

Terminal markings for electrical machinery & apparatus —

Part 6: Terminal Markings for rotating electrical machinery

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Contents

	Page
Co-operating organizations	Inside front cover
Foreword	iv
Section 1. A.C. Generators and motors	
1 Primary terminals	1
2 Secondary terminals	3
3 Excitation terminals	4
4 Capacitor terminals	4
5 Commutator machines	4
6 Composite machines	5
7 Colour markings for connecting leads	5
Section 2. D.C. Generators and motors	
8 Main letter markings	5
9 Suffix markings	6
10 Mechanical rotation and polarity of windings	7
11 Composite machines	7
12 Colour markings for connecting leads	7
Figure 1 — Three-phase winding, permanently delta-connected	8
Figure 2 — Three phase winding, permanently star-connected	8
Figure 3 — Two-phase winding, permanently L-connected	8
Figure 4 — Permanently-connected single-phase main and auxiliary windings	9
Figure 5 — Three-phase winding, both ends of each phase brought out	9
Figure 6 — Two-phase winding, both ends of each phase brought out	9
Figure 7 — Single-phase winding, both ends of phase winding and auxiliary winding brought out	9
Figure 8 — Three-phase winding divided into independent sections	10
Figure 9 — Single-phase winding divided into independent sections	10
Figure 10 — Six-phase winding permanently connected in double star (neutral brought out)	10
Figure 11 — Three-phase winding, permanently star connected, with one tapping per phase	10
Figure 12 — Three-phase winding, permanently delta connected, with one tapping per phase	11
Figure 13 — Three-phase winding with one tapping per phase and both ends of each phase winding brought out	11
Figure 14 — Two-winding, two-speed machine with windings permanently star-connected	11
Figure 15 — Two-winding, two-speed machine with both ends of all windings brought out	11
Figure 16 — Three-winding, three-speed machine with terminal common to all windings	12
Figure 17 — Three-winding, three-speed machine with windings permanently star-connected	12
Figure 18 — Multi-winding machine with one two-speed winding and two single-speed windings	12
Figure 19 — Two-phase winding with one tapping per phase and common phase terminal	12

	Page
Figure 20 — Two-phase winding with one tapping per phase and both ends of each winding brought out	13
Figure 21 — Two-phase, three-winding machine with both ends of each phase winding brought out	13
Figure 22 — Three-winding two-phase machine with both ends of each phase winding brought out, but with two-phase terminals common to all windings	13
Figure 23 — Three-winding, two-phase machine with common phase terminal for individual windings	13
Figure 24 — Three-winding, two-phase machine with common phase terminal for individual windings which is also common to all three windings	14
Figure 25 — Single-phase, two-winding, two-speed machine	14
Figure 26 — Three-phase, star-connected winding with neutral brought out	14
Figure 27 — Two-phase mesh-connected winding	14
Figure 28 — Six-phase, mesh-connected winding	15
Figure 29 — Six-phase, double-delta connected winding	15
Figure 30 — Three-phase, delta-connected winding: one connection left open	15
Figure 31 — Three-phase, delta-connected winding: one connection left open: one tapping per phase	15
Figure 32 — Three-phase secondary winding: delta-connected	16
Figure 33 — Three-phase secondary winding: star connected	16
Figure 34 — Six-phase secondary winding: star connected	16
Figure 35 — Two-phase secondary winding: L-connected (3 terminals)	16
Figure 36 — Two-phase secondary winding: L-connected (4 terminals)	16
Figure 37 — Mesh-connected secondary windings (4 terminals)	17
Figure 38 — Two three-phase secondary windings: delta-connected	17
Figure 39 — Two three-phase secondary windings: star-connected	17
Figure 40 — Two three-phase secondary windings: delta-connected: one phase common	17
Figure 41 — Two secondary windings 120° (electrical) apart	18
Figure 42 — Three-phase secondary winding: delta-connected, with each phase tapped	18
Figure 43 — Three-phase secondary winding: star-connected with each phase tapped	18
Figure 44 — Three-phase secondary windings: three-speed machine: one terminal common to all windings	18
Figure 45 — Six-phase secondary winding: mesh-connected	19
Figure 46 — Windings receiving separate d.c. excitation	19
Figure 47 — Two-terminal, single-phase machine	19
Figure 48 — Single-phase winding connected to sliprings	19
Figure 49 — Armature and shunt winding with tapping	20
Figure 50 — Armature, shunt and series windings	20
Figure 51 — Armature, shunt, series and compole windings	20
Figure 52 — Armature, compole and series windings with separately-excited field winding	20
Figure 53 — Armature, compole, compensating and series windings with separately-excited field winding	21

	Page
Figure 54 — Derived neutral (or mid-wire) terminal (single-phase tapplings)	21
Figure 55 — Derived neutral (or mid-wire) terminal (two-phase tapplings)	21
Figure 56 — Common terminal for shunt, series and compole windings	21
Figure 57 — Common terminal for compole and series windings	22
Figure 58 — Common terminal for shunt and series winding	22
Figure 59 — Shunt winding permanently connected to one side of armature and one side of series winding	22
Figure 60 — Compound machine with tapped series field	22
Figure 61 — Machine with divided shunt windings	23
Figure 62 — Machine with divided series windings	23
Figure 63 — Machine with alternative series windings	23
Figure 64 — To illustrate clockwise direction of rotation of simple compound wound machines	23
Figure 65 — To illustrate clockwise direction of rotation of compound machines with compensating and tapped series windings	24
Figure 66 — Two-lead d.c. machine	24
Publications referred to	Inside back cover

Foreword

This British Standard revises and supersedes BS 822:1938, in which recommendations were given for terminal markings for different types of electrical machinery and apparatus. So that the information given may be more readily kept up-to-date the standard is being published in a number of parts, and this foreword is common to all parts. The order of the parts has no significance.

Since 1938 many of the BSI committees responsible for preparing specifications for electrical machinery and apparatus have either endorsed the recommendations of the 1938 edition of BS 822 or have prescribed terminal markings in the British Standards for the particular pieces of apparatus with which they are concerned. This revision collates for convenient reference the terminal markings specified in a number of current British Standards. When changes are made in the terminal markings specified in those British Standards, the corresponding parts of BS 822 will be revised.

The introduction of the previous edition outlined the general rules to be observed in allotting terminal markings. The rules are, in the main, still valid but are not reproduced in this edition of BS 822 on the grounds that the basis on which terminal markings for a particular type of apparatus are allotted is a matter for decision by the committee directly responsible for the British Standard for the apparatus.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. A.C. Generators and motors

The terminal markings in this section are applicable to small-power electric motors and generators of sizes covered by BS 5000, “*Rotating electrical machines of particular types or for particular applications*” Part 11 | “*The electrical performance of small-power electric motors and generators*”.

1 Primary terminals (whether stator or rotor)

NOTE For the purpose of the diagrams it is assumed the primary windings are on the stator.

a) Main letter markings¹⁾:

3-phase or 6-phase	A B C
2-phase	A B
single-phase (main windings)	A
single-phase motor (auxiliary windings)	Z
polyphase star connection when brought out	N

These letter markings or a combination of same are used alone in the following cases of single undivided windings without tappings:

permanently delta-connected (see Figure 1)	A B C
permanently Y-connected (see Figure 2)	A B C
permanently L-connected (see Figure 3)	A B AB
permanently connected main and auxiliary single-phase windings (see Figure 4)	A Z AZ

The letter markings are supplemented where necessary by suffix numbers or prefix letters.

b) **Suffix and prefix markings.** When the letter markings given in a) above are not sufficient for the identification of the terminals, suffix or prefix markings are used. Suffix numbers commence at unity²⁾ and are assigned in order of increasing rated voltage.

i) *Both winding ends brought out.* The terminals at the two ends of a phase winding carry the same letter and are distinguished from one another by suffixes, e.g. “1” and “2” (see Figure 5, Figure 6 and Figure 7).

NOTE 1 The terminals bearing letters with the lower suffix number are those which are to be connected together when a 3-phase single Y connection is required (see Figure 5a) or a 2-phase single L connection is required (see Figure 6).

NOTE 2 For a delta connection A1 should join B2, B1 should join C2 and C1 should join A2 (see Figure 5b).

ii) *Winding divided in sections.* When a winding is divided into independent sections, e.g. for a series-parallel operation, suffixes are used, viz. “1” (if necessary), “2”, “3”, etc. These are so assigned that when the sections of one phase winding are connected in series according to the natural sequence of suffixes of their terminal markings, the induced electromotive forces in the sections are additive (see Figure 8 and Figure 9).

iii) *6-phase untapped winding permanently star connected.* The terminals of opposite phases bear the same letter and are distinguished by the suffixes 1 and 2, the symbols being in phase sequence order (see Figure 10).

A1 C2 B1 A2 C1 B2

iv) *3-phase winding with one tapping per phase (one end brought out).* When a 3-phase winding has one tapping per phase and is permanently star or delta connected (e.g. for a change-pole machine³⁾), the suffixes “2” and “3” are used (see Figure 11 and Figure 12):

terminals for single star or delta winding	A3 B3 C3
tappings in corresponding phases (star, Figure 11 or delta, Figure 12)	A2 B2 C2

¹⁾ Where a manufacturer wishes to use identification colours for leads for manufacturing purposes, it is recommended that the colour markings given in Clause 7 should be adopted.

²⁾ In certain cases the suffix unity may become suppressed, see 1 b iv) and vii) (see Figure 11 and Figure 12).

³⁾ Where a centre tapping is made in the winding of a two-speed machine, reversed rotation obtains for a given change from one speed to another.

v) *3-phase winding with one tapping per phase (both ends brought out)*. When a 3-phase winding has one tapping per phase and both ends of each phase are brought out to provide both star and delta connections, the markings of each phase are as follows:

"A" phase	A1	A2	A3
"B" phase	B1	B2	B3
"C" phase	C1	C2	C3

A1 B1 C1 are the terminals to be connected together for single star connections, and A2 B2 C2 are the tappings (see Figure 13).

vi) *More than one complete 3-phase winding*. When there are two or three or more complete 3-phase primary windings (e.g. change-pole machine) the terminals of the several windings are distinguished from one another by a prefix number⁴⁾.

Where each winding is associated with a different speed, the prefix number should indicate the order of the speed, e.g. for a three-speed machine, 1 for low speed, 2 for medium and 3 for high (see Figure 14, Figure 15, Figure 16 and Figure 17).

Where any of the windings are sub-divided or are tapped, the suffixes described in Subclauses b)(i) and b) v) should be used if appropriate (see Figure 18).

vii) *2-phase windings*. Suffixes and prefixes are used in the same manner as for 3-phase windings, except that a common terminal is marked AB (see Figure 19 to Figure 24).

Where there are two or more complete 2-phase primary windings (e.g. a change-pole machine), the terminals of the several windings are distinguished from one another by a prefix number as indicated in Subclause b) vi).

viii) *Single-phase windings*. Suffixes and prefixes are used in the same manner as for 3-phase windings except that a common terminal is marked AZ: letter A is used for the main winding and letter Z for the auxiliary winding (see Figure 7 and Figure 9).

Where there are two or more complete single-phase primary windings (e.g. change-pole machine), the terminals of the several windings are distinguished from one another by a prefix number as indicated in Subclause b) vi) (see Figure 25).

c) **Interconnected terminals.**

i) When the interconnection between phases to form a star, delta, mesh or L connection is an internal one within the machine, and there are no tappings, the lettering of all the interconnected terminals is not marked with suffixes except in the case of a 6-phase winding or 2-phase mesh winding, and the lettering of the common terminal or terminals is as follows:

3-phase delta-connected (see Figure 1)	A B C
polyphase-star connected, when the neutral is brought out (see Figure 26)	N
2-phase L-connected (see Figure 3)	AB
2-phase mesh-connected, the symbols are in the order of phase sequence (see Figure 27)	A1 B1 A2 B2
6-phase, whether mesh or double-delta connected:	A1 C1 B1
the symbols are in the order of phase sequence (see Figure 28 and Figure 29)	A2 C1 B2
junction of single-phase main and auxiliary windings (see Figure 4)	AZ

ii) For a 3-phase delta-connected winding without tappings in which two interconnections are made internally and one left open, the markings are as follows:

B C CA AB

B and C are the ends left open (see Figure 30).

iii) For a 3-phase delta-connected winding with one tapping per phase in which two interconnections are made internally and one left open, the markings are as follows (see Figure 31):

terminals of delta winding B1 and C3 are the ends left open. B1 C3 CA AB
tappings, respectively, opposite to CA, to AB, and to B1 and C3 B2 C2 A2

⁴⁾ A prefix letter may be used as an alternative to the preferred prefix number.

d) **Mechanical rotation and phase sequence.** The direction of rotation of a motor or generator is that observed when looking at (facing) its driving or driven end respectively.

NOTE For double-ended motors or generators reference should be made to separate paragraph below.

Phase sequence is the time order in which the terminal voltages attain their maximum values of the same polarity.

The lettering of machine terminals is related to the windings only and can be associated with phase sequence only when considered in conjunction with the direction of rotation of the machine.

i) *Motors.* The terminals of single-speed 3-phase motors or change-pole motors having independent windings for each speed shall be so marked A, B and C⁵⁾ that when connected to a supply giving a terminal phase sequence in the order A, B, C, then the rotation will be clockwise.

NOTE With terminals so marked, counterclockwise rotation of the motor can be obtained when connected to the supply so that the phase sequence of the motor terminals is in the order C, B, A.

For a change-pole motor, having tapped windings, the terminals shall be so marked that clockwise rotation will be obtained when the winding arranged for the top speed is connected to a supply giving a terminal phase sequence in the order A, B, C.

Where change-pole motors are provided with special windings such that opposite rotations at different speeds is an inherent feature, these rotations shall be clearly indicated on the manufacturer's diagrams.

For single-phase motors, the terminal or lead markings shall be such that clockwise rotation is obtained when the terminals or leads marked A1 and Z1 are connected together.

ii) *Generators.* The terminal markings of 3-phase generators should be such that when the machine is driven with clockwise rotation the terminal phase sequence will be in the order A, B, C.

NOTE With terminals so marked, a generator driven with counterclockwise rotation will give a terminal phase sequence in the order C, B, A.

iii) *Double-ended motors and generators.* Where a machine may drive or be driven from either or both ends, the correspondence between lettering and rotation should be clearly indicated.

Machines which are suitable for only one direction of rotation shall have this direction of rotation clearly indicated on the machine, together with the phase sequence of terminals associated with this rotation.

2 Secondary terminals (whether stator or rotor)

NOTE For the purpose of the diagrams it is assumed the secondary windings are on the rotor.

a) Main letter markings:

3-phase or 6-phase (see Figure 32, Figure 33 and Figure 34)	D E F
2-phase (see Figure 35, Figure 36 and Figure 37)	D E
2-phase common terminal, if any (see Figure 35)	DE

b) **Suffix and prefix markings.** When the above letter markings are not sufficient for the identification of the terminals, suffix or prefix markings are used as in i) to vii) below.

NOTE The exciting or secondary winding of a synchronous induction motor is treated as an a.c. winding and the terminals are marked as above.

i) *Two similar 3-phase windings having six sliprings or terminals:*

for one system 1D 1E 1F

for the other system (see Figure 38 and Figure 39) 2D 2E 2F

ii) *Two similar 3-phase windings with four sliprings or terminals* 1D E 2D F

The letters E and F are assigned to the common rings or terminals (see Figure 40).

iii) *Two windings 120° (electrical) apart having four sliprings or terminals:*

for one phase D1 D2

for the other phase (see Figure 41) E1 E2

⁵⁾ NOTE Where the letters A, B, C appear in the text, the text applies to these letters with appropriate identical prefixes and/or suffixes.

iv) *3-phase winding star or delta-connected, with one tapping in each phase, e.g. for a change-pole machine:*

terminals of single star or delta windings	D3	E3	F3
--	----	----	----

tappings (see Figure 42 and Figure 43)	D2	E2	F2
--	----	----	----

v) *For a plurality of 3-phase windings* E.g. for a three-speed machine with three windings each connected to its own sliprings or terminals with one common slipring or terminal (see Figure 44).

Common slipring or terminal	D		
other sliprings or terminals	1E	1F	
	2E	2F	
	3E	3F	

vi) *6-phase winding, whether mesh- or star-connected, with six sliprings or terminals (see Figure 34 and Figure 45)*

D1	F2	E1
D2	F1	E2

vii) *2-phase windings:*

when L-connected having three sliprings or terminals (see Figure 35)	D	DE	E
--	---	----	---

when mesh-connected or with separate phases, having

four sliprings or terminals (see Figure 36 and Figure 37)	D1	E1	D2	E2
---	----	----	----	----

3 Excitation terminals

Marking used for windings receiving separate d.c. excitation are:

two terminal windings (see Figure 46 a)	X	XX	
more than two terminals (see Figure 46 b)	X1	X2	X3 etc.

In the case of synchronous-induction motors, the terminal markings of the excitation windings will be those which would be used if the machine were used as an induction motor (see Note to Subclause 2 b).

4 Capacitor terminals

a) Markings when used for the terminals of capacitors fitted to or used in conjunction with single-phase capacitor machines are:

one capacitor	K1	K2
two capacitors	K1	K2
	K3	K4

Terminal K3 is connected to terminal K1, when the capacitors are connected in parallel

Group of capacitors having three terminals only K1 K2 K3

K2 is the tap terminal; and, if one outer terminal only is used under running conditions, that terminal is marked K1.

b) When a capacitor forming an integral part of the motor apparatus is permanently connected in series with a winding of the motor and a lead for connection to control apparatus is brought out from the circuit at a point beyond the capacitor, the marking shall be that appropriate to the adjacent winding end rather than that appropriate to the capacitor.

5 Commutator machines

The types of a.c. commutator machines are so diverse that it is beyond the scope of this standard to prescribe a complete system of terminal markings for such machines. However, the rules given in this Section, which are applicable to other forms of a.c. machines may be used for guidance.

For universal motors see for example Figure 66 b.