IEC TR 61340-5-2

Edition 2.0 2018-03

REDLINE VERSION

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Electrostatics –
Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.220.99; 29.020

ISBN 978-2-8322-5547-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROSTATICS –

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FOREWORD

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INTRODUCTION

This user guide has been produced for individuals and organizations that are faced with controlling electrostatic discharge (ESD). It provides guidance that can be used for developing, implementing and monitoring an electrostatic discharge control program in accordance with IEC 61340-5-1.

This user guide applies to activities that manufacture, process, assemble, install, package, label, service, test, inspect or otherwise handle electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 V using the human body model (HBM), 200 V charged device model (CDM) or 35 V on isolated conductors. Isolated conductors were historically represented by the machine model (MM). The MM test is no longer used for qualification of devices, only HBM and CDM. The MM is retained in this document for process control of isolated conductors. ~~The 100 V HBM limit was~~ These three levels were selected for IEC 61340-5-1 as the baseline susceptibility threshold, since a large majority of the ESD products on the market have a sensitivity of greater than 100 V HBM, 200 V CDM and 35 V for isolated conductors. If ESD sensitive devices (ESDS) of less than these values are being handled, additional controls can be implemented or some of the technical control item requirements can be adjusted.

The ~~limits~~ requirements established for each of the ESD control items are specified for an ESD control program designed for 100 V HBM ~~devices~~, 200 V CDM and 35 V for isolated conductors. The 100 V HBM value is predicated on maximum voltage levels attainable on an individual when they are grounded via techniques accepted throughout the electronics industry as outlined in IEC 61340-5-1.

For organizations concerned with charged device model damage, IEC 61340-5-1 establishes requirements concerning the use of insulators in the ESD protected area (EPA) based on maximum electrostatic field limits. ~~This topic is addressed in more detail in 4.6.~~

Any contact and physical separation of materials or flow of solids, liquids, or particle-laden gases can generate electrostatic charges. Common sources of ESD include charged: personnel, conductors, common polymeric materials, and processing equipment. ESD damage can occur when:

- a charged person or object comes into contact with an ESDS;
- an ESDS comes into direct contact with a highly conductive surface while exposed to an electrostatic field;
- a charged ESDS comes into contact with another conductive surface which is at a different electrical potential. This surface may or may not be grounded.

Examples of ESDS are microcircuits, discrete semiconductors, thick and thin film resistors, hybrid devices, printed circuit boards and piezoelectric crystals. It is possible to determine device and item susceptibility by exposing the device to simulated ESD events. The level of sensitivity, determined by test using simulated ESD events, may not necessarily relate to the level of sensitivity in a real life situation. However, the levels of sensitivity are used to establish a baseline of susceptibility data for comparison of devices with equivalent part numbers from different manufacturers. Three different models have been used for qualification of electronic components – human body model (HBM), machine model (MM), and charged device model (CDM). In current practice, devices are qualified only using HBM and CDM susceptibility tests.

The general principles described in IEC 61340-5-1 are not limited in their applicability to ESDS with ESD sensitivities ~~of~~ defined in IEC 61340-5-1 (e.g. 100 V HBM ~~or greater~~). For organizations that handle ESDS with ~~sensitivities of less than 100 V (HBM)~~ withstand voltages higher or lower than those defined in IEC 61340-5-1, the general principles of IEC 61340-5-1 can still be used. The organization ~~may have to~~ can modify some of the required limits specified in Tables 2 to 3 of IEC 61340-5-1:2016. The program documentation ~~would then identify that ESDS with sensitivities of less than 100 V HBM were being handled and that this~~

~~required a change to the limits established in IEC 61340-5-1~~ identifies the lowest ESDS withstand voltage(s) that can be handled, and if different to those defined in IEC 61340-5-1, appropriate changes to the limits specified in IEC 61340-5-1 can be made in the program documentation.

The fundamental ESD control principles that form the basis of IEC 61340-5-1 are as follows:

a) Avoid a discharge from any charged, conductive object (personnel, equipment) into the sensitive device:

   ~~This can be accomplished by bonding or electrically connecting all conductors in the environment~~ It is preferred that all conductors that may come into contact with ESDS including personnel, are bonded or electrically connected to a known ground or contrived ground (as on shipboard or on aircraft). This attachment creates an equipotential balance between all items and personnel. Electrostatic protection can be maintained at a potential different from “zero” voltage ground potential, as long as all items in the system are at the same potential. If a conductor that cannot be grounded (e.g. isolated conductor) comes into contact with an ESDS, the ESD risk should be evaluated and if necessary mitigated.

b) Avoid a discharge from any charged ESD sensitive device (the charging process that can lead to a discharge can result from direct contact and separation or can be field induced):

   ~~Necessary insulators in the environment~~ Insulators cannot lose their electrostatic charge by ~~attachment to~~ grounding. It is preferred that insulators should be removed from the vicinity of ESDS. Some insulators are essential to the process or product and cannot be removed from the vicinity of the ESDS. Ionization ~~systems~~ or other mitigating techniques can provide neutralization of charges on these ~~necessary~~ essential insulators (circuit board materials and some device packages are examples of ~~necessary~~ essential insulators). Assessment of the ESD hazard created by electrostatic charges on the ~~necessary~~ essential insulators in the work place is ~~required~~ done to ensure that appropriate actions are implemented, according to the risk.

c) Once outside of an electrostatic discharge protected area (hereafter referred to as an EPA) it is ~~often~~ generally not possible to control the above items, therefore, ESD protective packaging ~~may~~ can be ~~required~~ used. ESD protection can be achieved by enclosing ESD sensitive products in static protective materials, although the type of material depends on the situation and destination. Inside an EPA, ~~low charging and~~ static dissipative materials may provide adequate protection. Outside an EPA, low charging and static discharge shielding materials are recommended. While all of these materials are not discussed in this document, it is important to recognize the differences in their application. Requirements and associated test methods for ESD protective packaging are specified in IEC 61340-5-3.

Each organization has different processes, and so there will be a different blend of ESD prevention measures for an optimum ESD control program. It is vital that these measures are selected, based on technical necessity and carefully documented in an ESD control program plan, so that all concerned can be sure of the program requirements.

Training is an essential part of an ESD control program in order to ensure that the personnel involved understand the equipment and procedures they are to use in order to be in compliance with the ESD control program plan. Training is also essential in raising awareness and understanding of ESD issues. Without training, personnel are often a major source of ESD risk. With training, they become an effective first line of defence against ESD damage.

Regular compliance verification checks and tests are essential to ensure that equipment remains effective and that the ESD control program is correctly implemented in compliance with the ESD control program plan.

ELECTROSTATICS –

Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide

1 Scope

~~This technical report has been developed to support IEC 61340-5-1.~~

~~The controls and limits referenced in this standard were developed to protect devices that are susceptible to discharges of 100 V or greater using the human body model test method. However, the general concepts are still valid for devices that are susceptible to discharges of less than 100 V.~~

This part of IEC 61340, which has been developed to support IEC 61340-5-1, applies to activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment with withstand voltages greater than or equal to 100 V HBM, 200 V CDM and 35 V for isolated conductors. Additional control elements or adjusted limits can be applicable for ESDS with lower withstand voltages.

NOTE Isolated conductors were historically represented by MM.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*~~

~~IEC 61340-2-1 – *Electrostatics – Part 2-1: Measurement methods – Ability of materials and products to dissipate static electric charge*~~

~~IEC 61340-2-3 – *Electrostatics – Part 2-3:Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation*~~

~~IEC 61340-4-1 – *Electrostatics – Part 4-1:Standard test methods for specific applications – Electrostatic resistance of fIloor coverings and installed floors*~~

~~IEC 61340-4-3 – *Electrostatics – Part 4-3:Standard test methods for specific applications – Footwear*~~

~~IEC 61340-4-5 – *Electrostatics – Part 4-5:Standard test methods for specific applications – Methods for characterizing the electrostatic protection of footwear and flooring in combination with a person*~~

IEC 61340-5-1:2016, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

~~ANSI/ESD STM2.1, *Standard Test Method for the protection of electrostatic discharge susceptible items – Garments*~~

~~ANSI/ESD STM3.1, *Standard Test Method for the electrostatic discharge susceptible items - Ionization*~~

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TECHNICAL REPORT

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Electrostatics –
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IEC TR 61340-5-2:2018-03(en)

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