

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Conventions concerning electric circuits

Conventions concernant les circuits électriques

IEC 60375:2018
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INTERNATIONAL STANDARD

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONVENTIONS CONCERNING ELECTRIC CIRCUITS

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International Standard IEC 60375 has been prepared by IEC technical committee 25: Quantities and units, and their letter symbols.

This third edition cancels and replaces the second edition issued in 2003. This edition constitutes a technical revision.

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

- a) the clause on conventions concerning magnetic circuits has been removed; accordingly the title of the document has been abbreviated to read “Conventions concerning electric circuits”;
- b) text and figures have been revised and homogenised;
- c) Clause 3 has been structured into subclauses;
- d) Clause 4 – Orientation of geometrical objects – has been inserted, and thus the clause numbering has been altered.

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

FDIS	Report on voting
25/620/FDIS	25/622/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 in accordance with the ISO/IEC Directives, Part 2.

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- withdrawn,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
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CONVENTIONS CONCERNING ELECTRIC CIRCUITS

1 Scope

This International Standard specifies the rules for signs and reference directions and reference polarities for electric currents and voltages in electric networks.

In Clauses 3 to 10, the time dependence is arbitrary. It is assumed that the wavelength of the highest frequency involved is larger than the largest distance between two points of the network; processes are considered to be quasi-static. Clause 11 specifies the rules and recommendations for complex notation.

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 60617, *Graphical symbols for diagrams* ¹

3 Terms and definitions

For the purposes of this document, 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

orientation

<of a curve> property of a curve described by the position vector $r(u)$ which is associated with increasing or decreasing values of the parameter u

[SOURCE: IEC 60050-102:2007, 102-04-19]

3.2

orientation

<of a surface> for a surface having a tangent plane at any point, property determined by the choice, continuously from point to point, of one of the two normal unit vectors at each point

[SOURCE: IEC 60050-102:2007, 102-04-36, modified – Note 1 to entry omitted.]

3.3

electric charge

additive scalar quantity, associated with elementary particles and with macroscopic matter that characterizes their electromagnetic interactions

¹ IEC 60617 is a database containing symbols referenced in the form (IEC 60617-Sxxxxx) where Sxxxxx is the identity number of the symbol.

Note 1 to entry: The (electric) charge of a capacitor is defined in IEC 60050-131:2002, 131-12-11 differently by $q = \int i(\tau) d\tau$; where it is used in this document, it is marked with this source in square brackets.

[SOURCE: IEC 60050-121:1998, 121-11-01, modified – Note 1 to entry has been replaced and Note 2 to entry has been omitted.]

3.4

positive electric charge

electric charge which is of the same sign as that attributed by convention to a proton

[SOURCE: IEC 60050-113:2011, 113-02-12]

3.5

quasi-infinitesimal

for a system of elementary entities distributed in space, qualifies the length, the area, or the volume of an element of space, all the geometrical dimensions of which are small compared with those of the system under consideration but sufficiently large for the element of space to contain a large number of elementary entities; qualifies also an extensive quantity when summed for all elementary entities within such an element of space

[SOURCE: IEC 60050-121:1998, 121-11-06, modified – Notes to entry omitted.]

3.6

**electric current
current**

conduction current

scalar quantity equal to the flux of the electric current density J through a given oriented surface S :

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$$I = \int_S \mathbf{J} \cdot \mathbf{e}_n dA$$

where $\mathbf{e}_n dA$ is the vector surface element

[SOURCE: IEC 60050-121:1998, 121-11-13, modified – Notes to entry omitted.]

3.7

integral quantity

line, surface or volume integral of a quantity associated with an electromagnetic field

[SOURCE: IEC 60050-131:2002, 131-11-01, modified – Notes to entry omitted.]

3.8

circuit theory

study of electric and magnetic systems in which the electric and magnetic phenomena are described in terms of integral quantities

[SOURCE: IEC 60050-131:2002, 131-11-02, modified – Note to entry omitted.]

3.9

circuit element

in electromagnetism, mathematical model of a device characterized by one or more relations between integral quantities

[SOURCE: IEC 60050-131:2002, 131-11-03]

3.10**electric circuit element**

circuit element for which only relations between electric integral quantities are considered

[SOURCE: IEC 60050-131:2002, 131-11-04]

3.11**circuit**

set of interconnected circuit elements

[SOURCE: IEC 60050-131:2002, 131-11-06]

3.12**electric circuit**

circuit consisting of electric circuit elements only

[SOURCE: IEC 60050-131:2002, 131-11-07, modified – Synonym "electric network" and notes to entry omitted.]

3.13**terminal**

point of interconnection of an electric circuit element, an electric circuit or a network with other electric circuit elements, electric circuits or networks

[SOURCE: IEC 60050-131:2002, 131-11-11, modified – Notes to entry omitted.]

3.14***n*-terminal**

qualifies an electric circuit element, an electric circuit or a network having *n* terminals with *n* generally greater than two

[SOURCE: IEC 60050-131:2002, 131-11-12]

3.15***n*-terminal circuit element**

electric circuit element having *n* terminals with *n* generally greater than two

[SOURCE: IEC 60050-131:2002, 131-11-13, modified – Note to entry omitted.]

3.16***n*-terminal circuit**

electric circuit having *n* terminals with *n* generally greater than two

[SOURCE: IEC 60050-131:2002, 131-11-14, modified – Note to entry omitted.]

3.17**two-terminal circuit**

electric circuit having two terminals

[SOURCE: IEC 60050-131:2002, 131-11-15]

3.18**two-terminal element**

electric circuit element having two terminals

[SOURCE: IEC 60050-131:2002, 131-11-16]

3.19**phasor**

representation of a sinusoidal integral quantity by a complex quantity whose argument is equal to the initial phase and whose modulus is equal to the root-mean-square value

[SOURCE: IEC 60050-131:2002, 131-11-26, modified – Notes to entry omitted.]

3.20**direction of electric current**

by convention, the direction of the net flow of positive electric charge transferred from one terminal to another terminal

[SOURCE: IEC 60050-131:2002, 131-11-29, modified – Note to entry omitted.]

3.21**passive**

qualifies a circuit element or a circuit for which the time integral of the instantaneous power cannot be negative over any time interval beginning at an instant before the first supply of electric energy

[SOURCE: IEC 60050-131:2002, 131-11-34, modified – Notes to entry omitted.]

3.22**complex power**

under sinusoidal conditions, product of the phasor \underline{U} representing the voltage between the terminals of a linear two-terminal element or two-terminal circuit and the complex conjugate of the phasor \underline{I} representing the electric current in the element or circuit: $\underline{S} = \underline{U} \cdot \underline{I}^*$

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[SOURCE: IEC 60050-131:2002, 131-11-39, modified – Notes to entry omitted.]

3.23**apparent power**

product of the RMS voltage U between the terminals of a two-terminal element or two-terminal circuit and the RMS electric current I in the element or circuit: $S = UI$

[SOURCE: IEC 60050-131:2002, 131-11-41, modified – Notes to entry omitted.]

3.24**active power**

under periodic conditions, mean value, taken over one period T , of the instantaneous power P :

$$P = \frac{1}{T} \int_0^T p dt$$

[SOURCE: IEC 60050-131:2002, 131-11-42, modified – Notes to entry omitted.]

3.25**reactive power**

for a linear two-terminal element or two-terminal circuit, under sinusoidal conditions, quantity equal to the product of the apparent power S and the sine of the displacement angle φ

$$Q = S \sin \varphi$$

[SOURCE: IEC 60050-131: 2002, 131-11-44, modified – Notes to entry omitted.]

3.26**displacement angle**

under sinusoidal conditions, phase difference between the voltage applied to a linear two-terminal element or two-terminal circuit and the electric current in the element or circuit

[SOURCE: IEC 60050-131:2002, 131-11-48, modified – Note to entry omitted.]

3.27**voltage**

<in circuit theory> between two terminals A and B, quantity u_{AB} equal to the difference of the electric potentials V_A at A and V_B at B:

$$u_{AB} = V_A - V_B$$

[SOURCE: IEC 60050-131:2002, 131-11-56, modified – Note to entry omitted.]

3.28**resistive n -terminal element**

passive n -terminal circuit element characterized by functional relations between the voltages between any two terminals and the electric currents at the terminals

[SOURCE: IEC 60050-131:2002, 131-12-01, modified – Note to entry omitted.]

3.29**resistive two-terminal element** (standards.iteh.ai)

passive two-terminal element characterized by a functional relation between the voltage between the terminals and the electric current in the element

[SOURCE: IEC 60050-131:2002, 131-12-02, modified – Note to entry omitted.]

3.30**ideal resistor**

linear resistive two-terminal element

[SOURCE: IEC 60050-131:2002, 131-12-03, modified – Notes to entry omitted.]

3.31**resistance**

for a resistive two-terminal element or two-terminal circuit with terminals A and B, quotient of the voltage u_{AB} between the terminals by the electric current i in the element or circuit:

$$R = \frac{u_{AB}}{i}$$

where the electric current is taken as positive if its direction is from A to B and negative in the opposite case

[SOURCE: IEC 60050-131:2002, 131-12-04, modified – Notes to entry omitted.]

3.32**conductance**

for a resistive two-terminal element or two-terminal circuit with terminals A and B, quotient of the electric current i in the element or circuit by the voltage u_{AB} between the terminals:

$$G = \frac{i}{u_{AB}}$$

where the electric current is taken as positive if its direction is from A to B and negative in the opposite case

[SOURCE: IEC 60050-131:2002, 131-12-06, modified – Notes to entry omitted.]

3.33

capacitive n -terminal element

passive n -terminal circuit element characterized by $n - 1$ functional relations between the voltages between each of $n - 1$ terminals and the remaining terminal, and the electric charges [IEC 60050-131: 2002, 131-12-11] at these $n - 1$ terminals

[SOURCE: IEC 60050-131:2002, 131-12-09, modified – Notes to entry omitted.]

3.34

capacitive two-terminal element

passive two-terminal element characterized by a functional relation between the voltage between the terminals and the time integral of the electric current in the element

[SOURCE: IEC 60050-131:2002, 131-12-10, modified – Note to entry omitted.]

3.35

inductive m -terminal-pair element

passive m -terminal-pair circuit element characterized by functional relations between the instantaneous electric currents at each pair of terminals and the linked fluxes between the terminals of each pair

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[SOURCE: IEC 60050-131:2002, 131-12-15, modified – Note to entry omitted.]

3.36

inductive two-terminal element

passive two-terminal element characterized by a functional relation between the electric current in the element and the time integral of the voltage between the terminals

[SOURCE: IEC 60050-131:2002, 131-12-16, modified – Note to entry omitted.]

3.37

linked flux

<in circuit theory> time integral of the voltage u_{AB} between two terminals A and B of a two-terminal or n -terminal element:

$$\psi_{AB}(t) = \int_{t_0}^t u_{AB}(\tau) d\tau$$

where t_0 is any instant before the first supply of electric energy

[SOURCE: IEC 60050-131:2002, 131-12-17, modified – Notes to entry omitted.]

3.38

ideal voltage source

two-terminal element for which the voltage between its terminals is independent of the electric current in the element

[SOURCE: IEC 60050-131:2002, 131-12-21, modified – Note to entry omitted.]

3.39**source voltage
source tension**

voltage between the terminals of an ideal voltage source

[SOURCE: IEC 60050-131:2002, 131-12-22, modified – Note to entry omitted.]

3.40**ideal current source**

two-terminal element for which the electric current is independent of the voltage between its terminals

[SOURCE: IEC 60050-131:2002, 131-12-23, modified – Note to entry omitted.]

3.41**source current**

electric current in an ideal current source

[SOURCE: IEC 60050-131:2002, 131-12-24]

3.42**independent source**

ideal voltage source or ideal current source, the output quantity of which does not depend on any external voltage or electric current

[SOURCE: IEC 60050-131:2002, 131-12-25]

3.43**controlled source**

ideal voltage source or ideal current source, the output quantity of which depends on an external voltage or electric current

[SOURCE: IEC 60050-131:2002, 131-12-26, modified – Note to entry omitted.]

3.44**coupling**

<in circuit theory> interaction between circuit elements characterized by a relation between an integral quantity in one element and an integral quantity in another element

[SOURCE: IEC 60050-131:2002, 131-12-30]

3.45***n*-port
multiport**

device or network with a specified number *n* of separate ports

[SOURCE: IEC 60050-131:2002, 131-12-68, modified – Note to entry omitted.]

3.46**network**

in network topology, set of ideal circuit elements and their interconnections, considered as a whole

[SOURCE: IEC 60050-131:2002, 131-13-03, modified – Note to entry omitted.]