

**Short circuit currents in three-phase a.c. systems -
Part 0: Calculation of currents**

Short circuit currents in three-phase a.c. systems - Part
0: Calculation of currents

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60909-0:2002 sisaldab Euroopa standardi EN 60909-0:2001 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 18.12.2002 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on .

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 60909-0:2002 consists of the English text of the European standard EN 60909-0:2001.

This standard is ratified with the order of Estonian Centre for Standardisation dated 18.12.2002 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text .

The standard is available from Estonian standardisation organisation.

ICS 17.220.01, 29.240.20

Võtmesõnad: electrical faults, electrically-operated, electrically-operated de, fault currents, high voltage, low voltage, mathematical calculations, properties, short circuit impedance, short circuits, short-circuit currents, symbols, three-phase current, three-phase networks

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Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
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EUROPEAN STANDARD

EN 60909-0

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2001

ICS 17.220.01; 29.240.20

Supersedes HD 533 S1:1991

English version

Short-circuit currents in three-phase a.c. systems

Part 0: Calculation of currents

(IEC 60909-0:2001)

Courants de court-circuit dans les réseaux
triphases à courant alternatif
Partie 0: Calcul des courants
(CEI 60909-0:2001)

Kurzschlussströme in Drehstromnetzen
Teil 0: Berechnung der Ströme
(IEC 60909-0:2001)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 73/119/FDIS, future edition 1 of IEC 60909-0, prepared by IEC TC 73, Short-circuit currents, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60909-0 on 2001-07-01.

This European Standard supersedes HD 533 S1:1991.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (d'op) 2002-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-07-01

Annexes designated "normative" are part of the body of the standard. In this standard, annexes A and ZA are normative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60909-0:2001 was approved by CENELEC as a European Standard without any modification.

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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60038 (mod)	1983	Nominal voltages for low-voltage public electricity supply systems	HD 472 S1	1989
IEC 60050-131	1978	International Electrotechnical Vocabulary (IEV) Chapter 131: Electric and magnetic circuits	-	-
IEC 60050-151	1978	Chapter 151: Electrical and magnetic devices	-	-
IEC 60050-195	1998	Chapter 195: Earthing and protection against electric shock	-	-
IEC 60056 (mod)	1987	High-voltage alternating-current circuit-breakers	HD 348 S7 ¹⁾	1998
IEC 60071-1	1993	Insulation co-ordination Part 1: Definitions, principles and rules	EN 60071-1	1995
IEC 60781	1989	Application guide for calculation of short-circuit currents in low-voltage radial systems	HD 581 S1	1991
IEC 60865-1	1993	Short-circuit currents - Calculation of effects Part 1: Definitions and calculation methods	EN 60865-1	1993
IEC 60909-1	2)	Short-circuit currents calculation in three-phase a.c. systems Part 1: Factors for the calculation of short-circuit currents in three-phase a.c. systems according to IEC 60909-0	-	-

1) HD 348 S7 is based on IEC 60056:1987 + A3:1996.

2) To be published.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60909-2	1992	Electrical equipment - Data for short-circuit current calculations in accordance with IEC 60909	-	-
IEC 60909-3	1995	Part 3: Currents during two separate simultaneous single phase line-to-earth short circuits and partial short-circuit currents flowing through earth	-	-
IEC 60909-4	2)	Part 4: Examples for the calculation of short-circuit currents	-	-
IEC 60949	1988	Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects	-	-
IEC 60986	1989	Guide to the short-circuit temperature limits of electric cables with a rated voltage from 1,8/3 (3,6) kV to 18/30 (36) kV	-	-

2) To be published.

INTERNATIONAL STANDARD

IEC
60909-0

First edition
2001-07

Short-circuit currents in three-phase a.c. systems –

Part 0: Calculation of currents

*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 60909-0:2001(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.

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- **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.

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INTERNATIONAL STANDARD

IEC
60909-0

First edition
2001-07

Short-circuit currents in three-phase a.c. systems –

Part 0: Calculation of currents

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XB**

For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SHORT-CIRCUIT CURRENTS IN THREE-PHASE AC SYSTEMS –**Part 0: Calculation of currents**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60909-0 has been prepared by IEC technical committee 73: Short-circuit currents.

This first edition cancels and replaces IEC 60909 published in 1988 and constitutes a technical revision.

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

FDIS	Report on voting
73/119/FDIS	73/121/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.

Annex A forms an integral part of this standard.

This part of IEC 60909 shall be read in conjunction with the International Standards, Technical Reports and Technical Specifications mentioned below:

- IEC TR 60909-1,— *Short-circuit current calculation in three-phase a.c. systems – Part 1: Factors for the calculation of short-circuit currents in three-phase a.c. systems according to IEC 60909-0*¹⁾
- IEC TR3 60909-2:1992, *Electrical equipment – Data for short-circuit current calculations in accordance with IEC 60909*
- IEC 60909-3:1995, *Short-circuit current calculation in three-phase a.c. systems – Part 3: Currents during two separate simultaneous single-phase line-to-earth short circuits and partial short-circuit currents following through earth*
- IEC TR 60909-4:2000, *Short-circuit current calculation in three-phase a.c. systems – Part 4: Examples for the calculation of short-circuit currents*

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

The contents of the corrigendum of February 2002 have been included in this copy.

¹⁾ To be published.

SHORT-CIRCUIT CURRENTS IN THREE-PHASE AC SYSTEMS –

Part 0: Calculation of currents

1 General

1.1 Scope

This part of IEC 60909 is applicable to the calculation of short-circuit currents:

- in low-voltage three-phase a.c. systems
- in high-voltage three-phase a.c. systems

operating at a nominal frequency of 50 Hz or 60 Hz.

Systems at highest voltages of 550 kV and above with long transmission lines need special consideration.

This part of IEC 60909 establishes a general, practicable and concise procedure leading to results, which are generally of acceptable accuracy. For this calculation method, an equivalent voltage source at the short-circuit location is introduced. This does not exclude the use of special methods, for example the superposition method, adjusted to particular circumstances, if they give at least the same precision. The superposition method gives the short-circuit current related to the one load flow presupposed. This method, therefore, does not necessarily lead to the maximum short-circuit current.

This part of IEC 60909 deals with the calculation of short-circuit currents in the case of balanced or unbalanced short circuits.

In case of an accidental or intentional conductive path between one line conductor and local earth, the following two cases must be clearly distinguished with regard to their different physical properties and effects (resulting in different requirements for their calculation):

- line-to-earth short circuit, occurring in a solidly earthed neutral system or an impedance earthed neutral system;
- a single line-to-earth fault, occurring in an isolated neutral earthed system or a resonance earthed neutral system. This fault is beyond the scope of, and is therefore not dealt with in, this standard.

For currents during two separate simultaneous single-phase line-to-earth short circuits in an isolated neutral system or a resonance earthed neutral system, see IEC 60909-3.

Short-circuit currents and short-circuit impedances may also be determined by system tests, by measurement on a network analyzer, or with a digital computer. In existing low-voltage systems it is possible to determine the short-circuit impedance on the basis of measurements at the location of the prospective short circuit considered.

The calculation of the short-circuit impedance is in general based on the rated data of the electrical equipment and the topological arrangement of the system and has the advantage of being possible both for existing systems and for systems at the planning stage.

In general, two short-circuit currents, which differ in their magnitude, are to be calculated:

- the maximum short-circuit current which determines the capacity or rating of electrical equipment; and
- the minimum short-circuit current which can be a basis, for example, for the selection of fuses, for the setting of protective devices, and for checking the run-up of motors.

NOTE The current in a three-phase short circuit is assumed to be made simultaneously in all poles. Investigations of non-simultaneous short circuits, which may lead to higher aperiodic components of short-circuit current, are beyond the scope of this standard.

This standard does not cover short-circuit currents deliberately created under controlled conditions (short-circuit testing stations).

This part of IEC 60909 does not deal with the calculation of short-circuit currents in installations on board ships and aeroplanes.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60909. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60909 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60038:1983, *IEC standard voltages*

IEC 60050(131):1978, *International Electrotechnical Vocabulary – Chapter 131: Electric and magnetic circuits*

IEC 60050(151):1978, *International Electrotechnical Vocabulary – Chapter 151: Electric and magnetic devices*

IEC 60050-195:1998, *International Electrotechnical Vocabulary – Part 195: Earthing and protection against electric shock*

IEC 60056:1987, *High-voltage alternating-current circuit-breakers*

IEC 60071-1:1993, *Insulation coordination – Part 1: Definitions, principles and rules*

IEC 60781:1989, *Application guide for calculation of short-circuit currents in low-voltage radial systems*

IEC 60865-1:1993, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC TR 60909-1,— *Short-circuit currents calculation in three-phase a.c. systems – Part 1: Factors for the calculation of short-circuit currents in three-phase a.c. systems according to IEC 60909-0¹⁾*

IEC TR3 60909-2:1992, *Electrical equipment – Data for short-circuit current calculations in accordance with IEC 60909*

IEC 60909-3:1995, *Short-circuit current calculation in three-phase a.c. systems – Part 3: Currents during two separate simultaneous single phase line-to-earth short circuits and partial short-circuit currents flowing through earth*

IEC TR 60909-4:2000, *Short-circuit current calculation in three-phase a.c. systems – Part 4: Examples for the calculation of short-circuit currents*

IEC 60949:1988, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC 60986:1989, *Guide to the short-circuit temperature limits of electrical cables with a rated voltage from 1,8/3 (3,6) kV to 18/30 (36) kV*

1.3 Definitions

For the purposes of this part of IEC 60909, the definitions given in IEC 60050(131) and the following definitions apply.

1.3.1

short circuit

accidental or intentional conductive path between two or more conductive parts forcing the electric potential differences between these conductive parts to be equal or close to zero

1.3.1.1

line-to-line short circuit

accidental or intentional conductive path between two or more line conductors with or without earth connection

1.3.1.2

line-to-earth short circuit

accidental or intentional conductive path in a solidly earthed neutral system or an impedance earthed neutral system between a line conductor and local earth

1.3.2

short-circuit current

over-current resulting from a short circuit in an electric system

NOTE It is necessary to distinguish between the short-circuit current at the short-circuit location and partial short-circuit currents in the network branches (see figure 3) at any point of the network.

¹⁾ To be published.