SAE International™ SURFACE VEHICLE STANDARD

SAE J1113-2

CAN-CELLED AUG2010

Issued 1996-09
Cancelled 2010-08

Superseded by ISO 11452-10

Electromagnetic Compatibility Measurement Procedures and Limits for Vehicle Components (Except Aircraft)—Conducted Immunity, 15 Hz to 250 kHz—All Leads

1. *Scope*—This document is an SAE Standard and covers the requirements for determining the immunity characteristics of automotive electronic equipment, subsystems, and systems to EM energy injected individually onto each lead. This test may be used over the frequency range of 15 Hz to 250 kHz. The method is applicable to all input, output, and power leads. The method is particularly useful in evaluating DUTs with acoustic or visible display functions.

2. *References*

2.1 Applicable Publications—The following publication forms a part of this specification to the extent specified herein. Unless otherwise specified, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or http://www.sae.org.

SAE J1113-1—Electromagnetic Compatibility Measurement Procedures and limits for Components of Vehicles, Boats (up to 15 m), and Machines (Except Aircraft) (50 Hz to 18 GHz)

2.2 Related Publications—The following publication is provided for information purposes only and is not a required part of this document.

2.2.1 MILITARY PUBLICATIONS—Available from Global Engineering Documents, 7730 Carondelet Avenue, Suite 407, Clayton, MO 63105. Phone 800-854-7179 or http://dodssp.mil/assist.htm.

MIL-STD-461—Department of Defense Interface Standard—Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

3. *Definitions*—See SAE J1113-1 for definitions.

4. *Measurement Philosophy*—For the frequency range of this test, the impedances seen by the signal, load, and power supply leads are generally known and can be treated as lumped constants. In this test a wide range audio voltage source is coupled through a transformer in differential mode to each specified pin of the DUT. The signal source impedance must be low in comparison to the impedance of the circuit being tested. Experience has shown that a signal source impedance of 0.5 Ω maximum is adequate for the test. The DUT should be connected so it will operate in its normal manner. Actual loads and sources should be used where appropriate or may be simulated.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/J1113/2_201008

Filters incorporated into DUTs may experience excessive and potentially damaging current flow. To prevent this type of over stress in the DUT, a current probe is included in the test setup.

The impedance characteristics of the DUT line being tested may cause distortion to the test signal. This complicates the use of an AC voltmeter or EMI meter. A method of addressing this phenomenon is included in the test procedure.

5. ***Test Limits*—**See Appendix B for recommended limits.

6. ***Test Set-Up*—**The test set-up is shown in Figure 1. A DC power amplifier that satisfies the source impedance requirement of this document and can supply the power required by the DUT may be substituted for the power amplifier and isolation transformer for power supply lead testing.

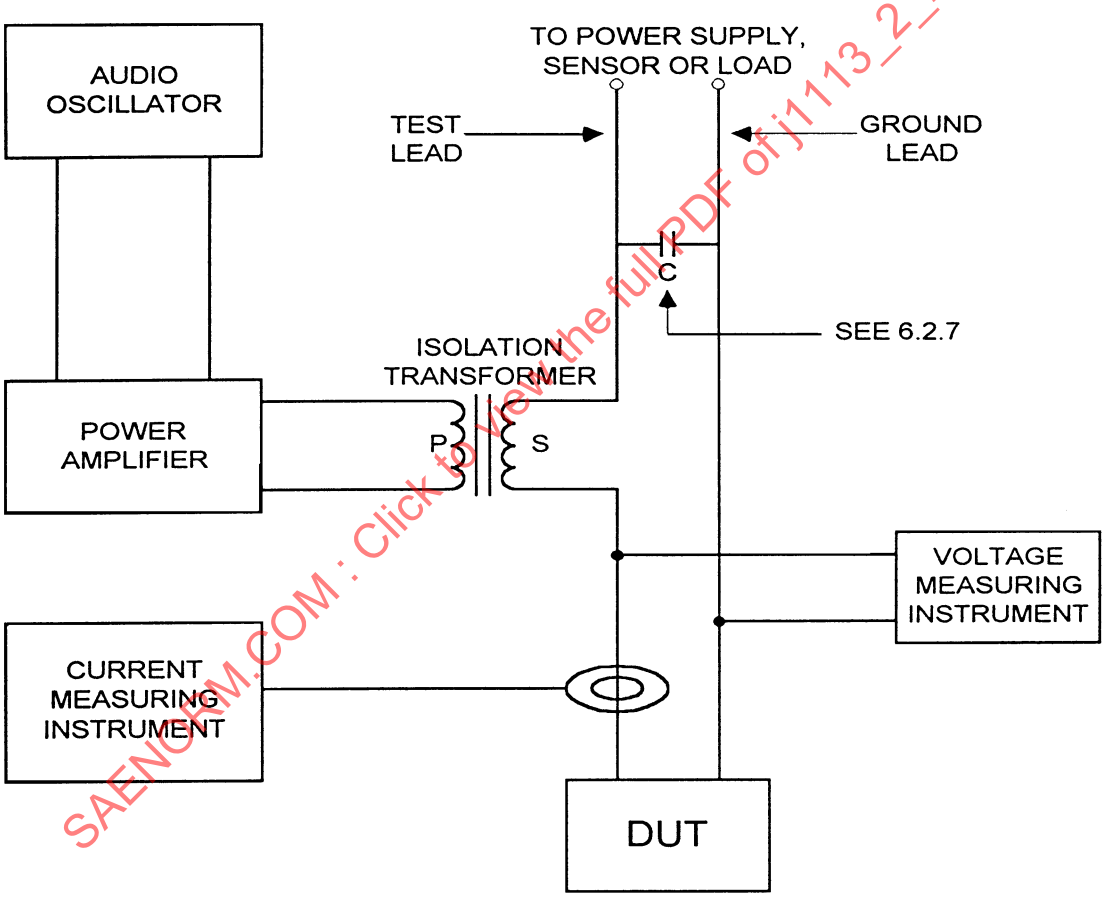

FIGURE 1—Test set-up for measuring conducted immunity, 15 Hz to 250 kHz

6.1 **Grounding and Shielding—**For the stated frequency range there are no special grounding and shielding requirements.

6.2 Apparatus—The primary functional requirement is that the appratus present a source impedance of less than 0.5 Ω to the DUT over the test frequency range. Appendix A details a procedure for verifying the source impedance of the test apparatus. The frequency range of the equipment used for the test must meet the test plan frequency range requirements.

NOTE—1) The upper frequency limit for the equipment in 6.2.1, 6.2.2, and 6.2.3 can be reduced in accordance with the user's frequency range requirements.

NOTE—2) It is recognized that other types of equipment can produce equivalent signals, e.g., a Power Oscillator can replace the oscillator and amplifier; a Power Operational Amplifier can replace the amplifier and power supply, etc.

6.2.1 AUDIO OSCILLATOR—15 Hz to 250 kHz frequency range.

6.2.2 AUDIO POWER AMPLIFIER—15 Hz to 250 kHz frequency range; 50 W outpout power minimum with ouput impedance equal to or less than 2.0 Ω (capable of delivering 50 W into a 0.5 Ω resistive load connected across the specified isolation transformer secondary.) The amplifier shall be capable of operating open circuit without damage.

6.2.3 ISOLATION TRANSFORMER—15 Hz to 250 kHz frequency range; 4:1 impedance ratio; secondary as connected shall be capable of handling the total lead (supply plus test signal) current flow without saturating the core.

NOTE—It has been verified that at least one commercially available 30 Hz to 250 kHz transformer satisfies the extended frequency requirements of this documents.

6.2.4 VOLTAGE MEASURING INSTRUMENT—Oscilloscope, AC Voltmeter, or other suitable high impedance meter.

6.2.5 CURRENT MEASURING INSTRUMENT—Negligible series impedance inducing probe with appropriate magnitude capability.

NOTE—A clip-on Hall effect probe is suitable.

6.2.6 POWER SUPPLY—The power supply used for this test shall have the equivalent of a 100 µF (minimum) capacitor across the output terminals.

6.2.7 CAPACITOR—A 100 µF capacitor may be used (for lines other than power lines) to shunt the source end of the isolation transformer to ground, if difficulty is encountered in obtaining sufficient test voltage.

NOTE—Verify that desired signals are not excessively disturbed by the inclusion of the 100 µF capacitor.

7. Test Procedure

7.1 The system power supply voltage shall be set as specified in the test plan. The user should take the voltage drop of the isolation transformer into account. The voltage drop across the transformer secondary can become significant at higher currents.

7.2 The audio oscillator shall be tuned through the required frequency range as specified in the test plan.

7.3 The injected signal level shall be progressively increased toward the level specified in the test plan. The lead current shall be simultaneously monitored to ensure that no more than 1 A_{rms} of test current is allowed to flow. Alternatively the test signal may be held at a specified test level and, if an effect on the DUT is detected, the test voltage reduced to determine the threshold.

7.4 The DUT shall be monitored for malfunction, degradation of performance, or deviation of parameters beyond tolerances indicated in the equipment specification or the test plan.

7.5 Where the impedance of the DUT lead causes significant distortion of the test signal, a suggested method of measuring the amplitude of the test signal is to connect a 4 Ω noninductive load in place of the DUT lead. This will allow an accurate reading to be taken in the substitute configuration. Do not change the signal generator or amplifier controls when substituting the 4 Ω resistor in place of the DUT lead.

7.6 The effects resulting from the injection of electromagnetic energy, the frequency and the threshold level shall be recorded.

8. ***Levels—***See Appendix B for recommended test level(s).

9. ***Notes***

9.1 Marginal Indicia

The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE EMI STANDARDS COMMITTEE

APPENDIX A

(INFORMATIVE) PROCEDURE TO VERIFY SOURCE IMPEDANCE

A.1 The following procedure can be used to verify the signal source impedance at the isolation transformer secondary terminals.

a. Set a voltage level at the primary terminals and measure the open circuit secondary voltage (V_{oc})
b. Connect a known load R of approximately 0.5 Ω across the secondary and measure the closed-circuit secondary voltage (V_{cc}).
c. The impedance shall be calculated as follows in Equation A1:

$$Z = \frac{R_L(V_{oc} - V_{cc})}{V_{cc}}(\Omega) \qquad \text{(Eq. A1)}$$

d. Repeat the previous procedure at one frequency per decade from 15 Hz and 250 kHz (including 15 Hz and 250 kHz).
e. The measured impedance shall be less than or equal to 0.5 Ω.

NOTE—The value of the known load R must be measured to two significant figures.