

ESD TR5.3.1-01-18

ESD Association Technical Report

ESD TR5.3.1-01-18

***For Electrostatic Discharge
Sensitivity Testing***

***Contact Charged Device Model
(CCDM) vs. Field Induced CDM
(FICDM) a Case Study***

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FOREWORD

This technical report discusses a new method of performing CDM (charged device model) testing, using a 50-ohm contact method rather than an air discharge, which is used in today's field induced CDM (FICDM) test methods. The joint ESDA/JEDEC CDM working group has decided to call this new method contact CDM or CCDM.

The major issue which negatively impacts today's FICDM tester repeatability and reproducibility is the air discharge's variable spark resistance. There are many variables that contribute to this measurement/testing uncertainty including humidity, pogo shape, DUT shape, contact alignment, surface cleanliness, approach speed, voltage level, and adjacent pin discharges. The CCDM test method eliminates these variables as discussed in the 2010 EOS/ESD paper "CDM2 - A New CDM Test Method for Improved Test Repeatability and Reproducibility" ^[1].

Most CDM testing performed today uses the FICDM methods, such as ANSI/ESDA/JEDEC JS-002 ^[2] as a means of device classification. As the industry continues to look for lower and lower failure thresholds, the variability of the FICDM discharge waveform becomes more pronounced, due to the increased environmental effects at lower charge levels. The Industry Council on ESD Target Levels White Paper 2, "Recommended ESD-CDM Target Levels" ^[5] recommendation is to lower the required failure thresholds on today's technologies to 250 volts, rather than the 500 volts commonly used today. This further illustrates a need for an improved CDM test method.

This technical report also reviews the work that has been performed during the development of the new CCDM test method. It highlights issues with the FICDM method and focuses on the improvements that the CCDM test method will provide for device testing. Another focus topic is the need for correlation testing to determine if this new method, CCDM, provides the same test results and failure signatures to that of FICDM test results, thereby being an equivalent test method. Correlation testing has begun and the results of the testing to this point are discussed.

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ESD Association Technical Report for Electrostatic Discharge Sensitivity Testing – Contact Charged Device Model (CCDM) Versus Field Induced CDM (FICDM) A Case Study

1.0 PURPOSE OF ESD TR5.3.1-01-18

This technical report (TR) explains issues associated with today's field induced charged device model (FICDM) test methods and describes the advantages and disadvantages of the new 50-ohm contact charged device model (CCDM) test method. In addition, it will also discuss the differences between real world charged device model (CDM) events, tester CDM simulations, and the equivalent circuits behind each of these events. Finally, it will discuss correlation work that has been performed to determine whether this new method provides the same results as the present FICDM test method and what additional work remains.

The present FICDM test method attempts to replicate CDM events which may occur during the device manufacturing, handling and testing process, to verify that on-chip ESD protection can adequately protect against this type of threat. However, in trying to reproduce a "real world" event using an air discharge, (mode of FICDM discharge), repeatability and reproducibility errors have been measured in the FICDM qualification testers that can exceed the specified measurement tolerance of 20% [4]. The scope and purpose of ANSI/ESDA/JEDEC JS-002 [2] are included below for reference purposes.

1.1 Scope and Purpose of Today's FICDM Test Method

1.1.1 Scope from ANSI/ESDA/JEDEC JS-002 – Joint CDM Document

ANSI/ESDA/JEDEC JS-002 establishes the procedure for testing, evaluating, and classifying devices and microcircuits according to their susceptibility (sensitivity) to damage or degradation by exposure to a defined field-induced charged device model (CDM) electrostatic discharge (ESD). All packaged semiconductor devices, thin film circuits, surface acoustic wave (SAW) devices, opto-electronic devices, hybrid integrated circuits (HICs), and multi-chip modules (MCMs) containing any of these devices are to be evaluated according to this standard. To perform the tests, the devices must be assembled into a package like that expected in the final application. This CDM document does not apply to socketed discharge model testers. This test method combines the key features of JEDEC JESD22-C101 [3] and ANSI/ESD S5.3.1 [4]. New verification procedures and test condition definitions have been introduced to facilitate this combination.

1.1.2 Purpose from ANSI/ESDA/JEDEC JS-002 – Joint CDM Document

The purpose (objective) of ANSI/ESDA/JEDEC JS-002 is to establish a test method that will replicate CDM failures and provide reliable, repeatable CDM ESD test results from tester to tester, regardless of device type. Repeatable data will allow accurate classifications and comparisons of CDM ESD sensitivity levels.

2.0 THE REAL WORLD CDM EVENT MODEL

Figure 1 shows the well accepted simplified CDM event model [1, 5] and the influence of the surrounding capacitances, resistances and inductances. The variable spark resistance during the air discharge is also represented along with the effect of all these variables on the CDM current, $I(t)$ as shown in Equation 1. The device under test (DUT) and any external conductive (metal) surface will each start with an amount of charge. This charge may be the result of triboelectric charging, or previous contact with or exposure to other charged objects. The DUT and the external conductive metal will each have capacitances to ground and to each other, based on their geometry. The potential on the DUT (V_{DUT}) and the external conductive metal (V_{EXT}) depend on the charge on each and their capacitance values.