INTERNATIONAL STANDARD

IEC 62305-4

First edition
2006-01

Protection against lightning –

Part 4:
Electrical and electronic systems within structures

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

Reference number
IEC 62305-4:2006(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (www.iec.ch/online_news/ justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC 62305-4

First edition
2006-01

Protection against lightning –

Part 4:
Electrical and electronic systems within structures

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE XD

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROTECTION AGAINST LIGHTNING –

Part 4: Electrical and electronic systems within structures

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62305-4 has been prepared by IEC technical committee 81: Lightning protection.

The IEC 62305 series (Parts 1 to 5), is produced in accordance with the New Publications Plan, approved by National Committees (81/171/RQ (2001-06-29)), which restructures in a more simple and rational form and updates the publications of the IEC 61024 series, IEC 61312 series and the IEC 61663 series.

The text of this first edition of IEC 62305-4 is compiled from and replaces

– IEC 61312-1, first edition (1995);
– IEC 61312-2, first edition (1998);
– IEC 61312-3, first edition (2000);
– IEC 61312-4, first edition (1998).

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

FDIS	Report on voting
81/265/FDIS	81/270/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, as close as possible, in accordance with the ISO/IEC Directives, Part 2.

IEC 62305 consists of the following parts, under the general title *Protection against lightning:*

Part 1: General principles

Part 2: Risk management

Part 3: Physical damage to structures and life hazard

Part 4: Electrical and electronic systems within structures

Part 5: Services[1]

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.

[1] To be published.

INTRODUCTION

Lightning as a source of harm is a very high-energy phenomenon. Lightning flashes release many hundreds of mega-joules of energy. When compared with the milli-joules of energy that may be sufficient to cause damage to sensitive electronic equipment in electrical and electronic systems within a structure, it is clear that additional protection measures will be necessary to protect some of this equipment.

The need for this International Standard has arisen due to the increasing cost of failures of electrical and electronic systems, caused by electromagnetic effects of lightning. Of particular importance are electronic systems used in data processing and storage as well as process control and safety for plants of considerable capital cost, size and complexity (for which plant outages are very undesirable for cost and safety reasons).

Lightning can cause different types of damage in a structure, as defined in IEC 62305-2:

D1 injuries to living beings due to touch and step voltages;

D2 physical damage due to mechanical, thermal, chemical and explosive effects;

D3 failures of electrical and electronic systems due to electromagnetic effects.

IEC 62305-3 deals with the protection measures to reduce the risk of physical damage and life hazard, but does not cover the protection of electrical and electronic systems.

This Part 4 of IEC 62305 therefore provides information on protection measures to reduce the risk of permanent failures of electrical and electronic systems within structures.

Permanent failure of electrical and electronic systems can be caused by the lightning electromagnetic impulse (LEMP) via:

a) conducted and induced surges transmitted to apparatus via connecting wiring;

b) the effects of radiated electromagnetic fields directly into apparatus itself.

Surges to the structure can be generated externally or internally:

– surges external to the structure are created by lightning flashes striking incoming lines or the nearby ground, and are transmitted to electrical and electronic systems via these lines;

– surges internal to the structure are created by lightning flashes striking the structure or the nearby ground.

The coupling can arise from different mechanisms:

– resistive coupling (e.g. the earth impedance of the earth termination system or the cable shield resistance);

– magnetic field coupling (e.g. caused by wiring loops in the electrical and electronic system or by inductance of bonding conductors);

– electric field coupling (e.g. caused by rod antenna reception).

NOTE The effects of electric field coupling are generally very small when compared to the magnetic field coupling and can be disregarded.

Radiated electromagnetic fields can be generated via

– the direct lightning current flowing in the lightning channel,
– the partial lightning current flowing in conductors (e.g. in the down conductors of an external LPS according to IEC 62305-3 or in an external spatial shield according to this standard).

PROTECTION AGAINST LIGHTNING –

Part 4: Electrical and electronic systems within structures

1 Scope

This part of IEC 62305 provides information for the design, installation, inspection, maintenance and testing of a LEMP protection measures system (LPMS) for electrical and electronic systems within a structure, able to reduce the risk of permanent failures due to lightning electromagnetic impulse.

This standard does not cover protection against electromagnetic interference due to lightning, which may cause malfunctioning of electronic systems. However, the information reported in Annex A can also be used to evaluate such disturbances. Protection measures against electromagnetic interference are covered in IEC 60364-4-44 and in the IEC 61000 series [1][2].

This standard provides guidelines for cooperation between the designer of the electrical and electronic system, and the designer of the protection measures, in an attempt to achieve optimum protection effectiveness.

This standard does not deal with detailed design of the electrical and electronic systems themselves.

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 60364-4-44:2001, *Electrical installations of buildings – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-5-53:2001, *Electrical installations of building – Part 5-53: Selection and erection of electrical equipment– Isolation, switching and control*

IEC 60664-1:2002, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-9:1993, *Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Pulse magnetic field immunity test*

IEC 61000-4-10:1993, *Electromagnetic compatibility (EMC) – Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test*

---

2 Figures in square brackets refer to the biblography.

IEC 61000-5-2:1997, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

IEC 61643-1:1998, *Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods*

IEC 61643-12:2002, *Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles*

IEC 61643-21:2000, *Low voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods*

IEC 61643-22:2004, *Low voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Part 22: Selection and application principles*

IEC 62305-1, *Protection against lightning. Part 1: General principles*

IEC 62305-2, *Protection against lightning. Part 2: Risk management*

IEC 62305-3, *Protection against lightning. Part 3: Physical damage to structures and life hazard*

ITU-T Recommendation K.20:2003, *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*

ITU-T Recommendation K.21:2003, *Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrent*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in other parts of IEC 62305, apply.

3.1
electrical system
system incorporating low voltage power supply components

3.2
electronic system
system incorporating sensitive electronic components such as communication equipment, computer, control and instrumentation systems, radio systems, power electronic installations

3.3
internal systems
electrical and electronic systems within a structure

3.4
lightning electromagnetic impulse
LEMP
electromagnetic effects of lightning current

NOTE It includes conducted surges as well as radiated impulse electromagnetic field effects.

3.5
surge
transient wave appearing as overvoltage and/or overcurrent caused by LEMP

NOTE Surges caused by LEMP can arise from (partial) lightning currents, from induction effects in installation loops and as a remaining threat downstream of SPD.

3.6
rated impulse withstand voltage level
U_w
impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against overvoltages

NOTE For the purposes of this standard, only withstand voltage between live conductors and earth is considered.

3.7
lightning protection level
LPL
number related to a set of lightning current parameters values relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning

NOTE Lightning protection level is used to design protection measures according to the relevant set of lightning current parameters.

3.8
lightning protection zone
LPZ
zone where the lightning electromagnetic environment is defined

NOTE The zone boundaries of an LPZ are not necessarily physical boundaries (e.g. walls, floor and ceiling).

3.9
LEMP protection measures system
LPMS
complete system of protection measures for internal systems against LEMP

3.10
grid-like spatial shield
magnetic shield characterized by openings

NOTE For a building or a room, it is preferably built by interconnected natural metal components of the structure (e.g. rods of reinforcement in concrete, metal frames and metal supports).

3.11
earth-termination system
part of an external LPS which is intended to conduct and disperse lightning current into the earth

3.12
bonding network
interconnecting network of all conductive parts of the structure and of internal systems (live conductors excluded) to the earth-termination system

3.13
earthing system
complete system combining the earth-termination system and the bonding network

3.14
surge protective device
SPD
device intended to limit transient overvoltages and divert surge currents. It contains at least one non linear component

3.15

SPD tested with I_{imp}
SPDs which withstand the partial lightning current with a typical waveform 10/350 µs require a corresponding impulse test current I_{imp}

NOTE For power lines, a suitable test current I_{imp} is defined in the Class I test procedure of IEC 61643-1.

3.16
SPD tested with I_n
SPDs which withstand induced surge currents with a typical waveform 8/20 µs require a corresponding impulse test current I_n

NOTE For power lines a suitable test current I_n is defined in the Class II test procedure of IEC 61643-1.

3.17

SPD tested with a combination wave
SPDs that withstand induced surge currents with a typical waveform 8/20 µs and require a corresponding impulse test current I_{sc}

NOTE For power lines a suitable combination wave test is defined in the Class III test procedure of IEC 61643-1 defining the open circuit voltage U_{oc} 1,2/50 µs and the short-circuit current I_{sc} 8/20 µs of an 2 Ω combination wave generator.

3.18
voltage switching type SPD
SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a voltage surge

NOTE 1 Common examples of components used as voltage switching devices include spark gaps, gas discharge tubes (GDT), thyristors (silicon controlled rectifiers) and triacs. These SPD are sometimes called "crowbar type".

NOTE 2 A voltage switching device has a discontinuous voltage/current characteristic.

3.19
voltage-limiting type SPD
SPD that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage

NOTE 1 Common examples of components used as non-linear devices are varistors and suppressor diodes. These SPDs are sometimes called "clamping type".

NOTE 2 A voltage-limiting device has a continuous voltage/current characteristic.

3.20
combination type SPD
SPD that incorporates both voltage-switching and voltage-limiting type components and which may exhibit voltage-switching, voltage-limiting or both voltage-switching and voltage-limiting behaviour, depending upon the characteristics of the applied voltage

3.21
coordinated SPD protection
set of SPD properly selected, coordinated and installed to reduce failures of electrical and electronic systems