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Rotating electrical machines -
Part 8: Terminal markings and direction of rotation

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Rotating electrical machines - Part 8: Terminal markings and direction of rotation

FOREWORD

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This commented version (CMV) of the official standard IEC 60034-8:2026 edition 4.0 allows the user to identify the changes made to the previous IEC 60034-8:2007+AMD1:2014 CSV edition 3.1. Furthermore, comments from IEC TC 2 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60034-8 has been prepared by IEC technical committee 2: Rotating machinery. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2007 and Amendment 1:2014. This edition constitutes a technical revision.

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

a) The inclusion of turbine-type synchronous machines in the scope.

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

Draft	Report on voting
2/2291/FDIS	2/2309/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.

A list of all the parts of the IEC 60034 series, under the general title *Rotating electrical machines,* can be found on the IEC website.

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.

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.

INTRODUCTION

The revision of this part of IEC 60034 provides worldwide uniformity in the electrical connections for rotating electrical machines and applies the recommendations of the basic safety publication IEC 60445 in specifying marking requirements.

These standardized connections will then enable the safe interchange of electric machines with their control and protective devices using standardized terminal markings.

NOTE Electrical connections of the machines are not the unique feature to be checked for safe interchange.

1 Scope

This part of IEC 60034 applies to AC and DC machines and specifies

a) rules for the identification of winding connection points;
b) marking of winding terminals;
c) direction of rotation;
d) relationship between terminal markings and direction of rotation;
e) terminal marking of auxiliary devices;
f) connection diagrams of machines for common applications.

~~Turbine-type synchronous machines are excluded from this standard.~~ 1

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 60034-1, *Rotating electrical machines - Part 1: Rating and performance*

IEC 60034-3, *Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators* 2

IEC 60034-33, *Rotating electrical machines - Part 33: Synchronous hydrogenerators including motor-generators - Specific requirements* 2

IEC 60417-1, *Graphical symbols for use on equipment - Part 1: Overview and application*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60034-1 and the following apply.

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

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1
terminal marking
permanent identification of the external termination of winding leads or auxiliary leads at the disposal of the user for connection of the machine to the supply or apparatus that indicates the function of the termination

3.2
~~connecting~~connection points
all current transfer points that are used to permanently interconnect winding or winding element ends internally

3.3
tapping points
intermediate connections to a portion of a winding element

3.4
winding leads
insulated conductors that make the electrical connection between a winding and its termination

3.5
winding
assembly of turns or coils having a defined function in an electrical rotating machine

[SOURCE: IEC 60050-411:1996, 411-37-01]

3.6
winding phase
one or more winding elements associated with a particular phase

3.7
winding element
part of a winding in which all the turns or coils ~~in that part being~~ are permanently connected together

3.8
separate windings
two or more windings, each having a separate function, and not interconnected, used only separately, whether fully or in part

3.9
multi-speed motor
motor, which can be operated at any one of two or more definite speeds

3.10
constant power
when a multi-speed motor provides approximately constant power over the speed range

3.11
constant torque
when a multi-speed motor provides approximately constant torque over the speed range

~~**3.12**~~
~~**variable torque**~~ **3**
~~when output torque of a multi-speed motor is proportional to approximately the square of the speeds~~

3.12
phase sequence
order in which the voltages successively reach their maximum positive values between supply conductors

3.13
D-end
that end of the machine which accommodates the shaft end

Note 1 to entry: For machines having two shaft ends, the D-end is the end

a) having the larger diameter;

b) opposite the external fan when the shaft ends are of the same diameter.

[SOURCE: IEC 60050-411:1996, 411-43-36]

4 Symbols

4.1 General

L	Supply conductor
PE	Protective earthing terminal
	User available terminal, marking mandatory
	Internal connection point
(....)	Internal terminal marking (showing element symbol), optional
[.... , ...]	Grouping of user joined terminals
;	Separation of terminals or groups of terminals

4.2 DC and single-phase commutator machines

A	Armature winding
B	Commutating winding
C	Compensating winding
D	Series excitation winding
E	Shunt excitation winding
F	Separately excited winding
H	Direct-axis auxiliary winding
J	Quadrature-axis auxiliary winding

4.3 AC machines without commutator

F	DC excitation winding
K	Secondary winding
L	Secondary winding
M	Secondary winding
N	Star point (neutral conductor) of the primary winding
Q	Star point (neutral conductor) of a secondary winding
U	Primary winding
V	Primary winding
W	Primary winding
Z	Auxiliary windings

~~NOTE~~ The primary and secondary symbol allocations are irrespective of whether the primary winding is located in the stator or rotor. Different symbols may be used as agreed between the manufacturer and the purchaser with special attention to safety rules. **4**

4.4 Auxiliary devices

BA	AC brakes
BD	DC brakes
BW	Brush-wear detector
CA	Capacitors
CT	Current transformer
HE	Heaters
LA	Lightning arrestor
PT	Potential transformer
R	Resistance thermometers
SC	Surge capacitor
SP	Surge protectors
S	Switches including plugging switches
TB	Thermostats opening on increase of temperature
TC	Thermocouples
TM	Thermostats closing on increase of temperature
TN	Thermistors, negative temperature coefficient
TP	Thermistors, positive temperature coefficient

~~NOTE~~ The above list standardizes the most commonly used auxiliary devices. The designation of other devices may be chosen by the manufacturer. Different symbols may be used as agreed between the manufacturer and the purchaser. **5**

5 Direction of rotation

The direction of rotation shall be that of the shaft observed when facing the D-end.

~~Machines with terminal markings according to this standard shall have a clockwise direction of rotation.~~

~~For other configurations, including Unidirectional machines, an arrow located on the enclosure shall show the direction of rotation.~~

Synchronous generators and motor-generators in the scope of IEC 60034-3 or IEC 60034-33 shall have the direction of rotation as imposed by the prime mover being in turbine or motor mode. For synchronous compensators, the direction of rotation shall be agreed between manufacturer and purchaser. This direction of rotation shall be marked as per 6.7. **6**

If not otherwise specified, all machines apart from synchronous and motor generators in the scope of IEC 60034-3 or IEC 60034-33 shall have a clockwise direction of rotation.”

Unidirectional machines, apart for synchronous generators and motor-generators in the scope of IEC 60034-3 or IEC 60034-33 shall have an arrow located on the enclosure to show the direction of rotation. **7**

6 Rules for terminal markings

6.1 General

6.1.1 Application

A terminal marking shall identify all winding leads and auxiliary device terminations accessible to the user.

NOTE External line connections and winding arrangements used for common applications are shown in Annex A.

6.1.2 Marking instructions

All three-phase AC machines with more than three terminals and all other machines (and auxiliary devices) with more than two terminals shall have connecting instructions consistent with this document.

The graphical symbols shall be in accordance with IEC 60417-1. 8

6.1.3 Alphanumeric marking notation

The terminal marking comprises upper-case Latin characters and Arabic numerals. The characters shall be arranged without spaces.

Each winding, winding phase or auxiliary circuit shall be assigned (a) letter symbol(s) in accordance with Clause 4.

To prevent confusion with the numerals 1 and 0, the letters “I” and “O” shall not be used.

6.1.4 Duplicate winding terminals

Several leads of a machine can have the same marking only if each of them is capable of completely fulfilling the same electrical function, so that either one of them can be used for the connection. See Figure 9.

6.1.5 Shared terminals

When several leads or conductors are provided to share the current, the terminal markings shall be identified by an additional numerical suffix separated by a hyphen. See Figure 10.

Some multi-speed motors having two or more independent windings may produce circulating currents in the de-energized winding. In this case, the terminal markings for the open delta connection shall be identified by an additional numerical suffix separated by a hyphen. See Figure A.15.

6.1.6 Omissions

Numerical suffixes and/or prefixes may be omitted if there is no risk of confusion. See Figure 2.

When two or more elements are connected to the same terminal, its marking shall be determined from one of the elements. The order of precedence shall be determined by the lower suffix. See Figure 8.

When two or more functionally different elements are connected internally, the combination of elements shall be considered a single element, and the terminal marking shall have the alpha notation of the primary element function. See Figure 24.

6.1.7 Earthing terminal

The termination for the protective earthing conductor shall be marked with the letters PE according to IEC 60445 (or marked with symbol IEC 60417-5019:2006-08). No other terminals shall be so marked.

6.2 Suffixes

6.2.1 Winding elements

The ends of each winding element are distinguished by a numerical suffix, in accordance with IEC 60445, as follows (see Figure 5):

– 1 and 2 for the first winding element (see Figure 1);
– 3 and 4 for the second winding element;
– 5 and 6 for the third winding element;
– 7 and 8 for the fourth winding element.

In all winding elements, the end closer to the supply connection shall be marked with the lower of the two numbers.

6.2.2 Internal connections

When several ends of winding elements are joined, the terminal marking for the connecting shall use the lower suffix; see Figure 8.

6.2.3 Tapping points

Tapping points of a winding element shall be marked in the sequence in which they occur in the winding element, as follows (see Figure 6):

– 11, 12, 13, etc. for the first winding element;
– 31, 32, 33, etc. for the second winding element;
– 51, 52, 53, etc. for the third winding element;
– 71, 72, 73, etc. for the fourth winding element.

The tap closest to the beginning of the winding shall be marked with the lowest suffix.

6.3 Prefixes

Winding elements that are separate (or belong to different current systems), but have a similar, but independent, function, shall be marked with the same letter, but distinguished by a numerical prefix.

Each of the terminals shall be marked with a numerical prefix corresponding to the separate winding (or current system) to which it belongs, as follows (see Figure 7):

– first winding 1
– second winding 2
– third winding 3
– fourth winding 4
– and so on…

With multi-speed machines, the sequence of the prefixes corresponds to the sequence of increasing speeds. See Figure A.19.

6.4 Winding identification for categories of Induction machines

6.4.1 Three-phase machines

The letter symbols shall be U, V, and W for the first (see Figure 1), second and third primary winding phase respectively and N when a neutral conductor is used (see Figure 3) and K, L, and M and Q when a secondary winding is used. See Figure 11.

Different symbols may be used as agreed between the manufacturer and the purchaser with special attention to safety rules. 9

6.4.2 Two-phase machines

The terminal markings of a two-phase machine shall be derived from the markings for three-phase machines, with the letter symbols W and M omitted.

6.4.3 Single-phase machines

The letter symbols assigned shall be U for the primary winding and Z for the auxiliary winding. See Figure 12, Figure 13, and Figure 14.

If the winding ends of a main and an auxiliary winding are connected to a common terminal, the terminal shall be marked according to the rule for the main phase.

6.4.4 Multiple three-phase group (for example, six-phase) machines

Each phase group shall be differentiated by a prefix according to 6.3. See Figure 15.

The numerical order of the prefix shall increase according to the order in which the U phase of each phase group reaches its maximum voltage value.

6.5 Synchronous machines

6.5.1 Primary windings of synchronous machines

The primary windings shall have terminal markings as derived for ~~asynchronous~~ induction machines.

6.5.2 Field winding of synchronous machines

Terminal markings of the DC separately excited field windings shall be F1 and F2.

6.5.3 Permanent magnet machines

Since these machines do not have a separate excitation, the windings shall have terminal markings as established for ~~asynchronous~~ induction machines. This is valid for both machines operating with ~~an adjustable frequency drive (AFD)~~ a frequency converter with permanent magnets located in or on the rotor and for machines suitable for across the line start, with permanent magnets inserted in or on the rotor with or without a squirrel cage rotor for starting.

6.6 DC machines

The letter symbols assigned to winding elements shall be as listed in 4.2 with terminal markings as shown in Figure 16 to Figure 24.