ESD Association Standard Practice

For Electrostatic Discharge Sensitivity Testing

Charged Device Model (CDM) Testing – Component Level

Low-Impedance Contact CDM as an Alternative CDM Characterization Method

ANSI/ESD SP5.3.3-2018

Electrostatic Discharge Association
7900 Turin Road, Bldg. 3
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ESD Association Standard Practice for Electrostatic Discharge Sensitivity Testing –

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Low-Impedance Contact CDM as an Alternative CDM Characterization Method

Approved October 5, 2018
EOS/ESD Association, Inc.

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FOREWORD

Charged device model (CDM) characterization and qualification is mandatory for all integrated circuits today. Real-world discharge events in manufacturing and assembly are similar to the CDM; therefore, testing and knowing the CDM robustness is essential for establishing adequate ESD control programs. The CDM robustness is typically characterized by the field-induced CDM (FICDM) methodology according to ANSI/ESDA/JEDEC JS-002.

As technology continues to scale and signaling rates increase, CDM thresholds continue to decrease. As CDM testing voltages decrease, the influence of the air spark variability in the FICDM discharge increases. For 150 volts and below, the natural variability of the FICDM waveform and particularly the FICDM peak current is no longer acceptable [1]. Peak current variations can be traced to the air spark inconsistencies. Air spark repeatability depends on many factors, including humidity, alignment of pogo pin to ball/pin, shape of pogo pin and package ball/pin, speed of approach, discharge voltage, surface conditions and contaminations.

The approach defined in this standard practice[1] [1] is a CDM characterization method using a contact-based pulse delivery method instead of the air discharge. By eliminating the air spark, the stress delivered becomes very repeatable and independent of humidity, approach speed, and discharge voltage. While this benefits characterization efforts at all voltage levels, it is particularly useful at 150 volts and below.

The low-impedance contact-CDM (CCDM) is similar to the 50-ohm contact charged device model (50-ohm CCDM) test method [2] and capacitively-coupled TLP (CC-TLP) [3]: all deliver a remotely generated pulse to the device under test (DUT) after contact with the DUT has been established. In contrast to 50-ohm CCDM and CC-TLP, the system impedance for the method described in this document is less than 50 ohms and is therefore referred to as “low-impedance contact-CDM.” The lower impedance results in a shorter RC time constant and, hence, a narrower pulse. Selecting the proper impedance allows generation of pulses with waveforms that closely replicate the defined waveform parameters of ANSI/ESDA/JEDEC JS-002. Specifically, this standard practice describes a test system with a 16.7-ohm system impedance. It has been shown [1] that in terms of peak current, this implementation of low-impedance contact-CDM can result in the same failure threshold on integrated circuits as conventional CDM with an air spark discharge.

Low-impedance contact-CDM can be applied to packaged units but can also be used for characterization of devices on wafer-level or bare dies. This standard practice only addresses the application of low-impedance contact-CDM to packaged devices.

Large parts of this standard practice are identical to ANSI/ESDA/JEDEC JS-002 (2014 version). By duplicating testing details of this standard instead of referencing it, this standard practice remains independent of future changes in ANSI/ESDA/JEDEC JS-002.

This standard practice was designated ESD WIP5.3.3-2018 and approved on October 5, 2018.

[1] **ESD Association Standard Practice:** A procedure for performing one or more operations or functions that may or may not yield a test result. Note, if a test result is obtained it may not be reproducible.

[1] N. Jack and T. Maloney, “Low Impedance Contact CDM,” EOS/ESD Symposium,” in *Proc. EOS/ESD Symp.,* 2015.

[2] R. Given, M. Hernandez, and T. Meuse, “CDM2 – A New CDM Test Method for Improved Test Repeatability and Reproducibility,” in *Proc. EOS/ESD Symp.,* 2010, pp. 359-367.

[3] H. Wolf, H. Gieser, W. Stadler, and W. Wilkening, “Capacitively coupled transmission line pulsing CC-TLP—A traceable and reproducible stress method in the CDM-domain,” in *Proc. EOS/ESD Symp.,* 2003, pp. 338-345.

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ESD Association Standard Practice for Electrostatic Discharge Sensitivity Testing – Charged Device Model (CDM) Testing – Component Level – Low-Impedance Contact CDM as an Alternative CDM Characterization Method

1.0 PURPOSE

The purpose of this standard practice is to define a low impedance contact-based test method for charged device model (CDM) characterization.

2.0 SCOPE

This standard practice establishes the procedure for testing devices and microcircuits according to their susceptibility (sensitivity) to damage or degradation by exposure to a defined contact CDM electrostatic discharge (ESD). All packaged semiconductor devices, thin film circuits, surface acoustic wave (SAW) devices, optoelectronic devices, hybrid integrated circuits (HICs), and multi-chip modules (MCMs) containing any of these devices can be characterized according to this standard practice.

3.0 REFERENCED PUBLICATIONS

Unless otherwise specified, the following documents of the latest issue, revision or amendment form a part of this standard practice to the extent specified herein:

ESD ADV1.0, Glossary of Terms[2]

ANSI/ESD S20.20, Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)[2]

ANSI/ESDA/JEDEC JS-002, Charged Device Model (CDM) – Device Level[2,3]

IEC61340-5-1 – Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General Requirements[4]

JESD625, Requirements for Handling Electrostatic Discharge-Sensitive (ESDS) Devices[3]

4.0 DEFINITIONS

The terms used in the body of this document are in accordance with the definitions found in ESD ADV1.0, EOS/ESD Association, Inc.'s Glossary of Terms available for complimentary download at www.esda.org.

coupling plate. A conductive plate covered by the dielectric layer on which the device under test (DUT) is placed (see Figure 1).

dielectric layer. A thin insulator placed on top of the coupling plate used to separate the device from the coupling plate.

ground plane. A conductive plate used to complete the circuitry for grounding/discharging the DUT (see Figure 1).

low-impedance CCDM. A contact-mode, non-socketed charged device model (CDM) test method with a system impedance of 16.7 ohms (50/3 ohms).

Note: For the purposes of this document, CCDM will be taken to represent low-impedance CCDM.

parallel impedance. Either a 50-ohm resistor or coaxial cable connected in parallel with the input/output cables (see Figure 1). This is used to reduce the system impedance to 16.7 ohms.

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[3] JEDEC, 3103 North 10th Street, Arlington, VA 22201; Ph: 703-907-7534; FAX: 703-907-7534; www.jedec.org
[4] IEC – International Electrotechnical Commission, www.iec.ch