ESD Association Technical Report

For the Protection of Electrostatic Discharge Susceptible Items

Human Metal Model (HMM)

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FOREWORD

This technical report addresses the need for a standard method of applying the IEC contact discharge waveform to devices and components. In response to this, the Work Group 5.6 was formed to develop a Standard Practice (SP)[1] document. This test model has come to be called the Human Metal Model (HMM). The name Human Metal Model derives from the anticipated ESD stress that could be generated from a person holding a tool. The current pulse delivered to the component in this test is intentionally the same pulse as defined in the IEC 61000-4-2 testing method. Customers of IC manufacturers have begun requesting that ICs be evaluated for their ability to withstand IEC 61000-4-2 stress pulses. However, as this IEC specification only describes testing a complete system, that specification cannot be directly applied to devices such as ICs and discrete components. This document attempts to provide the technical rationale for the new Standard Practice.

While ESD testing of devices and components has become standard for qualification of parts, the ESD testing done has normally only been applicable to electrostatic events occurring up to final assembly of the system or consumer product. System level testing has then been performed to verify that adequate protection is present to withstand typical electrostatic stresses in the field. Recently, some system manufacturers have begun requiring system level testing to be done on devices before designing them into the final product. While it may be prudent to require some level of testing on devices, modules, or components that are connected to external ports, merely using a system level test for these devices can yield ambiguous results. Without a full description of the test setup during stress the amount of stress current delivered to the component under stress testing can vary dramatically between different laboratories performing the test. Another source of ambiguity comes from the effect of the electromagnetic field (EMF) radiated from an ESD gun designed for system level testing. In a system, individual devices and components are afforded at least a certain amount of shielding by the packaging of the system. This is not present in the stand-alone device or component. Thus the EMF generated during a contact discharge ESD gun event can interact with the traces, connections and circuits much more directly and may cause false failures. Clearly, a method of testing is required that can deliver the types of stresses the component will experience in the final product in a manner that is systematic and controlled. The SP document seeks to do this by providing the user with instructions for producing two test setups that should allow repeatable IEC stress to devices. The first is a test setup that includes the use of the ESD gun as implemented in the system level test. The second is intended to eliminate excess EMF gun radiation and to provide a more stable pulse delivery system. The pulse is delivered through a 50 ohm coaxial cable to the test board holding the component under test (CUT) or device under test (DUT).

[1] Standard Practice (SP): 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 is not reproducible.

This technical report was prepared by the 5.6 Device Testing (HMM) Subcommittee. At the time TR5.6-01-09 was prepared, the 5.6 Device Testing (HMM) subcommittee had the following members:

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1.0 PURPOSE OF THIS TECHNICAL REPORT

Consumer electronics are tested for immunity to ESD stress with the IEC 61000-4-2 standard. In an effort to improve first pass success during ESD testing of these final products, system manufacturers are requiring their suppliers to test electrical components, such as integrated circuits, with the system level ESD test. IEC 61000-4-2 is not, however, designed for the testing of electrical components. The result is inconsistent testing of components with the IEC 61000-4-2 stress waveform.

To address this dilemma, a standard practice was developed defining how devices and components are to be tested if the IEC 61000-4-2 waveform is used. The ESDA subcommittee 5.6 Device Testing (HMM) has written a Standard Practice (SP) document describing the stressing of electrical components with the IEC 61000-4-2 stress waveform. This SP is intended as an initial document to serve the industry's demand for an ESD system level related stress of components. The purpose of this report is to provide the rationale for the HMM SP document and its usefulness to the industry. In the first Section, the scope and purpose of the IEC 61000-4-2 standard is summarized. As the IEC 61000-4-2 is dedicated to systems only, Section 2 provides the motivation for an ESD system level stress method to be applied to IC components. The scope, purpose and limitations of the current SP are discussed in Section 3; further directions of this working group are outlined in Section 4.

2.0 SCOPE AND PURPOSE OF IEC 61000-4-2

The IEC standard defines the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges from operators directly to the system being tested and to adjacent objects. Additionally it defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. It gives specifications for tests performed in "laboratories" and "post-installation tests" performed on equipment in the final installation. These specifications are the waveform of the discharge current, range of test levels, the required test equipment and set-up and the procedure for performing testing following the standard requirements [5].

2.1 (Correct) Usage of IEC Spec

The procedure for performing IEC 61000-4-2 testing is described in part 8 of the Standard. Several requirements are described: climatic and electromagnetic conditions, requirements regarding the operation of the equipment under test (EUT) during the testing and specification about the correct execution of the tests. However, these requirements apply strictly to completed electronic systems and have no specifications as to its applicability to testing of devices and components.

2.1.1 Climatic and Electromagnetic Conditions

To ensure that the environment does not influence the results all testing should be done in a controlled environment with constant pre-defined temperature and air pressure. It also includes the requirement that the desired electromagnetic environment does not influence the operation of the EUT. Even if the EUT is operated under conditions varying from the requirements in the standard, the testing has to be performed according to conditions given by the specifications of the EUT.