IEC 60364-4-44

Edition 3.0 2024-12

INTERNATIONAL STANDARD

colour inside

Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 91.140.50; 33.100.10; 33.100.20

ISBN 978-2-8327-0087-7

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 5
INTRODUCTION 7
440 Protection against voltage disturbances and electromagnetic disturbances 8
440.1 Scope 8
440.2 Normative references 8
440.3 Terms, definitions and symbols 9
440.3.1 Terms and definitions 9
440.3.2 Symbols 11
441 Void 12
442 Protection of low-voltage installations against temporary overvoltages due to earth faults in the high-voltage system and due to faults in the low-voltage system 12
442.1 Field of application 12
442.1.1 General 12
442.1.2 General requirements 12
442.2 Overvoltages in LV-systems during a high-voltage earth fault 12
442.2.1 General 12
442.2.2 Magnitude and duration of power-frequency fault voltage 14
442.2.3 Magnitude and duration of power-frequency stress voltages 15
442.2.4 Requirements for calculation of limits 16
442.3 Power-frequency stress voltage in case of loss of the neutral conductor in a TN and TT system 16
442.4 Power-frequency stress voltage in the event of an earth fault in an IT system with distributed neutral 16
442.5 Power-frequency stress voltage in the event of a short-circuit between a line conductor and the neutral conductor 17
443 Protection against transient overvoltages of atmospheric origin or due to switching 17
443.1 General 17
443.2 Void 18
443.3 Void 18
443.4 Overvoltage control 18
443.5 Risk assessment method 18
443.6 Classification of rated impulse voltages (overvoltage categories) 20
443.6.1 Purpose of classification of rated impulse voltages (overvoltage categories) 20
443.6.2 Rated impulse voltages of equipment and overvoltage categories 21
444 Measures against electromagnetic influences 22
444.1 General 22
444.2 Void 23
444.3 Void 23
444.4 Mitigation of electromagnetic interference (EMI) 23
444.4.1 General 23
444.4.2 Sources of EMI 23
444.4.3 Measures to reduce EMI 23
444.4.4 TN-system 25
444.4.5 TT system 28
444.4.6 IT system 29
444.4.7 Multiple-source supply 30

444.4.8 Transfer of supply 33
444.4.9 Services entering a building 36
444.4.10 Separate buildings 37
444.4.11 Inside buildings 37
444.4.12 Protective devices 39
444.4.13 Signal cables 39
444.5 Earthing and equipotential bonding 39
444.5.1 Interconnection of earth electrodes 39
444.5.2 Interconnection of incoming networks and earthing arrangements 39
444.5.3 Different structures for the network of equipotential conductors and earthing conductors 40
444.5.4 Equipotential bonding networks in buildings with several floors 42
444.5.5 Functional earthing conductor 43
444.5.6 Commercial or industrial buildings containing significant amounts of information technology equipment 44
444.5.7 Earthing arrangements and equipotential bonding of information technology installations for functional purposes 44
444.6 Segregation of circuits 45
444.6.1 General 45
444.6.2 Design requirements 45
444.6.3 Conditions for zero segregation 46
444.7 Cable management systems 47
444.7.1 General 47
444.7.2 Design guidelines 47
444.7.3 Installation guidelines 48
445 Protection against undervoltage 50
Annex A (informative) Examples of calculated risk level CRL for the use of SPDs 51
A.1 Example 1 – Building in rural environment 51
A.2 Example 2 – Building in rural environment powered in HV 51
A.3 Example 3 – Building in urban environment powered by overhead lines 52
A.4 Example 4 – Building in urban environment powered by underground cables 52
Annex B (informative) Guidance on overvoltage control by SPDs applied to overhead lines 53
Annex C (informative) List of notes concerning certain countries 54
Bibliography 56

Figure 1 – Representative schematic diagram for possible connections to earth in substation and LV-installation and occurring overvoltages in case of faults 13
Figure 2 – Tolerable fault voltage due to an earth-fault in the HV system 15
Figure 3 – Illustration of an installation showing the lengths to consider 20
Figure 4 – By-pass conductor for screen reinforcement to provide a common equipotential bonding system 24
Figure 5 – Example of a substitute or by-pass equipotential bonding conductor in a TT-system 25
Figure 6 – Avoidance of neutral conductor currents in a bonded structure by using the TN-S system from the origin of the public supply up to and including the final circuit within a building 26
Figure 7 – Avoidance of neutral conductor currents in a bonded structure by using a TN-S system downstream of a consumer’s private supply transformer 27

Figure 8 – TN-C-S system within an existing building installation 28
Figure 9 – TT system within a building installation 29
Figure 10 – IT system within a building installation 30
Figure 11 – TN multiple-source power supply with a non-suitable multiple connection between PEN and earth 31
Figure 12 – TN multiple-source power supplies to an installation with connection to earth of the star points at one and the same point 32
Figure 13 – TT multiple-source power supplies to an installation with connection to earth of the star points at one and the same point 33
Figure 14 – Three-phase alternative power supply with a 4-pole switch 34
Figure 15 – Neutral current flow in a three-phase alternative power supply with an unsuitable 3-pole switch 35
Figure 16 – Single-phase alternative power supply with 2-pole switch 36
Figure 17 – Armoured cables and metal pipes entering the buildings (examples) 37
Figure 18 – Illustration of measures in an existing building 38
Figure 19 – Interconnected earth electrodes 39
Figure 20 – Examples of protective conductors in star network 40
Figure 21 – Example of multiple meshed bonding star network 41
Figure 22 – Example of a common meshed bonding star network 42
Figure 23 – Example of equipotential bonding networks in structures without lightning protection systems 43
Figure 24 – Example of cable separation distance 46
Figure 25 – Cable arrangements in metal cable trays 48
Figure 26 – Continuity of metallic system components 48
Figure 27 – Location of cables inside metallic construction elements 49
Figure 28 – Connection of metallic sections 49

Table 1 – Power-frequency stress voltages and power-frequency fault voltage in low-voltage system 14
Table 2 – Permissible power-frequency stress voltage 16
Table 3 – Calculation of f_{env} 19
Table 4 – Required rated impulse voltage of equipment U_W 22
Table 5 – Summary of minimum separation distances where the specification or intended application of the information and communication technology cable is not available 46

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

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 60364-4-44 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock. It is an International Standard.

This third edition cancels and replaces the second edition published in 2007, Amendment 1:2015 and Amendment 2:2018. This edition constitutes a technical revision.

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

a) the structure of the document has been updated in accordance with the ISO/IEC Directives, Part 2:2021: the terms, definitions and symbols have been regrouped under a new Subclause 440.3, the tables and figures have been renumbered;

b) Clause 443 has been amended to better introduce the DC SPD and to improve some of the wording.

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

Draft	Report on voting
64/2696/FDIS	64/2737/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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60364 series, published under the general title *Low-voltage electrical installations,* can be found on the IEC website.

The reader's attention is drawn to the fact that Annex C lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60364 covers the protection of electrical installations and measures against voltage disturbances and electromagnetic disturbances.

The requirements are arranged into four clauses as follows:

Clause 442 Protection of low-voltage installations against temporary overvoltages due to earth faults in the high-voltage system and due to faults in the low-voltage system

Clause 443 Protection against transient overvoltages of atmospheric origin or due to switching

Clause 444 Measures against electromagnetic influences

Clause 445 Protection against undervoltage

LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

440 Protection against voltage disturbances and electromagnetic disturbances

440.1 Scope

This part of IEC 60364 provides requirements for the safety of electrical installations in the event of voltage disturbances and electromagnetic disturbances generated for different specified reasons.

The requirements of this document are not intended to apply to systems for distribution of energy to the public, or power generation and transmission for such systems (see the scope of IEC 60364-1) although such disturbances can be conducted into or between electrical installations via these supply systems.

440.2 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 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-5-52, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-53:2019, *Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and* monitoring
IEC 60364-5-53:2019/AMD1:2020
IEC 60364-5-53:2019/AMD2:2024

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective* conductors
IEC 60364-5-54:2011/AMD1:2021

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61196-7, *Coaxial communication cables – Part 7: Sectional specification for cables for BCT cabling in accordance with ISO/IEC 11801-4 – Indoor drop cables for systems operating at 5 MHz – 6 000 MHz*

IEC 61936-1, *Power installations exceeding 1 kV AC and 1,5 kV DC – Part 1: AC*

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

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC 14763-2:2019, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*