

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

## Elektromagnetisk kompatibilitet (EMC) – Del 4-2: Mät- och provningsmetoder – Provning av immunitet mot elektrostatiska urladdningar

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

Som svensk standard gäller europastandarden EN IEC 61000-4-2:2025. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61000-4-2:2025.

### Nationellt förord

Europastandarden EN IEC 61000-4-2:2025

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61000-4-2, Third edition, 2025 - Electromagnetic compatibility (EMC) - Part 4-2: Testing and measuring techniques - Electrostatic discharge immunity test**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61000-4-2, utg 2:2009 med eventuella tillägg, ändringar och rättelser gäller ej fr o m 2028-04-30.

## Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

## SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

## Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

## Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

## SEK Svensk Elstandard

Box 1042  
172 21 Sundbyberg  
Tel 08-444 14 00  
elstandard.se

English Version

**Electromagnetic compatibility (EMC) - Part 4-2: Testing and  
measurement techniques - Electrostatic discharge immunity test  
(IEC 61000-4-2:2025)**

Compatibilité électromagnétique (CEM) - Partie 4-2:  
Techniques d'essai et de mesure - Essai d'immunité aux  
décharges électrostatiques  
(IEC 61000-4-2:2025)

Elektromagnetische Verträglichkeit (EMV) - Teil 4-2: Prüf-  
und Messverfahren - Prüfung der Störfestigkeit gegen die  
Entladung statischer Elektrizität  
(IEC 61000-4-2:2025)

This European Standard was approved by CENELEC on 2025-04-11. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## **European foreword**

The text of document 77B/896/FDIS, future edition 3 of IEC 61000-4-2, prepared by SC 77B "High frequency phenomena" of IEC/TC 77 "Electromagnetic compatibility" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61000-4-2:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-04-30 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-04-30 document have to be withdrawn

This document supersedes EN 61000-4-2:2009 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a standardization request addressed to CEN-CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

### **Endorsement notice**

The text of the International Standard IEC 61000-4-2:2025 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 61000-6-1 NOTE Approved as EN IEC 61000-6-1

IEC 62368-1 NOTE Approved as EN IEC 62368-1

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

BASIC EMC PUBLICATION  
PUBLICATION FONDAMENTALE EN CEM

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

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 33.100.20

ISBN 978-2-8327-0258-1

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references.....	9
3 Terms, definitions and abbreviated terms.....	10
3.1 Terms and definitions.....	10
3.2 Abbreviated terms.....	12
4 General.....	12
5 Test levels.....	13
6 Test equipment.....	13
6.1 Overview.....	13
6.2 ESD generator.....	14
6.2.1 General.....	14
6.2.2 General characteristics.....	16
6.3 Calibration of the characteristics of the ESD generator.....	17
6.3.1 General.....	17
6.3.2 Equipment required for ESD generator calibration.....	18
6.3.3 Setup for ESD generator current waveform calibration.....	18
6.3.4 Procedure for the ESD generator calibration.....	19
7 Test setup.....	20
7.1 General.....	20
7.2 Test equipment.....	20
7.2.1 General.....	20
7.2.2 Verification of the ESD test equipment.....	21
7.3 Test setup for tests performed in laboratories.....	21
7.3.1 General.....	21
7.3.2 Test conditions.....	21
7.3.3 Table-top equipment.....	22
7.3.4 Floor-standing equipment.....	23
7.3.5 Particular requirements for ungrounded equipment.....	24
8 Test procedure.....	27
8.1 General.....	27
8.2 Laboratory reference conditions.....	27
8.2.1 Climatic conditions.....	27
8.2.2 Electromagnetic conditions.....	28
8.3 Execution of the test.....	28
8.3.1 EUT exercising.....	28
8.3.2 Direct application of discharges to the EUT.....	29
8.3.3 Indirect application of the discharge.....	30
9 Test report.....	31
Annex A (informative) Explanatory notes.....	32
A.1 General considerations.....	32
A.2 Influences of the environmental conditions on the levels of charge.....	32
A.3 ESD phenomenon from charged human body.....	33
A.4 Air discharge phenomena.....	34
A.5 Variations in air discharge.....	34

A.6	Temperature and humidity of air discharge .....	34
A.7	Relevance of contact discharge test .....	35
A.8	Selection of test levels .....	35
A.9	Selection of elements for the ESD generator.....	36
A.10	Rationale related to the generator specification.....	36
A.11	Rationale related to the waveform specification.....	36
Annex B (normative)	Calibration of the current measurement system .....	37
B.1	Current target specification – input impedance.....	37
B.2	Current target specification – insertion loss.....	37
B.2.1	Measurement chain.....	37
B.2.2	Target adapter line.....	38
B.2.3	Determining the insertion loss of a current target-attenuator-cable chain .....	38
B.3	Determining the low-frequency transfer impedance of a target-attenuator-cable chain.....	39
Annex C (informative)	Example of a calibration target meeting the requirements of Annex B .....	41
Annex D (informative)	Radiated fields from human metal discharge and ESD generators .....	46
D.1	Overview of the processes causing intended and unintended fields .....	46
D.1.1	General .....	46
D.1.2	Human ESD.....	46
D.1.3	ESD generator .....	47
D.2	EUT response to ESD testing .....	48
D.3	Transient fields of ESD reference event.....	48
D.4	Induced voltage in a small loop.....	50
D.5	Measuring radiated fields due to an ESD by using commercial field probes and ESD generators .....	51
D.6	Simple procedure to estimate radiated fields and voltages induced by ESD generators .....	53
Annex E (informative)	Selection of test points and number of pulses .....	55
E.1	General.....	55
E.2	Exclusions .....	55
E.3	Guidance for direct contact discharges .....	56
E.4	Guidance for air discharges.....	56
E.5	Guidance for indirect discharges .....	57
E.6	Investigatory testing .....	57
E.7	Number of pulses for direct contact discharges .....	58
Annex F (informative)	Measurement uncertainty (MU) considerations.....	59
F.1	General.....	59
F.2	Legend for contact and air discharge current waveform parameters.....	59
F.3	Limitations .....	60
F.4	Calculation of a coverage interval.....	60
F.5	Uncertainty contributors to the ESD current discharge measurement uncertainty.....	61
F.6	Uncertainty of the ESD generator current discharge measurement .....	61
F.6.1	General .....	61
F.6.2	Rise time of the ESD current discharge .....	61
F.6.3	First peak of the ESD current discharge.....	63
F.6.4	Second peak of the ESD current discharge .....	65
F.6.5	ESD current discharge at 30 ns or 60 ns.....	66

F.6.6	Further MU contributions to time measurements .....	68
F.7	Rise time of the step response and bandwidth of the frequency response of the measuring system .....	68
F.8	Impulse peak distortion due to the limited bandwidth of the measuring system .....	69
F.9	Application of uncertainties in the ESD compliance criterion .....	70
Annex G (informative)	Test setup for post-installation tests .....	71
Annex H (normative)	Escalation strategy .....	73
H.1	Variations in EUT performance .....	73
H.2	Escalation strategy .....	73
Annex I (normative)	Additional or further test setup for particular kind of equipment .....	74
I.1	Wall-mounted equipment .....	74
I.2	Wearable devices .....	75
Annex J (informative)	Wearable devices .....	76
J.1	General .....	76
J.2	Additional experimental test procedures for a wearable device .....	77
Annex K (informative)	Evaluation of test results .....	78
Bibliography	.....	79
Figure 1	– Simplified diagram of the ESD generator .....	14
Figure 2	– Ideal contact discharge current waveform at 4 kV .....	15
Figure 3	– Contact discharge tip of the ESD generator .....	17
Figure 4	– Air discharge tip of the ESD generator .....	17
Figure 5	– Arrangement for calibration of ESD generator performance .....	19
Figure 6	– Example test setup for table-top equipment .....	23
Figure 7	– Example test setup for floor-standing equipment .....	24
Figure 8	– Example test setup for ungrounded table-top equipment .....	26
Figure 9	– Example test setup for ungrounded floor-standing equipment .....	27
Figure A.1	– Typical maximum values of electrostatic voltages to which operators and materials can be charged while operating in different environments outside an electrostatic protective area .....	33
Figure B.1	– Example target adapter line attached to current target .....	38
Figure B.2	– Example front side of a current target .....	38
Figure B.3	– Example measurement of the insertion loss of a current target-attenuator-cable chain .....	39
Figure B.4	– Example circuit diagram to determine the low-frequency system transfer impedance .....	40
Figure C.1	– Mechanical drawing of a coaxial target showing central brass part .....	41
Figure C.2	– Mechanical drawing of a coaxial target showing PCB and resistors .....	42
Figure C.3	– Mechanical drawing of a coaxial target showing PTFE part .....	43
Figure C.4	– Mechanical drawing of a coaxial target showing the cover .....	44
Figure C.5	– Mechanical drawing of a coaxial target showing the mechanical assembly .....	45
Figure D.1	– Electric field of a real human, holding metal, charged at 5 kV measured at 0,1 m distance and for a spark length of 0,7 mm .....	49
Figure D.2	– Magnetic field of a real human, holding metal, charged at 5 kV, measured at 0,1 m distance and for a spark length of approximately 0,5 mm .....	49
Figure D.3	– Semi-circle loop on the ground plane .....	50

Figure D.4 – Voltages induced in a semi-loop .....	50
Figure D.5 – Example test setup to measure radiated ESD fields .....	51
Figure D.6 – Comparison between measured (solid line) and calculated numerically (dot line) voltage drop on the loop for a distance of 45 cm .....	52
Figure D.7 – Comparison between calculated H-field from measured data (solid line) and H-field calculated by numerical simulation (dotted line) for a distance of 45 cm.....	52
Figure D.8 – Structure illuminated by radiated fields and equivalent circuit.....	53
Figure D.9 – Radiated H-fields .....	54
Figure G.1 – Example of test setup for floor-standing equipment, post-installation tests .....	72
Figure I.1 – Example of test setup for wall-mounted equipment on non-conductive surfaces .....	74
Figure I.2 – Example of test setup for wall-mounted equipment on conductive surfaces.....	75
Figure J.1 – Example of air discharge current waveforms for locations on a 1 kV charged human body, discharged via an air discharge tip .....	77
Table 1 – Test levels.....	13
Table 2 – General ESD generator parameters .....	16
Table 3 – Discharge current waveform parameters .....	16
Table A.1 – Guidelines for the selection of the air discharge test levels from the human body.....	35
Table E.1 – Cases for application of ESD on connectors.....	56
Table F.1 – Example uncertainty budget for ESD current discharge rise time ( $t_r$ ).....	62
Table F.2 – Example uncertainty budget for the first peak of the ESD current discharge ( $I_{p1}$ ).....	64
Table F.3 – Example uncertainty budget for the second peak of the ESD current discharge ( $I_{p2}$ ) .....	65
Table F.4 – Example of uncertainty budget for the ESD current discharge at 30 ns ( $I_{30}$ ) .....	66
Table F.5 – Example uncertainty budget for the ESD current discharge at 60 ns ( $I_{60}$ ) .....	67
Table F.6 – $\alpha$ factor – Formula (F.3) – of different unidirectional impulse responses corresponding to the same bandwidth of the system $B$ .....	69
Table J.1 – Example of waveform parameters to characterize discharge currents of the ESD generator, hand-held and body-mounted electrodes with a 1 kV charged voltage.....	77

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ELECTROMAGNETIC COMPATIBILITY (EMC) –

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

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

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

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

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

This edition includes the following significant technical changes with respect to the previous edition:

- a) added a calibration requirement for ESD generators with air discharge tip;
- b) added a normative annex for test setups for particular kind of equipment (see Annex I);

- c) added an informative annex for wearable devices (see Annex J);
- d) added an informative annex on how to select test points and give guidance on how to specify the number of pulses for direct contact discharges (see Annex E);
- e) moved Clause 9 into a new informative annex (see Annex K);
- f) improved current calibration procedure;
- g) improved measurement uncertainty considerations with examples of uncertainty budgets;
- h) moved post-installation tests into a new informative Annex G since they cannot be performed in a controlled environment.

The text of this International Standard is based on the following documents:

Draft	Report on voting
77B/896/FDIS	77B/897/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in 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 document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

## 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 objective of this document 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 document specifies:

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

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

This document 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 document 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**

There are no normative references in this document.