

# TECHNICAL REPORT



Low-voltage switchgear and controlgear – Electromagnetic compatibility  
assessment for switchgear and controlgear and their assemblies

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INTERNATIONAL  
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**

**Electromagnetic compatibility assessment  
for switchgear and controlgear and their assemblies**

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 63216, which is a technical report, has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

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

Enquiry draft	Report on voting
121A/292/DTR	121A/306A/RVDTR

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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## INTRODUCTION

Low-voltage switchgear and controlgear and their assemblies (hereinafter referred to as "equipment") compliant with their standards, when installed and used in accordance with manufacturer's instructions, operate safely and reliably with a good level of immunity and do not produce interferences in normal operation or reasonably foreseeable faulty conditions.

This document is intended to support discussions within IEC TC 121 and its sub-committees, and with other TCs/SCs, by explaining electromagnetic compatibility assessment of equipment and compatibility measures contained in the IEC 60947 series of standards.

Those measures are based on a system approach, depending on the EMC environment in industrial applications. They include design rules and type tests to ensure the compatibility of equipment to the intended electromagnetic environment.

The collection of IEC 61000 series is very large and very generic. The intent of this document is to provide the essential applicable EMC concepts for IEC TC 121 and its sub-committees' working groups, maintenance teams and project teams.

For this intent, this document defines specific descriptions of the relevant EMC environments which are derived from the generic ones of IEC 61000 series. In addition, these environments are consistent with the zones defined by IEC 61131-2.

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## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

### Electromagnetic compatibility assessment for switchgear and controlgear and their assemblies

#### 1 Scope

The purpose of this document is to define homogeneous categories for the electromagnetic environments in order to harmonize as far as practicable all general rules and product standard requirements of electromagnetic compatibility (EMC), applicable to low-voltage switchgear, controlgear and their assemblies with built-in electronic circuits.

This document also addresses incorporated radiocommunication functions.

The typical application environments for such equipment include the electrical distribution in infrastructure, commercial and industrial buildings and the control systems of machinery, including motor-driven systems.

The primary intention of EMC requirements is to ensure the safe and reliable operation of the equipment, as well as the communication efficiency of the radiocommunication equipment within their intended environments.

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#### 2 Normative references

[IEC TR 63216:2019](#)

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 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC 60050-161:1990/AMD1:1997

IEC 60050-161:1990/AMD2:1998

IEC 60050-161:1990/AMD3:2014

IEC 60050-161:1990/AMD4:2014

IEC 60050-161:1990/AMD5:2015

IEC 60050-161:1990/AMD6:2016

IEC 60050-161:1990/AMD7:2017

IEC 60050-161:1990/AMD8:2018

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*

IEC 60364-4-44, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

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

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

IEC 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 61000-2-4:2002, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

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

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-13, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-19, *Electromagnetic compatibility (EMC) – Part 4-19: Testing and measurement techniques – Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment*

IEC 61000-6-7, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61131-2, *Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61800-3, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*

IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 11:2015/AMD1:2016

CISPR 11:2015/AMD2:2019

CISPR 32, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

EN 50160, *Voltage characteristics of electricity supplied by public electricity networks*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60050-441 and IEC 60050-161 as well as the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **compatibility level**

##### **electromagnetic compatibility level**

specified electromagnetic disturbance level used as a reference level for co-ordination in the setting of emission and immunity limits

Note 1 to entry: By convention, the compatibility level is chosen so that there is only a small probability that it will be exceeded by the actual disturbance level. However, electromagnetic compatibility is achieved only if emission and immunity levels are controlled such that, at each location, the disturbance level resulting from the cumulative emissions is lower than the immunity level for each device, equipment and system situated at this same location.

Note 2 to entry: The compatibility level may be phenomenon, time or location dependent.

[SOURCE: IEC 60050-161:1990, 161-03-10]

#### 3.2

##### **electromagnetic compatibility**

##### **EMC**

ability of a device, equipment or 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, modified – Addition of “device”.]

### 3.3 electromagnetic environment

totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, this totality is time-dependent, and its description can need a statistical approach.

[SOURCE: IEC 60050-161:2018, 161-01-01, modified – In Note 1 to entry, replacement of "the electromagnetic environment" by "this totality".]

### 3.4 immunity

<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]

### 3.5 radiocommunication equipment

telecommunications equipment which includes one or more radio transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application

Note 1 to entry: It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

[SOURCE: ITU-T K.48:2006, 3.21]

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### 3.6 radio link

telecommunication facility of specified characteristics between two points provided by means of radio waves

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[SOURCE: ITU-R V.573-5:2015, A21]

### 3.7 enclosure port

physical boundary of the equipment that electromagnetic fields may radiate through or impinge on

### 3.8 power port

port at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of equipment or associated equipment is connected to the equipment

### 3.9 signal port

port at which a conductor or cable intended to carry signals is connected to the equipment

### 3.10 antenna port

port that is connected to an antenna, which can be external or internal to the building, either directly or by a cable

Note 1 to entry: Antenna ports connected to antennas internal to the building are covered by signal ports.

[SOURCE: IEC 61000-6-6:2003, 4.1, modified – Definition reworded to comply with the latest ISO/IEC Directives Part 2.]