SLOVENSKI STANDARD
SIST EN 60909-0:2016

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SIST EN 60909-0:2002

Kratkostični toki v izmeničnih trifaznih sistemih - 0. del: Računanje tokov

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

Kurzschlussströme in Drehstromnetzen - Teil 0: Berechnung der Ströme

Courants de court-circuit dans les réseaux triphasés à courant alternatif - Partie 0: Calcul des courants

Ta slovenski standard je istoveten z: EN 60909-0:2016

ICS:

17.220.01	Elektrika. Magnetizem. Splošni vidiki	Electricity. Magnetism. General aspects
29.240.20	Daljnovodi	Power transmission and distribution lines

SIST EN 60909-0:2016 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 60909-0

June 2016

ICS 17.220.01; 29.240.20

Supersedes EN 60909-0:2001

English Version

Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents (IEC 60909-0:2016)

Courants de court-circuit dans les réseaux triphasés à courant alternatif - Partie 0: Calcul des courants (IEC 60909-0:2016)

Kurzschlussströme in Drehstromnetzen - Teil 0: Berechnung der Ströme (IEC 60909-0:2016)

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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.

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CENELEC

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

The text of document 73/172/CDV, future edition 2 of IEC 60909-0, prepared by IEC/TC 73 "Shortcircuit currents" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60909-0:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-12-10
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-06-10

This document supersedes EN 60909-0:2001.

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Endorsement notice

The text of the International Standard IEC 60909-0:2016 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 standards indicated:

IEC 60865-1	NOTE	Harmonized as EN 60865-1.
IEC 62428	NOTE	Harmonized as EN 62428.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 60038 (mod)	2009	IEC standard voltages	EN 60038	2011
IEC 60050-131	-	International Electrotechnical Vocabulary (IEV) - Part 131: Circuit theory	-	-
IEC/TR 60909-1	2002	Short-circuit currents in three-phase e.c. systems - Part 1: Factors for the calculation of short-circuit currents according to IEC 60909-0	-	-
IEC/TR 60909-2	2008	Short-circuit currents in three-phase a.c. systems - Part 2: Data of electrical equipment for short-circuit current calculations	-	-
IEC 60909-3	2009	Short-circuit currents in three-phase a.c systems - Part 3: Currents during two separate simultaneous line-to-earth short-circuits and partial short-circuit currents flowing through earth	EN 60909-3	2010
IEC/TR 60909-4	2000	Short-circuit currents in three-phase a.c. systems - Part 4: Examples for the calculation of short-circuit currents	-	-

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Courants de court-circuit dans les réseaux triphasés à courant alternatif – Partie 0: Calcul des courants

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SHORT-CIRCUIT CURRENTS IN THREE-PHASE AC SYSTEMS –

Part 0: Calculation of currents

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

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

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

a) contribution of windpower station units to the short-circuit current;
b) contribution of power station units with ful size converters to the short-circuit current;
c) new document structure.

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

CDV	Report on voting
73/172/CDV	73/175A/RVC

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 in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60909 series, published under the general title *Short-circuit currents in three-phase a.c. systems*, can be found on the IEC website.

This part of IEC 60909 is to be read in conjunction with the following International Standards and Technical Reports:

– IEC TR 60909-1:2002, *Short-circuit currents in three-phase a.c. systems – Part 1: Factors for the calculation of short-circuit currents according to IEC 60909-0*

– IEC TR 60909-2:2008, *Short-circuit currents in three-phase a.c. systems – Part 2: Data of electrical equipment for short-circuit current calculations*

– IEC 60909-3:2009, *Short-circuit currents in three-phase a.c. systems – Part 3: Currents during two separate simultaneous line-to-earth short circuits and partial short-circuit currents flowing through earth*

– IEC TR 60909-4:2000, *Short-circuit currents 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 the stability date indicated on the IEC website 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.

SHORT-CIRCUIT CURRENTS IN THREE-PHASE AC SYSTEMS –

Part 0: Calculation of currents

1 Scope

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

- in low-voltage three-phase AC systems, and
- in high-voltage three-phase AC 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.

A single line-to-earth fault is beyond the scope of this part of IEC 60909.

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 analyser, 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 types short-circuit currents, which differ in their magnitude, are considered:

- 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 part of IEC 60909.

This part of IEC 60909 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.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038:2009, *IEC standard voltages*

IEC 60050-131, *International Electrotechnical Vocabulary – Part 131: Circuit theory* (available at: www.electropedia.org)

IEC TR 60909-1:2002, *Short-circuit currents in three-phase a.c. systems – Part 1: Factors for the calculation of short-circuit currents according to IEC 60909-0*

IEC TR 60909-2:2008, *Short-circuit currents in three-phase a.c. systems – Data of electrical equipment for short-circuit current calculations*

IEC 60909-3:2009, *Short-circuit currents in three-phase a.c. systems – Part 3: Currents during two separate simultaneous line-to-earth short circuits and partial short-circuit currents flowing through earth*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-131 and the following apply.

3.1
short circuit
accidental or intentional conductive path between two or more conductive parts (e.g. three-phase short circuit) forcing the electric potential differences between these conductive parts to be equal or close to zero

3.1.1
line-to-line short circuit
two-phase short circuit
accidental or intentional conductive path between two line conductors with or without earth connection

3.1.2
line-to-earth short circuit
single-phase 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

3.2
short-circuit current
over-current resulting from a short circuit in an electric system

Note 1 to entry: 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.

3.3
prospective short-circuit current
current that would flow if the short circuit were replaced by an ideal connection of negligible impedance without any change of the supply

Note 1 to entry: 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 part of IEC 60909.

3.4
symmetrical short-circuit current
rms value of the AC symmetrical component of a prospective short-circuit current (see 3.3), the aperiodic component of current, if any, being neglected

3.5
initial symmetrical short-circuit current
I''_k
rms value of the AC symmetrical component of a prospective short-circuit current (see 3.3), applicable at the instant of short circuit if the impedance remains at zero-time value

SEE: Figures 1 and 2

3.6
initial symmetrical short-circuit power
S''_k

fictitious value determined as a product of the initial symmetrical short-circuit current I''_k (see 3.5), the nominal system voltage U_n (see 3.13) and the factor $\sqrt{3}$: $S''_k = \sqrt{3} \cdot U_n \cdot I''_k$

Note 1 to entry: The initial symmetrical short-circuit power S''_k is not used for the calculation procedure in this part of IEC 60909. If S''_k is used in spite of this in connection with short-circuit calculations, for instance to calculate the internal impedance of a network feeder at the connection point Q, then the definition given should be used in the following form: $S''_{kQ} = \sqrt{3} \cdot U_{nQ} \cdot I''_{kQ}$ or $Z_Q = c \cdot U^2_{nQ} / S''_{kQ}$.

3.7
decaying (aperiodic) component of short-circuit current or DC component
i_{DC}
mean value between the top and bottom envelope of a short-circuit current decaying from an initial value to zero according to Figures 1 and 2

3.8
peak short-circuit current
i_p
maximum possible instantaneous value of the prospective short-circuit current

SEE: Figures 1 and 2

Note 1 to entry: Sequential short circuits are not considered.

3.9
symmetrical short-circuit breaking current
I_b
rms value of an integral cycle of the symmetrical AC component of the prospective short-circuit current at the instant of contact separation of the first pole to open of a switching device

3.10
steady-state short-circuit current
I_k
rms value of the short-circuit current which remains after the decay of the transient phenomena

SEE: Figures 1 and 2

3.11
symmetrical locked-rotor current
I_{LR}
symmetrical rms current of an asynchronous motor with locked rotor fed with rated voltage U_{rM} at rated frequency

3.12
equivalent electric circuit
model to describe the behaviour of a circuit by means of a network of ideal elements

3.13
nominal system voltage
U_n
voltage (line-to-line) by which a system is designated, and to which certain operating characteristics are referred

Note 1 to entry: Values are given in IEC 60038.

3.14
equivalent voltage source
$cU_n / \sqrt{3}$
voltage of an ideal source applied at the short-circuit location for calculating the short-circuit current according to 5.3.1

Note 1 to entry: This is the only active voltage of the network.

3.15
voltage factor
c
ratio between the equivalent voltage source and the nominal system voltage U_n divided by $\sqrt{3}$

Note 1 to entry: The values are given in Table 1.

Note 2 to entry: The introduction of a voltage factor c is necessary for various reasons. These are:

– voltage variations depending on time and place,
– changing of transformer taps,
– neglecting loads and capacitances by calculations according to 5.2,
– the subtransient behaviour of generators and motors.

3.16
far-from-generator short circuit
short circuit during which the magnitude of the symmetrical AC component of the prospective short-circuit current remains essentially constant

SEE: Figure 1

3.17
near-to-generator short circuit
short circuit during which the magnitude of the symmetrical AC component of the prospective short-circuit current decreases