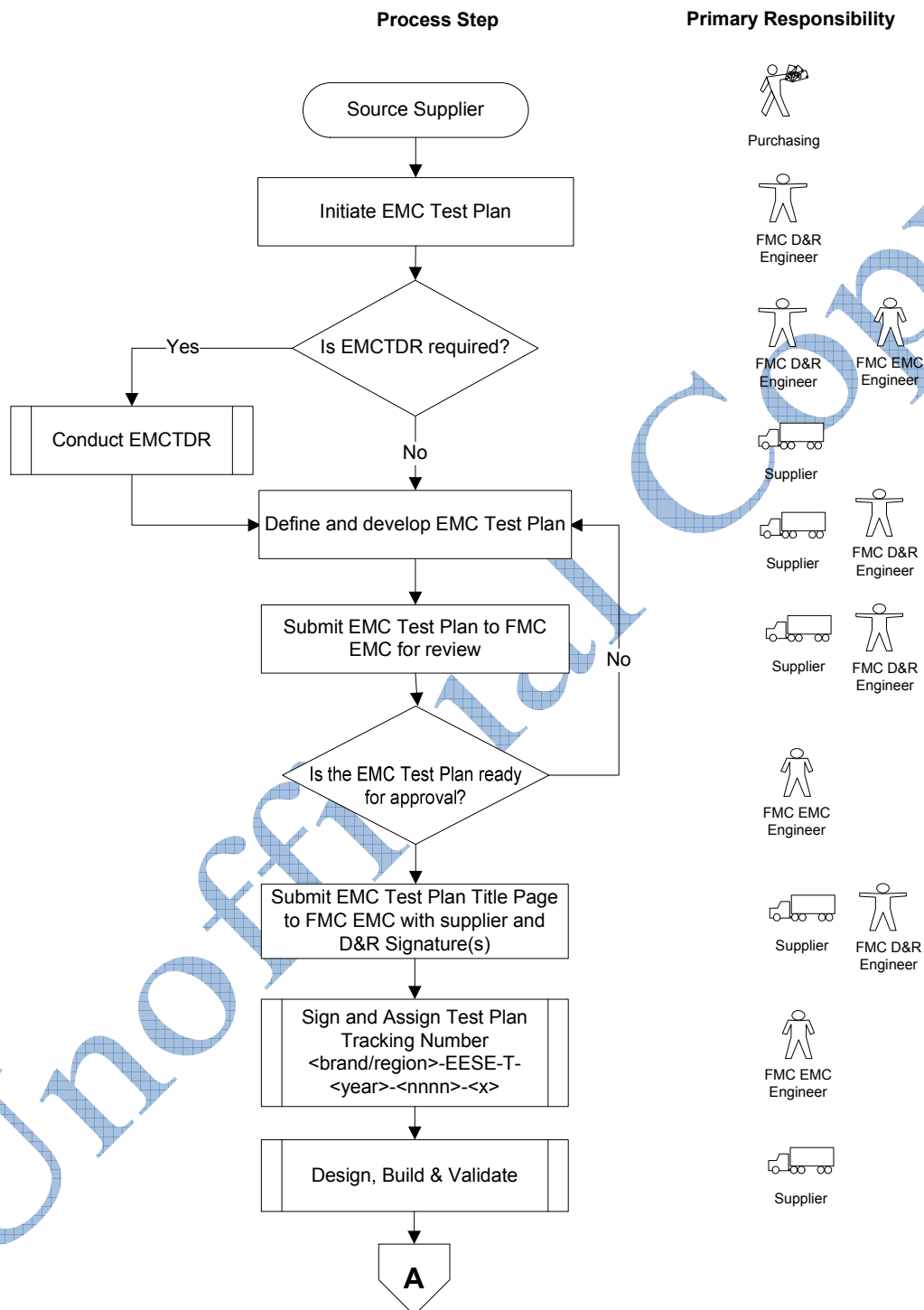
<year> = the year the test plan was accepted by region

<nnnn> = the sequential test plan number (e.g. 0001, 0002...0103, etc)

< x > = test plan revision letter (e.g. A, B, C, D, E.....)

- The Supplier shall inform FMC D&R/EMC Engineer if any changes/updates are required to an approved EMC Test Plan.
- The supplier shall submit the updated test plan for re-approval.
- The FMC EMC Engineer shall authorize the changes by assigning a revision number or assign a new Test Plan Tracking Number at his/her discretion (see section 7.0 for details).
- The EMC Test Plan template is located at: <http://www.fordemc.com/docs/Downloads.htm>

Figure 4-1: EMC Test Plan Process





## 5.0 Test Execution and Reporting (Sign-Off Test) Process

This section describes the procedures necessary to satisfy requirements for the preparation, submission of Test Reports for component/sub-system Sign-Off testing.

### 5.1 Requirements

The Supplier shall execute SIGN-OFF EMC testing at a FMC Recognized Test Laboratory with a FMC EMC Accepted Test Plan. A list of Ford Recognized EMC Test Laboratories can be downloaded [http://www.fordemc.com/docs/Rec\\_Labs.htm](http://www.fordemc.com/docs/Rec_Labs.htm)

EMC Testing shall be completed as follows:

- EMC DV Testing for all UN components except PCM shall be completed, no later than the M-1DC milestone. EMC DV Testing for all UP components shall be completed, no later than the VP MRD milestone. DV testing shall be performed using production representative components but not necessarily components constructed from production tooling.
  - Where 1<sup>st</sup> pass validation test cannot be completed by M-1DC for UN and VP MRD for UP components, the supplier shall obtain approval from D&R and FMC EMC for any recovery plan.
  - EMC DV1 Testing for PCM shall be completed, no later than the M-1DC milestone. Testing shall be performed with test software mutually agreed to by FMC D&R, EMC and the supplier.
  - EMC DV2 Testing for PCM shall be completed, 3 months before PEC milestone using Production Intent hardware and the latest available Application Software.
- EMC PV Testing (if necessary) shall be completed as required to support PPAP process. Refer to Section 7.0 Change Management and Revalidation Process for PV testing process (see figures 7-1 & 7-2 for details).
  - PV testing is only required if the samples tested during DV have been changed. If there are no changes in DV design, DV test data can be surrogated for PV.
  - Certain products(e.g. including but not limited to devices with RF components, high speed communication or safety critical functions.....) will be required to perform limited PV testing to ensure the EMC performance is not degraded by the change in manufacturing process or manufacturing location. Contact FMC EMC Department for details.

### 5.2 Test Laboratory Roles and Responsibilities

The FMC Recognized Test Laboratory shall:

- Provide a EMC Test Summary directly to the Supplier, with a copy emailed directly to EMCDATA@ford.com within 5 business days of test completion.
- Provide a Detailed EMC Test Report directly to the Supplier, with a copy emailed directly to EMCDATA@ford.com within 25 business days of test completion.
- The subject field of the e-mail shall contain the FMC EMC approved test plan number and the product name.

Detailed Test Report shall be prepared in accordance with the outline shown in Section 8 of this document.

### 5.3 Test Execution and Reporting Process Description

The detailed process requirements for Test Execution and Reporting shown in Figure 5-1 are described as follows:

- All Sign-Off testing shall be performed using a test plan accepted by FMC EMC.
- All FMC EMC accepted plans shall have a test plan tracking number.
- All pages of the Sign-Off test report (including plots) shall be clearly marked "**Sign-off Test Results**" by the test laboratory. The test report cover page shall reference the EMC test plan tracking number. A copy of the EMC test plan with the signed title page shall be included with the test report.



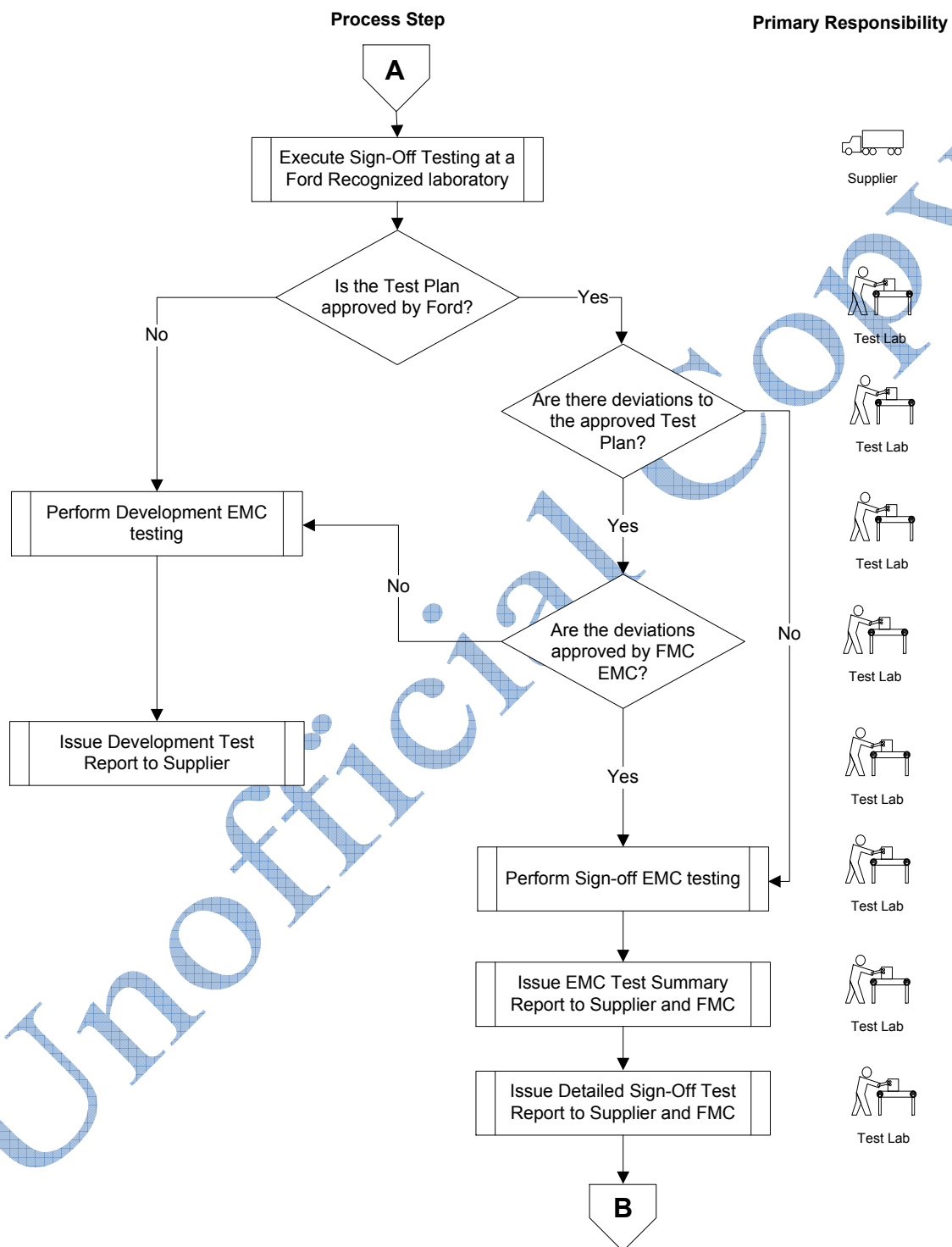
- If the test plan does not have a tracking number, the test laboratory shall advise their customer that FMC will not consider the test results as valid Sign-Off data. If the customer requests testing to be performed without a FMC accepted test plan or if the customer declares the testing to be for development purposes (with or without an accepted test plan), all pages of the test report shall be marked "**Development Test Results. Not for Sign-Off**" by the test laboratory.
- Sign-Off testing shall be performed using two identical test samples in accordance to requirements delineated in the FMC accepted EMC test plan. All applicable tests and test modes shall be performed on both test samples unless specifically stated in the test plan.
- At no time during testing shall test samples be replaced without prior written approval from the FMC EMC department.
- If a test sample is damaged during testing, the test lab may replace the damaged sample and complete rest of the testing with the prior written approval of FMC EMC department. If the test lab replaces a damaged sample it shall be noted in the test report along with the documented approval by FMC EMC department. The replacement sample shall be subjected to ESD testing prior to the commencement of rest of the testing. Some testing may have to be repeated on the replacement sample per review of FMC EMC department.
- If either test sample is found to be non-compliant to any of the tests listed in the EMC test plan, those non-compliances shall be reported in the test report. Test samples may not be modified at anytime during testing in an attempt to resolve individual non-compliances. If the samples are modified during testing, the test laboratory shall advise their customer that FMC will not consider the test results as valid Sign-Off data. The test laboratory shall note these modifications in the test report and all pages of that test report shall be marked "**Development Test Results. Not for Sign-Off**".
- Deviations from the approved EMC test plan are not permitted without prior written authorization by the FMC EMC department.
- A copy of the approved Test Plan shall be included in the Sign-Off test report.
- Development testing is considered informal and cannot be used to support Sign-Off testing. Development testing includes any pre-design testing and/or investigational testing as the result of non-compliance to Sign-Off testing. Development testing may be performed at any EMC laboratory. Development testing may be performed without an approved test plan. The results of development testing do not have to be reported to FMC. If a test report is requested by the laboratory's customer, each page of the test report shall be clearly marked: "**Development Test Results. Not for Sign-Off**" by the test laboratory.
- The supplier may at their discretion elect to change their declaration to Development testing. However, the test laboratory shall note this change in the test report and all pages of that test report shall be marked "**Development Test Results. Not for Sign-Off**". Supplier shall notify FMC D&R and EMC Engineer when they elect to change Sign-off testing to Development testing and provide a recovery plan to complete Sign-off testing.
- If the test lab commences testing as Development test, the test lab shall issue a test report marked as "**Development Test Results. Not for Sign-Off**". The test lab shall not change a Development Test Result to Sign-off Test Result
- During Sign-off testing, all observed or measured effects shall be fully documented in the test report. Additionally, the lab shall summarize all effects that do not meet the acceptance criteria delineated in section 3.4 of the component test plan.
- The test laboratory shall document all deviations from normal device functionality (i.e. Status I) during immunity testing. The lab shall not make use of the terms "pass" or "fail" in the test report for Status II and III performance. Immunity tests for status I and IV as well as emissions test shall be classified as Pass or Fail based on test results.
- Verification of compliance to these requirements shall be performed via joint review of the formal test report by FMC D&R and EMC departments (see section 6.0 for details).
- The test laboratory shall document the deviations in the format shown in section 8.0
- All test reports shall be reviewed and signed off by the Ford approved manager or their deputy of the EMC test laboratory.
- All test data shall be reviewed by FMC D&R and EMC department to verify compliance to the requirements.



- Component/Subsystem final compliance shall be determined by the FMC. Refer to Section 6.0 for Data Review and Acceptance Process.

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Figure 5-1: Test Execution and Reporting Process



## 6.0 Data Review and Acceptance Process

The Electromagnetic Compatibility Sub-system / Component Data Review and Acceptance Process is the final check point in the design and product validation process, to bring acceptance of each E/E Sub-system / Component prior to Vehicle level EMC testing. This section describes the procedures necessary to satisfy the Supplier requirement for FMC Data Review and acceptance of an EMC Test Data for component/sub-system design & production validation testing.

### 6.1 Requirement

The Data Review and Acceptance process is applicable to all E/E Sub-system / Component, having completed Sign-Off EMC Testing. It is also applicable to sub-systems / components that have been revalidated due to a design change.

- If requested, the Supplier/Test Laboratory shall provide all test documents and test data necessary to enable FMC EMC department to verify product compliance to the requirements.
- If requested, the Supplier shall support the FMC Data Review.
- Compliance Verification to EMC requirements shall be performed via joint review of the formal test report by FMC D&R and EMC departments
- Component/Subsystem final compliance shall be determined by the FMC. The Supplier or the EMC test laboratory shall not determine the compliance of a product.

### 6.2 Supplier Roles and Responsibilities

- The Supplier shall provide all deliverables to support EMC Data Review by FMC.
- The Supplier shall deliver production representative product to support VP vehicle testing.
- The Supplier shall support EMC Data Review when requested.
- The Supplier shall be responsible for evaluation of all FMC EMC recommendations and determine appropriate design actions.

### 6.3 Data Review and Acceptance Process Description

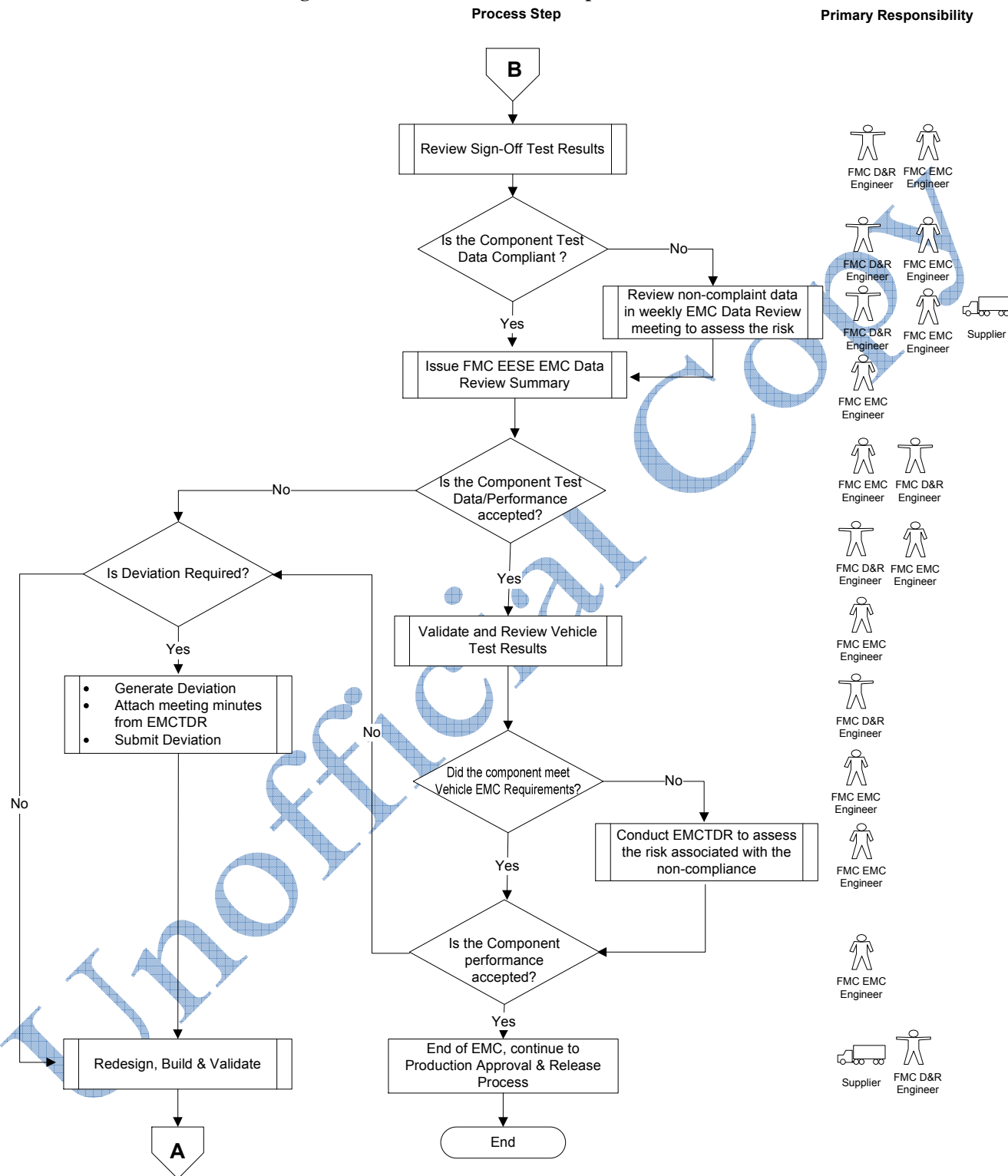
The EMC Data Review and Acceptance process steps shown in Figure 6-1 are described as follows:

- FMC D&R and EMC Engineer shall perform a joint review of the formal test report to determine the EMC Compliance Status of the Product.
- The FMC EMC/D&R Engineer shall review the Sign-Off Test Data and determine the level of risk to the Vehicle Program and future programs covering different markets if anomalies are noted.
- At the completion of joint review, if all of the required tests are found to be compliant, the FMC EMC Engineer shall issue a Data Review Summary(Figure-8) indicating the EMC Compliance Status of the product.
- If any of the required tests are found to be non-compliant, the D&R and FMC EMC Engineer shall review the non-compliant data in the weekly EMC Data Review to assess the risk associated with the non-compliance and to determine the action required to address the non-compliance.
- At the completion of EMC Data Review, the FMC EMC Engineer shall assign a Compliance Status (Pass or Fail) for each of the required test and issue a EMC Data Review Summary Sheet. Refer to figure-8 for EMC Data Review Summary format. Below is the key to EMC Compliance Status (Pass or Fail).
  - **PASS:**
    - Compliant to requirement
  - **FAIL:**
    - **F1:** Non-compliant to requirement but Production Acceptable. Deviation Not Required.
    - **F2:** Non-compliant to requirement. Corrective Action Required. Deviation Acceptable.
    - **F3:** Non-compliant to requirement. Corrective Action Required. Deviation Not Acceptable. . Requires management (LL5+) review and final assessment.
- The FMC D&R shall determine in consultation with FMC EMC Department if a Sub-system/Component can be released for Vehicle EMC Validation.

- Compliance at component level does not absolve the Supplier of EMC non-compliances at the Vehicle level. If non-compliances are observed in the vehicle, the supplier shall provide necessary support to determine appropriate actions to resolve the Vehicle level non-compliances.
- The Sub-system / component acceptance review process is progressive and the final outcome is based on success at both component and vehicle level. The results from the component level shall predetermine the severity of risk to the vehicle level test. The assessed risk shall then determine progression to the vehicle level test.
- A successful outcome at the component level and vehicle level shall determine the path of acceptance for the E/E Sub-system / Component and progression to Production Part Approval Process (PPAP).

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Figure 6-1: Data Review and Acceptance Process



## 7.0 Change Management & Revalidation Process

Components & Sub-systems are often subject to change after EMC Sign-Off testing has been performed. These changes may have a potential impact on EMC performance for which repeat EMC testing is necessary to validate any potential change in EMC characteristics.

### 7.1 Requirements

- The Supplier shall inform FMC when any change to the Component or Sub-system (example: design, PCB, software, electrical components, manufacturing location, manufacturing process, component sourcing, packaging... etc.) occurs.
- The Supplier shall follow the EMC Change Management and Revalidation Process for PV testing (if required). Refer to Figure 7-2 for PV test process details. The FMC EMC Engineer shall determine the tests required to validate any potential change in EMC characteristics. The FMC EMC Engineer may request to repeat all of the EMC tests at his/her discretion.
- The Supplier shall inform FMC when any changes are required to an approved EMC test plan.
- The Supplier shall submit a completed **EMC Change Management & Revalidation Form**.
- The Supplier may be required to support an EMC Technical Design Review (EMCTDR) at the request of the FMC.

### 7.2 Supplier Roles and Responsibilities

The Supplier shall be responsible for the maintenance of component/sub-system EMC and compliance. The EMC Change management responsibility includes, but is not limited to:

- Informing FMC D&R that a change has occurred.
- Provision of technical evaluation of impact to Component EMC for each change.
- Qualitative and Quantitative Risk Assessment to overall component/subsystem EMC.
- Specification of test requirements necessary to revalidate using original accepted EMC Test Plan.
- Submission of Change Management & Revalidation Form to FMC D&R Engineer with supporting documentation.
- Execution of agreed revalidation testing at a FMC recognized EMC Laboratory.

### 7.3 EMC Change Management - Process Steps

The EMC Change Management process steps shown in Figure 7-1 are described as follows:

- The Supplier Design Engineer / EMC Engineer responsible for the E/E subsystem / component should evaluate all changes for potential impact to product EMC compliance.
- The FMC D&R Engineer shall review the design change with a FMC Product Design Specialist to ensure the overall design of the product has not been compromised by the subsequent design change.
- All changes that impact EMC shall be documented using the EMC change management & Revalidation form. Each change should be analyzed for appropriate revalidation testing requirements against the original EMC Validation Test Plan. This enables the Supplier to justify partial revalidation requirements in mitigation of full revalidation testing.
- Submit the EMC Change Management & Revalidation Form and supporting information to FMC D&R / EMC Engineer for review and approval of revalidation requirements.
- The FMC responsible D&R Engineer / EMC Engineer may determine the need for an EMCTDR. This would enable more detailed collaboration and understanding on a cost effective revalidation plan.
- The Supplier shall submit PCB layout (CAD format), Hardware Schematic (CAD &/or electronic PDF), EMC related analysis and necessary documentation for EMCTDR.





- The FMC EMC Engineer shall the review revalidation requirements and either:
  - Approve Requirements, providing a revised test plan number per the numbering format in Change Management & Revalidation form
  - Continue to work with the Supplier to agree on comprehensive re-validation requirements
- The Approved Change Management form/ Re-validation # shall provide the authority to the recognized test laboratory to proceed with SIGN-OFF testing. The test laboratory may contact the FMC EMC Engineer to confirm.
- The Change Management & Revalidation form is located at: <http://www.fordemc.com/docs/Downloads.htm>

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Figure 7-1: EMC Change Management & Revalidation Process

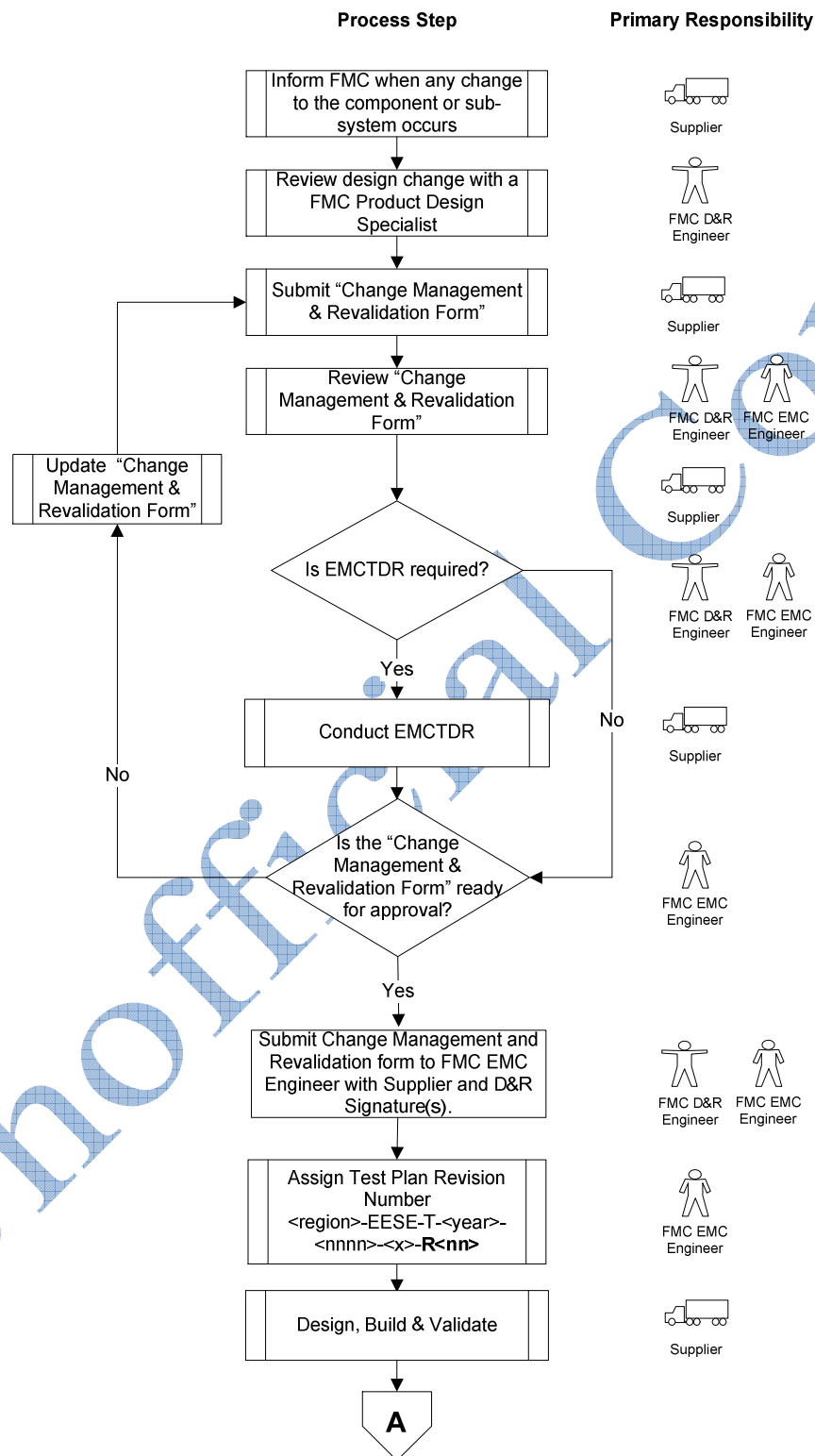
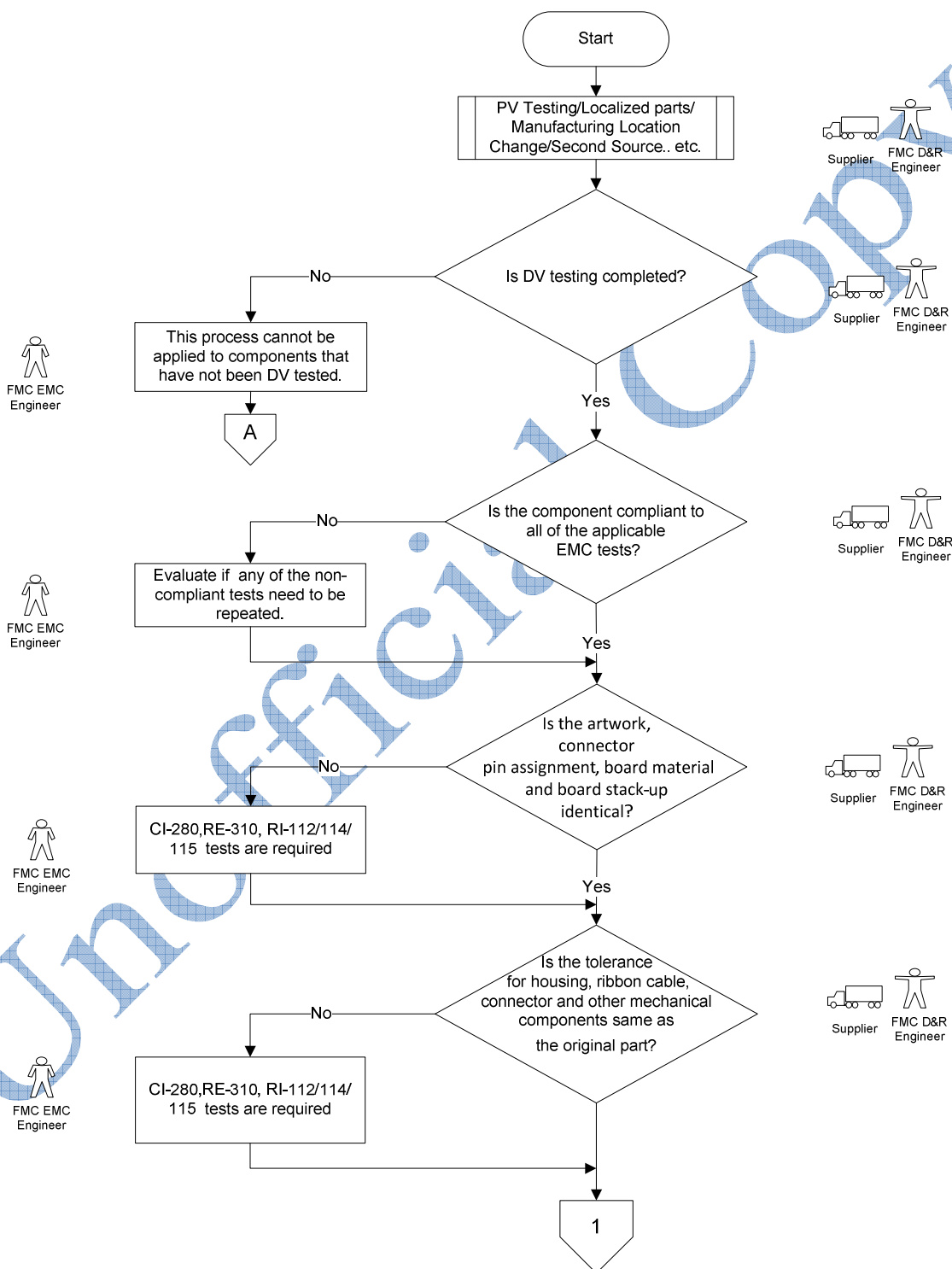


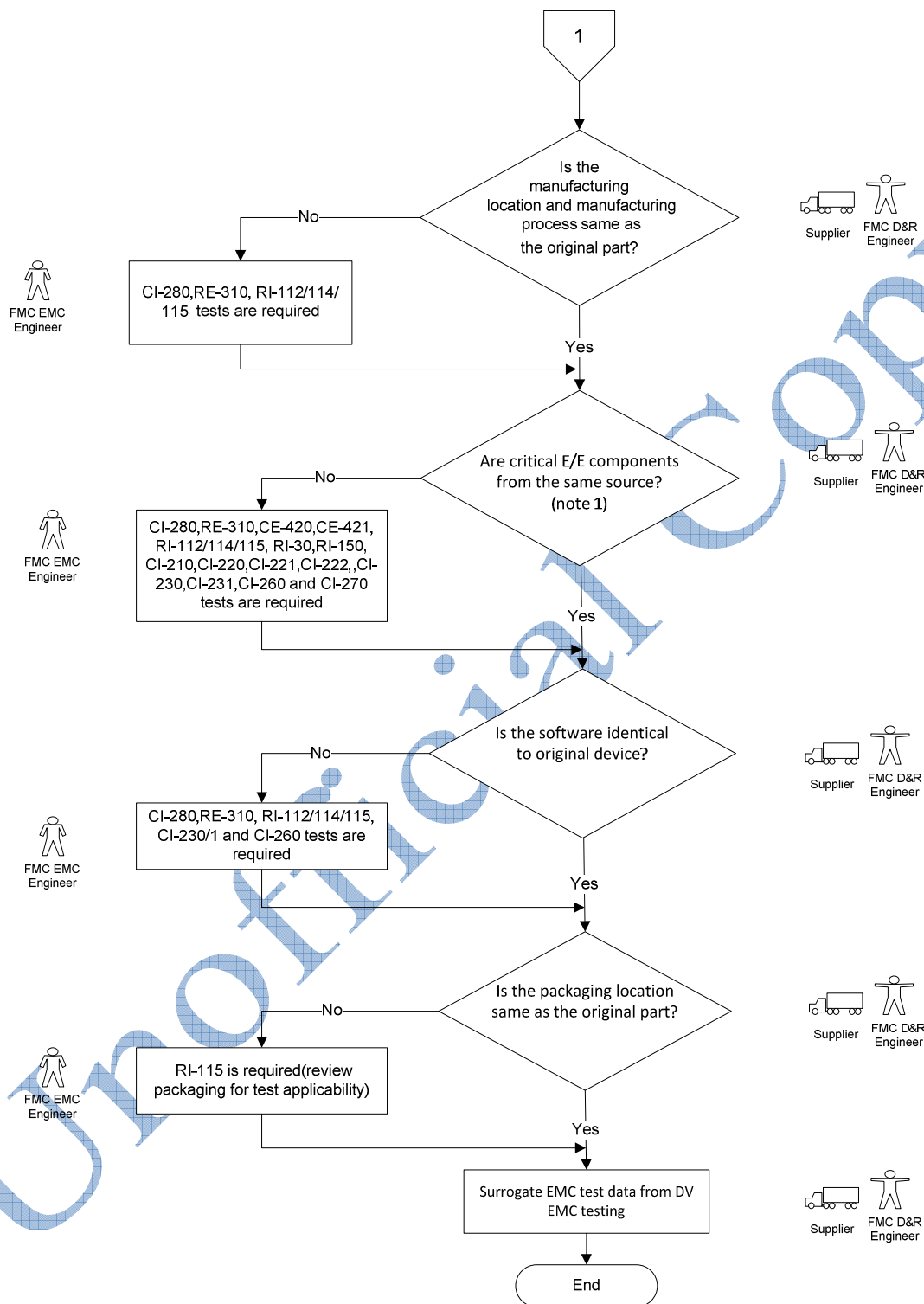
Figure 7-2: EMC Change Management and Test Selection Process

Primary Responsibility

Process Step

Primary Responsibility





Note 1: Critical Electrical/Electronic(E/E) Components include but not limited to microprocessors, voltage regulators, semiconductor devices, transient suppressors, oscillators, resonators, resistors, capacitors, inductors, common mode chokes, ESD protection devices etc

## 8.0 Data Reporting

Specific reporting requirement for each test requirement delineated herein. These reporting requirements do not apply to development test data.

- Test reports shall comply with the requirements of ISO17025 except where noted in this document.
- A single report shall be issued covering ALL test samples and ALL tests.
- There shall be a Test Report Summary indicating the observed functional performance status and performance deviation (if any) of every test.
- Test results shall be reported accurately, clearly, unambiguously and objectively.
- The test laboratory shall document all deviations from normal device functionality (i.e. Status I) during immunity testing. The lab shall not make use of the terms “pass” or “fail” in the test report for Status II and III performance. Immunity tests for status I and IV as well as emissions test shall be classified as PASS or FAIL based on test results.
- Due to the definitions of Status II and III performance, the laboratory shall not make determination of compliance to immunity requirements. Verification of compliance to these requirements shall be performed via joint review of the formal test report by FMC D&R and EMC departments (see section 6.0 for details).
- The test report shall identify DUT details including part numbers, PWB numbers and design version (hardware and software).
- All reporting shall be done electronically using a PDF format unless authorized by FMC EMC department.

### 8.1 Test Report Summary

The test report shall contain a summary sheet with the observed performance deviation for each of the applicable test. An example of Test Report Summary is illustrated in Figure 8-1.

- The test lab shall hyperlink each of the test in the summary sheet to the relevant page in the test report to facilitate data search.



Figure 8-1:  
E/E Component EMC Test Summary:

(Created by Recognized Laboratory)

<b>Product Description:</b> 2017 MY P475 Instrument Cluster		
<b>Test Laboratory Name &amp; Location:</b> EMC Laboratory, 123 Street name, City, State, Zip Code		
<b>Test Report #:</b> 2009-1256		<b>Approved Test Plan Number:</b> N-EESE-T-2009-0004
Test Type: Sign-off Testing		Test Specification Number: FMC1278
Test Requested by: Requestor Name Company Name and Location		Phone Number: (123)456-789
<b>Product Part Number:</b> AABB-2C222-DD AABB-2C222-DD	<b>Product Serial Number:</b> ABC8-009 ABC8-016	<b>Product Tracking Number:</b> 1-1 1-2
<b>Date Parts Received:</b> 04/15/2015	<b>Testing Started:</b> 04/24/2015	<b>Testing Completed:</b> 05/20/2015

Test Requested	Test ID	Test Description	Performance deviations?	Functional Performance Status Observed	Test Data Detail	Concurrence by FMC D&R and EMC (to be completed by FMC)
YES/NO			YES/NO	Status I/II/III	Annex #	PASS/FAIL
Yes	8.0 RE 310	<a href="#">Radiated RF Emission</a>	Yes	FAIL	Annex 1	
Yes	9.0 CE 420	<a href="#">Conducted RF Emissions</a>	No	PASS	Annex 2	
Yes	10.0 CE421	<a href="#">Conducted AF Emissions</a>	Yes	FAIL	Annex 3	
Yes	11.0 CE410	<a href="#">Conducted Transient Emission</a>	N/A	N/A	Annex 4	
Yes	12.5 RI 112	<a href="#">RF Immunity-Bulk Current Injection</a>	Yes	Status II	Annex 5	
Yes	12.6 RI 114	<a href="#">RF Immunity-ALSE/Reverb</a>	Yes	Status II	Annex 6	
Yes	12.7 RI 115	<a href="#">RF Immunity-Portable Transmitter</a>	Yes	Status II	Annex 7	
Yes	13.0 RI 130	<a href="#">Coupled Immunity-Inductive Transients</a>	No	Status I	Annex 8	
No	14.0 RI 140	<a href="#">Magnetic Field Immunity</a>	N/A	N/A	Annex 9	
Yes	15.0 RI 150	<a href="#">Coupled Immunity-Charging System</a>	No	Status I	Annex 10	
Yes	16.0 CI 210	<a href="#">Continuous Power Line Disturbances</a>	No	Status I	Annex 11	
Yes	17.0 CI 220	<a href="#">Transients Disturbances :Pulse A1</a>	Yes	Status II	Annex 12	
Yes	17.0 CI 220	<a href="#">Transients Disturbances: Pulse A2-1</a>	Yes	Status II	Annex 12	
Yes	17.0 CI 220	<a href="#">Transients Disturbances: Pulse A2-2</a>	Yes	Status II	Annex 12	
Yes	17.0 CI 220	<a href="#">Transients Disturbances: Pulse C1 &amp; C2</a>	No	Status I	Annex 12	
Yes	18.0 CI 221	<a href="#">Transients Disturbances: ISO Test Pulse 1</a>	Yes	Status II	Annex 13	
Yes	18.0 CI 221	<a href="#">Transients Disturbances: ISO Test Pulse 2a</a>	No	Status I	Annex 13	
Yes	18.0 CI 221	<a href="#">Transients Disturbances :ISO Test Pulse 2b</a>	Yes	Status II	Annex 13	
Yes	18.0 CI 221	<a href="#">Transients Disturbances: ISO Test Pulse 3a</a>	No	Status I	Annex 13	
Yes	18.0 CI 221	<a href="#">Transients Disturbances: ISO Test Pulse 3b</a>	No	Status I	Annex 13	
Yes	19.0 CI 222	<a href="#">Load Dump: ISO Test Pulse 5a</a>	Yes	Status III	Annex 14	
Yes	19.0 CI 222	<a href="#">Load Dump: ISO Test Pulse 5b</a>	Yes	Status III	Annex 14	
Yes	20.0 CI 230	<a href="#">Power Cycling</a>	Yes	Status II	Annex 15	
Yes	21.0 CI 231	<a href="#">Power Cycling</a>	Yes	Status II	Annex 16	
Yes	22.0 CI 250	<a href="#">Ground Voltage Offset</a>	No	Status I	Annex 17	
Yes	23.0 CI 260	<a href="#">Voltage Dropout Waveform A</a>	Yes	Status II	Annex 18	
Yes	23.0 CI 260	<a href="#">Voltage Dropout Waveform B</a>	Yes	Status II	Annex 18	
Yes	23.0 CI 260	<a href="#">Voltage Dropout Waveform C</a>	No	Status I	Annex 18	



Yes	23.0 CI 260	<a href="#">Voltage Dropout Waveform D</a>	Yes	Status II	Annex 18	
Yes	24.0 CI 270	<a href="#">Voltage Overstress</a>	Yes	Status II	Annex 19	
Yes	25.0 CI 280	<a href="#">Electrostatic Discharge</a>	Yes	Status II	Annex 20	

Comments:

This Test Report was reviewed by:	<b>Signature:</b> <i>Engineer</i>	<b>Signature:</b> <i>Manager</i>
<b>Date:</b> 05/22/2009	<b>Name:</b> Engineer	<b>Name:</b> Manager
	<b>Title:</b> EMC Engineer	<b>Title:</b> EMC Lab Manager
	<b>Phone #:</b> (012)345-678	<b>Phone #:</b> (012)345-789
	<b>E-mail:</b> engineer@email.com	<b>E-mail:</b> manager@email.com

For Internal Ford Motor Company(FMC) Use(Do not Mark)

Component/Subsystem EMC Performance Status Key and Risk Assessment

**PASS:**

Performance conforms to requirement

**FAIL:**

F1: Non-compliant to requirement but Production Acceptable. Deviation not Required.

F2: Non-compliant to requirement. Corrective Action Required. Deviation Acceptable.

F3: Non-complaint to requirement. Corrective Action Required. Deviation Not Acceptable. Requires management (LL5+) review and final assessment.

<b>Date:</b>	<b>Signature:</b>	<b>Signature:</b>
This Test Report was reviewed by :	<b>Name:</b>	<b>Name:</b>
	<b>Title:</b> FMC D&R Engineer	<b>Title:</b> FMC EMC Engineer



## 8.2 RE 310

DUT radiated emissions shall be plotted over each frequency band. The plots shall be clearly annotated with the following information:

- DUT operating mode
- DUT identification (e.g. serial number)
- Measurement system bandwidth (MBW)
- Limit reference (i.e. Limit A, Limit B)
- Antenna polarization
- Detection scheme (i.e. Peak, Quasi Peak, Average)
- Measurement dwell time or sweep rate
- Date of measurement

In addition to the plotted data, a tabularized summary for DUT emissions shall be provided for each frequency band where non-compliances are noted. The table shall include the band #, maximum DUT emission level measured for the band, and the associated band limit. Non-compliance to any band requirement shall be clearly noted. The data may be present on a separate sheet or combined with the plotted data. Examples of this format are illustrated in Figures 8-2, 8-3 and 8-4.

Additional information required includes:

- Plots of the test Setup ambient data. Test setup ambient measurements shall be performed using a 9/10 kHz MBW with peak detection except for bands G1, G8 and G9, which require use of average detection. All test setup ambient measurements shall be performed using only vertical polarization of the measurement antenna.
- Photographs of the test setup
- Any deviations in the test setup, as delineated in the EMC test plan, shall be noted



Figure 8-2: Example RE310 Data Report (Bands M1, M2, M3)

Test ID : RI 310 (Level 1)

DUT Description: Engine Controller

Approved Test Plan #: N-EESE-T-2009-0004

DUT Operating Mode: Engine Idle

Date Tested: 10/1/2009

Antenna Polarization: Vertical

Bandwidth / Detector: 120 kHz / Average

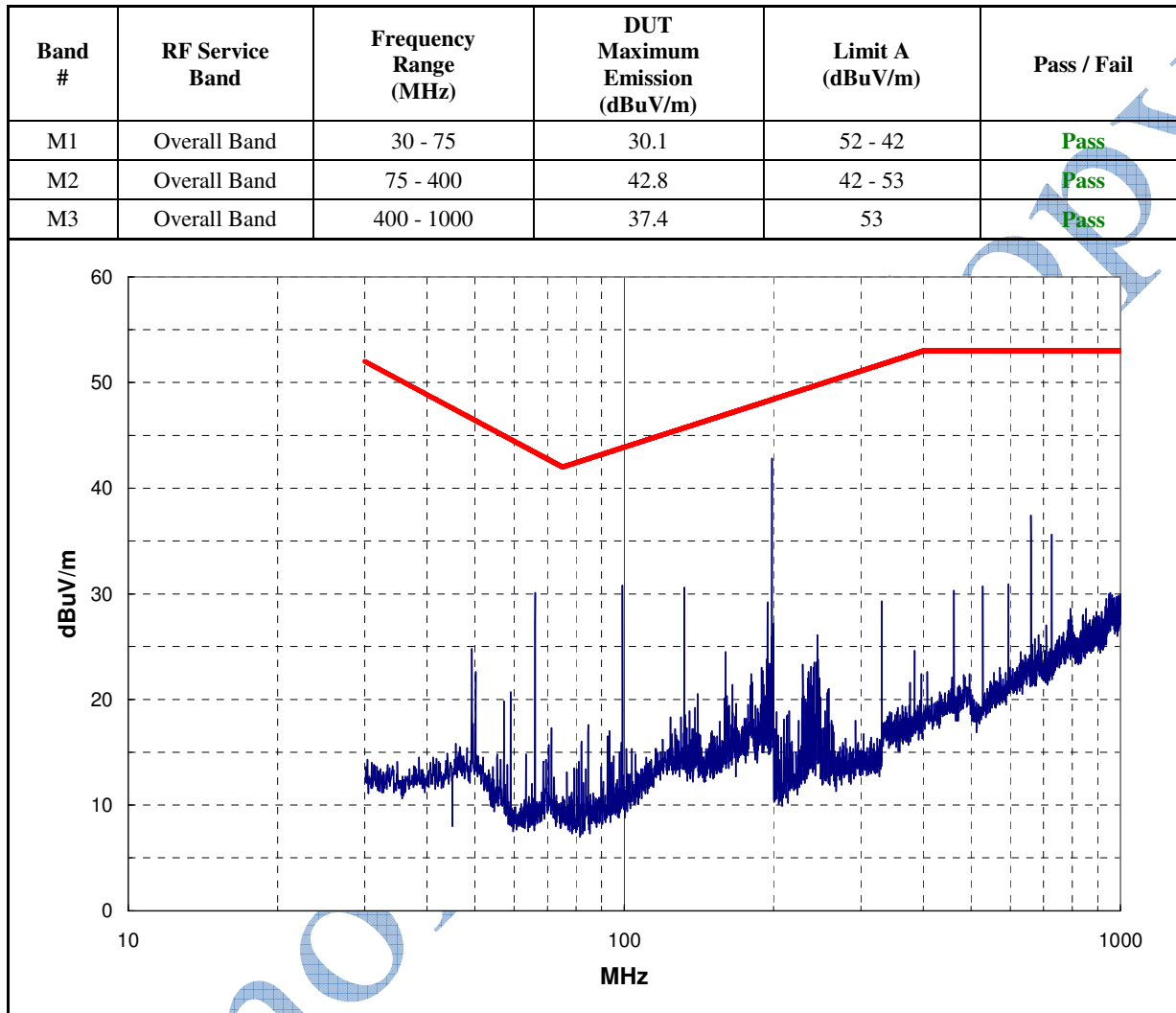




Figure 8-3: Example RE310 Data Report (Bands EU2, G1)

Test ID : RI 310 (Level 2)

DUT Description: Engine Controller

Approved Test Plan #: N-EESE-T-2009-0004

DUT Operating Mode: Engine Idle

Date Tested: 10/1/2009

Antenna Polarization: Vertical

Bandwidth / Detector: 9 kHz / Average

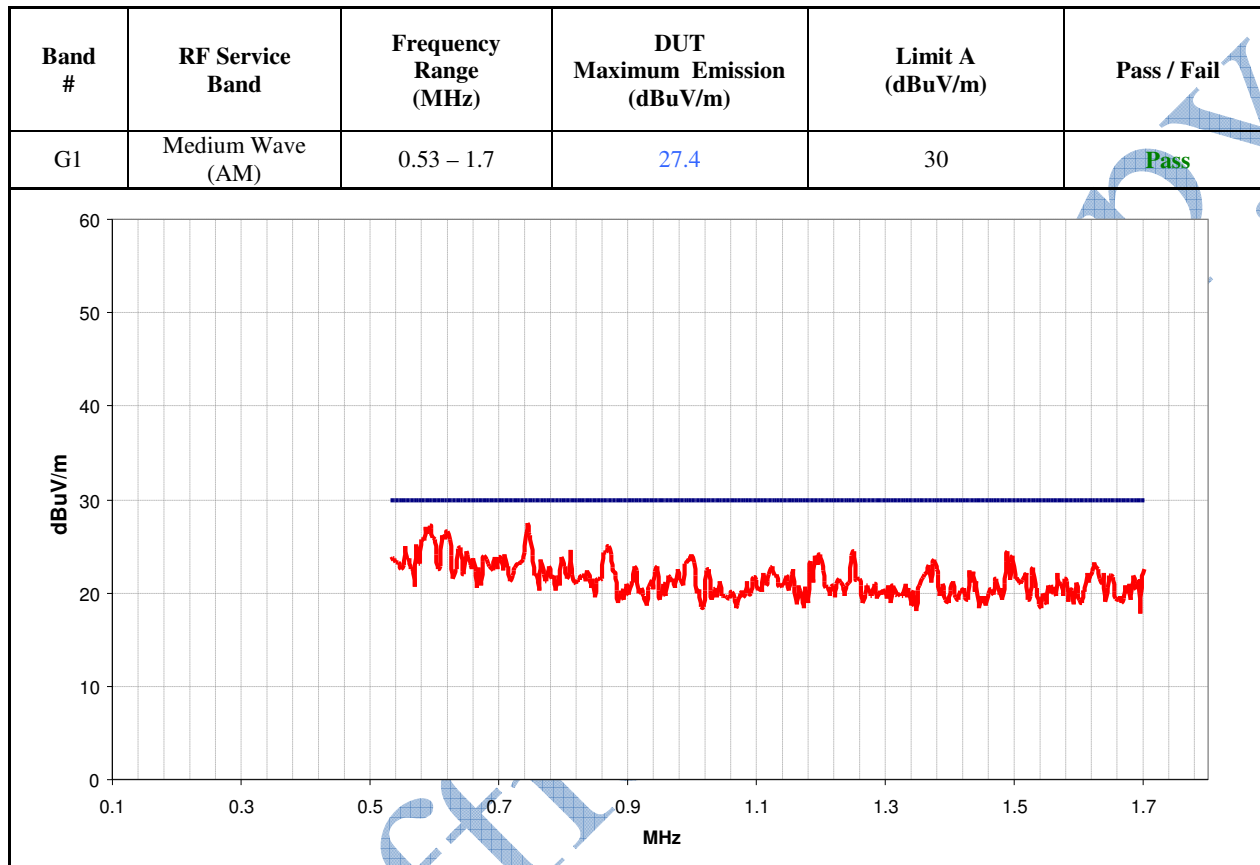




Figure 8-4: Example RE310 Data Report (30 – 300 MHz)

Test ID : RI 310 (Level 2)

DUT Description: Engine Controller

Approved Test Plan #: N-EESE-T-2009-0004

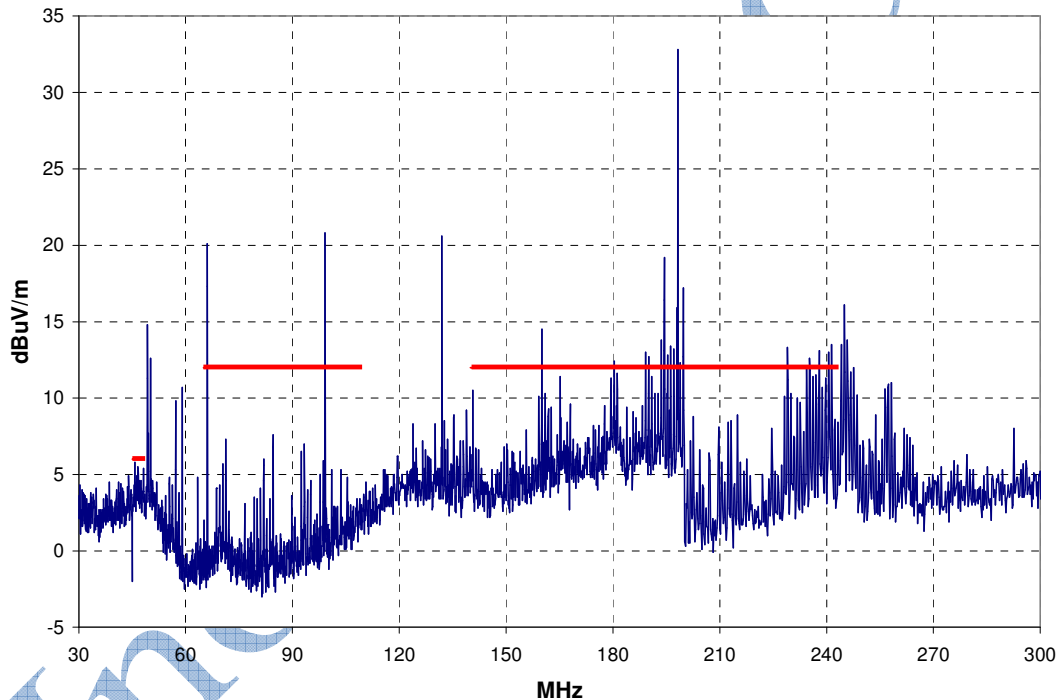
DUT Operating Mode: Engine Idle

Date Tested: 10/1/2009

Antenna Polarization: Vertical

Bandwidth / Detector: 9 kHz / Average

Band #	RF Service Band	Frequency Range (MHz)	DUT Maximum Emission (dBuV/m)	Limit A (dBuV/m)	Pass / Fail
NA1	DOT 1	45 - 48	5.8	6	Pass
G2	4 Meter	65- 89	20.0	12	Fail
JA1	FM 1	75 - 91	7.6	12	Pass
G3	FM 2	86 - 109	99.28	12	Fail
G4	2 Meter	140 - 176	14.5	12	Fail
EU2	DAB I	172 - 243	32.8	12	Fail



### 8.3 CE420, CE 421

Reporting requirements are identical to RE 310 except for the omission of antenna polarization.

### 8.4 Conducted Transient Emissions: CE 410

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Report the peak positive and negative transient voltages exceeding the limit for each time base
- If the oscilloscope was not triggered during any testing, that information shall be noted in the test report along with recorded data.
- Plots of measured Pulses
- Photographs of the test setup
- Date of measurement

### 8.5 RI 112

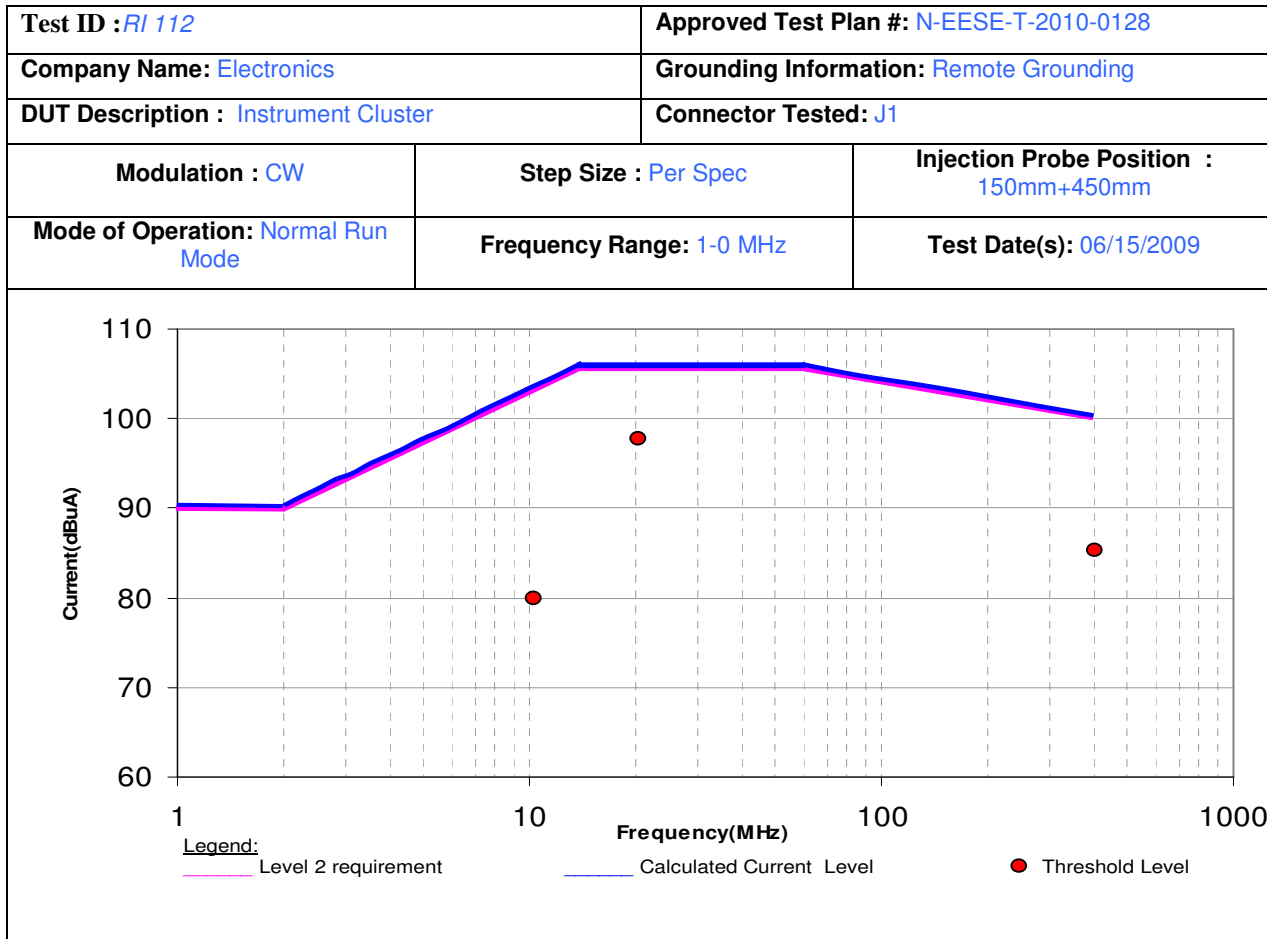
The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- DUT harness/connector tested (*applicable for DUTs with multiple connectors*)
- Description of the functions monitored
- Modulation used (e.g. CW, AM)
- Any performance deviations
- Tabular data and plots from the two probe positions.
- Combined tabular data and plots to form a single worst-case data set for deviations observed. At each frequency, the probe position with the lowest deviation threshold is chosen for the combined data set. All deviations shall be clearly described.
- Immunity threshold plot (calculated current in dB $\mu$ A vs. frequency)
- Measured currents from current monitor probe if used (optional)
- Photographs of the test setup
- Date test performed
- Electrical and Non-electrical data acquired during testing

Example of RI 112 data reporting format is illustrated in Figure 8-5.



Figure 8-5: RI 112 Example Data Report (CW, 150+ 450mm)



Frequency (MHZ)	Required Level (dBuA)	Target Level (dBuA)	Forward Power (dBm)	Threshold Level (dBuA)	Observation	Data Reporting
10	100.6	100.7	34.2	80	Warning indicator #1 turned ON. Self recovered.	DVD: File # 4
20	106	106.2	38.5	98	Output #2 deviated from the test plan acceptance criteria.	Chart Recorder: Graph #13
400	100	100.2	34	85	Warning Indicator #3 turned ON. Self recovered.	DVD: File #6

## 8.6 RI 114

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Description of the functions monitored
- Modulation used (e.g. CW, AM, Pulsed)
- Any performance deviations
- Tabular and plotted data showing the minimum RF field strength at each frequency where deviations occur. Include modulation and polarization (ALSE Method only).
- Photographs of the test setup
- Photographs of the three DUT positions (ALSE Method Only)

## 8.7 RI 115

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Description of the functions monitored
- Any performance deviations
- Tabular and plotted data showing the minimum power at each frequency where deviations occur. Include antenna position and polarization.
- Photographs showing the antenna positions, especially in cases of non-compliance

## 8.8 RI 140

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Details of the test Setup including locations/orientations tested and Helmholtz coil separation
- Any performance deviations
- Tabular and plotted data showing the minimum field strength at each frequency where deviations occur
- Tabular data showing verification of the calibration of the radiating loop
- Photographs of the test setup

## 8.9 RI 130 and RI 150

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Any performance deviations
- Photographs of the test setup

Example of RI 130 data reporting format is illustrated in Figure 8-6.





Figure 8-6: Example RI-130 Data Report

**Test ID : RI 130**

DUT Description: Multi Function Display

Approved Test Plan #: N-EESE-T-2009-0004

DUT Operating Mode: Normal

Date Tested: 10/1/2009

DUT Part Number: AABB-2C222-DD

DUT Serial Number: ABC8-009

Lead Under Test	Applied Test Pulse	Required	Actual	Observed Effects
J1-1	Mode 2,A2-1	I	I	None
J1-1	Mode 2,A2-2	I	II	Note 1
J1-1	Mode 3,A2-1	I	I	None
J1-1	Mode 3,A2-2	I	I	None
J1-2	Mode 2,A2-1	I	I	None
J1-2	Mode 2,A2-2	I	II	Note 1
J1-2	Mode 3,A2-1	I	I	None
J1-2	Mode 3,A2-2	I	I	None
J1-3	Mode 2,A2-1	I	I	None
J1-3	Mode 2,A2-2	I	III	Note 2
J1-3	Mode 3,A2-1	I	I	None
J1-3	Mode 3,A2-2	I	I	None
J1-4	Mode 2,A2-1	I	I	None
J1-4	Mode 2,A2-2	I	II	Note 1
J1-4	Mode 3,A2-1	I	I	None
J1-4	Mode 3,A2-2	I	I	None

Note 1: Display flickers. Recovers when disturbance is removed.

Note 2: Display blanks out. Does not self-recover. Power cycle required to restore mode of operation.

**8.10 CI 210, CI 220, CI-221, CI-222, CI 230, CI-231, CI 250, CI 260 and CI-270**

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Any performance deviations
- Test Pulse being applied (name and number)
- Photographs of the test setup

**8.11 CI 280**

The following elements shall be included in the test report:

- DUT operating mode
- DUT identification (e.g. serial number)
- Any discharges and associated observations
- Any performance deviations
- Photographs of the test setup
- Temperature / Humidity during testing