

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

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Electrostatics
Part 5-2: Protection of electronic devices
from electrostatic phenomena -
User guide
(IEC 61340-5-2:1999)

Electrostatique
Partie 5-2: Protection des dispositifs
électroniques contre les phénomènes
électrostatiques -
Guide d'utilisation
(CEI 61340-5-2:1999)

Elektrostatik
Teil 5-2: Schutz von elektronischen
Bauelementen gegen elektrostatische
Phänomene -
Benutzerhandbuch
(IEC 61340-5-2:1999)

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This European Standard was approved by CENELEC on 2000-11-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the technical specification IEC 61340-5-2:1999, prepared by IEC TC 101, Electrostatics, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61340-5-2 on 2000-11-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-11-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-11-01

This part 5-2 is to be read in conjunction with EN 61340-5-1.

Subclauses, tables or figures which are additional to those in EN 61340-5-1 are numbered starting from 101. Additional annexes are lettered DD, EE, etc.

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A and ZA are normative and annexes B, C, DD, EE and FF are informative.

Annex ZA has been added by CENELEC.

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Endorsement notice

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The text of the technical specification IEC 61340-5-2:1999 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60479-1	1994	Effects of current on human beings and livestock Part 1: General aspects	-	-
IEC 60479-2	1987	Part 2: Special aspects	-	-
IEC 61010-1 (mod)	1990	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements	EN 61010-1 ¹⁾	1993
IEC 61340-4-1	1995	Electrostatics Part 4-1: Standard test methods for specific applications - Electrostatic behaviour of floor coverings and installed floors	-	-
IEC 61340-5-1	1998	Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements	EN 61340-5-1	2001

¹⁾ EN 61010-1 is superseded by EN 61010-1:2001, which is based on IEC 61010-1:2001.

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Partie 5-2:

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Part 5-2:

Protection of electronic devices
from electrostatic phenomena –
User guide

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CONTENTS

	Page
FOREWORD	9
INTRODUCTION	13
Page	
1 Scope	17
2 Normative references	19
3 Definitions	21
4 Signs and markings – General	23
4.1 Markings	23
4.1.1 ESDS marking	23
4.1.2 Packaging marking	25
4.1.3 Equipment marking	25
4.3 Signs for ESD protected areas (EPA)	25
5 ESD protected area (EPA) – General	25
5.1 Configuration	27
5.1.1 General	27
5.1.3 High-voltage EPA	27
5.2 Requirements for specific ESD protective items	29
5.2.1 General	29
5.2.2 Working surfaces and storage racks	29
5.2.3 Floors	29
5.2.4 Seating	31
5.2.5 Garments	31
5.2.6 Gloves and finger cots	33
5.2.7 Wrist strap	33
5.2.8 Footwear	35
5.2.9 Ionizers (see [3])	35
5.2.10 Tools, machinery, dispensers and test equipment	45
5.2.11 Trolleys and carts	47
5.3 Construction of an EPA	49
5.3.1 General	49
5.3.2 EPA ground facility	49
5.3.3 EPA ground bonding point (EBP)	49
5.3.4 EPA ground cords	51
5.3.5 Electrostatic fields	51
5.3.6 Certification of conformance	51
5.4 Field work	51
5.5 EPA working practices	53
6 Protective packaging	55
7 Purchase, receipt, storage and handling	59
7.1 General	59
7.2 Purchase	59
7.3 Receipt and storage	61
7.4 Unpacking, inspection and storage within an EPA	61

Clause	Page
8 Training	61
8.1 Relevant structured training ESD.....	61
8.2 Personnel training.....	63
8.4 Items for consideration in training.....	63
8.5 Retraining	65
8.6 Register of trained personnel	65
8.7 Training provided by the ESD co-ordinator	65
8.8 Training officer qualification	65
9 Quality responsibilities	65
9.1 Responsibilities.....	65
9.2 ESD co-ordinator	67
9.3 Procurement of ESD protective items	67
9.4 Checking of electrostatic precautions	67
9.6 Daily checks	69
9.6.1 Visual daily check.....	69
9.6.2 Wrist straps.....	71
9.6.3 Non-permanent footwear	71
9.7 Monthly checks	71
9.8 Six-monthly checks	71
9.8.1 General.....	71
9.8.2 Electrostatic fields	71
9.8.3 Signs and labels	73
10 Periodic audit instructions.....	73
10.1 Table 1 of IEC 61340-5-1 – ESD protective item requirements.....	75
10.2 Table 2 of IEC 61340-5-1 – Packaging characteristics	77
10.3 Table 3 of IEC 61340-5-1 – Example of audit report (summary)	77
10.4 Table 4 of IEC 61340-5-1 – EPA equipment list	79
 Annex A (normative) Test methods.....	 81
A.1 Resistance measurement method for the testing of floor, working surface or storage rack	 81
A.2 Resistance measurement method for the testing of seating	81
A.3 Resistance measurement method for the testing of garments.....	81
A.5 Wrist straps, footwear, gloves, finger cots and tools.....	83
A.6 Test method and equipment for ionization (see [3]).....	83
A.7 Test method for evaluating the performance of electrostatic discharge shielding material – Bags (see [3])	 85
 Annex B (informative) Test methods for charge decay	 89
B.1 Method of measurement of charge decay.....	89

Clause	Page
Annex C (informative) Design considerations to minimize the effects of ESD.....	91
C.1 Identification.....	91
C.3 Design of electrostatic discharge sensitive devices (ESDS).....	91
C.4 Design of assemblies	93
C.5 Packaging design	95
C.6 System design.....	95
C.7 Design evaluation procedure.....	95
Annex DD (informative) Principles and methods of controlling static electricity	97
DD.1 Methods	97
DD.2 Principles	97
Annex EE (informative) Principles of relationship between charge, charge density, field and potential	103
EE.1 Insulated conducting body	103
EE.2 Insulating body	103
Annex FF (informative) Bibliography	109
Figure 101 – Maximum body voltage generated against resistance.....	55

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SIST EN 61340-5-2:2002

<https://standards.iteh.ai/catalog/standards/sist/b2910f2a-527a-495b-8883-26e8e1511e17/sist-en-61340-5-2-2002>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROSTATICS –

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

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this Technical Specification may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- The subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 61340-5-2, which is a technical specification, has been prepared by IEC technical committee 101: Electrostatics.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
101/19/CDV	101/40/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

This technical specification is to be read in conjunction with IEC 61340-5-1. The clause numbering system follows the numbering system of IEC 61340-5-1. Not all clauses or subclauses need explanation in this user guide. Where this is the case, they have been omitted.

Subclauses, figures or tables which are additional to those in IEC 61340-5-1 are numbered starting from 101; supplementary annexes are entitled DD, EE, etc.

Annex A forms an integral part of this technical specification.

Annexes B, C, DD, EE and FF are for information only.

IEC 61340 consists of the following parts, under the general title *Electrostatics*:

- Part 1 *General*
- Part 2-1 *Measurement methods in electrostatics – Chargeability*
- Part 2-2 *Measurement methods in electrostatics – Resistances and resistivities*
- Part 3-1 *Methods for simulating electrostatic effects – Electrostatic discharge simulation – Human Body Model (HBM)*
- Part 3-2 *Method for simulating electrostatic effects – Electrostatic discharge simulation – Machine Model (MM)*
- Part 3-1 *Methods for simulating electrostatic effects – Electrostatic discharge simulation – Charged Device Model (CDM)*
- Part 4-1 *Standard test methods for specific applications – Electrostatic behaviour of floor coverings and installed floors*
- Part 4-2 *Under consideration*
- Part 4-3 *Standard test methods for specific applications – Test methods for the characterization of electrostatic protective footwear*
- Part 5-1 *Protection of electronic devices from electrostatic phenomena – General requirements*
- Part 5-2 *Protection of electronic devices from electrostatic phenomena – User guide*

INTRODUCTION

Electrostatic Discharge (ESD) has been known to man for a very long time, but apart from the relatively few who have been unlucky enough to have been struck by lightning, it has had very little impact on our lives. Developments over more recent times have changed this, and today electrostatic discharge affects more areas of our lives. In particular, those working with explosives, high technology medical care and electronics need to have an awareness of the effects, and how these may be prevented.

Risks of damage to semiconductor devices and some other electronic components arise in two main ways from static electricity:

- discharges of static electricity from conductors or charged insulators causing melting and evaporation of fine tracks on integrated circuit chips;
- electric fields from charged conductors and insulators causing electrical breakdown on insulation between features on integrated circuits.

To avoid these risks, it is necessary to ensure that no high voltages will arise on surfaces in proximity or coming into contact with sensitive devices and that there will be no discharge to such devices.

In writing IEC 61340-5-1, consideration has been given to its use by companies of all sizes. Factors including economics (cost effectiveness) and ease of use, in addition to the traditional considerations such as technical effectiveness, have been considered. All attempts have been made to ensure it is scientifically correct, but the practicalities of its use have always been the prime consideration.

Safety to personnel has been a consideration in the writing of IEC 61340-5-1, with the emphasis being that in setting up an electrostatic discharge protected area (EPA), no additional safety risk will be caused by the use of this technical specification. It is not intended that the application of IEC 61340-5-1 alone will guarantee a safe area or working environment. Therefore, in addition to following IEC 61340-5-1, all local relevant legislation and working practices need to be followed.

Many users of IEC 61340-5-1 will need or want to implement it in full. There will, however, be some cases where parts of it are not relevant to, or needed by, the processes carried out. Where this is the case then only the relevant parts of the technical specification need to be followed. However, in cases where only partial compliance is achieved or attempted, this should be made clear to all concerned.

IEC 61340-5-1 and this user guide are aimed purely at electronics. Many people, including some within the semiconductor and electronics industry, have been sceptical about the effects of ESD damage. This applies particularly where the ESD charges and potentials have been below those which are normally detected by human senses (between 2 kV and 5 kV) with many devices suffering damage down to the 1 kV level or lower. Through an ongoing education process, most of the industry is now fully aware of the consequences of ESD damage and appreciate that damage is very costly.

Where no ESD handling precautions are taken, a high proportion of electronic apparatus failure can be attributed to ESD damage. This figure could in theory be reduced to zero by adopting the precautions described in IEC 61340-5-1 in all areas. Currently, the most difficult area in which to carry out full precautions are clean room areas in wafer fabrication assemblies.

IEC 61340-5-1 is based mainly on earlier work which resulted in the publication of European standard EN 100015 [1]¹⁾ In general, the text of EN 100015 has been used; however, some changes have been made in the light of more recent knowledge. Some EPA, originally in compliance with the European standard or other standards, may not conform to the requirements of IEC 61340-5-1. In these cases, the ESD co-ordinator should make every effort to improve the EPA in the shortest possible time in order that it complies with IEC 61340-5-1.

Compliance with IEC 61340-5-1 concerns the installation of new equipment only; existing equipment not in compliance should be replaced as soon as practical. For the duration of the changeover period, extra precautions should be taken.

The decision to produce a user guide to complement IEC 61340-5-1 was taken to help the user implement IEC 61340-5-1 without having to employ an array of specialists and consultants. It does not attempt to act as a comprehensive text book on the theory of electrostatics. There are many books and magazines already on the market which cover this area more than adequately.

The production of this user guide, which contains guidance as well as the reasons behind specific requirements, has permitted to produce a slimmer and clearer requirement document.

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1) Figures in square brackets refer to the bibliography given in annex FF.

ELECTROSTATICS –

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

1 Scope

1.1 This technical specification is intended to cover the protection from ESD damage of all electronic devices with voltage sensitivity of not lower than 100 V through their entire life. This is from the commencement of manufacture, through product assembly, product use and possible repair until the end of the product life.

This technical specification is intended to cater for electronic components, assemblies and subassemblies with a sensitivity of 100 V or greater (human body model (HBM)), and as such covers most items available. There are on the market a few items which may suffer damage at lower levels. Where these are used, additional or alternative methods should be used. These are not covered by either IEC 61340-5-1 or this user guide, as it would not be reasonable or economic to equip the general EPA to cater for these. Additional information on these may be found in many of the references in the bibliography.

The HBM has been chosen as the major criteria, as damage from human contact is still the most common source even in today's automated society. There are several values given in different sources for HBM, but the chosen one is 100 pF and 1 500 Ω .

1.2 Low humidity

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At low relative humidities the dissipation of static charges often becomes more difficult, and some materials may not work efficiently. Above about 20 % relative humidity most materials maintain most of their efficiency. Where relative humidity may go lower the user should pay particular attention that the materials selected will perform effectively at the minimum expected relative humidity. This is of particular importance in very cold and non-oceanic climates.

1.3 Clean rooms

For clean rooms, the specialist areas are considered to be class 100 or tighter. Many of the techniques in current use for ESD protection will not satisfy the clean room constraints, for example, carbon breaking down, ionics from spray or particles from ionizer needles. Some alternative materials are available, with improved ones still being developed, that will cope with both conditions and these should be used. This area is particularly important as clean operation is an essential part of semiconductor manufacture. Damage occurring at this stage may result in undetected "walking wounded" devices which can have very expensive results. The clean room application is currently the most difficult to control, particularly in class 10 and class 1 rooms. IEC 61340-5-1 embodies current technology. As new and improved materials and techniques become available this area will be improved, with benefits in reliability.