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ANSI Y32.1-1972

CSA Z99-1972)

IEEE Standard

American National Standard

Canadian Standard

Graphic Symbols for Electrical and Electronics Diagrams

(Including Reference Designation Letters)

Sponsor

IEEE Standards Coordinating Committee 11, Graphic Symbols

Secretariat for American National Standards Committee Y32

**American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers**

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IEEE Standards Board

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American National Standards Institute

Approved October 9, 1975
Canadian Standards Association

Approved Adopted for Mandatory Use October 31, 1975
Department of Defense, United States of America

IEEE Std 315-1975
(ANSI Y32.2-1975)
31 October, 1975

Acceptance Notice

The following Industry Standardization Document was adopted on 31 October 1975 for mandatory use by the DoD. The indicated industry groups have furnished the clearances required by existing regulations. Copies of the documents are stocked by DoD Single Stock Point, Naval Publications and Forms Center, Philadelphia, PA, 19120, for issue to military activities only.

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(b) 31 October, 1975

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(b) American National Standards Institute, Inc.

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Certain provisions of this standard are subject of International Standardization Agreement, ABC NAVY STD-28A, Symbols and Abbreviations for Electrical and Electronics Drawings, to which the U.S. Army also subscribes. When reaffirmations, amendment, revision, or cancellation of this standard is proposed which will effect or violate the international agreement concerned, the Military Coordinating Activity will take appropriate reconciliation action through military international standardization channels including departmental standardization offices, if required.

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Preface to CSA Standard Z99-1975 C11B

Graphic Symbols for Electrical and Electronics Diagrams

REXDALE, October 9, 1975

American National Standard Y32.2-1975 (IEEE Std 315-1975), with the modifications shown in Section 100, has been approved as CSA Standard Z99. This action was proposed by the Committee on Electrical Symbols, under the jurisdiction of the Sectional Committee on Abbreviations, Definitions and Symbols and was formerly approved by these Committees.

See Section 100, Canadian Standard Z99 modifications to American National Standard Y32.2-1975 on page 83.

NOTE: In order to keep abreast of progress in the industries concerned, CSA publications are subject to periodic review. Suggestions for improvement will be welcomed at all times. They will be recorded and in due course brought to the attention of the appropriate Committee for consideration.

Also, requests for interpretation will be accepted by the Committee. They should be worded in such a manner as to permit a simple “yes” or “no” answer based on the literal text of the requirement concerned.

All inquiries regarding this standard should be addressed to Canadian Standards Association, 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada.

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Approved September 4, 1975

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Foreword

(This foreword is not a part of American National Standard Graphic Symbols for Electrical and Electronics Diagrams, Y32.2-1975 [IEEE Std 315-1975])

This American National Standard is a revision and expansion of American National Standard Graphic Symbols for Electrical and Electronics Diagrams, Y32.2-1970 (IEEE Std 315-1971).

A variety of specialized symbols originally used for aircraft applications have been added to make this standard more comprehensive. To improve coordination with IEC publication 117, IEC approved versions of capacitor, transformer, delay, associated conductors and specialized ground symbols have been added as alternates to those long used and standardized in the United States. A number of small changes have made the existing material more closely parallel to IEC Publication 117. Symbols have been added to cover additional devices in the photo sensitive semiconductor and specialized semiconductor fields, as well as for an electronic flash lamp. Known errors have been corrected and some items have been clarified.

The reference designation class letters were revised to include the added new device symbols and to clarify the DS and LS categories. “D” is now listed as an alternate to the common “CR” for the common semiconductor diode family of devices.

All of the symbols are designed so that their connection points fall on a modular grid. This should help those who use a grid basis for the preparation of diagrams. By proper enlargement of the symbols the usual coordinate-grid sizes can be matched. Most symbols appearing in this standard were reproduced from original drawings prepared for the Mergenthaler Diagrammer.

A substantial effort has been made to have this American National Standard compatible with approved International Electrotechnical Commission (IEC) Recommendations (IEC Publication 117, in various parts). Electrical diagrams are a factor in international trade; the use of *one* common symbol language ensures a clear presentation and economical diagram preparation for a variety of users. Members of the preparing committee have been active in transmitting USA viewpoints to the cognizant IEC Technical Committee.

Alternative symbols are shown only in those cases where agreement on a common symbol could not be attained at this time. It is hoped that the number of alternative symbols will be reduced in future editions.

The symbols in this standard represent the best consensus that can be attained at this time. Standardization, however, must be dynamic, not static, and any solution of a problem should be tested through use and revised if necessary. It is anticipated that the contents of this standard will be modified as future needs dictate; such modifications will be made available through the issuance of approved supplements. Suggestions for improvement are welcomed. They should be addressed to:

Secretary, IEEE Standards Board
Institute of Electrical and Electronics Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

This standard has been prepared by the Institute of Electrical and Electronics Engineers (IEEE) Standards Coordinating Committee for Letter and Graphic Symbols (SCC 11), acting for the Y32.2 Task Group on Graphic Symbols for Electrical and Electronics Diagrams of the American National Standards Committee Y32, Graphic Symbols and Designations. There has been close cooperation between the industry and DOD representatives to provide one standard that can be universally used, rather than separate documents with their tendency to differ in various respects. While credit for this accomplishment is due all participants and the organizations they represent, particular mention is given to the U.S. Department of Defense, without whose strong support in reaching the objective—standard symbols acceptable to both industry and the military departments—the effort would not have succeeded.

This standard is complemented by a number of related standards listed in Section 23.

The American National Standards Committee on Graphic Symbols and Designations, Y32, had the following personnel at the time it approved this standard:

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The Task Group on Graphic Symbols, Y32.2, which revised and processed this standard, had the following personnel:

C. A. Fricke*, *Chair*
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H. L. Cook	R. Legg*	R. M. Stern*
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The IEEE Subcommittee on Graphic Symbols, SCC 11.1, and the IEC Experts Subcommittee, SCC 11.6, had the following membership:

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C. A. Fricke, *Chair pro tem, SCC 11.6*

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* Member of Y32.2 Editorial Committee.

‡ Retired.

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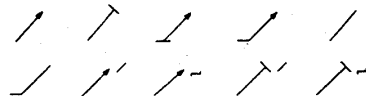
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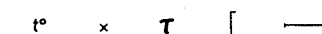
Quick Reference to Symbols

1. Qualifying Symbols

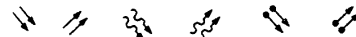
1.1 Adjustability Variability



1.2 Special-Property Indicators



1.3 Radiation Indicators



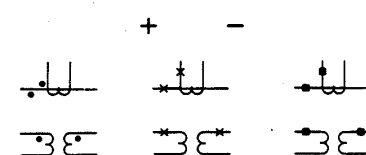
1.4 Physical State Recognition Symbols



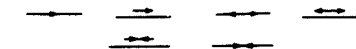
1.5 Test-Point Recognition Symbol



1.6 Polarity Markings



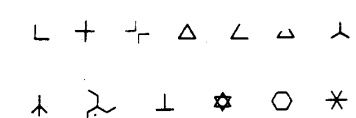
1.7 Direction of Flow of Power, Signal, or Information



1.8 Kind of Current



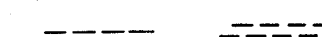
1.9 Connection Symbols



1.10 Envelope Enclosure



1.11 Shield Shielding



1.12 Special Connector or Cable Indicator

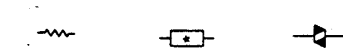


1.13 Electret

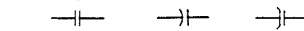


2. Fundamental Items

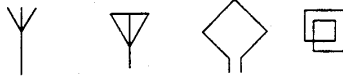
2.1 Resistor



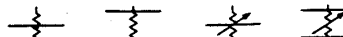
2.2 Capacitor



2.3 Antenna



2.4 Attenuator



2.5 Battery



2.6 Delay Function Delay Line Slow-Wave Structure



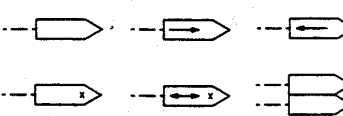
2.7 Oscillator Generalized Alternating-Current Source



2.8 Permanent Magnet



2.9 Pickup Head



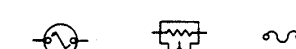
2.10 Piezoelectric Crystal Unit



2.11 Primary Detector Measuring Transducer



2.12 Squib, Electrical



2.13 Thermocouple



2.14 Thermal Element Thermomechanical Transducer



2.15 Spark gap Igniter gap



2.16 Continuous Loop Fire Detector (temperature sensor)

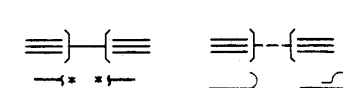
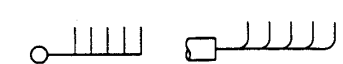
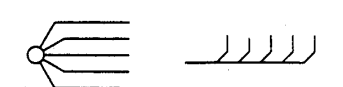
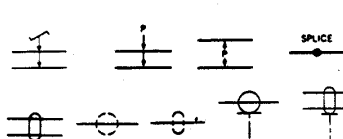
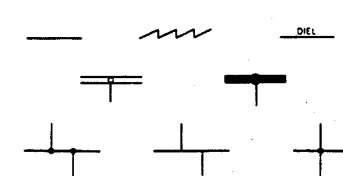


2.17 Ignitor Plug

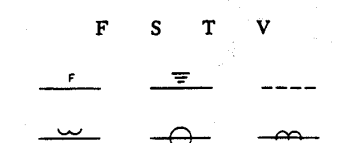


3. Transmission Path

3.1 Transmission Path Conductor Cable Wiring



3.2 Distribution lines Transmission lines



3.3 Alternative or Conditioned Wiring



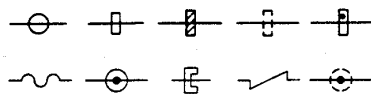
3.4 Associated or Future



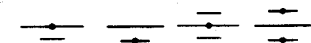
3.5 Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications



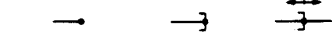
3.6 Waveguide



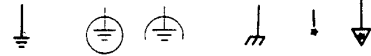
3.7 Strip-Type Transmission Line



3.8 Termination



3.9 Circuit Return

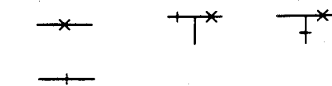


3.10 Pressure-Tight Bulkhead Cable Gland Cable Sealing End

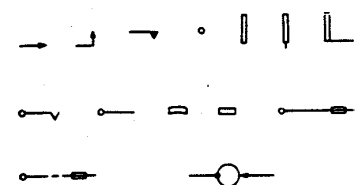


4. Contacts, Switches, Contactors, and Relays

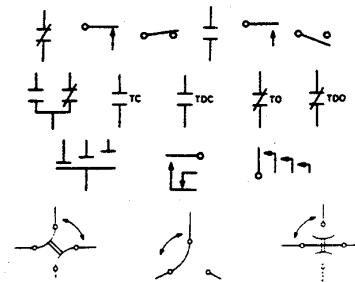
4.1 Switching Function



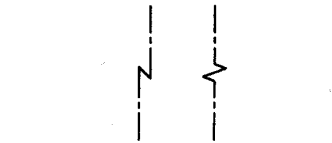
4.2 Electrical Contact



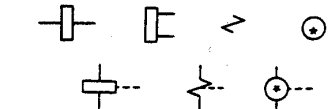
4.3 Basic Contact Assemblies



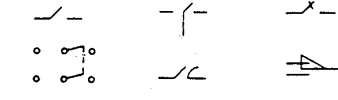
4.4 Magnetic Blowout Coil



4.5 Operating Coil Relay Coil



4.6 Switch



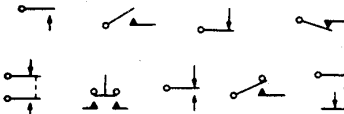
4.7 Pushbutton, Momentary or Spring-Return



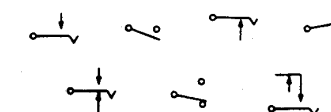
4.8 Two-Circuit, Maintained or Not Spring-Return



4.9 Nonlocking Switch, Momentary or Spring-Return



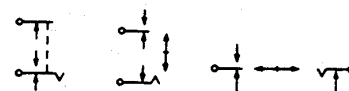
4.10 Locking Switch



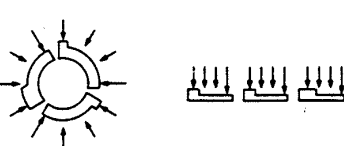
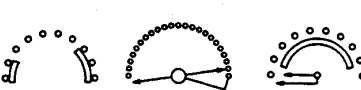
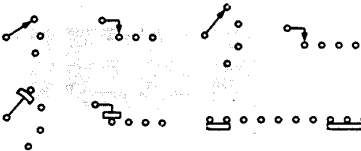
4.11 Combination Locking and Non-locking Switch



4.12 Key-Type Switch Lever Switch



4.13 Selector or Multiposition Switch



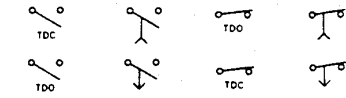
4.14 Limit Switch Sensitive Switch



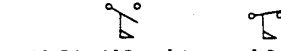
4.15 Safety Interlock



4.16 Switches with Time-Delay Features



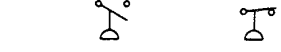
4.17 Flow-Actuated Switch



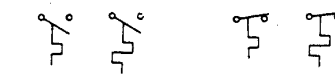
4.18 Liquid-Level-Actuated Switch



4.19 Pressure- or Vacuum-Actuated Switch



4.20 Temperature-Actuated Switch



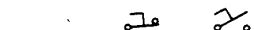
4.21 Thermostat



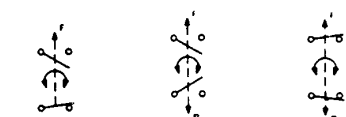
4.22 Flasher Self-interrupting switch



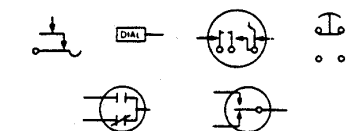
4.23 Foot-Operated Switch Foot Switch



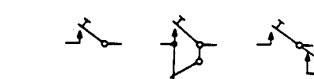
4.24 Switch Operated by Shaft Rotation and Responsive to Speed or Direction



4.25 Switches with Specific Features



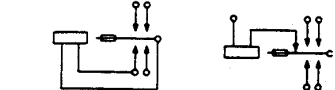
4.26 Telegraph Key



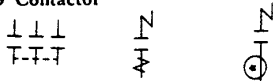
4.27 Governor Speed Regulator



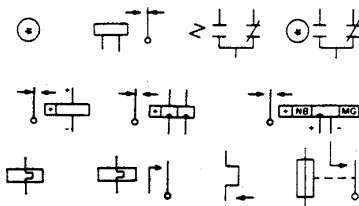
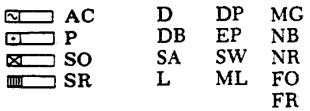
4.28 Vibrator Interrupter



4.29 Contactor



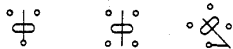
4.30 Relay



4.31 Inertia Switch



4.32 Mercury Switch

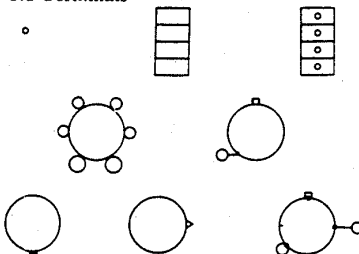


4.33 Aneroid Capsule



Terminals and Connectors

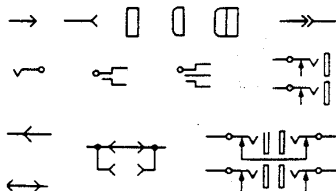
5.1 Terminals



5.2 Cable Termination



5.3 Connector Disconnecting Device



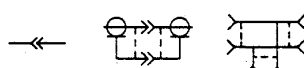
5.4 Connectors of the Type Commonly Used for Power-Supply Purposes



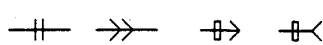
5.5 Test Blocks



5.6 Coaxial Connector

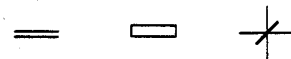


5.7 Waveguide Flanges Waveguide junction



6. Transformers, Inductors, and Windings

6.1 Core



6.2 Inductor Winding Reactor

Radio frequency coil
Telephone retardation coil

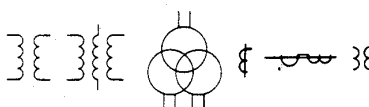
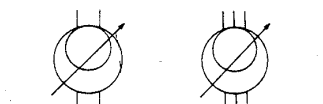
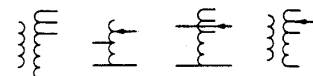
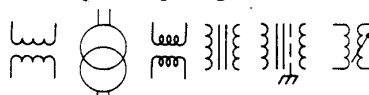


6.3 Transducer



6.4 Transformer

Telephone induction coil
Telephone repeating coil

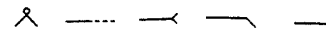
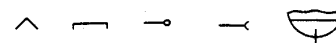


6.5 Linear Coupler



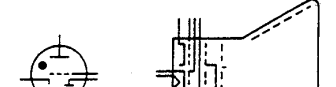
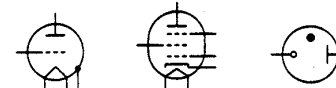
7. Electron Tubes and Related Devices

7.1 Electron Tube

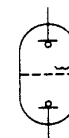


7.2 General Notes

7.3 Typical Applications



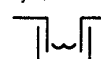
7.4 Solion Ion-Diffusion Device



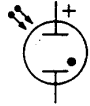
7.5 Coulomb Accumulator Electrochemical Step-Function Device



7.6 Conductivity cell



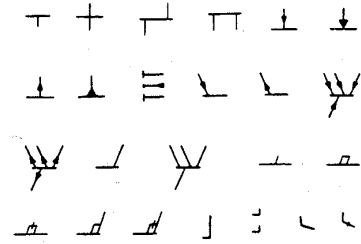
7.7 Nuclear-Radiation Detector Ionization Chamber Proportional Counter Tube Geiger-Müller Counter Tube



8. Semiconductor Devices

8.1 Semiconductor Device Transistor Diode

8.2 Element Symbols

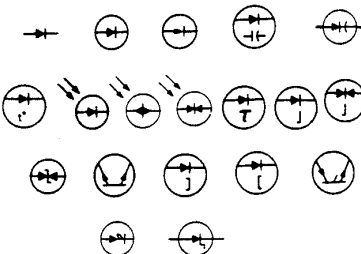


8.3 Special Property Indicators

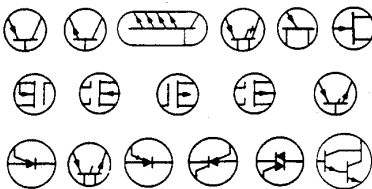


8.4 Rules for Drawing Style 1 Symbols

8.5 Typical Applications: Two-Terminal Devices



8.6 Typical Applications: Three- (or More) Terminal Devices



8.7 Photosensitive Cell



8.8 Semiconductor Thermocouple



8.9 Hall Element Hall Generator



8.10 Photon-coupled isolator

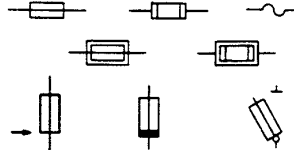


8.11 Solid-state-thyatron



9. Circuit Protectors

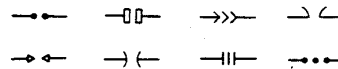
9.1 Fuse



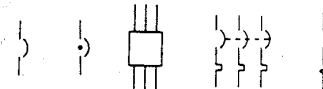
9.2 Current Arrester



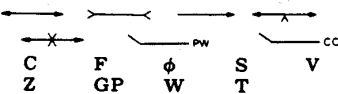
9.3 Lightning Arrester Arrester Gap



9.4 Circuit Breaker

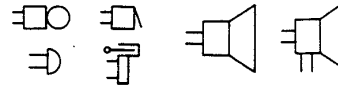


9.5 Protective Relay



10. Acoustic Devices

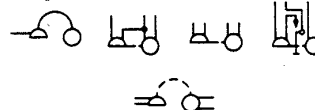
10.1 Audible-Signaling Device



10.2 Microphone



10.3 Handset Operator's Set

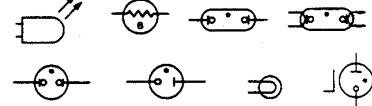


10.4 Telephone Receiver Earphone Hearing-Aid Receivers

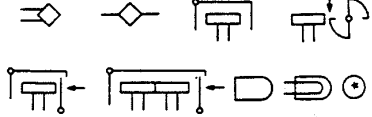


11. Lamps and Visual-Signaling Devices

11.1 Lamp

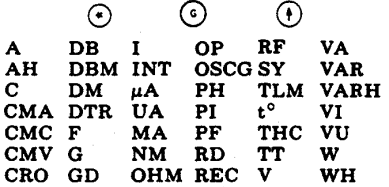


11.2 Visual-Signaling Device



12. Readout Devices

12.1 Meter Instrument

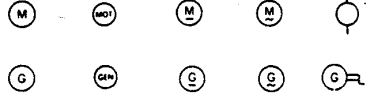


12.2 Electromagnetically Operated Counter Message Register



13. Rotating Machinery

13.1 Rotating Machine



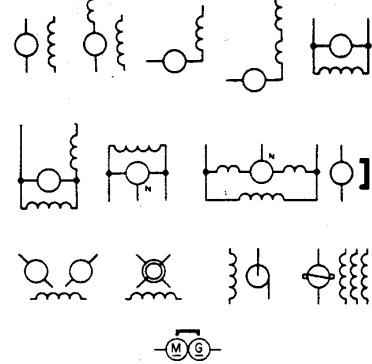
13.2 Field, Generator or Motor



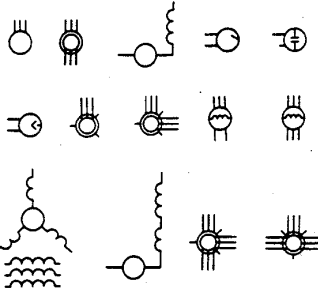
13.3 Winding Connection Symbols



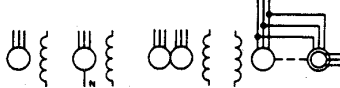
13.4 Applications: Direct-Current Machines



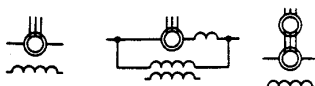
13.5 Applications: Alternating-Current Machines



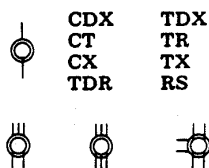
13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation



13.7 Applications: Alternating- and Direct-Current Composite

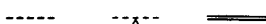


13.8 Synchro

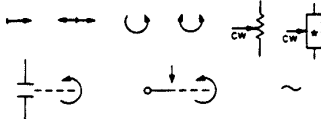


14. Mechanical Functions

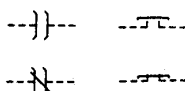
14.1 Mechanical Connection Mechanical Interlock



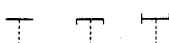
14.2 Mechanical Motion



14.3 Clutch Brake

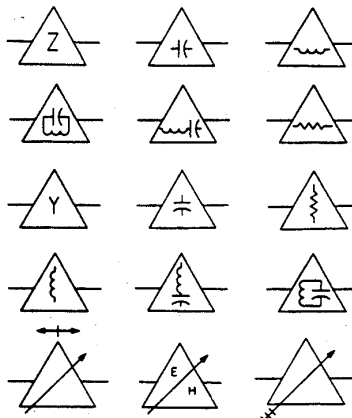


14.4 Manual Control

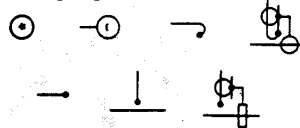


15. Commonly Used in Connection with VHF, UHF, SHF Circuits

15.1 Discontinuity



15.2 Coupling



15.3 Directional Coupler



15.4 Hybrid Directionally Selective Transmission Devices



15.5 Mode Transducer



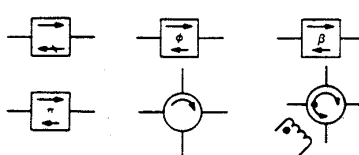
15.6 Mode Suppression



15.7 Rotary Joint



15.8 Non-reciprocal devices



15.9 Resonator Tuned Cavity



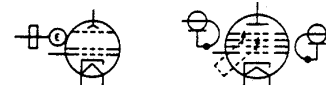
15.10 Resonator (Cavity Type) Tube



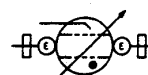
15.11 Magnetron



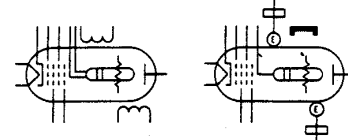
15.12 Velocity-Modulation (Velocity-Variation) Tube



15.13 Transmit-Receive (TR) Tube



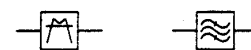
15.14 Traveling-Wave-Tube



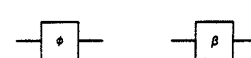
15.15 Balun



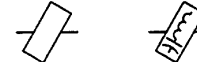
15.16 Filter



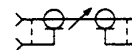
15.17 Phase shifter



15.18 Ferrite bead rings



15.19 Line stretcher



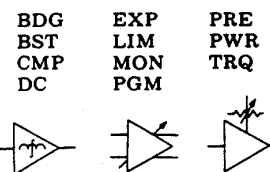
16. Composite Assemblies

16.1 Circuit assembly Circuit subassembly Circuit element



EQ	FL-BP	RG	TPR
FAX	FL-HP	RU	TTY
FL	FL-LP	DIAL	CLK
FL-BE	PS	TEL	IND
ST-INV			

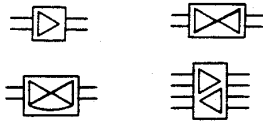
16.2 Amplifier



16.3 Rectifier



16.4 Repeater



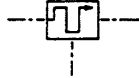
16.5 Network



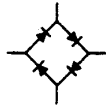
16.6 Phase Shifter Phase-Changing Network



16.7 Chopper



16.8 Diode-type ring demodulator Diode-type ring modulator



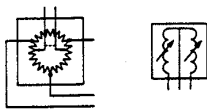
16.9 Gyro Gyroscope Gyrocompass



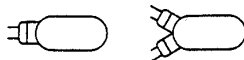
16.10 Position Indicator



16.11 Position Transmitter



16.12 Fire Extinguisher Actuator Head

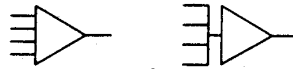


17. Analog Functions

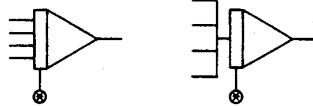
17.1 Operational Amplifier



17.2 Summing Amplifier



17.3 Integrator



17.4 Electronic Multiplier



17.5 Electronic Divider



17.6 Electronic Function Generator



17.7 Generalized Integrator



17.8 Positional Servo-mechanism



17.9 Function Potentiometer

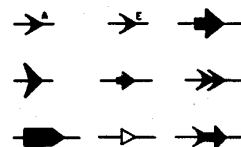


18. Digital Logic Functions

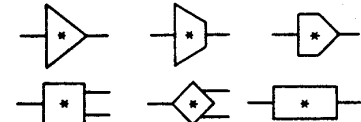
18.1 Digital Logic Functions (See cross references)

19. Special Purpose Maintenance Diagrams

19.1 Data flow code signals

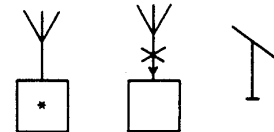


19.2 Functional Circuits

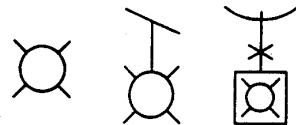


20. System Diagrams, Maps and Charts

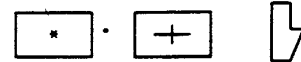
20.1 Radio station



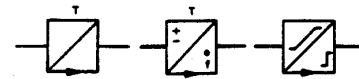
20.2 Space station



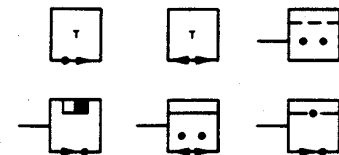
20.3 Exchange equipment



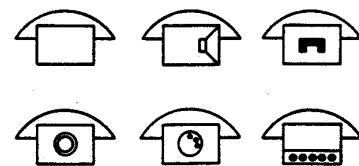
20.4 Telegraph repeater



20.5 Telegraph equipment



20.6 Telephone set

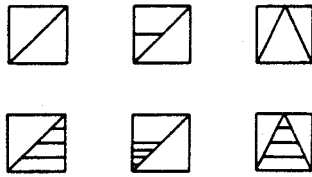


21. System Diagrams, Maps and Charts

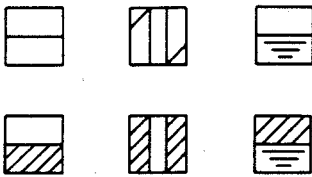
21.1 Generating station



21.2 Hydroelectric generating station



21.3 Thermoelectric generating station



21.4 Prime mover



21.5 Substation



22. Class Designation Letters

A	DS	J	PU	TP
AR	E	K	Q	TR
AT	EQ	L	R	U
B	F	LS	RE	V
BT	FL	M	RT	VR
C	G	MG	RV	W
CB	H	MK	S	WT
CP	HP	MP	SQ	X
CR	HR	MT	SR	Y
D	HS	N	T	Z
DC	HT	P	TB	
DL	HY	PS	TC	

IEEE Standard
American National Standard
Canadian Standard

Graphic Symbols for Electrical and Electronics Diagrams

(Including Reference Designation Letters)

Introduction

A1. Scope

A1.1 Purpose

This standard provides a list of graphic symbols and class designation letters for use on electrical and electronics diagrams.

A1.2 Definition and Use

Graphic symbols for electrical engineering are a shorthand used to show graphically the functioning or interconnections of a circuit. A graphic symbol represents the *function* of a part in the circuit.¹ Graphic symbols are used on single-line (one-line) diagrams, on schematic or elementary diagrams, or, as applicable, on connection or wiring diagrams. Graphic symbols are correlated with parts lists, descriptions, or instructions by means of designations.

The class designation letter portion of a reference designation is for the purpose of identifying an item by category or class, using a class letter as defined in Section 22 of this standard. The assignment of the reference designation should

¹For example, when a lamp is employed as a nonlinear resistor, the nonlinear resistor symbol is used. For reference designation information, see Section 22 of this standard.

be in accordance with American National Standard Reference Designations for Electrical and Electronics Parts and Equipment, Y32.16-1975 (IEEE Std 200-1975).

A2. Arrangement

A2.1 Indexing, Grouping, and Standard Item Names

All terms appear in the Index. In the index, “Item” refers to a numbered paragraph in the list of symbols. Items are arranged sectionally in family groups by general type. Terms in preferred usage and current alternatives are listed.  indicates item names from the Federal Item Identification Guide, Cataloging Handbook H6-1 (published by the Defense Supply Agency, Defense Logistics Services Center, Battle Creek, Michigan).

A2.2 Significance of Columnar Placement of Symbols

In the list, graphic symbols appear under their respective family names. Symbols for single-line (one-line) diagrams appear at the left in each column; symbols for complete diagrams appear at the right. Symbols suitable for all types of diagrams appear in the center.

Symbols appearing only at the right may be used on one-line diagrams provided connections are restricted to main signal paths. Symbols appearing at the left may be used for other diagrams provided all connections are shown and adequate notations are included, if needed.

A2.3 IEC Identification

Symbols and buildups using symbols that have been recommended by the International Electrotechnical Commission are indicated by .

A2.4 Alternative Symbols

When alternative symbols are shown, the relative position of the symbols does not imply a preference; however, alternative symbols identified as  are recommended.

A3. Application

A3.1 Generation of Symbols Not Shown (Buildups)

An application is an example of a combination of symbols in the list. No attempt has been made to list all possible applications (buildups); typical applications usually have been shown using only one of the possible alternatives. Additional applications may be devised using basic symbols in the list to complete the buildup, provided they are a reasonable and intelligible use of the symbols. If a specific symbol appears in this standard for an item, however, it shall be used in lieu of buildup symbols of the individual elements unless a clarification of the internal operation of the item is necessary.

A3.2 Qualifying Symbols (Section 1)

Qualifying symbols may be added to symbols if the special characteristic is important to the function of the device and aids in the understanding of the over-all function performed. When the special characteristic represented by the qualifying symbol is not important to the over-all function performed, the qualifying symbol may be omitted from the buildup symbols which appear in this standard, provided the absence of the qualifying symbol will not change the identity of the item. For example, see symbol 2.1.12.1.1.

A3.3 Application Data Reference

For application of these symbols on electrical diagrams, see American National Standard Drafting Practices; Electrical and Electronics Diagrams, Y14.15-1966 (R1973).

A3.4 Graphic Symbols and Class Designation Letters Used in Existing Technical Documents

Unless otherwise specified, when revising an existing document use the most recently approved graphic symbols and reference designation class letters for any new symbols to be added to that document. Superseded symbols and reference designations already appearing in the document and in accordance with former additions of this standard may remain.

A3.5 Similar or Identical Graphic Symbols, Letter Combinations, and Notations

Graphic symbols in this document may be similar or identical to symbols with different meanings used (1) in diverse fields within this standard or (2) in standards adopted by other technologies. Only one meaning shall apply to a specific symbol used on a diagram. If symbols having multiple meanings must be used on a diagram the possibility of conflicts and misinterpretations can be minimized by the liberal use of caution notes, asterisks, and flagging techniques; a tabulation listing the intended meanings should be provided. This requirement is especially critical if the graphic symbols used are from different disciplines and therefore represent devices, conductors, or lines of flow that if misinterpreted may result in damage to the equipment or be hazardous to the life of servicing or operating personnel.

A4. Drafting Practices Applicable to Graphic Symbols

A4.1 Definitions

A4.1.1 Single-Line (One-Line) Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

A4.1.2 Schematic or Elementary Diagram: A diagram which shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component device or parts.

A4.1.3 Symbol: A symbol shall be considered as the aggregate of all its parts.

A4.2 Orientation

Except where noted, the orientation of a symbol on a drawing, including a mirror-image presentation, does not alter the meaning of the symbol. Letters and numbers that constitute a part of a symbol shall not be presented in mirror-image form.

A4.3 Line Width

The width of a line does not affect the meaning of the symbol. In specific cases, a wider (heavier) line may be used for emphasis.

A4.4 Enlargement or Reduction

A symbol may be drawn to any proportional size that suits a particular drawing, depending on reduction or enlargement anticipated. If essential for purposes of contrast, some symbols may be drawn relatively smaller than the other symbols on a diagram. It is recommended that only two sizes be used on any one diagram.

A4.5 Relative Symbol Size²

The symbols shown in this edition of the standard are in their correct relative size. This relationship shall be maintained as nearly as possible on any particular drawing, regardless of the size of the symbol used.

A4.6 Arrowheads

The arrowhead of a symbol may be closed $\longrightarrow$ or open $\rightarrow$ unless otherwise noted in this standard.

A4.7 Terminal Symbols

The standard symbol for a TERMINAL (O) may be added to each point of attachment of connecting lines to any one of the graphic symbols. Such added terminal symbols should not be considered as part of the individual graphic symbol, unless the terminal symbol is included in the symbol shown in this standard.

A4.8 Correlation of Symbol Parts

For simplification of a diagram, parts of a symbol for a device, such as a relay or contactor, may be separated. If this is done, provide suitable designations to show proper correlation of the parts.

A4.9 Angle of Connecting Lines

In general, the angle at which a connecting line is brought to a graphic symbol has no particular significance unless otherwise noted or shown in this standard.

A4.10 Future or Associated Paths and Equipment

Associated or future paths and equipment shall be shown by lines composed of short dashes:- - -. For example:



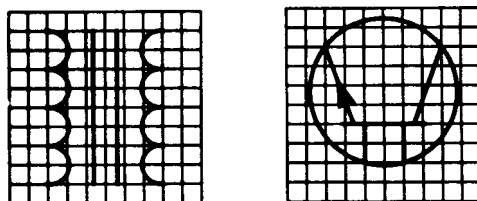
A4.11 Envelope or Enclosure

A4.11.1

The envelope or enclosure symbol shall be used:

- a) If the enclosure has an essential operating function, as in an electron tube, solenoid, switch in an evacuated envelope, etc.

²The symbols shown in this edition of the standard are larger in size than those shown in the 1967 edition. All of the symbols have been prepared so that the connection points are located at intersections of a modular (incremental) grid.



- b) If the device envelope is electrically connected to one of the device elements and this is an essential (not merely incidental) functional property of the device.

A4.11.2

The envelope or enclosure symbol should be used:

- a) To emphasize that certain symbols having nonconnected lines are a single assembly (for example, see symbol 8.6.10.5).
- b) If it is desired to distinguish a class of devices, such as transistors or semiconductor controlled rectifiers, from other devices (but this should be consistent for all devices of the same class on any one diagram).
- c) To associate the parts of symbols having adjacent characteristic qualifiers (for example: t° , τ , ω , $\times$).

A4.11.3

The envelope or enclosure symbol may be omitted from a symbol referencing this paragraph, where confusion would not result (but this should be consistently applied to all symbols of the same class in any one diagram).

A4.12 Addition of Supplementary Data

Details of type, impedance, rating, etc, may be added adjacent to any symbol, when required. If used, abbreviations should be from American National Standard Abbreviations for Use on Drawings and in text, Y1.1-1972. For military applications, see Section 23. Letter combinations used as parts of graphic symbols are not abbreviations or designations.

Recommendations for corrections and additions to or deletions from this standard should be sent to the Secretary, IEEE Standards Board, Institute of Electrical and Electronics Engineers, 345 East 47 Street, New York, N.Y. 10017, and should include the following:

- 1) Requestor (name, address, affiliation)
- 2) Reason for (and urgency of) request
- 3) Item name—list all known names for the item, including tradenames (include Federal Item Identification Guide, Handbook H6-1, listing if applicable)
- 4) Item definition (list source documents)
- 5) Symbols currently in use or known to be used (single-line/schematic/both)
- 6) Proposed symbol
- 7) Reference designation class designation letter
- 8) Areas of application (military/industry/commercial)
- 9) Fields of application (computer/power/radio, etc)
- 10) Circuit application (amplifier/rectifier/flip-flop, etc)
- 11) Hardware characteristics (microcircuit/conventional, etc)
- 12) Present and anticipated frequency of use (per circuit/per equipment/in general)
- 13) Copy of drawing showing use of symbol

1. Qualifying Symbols

1.1 Adjustability Variability

These recognition symbols shall be drawn at about 45 degrees across the body of symbol to which they are applied. For typical applications, see symbols 2.1.5, 2.2.4, 2.4.4, and 16.2.5.

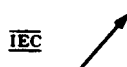
Use only if essential to indicate special property.

NOTES:

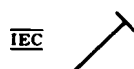
- 1 — See introduction for general information (note especially A3.1).
- 2 — Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.
- 3 — For centered figures with symbols appearing side by side, the symbol on the left-hand side should be considered to be for a single line (one-line) diagram and the symbol on the right-hand side for a complete diagram, i.e., 1.5.1.

1.1.1 Adjustability (extrinsic adjustability)

1.1.1.1 General



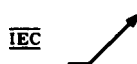
1.1.1.2 Preset, general



1.1.1.3 Linear (shown applied to 1.1.1.1)

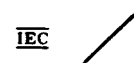


1.1.1.4 Nonlinear (shown applied to 1.1.1.1)

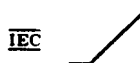


1.1.2 Inherent variability (intrinsic variability)

1.1.2.1 Linear

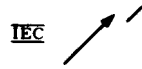


1.1.2.2 Nonlinear

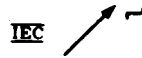


1.1.3 Special features (shown applied to the general adjustability symbol)

1.1.3.1 Continuous

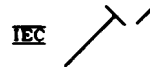


1.1.3.2 In steps

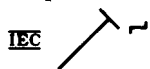


1.1.4 Special features (shown applied to the general preset symbol)

1.1.4.1 Continuous



1.1.4.2 In steps



1.2 Special-Property Indicators

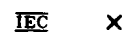
A special function or property essential to circuit operation shall be indicated by a supplementary symbol placed within the envelope or adjacent to the symbol.

NOTE — 1.2A: Basic symbols (such as resistor, capacitor, inductor, piezoelectric crystal, etc) may be used as qualifying symbols to other symbols for purposes of indicating special properties of the device.

1.2.1 Temperature dependence



1.2.2 Magnetic-field dependence

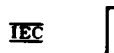
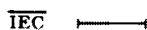


1.2.3 Storage (Greek letter tau)



1.2.4 Saturable properties (general)

May be drawn between or across two or more windings (see symbol 6.3.1) that are magnetically coupled by a saturable core.

**1.2.5 Delay****1.3 Radiation Indicators (electromagnetic and particulate)**

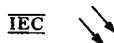
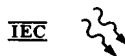
Use only if essential to indicate special property.

NOTES:

1.3A — Arrows pointing toward a symbol denote that the device symbolized will respond to incident radiation of the indicated type.

1.3B — Arrows pointing away from a symbol denote the emission of the indicated type of radiation by the device symbolized.

1.3C — Arrows located within a symbol denote a self-contained radiation source.

1.3.1 Radiation, nonionizing, electromagnetic (e.g., radio waves or visible light)**1.3.2 Radiation, ionizing**

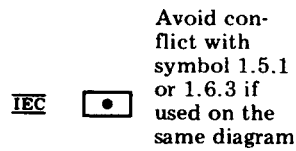
NOTE — 1.3.2A: If it is necessary to show the specific type of ionizing radiation, the symbol may be augmented by the addition of symbols or letters such as the following IEC:

Alpha particle	α
Beta particle	β
Gamma ray	γ
Deuteron	d
Proton	p
Neutron	n
Pion	π
K-meson	τ
Muon	K
X-ray	X

1.4 Physical State Recognition Symbols

NOTE — 1.4A: The rectangle is not part of the symbol.

1.4.1 Gas (air); pneumatic



See Note 1.4A

1.4.2 Liquid



See Note 1.4A

1.4.3 Solid



See Note 1.4A

1.4.4 Showing two or more states

Use only if essential to indicate special condition.

NOTES:

1.4.4A — A combination of physical state recognition symbols indicates a material in more than one state. The relative sizes and locations of the recognition symbols indicate the normal or predominant state of the device.

1.4.4B — Do not rotate or show in mirror-image form.

1.4.4.1 Application: Gaseous liquid



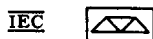
See Notes 1.4.4A and B

1.4.4.2 Application: Steam (or moist gas)



See Notes 1.4.4.A and B

1.4.5 Electret material

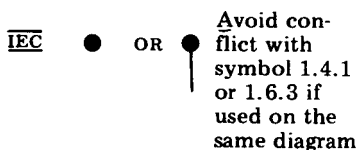


1.5 Test-Point Recognition Symbol

Used if necessary to emphasize test points.

NOTE — 1.5A: If other types of symbols (such as, stars, numbered circles, etc.) are substituted for the test-point recognition symbol, they shall be explained on the diagram or referenced document.

1.5.1 General



1.5.2 Application: test-point recognition for a test jack



1.5.3 Application: test-point recognition for the plate of a triode



1.5.4 Application: test-point recognition for a circuit terminal



1.6 Polarity Markings

1.6.1 Positive



1.6.2 Negative

IEC —

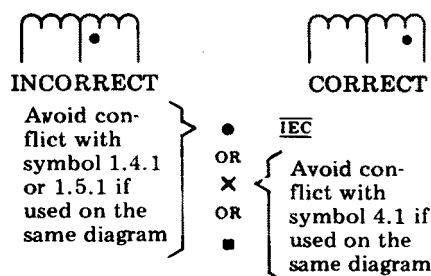
1.6.3 Instantaneous polarity markings

These polarity marks shall be used only when it is necessary to show the relative polarity of the windings.

NOTES:

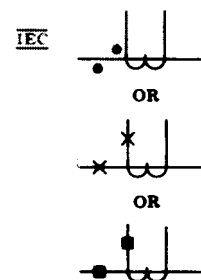
1.6.3A — Instantaneous polarity of voltage across windings corresponds at points indicated by polarity marks. Instantaneous direction of current into (or out of) one polarity mark corresponds to current out of (or into) the other polarity mark. If instantaneous currents enter the windings at the marked points, they will produce aiding fluxes.

1.6.3B — The polarity marks shall be placed near one end of each coil or winding symbol. The exact location is immaterial as long as they are unambiguously placed, especially where other windings are drawn nearby. There shall be only one polarity mark per winding, even if the winding is tapped. The following is NOT permitted:



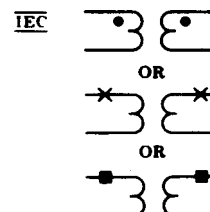
1.6.3.1 Application: instantaneous polarity markings with current transformer shown

See Note 1.6.3B



1.6.3.2 Application: instantaneous polarity markings with potential transformer shown

See Note 1.6.3B

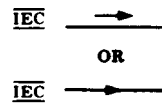


1.7 Direction of Flow of Power, Signal, or Information

Avoid conflict with symbols 9.5, 9.5.2, and 9.5.4 if used on the same diagram

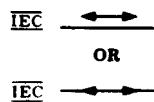
1.7.1 One-way

NOTE — 1.7.1A: The lower symbol is used if it is necessary to conserve space. The arrowhead in the lower symbol shall be filled.



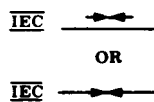
See Note 1.7.1A

1.7.2 Either way (but not simultaneously)



See Note 1.7.1A

1.7.3 Both ways, simultaneously

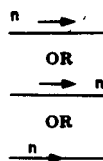


See Note 1.7.1A

Avoid conflict with symbol 9.2 if used on the same diagram

1.7.4 Application: one-way, general

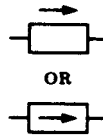
NOTE — 1.7.4A: The “n” is not part of the symbol. A significant waveform, frequency, or frequency range shall be substituted for “n.”



See Note 1.7.4A

1.7.5 Application: one-way circuit element, general

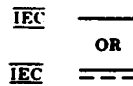
NOTE — 1.7.5A: In all cases, indicate the type of apparatus by appropriate words or letters in the rectangle.



See Note 1.7.5A

1.8 Kind of Current (General)

NOTE — 1.8A: Use only if necessary for clarity.

1.8.1 Direct current

To be used in cases when other symbol is not suitable

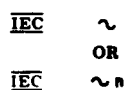
1.8.2 Alternating current**1.8.3 Alternating current, frequency ranges**

Use only if necessary to distinguish among different frequency bands.

NOTES:

1.8.3A — The “n” is not part of the symbol. The frequency range shall be substituted for “n.”

1.8.3B — Only one name for the unit of frequency (hertz or cycle per second) should be used on any one diagram.

1.8.3.1 Power frequencies

See Notes 1.8.3.A and B

1.8.3.2 Audio frequenciesIEC

OR

IEC

See Notes 1.8.3A and B

1.8.3.3 Superaudio, carrier, and radio frequenciesIEC

OR

IEC

See Notes 1.8.3A and B

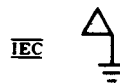
1.8.4 Direct or alternating current (universal)IEC**1.8.5 Undulating or rectified current**IEC**1.9 Connection Symbol**

For use adjacent to the symbols; e.g., see symbols 6.4.15.1 and 13.3.

1.9.1 2-phase 3-wire, ungroundedIEC**1.9.1.1 2-phase 3-wire, grounded**IEC**1.9.2 2-phase 4-wire**

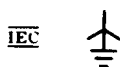
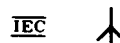
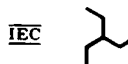
OR

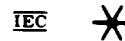
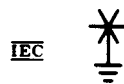
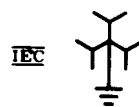
IEC

1.9.2.1 2-phase 5-wire, grounded**1.9.3** 3-phase 3-wire, delta or mesh**1.9.3.1** 3-phase 3-wire, delta, grounded**1.9.4** 3-phase 4-wire, delta, ungrounded**1.9.4.1** 3-phase 4-wire, delta, grounded**1.9.5** 3-phase, open-delta**1.9.5.1** 3-phase, open-delta, grounded at common point**1.9.5.2** 3-phase, open-delta, grounded at middle point of one winding

1.9.6 3-phase, broken-delta**1.9.7** 3-phase, wye or star, ungrounded**1.9.7.1** 3-phase, wye, grounded neutral

The direction of the stroke representing the neutral can be chosen arbitrarily.

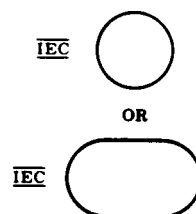
**1.9.8** 3-phase 4-wire, ungrounded**1.9.9** 3-phase, zigzag, ungrounded**1.9.9.1** 3-phase, zigzag, grounded**1.9.10** 3-phase, Scott or T**1.9.11** 6-phase, double-delta

1.9.12 6-phase, hexagonal (or chordal)**1.9.13** 6-phase, star (or diametrical)**1.9.13.1** 6-phase, star, with grounded neutral**1.9.14** 6-phase, double zigzag with neutral brought out and grounded**1.10 Envelope Enclosure**

The general envelope symbol identifies the envelope or enclosure regardless of evacuation or pressure. When used with electron-tube component symbols, the general envelope symbol indicates a vacuum enclosure unless otherwise specified. A gas-filled device may be indicated by a dot within the envelope symbol.

See paragraph A4.11.1 of the Introduction

NOTE — 1.10A: The shape of the envelope symbol may be modified to approximate the distinctive shape of a device if the shape will aid in recognition of the device, or in depicting the device function, e.g., cathode-ray tube, iconoscope, image orthicon, vidicon, X-ray tube, etc. For typical applications, see symbols 7.3.6.1 and 7.3.6.2.2.

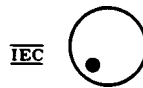
1.10.1 General

1.10.2 Split envelope

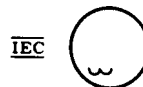
If necessary, envelope may be split.

**1.10.3 Application: gas-filled envelope**

The gas-recognition symbol (dot) may be located as convenient. See symbol 1.4.1

**1.10.4 Application: liquid-filled envelope**

The liquid-recognition symbol may be located as convenient. See symbol 1.4.2

**1.11 Shield
Shielding**

Normally used for electric or magnetic shielding.

NOTE — 1.11.1A: If essential to show type of shielding add E for electric and M for magnetic shielding.

When used for other shielding, a note should so indicate. For typical applications see

CAPACITOR (symbol 2.2.3)

TRANSMISSION PATH (symbols 3.1.8.1, 3.1.8.2, and 3.1.8.3)

TRANSFORMER (symbols 6.4.2.2 and 6.4.2.3)

1.11.1 General

These are long dashes.



1.11.2 Optical



1.12 Special Connector or Cable Indicator

NOTES:

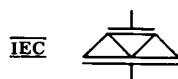
1.12A — If it is essential to denote on a system-type interconnection wiring diagram that the connector or cable is furnished with the equipment by the equipment manufacturer the following symbol shall be used.

1.12B— It is recommended that the symbol be drawn using a 0.20 inch diameter circle.



1.13 Electret (shown with electrodes)

NOTE — 1.13A: The longer line represents the positive pole.



Cross References

See also Section 19.

NOTES:

- 1 — See Introduction for general information (note especially A3.1).
- 2 — Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.
- 3 — For centered figures with symbols appearing side by side, the symbol on the left-hand side should be considered to be for a single line (one-line) diagram and the symbol on the right-hand side for a complete diagram, i.e., 1.5.1.

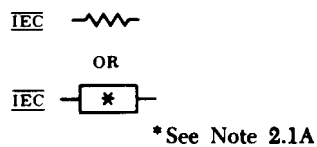
2. Graphic Symbols for Fundamental Items (not included in other sections)

2.1 Resistor

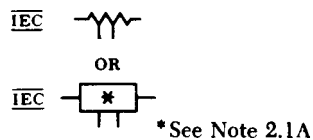
For resistors with nonlinear characteristics, see also BALLAST LAMP (symbol 11.1.5)

NOTE — 2.1A: The asterisk is not part of the symbol. Always add identification within or adjacent to the rectangle.

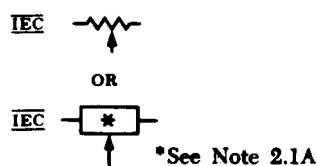
2.1.1 General



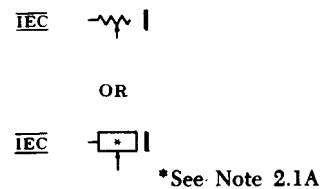
2.1.2 Tapped resistor



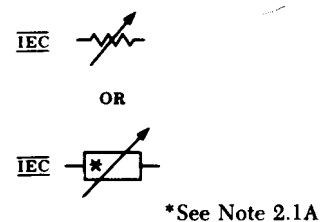
2.1.3 Application: with adjustable contact. See also symbol 14.2.5

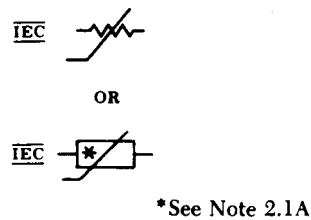
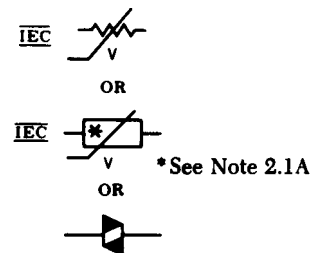
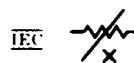
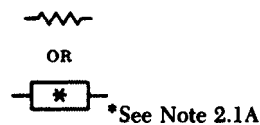


2.1.3.1 Application: with adjustable contact and OFF (disconnect) position



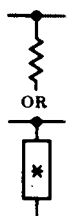
2.1.4 Application: adjustable or continuously adjustable (variable) resistor ; rheostat



2.1.5 Nonlinear resistor (intrinsic)**2.1.6 Symmetrical varistor (intrinsic); voltage-sensitive resistor** (silicon carbide, etc)**2.1.7 Magnetoresistor (intrinsic) (linear type shown)****2.1.8 Heating resistor****2.1.9 Instrument or relay shunt**

Connect instrument or relay to terminals in the rectangle

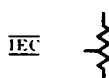


2.1.10 Shunt resistor

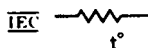
* See Note 2.1A

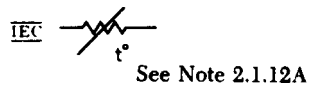
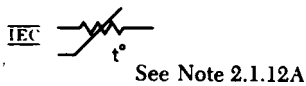
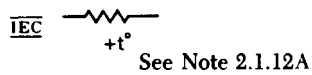
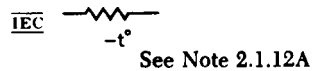
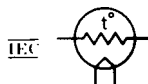
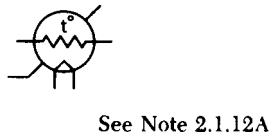
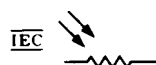
2.1.11 Resistive termination

Commonly used in coaxial and waveguide diagrams.

**2.1.11.1 Application: series resistor and path open****2.1.11.2 Application: series resistor and path short-circuited****2.1.11.3 Bolometer element (- - - lines indicate direct-current connections and are not part of the symbol)****2.1.12 Thermistor; thermal resistor $\square$; temperature-sensing element**

NOTE — 2.1.12A: Use only if essential to indicate special characteristic.

2.1.12.1 General

2.1.12.1.1 Linear**2.1.12.1.2** Nonlinear**2.1.12.1.3** Positive temperature coefficient**2.1.12.1.4** Negative temperature coefficient**2.1.12.2** With independent integral heater**2.1.12.2.1** Nonlinear**2.1.13** Symmetrical photoconductive transducer (resistive)

2.2 Capacitor

NOTES:

2.2A — Capacitors may be represented by either of two methods. For convenience in referring to the capacitor symbols in this section, they are classified as follows:

Style 1 symbols are drawn with two parallel lines (IEC preferred).

Style 2 symbols are drawn with one straight and one curved line.

2.2B — Where there is only one style shown and reference is made to the general symbol 2.2.1, this indicates that either style may be used, as modified for that particular application.

2.2C — The distance between the plates shall be between one-fifth and one-third of the length of a plate. IEC

2.2.1 General

Style 1  IEC

OR

Style 2  IEC

2.2.1.1 With identified electrode

NOTES:

2.2.1.1A — For style 1, if it is necessary to identify the capacitor electrodes, the modified element shall represent the outside or lower potential electrode. IEC

2.2.1.1B — For style 2, if it is necessary to identify the capacitor electrodes, the curved element shall represent:

- a) The outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors;
- b) The moving element in adjustable and variable capacitors;
- c) The low-potential element in feed-through capacitors. IEC

See General Symbols 2.2.1 and Note 2.2B

Style 1  IEC

OR

Style 2  IEC

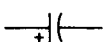
See Note 2.2.1.1B

2.2.2 Polarized capacitor

See General Symbols 2.2.1 and Note 2.2B

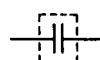
Style 1  IEC

OR

Style 2 

2.2.3 Shielded capacitor

See General Symbols 2.2.1 and Note 2.2B

 IEC

2.2.4 Adjustable or variable capacitors

NOTE — 2.2.4A: If it is necessary to identify trimmer capacitors, the letter T should appear adjacent to the symbol.

See General Symbols 2.2.1 and Note 2.2B

2.2.4.1 With moving element indicated

 IEC

NOTE — 2.2.4.1A: If it is desired to indicate the moving element, the common intersection of the moving element with the symbol for variability and the connecting line is marked with a dot. IEC

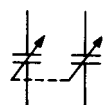
See General Symbols 2.2.1 and Note 2.2B

 IEC OR  IEC

Style 1 OR Style 2

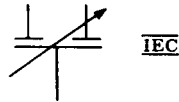
2.2.5 Application: adjustable or variable capacitors with mechanical linkage of units

See General Symbols 2.2.1 and Note 2.2B

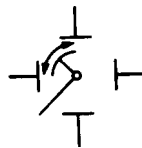
 IEC

2.2.6 Continuously adjustable or variable differential capacitor

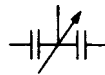
The capacitance of one part increases as the capacitance of the other part decreases. See General Symbols 2.2.1 and Note 2.2B

**2.2.7** Phase-shifter capacitor

See General Symbols 2.2.1 and Note 2.2B

**2.2.8** Split-stator capacitor

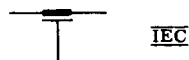
The capacitances of both parts increase or decrease simultaneously. See General Symbols 2.2.1 and Note 2.2B

**2.2.9** Feed-through capacitor

Commonly used for bypassing high-frequency currents to chassis.

NOTE — 2.2.9A: For purposes of clarity, terminals may be shown on the feed-through element.

See General Symbols 2.2.1 and Note 2.2B

**2.2.9.1** Application: feed-through capacitor between two inductors with third lead connected to chassis

See General Symbols 2.2.1 and Note 2.2B

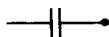


2.2.10 Capacitive termination

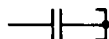
Commonly used on coaxial and wave-guide diagrams.

2.2.10.1 Application: series capacitor and path open

See General Symbols 2.2.1 and Note 2.2B

**2.2.10.2** Application: series capacitor and path short-circuited

See General Symbols 2.2.1 and Note 2.2B

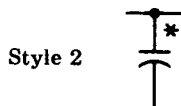
**2.2.11** Shunt capacitor

Style 2

2.2.12 Coupling capacitor (for power-line carrier)

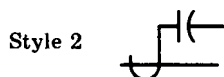
NOTE — 2.2.12A: The asterisk is not part of the symbol. If specific identifications is desired, the asterisk is to be replaced by one of the following letter combinations:

COM	Carrier communication
LC	Carrier load control
REL	Carrier relaying
SUP	Carrier supervisory
TLM	Carrier telemetering
TT	Carrier transferred trip

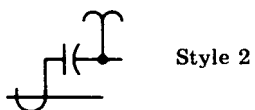


Style 2

*See Note 2.2.12

2.2.13 Capacitor bushing for circuit breaker or transformer

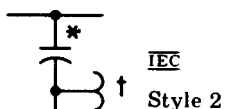
Style 2

2.2.14 Application: capacitor-bushing potential device

Style 2

2.2.15 Application: carrier-coupling capacitor potential device (used to provide a power-system-frequency voltage and also coupling for carrier signals)

NOTE — 2.2.15A: The dagger is not part of the symbol. If specific indication is desired, the dagger is to be replaced by a letter combination from item 12.1, Note 12.1A.

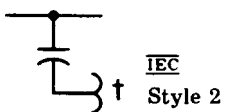


IEC

Style 2

*See Note 2.2.12A

†See Note 2.2.15A

2.2.16 Application: coupling capacitor potential device (used only to provide a power-system-frequency voltage)

IEC

Style 2

†See Note 2.2.15

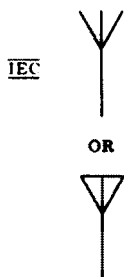
2.3 Antenna **2.3.1** General

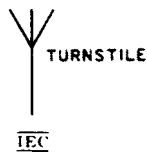
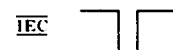
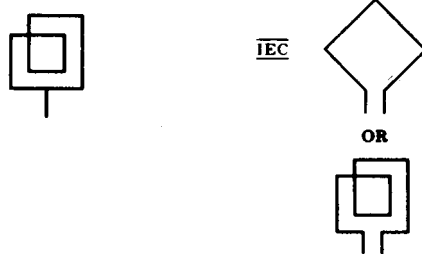
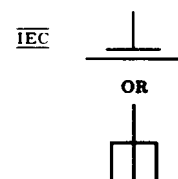
Types of functions may be indicated by words or abbreviations adjacent to the symbol.

Qualifying symbols may be added to the antenna symbol to indicate polarization, direction of radiation, or special application.

If required, the general shape of the main lobes of the antenna polar diagrams may be shown adjacent to the symbol. Notes may be added to show the direction and rate of lobe movement.

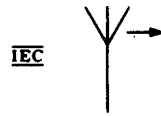
The stem of the symbol may represent any type of balanced or unbalanced feeder, including a single conductor.



2.3.1.1 Application: turnstile antenna**2.3.2** Dipole**2.3.3** Loop**2.3.4** Antenna counterpoise**2.3.5** Qualifying symbols to indicate polarization

Use only if essential to indicate special property of an antenna.

2.3.5.1 Plane polarization

2.3.5.2 Application: antenna with horizontal polarization**2.3.5.3** Application: antenna with vertical polarization**2.3.5.4** Circular polarization**2.3.5.5** Application: antenna with circular polarization**2.3.6** Qualifying symbols to indicate direction of radiation

Use only if essential to indicate special property of an antenna.

NOTES:

2.3.6A — Any applicable adjustability symbol (item 1.1) may be used to supplement a qualifying symbol.

2.3.6B — Antenna rotation can be accomplished by electromechanical or electronic means.

2.3.6.1 Fixed in azimuth**2.3.6.2** Adjustable in azimuth