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Function Performance Status Classification for EMC Susceptibility Testing of Automotive Electronic and Electrical Devices

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HIGHWAY VEHICLE REPORT

SAE J1812

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FUNCTION PERFORMANCE STATUS CLASSIFICATION FOR EMC SUSCEPTIBILITY TESTING OF AUTOMOTIVE ELECTRONIC AND ELECTRICAL DEVICES

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1. PURPOSE:

1.1 The purpose of this document is to provide a general method for defining the function performance status classification for the functions of automotive electronic devices upon application of the test conditions specified as described in appropriate test procedures (for example SAE J1113).

2. SCOPE:

2.1 The process described in this document is generally applicable to provide a means to classify the function performance status of automotive electronic devices. Testing of devices could be performed either on or off vehicles. Appropriate test pulse and methods, functional status classification, region of performance, and test pulse severity level would have to be specified in the individual cases.

3. INTRODUCTION:

3.1 Electrical and radio frequency interference occurs during the normal operation of many items of motor vehicle equipment and when the vehicle is subjected to electromagnetic noises from the outside environment. It is generated over a wide frequency range with various electrical characteristics and may be distributed to on-board electronic devices and systems by conduction or radiation, or both.

3.2 During recent years, an increasing number of electronic devices has been introduced into vehicle designs in order to perform, control, monitor and display various functions including the engine management system. It has been necessary, therefore, to consider the electrical and electromagnetic environment in which these devices are required to operate. Interference can be generated in the vehicle electrical system itself by the normal operation of various power devices such as power window, power lock, air conditioning, etc. This interference can cause a temporary malfunction or even permanent damage to the electronic equipment. Significant number of performance deviations, resulting from this interference, have been reported.

3.3 Narrow band and broad band signals generated from sources inside or outside the vehicle could also be coupled into the electrical/electronic system, affecting the normal performance of electronic devices. These sources of electromagnetic interference are, for example, vehicle's ignition system, mobile telephones, broadcast transmitters, etc. Protection from this potential interference has to be considered in a total system validation.

3.4 It must be emphasized that components or systems shall only be tested with the conditions, as described in SAE J1113, that represent the simulated automotive electromagnetic environments to which the devices would actually be subjected. This will help to assure a sound technically and economically optimized design for potentially susceptible components and systems.

3.5 It should also be noted that this document is not intended to be a product specification and cannot function as one. It should be used in conjunction with a test procedure such as the SAE J1113. Therefore, no specific values for the test pulse severity level were given in the document since they should be determined by the vehicle manufacturers and the suppliers. Nevertheless, using the concepts described in this document and by careful application and agreement between manufacturer and supplier, this document could be used to describe the functional status requirements for a specific device. This could then, in fact, be a statement of how a particular device could be expected to perform under the influence of the specified interference signals.

3.6 Examples for the application of how the concept of function performance status classification could be applied to the conducted and radiated susceptibility testing are included in this document (see Appendix A and Appendix B).

4. ESSENTIAL ELEMENTS OF FUNCTION PERFORMANCE STATUS CLASSIFICATION:

4.1 There are four elements required to describe a function performance status classification. They can be generically applied to all electromagnetic interference susceptibility test procedures (both conducted and radiated). These four elements are listed below and they will be discussed in detail in section 5,6,7, and 8 of this document.

4.1.1 Test Pulse and Method: This element provides the reference to respective test pulses applied to device under test and the method of test. They are usually referred to a specific test procedure (for example, appropriate section in SAE J1113).

4.1.2 Functional Status Classifications: This element describes the operational status of the function for an electrical/electronic device within the vehicle.

4.1.3 Region of Performance: This element describes the region, bounded by two test pulse severity levels, which defines the expected performance objectives of the device under test.

4.1.4 Test Pulse Severity Level: This element defines the specification of test pulse severity level of essential pulse parameters as described in section 5.

5. TEST PULSE AND METHOD:

5.1 The test procedures used and methods of application are to be described in specific documents such as SAE J1113. The function performance status classification resulting from these tests would be applicable only to those particular test procedures.

6. FUNCTIONAL STATUS CLASSIFICATION:

6.1 Note: All classifications are for the total device/system functional status. A given device or system may have several different functions and each individual function may have its own class of functional status. The classification of the function for any given device should be determined between the manufacturer and supplier. It is important to point out that, in many cases, only one or two classification(s) will apply to a particular product or function. For example, if the device has only one function, only part of Appendix A and Appendix B will apply (class A, B, or C).

6.1.1 Class A: Any function that provides a convenience (for example, entertainment, comfort).

6.1.2 Class B: Any function that enhances, but is not essential to the operation or control of the vehicle (for example, speed display).

6.1.3 Class C: Any function that is essential to the operation or control of the vehicle (for example, braking, engine management).

7. REGION OF PERFORMANCE:

7.1 Note: The region of performance defines performance objectives of a specific functional status classification when the device is subjected to different test pulse severity levels under various test pulses and test methods.

The four regions are listed below:

7.1.1 Region I: The function shall operate as designed during and after exposure to a disturbance.

7.1.2 Region II: The function may deviate from design but will return to normal after the disturbance is removed.

7.1.3 Region III: The function may deviate from designed performance during exposure to a disturbance but simple operator action may be required to return the function to normal, once the disturbance is removed.

7.1.4 Region IV: The device/function must not sustain any damage after the disturbance is removed.

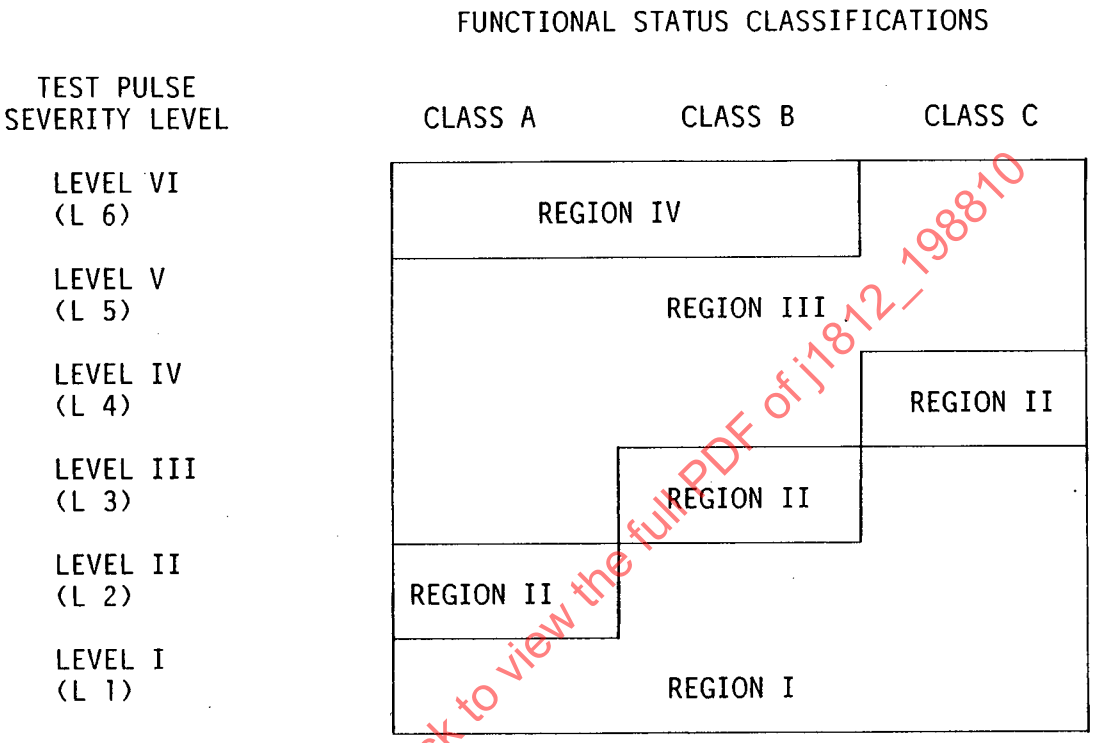
8. TEST PULSE SEVERITY LEVEL:

8.1 The test pulse severity level is the stress level (voltage, volts per meter etc.) applied to the device under test for any given test method (section 5). The device should perform according to its functional status classification (section 6) and region of performance (section 7) during the test.

The test pulse severity level should be determined by the manufacturer and supplier (examples for how the test pulse severity level could be applied are included in Appendix A and B).

APPENDIX A – Functional Status Classification, Region of Performance and Test Pulse Severity Level for Conducted Susceptibility

A.1 Application of Functional Status Classification, Region of Performance and Test Pulse Severity Level:

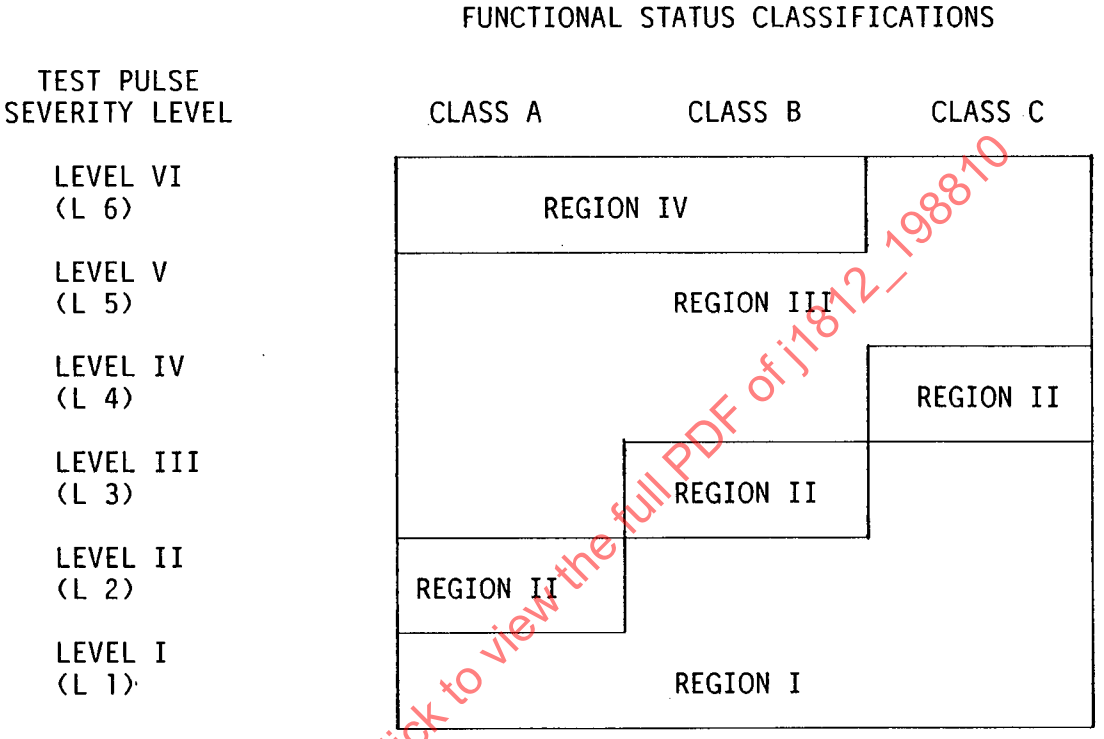


A.2 Test Pulse Severity Level Selection Table: Severity levels for each pulse or pulses corresponding to respective test pulse and method for Level I, II, III, IV, V, and VI are determined and entered in the table according to the test plan for the device under test (DUT). An example of a typical table (per SAE J1113) is listed below:

	PULSE 1	PULSE 2	PULSE 3a	PULSE 3b	PULSE 4	PULSE 5	PULSE 6	PULSE 7
L 6								
L 5								
L 4								
L 3								
L 2								
L 1								

APPENDIX B – Functional Status Classification, Region of Performance and Test Pulse Severity Level for Radiated Susceptibility

B.1 Functional Status Classification, Region of Performance and Test Pulse Severity Level



B.2 Test Pulse Severity Level Selection Table: The pulse severity levels for the electric field (E) and magnetic field (H) strength corresponding to respective test pulse and method are determined and entered in the table according to the test plan for the device under test (DUT). An example of a typical table (per SAE J1113) is listed below:

PULSE SEVERITY LEVEL	E FIELD STRENGTH (VOLTS PER METER)	H FIELD STRENGTH (AMPERES PER METER)
L 6		
L 5		
L 4		
L 3		
L 2		
L 1		