

	SURFACE VEHICLE RECOMMENDED PRACTICE	SAE J1113-13 JUN2011
		Issued 1995-02 Reaffirmed 2011-06
		Superseding J1113-13 NOV2004
Electromagnetic Compatibility Measurement Procedure for Vehicle Components - Part 13: Immunity to Electrostatic Discharge		

RATIONALE

EMC committee is requesting a 28 days re-affirmation ballot for J1113-13 as part of the systematic review process. The committee is considering a 2 year plan to determine if J1113-13 would be

1. maintained as a stand alone standard or
2. as an exceptional document while referencing to ISO 10605 or
3. canceled in favor of using ISO 10605

TABLE OF CONTENTS

1.	Scope	1
2.	References.....	2
3.	Test Equipment	3
4.	Test Setup and Procedure for Powered Mode Component Tests.....	6
5.	Test Setup and Procedure for Packaging and Handling Sensitivity Classification Test (Non-Powered Mode Test).....	11
6.	Test Severity Levels.....	14
Appendix A	Electrostatic Discharge Simulator Verification Procedure	16
Appendix B	RC Time Constant Example	24
Appendix C	Function Performance Status Classifications and Sensitivity Classifications for ESD Sensitive Devices.....	26

1. Scope

This SAE Standard specifies the test methods and procedures necessary to evaluate electrical components intended for automotive use to the threat of Electrostatic Discharges (ESDs). It describes test procedures for evaluating electrical components on the bench in the powered mode and for the packaging and handling non-powered mode.

A procedure for calibrating the simulator that is used for electrostatic discharges is given in Appendix A.

An example of how to calculate the RC Time Constant is given in Appendix B

Functional Performance Status Classifications for immunity to ESD and Sensitivity classifications for ESD sensitive devices are given in Appendix C.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2011 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

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
 http://www.sae.org

SAE values your input. To provide feedback
 on this Technical Report, please visit
http://www.sae.org/technical/standards/J1113/13_201106

1.1 Measurement Philosophy

The familiar static charge generated and discharged when moving about inside a vehicle or exiting from a vehicle has assumed greater significance with the increase of vehicular electronic components. Tests simulating the electrostatic discharge of humans, in common use by non-automotive industries, were examined and it was determined that they were not applicable to the automotive environment. As a consequence, tests tailored to the automotive environment were developed.

Tests that simulate an electrostatic discharge (ESD) into a vehicular electrical system are based on the human ESD model. The ESD model consists essentially of a capacitor formed by a person to his surroundings and discharged through a path that includes that person's resistance as well as vehicle loads. Sensitive electrical devices can be adversely affected by energy either injected or coupled from electrostatic discharges.

ESD generates transient coupled EM fields as a result of the rapid high-voltage charge transfer. These EM fields are an inherent part of the discharge event and are not simulated separately.

Components can also be damaged by ESD during handling and they should therefore be evaluated for ESD sensitivity in a non-powered mode. The test procedures to evaluate the ESD sensitivity classification of components in a non-powered mode is detailed in Section 5 of this document.

2. References

2.1 Applicable Publications

The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1113-1—Electromagnetic Compatibility Measurement Procedures and Limits for Vehicle Components (Except Aircraft) (60 Hz to 18 GHz)

2.1.2 IEC PUBLICATION

Available from International Electrotechnical Commission, 3, rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland.

IEC 61000-4-2:2001-04—Electromagnetic compatibility (EMC)—Part 4-2: Testing and measurement techniques—Electrostatic discharge immunity test

2.1.3 ISO PUBLICATION

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 10605—Road vehicles—Electrical disturbances from electrostatic discharges

3. Test Equipment

This section describes test equipment that is applicable to all parts of this document.

3.1 An ESD simulator that simulates the Human Body ESD model (see Figures 1A and 1B) having the following characteristics shall be used:

- a. Voltage Range—Variable from -25 to $+25$ kV
- b. Capacitance— $330\text{ pF} \pm 10\%$, $150\text{ pF} \pm 10\%$ (Multiple Probes)
- c. Resistance— $2000\ \Omega \pm 10\%$
- d. Risetime
 1. Direct Contact— 0.7 to 1.0 ns (into a $2\ \Omega$ load)
 2. Air Discharge ≤ 20 ns (into a $2\ \Omega$ load)
- e. Tip—(see Figure 2)—IEC Standard 61000-4-2

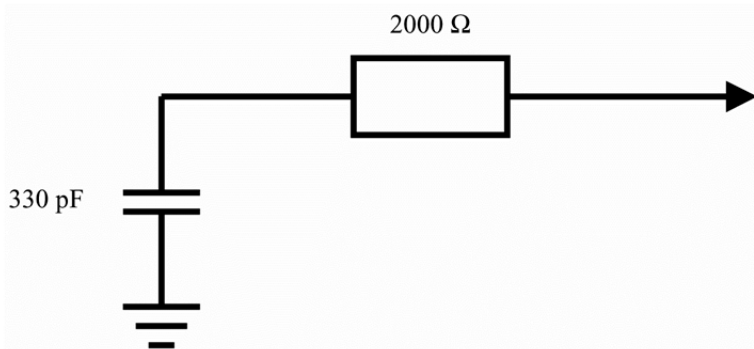


FIGURE 1A—POWERED MODE TEST SIMULATOR PARAMETERS

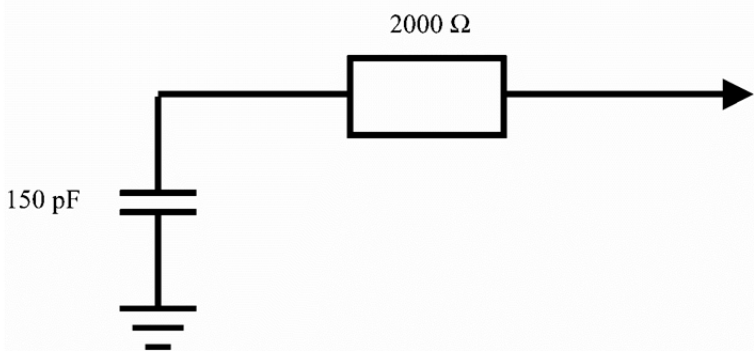


FIGURE 1B—PACKAGING AND HANDLING TEST SIMULATOR PARAMETERS

FIGURE 1—ESD HUMAN BODY MODEL PARAMETERS

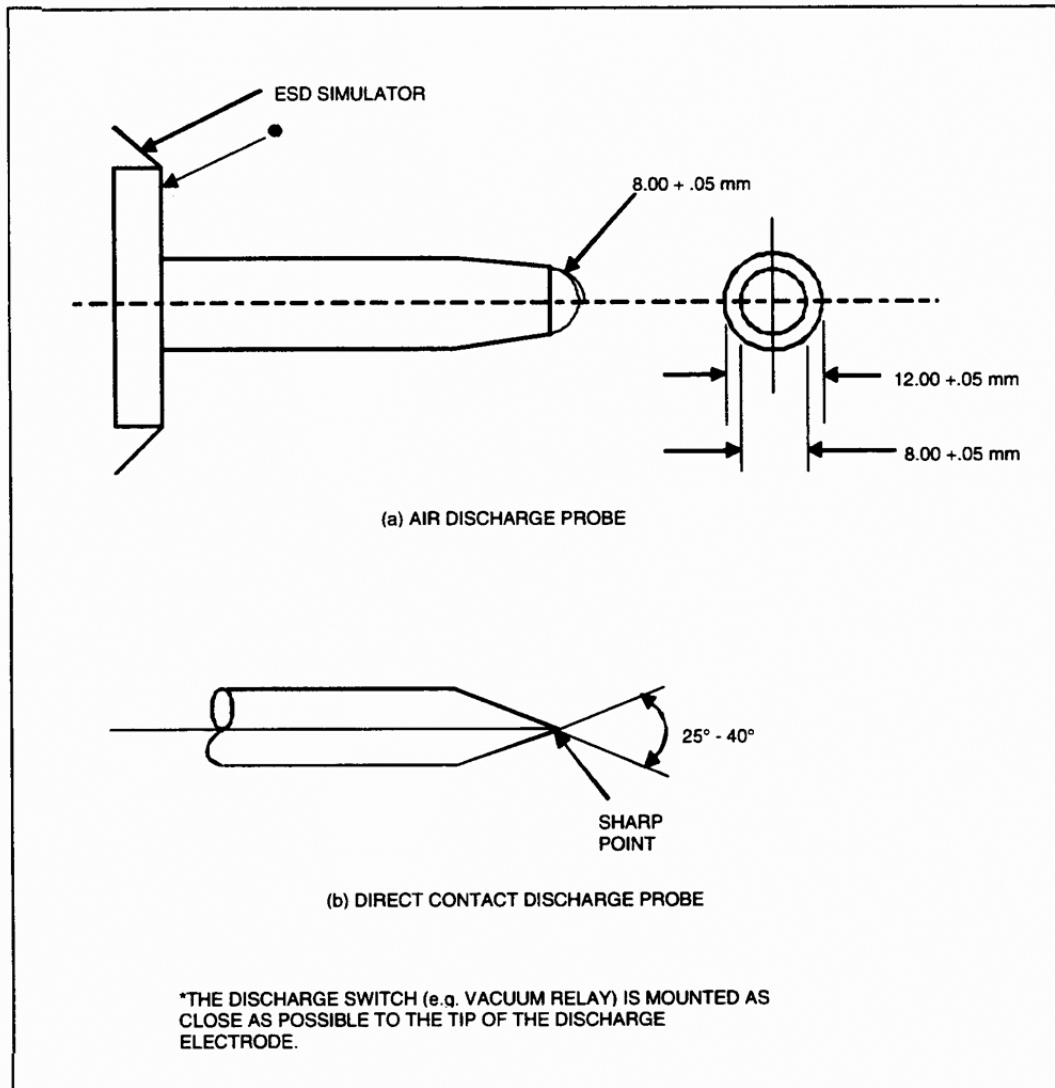


FIGURE 2—ESD SIMULATOR DISCHARGE TIP PROBES

- 3.1.1 The ESD simulator shall be designed so that the discharge capacitance is fully charged to the desired voltage before the energy can be switched to the DUT and shall not allow bleed off prior to discharge.
- 3.1.2 The ESD Simulator is commercially available.

3.2 Ground Plane

The ground plane shall be a conductive metallic sheet (i.e., copper, brass or galvanized steel)¹ as defined in SAE J1113-1. The ground plane shall be connected to the facility earth ground by a ground strap as short as possible. Length less than 2 m suggested.

3.3 Isolation Blocks

Isolation blocks, if used, shall be constructed of clean, non-hygroscopic, insulating material. The blocks are to be 25 mm $\pm$ 2.5 mm in height and project beyond the DUT by at least 20 mm on all sides.

3.4 Coaxial Target

A coaxial target specified by the International Electrotechnical Commission IEC 61000-4-2 shall be used during the ESD simulator verification of Appendix A.

3.5 20 dB Attenuator

A 50 Ω , 20 dB wideband attenuator (bandwidth 18 GHz) may be needed at the output of the coaxial target during the simulator verification of Appendix A.

3.6 Measurement Instrumentation

Verification of the risetime for the ESD simulator requires an analog measurement device with a minimum effective single shot bandwidth of 1 GHz or a digital measurement device with a minimum sampling rates of 4 Gigasamples per second and a single shot bandwidth of at least 1 GHz. Each instrument shall have 50 Ω input impedance. The use of a Faraday Shield, to separate the target from the measurement instrumentation, is highly recommended.

3.7 Voltage Probe (Electrometer)

The ESD simulator charging voltage shall be verified using an electrometer (input resistance 100 Gigohm minimum).

3.8 Test Equipment used to verify the requirements of the DUT shall not be sensitive to ESD.

3.9 Static Dissipative Mat

The surface resistivity of this mat shall be between 10^5 to 10^{12} Ω per square and placed on and connected to a ground plane if required by the Mat manufacturer.

4. Test Setup and Procedure for Powered Mode Component Tests

4.1 Prior to performing the test, a test plan shall be generated which shall include interface test points, component mode of operation, module orientation requirements, number of test units, and any special instructions and changes from the standard test.

¹ Aluminum ground planes are not recommended because aluminum oxide buildup causes a nonconductive layer.

4.1.1 The test plan may specify DUT's other than those used for non-powered mode testing.

4.2 Before application of any discharges to the DUT, verify that the ESD Simulator Discharge Verification procedure of Appendix A has been performed.

4.2.1 For this test (powered mode test), the ESD simulator shall be configured with the 330 pF capacitor probe shown in Figure 1A.

4.3 Test Environment

4.3.1 TEMPERATURE RANGE

23 °C ± 3 °C; 20 °C preferred.

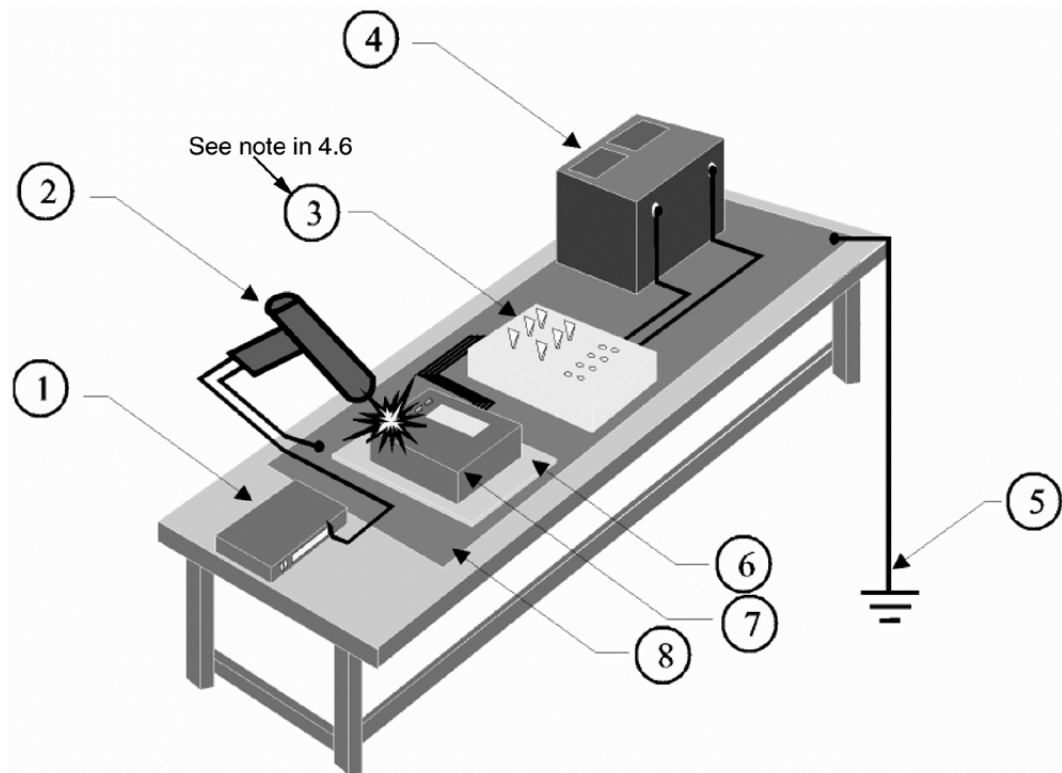
4.3.2 RELATIVE HUMIDITY

20 to 50%; 30% preferred.

4.3.3 IONIZER

Charge dissipation between discharges of some modules (instrument panels, large plastic modules, etc.) may require use of an ionizer.

4.4 The test setup shall be configured in accordance with Figure 3.

**Key**

1. Simulator power supply
2. ESD simulator
3. Exerciser
4. Battery
5. Ground Strap
6. Insulation block (if necessary)
7. Device under test
8. Ground plane

FIGURE 3—TEST SETUP FOR POWERED MODE COMPONENT TEST

- 4.5** The ESD simulator high voltage ground shall be directly connected to the ground plane by an insulated grounding strap less than 2 m long. For all discharge return cable lengths used, the simulator shall meet the requirements of Appendix A.
- 4.5.1** The connection of the simulator return cable to the Ground Reference plane and all bonding should be of low impedance at high frequencies. The discharge return cable of the simulator (if required) should be positioned at least 0.2 m from the DUT while the discharge is being applied. This measure is needed to reduce radiation from this cable from affecting the test results. The end of the discharge return cable connected to the simulator may be closer to the DUT.

- 4.6** The DUT shall be placed on the ground plane (see Figure 3). Chassis-mounted components are to be placed directly on the ground plane. Components which will be isolated from ground in normal installation shall be tested with an insulator between the components and the ground plane using the isolation blocks defined in 3.3. All voltage supply pins shall be connected to an appropriate power source (automotive battery). All other pins shall have inputs applied as necessary to put the DUT into a simulated mode of operation.

NOTE—Test equipment susceptibility to ESD may limit the ability to conduct testing using normal operational inputs; at a minimum the DUT shall be in a powered, idling mode.

- 4.7** Each exposed shaft, button, switch, or surface of the DUT, which will be accessible to the occupant from inside the vehicle, shall be tested at each of the voltage levels as defined in Appendix C or as specified in the test plan in accordance with the following two methods.

4.7.1 DIRECT CONTACT DISCHARGE

Use the direct contact probe (Figure 2b). The ESD simulator shall be placed in direct contact with all accessible discharge points. Each discharge point shall be tested to the contact discharge voltage levels in Appendix A.

4.7.2 AIR DISCHARGE

Use the air discharge probe (Figure 2a). The ESD simulator shall be placed at a minimum distance of 15 mm away from the DUT.

The simulator fingertip probe shall be held perpendicular (± 15 degrees) to the discharge location. The simulator fingertip probe shall very slowly be moved towards the DUT at 5 mm/s or less until a discharge is obtained. Each point shall be tested to the air discharge voltage levels in Appendix A.

NOTE—If no discharge occurs, continue moving the probe towards the DUT until the simulator discharge tip is in contact with the discharge point. If the simulator makes contact with discharge point and no discharge has occurred, discontinue testing at that voltage level and location.

- 4.8** Each discharge point shall be subjected to a minimum of three positive polarity and three negative polarity discharges at each voltage level. The time duration between discharges shall be a minimum of 5 s.

NOTE—At each voltage level, all discharge points of a device may be tested first at a single polarity and then tested with the alternate polarity.

- 4.9** During and after each series of three discharges, the DUT shall meet all applicable performance requirements.

- 4.10** Record all deviations noted (visible, audible, failures, etc.) on a data sheet such as the example Data Sheet 1 (Figure 4).