SLOVENSKI STANDARD
oSIST prEN IEC 61000-4-2:2024

01-julij-2024

Elektromagnetna združljivost (EMC) - 4-2. del: Preskusne in merilne tehnike - Preskus odpornosti proti elektrostatični razelektritvi

Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

Elektromagnetische Verträglichkeit (EMV) - Teil 4-2: Prüf- und Messverfahren - Prüfung der Störfestigkeit gegen die Entladung statischer Elektrizität

Compatibilité électromagnétique (CEM) - Partie 4-2: Techniques d'essai et de mesure - Essai d'immunité aux décharges électrostatiques

Ta slovenski standard je istoveten z: **prEN IEC 61000-4-2:2024**

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COMMITTEE DRAFT FOR VOTE (CDV)

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DATE OF CIRCULATION: **2024-05-03**	CLOSING DATE FOR VOTING: **2024-07-26**
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IEC SC 77B : HIGH FREQUENCY PHENOMENA	
SECRETARIAT: France	SECRETARY: Mr Franck GRUFFAZ
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 44,TC 61,TC 62,SC 65A,TC 66,TC 77,SC 77A,TC 82,TC 108,TC 124,CIS/B,CIS/F,CIS/I	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☐ ENVIRONMENT	☐ QUALITY ASSURANCE ☐ SAFETY
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

FOREWORD

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International Standard IEC 61000-4-2 has been prepared by subcommittee 77B: High-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This third edition cancels and replaces the second edition published in 2008 and constitutes a technical revision.

It forms Part 4-2 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

The main changes with respect to the second edition of this standard are the following:

- Add a calibration requirement for ESD generators with air discharge tip;
- Add a normative annex for test setups for specific equipment;
- add a test method for wall mounted equipment and wearable devices (see Annex);
- add an informative annex for wearable devices;
- add an informative annex for improvement of how to select test points and give guidance on how to specify the number of pulses for direct contact discharges;

- moving clause 9 into a new informative annex;
- improvement of the current calibration procedure;
- improvement of the measurement uncertainty considerations with examples of uncertainty budgets;
- Because post installation tests cannot be performed in a controlled environment, this test method has been moved into a new Annex G.

The text of this standard is based on the following documents:

FDIS	Report on voting
77B/xxx/FDIS	77B/xxx/RVD

Full information on the voting for the approval of this standard 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 2.

A list of all parts of the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 61000-4 is a part of the IEC 61000 series, according to the following structure:

Part 1: General

General consideration (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

This part of IEC 61000 is an International Standard which gives immunity requirements and test procedures related to electrostatic discharge.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

1 Scope

This part of IEC 61000 relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges from operators directly and from personnel to adjacent objects. It additionally specifies ranges of test levels which relate to different environmental and installation conditions and establishes test procedures.

The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which can occur from personnel to objects near the equipment.

This standard specifies:

– nominal waveform of the discharge current;
– range of test levels;
– test equipment;
– test setup;
– test procedure;
– calibration procedure;
– measurement uncertainty.

This standard gives specifications for tests performed in laboratories and guidance to post-installation tests.

This standard is not intended to specify the tests to be applied to particular apparatus or systems. The main aim is to give a general basic reference to all concerned product committees. The product committees remain responsible for the appropriate choice of the tests and the severity level to be applied to their equipment.

This standard excludes tests intended to evaluate the ESD sensitivity of devices during handling and packaging. It is not intended for use in characterizing the performance of ESD protection circuits.

2 Normative references

The following referenced documents are indispensable for the application 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 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this part of IEC 61000, the following terms and definitions apply and are applicable to the restricted field of electrostatic discharge; not all of them are included in IEC 60050(161) [IEV].

3.1.1
accessible

surfaces of the EUT which can be touched by means of the air discharge tip of the ESD generator

[SOURCE: IEC 60050-442:1998, 442-01-15, modified]

3.1.2
air discharge method

method of testing in which the charged tip of the test generator is moved towards the EUT until it touches the EUT

3.1.3
calibration

set of operations which establishes, by reference to standards, the relationship which exists, under specified conditions, between an indication and a result of a measurement

NOTE 1 to entry This term is based on the "uncertainty" approach.

NOTE 2 to entry The relationship between the indications and the results of measurement can be expressed, in principle, by a calibration diagram.

[SOURCE: IEC 60050-311:2001, 311-01-09]

3.1.4
contact discharge method

method of testing in which the tip of the test generator is kept in contact with the EUT or coupling plane and the discharge is actuated by the discharge switch within the generator

3.1.5
coupling plane

metal sheet or plate, to which discharges are applied to simulate electrostatic discharge to objects adjacent to the EUT; HCP: Horizontal Coupling Plane; VCP: Vertical Coupling Plane

3.1.6
degradation (in performance)

undesired departure in the operational performance of any device, equipment or system from its intended performance

NOTE to entry The term "degradation" can apply to temporary or permanent failure.

[SOURCE: IEC 60050-161:1990, 161-01-19]

3.1.7
direct application

application of the discharge directly to the EUT

3.1.8
electromagnetic compatibility (EMC)

ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:2018, 161-01-07]

3.1.9
electrostatic discharge (ESD)
transfer of electric charge between bodies of different electric potential in proximity or through direct contact

NOTE to entry Literature and teaching generally refer to transfers of charge, although strictly speaking charge carriers (113-06-25) are transferred.

[SOURCE: IEC 60050-161:2014, 161-01-22]

3.1.10
energy storage capacitor
capacitor of the ESD-generator representing the capacity of a human body charged to the test voltage value

NOTE to entry This element can be provided as a discrete component or a distributed capacitance.

3.1.11
EUT
equipment under test

3.1.12
holding time
interval of time within which the decrease of the test voltage due to leakage, prior to the discharge, is not greater than 10 %

3.1.13
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-01-20]

3.1.14
indirect application
application of the discharge to a coupling plane in the vicinity of the EUT to simulate personnel discharge to objects which are adjacent to the EUT

3.1.15
reference ground plane (RGP)
flat conductive surface that is at the same electric potential as reference ground, which is used as a common reference, and which contributes to a reproducible parasitic capacitance with the surroundings of the equipment under test (EUT)

NOTE to entry In some regions, the term ‘earth’ is used in place of ‘ground’.

[SOURCE: IEC 60050-161:2014, 161-04-36]

3.1.16
rise time
interval of time between the instants at which the instantaneous value of a pulse first reaches the specified lower and upper limits

NOTE to entry Unless otherwise specified, the lower and upper values are fixed at 10 % and 90 % of the pulse magnitude.

[SOURCE: IEC 60050-161:1990, 161-02-05, modified]

3.1.17
verification
set of operations which is used to check the test equipment system (e.g. the test generator and the interconnecting cables) and to gain confidence that the test system is functioning. Details are given in 7.2.2.

NOTE 1 The methods used for verification can be different from those used for calibration.

NOTE 2 For the purpose of this basic EMC standard this definition is different from the definition given in IEV 311-01-13.

3.2 Abbreviated terms

AD	Air Discharge
AE	Auxiliary Equipment
CD	Contact Discharge
EMC	ElectroMagnetic Compatibility
ESD	ElectroStatic Discharge
EUT	Equipment Under Test
HCP	Horizontal Coupling Plane
HV	High Voltage
MU	Measurement Uncertainty
PE	Protective Earth
RGP	Reference Ground Plane
VCP	Vertical Coupling Plane

4 General

This standard relates to equipment, systems, subsystems and peripherals which can be involved in static electricity discharges as a result of environmental and installation conditions, such as low relative humidity, use of low-conductivity (artificial-fiber) carpets, synthetic-fabric garments, etc., which can exist in all locations classified in standards relevant to electrical and electronic equipment. Detailed information is specified in Annex A.

NOTE From the technical point of view, the precise term for the phenomenon would be static electricity discharge. However, the term electrostatic discharge (ESD) is widely used in the technical world and in technical literature. Therefore, it has been decided to retain the term electrostatic discharge in the title of this standard.

Electrostatic discharges are categorized as contact discharges and air discharges. In addition, contact discharges are categorized as direct discharges and indirect discharges. Direct discharges are applied to conductive surfaces while indirect discharges are applied to coupling planes in the vicinity of EUTs.

5 Test levels

The preferred range of test levels for the ESD test is specified in Table 1.

Contact discharge is the preferred test method. Air discharges shall be used where contact discharge cannot be applied. Voltages for each test method are specified in Table 1. The voltages shown are different for each method due to the differing test methods. This does not imply that the test severity is equivalent between test methods.

Details concerning the various parameters which can influence the voltage to which the human body can be charged are given in Clause A.2. Clause A.8 also contains examples of the application of the test levels related to environmental (installation) classes.

For air discharge testing, the test shall be applied at all test levels in Table 1 up to and including the specified test level. For contact discharge testing, the test shall be applied at the specified test level.

For further information on test level variations and applications between air and contact discharge, refer to Annex A, specifically clause A.3 through clause A.7.

Table 1 – Test levels

Level	Test voltage	
	Contact discharge	Air discharge
1	2 kV	2 kV
2	4 kV	4 kV
3	6 kV	8 kV
4	8 kV	15 kV

NOTE Product committees can specify different test levels.

6 Test equipment

6.1 Overview

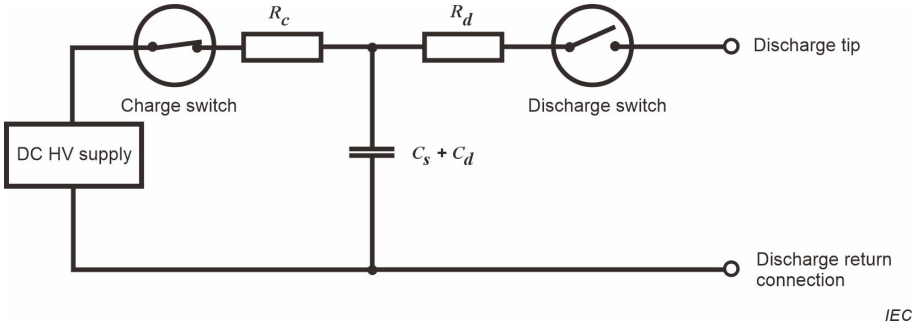
The ESD generator is designed to meet the characteristics in 6.2.2 and shall be calibrated in accordance with the procedure in clause 6.3 and Annex B to ensure that the intended current waveform shown in Figure 2 at the indicated voltage is delivered to the test point of the EUT or coupling plane.

6.2 ESD generator

6.2.1 General

A simplified circuit diagram of an ESD generator is shown in Figure 1. Although construction details (shape, size, weight, materials, etc.) of the generator are not specified, the following main items are used in the design of an ESD generator:

- charging resistor R_c;
- energy-storage capacitor C_s;
- distributed capacitance C_d;
- discharge resistor R_d;
- voltage indicator;
- discharge switch;
- charge switch;
- interchangeable discharge tips (see Figure 3 and Figure 4);
- discharge return cable;
- power supply unit.



Components

C_d is a distributed capacitance which exists between the generator and its surroundings.

$C_s + C_d$ has a typical value of 150 pF.

R_d has a typical value of 330 Ω.

Figure 1 – Simplified diagram of the ESD generator

The ESD generator shall meet the requirements specified in 6.2.2 and indicated in Figure 2 when evaluated according to the procedures in 6.3. Therefore, neither the diagram in Figure 1, nor the component values are specified in detail.

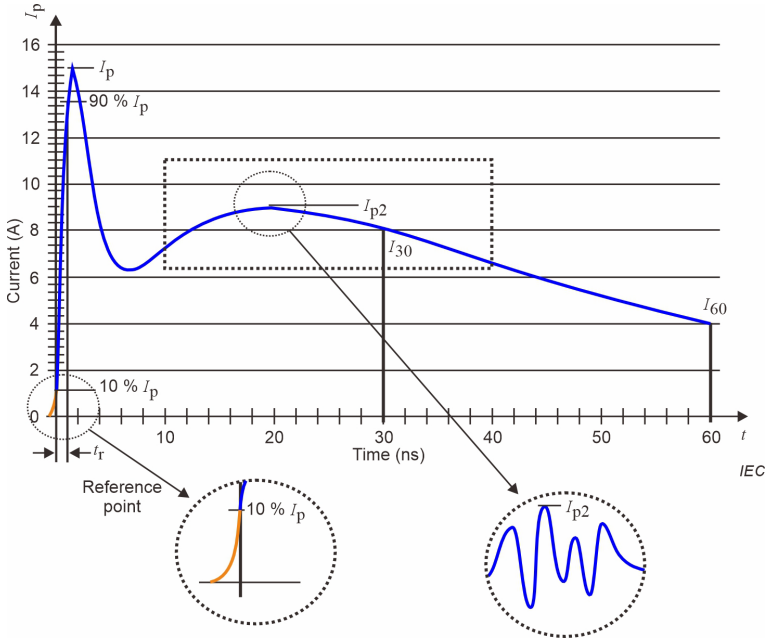


Figure 2 – Ideal contact discharge current waveform at 4 kV

An equation to generate the waveform in Figure 2, $I(t)$, is as follows:

$$I(t) = \frac{I_1}{k_1} \times \frac{\left(\frac{t}{\tau_1}\right)^n}{1+\left(\frac{t}{\tau_1}\right)^n} \times \exp\left(\frac{-t}{\tau_2}\right) + \frac{I_2}{k_2} \times \frac{\left(\frac{t}{\tau_3}\right)^n}{1+\left(\frac{t}{\tau_3}\right)^n} \times \exp\left(\frac{-t}{\tau_4}\right)$$

where

$$k_1 = \exp\left(-\frac{\tau_1}{\tau_2}\left(\frac{n\,\tau_2}{\tau_1}\right)^{1/n}\right)$$

$$k_2 = \exp\left(-\frac{\tau_3}{\tau_4}\left(\frac{n\,\tau_4}{\tau_3}\right)^{1/n}\right)$$

and

τ_1 = 1,1 ns; τ_2 = 2,0 ns; τ_3 = 12,0 ns; τ_4 = 37,0 ns;

I_1 = 16,6 A (at 4 kV); I_2 = 9,3 A (at 4 kV);

n = 1,8.

6.2.2 General characteristics

6.2.2.1 Specifications of the ESD generator

The parameters of the ESD generator are specified in Table 2 and Table 3.