IS 12032-6 (1987): Graphical symbols for diagrams in the field of electrotechnology, Part 6: Production and conversion of electrical energy [ETD 1: Basic Electrotechnical Standards]

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IS : 12032 (Part 6) - 1987
IEC Pub 617-6 (1983)

Indian Standard

GRAPHICAL SYMBOLS FOR DIAGRAMS IN THE FIELD OF ELECTROTECHNOLOGY

PART 6 PRODUCTION AND CONVERSION OF ELECTRICAL ENERGY

(IEC Title : Graphical Symbols for Diagrams — Part 6 : Production and Conversion of Electrical Energy)

UDC 621·3·061 : 003·62

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 9

November 1988

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GRAPHICAL SYMBOLS FOR DIAGRAMS IN THE FIELD OF ELECTROTECHNOLOGY

PART 6 PRODUCTION AND CONVERSION OF ELECTRICAL ENERGY

(IEC Title: Graphical Symbols for Diagrams — Part 6 : Production and Conversion of Electrical Energy)

Basic Electrotechnical Standards Sectional Committee, ETDC 1 [Ref : Doc : ETDC 1 (3053)]

National Foreword

This Indian Standard (Part 6) which is identical with IEC Pub 617-6 (1983) 'Graphical symbols for diagrams — Part 6: Production and conversion of electrical energy', issued by the International Electrotechnical Commission (IEC), was adopted by the Bureau of Indian Standards on the recommendation of the Basic Electrotechnical Standards Sectional Committee and approval of the Electrotechnical Division Council.

Cross Reference

International Standard	*Corresponding Indian Standard*
IEC Pub 76(1967) Power transformers	IS : 2026 Power transformers (in 4 parts)
IEC Pub 375(1972) Conventions concerning electric and magnetic circuits	IS : 9499-1980 Conventions concerning electric and magnetic circuits

Adopted 18 June 1987

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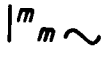
CHAPTER 1: QUALIFYING SYMBOLS FOR WINDING INTERCONNECTIONS

SECTION 1 – SEPARATE WINDINGS

No.	Symbol	Description
06-01-01		One winding *Notes 1.* – The number of separate windings should be indicated: – either by the number of strokes drawn, – or by adding a figure to the symbol.
06-01-02		*Examples:* Three separate windings
06-01-03		Six separate windings 2. – Symbol 06-01-01 may also be used to represent windings which can be externally connected in various ways.
06-01-04		*Examples:* Three-phase winding, phases not interconnected
06-01-05		*m*-phase winding, phases not interconnected
06-01-06		Two-phase winding, four-wire

SECTION 2 – INTERNALLY CONNECTED WINDINGS

2.1 The method of connecting *transformer* windings may also be indicated by codes. See IEC Publication 76: Power Transformers.

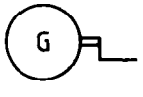
No.	Symbol	Description
06-02-01		Two-phase winding
06-02-02		Three-phase winding, V (60°)
06-02-03		Four-phase winding with neutral brought out
06-02-04		Three-phase winding, T
06-02-05		Three-phase winding, delta *Note.* – This symbol may be used to symbolize a multiphase polygon connection of windings by adding a figure to denote the number of phases.
06-02-06		Three-phase winding, open delta
06-02-07		Three-phase winding, star *Note.* – This symbol may be used to symbolize a multiphase star connection of windings by adding a figure to denote the number of phases.
06-02-08		Three-phase winding, star, with neutral brought out
06-02-09		Three-phase winding, zigzag or interconnected star
06-02-10		Six-phase winding, double delta
06-02-11		Six-phase winding, polygon
06-02-12		Six-phase winding, star
06-02-13		Six-phase winding, fork with neutral brought out

CHAPTER II: MACHINES

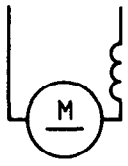
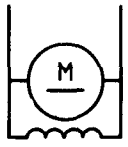
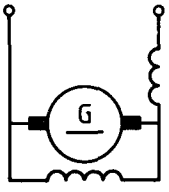
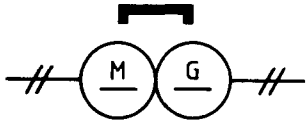
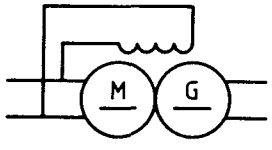
SECTION 3 – ELEMENTS OF MACHINES

No.	Symbol	Description
		Differentiation between windings having different functions
06-03-01		Commutating or compensating winding
06-03-02		Series winding
06-03-03		Shunt winding or separate winding
06-03-04		Brush (on slip-ring or commutator) *Note.* – Brushes are shown only if necessary. For example of application, see symbol 06-05-03.

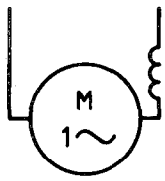
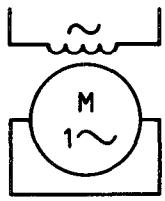
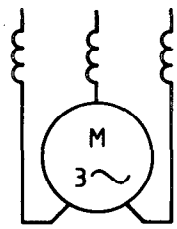
SECTION 4 – TYPES OF MACHINES

No	Symbol	Description
06-04-01		Machine, general symbol The asterisk * shall be replaced by a letter designation as follows: C synchronous converter G generator GS synchronous generator M motor MG machine capable of use as a generator or motor MS synchronous motor *Note.* – Symbols 02-02-01 and 02-02-04 may be added, as shown in Sections 5 to 8.
06-04-02		Linear motor, general symbol
06-04-03		Stepping motor, general symbol
06-04-04		Hand-generator (magneto caller)

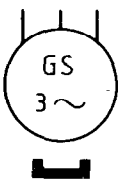
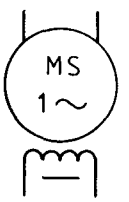
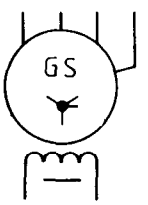
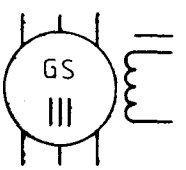
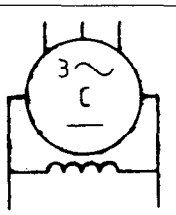
SECTION 5 – EXAMPLES OF DIRECT CURRENT MACHINES

No.	Symbol	Description
06-05-01		D.C. two-wire series motor
06-05-02		D.C. two-wire shunt motor
06-05-03		D.C. two-wire generator, compound excited, short shunt, shown with terminals and brushes
06-05-04		D.C. to d.c. rotary converter with common permanent magnet field (rotary transformer d.c./d.c. dynamotor)
06-05-05		D.C. to d.c. rotary converter with common field winding (rotary transformer d.c./d.c., dynamotor)

SECTION 6 – EXAMPLES OF ALTERNATING CURRENT COMMUTATOR MACHINES

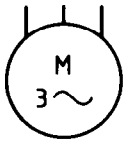
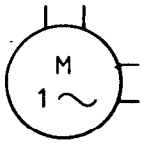
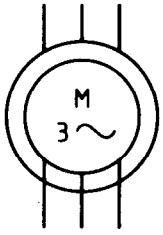
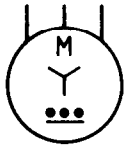
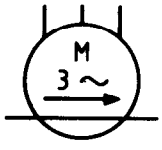
No.	Symbol	Description
06-06-01		A.C. series motor, single-phase
06-06-02		Repulsion motor, single-phase
06-06-03		A.C. series motor, three-phase

SECTION 7 – EXAMPLES OF SYNCHRONOUS MACHINES

No.	Symbol	Description
06-07-01		Synchronous generator, three-phase, permanent magnet
06-07-02		Synchronous motor, single-phase
06-07-03		Synchronous generator, three-phase, star-connected, with neutral brought out
06-07-04		Synchronous generator, three-phase, both leads of each phase brought out
06-07-05		Synchronous converter, three-phase, shunt excited

SECTION 8 – EXAMPLES OF INDUCTION TYPE (ASYNCHRONOUS) MACHINES

8.1 The general symbol for a machine (06-04-01) should be used to represent an asynchronous machine if no external connections to the rotor exist, for example in a squirrel cage motor. An inner circle, representing the rotor, should be shown in those cases where external connections exist, see for example symbol 06-08-03.

No.	Symbol	Description
06-08-01		Induction motor, three-phase, squirrel cage
06-08-02		Induction motor, single-phase, squirrel cage, leads of split phase brought out
06-08-03		Induction motor, three-phase, with wound rotor
06-08-04		Induction motor, three-phase, star-connected, with automatic starter in the rotor
06-08-05		Linear induction motor, three-phase, movement limited to one direction

CHAPTER III: TRANSFORMERS AND REACTORS

III.1 Two forms of symbol are shown for the same type of transformer:

- Form 1 uses a circle to represent each winding. Its use is preferably restricted to single-line representation.
  Symbols for transformer cores are not used with this form.

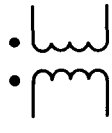
- Form 2 uses symbol 04-03-01 to represent each winding. The number of half-circles may be varied to differentiate between certain windings.

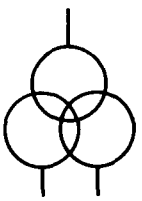
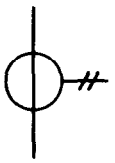
III.2 For the representation of transformer cores, see Note 2 with symbol 04-03-01.

III.3 In the case of symbols for current and pulse transformers, straight lines, representing windings may be used with either form.
See Section 13.

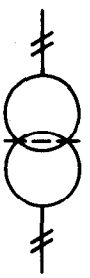
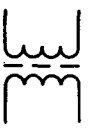
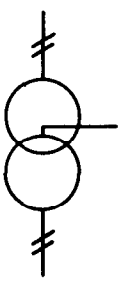
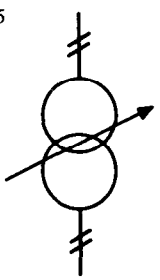
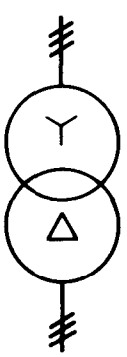
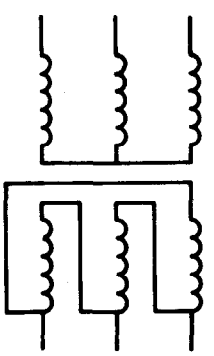
III.4 IEC Publication 375: Conventions Concerning Electric and Magnetic Circuits, gives a method of indicating the instantaneous voltage polarities of coupled electric circuits. For an example of application, see symbol 06-09-03.

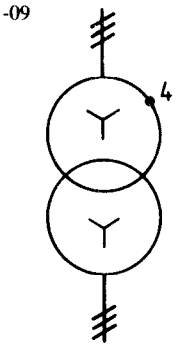
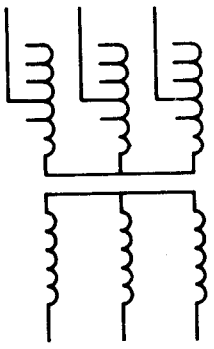
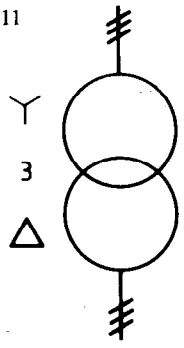
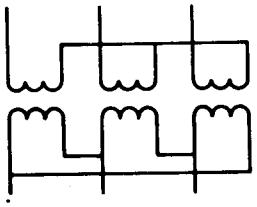
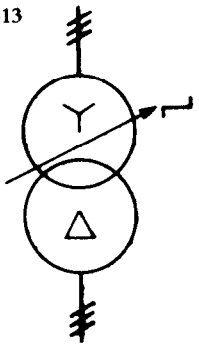
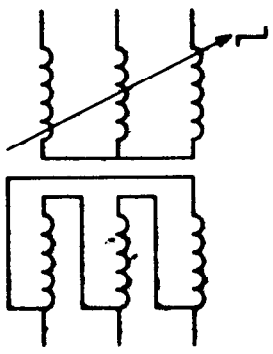
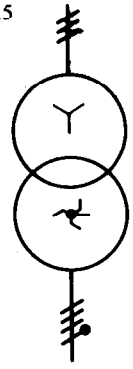
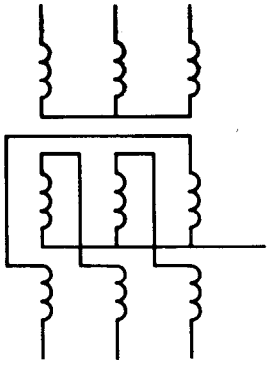
SECTION 9 - GENERAL SYMBOLS

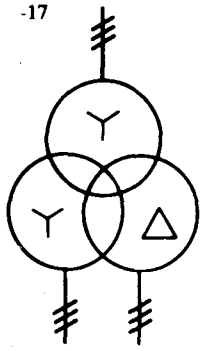
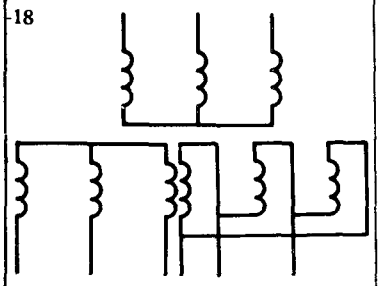
No.	Symbol		Description
	Form 1	Form 2	
06-09-01 06-09-02	-01 	02 	**Transformer with two windings**
06-09-03			*Note.* – The instantaneous voltage polarities may be indicated in form 2 of the symbol. *Example:* – Transformer with two windings, shown with instantaneous voltage polarity indicators Instantaneous currents entering the marked ends of the windings produce aiding fluxes

No.	Symbol		Description
	Form 1	Form 2	
06-09-04 06-09-05	-04 	-05 	Transformer with three windings
06-09-06 06-09-07	-06 	-07 	Auto-transformer
06-09-08 06-09-09	-08 	-09 Use symbol 04-03-01	Choke Reactor
06-09-10 06-09-11	-10 	-11 	Current transformer Pulse transformer

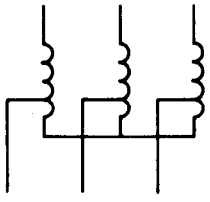
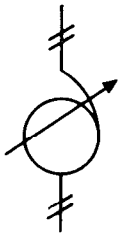
SECTION 10 – EXAMPLES OF TRANSFORMERS WITH SEPARATE WINDINGS

No.	Symbol		Description
	Form 1	Form 2	
06-10-01 06-10-02	-01 	-02 	Single-phase transformer with two windings and screen
06-10-03 06-10-04	-03 	-04 	Transformer with centre tapping on one winding
06-10-05 06-10-06	-05 	-06 	Transformer with variable coupling
06-10-07 06-10-08	-07 	-08 	Three-phase transformer, connection star-delta

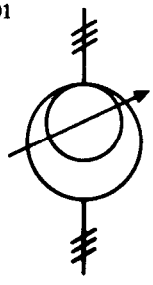
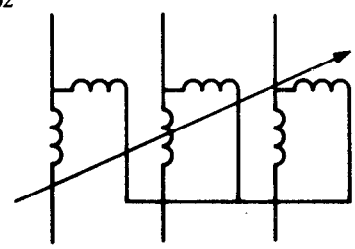
No.	Symbol		Description
	Form 1	Form 2	
06-10-09 06-10-10	-09 	-10 	Three-phase transformer with four tappings (main tapping not included), connection star-star
06-10-11 06-10-12	-11 	-12 	Three-phase bank of single-phase transformers, connection star-delta
06-10-13 06-10-14	-13 	-14 	Three-phase transformer with on-load tap changer, connection star-delta
06-10-15 06-10-16	-15 	-16 	Three-phase transformer, connection star-zigzag

No.	Symbol		Description
	Form 1	Form 2	
06-10-17 06-10-18	-17 	-18 	Three-phase transformer, connection star-star-delta

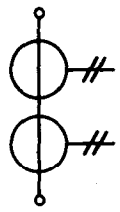
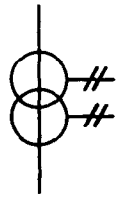
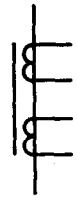
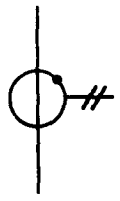
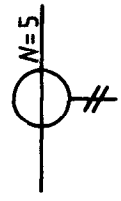
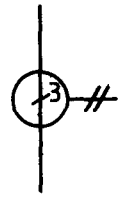
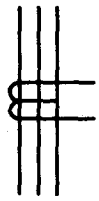
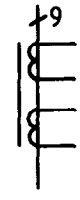
SECTION 11 – EXAMPLES OF AUTO-TRANSFORMERS

No.	Symbol		Description
	Form 1	Form 2	
06-11-01 06-11-02	-01 	-02 	Auto-transformer, single-phase
06-11-03 06-11-04	-03 	-04 	Auto-transformer, three-phase, connection star
06-11-05 06-11-06	-05 	-06 	Auto-transformer, single-phase with voltage regulation

SECTION 12 – EXAMPLES OF INDUCTION REGULATORS

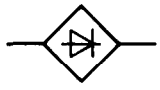
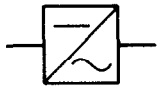
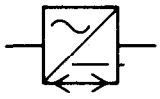
06-12-01 06-12-02	-01 	-02 	Three-phase induction regulator

SECTION 13 – EXAMPLES OF MEASURING TRANSFORMERS AND PULSE TRANSFORMERS

No.	Symbol		Description
	Form 1	Form 2	
06-13-01	Use appropriate symbol in Section 9		Voltage transformer
06-13-02 06-13-03	-02 	-03 	Current transformer with two cores and two secondary windings The terminal symbols shown at each end of the primary circuit indicate that only a single device is represented. *Note.* – In form 2, core symbols may be omitted.
06-13-04 06-13-05	-04 	-05 	Current transformer with two secondary windings on one core *Note.* – In form 2, the core symbol must be drawn.
06-13-06 06-13-07	-06 	-07 	Current transformer with one secondary winding with three tappings
06-13-08 06-13-09	-08 	-09 	Current transformer where the primary conductor forms five winding turns
06-13-10 06-13-11	-10 	-11 	Pulse or current transformer with one permanent winding and three threaded windings
06-13-12 06-13-13	-12 	-13 	Pulse or current transformer with two permanent windings on the same core and with nine threaded windings

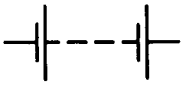
CHAPTER IV: POWER CONVERTERS

SECTION 14 – BLOCK SYMBOLS FOR POWER CONVERTERS

No.	Symbol	Description
06-14-01	Use symbol 02-17-06	Converter, general symbol
06-14-02		D.C. converter
06-14-03		Rectifier
06-14-04		Rectifier in full wave (bridge) connection
06-14-05		Inverter
06-14-06		Rectifier/inverter

CHAPTER V: PRIMARY CELLS AND ACCUMULATORS

SECTION 15 – PRIMARY CELLS AND ACCUMULATORS

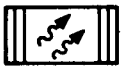
No.	Symbol	Description
06-15-01		Primary cell or accumulator *Note.* – The longer line represents the positive pole, the short line the negative pole. The short line may be thickened for emphasis.
06-15-02 Form 1		Battery of accumulators or primary cells
06-15-03 Form 2		*Note.* – Symbol 06-15-01 may also be used to indicate a battery, if there is no risk of confusion; otherwise, the voltage or the number and kind of cells should be indicated.

CHAPTER VI: POWER GENERATORS

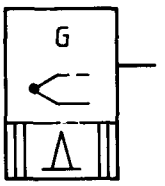
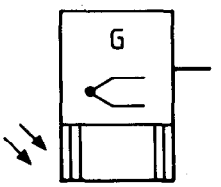
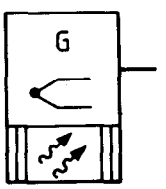
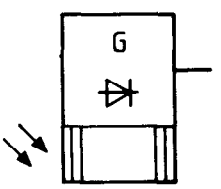
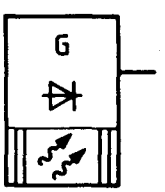
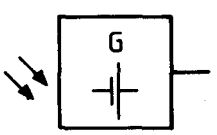
SECTION 16 – GENERAL SYMBOL

No.	Symbol	Description
06-16-01		Generator, general symbol *Note.* – For a rotating generator, use symbol 06-04-01.

SECTION 17 – HEAT SOURCES

No.	Symbol	Description
06-17-01		Heat source, general symbol
06-17-02		Radio-isotope heat source
06-17-03		Combustion heat source

SECTION 18 – EXAMPLES OF POWER GENERATORS

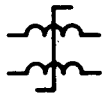
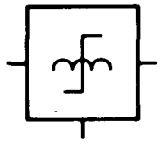
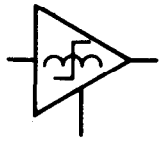
No.	Symbol	Description
06-18-01		Thermoelectric generator, with combustion heat source
06-18-02		Thermoelectric generator with non-ionizing radiation heat source
06-18-03		Thermoelectric generator with radio-isotope heat source
06-18-04		Thermionic diode generator with non-ionizing radiation heat source
06-18-05		Thermionic diode generator with radio-isotope heat source
06-18-06		Photovoltaic generator

APPENDIX A: OLDER SYMBOLS FOR TRANSDUCTORS AND MAGNETIC AMPLIFIERS

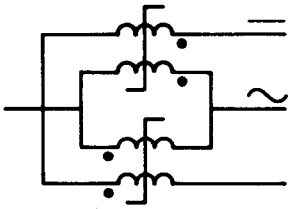
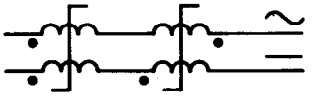
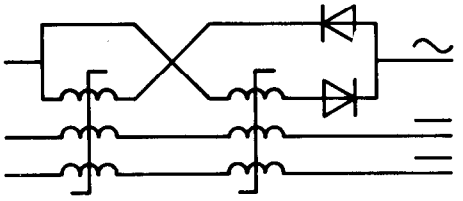
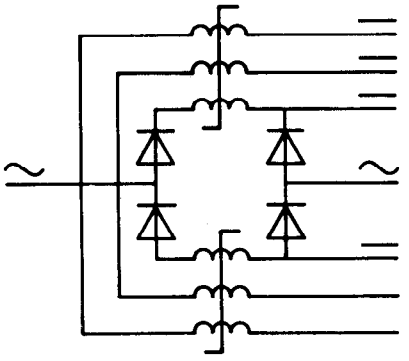
SECTION A1 – SYMBOL ELEMENTS AND BLOCK SYMBOLS

A1.1 Symbol 04-03-01 is used to represent the winding of a transductor.

A1.2 For distinction, the power windings and/or the leads to the power windings can be drawn thicker than the control or excitation windings. Alternatively, the number of half-circles for the power winding may be less than the number used for the control or excitation windings.

No.	Symbol	Description
06-A1-01		Transductor core *Note.* – This symbol indicates that the saturation properties of the core are being utilized. It shows at the same time the magnetic coupling between two or more windings.
06-A1-02		Transductor element shown with two windings and a common core
06-A1-03		Transductor, block symbol
06-A1-04		Magnetic amplifier, block symbol

SECTION A2 – EXAMPLES OF TRANSDUCTORS

No.	Symbol	Description
06-A2-01		Single-phase parallel transductor *Note.* – An increase of current entering the end of the control winding marked with a dot causes an increase in the power output.
06-A2-02		Single-phase series transductor *Note.* – The note with symbol 06-A2-01 applies.
06-A2-03		Self-exciting transductor with two control circuits
06-A2-04		Transductor with direct-current output with two control circuits

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