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ANSI Y32.2-1975 (Reaffirmed 1989)
CSA Z99-1975
(Revision of IEEE Std 315-1971
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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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.

Title of Document: Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Class Designation Letters)

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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 reconcilliation action through military international standardization channels including departmental standardization offices, if required.

NOTICE: When reaffirmation, amendment, revision, or cancellation of this standard is initially proposed, the cognizant secretariat of the industry standard shall inform the Military Coordinating Activity of the proposed change and request their participation.

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.

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 form original drawings prepared for the Mergenthaler Diagrammer.

A substantial effort has been made to have this American National Standard compatible with approved International Electronical 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:

Charles A. Fricke, *Chair*
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James L. Fisher, Jr., *Vice Chair, Pictographic Symbols*
James R. Couper, *Vice Chair, Chemical and Process*
George Platt, *Vice Chair, Mechanical*
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US Department of the Interior	Ray Freeman
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Western Union Telegraph Company	*(Vacant)*

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J. Zeno

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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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* Member of Y32.2 Editorial Committee.
‡ Retired.

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Variability

1.2 Special-Property Indicators

t° × T ∫

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

DIEL

SPLICE

3.2 Distribution lines
Transmission lines

F S T V

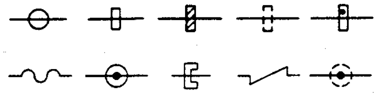
F

3.3 Alternative or Conditioned Wiring

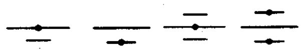
3.4 Associated or Future

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

3.6 Waveguide

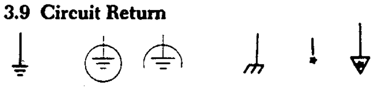


3.7 Strip-Type Transmission Line

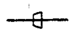


3.8 Termination

3.9 Circuit Return

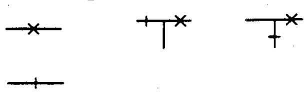


3.10 Pressure-Tight Bulkhead Cable Gland
Cable Sealing End

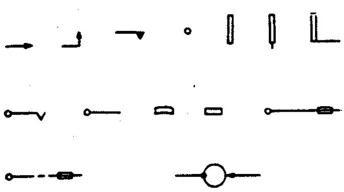


4. Contacts, Switches, Contactors, and Relays

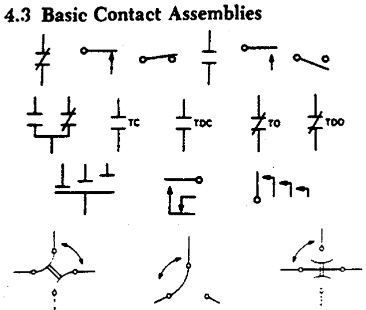
4.1 Switching Function



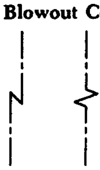
4.2 Electrical Contact



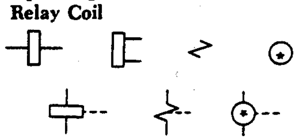
4.3 Basic Contact Assemblies



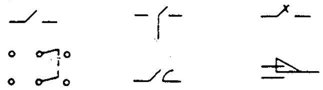
4.4 Magnetic Blowout Coil



4.5 Operating Coil
Relay Coil

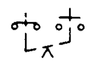


4.6 Switch

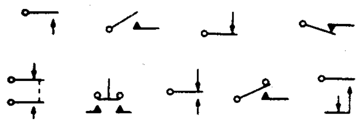


4.7 Pushbutton, Momentary or Spring-Return

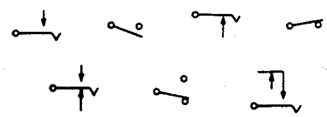
4.8 Two-Circuit, Maintained or Not Spring-Return



4.9 Nonlocking Switch, Momentary or Spring-Return

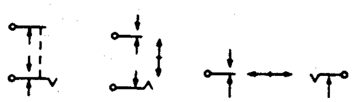


4.10 Locking Switch

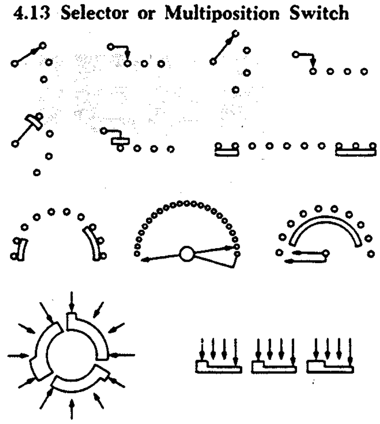


4.11 Combination Locking and Non-locking Switch

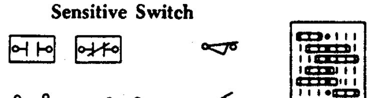
4.12 Key-Type Switch
Lever Switch



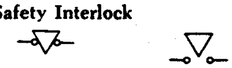
4.13 Selector or Multiposition Switch



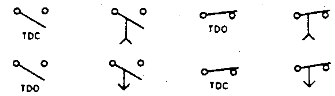
4.14 Limit Switch
Sensitive Switch



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

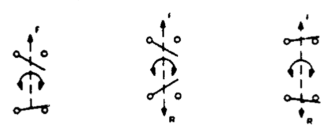
4.20 Temperature-Actuated Switch

4.21 Thermostat

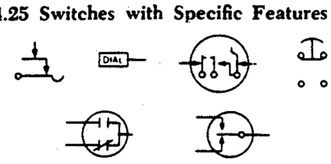
4.22 Flasher
Self-interrupting switch

4.23 Foot-Operated Switch
Foot Switch

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



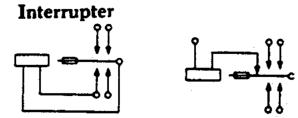
4.25 Switches with Specific Features



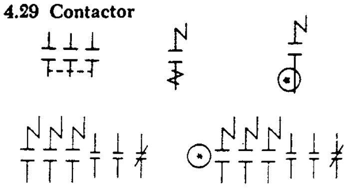
4.26 Telegraph Key

4.27 Governor
Speed Regulator

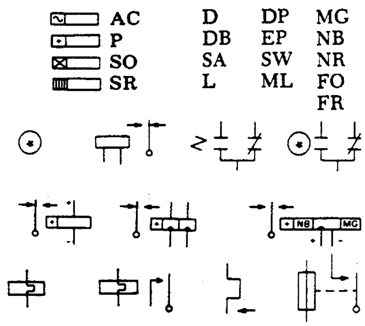
4.28 Vibrator
Interrupter



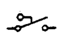
4.29 **Contactor**



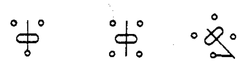
4.30 **Relay**



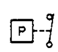
4.31 **Inertia Switch**



4.32 **Mercury Switch**

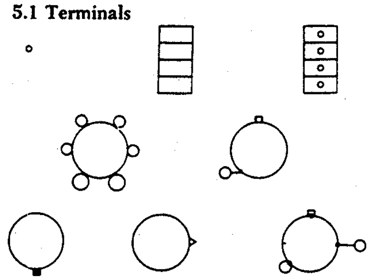


4.33 **Aneroid Capsule**

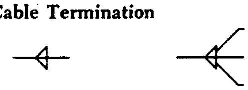


Terminals and Connectors

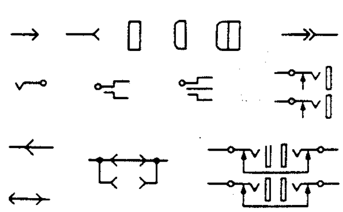
5.1 **Terminals**



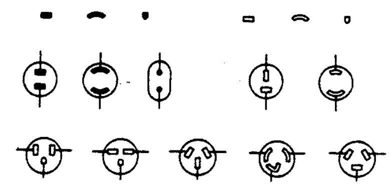
5.2 **Cable Termination**



5.3 **Connector**
Disconnecting Device

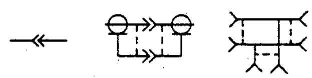


5.4 **Connectors of the Type Commonly Used for Power-Supply Purposes**



5.5 **Test Blocks**

5.6 **Coaxial Connector**

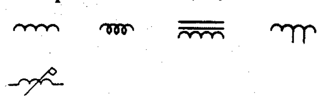


5.7 **Waveguide Flanges**
Waveguide junction

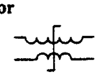
6. Transformers, Inductors, and Windings

6.1 **Core**

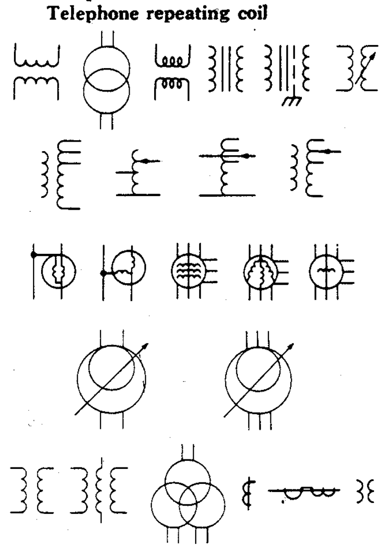
6.2 **Inductor**
Winding
Reactor
Radio frequency coil
Telephone retardation coil



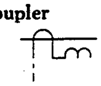
6.3 **Transductor**



6.4 **Transformer**
Telephone induction coil
Telephone repeating coil

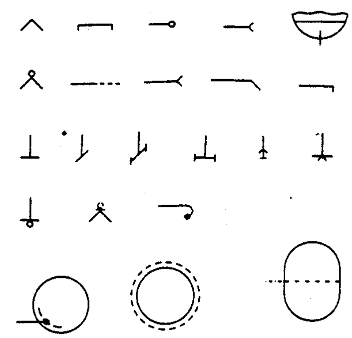


6.5 **Linear Coupler**



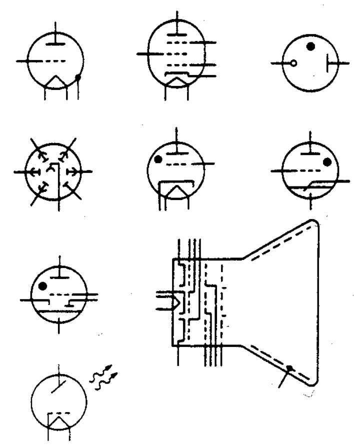
7. Electron Tubes and Related Devices

7.1 **Electron Tube**

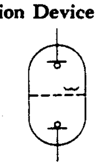


7.2 **General Notes**

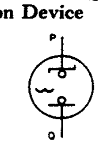
7.3 **Typical Applications**



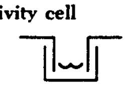
7.4 **Solion**
Ion-Diffusion Device



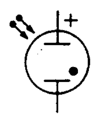
7.5 **Coulomb Accumulator**
Electrochemical Step-Function Device



7.6 **Conductivity cell**



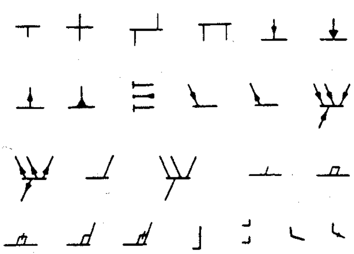
7.7 Nuclear-Radiation Detector
Ionization Chamber
Proportional Counter Tube
Geiger-Müller Counter Tube



8. Semiconductor Devices

8.1 Semiconductor Device
Transistor
Diode

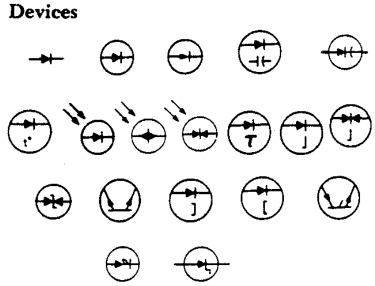
8.2 Element Symbols



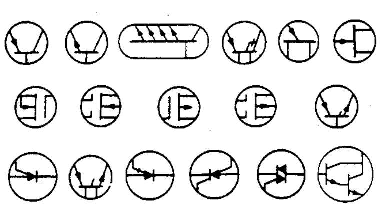
8.3 Special Property Indicators

8.4 Rules for Drawing Style 1 Symbols

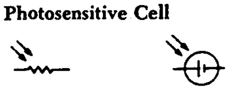
8.5 Typical Applications: Two-Terminal Devices



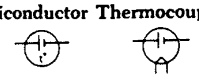
8.6 Typical Applications: Three- (or More) Terminal Devices



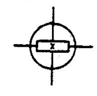
8.7 Photosensitive Cell



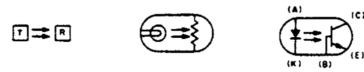
8.8 Semiconductor Thermocouple



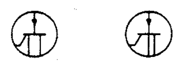
8.9 Hall Element
Hall Generator



8.10 Photon-coupled isolator

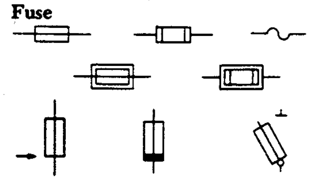


8.11 Solid-state-thyratron



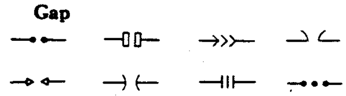
9. Circuit Protectors

9.1 Fuse

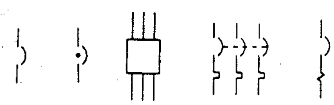


9.2 Current Arrester

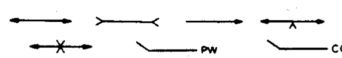
9.3 Lightning Arrester
Arrester
Gap



9.4 Circuit Breaker



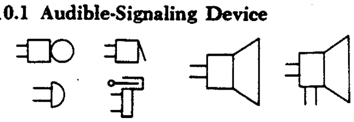
9.5 Protective Relay



C F φ S V
Z GP W T

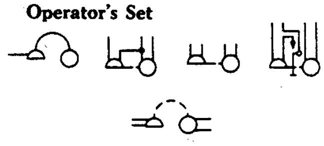
10. Acoustic Devices

10.1 Audible-Signaling Device



10.2 Microphone

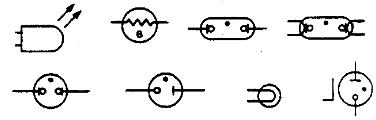
10.3 Handset
Operator's Set



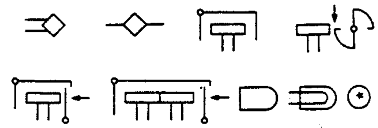
10.4 Telephone Receiver
Earphone
Hearing-Aid Receivers

11. Lamps and Visual-Signaling Devices

11.1 Lamp



11.2 Visual-Signaling Device



12. Readout Devices

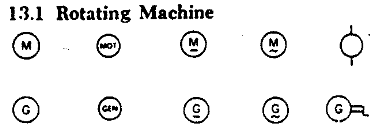
12.1 Meter
Instrument

A	DB	I	OP	RF	VA
AH	DBM	INT	OSCG	SY	VAR
C	DM	μA	PH	TLM	VARH
CMA	DTR	UA	PI	t°	VI
CMC	F	MA	PF	THC	VU
CMV	G	NM	RD	TT	W
CRO	GD	OHM	REC	V	WH

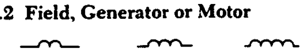
12.2 Electromagnetically Operated Counter
Message Register

13. Rotating Machinery

13.1 Rotating Machine

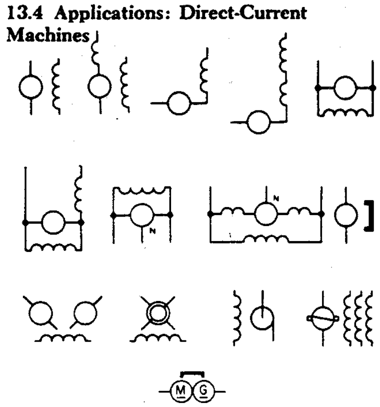


13.2 Field, Generator or Motor

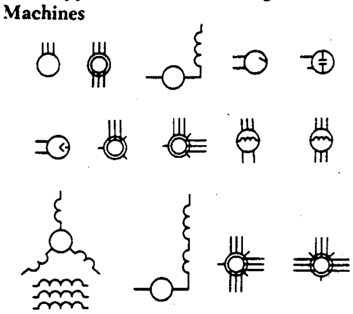


13.3 Winding Connection Symbols

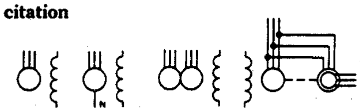
13.4 Applications: Direct-Current Machines



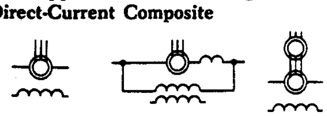
13.5 Applications: Alternating-Current Machines



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

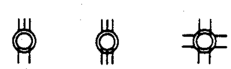


13.7 Applications: Alternating- and Direct-Current Composite



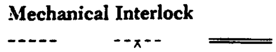
13.8 Synchro

CDX	TDX
CT	TR
CX	TX
TDR	RS

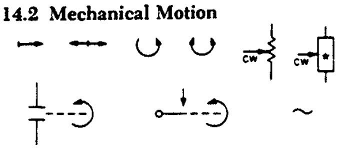


14. Mechanical Functions

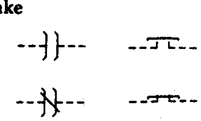
14.1 Mechanical Connection
Mechanical Interlock



14.2 Mechanical Motion



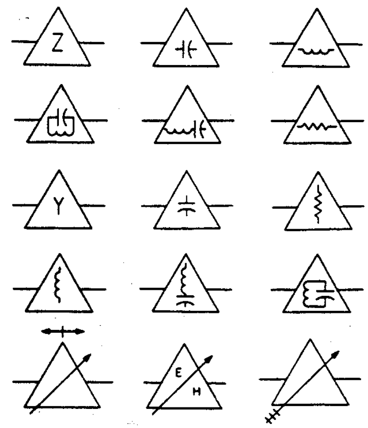
14.3 Clutch
Brake



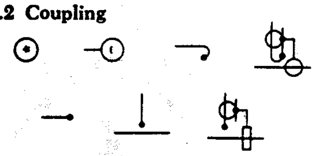
14.4 Manual Control

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

15.1 Discontinuity



15.2 Coupling



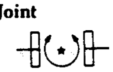
15.3 Directional Coupler

15.4 Hybrid
Directionally Selective Transmission Devices

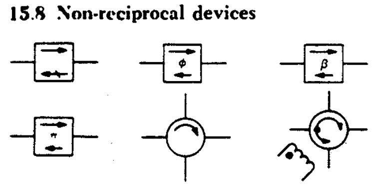
15.5 Mode Transducer

15.6 Mode Suppression

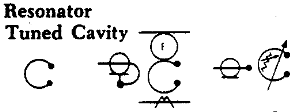
15.7 Rotary Joint



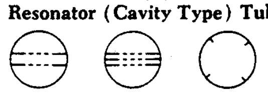
15.8 Non-reciprocal devices



15.9 Resonator
Tuned Cavity



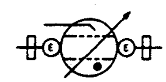
15.10 Resonator (Cavity Type) Tube



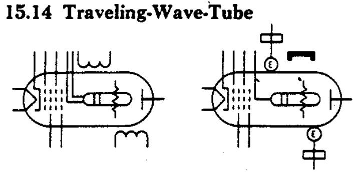
15.11 Magnetron

15.12 Velocity-Modulation (Velocity-Variation) Tube

15.13 Transmit-Receive (TR) Tube



15.14 Traveling-Wave-Tube

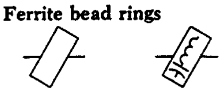


15.15 Balun

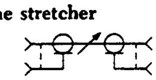
15.16 Filter

15.17 Phase shifter

15.18 Ferrite bead rings

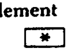


15.19 Line stretcher



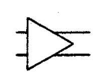
16. Composite Assemblies

16.1 Circuit assembly
Circuit subassembly
Circuit element

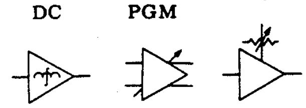


EQ	FL-BP	RG	TPR
FAX	FL-HP	RU	TTY
FL	FL-LP	DIAL	CLK
FL-BE	PS	TEL	IND
ST-INV			

16.2 Amplifier

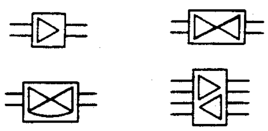


BDG	EXP	PRE
BST	LIM	PWR
CMP	MON	TRQ
DC	PGM	



16.3 Rectifier

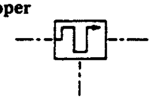
16.4 Repeater



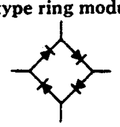
16.5 Network

16.6 Phase Shifter
Phase-Changing Network

16.7 Chopper



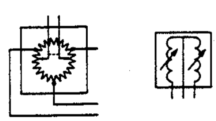
16.8 Diode-type ring demodulator
Diode-type ring modulator



16.9 Gyro
Gyroscope
Gyrocompass

16.10 Position Indicator

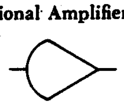
16.11 Position Transmitter



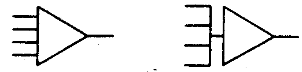
16.12 Fire Extinguisher Actuator Head

17. Analog Functions

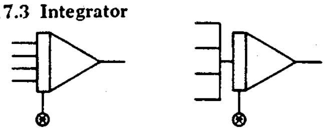
17.1 Operational Amplifier



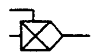
17.2 Summing Amplifier



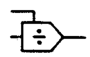
17.3 Integrator



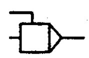
17.4 Electronic Multiplier



17.5 Electronic Divider



17.6 Electronic Function Generator



17.7 Generalized Integrator

17.8 Positional Servo-mechanism

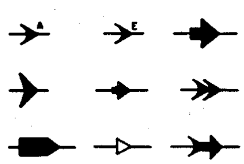
17.9 Function Potentiometer

18. Digital Logic Functions

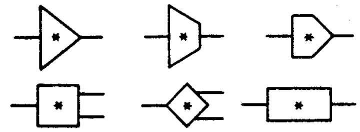
18.1 Digital Logic Functions
(See cross references)

19. Special Purpose Maintenance Diagrams

19.1 Data flow code signals

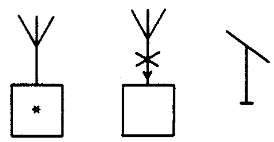


19.2 Functional Circuits

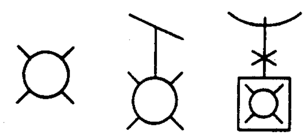


20. System Diagrams, Maps and Charts

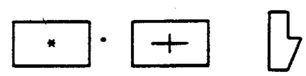
20.1 Radio station



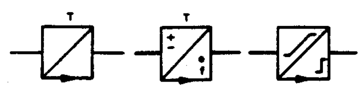
20.2 Space station



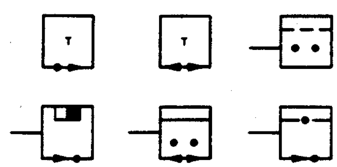
20.3 Exchange equipment



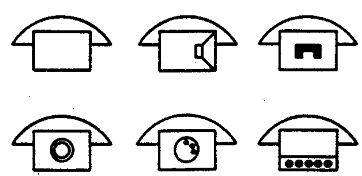
20.4 Telegraph repeater



20.5 Telegraph equipment

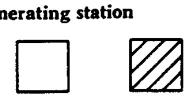


20.6 Telephone set

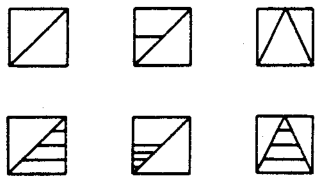


21. System Diagrams, Maps and Charts

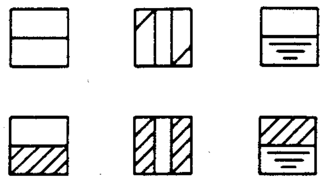
21.1 Generating station



21.2 Hydroelectric generating station

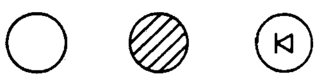


21.3 Thermoelectric generating station



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

[1]For 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. $\boxed{F}$ 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 $\overline{\underline{\text{IEC}}}$.

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 $\overline{\underline{\text{IEC}}}$ 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 Size[2]

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 ⟶ or open → 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, solion, switch in an evacuated envelope, etc.

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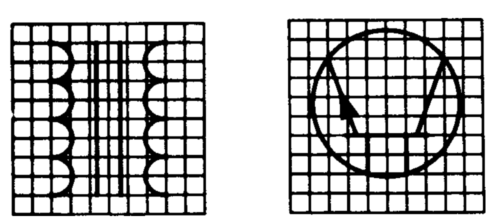
[2] The symbols shown in this edition of the standard are larger in size than those shown in the 1967 edition. All of the symbols have been prepared so that the connection points are located at intersections of a modular (incremental) grid.



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

IEC 

1.1.1.2 Preset, general

IEC 

1.1.1.3 Linear (shown applied to 1.1.1.1)

1.1.1.4 Nonlinear (shown applied to 1.1.1.1)

IEC 

1.1.2 Inherent variability (intrinsic variability)

1.1.2.1 Linear

IEC 

1.1.2.2 Nonlinear

IEC 

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

1.1.3.1 Continuous

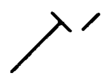
IEC 

1.1.3.2 In steps

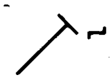
IEC 

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

1.1.4.1 Continuous

IEC 

1.1.4.2 In steps

IEC 

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

IEC $t°$

1.2.2 Magnetic-field dependence

IEC $\times$

1.2.3 Storage (Greek letter tau)

τ

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.

IEC 

1.2.5 Delay

IEC

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)

IEC 

1.3.2 Radiation, ionizing

IEC 

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
Deutron	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

IEC

Avoid conflict with symbol 1.5.1 or 1.6.3 if used on the same diagram

See Note 1.4A

1.4.2 Liquid

IEC

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

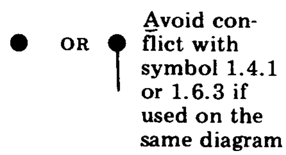
IEC 

1.5 Test-Point Recognition Symbol

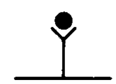
Used if necessary to emphasize test points.

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.

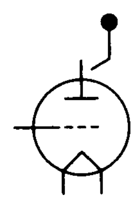
1.5.1 General

IEC 

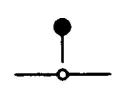
1.5.2 Application: test-point recognition for a test jack



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

IEC +

1.6.2 Negative

IEC –

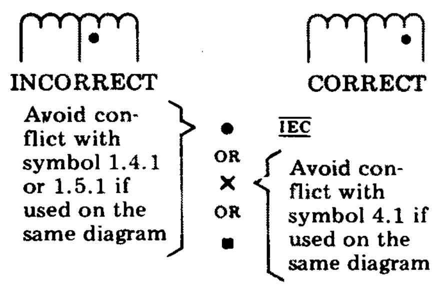
1.6.3 Instantaneous polarity markings

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

NOTES:

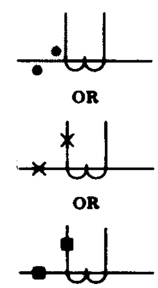
1.6.3A — Instantaneous polarity of voltage across windings corresponds at points indicated by polarity marks. Instantaneous direction of current into (or out of) one polarity mark corresponds to current out of (or into) the other polarity mark. If instantaneous currents enter the windings at the marked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



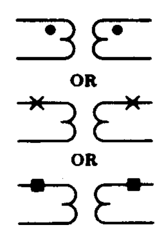
1.6.3.1 Application: instantaneous polarity markings with current transformer shown

See Note 1.6.3B IEC



1.6.3.2 Application: instantaneous polarity markings with potential transformer shown

See Note 1.6.3B IEC

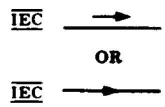


1.7 Direction of Flow of Power, Signal, or Information

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

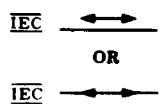
1.7.1 One-way

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.



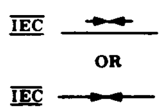
See Note 1.7.1A

1.7.2 Either way (but not simultaneously)



See Note 1.7.1A

1.7.3 Both ways, simultaneously

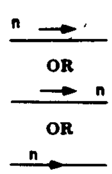


See Note 1.7.1.A

Avoid conflict with symbol 9.2 if used on the same diagram

1.7.4 Application: one-way, general

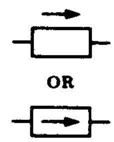
NOTE — 1.7.4A: The “n” is not part of the symbol. A significant waveform, frequency, or frequency range shall be substituted for “n.”



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.

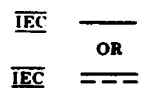


See Note 1.7.5A

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

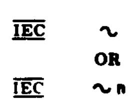
Use only if necessary to distinguish among different frequency bands.

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 frequencies

IEC 

OR

IEC

See Notes 1.8.3A and B

1.8.3.3 Superaudio, carrier, and radio frequencies

IEC 

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

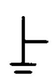
1.9 Connection Symbol

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

1.9.1 2-phase 3-wire, ungrounded

IEC 

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

IEC 

1.9.3.1 3-phase 3-wire , delta, grounded

IEC 

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

IEC 

1.9.7.1 3-phase, wye, grounded neutral

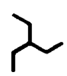
The direction of the stroke representing the neutral can be chosen arbitrarily.

IEC 

1.9.8 3-phase 4-wire, ungrounded

IEC 

1.9.9 3-phase, zigzag, ungrounded

IEC 

1.9.9.1 3-phase, zigzag, grounded

IEC 

1.9.10 3-phase, Scott or T

IEC 

1.9.11 6-phase, double-delta

IEC 

1.9.12 6-phase, hexagonal (or chordal)

IEC 

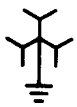
1.9.13 6-phase, star (or diametrical)

IEC 

1.9.13.1 6-phase, star, with grounded neutral

IEC 

1.9.14 6-phase, double zigzag with neutral brought out and grounded

IEC 

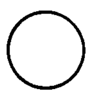
1.10 Envelope Enclosure

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.

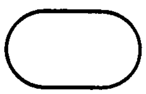
See paragraph A4.11.1 of the Introduction

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

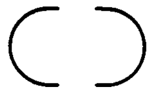
IEC 

OR

IEC 

1.10.2 Split envelope

If necessary, envelope may be split.

IEC 

1.10.3 Application: gas-filled envelope

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

IEC 

1.10.4 Application: liquid-filled envelope

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

IEC 

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:

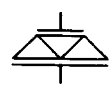
1.12A — If it is essential to denote on a system-type interconnection wiring diagram that the connector or cable is furnished with the equipment by the equipment manufacturer the following symbol shall be used.

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.

IEC



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.

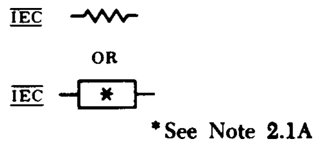
2. Graphic Symbols for Fundamental Items (not included in other sections)

2.1 Resistor

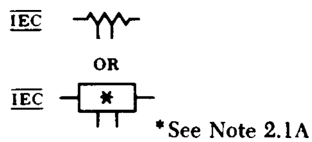
For resistors with nonlinear characteristics, see also BALLAST LAMP (symbol 11.1.5)

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

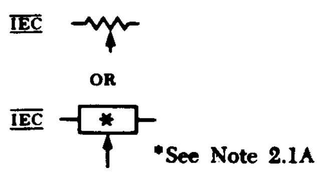
2.1.1 General



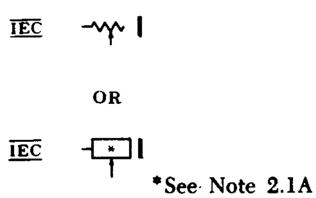
2.1.2 Tapped resistor



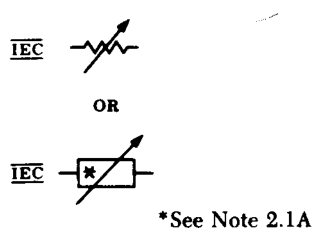
2.1.3 Application: with adjustable contact. See also symbol 14.2.5



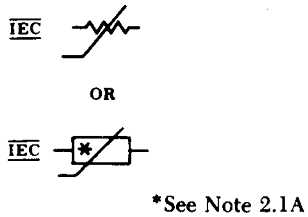
2.1.3.1 Application: with adjustable contact and OFF (disconnect) position



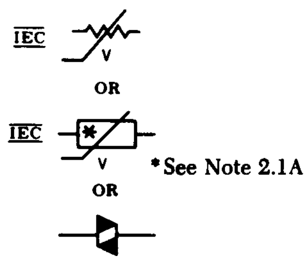
2.1.4 Application: adjustable or continuously adjustable (variable) resistor F; rheostat



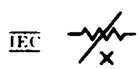
2.1.5 Nonlinear resistor (intrinsic)



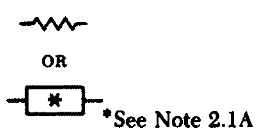
2.1.6 Symmetrical varistor (intrinsic); voltage-sensitive resistor F (silicon carbide, etc)



2.1.7 Magnetoresistor (intrinsic) (linear type shown)



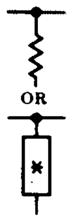
2.1.8 Heating resistor



2.1.9 Instrument or relay shunt

Connect instrument or relay to terminals in the rectangle

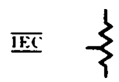
2.1.10 Shunt resistor



* 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

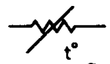
2.1.11.3 Bolometer element (- — - lines indicate direct-current connections and are not part of the symbol)

2.1.12 Thermistor; thermal resistor $\boxed{F}$; temperature-sensing element

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

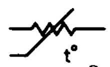
2.1.12.1 General

2.1.12.1.1 Linear

IEC 

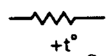
See Note 2.1.12A

2.1.12.1.2 Nonlinear

IEC 

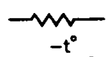
See Note 2.1.12A

2.1.12.1.3 Positive temperature coefficient

IEC 

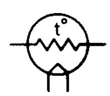
See Note 2.1.12A

2.1.12.1.4 Negative temperature coefficient

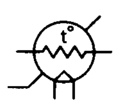
IEC 

See Note 2.1.12A

2.1.12.2 With independent integral heater

IEC 

2.1.12.2.1 Nonlinear



See Note 2.1.12A

2.1.13 Symmetrical photoconductive transducer (resistive)

IEC 

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:

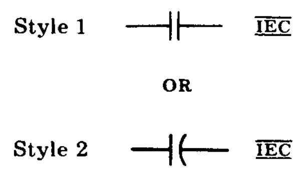
Style 1 symbols are drawn with two parallel lines (IEC preferred).

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



2.2.1.1 With identified electrode

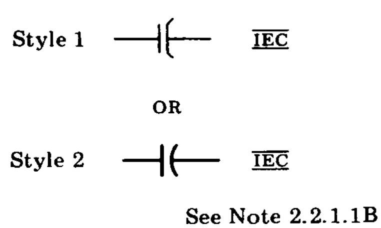
NOTES:

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:

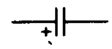
a) The outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors;
b) The moving element in adjustable and variable capacitors;
c) The low-potential element in feed-through capacitors. IEC

See General Symbols 2.2.1 and Note 2.2B

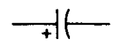


2.2.2 Polarized capacitor

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

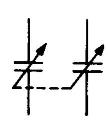
NOTE — 2.2.4.1A: If it is desired to indicate the moving element, the common intersection of the moving element with the symbol for variability and the connecting line is marked with a dot. IEC

See General Symbols 2.2.1 and Note 2.2B

IEC
Style 1  OR  Style 2

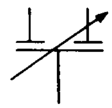
2.2.5 Application: adjustable or variable capacitors with mechanical linkage of units

See General Symbols 2.2.1 and Note 2.2B

 IEC

2.2.6 Continuously adjustable or variable differential capacitor

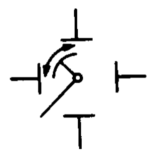
The capacitance of one part increases as the capacitance of the other part decreases. See General Symbols 2.2.1 and Note 2.2B



IEC

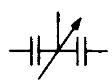
2.2.7 Phase-shifter capacitor

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

IEC

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

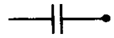
See General Symbols 2.2.1 and Note 2.2B

2.2.10 Capacitive termination

Commonly used on coaxial and wave-guide diagrams.

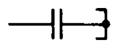
2.2.10.1 Application: series capacitor and path open

See General Symbols 2.2.1 and Note 2.2B

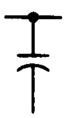


2.2.10.2 Application: series capacitor and path short-circuited

See General Symbols 2.2.1 and Note 2.2B



2.2.11 Shunt capacitor



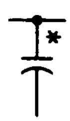
Style 2

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

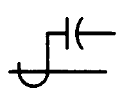
Style 2



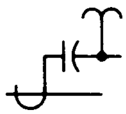
***See Note 2.2.12**

2.2.13 Capacitor bushing for circuit breaker or transformer

Style 2



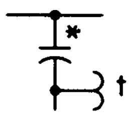
2.2.14 Application: capacitor-bushing potential device



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.

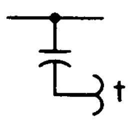


IEC

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 F

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.

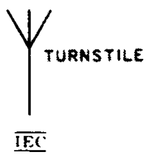
If required, the general shape of the main lobes of the antenna polar diagrams may be shown adjacent to the symbol. Notes may be added to show the direction and rate of lobe movement.

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

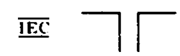
IEC

OR

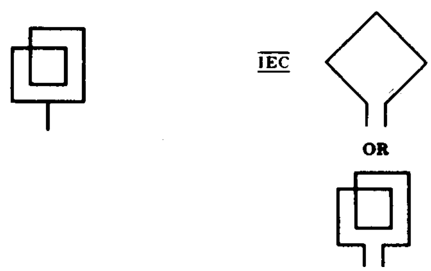
2.3.1.1 Application: turnstile antenna



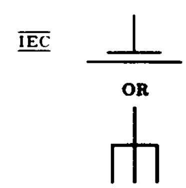
2.3.2 Dipole



2.3.3 Loop



2.3.4 Antenna counterpoise F

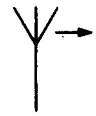


2.3.5 Qualifying symbols to indicate polarization

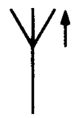
Use only if essential to indicate special property of an antenna.

2.3.5.1 Plane polarization

2.3.5.2 Application: antenna with horizontal polarization

IEC 

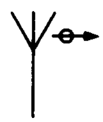
2.3.5.3 Application: antenna with vertical polarization

IEC 

2.3.5.4 Circular polarization

IEC 

2.3.5.5 Application: antenna with circular polarization

IEC 

2.3.6 Qualifying symbols to indicate direction of radiation

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

NOTES:

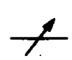
2.3.6A — Any applicable adjustability symbol (item 1.1) may be used to supplement a qualifying symbol.

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

2.3.6.1 Fixed in azimuth

IEC

2.3.6.2 Adjustable in azimuth

IEC 

2.3.6.3 Fixed in elevation

IEC 

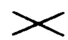
2.3.6.4 Adjustable in elevation

IEC 

2.3.6.5 Fixed in azimuth and elevation

IEC 

2.3.6.6 Direction finder, radio goniometer or beacon

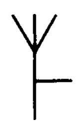
IEC 

2.3.6.7 Rotation

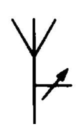
See symbols 14.2.3, 14.2.4 and 14.2.4.1; see Note 2.3.6B

2.3.7 Application: antenna with qualifying symbols and notes

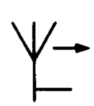
2.3.7.1 Antenna with direction of radiation fixed in azimuth

IEC 

2.3.7.2 Antenna with direction of radiation adjustable in azimuth

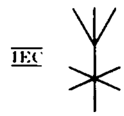
IEC 

2.3.7.3 Antenna with direction of radiation fixed in azimuth, horizontal polarization

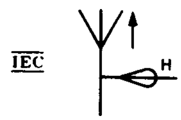
IEC 

2.3.7.4 Antenna with adjustable directivity in elevation

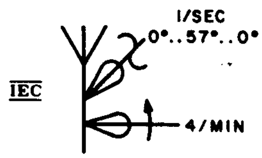
2.3.7.5 Direction finding, radio goniometer, or radio beacon antenna



2.3.7.6 Antenna with direction of radiation fixed in azimuth, vertically polarized, with horizontal polar diagram



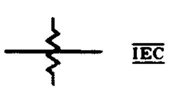
2.3.7.7 Radar antenna, rotating 4 times per minute in azimuth and reciprocating in elevation, 0° to 57° to 0° in one second



See Note 2.3.6B

2.4 Attenuator

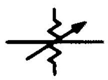
2.4.1 Fixed attenuator F; pad (general)



2.4.2 Balanced, general

2.4.3 Unbalanced, general

2.4.4 Variable attenuator $\boxed{\text{F}}$ (general)

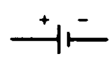
 IEC

2.4.5 Balanced, general

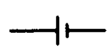
2.4.6 Unbalanced, general

2.5 Battery

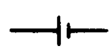
The long line is always positive, but polarity may be indicated in addition. Example:

IEC 

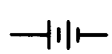
2.5.1 Generalized direct-current source



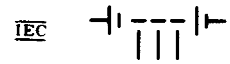
2.5.2 One cell

IEC 

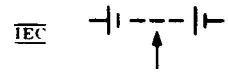
2.5.3 Multicell

IEC 

2.5.4 Multicell battery with 3 taps



2.5.5 Multicell battery with adjustable tap



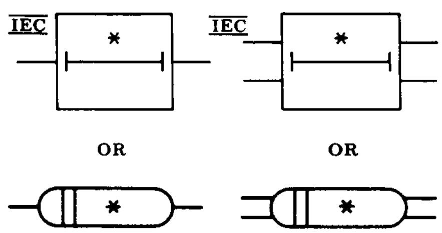
2.6 Delay Function
Delay Line F
Slow-Wave Structure

2.6.1 Delay element, general

NOTES:

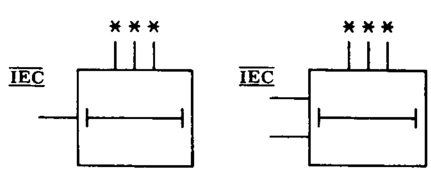
2.6.1A — Length of delay may be indicated. Asterisk is not part of symbol.

2.6.1B — The two vertical lines indicate input side.



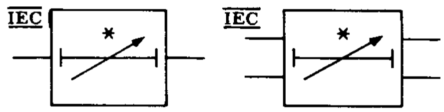
*See Note 2.6.1A

2.6.2 Tapped delay element



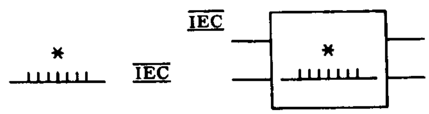
*See Note 2.6.1A and general symbols 2.6.1

2.6.3 Variable delay element



*See Note 2.6.1A and general symbols 2.6.1

2.6.4 Slow-wave structure



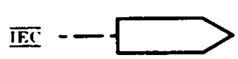
*See Note 2.6.1A

2.7 Oscillator Generalized Alternating-Current Source

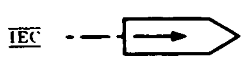
2.8 Permanent Magnet F

2.9 Pickup Head

2.9.1 [3] General



2.9.2 [3] Writing; recording; head, sound-recorder F



[3]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

2.9.3 [4] Reading; playback; head, sound-reproducer F

IEC 

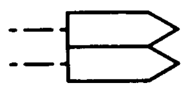
2.9.4 [4] Erasing; magnetic eraser F

IEC 

2.9.5 [4] Application: writing, reading, and erasing

IEC 

2.9.6 [4] Stereo



2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz F)

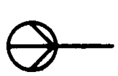
IEC 

2.11 Transducer F
Accelerometer F
Motional Pickup Transducer F

Use only if a more specific symbol is not applicable, e.g., tachometer generator, microphone, motor, loudspeaker, etc.

For other measuring transducers, see Hall Generator (8.9) and Thermal Converter (12.1)

2.11.1 General, electrical output

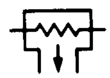


[4]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

2.12 Squib, Electric F

2.12.1 Explosive

2.12.2 Igniter



2.12.3 Sensing link; fusible link, ambient-temperature operated

Avoid conflict with symbol 3.6.4 if used on the same diagram

2.13 Thermocouple (dissimilar-metals device)

2.13.1 Temperature-measuring

IEC 

2.13.2 Current-measuring

NOTE — 2.13.2A: Explanatory words and arrows are not part of the symbols shown.

2.13.2.1 With integral heater internally connected

IEC 

See Note 2.13.2A

2.13.2.2 With integral insulated heater

See paragraph A4.11 of the introduction

IEC 

See Note 2.13.2A

2.13.3 Thermopile

2.14 Thermal Element Thermomechanical Transducer

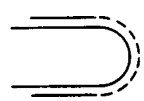
Actuating device, self-heating or with external heater. (Not operated primarily by ambient temperature.) See item 9.1 for fuses, one-time devices. See item 4.30.5 for thermally operated relay.

OR

2.15 Spark Gap Igniter Gap

USE SYMBOL 9.3.1

2.16 Continuous Loop Fire Detector (temperature sensor)



IEC

2.17 Ignitor Plug

IEC

Cross References

Semiconductor Thermocouple (item 8.8)

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.

3. Graphic Symbols for Transmission Path

3.1 Transmission Path
Conductor
Cable
Wiring

3.1.1 Guided path, general

A single line represents the entire group of conductors or the transmission path needed to guide the power or signal. For coaxial and waveguide work, the recognition symbol is used at the beginning and end of each kind of transmission path and at intermediate points as needed for clarity. In waveguide work, mode may be indicated. IEC

When required, the length between two significant points may be indicated, e.g., $\lambda/4$. IEC

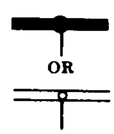
When required, details of structure (e.g., elbow), type, impedance, ratings, etc, may be added adjacent to or within any symbol or in a note. IEC

See also item 3.2.1

IEC

3.1.1.1 Bus bar (with connections shown)

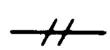
Use only if essential to distinguish bus from other circuit paths.



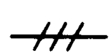
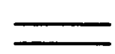
3.1.2 Conductive path or conductor; wire

IEC

3.1.2.1 Two conductors or conductive paths

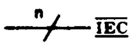
 IEC IEC

3.1.2.2 Three conductors or conductive paths

 IEC IEC 

3.1.2.3 “n” conductors or conductive paths

NOTE — 3.1.2.3A: The “n” is not part of the symbol. A number representing the actual number of paths shall be substituted for “n”.



“n” conductors
OR
Draw individual paths

See Note 3.1.2.3A

3.1.3 Air or space path

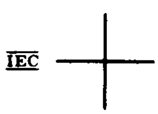
See also symbol 3.2.6

3.1.4 Dielectric path other than air

Commonly used for coaxial and waveguide transmission.

3.1.5 Crossing of paths or conductors not connected

The crossing is not necessarily at a 90-degree angle.

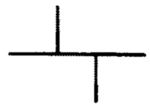


3.1.6 Junction of paths or conductors

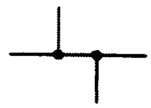
3.1.6.1 Junction (if desired)

3.1.6.2 Application: junction of paths, conductors, or cables. If desired, indicate path type, or size

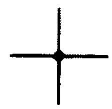
3.1.6.3 Application: junction of connected paths, conductors, or wires

IEC 

OR

IEC 

OR ONLY IF REQUIRED BY LAYOUT CONSIDERATIONS

IEC 

For microwave circuits, the type of coupling, power-division proportions, reflection coefficients, plane of junction, etc., may be indicated if desired.

3.1.6.4 Splice (if desired) of same size cables. Junction of conductors of same size or different size cables. If desired, indicate sizes of conductors

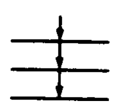
SPLICE

3.1.6.5 Conductor junction (such as hermaphroditic connectors)

IEC 

3.1.7 Associated conductors

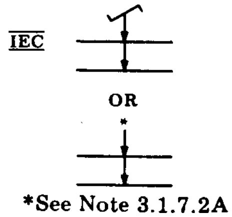
3.1.7.1 General (shown with 3 conductors)

IEC 

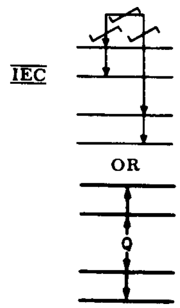
3.1.7.2 Twisted (shown with 2 twisted conductors)

NOTE — 3.1.7.2A: The asterisk is not part of the symbol. Always replace the asterisk by one of the following letters:

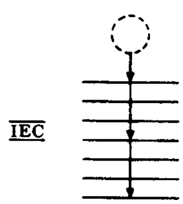
P = Pair
T = Triple



3.1.7.3 Quad



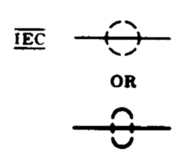
3.1.7.4 Shielded (shown with 3 conductors out of 7 within shield)



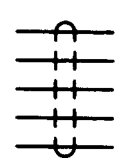
3.1.8 Assembled conductors; cable

Commonly used in communication diagrams.

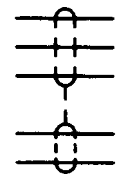
3.1.8.1 Shielded single conductor



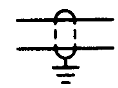
3.1.8.2 Application: shielded 5-conductor cable



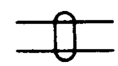
3.1.8.3 Application: shielded 5-conductor cable with conductors separated on the diagram for convenience



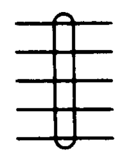
3.1.8.4 Application: shielded 2-conductor cable with shield grounded



3.1.8.5 2-conductor cable

IEC 

3.1.8.6 Application: 5-conductor cable

IEC 

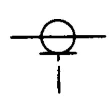
3.1.9 [5] Coaxial cable, recognition symbol; coaxial transmission path; radio-frequency cable $\boxed{F}$ (coaxial)

NOTES:

3.1.9A — If necessary for clarity, an outer-conductor connection shall be made to the symbol.

3.1.9B — If the coaxial structure is not maintained, the tangential line shall be drawn only on the coaxial side.

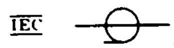
3.1.9.1 [5] General

IEC 

See Note 3.1.9A

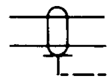
[5]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

3.1.9.2 Application: coaxial structure not maintained on the right



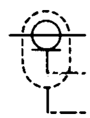
See Note 3.1.9B

3.1.9.3 [6] Two conductors (balanced) with one outer-conductor connection (twinax)



See Note 3.1.9A

3.1.9.4 [6] One conductor with one outer-conductor connection and one shielded connection (triax)

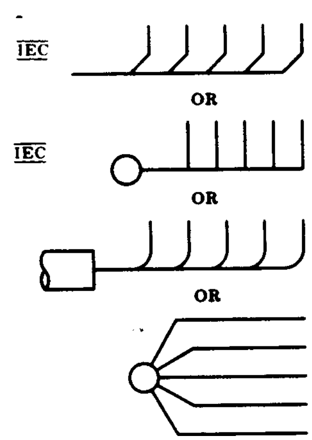


See Note 3.1.9A

3.1.10 Grouping of leads

3.1.10.1 General

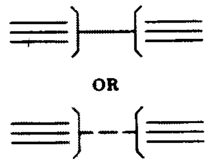
Bend of line indicates direction in which other ends of path will be found.



3.1.10.2 Interrupted (on diagram), shown with individual paths at each side of diagrammatic interruption.

The lower symbol consists of long dashes.

[6]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.



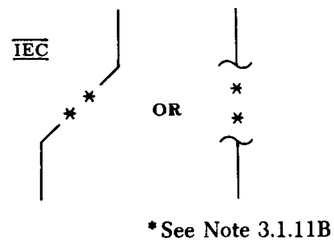
3.1.11 Interrupted path

Symbol normally used only when required for complex or special-purpose diagrams.

NOTES:

3.1.11A — To ensure continuity, the interrupted-path break points must be in alignment.

3.1.11B — The asterisk is not part of the symbol. Identifying values, letters, numbers, or marks shall replace the asterisk.



3.1.12 Conductor or cable end, not connected

3.1.12.1 With end especially insulated

3.2 Distribution Lines Transmission Lines

Commonly used on system diagrams, maps, and charts.

3.2.1 Type of circuit

USE SYMBOL 3.1.1

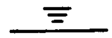
The following letters may be used to indicate type of transmission:

F	telephony IEC
S	sound (television) IEC
T	telegraphy transmission of data IEC
V	video (television) IEC

3.2.1.1 Application: telephone line

IEC 

3.2.2 Cable underground; underground line

IEC 

OR

These are long dashes.

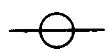
Avoid conflict with symbol 3.2.6 if used on the same diagram.

3.2.3 Submarine line; underwater line

IEC

3.2.4 Overhead line

Avoid conflict with symbol 3.6.1 if used on the same diagram.

IEC 

3.2.5 Loaded line

Avoid conflict with symbol 6.4.18 if used on the same diagram.

IEC 

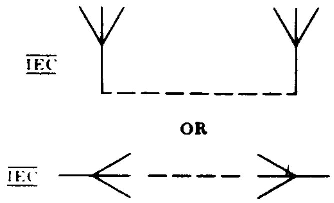
3.2.6 Radio link

Use only if essential to distinguish radio links or any radio portion of a circuit.

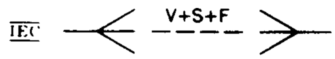
Avoid conflict with symbol 3.2.2 if used on the same diagram.

These are long dashes.

3.2.6.1 Application: radio link (with antenna shown)



3.2.6.2 Application: radio link carrying television (video with sound) and telephony (with antenna shown)



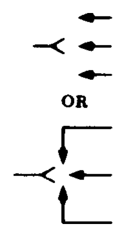
3.3 Alternative or Conditional Wiring

The arrowheads in this case shall be solid.

NOTE — 3.3A: A note shall explain the connections.

See Note 3.3A

3.3.1 Application: 3 alternative paths



See Note 3.3A

3.4 Associated or Future

See also paragraph A4.10 of the Introduction

These are short dashes.

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

3.6 Waveguide F

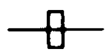
The mode of propagation or other special characteristics may be shown at the side of the waveguide symbol.

3.6.1 Circular, recognition symbol

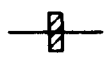
Avoid conflict with symbol 3.2.4 if used on the same diagram.

IEC 

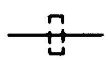
3.6.2 Rectangular, recognition symbol

IEC 

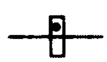
3.6.2.1 Dielectric-filled metallic rectangular waveguide

IEC 

3.6.2.2 Solid-dielectric rectangular waveguide

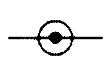
IEC 

3.6.2.3 Gas-filled rectangular waveguide

IEC 

3.6.3 Coaxial waveguide

See also item 3.1.9

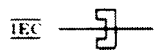
IEC 

3.6.4 Flexible waveguide

Avoid conflict with symbol 2.12.3 if used on the same diagram.

3.6.5 Twisted waveguide

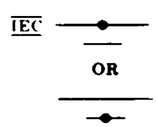
3.6.6 Ridged waveguide



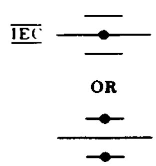
3.6.7 Goubau line (single-wire transmission line within solid dielectric)

3.7 Strip-Type Transmission Line

3.7.1 Unbalanced stripline



3.7.2 Balanced stripline



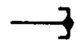
3.8 Termination

Commonly used on coaxial and waveguide diagrams.

3.8.1 Open circuit (open). Not a fault.

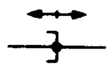
3.8.2 Short circuit (short). Not a fault.

NOTE — 3.8.2A: Use of the dot is optional.

IEC 

See Note 3.8.2A

3.8.3 Application: movable short circuit



See Note 3.8.2A

3.9 Circuit Return

3.9.1 Ground, general symbol

NOTE — 3.9.1A: Supplementary information may be added to define the status or purpose of the earth if this is not readily apparent.

1) A direct conducting connection to the earth or body of water that is a part thereof.
2) A conducting connection to a structure that serves a function similar to that of an earth ground (that is, a structure such as a frame of an air, space, or land vehicle that is not conductively connected to earth).

IEC 

3.9.1.1 Low-noise ground (IEC) noiseless, clean earth)

IEC 

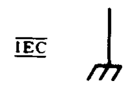
3.9.1.2 Safety or protective ground

NOTE — 3.9.1.2A: This symbol may be used in place of symbol 3.9.1 to indicate a ground connection having a specified protective function (e.g., for protection against electrical shock in case of a fault).

IEC 

3.9.2 Chassis or frame connection; equivalent chassis connection (of printed-wiring boards)

A conducting connection to a chassis or frame, or equivalent chassis connection of a printed-wiring board. The chassis or frame (or equivalent chassis connection of a printed-wiring board) may be at substantial potential with respect to the earth or structure in which this chassis or frame (or printed-wiring board) is mounted.



3.9.3 Common connections

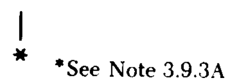
Conducting connections made to one another.

All like-designated points are connected.

NOTE — 3.9.3A: The asterisk is not part of the symbol. Identifying values, letters, numbers, or marks shall replace the asterisk. For the triangular symbol, this identification shall be placed within the triangle or, if essential for legibility, adjacent to the triangle.

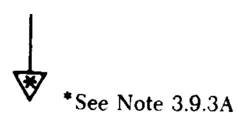
3.9.3.1 Specific potential difference

To be used when there is a specific potential difference with respect to a potential reference level.



3.9.3.2 Potential level not specified by a numerical value

To be used when identically annotated common-return connections are at the same potential level.



3.10 Pressure Tight Bulkhead Cable Gland Cable Sealing End

NOTE — 3.10A: The high pressure side is to the right of the trapezoid, thus retaining gland.

Cross References

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.

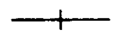
3 — For centered figures with symbols appearing side by side, the symbol on the left-hand side should be considered to be for a single line (one-line) diagram and the symbol on the right-hand side for a complete diagram, i.e., 1.5.1.

4. Graphic Symbols for Contacts, Switches, Contactors, and Relays

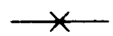
4.1 Switching Function

NOTE — 4.1A: Switching function symbols are suitable for use on "detached contact" diagrams, but may be used in other applications.

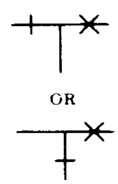
4.1.1 Conducting, closed contact (break)



4.1.2 Nonconducting, open contact (make)



4.1.3 Application: transfer



4.2 Electrical Contact F

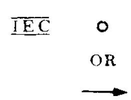
For buildups or forms using electrical contacts, see applications under 5.3.5 and 5.3.6.

See paragraph A4.6 of the Introduction

4.2.1 Fixed contact

4.2.1.1 Fixed contact for jack, key, relay, switch, etc

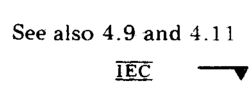
See also symbol 4.2.1.2



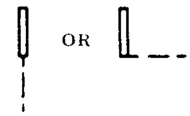
4.2.1.2 Fixed contact with momentary contact (automatic return)

NOTE — 4.2.1.2A: When this symbol (representing a contact with automatic return) is used on a diagram for international use, the convention should be so noted on the diagram or associated documentation. IEC

See also 4.9 and 4.11

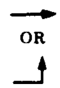


4.2.1.3 [7] Sleeve



4.2.2 Moving Contact

4.2.2.1 Adjustable or sliding contact for resistor, inductor, etc

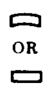


4.2.2.2 Locking

4.2.2.3 Nonlocking

4.2.2.4 Segment; bridging contact

See also items 4.13.3 and 4.13.4



4.2.2.5 Vibrator reed

4.2.2.6 Vibrator split reed

4.2.2.7 Rotating contact (slip ring) and brush

[7] The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

4.3 Basic Contact Assemblies

The standard method of showing a contact is by a symbol indicating the circuit condition it produces when the actuating device is in the deenergized or nonoperated position. The actuating device may be of a mechanical, electrical, or other nature, and a clarifying note may be necessary with the symbol to explain the proper point at which the contact functions; for example, the point where a contact closes or opens as a function of changing pressure, level, flow, voltage, current, etc. In cases where it is desirable to show contacts in the energized or operated condition and where confusion may result, a clarifying note shall be added to the drawing.

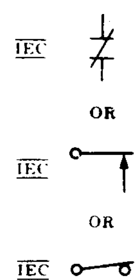
Auxiliary switches or contacts for circuit breakers, etc, may be designated as follows:

- a) Closed when device is energized or operated position.
- b) Closed when device is in deenergized or nonoperated position.
  - aa) Closed when operating mechanism of main device is in energized or operated position.
  - bb) Closed when operated mechanism of main device is in deenergized or nonoperated position.

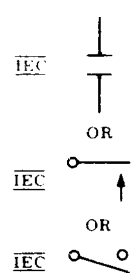
See American national Standard Manual and Automatic Station Control, Supervisory, and Associated Telemetering Equipment, C37.2-1970, for further details.

In the parallel-line contact symbols shown below, the length of the parallel lines shall be approximately $1^1/_4$ times the width of the gap (except for symbol 4.3.7).

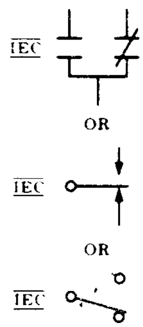
4.3.1 Closed contact (break)



4.3.2 Open contact (make)

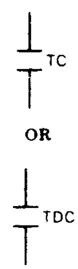


4.3.3 Transfer

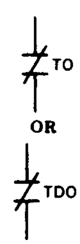


4.3.4 Make-before-break

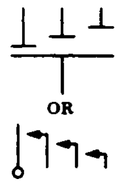
4.3.5 Application: open contact with time closing (TC) or time-delay closing (TDC) feature



4.3.6 Application: closed contact with time opening (TO) or time-delay opening (TDO) feature

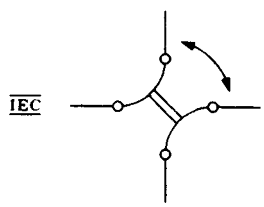


4.3.7 Time sequential closing

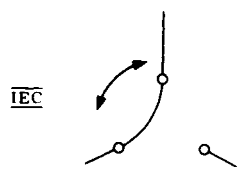


4.3.8 Multiway transfer switch

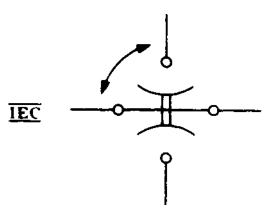
4.3.8.1 Two-position switch (90° step)



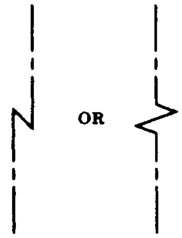
4.3.8.2 Three-position switch (120° step)



4.3.8.3 Four-position switch (45° step)



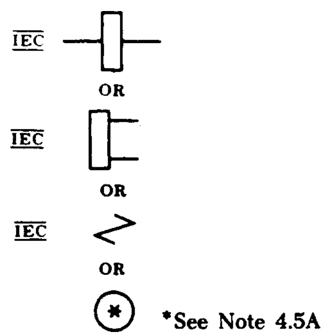
4.4 [8] Magnetic Blowout Coil F



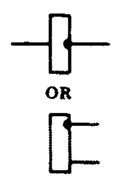
4.5 Operating Coil F
Relay Coil

See also INDUCTOR; WINDING; etc (item 6.2)

NOTE — 4.5A: The asterisk is not part of the symbol. Always replace the asterisk by a device designation. See, for example, ANSI C37.2-1970.

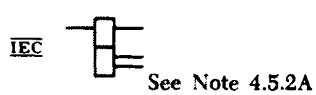


4.5.1 Semicircular dot indicates inner end of winding



4.5.2 Application: multiwinding coil (2 windings shown)

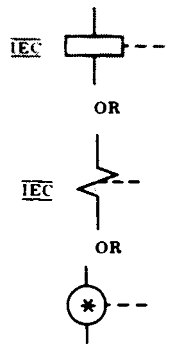
NOTE — 4.5.2A: The ends of a given winding shall be shown directly opposite each other on opposite sides of the core, or adjacent to each other on the same side of the core.



[8]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

4.5.3 Electromagnetic actuator (solenoid), with mechanical linkage shown

NOTE — 4.5.3A: The mechanical linkage may be omitted if the intent is clear.



* See Notes 4.5A and 4.5.3A

4.6 Switch

See also FUSE (item 9.1); and paragraphs A4.7 and A4.9 of the Introduction

Fundamentals symbols for contacts, mechanical connections, etc, may be used for switch symbols.

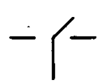
The standard method of showing switches is in a position with no operating force applied. For switches that may be in any of two or more positions with no operating force applied, and for switches actuated by some mechanical device (as in air-pressure, liquid-level, rate-of-flow, etc, switches), a clarifying note may be necessary to explain the point at which the switch functions.

When the basic switch symbols in items 4.6.1 through 4.6.3 are shown in the closed position on a diagram, terminals must be added for clarity.

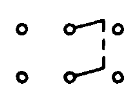
4.6.1 Single-throw, general

IEC 

4.6.2 Double-throw, general

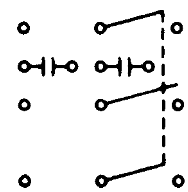


4.6.2.1 Application: 2-pole double-throw switch with terminals shown



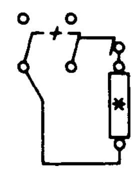
4.6.3 Knife switch F, general

4.6.4 Application: 3-pole double-throw knife switch with auxiliary contacts and terminals



4.6.5 Application: 2-pole field-discharge knife switch with terminals and discharge resistor

NOTE — 4.6.5A: The asterisk is not part of the symbol. Always add identification within or adjacent to the rectangle.



*See Note 4.6.5A

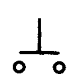
4.6.6 Switch with horn gap

4.6.7 Sector switch F

IEC 

4.7 Pushbutton F, Momentary or Spring-Return

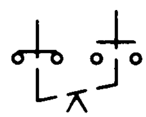
4.7.1 Circuit closing (make)



4.7.2 Circuit opening (break)

4.7.3 Two-circuit

4.8 Two-circuit, Maintained or Not Spring-Return

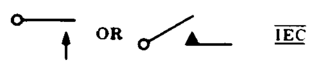


4.9 Nonlocking Switch, Momentary or Spring-Return

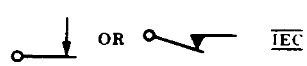
The symbols to the left are commonly used for spring buildups in key switches, relays, and jacks.

The symbols to the right are commonly used for toggle switches.

4.9.1 Circuit closing (make)

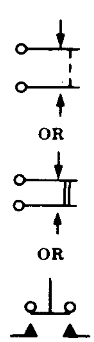


4.9.2 Circuit opening (break)

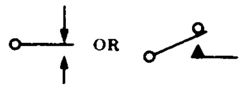


4.9.3 Two-circuit

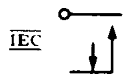
See Note 14.1.1A



4.9.4 Transfer



4.9.5 Make-before-break

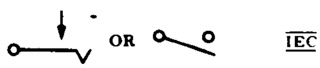


4.10 Locking Switch

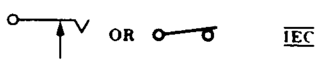
The symbols to the left are commonly used for spring buildups in key switches and jacks.

The symbols to the right are commonly used for toggle switches.

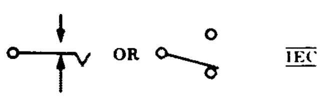
4.10.1 Circuit closing (make)



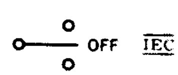
4.10.2 Circuit opening (break)



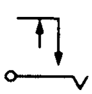
4.10.3 Transfer, 2-position



4.10.4 Transfer, 3-position



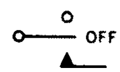
4.10.5 Make-before-break



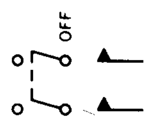
4.11 Combination Locking and Nonlocking Switch

Commonly used for toggle switches

4.11.1 3-position, 1-pole: circuit closing (make), off, momentary circuit closing (make)

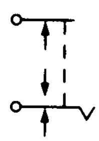


4.11.2 3-position, 2-pole: circuit closing (make), off, momentary circuit closing (make)

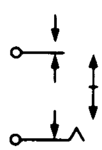


4.12 Key-Type Switch
Lever Switch

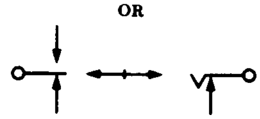
4.12.1 2-position with locking transfer and break contacts



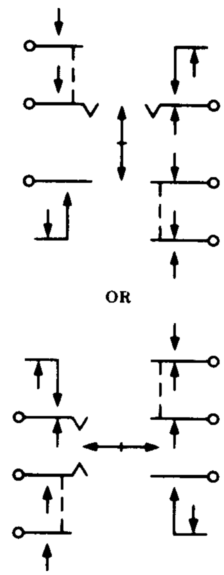
4.12.2 3-position with nonlocking transfer and locking break contacts



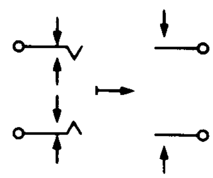
OR



4.12.3 3-position, multicontact combination



4.12.4 2-position, half of key switch normally operated, multicontact combination

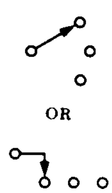


4.13 Selector or Multiposition Switch

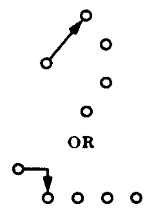
The position in which the switch is shown may be indicated by a note or designation of switch position.

4.13.1 General (for power and control diagrams)

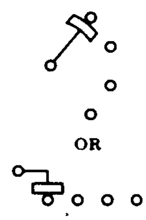
Any number of transmission paths may be shown.



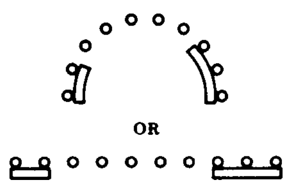
4.13.2 Break-before-make, nonshorting (nonbridging) during contact transfer



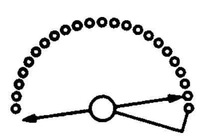
4.13.3 Make-before-break, shorting (bridging) during contact transfer



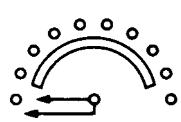
4.13.4 Segmental contact



4.13.5 22-point selector switch

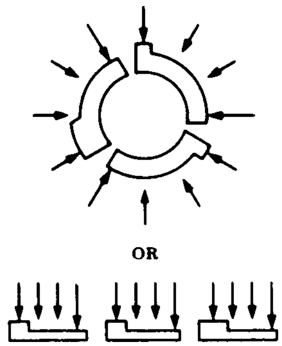


4.13.6 10-point selector switch with fixed segment



4.13.7 Rotary (section-, deck-, or wafer-type) $\boxed{F}$

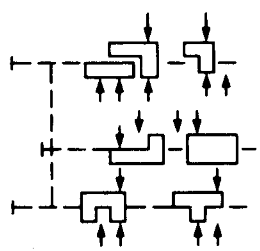
Viewed from end opposite control knob or actuator unless otherwise indicated. For more than one section, the first section is the one nearest control knob or actuator. When contacts are on both sides, front contacts are nearest control knob.



4.13.8 Slide switch, typical ladder-type interlock

In the example, one slide is shown operated.

Slides are shown in released position unless otherwise noted.



4.13.9 Master or control switch

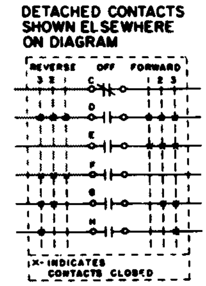
A table of contact operation must be shown on the diagram. A typical table is shown below.

DETACHED CONTACTS SHOWN ELSEWHERE ON DIAGRAM

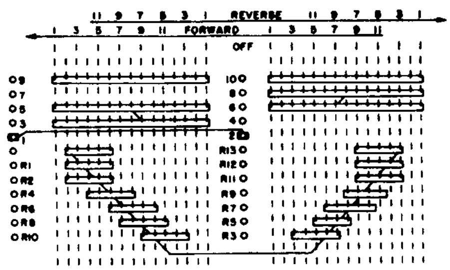
CONTACT	INDICATOR POSITION		
	A	B	C
1 – 2			X
3 – 4	X		
5 – 6			X
7 – 8	X		
X- INDICATES CONTACTS CLOSED			

4.13.10 Master or control switch (cam-operated contact assembly), 6-circuit 3-point reversing switch

A table of contact operation must be shown on the diagram. A typical table is shown below. Tabulate special features in note.



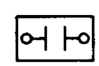
4.13.11 Drum switch, sliding-contact type, typical example



4.14 Limit Switch
Sensitive Switch F

NOTE — 4.14A: Identify by LS or other suitable note.

4.14.1 Track-type, circuit-closing contact

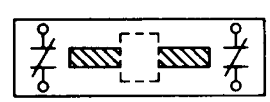


See Note 4.14A

4.14.2 Track-type, circuit-opening contact

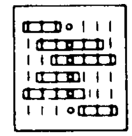
See Note 4.14A

4.14.3 Lead-screw type, circuit-opening contacts



See Note 4.14A

4.14.4 Rotary-type



See Note 4.14A

4.14.5 Limit switch, directly actuated, spring returned

4.14.5.1 Normally open

4.14.5.2 Normally open—held closed

4.14.5.3 Normally closed

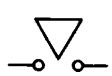
4.14.5.4 Normally closed—held open

4.15 Safety Interlock

If specific type identification is not required, use applicable standard symbol.

4.15.1 If specific type identification is required: circuit opening

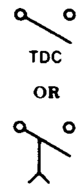
4.15.2 If specific type identification is required: circuit closing



4.16 Switches with Time-Delay Feature

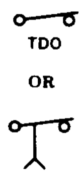
NOTE — 4.16A: The point of the arrow indicates the direction of switch operation in which contact action is delayed.

4.16.1 Open switch with time-delay closing (TDC) feature



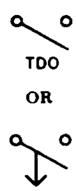
See Note 4.16A

4.16.2 Closed switch with time-delay opening (TDO) feature



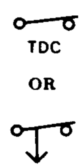
See Note 4.16A

4.16.3 Open switch with time-delay opening (TDO) feature



See Note 4.16A

4.16.4 Closed switch with time-delay closing (TDC) feature

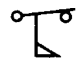


See Note 4.16A

4.17 Flow-Actuated Switch

4.17.1 Closes on increase in flow.

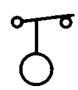
4.17.2 Opens on increase in flow



4.18 Liquid-Level-Actuated Switch

4.18.1 Closes on rising level

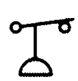
4.18.2 Opens on rising level



4.19 Pressure- or Vacuum-Actuated Switch

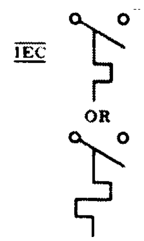
4.19.1 Closes on rising pressure

4.19.2 Opens on rising pressure

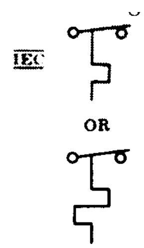


4.20 Temperature-Actuated Switch

4.20.1 Closes on rising temperature



4.20.2 Opens on rising temperature



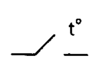
4.21 Thermostat

NOTES:

4.21A — The t° symbol shall be shown or be replaced by data giving the nominal or specific operating temperature of the device.

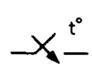
4.21B — If clarification of direction of contact operation is needed, a directional arrow may be added. The arrowhead shall point in the direction of rising temperature operation. A directional arrow shall always be shown for central-off (neutral) position devices.

4.21.1 Closes on rising temperature



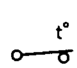
See Note 4.21A

4.21.1.1 With contact-motion direction clarified



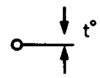
See Note 4.21B

4.21.2 Opens on rising temperature



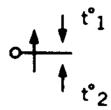
See Note 4.21A

4.21.3 Transfers on rising temperature



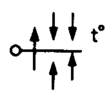
See Note 4.21A

4.21.4 Transfer, with intended central-off (neutral) position



See Notes 4.21A and B

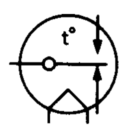
4.21.5 Application: multifunction, typical



See notes 4.21A and B

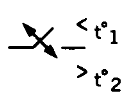
4.21.6 With integral heater and transfer contacts

Use only if essential to indicate integral heater details.



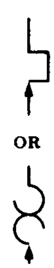
See Notes 4.21A and B

4.21.7 Application: with operating temperatures indicated



See Notes 4.21A and B

4.22 Flasher Self-Interrupting Switch



4.23 Foot-Operated Switch
Foot Switch F

4.23.1 Opens by foot pressure

4.23.2 Closes by foot pressure

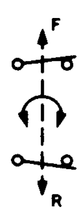
4.24 Switch Operated by Shaft Rotation and Responsive to Speed or Direction

See also item 4.27

4.24.1 Speed

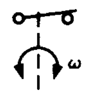
4.24.2 Plugging: to stop drive after it has come practically to rest

4.24.3 Anti-plugging: to prevent plugging of drive



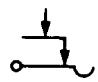
4.24.4 Centrifugal switch (opening on increasing speed)

See also symbol 14.2.6

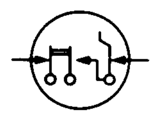


4.25 Switches with Specific Features

4.25.1 Hook switch $\boxed{F}$

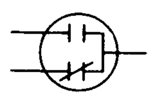


4.25.2 Telephone dial $\boxed{F}$ (switch)

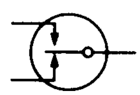


TYPICAL

4.25.3 Switch in evacuated envelope, 1-pole double-throw



OR



4.25.4 Mushroom-head safety feature

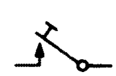
Application to 2-circuit pushbutton switch.

4.25.5 Key-operated lock switch

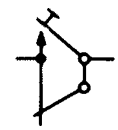
Use appropriate standard symbol and add key designation or other information in note.

4.26 Telegraph Key $\boxed{F}$

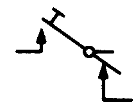
4.26.1 Simple



4.26.2 Simple with shorting switch



4.26.3 Open-circuit or pole-changing



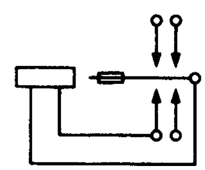
4.27 Governor F (Contact-making) Speed Regulator

Contacts open or closed as required (shown here as closed).

4.28 Vibrator, Interrupter F

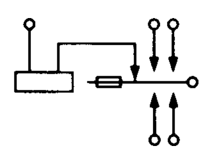
4.28.1 Typical shunt drive (with terminals shown)

Show contacts as required.



4.28.2 Typical separate drive (with terminals shown)

Show contacts as required.

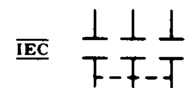


4.29 Contactor

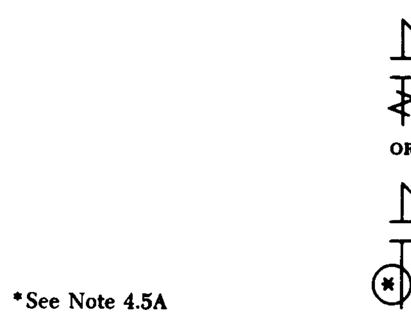
See also CIRCUIT BREAKER (item 9.4)

Fundamental symbols for contacts, coils, mechanical connections, etc, are the basis of contactor symbols and should be used to represent contactors on complete diagrams. Complete diagrams of contactors consist of combinations of fundamental symbols for control coils, mechanical connections, etc, in such configurations as to represent the actual device. Mechanical interlocking should be indicated by notes.

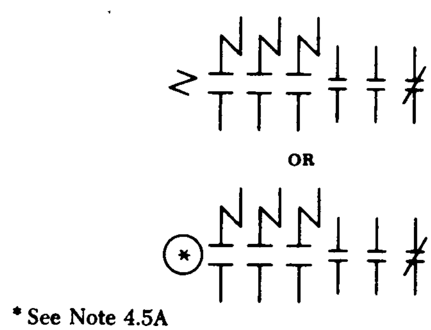
4.29.1 Manually operated 3-pole contactor



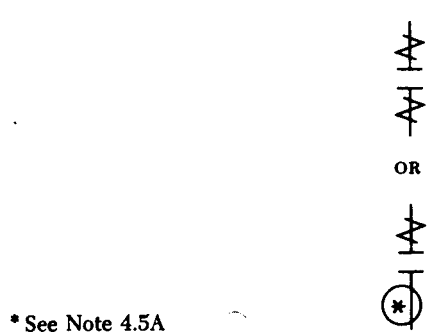
4.29.2 Electrically operated 1-pole contactor with series blowout coil



4.29.3 Electrically operated 3-pole contactor with series blowout coils; 2 open and 1 closed auxiliary contacts (shown smaller than the main contacts)



4.29.4 Electrically operated 1-pole contactor with shunt blowout coil



4.30 Relay

See OPERATING COIL; RELAY COIL (item 4.5)

Fundamental symbols for contacts, mechanical connections, coils, etc, are the basis of relay symbols and should be used to represent relays on complete diagrams.

The following letter combinations or symbol elements may be used with relay symbols. The requisite number of these letters or symbol elements may be used to show what special features a relay possesses

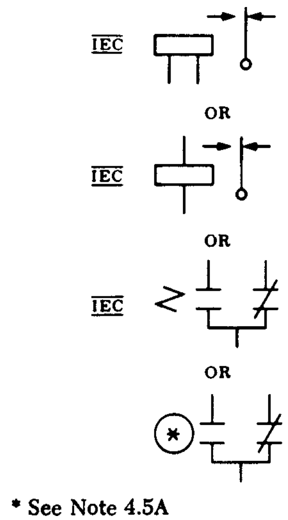
The terms “slow” and “fast” are relative, and the degree is not to be noted by a multiplicity of the same relay symbol on a diagram. Relays that are direct-current operated are not marked to indicate dc operation.

IEC  AC Alternating-current or ringing relay
D Differential
DB Double-biased (biased in both directions)
DP Dashpot
EP Electrically polarized
FO Fast-operate
FR Fast-release
L Latching
MG Marginal
ML Magnetic-latching (remanent)
NB No bias
NR Nonreactive
 P Magnetically polarized using biasing spring, or having magnet bias
SA Slow-operate and slow-release
IEC  SO Slow-operate
 SR Slow-release
SW Sandwich-wound to improve balance to longitudinal currents

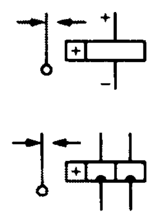
The proper poling for a polarized relay shall be shown by the use of + and - designations applied to the winding leads. The interpretation of this shall be that a voltage applied with the polarity as indicated shall cause the armature to move toward the contact shown nearer the coil on the diagram. If the relay is equipped with numbered terminals, the proper terminal numbers shall also be shown.

4.30.1 Basic

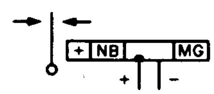
4.30.2 Application: relay with transfer contacts



4.30.3 Application: polarized relay with transfer contacts (two typical types shown)



4.30.4 Application: polarized (no bias) marginal relay with transfer contacts



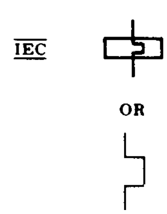
4.30.5 Relay, thermally operated

4.30.5.1 Activating device for thermally operated relay

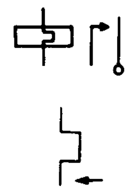
Time of delay may be shown.

Contacts may be shown separately from the operating device.

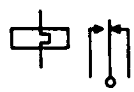
See also item 2.14



4.30.5.2 With normally open contacts shown (two typical types)

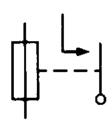
IEC 

4.30.5.3 With transfer contacts shown

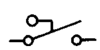
IEC 

4.30.6 Thermal relay, one-time type, not reusable

Normally open contact type shown.

IEC 

4.31 Inertia Switch (operated by sudden deceleration)

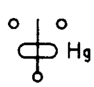
 IEC

NOTE — 4.31A: This symbol is commonly used on diagrams for aerospace applications.

4.32 Mercury Switch

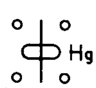
4.32.1 Leveling

4.32.1.1 Three terminal



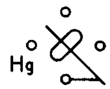
IEC

4.32.1.2 Four terminal



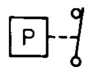
IEC

4.32.2 With acceleration cutoff (four terminal)



IEC

4.33 Aneroid Capsule (air pressure) Operated Switch



IEC

Cross References

Protective Relay (item 9.5)

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.

5. Graphic Symbols for Terminals and Connectors

5.1 Terminals

5.1.1 Circuit terminal

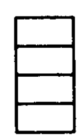
IEC

5.1.1.1 Terminal board  or terminal strip, with 4 terminals shown; group of 4 terminals

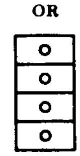
Number and arrangement as convenient.

NOTE — 5.1.1.1A: Internal lines and terminals may be omitted if terminal identifications are shown within the symbol.

IEC



OR



See Note 5.1.1.1A

5.1.2 Terminals for electron tubes, semiconductor devices, etc

Used primarily in application-data terminal diagrams for electron tubes, semiconductor devices, and other devices having terminations of similar type.

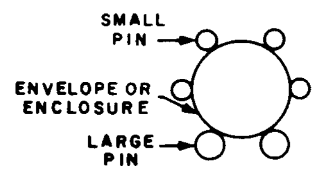
NOTES:

5.1.2A — Explanatory words and arrows are not part of the symbol.

5.1.2B — The following letter combinations, if shown adjacent to terminal symbols requiring special attention, shall signify the following:

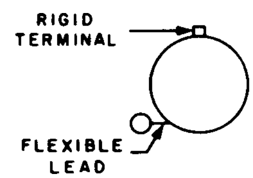
- S Connection to an external shield integral with a device (including metal tube shell, base sleeve or shell; external conductive coating or casing). Not to be used if the external conductive coating serves as one side of a capacitor (as in cathode-ray tubes) and is not designed to function as an electrostatic shield.
- IC Internal connection: not intended to be used for circuit connection.
- IS Internal shield not depicted in terminal diagram.

5.1.2.1 Base-pin terminals (electron tubes, etc); pin terminals (semiconductor devices, etc)



See Note 5.1.2A

5.1.2.2 Envelope terminals

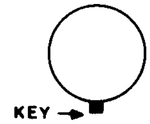


See Note 5.1.2A

The rigid-terminal symbol is used to indicate customary rigid terminals (caps, rods, rings, etc) as well as to indicate:

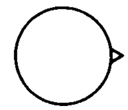
1) Any metallic envelope or external conductive coating or casing that has a contact area (as in cathode-ray tubes, disc-seal tubes, pencil tubes, etc).
2) Mounting flange or stud when it serves as a terminal.

5.1.2.3 Device with base-orientation key

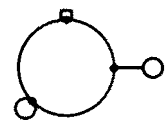


See Note 5.1.2A

5.1.2.4 Devices with reference point (such as a boss, colored dot, index pin, index tab, or bayonet pin)

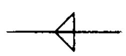
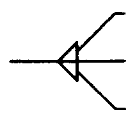


5.1.2.5 Terminals connected to metallic envelope or enclosure



5.2 Cable Termination

Line shown on left of symbol indicates cable.

 IEC 

5.3 Connector
Disconnecting Device
Jack F
Plug F

The contact symbol is not an arrowhead. It is larger and the lines are drawn at a 90-degree angle.

5.3.1 Female contact

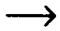
IEC 

5.3.2 Male contact

IEC

5.3.3 Connector assembly, movable or stationary portion; jack, plug, or receptacle

NOTE — 5.3.3A: Use appropriate number of contact symbols.


IEC

OR


IEC

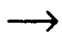
See Note 5.3.3A

5.3.3.1 Receptacle or jack (usually stationary)

NOTE — 5.3.3.1A: The asterisk is not part of the symbol. If desired, indicate the type of contacts: male (→) or female (≻—).

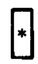

IEC

OR


IEC

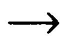
See Note 5.3.3A

OR



*See Note 5.3.3.1A

5.3.3.2 Plug (usually movable)


IEC

OR

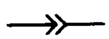

IEC

See Note 5.3.3A

OR

*See Note 5.3.3.1A

5.3.4 Separable connectors (engaged)

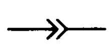

IEC

See Note 5.3.3A

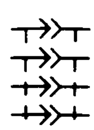
OR

*See Note 5.3.3.1A

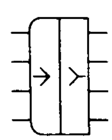
5.3.4.1 Application: engaged 4-conductors (female plug male receptacle shown)


IEC

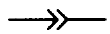
IEC



OR

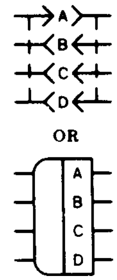


5.3.4.2 Application: engaged 4-conductor connectors; the plug has 1 male and 3 female contacts with individual contact designations shown in the complete-symbol column



IEC

IEC

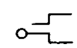


5.3.5 Communication switchboard-type connector

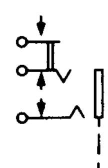
See also symbol 4.2.1.4

5.3.5.1 2-conductor (jack)

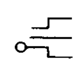
5.3.5.2 2-conductor (plug)



5.3.5.3 [9] 3-conductor (jack) with 2 break contacts (normals) and 1 auxiliary make contact



5.3.5.4 3-conductor (plug)



5.3.6 Communication switchboard-type connector with circuit normalled through "Normalled" indicates that a through circuit may be interrupted by an inserted connector. As shown here, the inserted connector opens the through circuit and connects to the circuit towards the left.

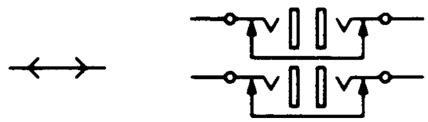
Items 5.3.6.1 through 5.3.6.4 show 2-conductor jacks. The "normal" symbol is applicable to other types of connectors.

See also symbol 4.2.1.3

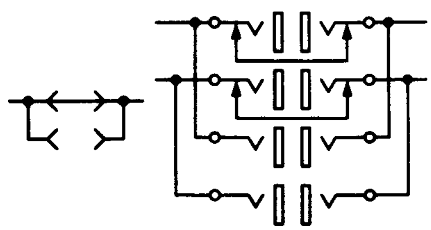
[9]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

5.3.6.1 Jacks with circuit normalled through one way

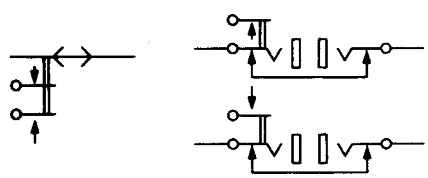
5.3.6.2 Jacks with circuit normalled through both ways



5.3.6.3 Jacks in multiple, one set with circuit normalled through both ways



5.3.6.4 Jacks with auxiliary contacts, with circuit normalled through both ways



5.4 Connectors of the Type Commonly Used for Power-Supply Purposes (convenience outlets and mating connectors). American National Standard Dimensions of Attachment Plugs and Receptacles. C73.10-1966 (R1972) through C73.68-1966 (R1972).

See also symbols 5.3.3.1 and 5.3.3.2

The following symbols are primarily for applications where the type of connector must be indicated semipictorially.

Contacts and contact arrangements shall be shown in simplified form as viewed from the mating face, approximately in proportion to the arrangement in the physical item. A simplified-shape outline shall surround the contact symbols.

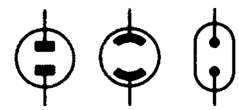
5.4.1 Male contact

Filled outline, approximating contact end-view (3 typical forms are shown)

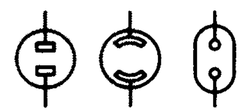
5.4.2 Female contact

Open outline, approximating limiting shape of mating male contact (3 typical forms are shown)

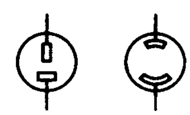
5.4.3 Application: 2-conductor nonpolarized connector with male contacts (3 typical forms are shown)



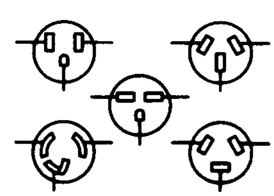
5.4.4 Application: 2-conductor nonpolarized connector with female contacts (3 typical forms are shown)



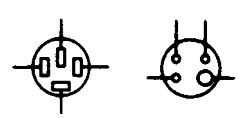
5.4.5 Application: 2-conductor polarized connector (2 typical forms with female contacts are shown)



5.4.6 Application: 3-conductor polarized connector (5 typical forms with female contacts are shown)



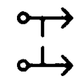
5.4.7 Application: 4-conductor polarized connector (2 typical forms with female contacts are shown)



5.5 Test Block

5.5.1 Female portion with short-circuiting bar (with terminals shown)

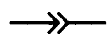
5.5.2 Male portion (with terminals shown)



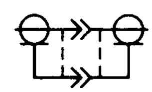
5.6 Coaxial Connector
Coaxial Junction

5.6.1 Engaged coaxial connectors

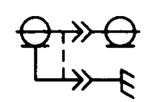
Coaxial recognition symbol may be added if necessary. See COAXIAL TRANSMISSION PATH (item 3.1.9)

IEC 

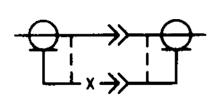
5.6.2 Application: coaxial with the outside conductor shown carried through

IEC 

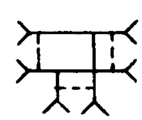
5.6.3 Application: coaxial with center conductor shown carried through; with outside conductor terminated on chassis

IEC 

5.6.4 Application: coaxial with center conductor shown carried through; outside conductor not carried through

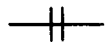


5.6.5 Application: T or Y adapter with outer conductor carried through



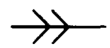
5.7 Waveguide Flanges
Waveguide Junction

5.7.1 Mated pair of symmetrical waveguide connectors

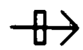
IEC 

5.7.2 Mated pair of asymmetrical waveguide connectors

The line is not interrupted at the junction whether or not it is a plain-type or choke-type connection.

IEC 

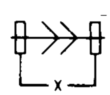
5.7.3 Plain (rectangular waveguide)

IEC 

5.7.4 Choke (rectangular waveguide)

IEC 

5.7.5 Application: rectangular waveguide with mated plain and choke flanges with direct-current isolation (insulation) between sections of waveguide



Cross References

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.

6. Graphic Symbols for Transformers, Inductors, and Windings

6.1 Core

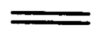
6.1.1 General or air core

If it is necessary to identify an air core, a note should appear adjacent to the symbol of the inductor or transformer

NO SYMBOL

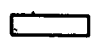
6.1.2 Magnetic core of inductor or transformer

Not to be used unless it is necessary to identify a magnetic core.



6.1.3 Core of magnet

For use if representation of the core is necessary. See PERMANENT MAGNET (item 2.8)

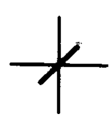


6.1.4 Magnetic-memory core

Commonly used in magnetic-memory and magnetic channel-selector devices.

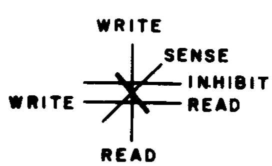
See also item 15.18.

6.1.4.1 Single-aperture type with windings shown



6.1.4.2 Application: in an array having four windings—two WRITE-READ windings, one INHIBIT winding, and one SENSE winding

NOTE — 6.1.4.2A: Words are for explanation and are not part of the symbol.



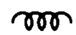
See Note 6.1.4.2A

6.2 Inductor
Winding (machine or transformer)
Reactor Radio-Frequency Coil
Telephone Retardation Coil

See also OPERATING COIL (item 4.5) For polarity markings see item 1.6.3

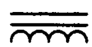
6.2.1 General

NOTE — 6.2.1A: This symbol is deprecated and should not be used on new schematics.

IEC  OR 

6.2.2 Magnetic-core inductor
Telephone loading coil

If necessary to show a magnetic core.



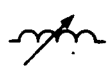
6.2.3 Tapped

IEC 

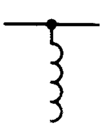
6.2.4 Adjustable inductor

IEC 

6.2.5 Adjustable or continuously adjustable inductor

IEC 

6.2.6 Shunt inductor



6.2.7 Inductive termination

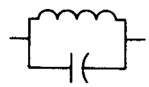
Commonly used in coaxial and waveguide diagrams.

6.2.7.1 Application: series inductor and path open

6.2.7.2 Application: series inductor and path short-circuited

6.2.8 Carrier line trap (carrier elimination filter)

6.2.8.1 General



NOTE — 6.2.8.1A: If it is essential to indicate the following characteristics, the specified letter or letters may be inserted within or placed adjacent to the symbol.

2f	Two frequency
WB	Wide band
NB	Narrow band

6.2.9 Coil operated flag indicator

6.3 Transductor Saturable-Core Inductor Saturable-Core Reactor

NOTES:

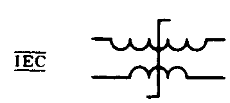
6.3A — If essential for clarity, the magnetic core symbol, 6.1.2, may be added where applicable.

6.3B — Power windings are drawn with three scallops or loops, control windings with five.

6.3C — The saturable-properties indicator, symbol 1.2.4, may also be used to indicate two or more windings.

6.3.1 Transductor element, assembled

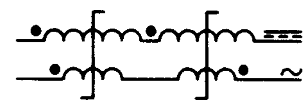
When windings are separated on a drawing, suitable indication shall be provided to show that they are on the same core.



6.3.2 Application: single-phase series transductor with winding-polarity and kind-of-current markings shown

NOTE — 6.3.2A: An increase of current entering the end of the control winding marked with a dot causes an increase in the power output.

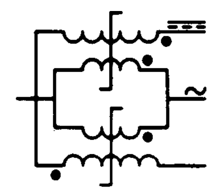
IEC



See Notes 6.3B and C

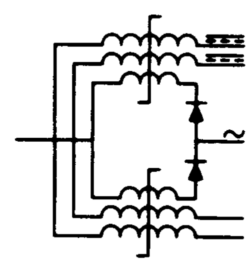
6.3.3 Application: single-phase parallel transductor with winding-polarity and kind-of-current markings shown

IEC



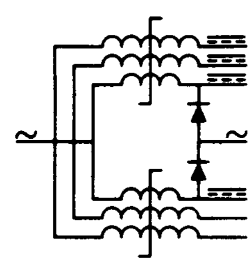
See Notes 6.3B, 6.3C, and 6.3.2A

6.3.4 Application: self-exciting transductor with two control circuits and kind-of-current markings shown



See Note 6.3B

6.3.5 Application: transductor with direct-current output and kind-of-current markings shown



See Note 6.3B

6.4 Transformer F
Telephone Induction Coil
Telephone Repeating Coil

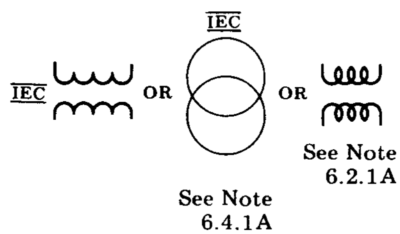
6.4.1 General

Additional windings may be shown or indicated by a note.

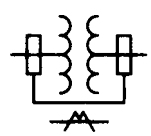
For polarity markings on current and potential transformers, see symbol 1.6.3.

In coaxial and waveguide circuits, this symbol represents a taper or step transformer without mode change.

NOTE — 6.4.1A: This symbol is the preferred symbol from IEC Publication 117, Recommended Graphical Symbols. It should be used on schematics for equipments having international usage, especially when the equipment will be marked using this symbol (in accordance with IEC Publication 417, Graphical Symbols for Use on Equipment).



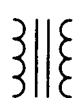
6.4.1.1 Application: transformer with direct-current connections and mode suppression between two rectangular waveguides



6.4.2 Magnetic-core transformer

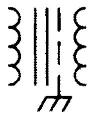
If necessary to show a magnetic core.

6.4.2.1 Nonsaturating



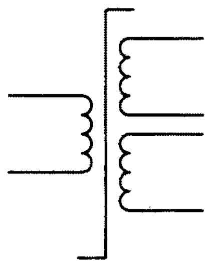
6.4.2.2 Application: shielded transformer with magnetic core shown

6.4.2.3 Application: transformer with magnetic core shown and with an electrostatic shield between windings. The shield is shown connected to the frame.

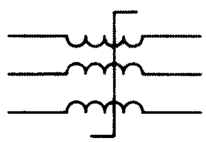


6.4.3 Saturating transformer

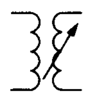
See SATURABLE-PROPERTIES INDICATOR (symbol 1.2.4)



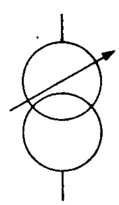
OR

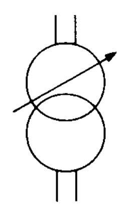


6.4.4 One winding with adjustable inductance

IEC 

OR

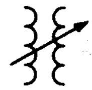




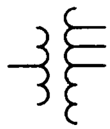
6.4.5 Each winding with separately adjustable inductance

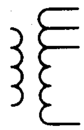
IEC 

6.4.6 Adjustable mutual inductor; constant-current transformer

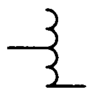


6.4.7 With taps, 1-phase

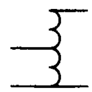




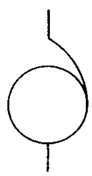
6.4.8 Autotransformer, 1-phase



IEC

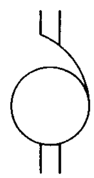


OR



IEC

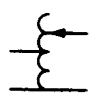
IEC



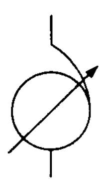
See Note 6.4.1A

See Note 6.4.1A

6.4.9 Adjustable

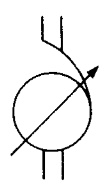


OR



IEC

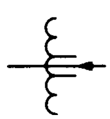
IEC

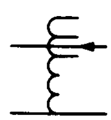


See Note 6.4.1A

See Note 6.4.1A

6.4.10 Step-voltage regulator or load-ratio control autotransformer





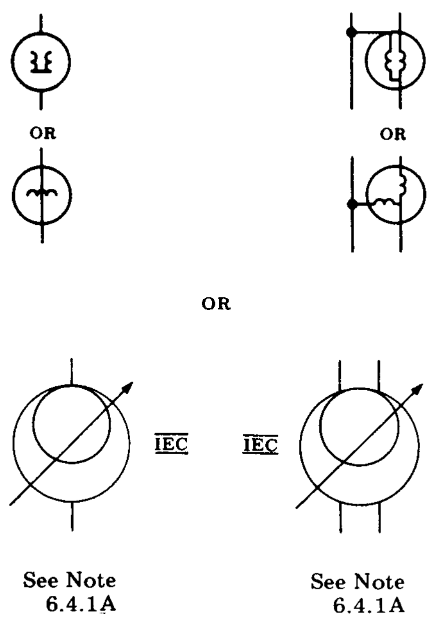
6.4.10.1 Step-voltage regulator

6.4.10.2 Load-ratio control auto-transformer

6.4.11 Load-ratio control transformer with taps

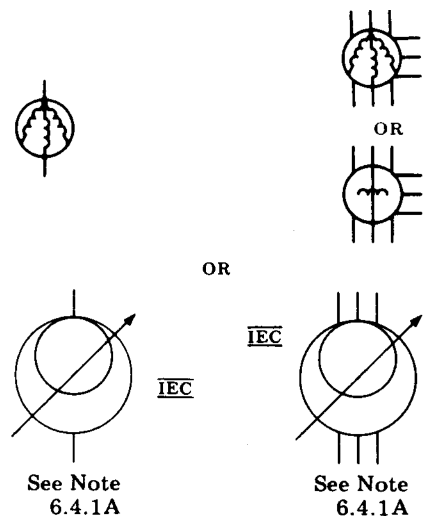
6.4.12 1-phase induction voltage regulator(s)

Number of regulators may be written adjacent to the symbol.

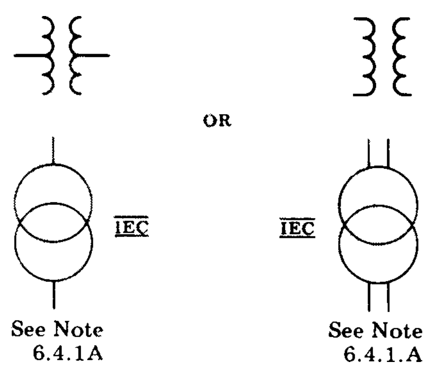


6.4.13 Triplex induction voltage regulator

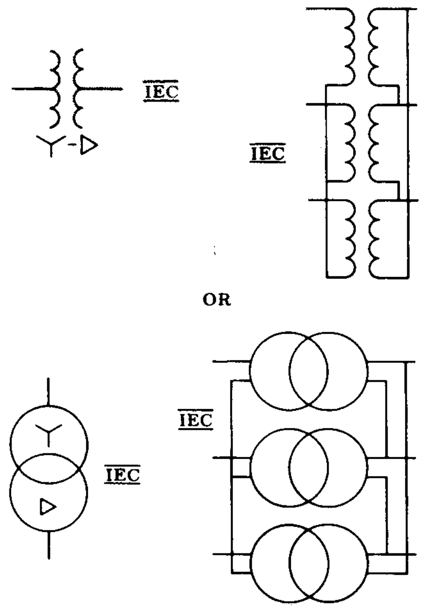
6.4.14 3-phase induction voltage regulator



6.4.15 1-phase, 2-winding transformer

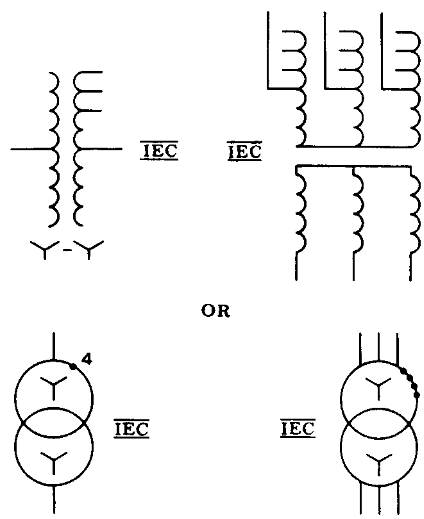


6.4.15.1 Application: 3-phase bank of 1-phase, 2-winding transformers with wye-delta connections

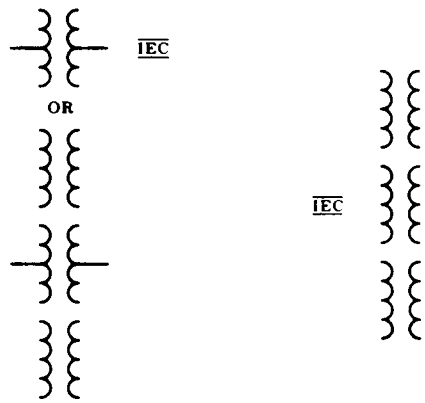


See Note 6.4.1A   See Note 6.4.1A

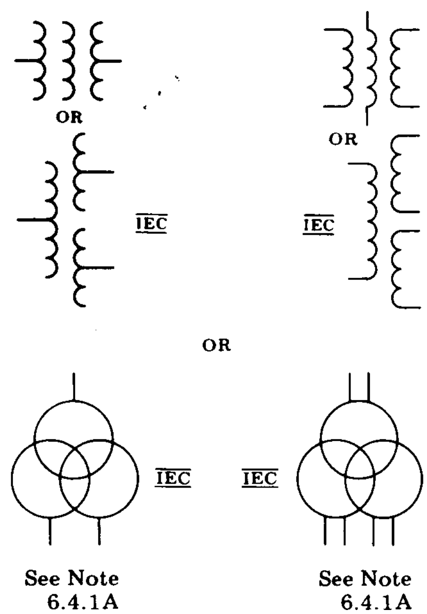
6.4.15.2 Three phase transformer with 4 taps with wye-wye connections



6.4.16 Polyphase transformer

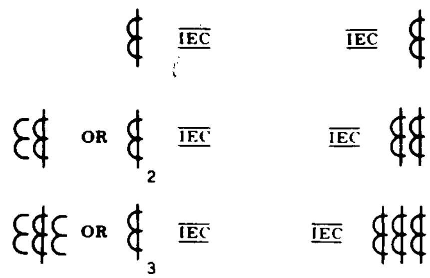


6.4.17 1-phase, 3-winding transformer



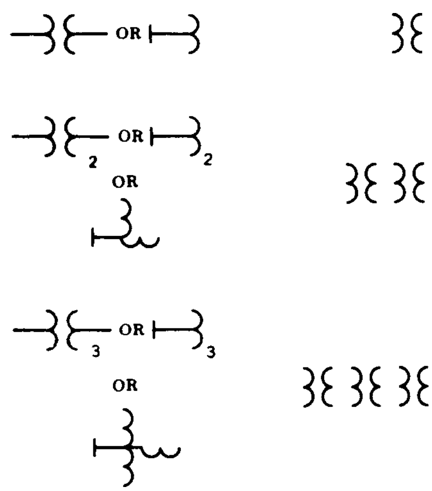
6.4.18 Current transformer(s)

Avoid conflict with symbol 3.2.5 if used on the same diagram.



6.4.19 [10] Bushing-type current transformer

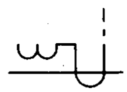
6.4.20 Potential transformer(s)



6.4.21 Outdoor metering device

[10]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

6.5 [11] Linear Coupler

Cross References

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.

7. Graphic Symbols for Electron Tubes and Related Devices

7.1 Electron Tube F

See also ENVELOPE; ENCLOSURE (item 1.10) and TERMINALS FOR ELECTRON TUBES, SEMICONDUCTOR DEVICES, ETC (item 5.1.2)

Tube-component symbols are shown first. These are followed by typical applications showing the use of these specific symbols in the various classes of devices such as thermionic, cold-cathode, and photoemissive tubes of varying structures and combinations of elements (triodes, cathode-ray tubes, etc).

Lines outside of the envelope are not part of the symbol but are electrical connections thereto.

Connections between the external circuit and electron-tube symbols within the envelope may be located as required to simplify the diagram.

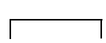
7.1.1 Emitting electrode

7.1.1.1 Directly heated (filamentary) cathode

NOTE — 7.1.1.1A: Leads may be connected in any convenient manner to ends of the ∧ provided the identity of the ∧ is retained.

IEC  **See Note 7.1.1.1A**

7.1.1.2 Indirectly heated cathode

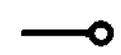
Lead may be connected to either extreme end of the  or, if required, to both ends, in any convenient manner.

---

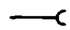
[11]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

IEC

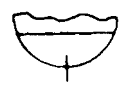
7.1.1.3 Cold cathode (including ionically heated cathode)

IEC 

7.1.1.4 Photocathode

IEC 

7.1.1.5 Pool cathode

IEC 

7.1.1.6 Ionically heated cathode with provision for supplementary heating

IEC 

See Note 7.1.1.1A

7.1.2 Controlling electrode

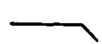
7.1.2.1 Grid (including beam-confining or beam-forming electrodes)

IEC

7.1.2.2 Deflecting electrodes (used in pairs); reflecting or repelling electrode (used in velocity-modulated tubes)

IEC 

7.1.2.3 Ignitor (in pool tubes) (should extend into pool); starter (in gas tubes)

IEC 

7.1.2.4 Excitor (contactor type)

7.1.3 Collecting electrode

7.1.3.1 Anode or plate

IEC 

7.1.3.2 Target or x-ray anode

Drawn at about a 45-degree angle.

IEC 

7.1.3.3 Fluorescent target

Drawn at about a 45-degree angle.

IEC 

7.1.3.4 Collector

7.1.4 Collecting and emitting electrode

7.1.4.1 Dynode

IEC 

7.1.4.2 Alternately collecting and emitting electrode

7.1.4.2.1 Composite anode-photocathode

IEC 

7.1.4.2.2 Composite anode-cold cathode

IEC 

7.1.4.2.3 Composite anode-ionically heated cathode with provision for supplementary heating

IEC 

See Note 7.1.1.1A

7.1.5 Heater

IEC 

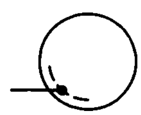
See Note 7.1.1.1A

7.1.6 Shield

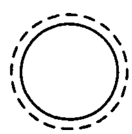
See symbol 7.2.10

This is understood to shield against electric fields unless otherwise noted.

7.1.6.1 Any shield against electric fields that is within the envelope and that is connected to an independent terminal



7.1.6.2 Outside envelope of x-ray tube

IEC 

7.1.7 Coupling

See COUPLING (item 15.2), COAXIAL TRANSMISSION PATH (item 3.1.9), and WAVEGUIDE (item 3.6)

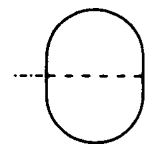
7.1.7.1 Coupling by loop (electromagnetic type)

Coupling loop may be shown inside or outside envelope as desired.

7.1.8 [12] Ion-diffusion barrier, shown with envelope

Commonly used with liquid-filled tubes.

[12]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.



7.2 General Notes

7.2.1 If new symbols are necessary, they should be formed where possible from component symbols. For example, see DYNODE (item 7.1.4.1), which combines the anode and photocathode conventions.

7.2.2 A connection to anode, dynode, pool cathode, photocathode, deflecting electrode, composite anode-photocathode, and composite anode-cold cathode shall be to the center of that symbol. Connection to any other electrode may be shown at either end or both ends of the electrode symbol.

7.2.3 A diagram for a tube having more than one heater or filament shall show only one heater or filament symbol $\wedge$ unless they have entirely separate connections. If a heater or filament tap is made, either brought out to a terminal or internally connected to another element, it shall be connected at the vertex of the symbol, regardless of the actual division of voltage across the heater or filament.

7.2.4 Standard symbols, such as the inclined arrow for tunability and connecting dotted lines for ganged components, may be added to a tube symbol to extend the meaning of the tube symbol, provided such added feature or component is integral with the tube.

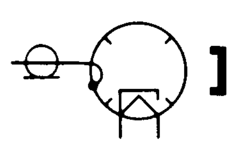
7.2.5 Electric components, such as resistors, capacitors, or inductors, which are integral parts of the tube and are important to its functional operation, shall be shown in the standard manner.

7.2.6 Multiple equipotential cathodes that are directly connected inside the tube shall be shown as a single cathode.

7.2.7 A tube having two or more grids tied internally shall be shown with symbols for each grid, except when the grids are adjacent in the tube structure. Thus, the diagram for a twin pentode having a common screen-grid connection for each section and for a converter tube having the No. 3 and No. 5 grids connected internally would show separate symbols for each grid. A triode where the control grid is physically in the form of two grid windings, however, would show only one grid.

7.2.8 A tube having a grid adjacent to a plate but internally connected to the plate to form a portion of it shall be shown as having a plate only.

7.2.9 Associated parts of a circuit, such as focusing coils, deflecting coils, field coils, etc, are not part of the tube symbol but may be added to the circuit in the form of standard symbols. For example, a resonant-type magnetron with permanent magnet may be shown as follows (see symbol 15.11.1):



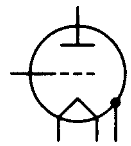
7.2.10 External and internal shields, whether integral parts of tubes or not, shall be omitted from the circuit diagram unless the circuit diagram requires their inclusion.

7.2.11 In line with standard drafting practice, straight-line crossovers are recommended.

7.3 Typical Applications

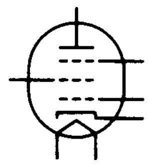
7.3.1 Triode with directly heated filamentary cathode and envelope connection to base terminal

IEC



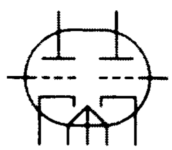
7.3.2 Equipotential-cathode pentode showing use of elongated envelope

IEC



7.3.3 Equipotential-cathode twin triode showing use of elongated envelope and rule of item 7.2.3.

IEC

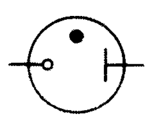


7.3.4 Cold-cathode gas-filled tube

7.3.4.1 Rectifier; voltage regulator for direct-current operation

See also symbol 11.1.3.2

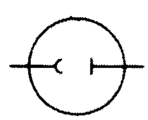
IEC



7.3.5 Phototube

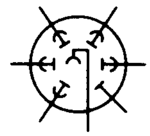
7.3.5.1 Single-unit, vacuum-type

IEC



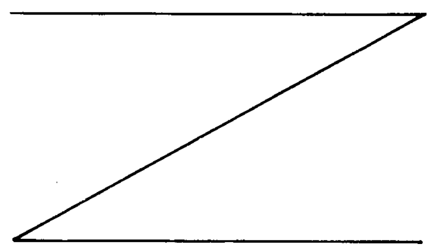
7.3.5.2 Multiplier-type

IEC



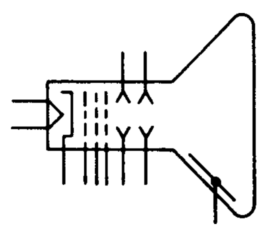
7.3.6 Cathode-ray tube

See Note 1.10A



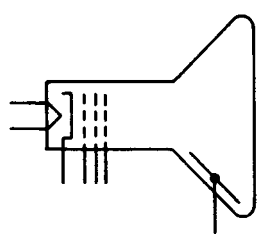
7.3.6.1 With electric-field (electrostatic) deflection

IEC

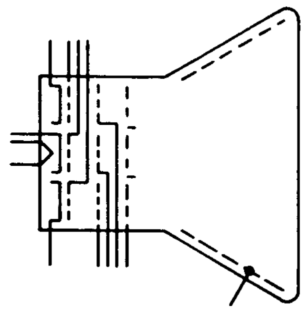


7.3.6.2 For electromagnetic deflection

7.3.6.2.1 Single-gun

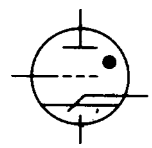


7.3.6.2.2 Multiple-gun (three-gun shown)

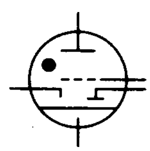


7.3.7 Mercury-pool tube

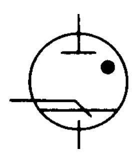
7.3.7.1 With ignitor and control grid



7.3.7.2 With excitor, control grid, and holding anode

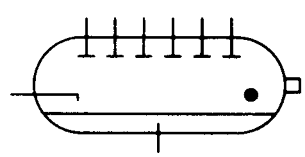


7.3.7.3 Single-anode pool-type vapor rectifier with ignitor

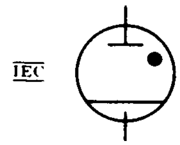


7.3.7.4 6-anode metallic-tank pool-type vapor rectifier with excitor, showing rigid-terminal symbol for control connection to tank (pool cathode is insulated from tank)

Anode symbols are located as convenient.



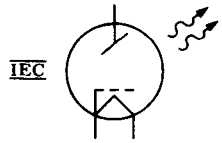
7.3.7.5 Pool-type cathode power rectifier



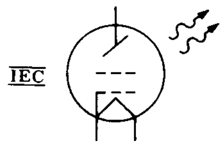
7.3.8 X-ray tube

7.3.8.1 With filamentary cathode and focusing grid (cup)

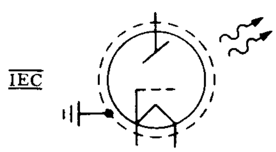
The anode may be cooled by fluid or radiation.



7.3.8.2 With control grid, filamentary cathode, and focusing cup

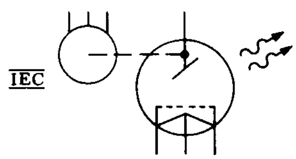


7.3.8.3 With grounded electrostatic shield



7.3.8.4 Double focus with rotating anode

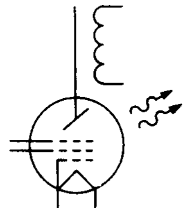
See item 7.2.9



7.3.8.5 With multiple accelerating electrode electrostatically and electromagnetically focused

See item 7.2.9

IEC

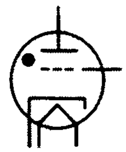


7.3.9 Thyratron

See also symbol 8.11

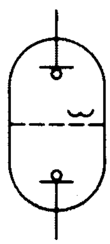
7.3.9.1 With indirectly heated cathode

IEC



7.4 Solion
Ion-Diffusion Device

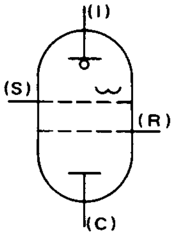
7.4.1 Diode solion



7.4.2 Tetrode solion

NOTE — 7.4.2A: Letters in parentheses are not part of the symbol.

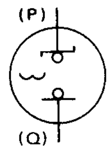
I	Input
S	Shield
R	Readout
C	Common



See Note 7.4.2A

7.5 Coulomb Accumulator
Electrochemical Step-Function Device

NOTE — 7.5A: Letters in parentheses are not part of the symbol, but are for explanation only. For a precharged cell, with + polarity applied to P, the cell internal resistance and voltage drop will remain low until the designed coulomb quantity has passed; then the internal resistance will rise to its high value.



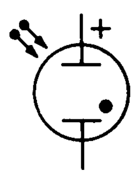
See Note 7.5A

7.6 Conductivity Cell

7.7 Nuclear-Radiation Detector (gas-filled)
Ionization Chamber
Proportional Counter Tube
Geiger-Müller Counter Tube

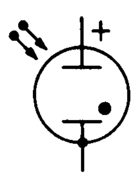
NOTE — 7.7A: For other types of radiation-sensitivity indicators, see item 1.3.

7.7.1 General



See Note 7.7A

7.7.2 Application: metal enclosure, having one collector connected to the enclosure



See Note 7.7A

Cross References

Magnetron (item 15.11)

Resonator (cavity-type) Tube (item 15.10)

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.

8. Graphic Symbols for Semiconductor Devices

8.1 Semiconductor Device
Transistor
Diode

See paragraph A4.11 of the Introduction

NOTES:

8.1A — Some semiconductor devices may be represented by either of two methods.

For convenience in referring to semiconductor symbols in this section, they are classified as follows (Symbols not otherwise identified are Style 1):

Style 1 symbols are composed of basic element symbols depicting the internal buildup of the device.

Style 2 symbols (primarily diode devices) incorporate special-property symbols into the basic-element symbol, rather than by showing the special-property symbol adjacent to the Style 1 symbols.

Style 3 symbols are composed of symbol elements representing functions of the device without regard to the method by which the function is performed within the device.

8.1B — Numbers and letters in parentheses are to correlate illustrations in the standard and are not intended to represent terminal identification.

8.1C — In general, the angle at which a lead is brought to a symbol element has no significance. IEC

8.1D — Orientation, including a mirror-image presentation, does not change the meaning of a symbol. IEC For exceptions to this rule, see item 8.3.

8.1E — The elements of the symbol must be drawn in such an order as to show clearly the operating function of the device. IEC

8.2 Element Symbols

8.2.1 Semiconductor region with one ohmic connection

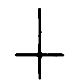
As shown, the horizontal line is the semiconductor region and the vertical line is an ohmic connection.

The line representing the ohmic connection shall not be drawn at the very end of the line representing the semiconductor region.

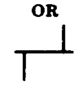
IEC 

8.2.1.1 Semiconductor region with a plurality of ohmic connections

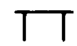
Examples show 2 ohmic connections.

IEC 

OR

IEC 

OR

IEC 

8.2.2 Rectifying junction or junction which influences a depletion layer

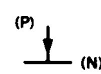
Arrowheads (→|) shall be half the length of the arrow away from the semiconductor base region. IEC

See item 8.6

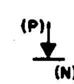
The equilateral (→|—) triangle shall be filled and shall touch the semiconductor base-region symbol. IEC

NOTE — 8.2.2A: The triangle points in the direction of the forward (easy) current as indicated by a direct-current ammeter, unless otherwise noted adjacent to the symbol. Electron flow is in the opposite direction.

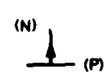
8.2.2.1 P region N region

IEC 

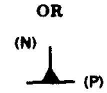
OR

IEC 

8.2.2.2 N region on P region

IEC 

OR

IEC 

8.2.3 Enhancement-type semiconductor region with plurality of ohmic connections and a rectifying junction

Portions of the interrupted channel line having ohmic contacts shall be of equal length and drawn significantly longer than the center-channel section. Channel gaps shall be of equal length and approximately equal to the center-channel length.

8.2.4 Emitter on region of dissimilar-conductivity type

As shown, the slant line with arrow represents the emitter. Arrowheads on both the N and P emitter symbols shall be half the length of the arrow away from the semiconductor base-region symbol. IEC

Emitter element symbols shall be drawn at an angle of approximately 60 degrees to the semiconductor base-region symbol. IEC

8.2.4.1 P emitter on N region

IEC

8.2.4.1.1 Plurality of P emitters N on region

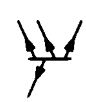
IEC

8.2.4.2 N emitter on P region

IEC

8.2.4.2.1 Plurality of N emitters on P region

IEC



8.2.5 Collector on region of dissimilar-conductivity type

As shown, the slant line represents the collector.

Collector element symbols shall be drawn at an angle of approximately 60 degrees to the semiconductor base-region symbol. IEC

IEC

8.2.5.1 Plurality of collectors on region of dissimilar-conductivity type

IEC 

8.2.6 Transition between regions of dissimilar-conductivity types, either P to N or N to P.

The short slant line indicates point of change along the horizontal line from P to N or N to P. No connections shall be made to the short slant line. IEC

Transition-line element symbols shall be drawn at an angle of approximately 60 degrees to the semiconductor base-region symbol. IEC

The short lines used in transition symbols shall be appreciably shorter than collector or emitter symbols. IEC

IEC 

8.2.7 Intrinsic region between 2 regions

The intrinsic region lies between the linked slant lines. IEC

8.2.7.1 Between regions of dissimilar-conductivity type, either PIN or NIP

IEC 

8.2.7.2 Between regions of similar-conductivity type, either PIP or NIN

IEC 

8.2.7.3 Between a collector and a region of dissimilar-conductivity type, either PIN or NIP

The connection to the collector is made to the long slant line. IEC

IEC 

8.2.7.4 Between a collector and a region of similar conductivity type, either PIP or NIN

The connection to the collector is made to the long slant line. IEC

IEC 

8.2.8 Insulated gate

The L-shaped insulated-gate element shall be drawn with one side spaced from, and parallel to, the channel between ohmic contacts. The corner of the gate element shall be drawn opposite the preferred-source ohmic contact.

8.2.8.1 One gate

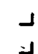
For an application, see symbol 8.6.10.2

8.2.8.2 Multiple gate (2 gates shown)

For an application, see symbol 8.6.10.4.1

Insulated-gate elements are drawn as long as necessary to show each gate.

The insulated-gate element drawn opposite the preferred source is designated as the primary gate. Additional gates are secondary gates.



8.2.9 Gate; control electrode

Applicable only to Style 3 symbols.

NOTE — 8.2.9A: The gate symbol shall be drawn at an angle of approximately 30° to the axis of the basic diode symbol, and shall touch the cathode (or anode) symbol at a point approximately halfway between the center line of the symbol and the extremity of the cathode (or anode) symbol.

8.2.9.1 Gate (external connection)

8.2.9.1.1 General

For application, see symbol 8.6.12.1

Style 3 

See Note 8.2.9A

8.2.9.1.2 Having turn-off feature

For application, see symbol 8.2.12.2

This special feature shall be indicated by a short line crossing the gate lead.

Style 3

See Note 8.2.9A

8.2.9.2 Gate (no external connection)

For application, see symbol 8.5.9

Because there is no external connection to the gate, this lead shall not extend to the envelope symbol, if any.

Style 3 

See Note 8.2.9A

8.3 Special-Property Indicators

See Note 8.1A

See also item 1.2

If necessary, a special function or property essential for circuit operation shall be indicated (a) by a supplementary symbol placed within the envelope or adjacent to the symbol, as shown in Style 1 symbols, or (b) included as part of the symbol, as shown in Style 2 symbols in item 8.5.

The orientation of the Style 1 special-property indicators with respect to the basic symbol is critical. See the applications in item 8.5.

8.3.1 Breakdown

Do not rotate or show in mirror-image form.

Style 1 IEC

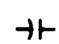
8.3.2 Tunneling

Style 1 IEC

8.3.3 Backward

Style 1 IEC 

8.3.4 Capacitive

Style 1 IEC 

8.4 Rules for Drawing Style 1 Symbols

To draw a device symbol, start at an electrode whose polarity is known (usually an emitter) and proceed along the device, showing all of its regions individually. Finally, indicate ohmic connections where required.

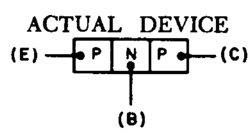
NOTE — 8.4A: Numbers, letters, and words in parentheses are to correlate illustrations in the standard; they are not intended to represent device terminal numbering or identification and are not part of the symbol as shown in items 8.5, 8.6, 8.10, and 8.11.

Name of Terminal	**Letter**
Anode	A
Base	B
Collector	C
Drain	D
Emitter	E
Gate	G
Cathode	K
Source	S
Main terminal*	T
Substrate (bulk)	U

*Used with bidirectional thyristors. The terminals are differentiated by numerical subscripts 1 and 2, T_1 being the terminal to which the gate trigger signal is referenced, if applicable.

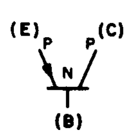
8.4.1 PNP transistor (example of a three-element device)

IEC

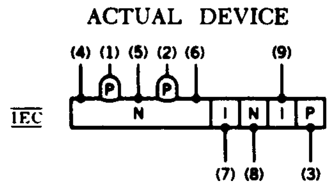


Construction of symbol by successively using symbols 8.2.4.1, 8.2.5, and 8.2.1.

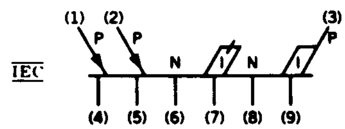
IEC



8.4.2 PNINIP device (example of a complex device with multiple emitters and bases)



Construction of symbol by successively using symbols 8.2.4.1.1, 8.2.7.2, 8.2.7.3, and 8.2.1.1.

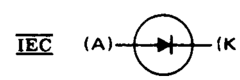


8.5 Typical Applications, Two-Terminal Devices

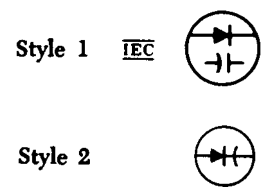
See paragraph A4.11 of the Introduction

See Note 8.4A

8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier



8.5.2 Capacitive diode (varactor)

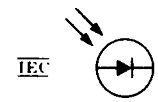


8.5.3 Temperature-dependent diode

8.5.4 Photodiode

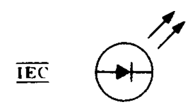
See item 1.3

8.5.4.1 Photosensitive type



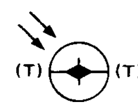
8.5.4.2 Photoemissive type

See also item 11.1.1

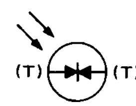


8.5.4.3 Bidirectional photodiode; photo-duo-diode (photosensitive type)

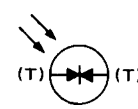
8.5.4.3.1 NPN-type



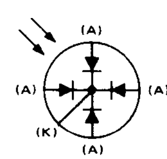
8.5.4.3.2 PNP-type



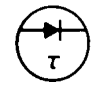
8.5.4.4 Photosensitive type: 2-segment, with common cathode lead



8.5.4.5 Photosensitive type: 4-quadrant, with common cathode lead



8.5.5 Storage diode

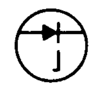


8.5.6 Breakdown diode; overvoltage absorber

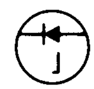
See also item 9.3

8.5.6.1 Unidirectional diode; voltage regulator

Style 1



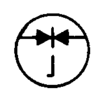
OR



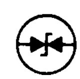
Style 2

8.5.6.2 Bidirectional diode

Style 1



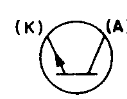
Style 2 IEC



8.5.6.3 Unidirectional negative resistance breakdown diode; trigger diac

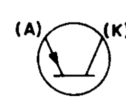
8.5.6.3.1 NPN-type

IEC



8.5.6.3.2 PNP-type

IEC



8.5.6.4 Bidirectional negative-resistance breakdown diode; trigger diac

8.5.6.4.1 NPN-type

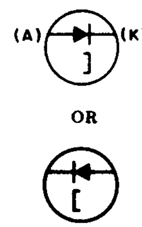
8.5.6.4.2 PNP-type

8.5.7 Tunnel and backward diodes

8.5.7.1 Tunnel diode

For this application, Note 8.2.2A does not apply.

Style 1

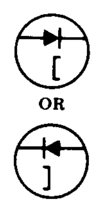


Style 2 IEC

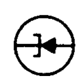
8.5.7.2 Backward diode; tunnel rectifier

For this application, Note 8.2.2A does not apply.

Style 1



Style 2



8.5.8 Thyristor, reverse-blocking diode-type

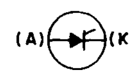
8.5.8.1 General

Style 1 IEC

OR

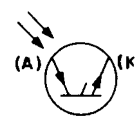
IEC

Style 3



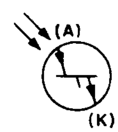
8.5.8.2 Light-activated type

Style 1 IEC

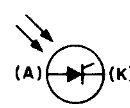


OR

IEC

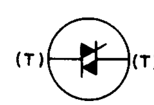


Style 3



8.5.9 Thyristor, bidirectional diode type; bi-switch

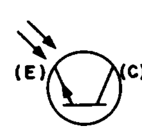
See also symbol 8.6.15



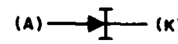
8.5.10 Phototransistor (NPN-type) (without external base connection)

See also symbol 8.6.16, for 3-terminal device

IEC

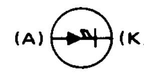


8.5.11 Current regulator

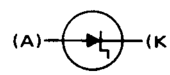


8.5.12 PIN-type diode

NOTE — 8.5.12A: Use symbol 8.5.1 unless essential to show intrinsic region.

Style 1


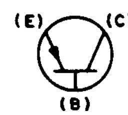
8.5.13 Step recovery diode

Style 2


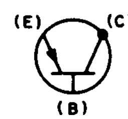
8.6 Typical Applications, Three- (or more) Terminal Devices

8.6.1 PNP transistor (also PNIP transistor, if omitting the intrinsic region will not result in ambiguity)

See paragraph A4.11 of the Introduction

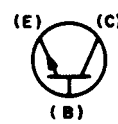
IEC


8.6.1.1 Application: PNP transistor with one electrode connected to envelope (in this case, the collector electrode)

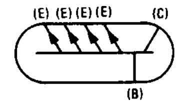
IEC


8.6.2 NPN transistor (also NPIN transistor, if omitting the intrinsic region will not result in ambiguity)

See paragraph A4.11 of the Introduction

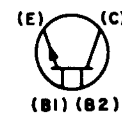
IEC


8.6.2.1 Application: NPN transistor with multiple emitters (with 4 emitters shown)

IEC 

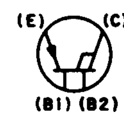
8.6.3 NPN transistor with transverse-biased base

See paragraph A4.11 of the Introduction

IEC 

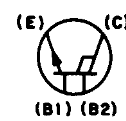
8.6.4 PNIP transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction

IEC 

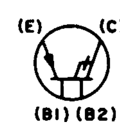
8.6.5 NPIN transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction

IEC 

8.6.6 PNIN transistor with ohmic connection to the intrinsic region

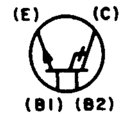
See paragraph A4.11 of the Introduction

IEC 

8.6.7 NPIP transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction

IEC



8.6.8 Unijunction transistor with N-type base

See paragraph A4.11 of the Introduction

IEC

8.6.9 Unijunction transistor with P-type base

See paragraph A4.11 of the Introduction

IEC

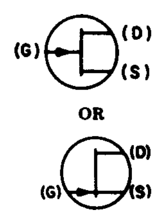
8.6.10 Field-effect transistor with N-channel (junction gate and insulated gate)

8.6.10.1 N-channel junction gate

If desired, the junction-gate symbol element may be drawn opposite the preferred source.

See paragraph A4.11 of the Introduction

IEC



8.6.10.2 N-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate) three-terminal device

IEC

8.6.10.3 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) internally terminated to source, three-terminal device

IEC

8.6.10.4 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

IEC

8.6.10.4.1 Application: N-channel insulated-gate, depletion-type, two-gate, five-terminal device

IEC

8.6.10.5 N-channel insulated-gate, enhancement-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

IEC

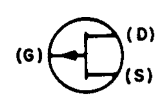
8.6.10.5.1 Application: N-channel insulated-gate, enhancement-type, two-gate, five-terminal device

IEC

8.6.11 Field-effect transistor with P-channel (junction gate and insulated gate)

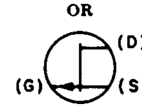
8.6.11.1 P-channel junction gate

See paragraph A4.11 of the Introduction



OR

IEC



8.6.11.2 P-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate) three-terminal device

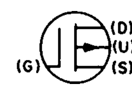
IEC

8.6.11.3 P-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) internally terminated to source, three-terminal device

IEC

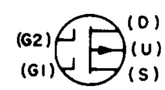
8.6.11.4 P-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

IEC



8.6.11.4.1 Application: P-channel insulated-gate, depletion-type, two-gate, five-terminal device

IEC

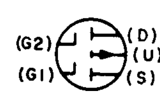


8.6.11.5 P-channel insulated-gate, enhancement-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

IEC

8.6.11.5.1 Application: P-channel insulated-gate, enhancement-type, two-gate, five-terminal device

IEC

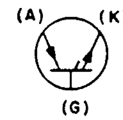


8.6.12 Thyristor, reverse-blocking triode-type, N-type gate; semiconductor controlled rectifier, N-type gate

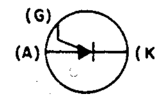
See paragraph A4.11 of the Introduction

8.6.12.1 General

Style 1

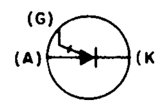


Style 3 IEC



8.6.12.2 Gate turn-off type

Style 3

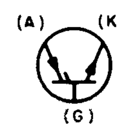


8.6.13 Thyristor, reverse-blocking triode-type, P-type gate; semiconductor controlled rectifier, P-type gate

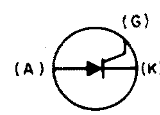
See paragraph A4.11 of the Introduction

8.6.13.1 General

Style 1

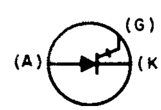


Style 3 IEC



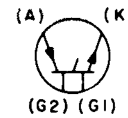
8.6.13.2 Gate turn-off type

Style 3



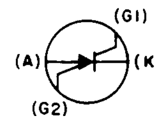
8.6.14 Thyristor, reverse-blocking tetrode-type; semiconductor controlled switch

Style 1



Style 3

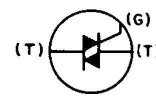
IEC



8.6.15 Thyristor, bidirectional triode-type; triac; gated switch

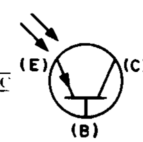
See also symbol 8.5.9

Style 3



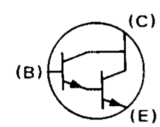
8.6.16 Phototransistor (PNP-type) See also symbol 8.5.10, for 2-terminal device

IEC



8.6.17 Darlington transistor (NPN-type)

IEC



8.7 Photosensitive Cell

See paragraph A4.11 of the Introduction

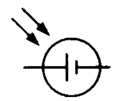
8.7.1 Asymmetrical photoconductive transducer

USE SYMBOL 8.5.4.1

8.7.2 Symmetrical photoconductive transducer (resistive)

USE SYMBOL 2.1.13

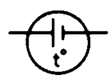
8.7.3 Photovoltaic transducer; barrier photocell; blocking-layer cell; solar cell



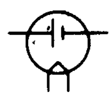
8.8 Semiconductor Thermocouple

8.8.1 Temperature-measuring

See paragraph A4.11 of the Introduction



8.8.2 Current-measuring

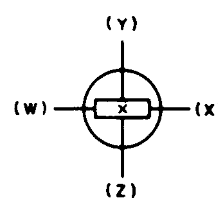


8.9 Hall Element
Hall Generator

See paragraph A4.11 of the Introduction

NOTE — 8.9A: W and X are the current terminals; Y and Z are the voltage output terminals. Letters are for explanation and are not part of the symbol.

If polarity markings (symbol 1.6) are shown, the direction of the magnetic field must be defined.



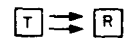
See Note 8.9A

8.10 Photon-Coupled Isolator

See also symbol 15.8.1

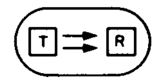
NOTE — 8.10A: T is the transmitter; R is the receiver. The letters are for explanation and are not part of the symbol. Explanatory information should be added to explain circuit operation.

8.10.1 General



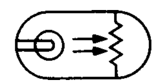
See Note 8.10A

8.10.2 Complete isolator (single-package type)

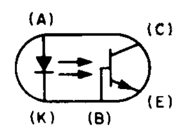


See Note 8.2.9A

8.10.3 Application: Incandescent lamp and symmetrical photoconductive transducer



8.10.4 Application: Photoemissive diode and phototransistor

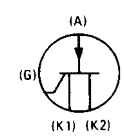


8.11 Solid-State Thyratron (replacement type)

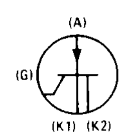
See symbol 7.3.9

NOTE — 8.11A: If the thyratron replacement has only one cathode lead, see symbol 8.6.13.1, Style 3.

8.11.1 Balanced



8.11.2 Unbalanced



Cross References

Bridge-Type Rectifier

(item 16.3.3)

NOTES:

1 — See Introduction for general information (note especially A3.1).

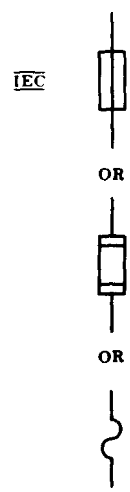
2 — Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

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.

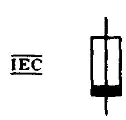
9. Graphic Symbols for Circuit Protectors

9.1 Fuse (one-time thermal current-overload device)

9.1.1 General

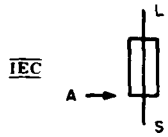


9.1.1.1 Fuse, supply side indicated by a thick line



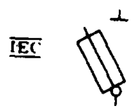
9.1.2 Fuse with alarm contact

NOTE — 9.1.2A: When fuse blows, alarm bus A is connected to power supply bus S. The letters S (supply), L (load), and A (alarm circuit) are for explanation only, and are not part of the symbol.

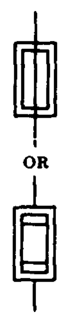


See Note 9.1.2A

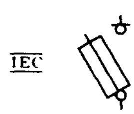
9.1.3 Isolating fuse-switch; high-voltage primary fuse cutout, dry



9.1.4 High-voltage primary fuse cutout, oil



9.1.5 Isolating fuse-switch for on-load switching



9.1.6 Temperature-sensitive fuse (ambient-temperature operated)

USE SYMBOL 2.12.3

9.2 Current Limiter (for power cable)

The arrowheads in this case are filled.

NOTE — 9.2A: Use appropriate number of single-line diagram symbols.

See Note 9.2A

Avoid conflict with symbol 1.7.3 if used on the same diagram.

9.3 Lightning Arrester F
Arrester (electric surge, etc)
Gap

See also symbol 8.5.6

9.3.1 General

9.3.2 Carbon block; telephone protector block F

The sides of the rectangle shall be approximately in the ratio of 1 to 2 and the space between rectangles shall be approximately equal to the width of a rectangle.

9.3.3 Electrolytic or aluminum cell

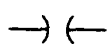
This symbol is not composed of arrowheads.

9.3.4 Horn gap

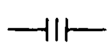
9.3.5 Protective gap

These triangles shall not be filled.

9.3.6 Sphere gap



9.3.7 Valve or film element



9.3.8 Multigap, general

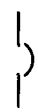
9.3.9 Application: gap plus valve plus ground, 2-pole

9.4 Circuit Breaker F

If it is desired to show the condition causing the breaker to trip, the relay protective-function symbols in item 9.5.1 may be used alongside the breaker symbol.

9.4.1 General

IEC



9.4.2 Air circuit breaker, if distinction is needed; for alternating-current circuit breakers rated at 1,500 volts or less and for all direct-current circuit breakers

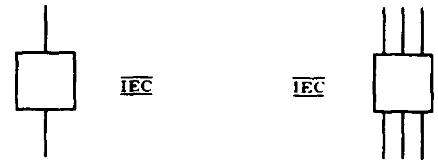
IEC

9.4.3 Network protector

9.4.4 Circuit breaker, other than covered by symbol 9.4.1

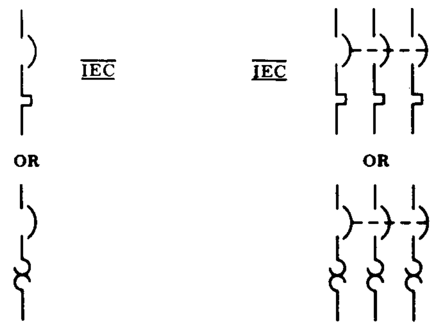
The symbol in the right column is for a 3-pole breaker.

NOTE — 9.4.4A: On a power diagram, the symbol may be used without other identification. On a composite drawing where confusion with the general circuit element symbol (item 16.1) may result, add the identifying letters CB inside or adjacent to the square.

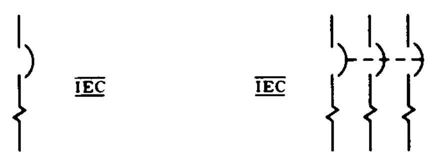


See Note 9.4.4A

9.4.5 Application: 3-pole circuit breaker with thermal-overload device in all 3 poles



9.4.6 Application: 3-pole circuit breaker with magnetic-overload device in all 3 poles



9.4.7 Application: 3-pole circuit breaker, drawout type

9.5 Protective Relay

Fundamental symbols for contacts, coils, mechanical connections, etc, are the basis of relay symbols and should be used to represent relays on complete diagrams.

See RELAY COIL; OPERATING COIL (item 4.5) and RELAY (item 4.30)

9.5.1 Relay protective functions

The following symbols may be used to indicate protective functions, or device-function numbers may be placed in the circle or adjacent to the basic symbol (see American National Standard for Manual and Automatic Station Control, Supervisory, and Associated Telemetering Equipments, C37.2-1970).

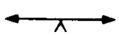
NOTE — 9.5.1A: An operating-quantity symbol must be added to the general symbols 9.5.2 through 9.5.6 in accordance with the rules of 9.5.9.

9.5.2 Over, general

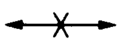
9.5.3 Under, general

9.5.4 Direction, general; directional over

9.5.5 Balance, general



9.5.6 Differential, general



9.5.7 Pilot wire, general

9.5.8 Carrier current, general

9.5.9 Operating quantity

The operating quantity is indicated by the following letters or symbols placed either on or immediately above the relay protective-function symbols shown above.

C Current[13]

[13]The use of the letter may be omitted in the case of current, and the absence of such letter presupposes that the relay operates on current.

Z	Distance
F	Frequency
GP	Gas pressure
ϕ	Phase
W	Power
S	Synchronism
T	Temperature
V	Voltage

9.5.10 Ground relays

Relays operative on residual current only are so designated by attaching the ground symbol

to the relay protective-function symbol. Note that the zero phase-sequence designation given below may be used instead when desirable.

9.5.11 Phase-sequence quantities

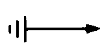
Operations on phase-sequence quantities may be indicated by the use of the conventional subscripts 0, 1, and 2 after the letter indicating the operating quantity.

9.5.12 Applications

9.5.12.1 Overcurrent

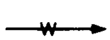
9.5.12.2 Directional overcurrent

9.5.12.3 Directional residual overcurrent

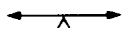


9.5.12.4 Undervoltage

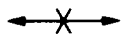
9.5.12.5 Power directional



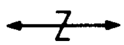
9.5.12.6 Balanced current



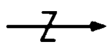
9.5.12.7 Differential current



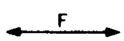
9.5.12.8 Distance



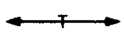
9.5.12.9 Directional distance



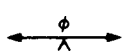
9.5.12.10 Overfrequency



9.5.12.11 Overtemperature



9.5.12.12 Phase balance



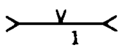
9.5.12.13 Phase sequence

9.5.12.14 Pilot wire, differential-current

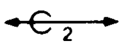
9.5.12.15 Pilot wire, directional-comparison

9.5.12.16 Carrier pilot

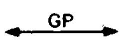
9.5.12.17 Positive phase-sequence undervoltage



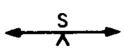
9.5.12.18 Negative phase-sequence overcurrent



9.5.12.19 Gas-pressure (Buchholz)



9.5.12.20 Out-of-step



Cross References

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.

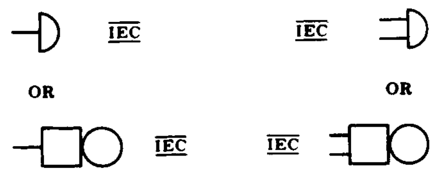
3 — For centered figures with symbols appearing side by side, the symbol on the left-hand side should be considered to be for a single line (one-line) diagram and the symbol on the right-hand side for a complete diagram, i.e., 1.5.1.

10. Graphic Symbols for Acoustic Devices

10.1 Audible-Signaling Device

10.1.1 Bell, electrical ; telephone ringer

NOTE — 10.1.1A: If specific identification is required, the abbreviation AC (or symbol 1.8.2) or DC (or lower symbol 1.8.1) may be added within or adjacent to the symbol.



See Note 10.1.1A

10.1.1.1 Single-stroke

10.1.2 Buzzer F

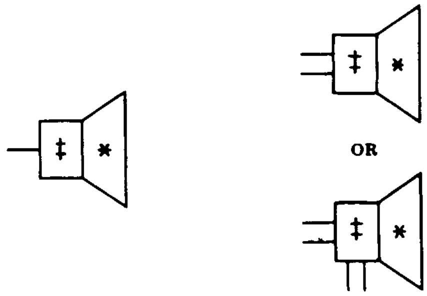
10.1.3 Loudspeaker F IEC
Horn, Electrical F
Siren F
Underwater Sound Transducer (with acoustic output)
Sound Reproducer

10.1.3.1 General

10.1.3.2 Application: specific types

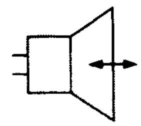
If specific identification of loudspeaker types is required, the following letter combinations may be added in the symbol at the locations indicated by the * and the ‡:

* HN	Horn, electrical F
* HW	Howler
* LS	Loudspeaker F
* SN	Siren F
‡ EM	Electromagnetic with moving coil (moving-coil leads should be identified)
‡ EMN	Electromagnetic with moving coil and neutralizing winding (moving-coil leads should be identified)
‡ MG	Magnetic armature
‡ PM	Permanent magnet with moving coil



Note: The * and ‡ are not part of the symbol.

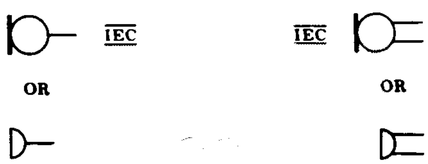
10.1.3.3 Loudspeaker-microphone; underwater sound transducer, two-way



10.1.4 Telegraph sounder F

10.2 Microphone F
Telephone Transmitter

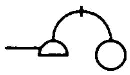
10.2.1 General



10.3 Handset
Operator's Set

10.3.1 General

10.3.2 With push-to-talk switch



10.3.3 3-conductor handset

10.3.4 4-conductor handset

10.3.5 4-conductor handset with push-to-talk switch

10.3.6 Operator's set

10.4 Telephone Receiver Earphone F Hearing-Aid Receiver

10.4.1 General

10.4.2 Headset, double

10.4.3 Headset, single

Cross References

NOTES:

1 — See Introduction for general information (note especially A3.1).

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11. Graphic Symbols for Lamps and Visual-Signaling Devices

11.1 Lamp

See also item 8.5.4.2

11.1.1 Lamp, general; high source, general

See also item 11.2.7

NOTES:

11.1.1A — This symbol may be used to represent one or more lamps with or without operating auxiliaries.

11.1.1B — If it is essential to indicate the following characteristics, the specified letter or letters may be inserted within or placed adjacent to the symbol.

A	Amber
B	Blue
C	Clear
G	Green
O	Orange
OP	Opalescent
P	Purple
R	Red
W	White
Y	Yellow
ARC	Arc
EL	Electroluminescent
FL	Fluorescent
HG	Mercury vapor

IN	Incandescent
IR	Infrared
NA	Sodium vapor
NE	Neon
UV	Ultraviolet
XE	Xenon
LED	Light-emitting diode

11.1.1C — For polarity-sensitive devices, identify the appropriate lead with the (+) polarity mark.

11.1.2 Fluorescent lamp F

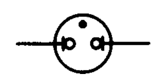
11.1.2.1 2-terminal

11.1.2.2 4-terminal

11.1.3 Glow lamp F, cold-cathode lamp; neon lamp

11.1.3.1 Alternating-current type

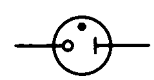
IEC



11.1.3.2 Direct-current type

See also ELECTRON TUBE (symbol 7.3.4.1)

IEC

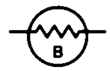


11.1.4 Incandescent lamp F (incandescent-filament illuminating lamp)

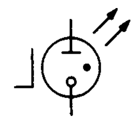
11.1.5 Ballast lamp; ballast tube

The primary characteristic of the element within the circle is designed to vary non-linearly with the temperature of the element.

See paragraph A4.11 of the Introduction



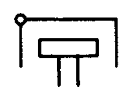
11.1.6 Electronic flash tube (lamp)



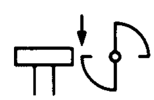
11.2 Visual-Signaling Device

11.2.1 Annunciator $\boxed{F}$ (general)

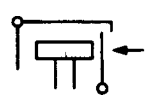
11.2.2 Annunciator drop or signal, shutter or grid type



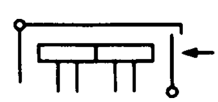
11.2.3 Annunciator drop or signal, ball type



11.2.4 Manually restored drop



11.2.5 Electrically restored drop

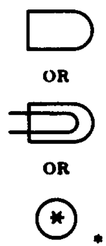


11.2.6 Communication switchboard-type lamp; indicating lamp

11.2.7 Indicating, pilot, signaling, or switchboard light; indicator light ; signal light

NOTE — 11.2.7A: The asterisk is not part of the circular symbol. Always add the letter or letters for colors specified in Note 11.1.1B within or adjacent to the circle. To avoid confusion with meter or basic relay symbols, add suffix L or IL to the letter or letters, for example, RL or RIL placed within or adjacent to the circle.

If confusion with other circular symbols may occur, the D-shaped symbol should be used.

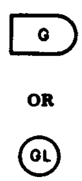


See Note 11.1.1B

* See Note 11.2.7A

Avoid conflict with symbols 4.5, 12.1.1, and 13.1.2 if used on the same diagram.

11.2.7.1 Application: green signal light



11.2.8 Jeweled signal light

See Note 11.1.1B

Cross References

NOTES:

1 — See Introduction for general information (note especially A3.1).

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12. Graphic Symbols for Readout Devices

12.1 Meter

Instrument

NOTE — 12.1A: The asterisk is not part of the symbol. Always replace the asterisk by one of the following letter combinations, depending on the function of the meter or instrument, unless some other identification is provided in the circle and explained on the diagram.

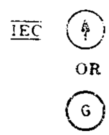
* See Note 12.1A

A	Ammeter $\boxed{F}$ $\overline{\text{IEC}}$
AH	Ampere-hour meter
C	Coulombmeter
CMA	Contact-making (or breaking) ammeter
CMC	Contact-making (or breaking) clock
CMV	Contact-making (or breaking) voltmeter
CRO	Oscilloscope $\boxed{F}$
	Cathode-ray oscillograph
DB	DB (decibel) meter
	Audio level/meter $\boxed{F}$
DBM	DBM (decibels referred to 1 milliwatt) meter
DM	Demand meter
DTR	Demand-totalizing relay
F	Frequency meter $\boxed{F}$
GD	Ground detector
I	Indicating meter
INT	Integrating meter
μA or UA	Microammeter
MA	Milliammeter
NM	Noise meter
OHM	Ohmmeter $\boxed{F}$
OP	Oil pressure meter
OSCG	Oscillograph, string
PF	Power factor meter
PH	Phasemeter $\boxed{F}$
PI	Position indicator
RD	Recording demand meter
REC	Recording meter
RF	Reactive factor meter
SY	Synchroscope
t°	Temperature meter
THC	Thermal converter
TLM	Telemeter
TT	Total time meter
	Elapsed time meter
V	Voltmeter $\boxed{F}$ $\overline{\text{IEC}}$
VA	Volt-ammeter

VAR	Varmeter F
VARH	Varhour meter
VI	Volume indicator
	Audio-level meter F
VU	Standard volume indicator
	Audio-level meter F
W	Wattmeter F IEC
WH	Watthour meter

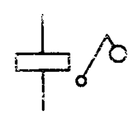
12.1.1 Galvanometer F

Avoid conflict with symbols 4.5 and 13.1.2 if used on the same diagram.

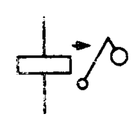


12.2 Electromagnetically Operated Counter Message Register

12.2.1 General



12.2.2 With make contact



Cross References

NOTES:

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13. Graphic Symbols for Rotating Machinery

13.1 Rotating Machine

13.1.1 Basic

IEC 

13.1.2 Generator (general)

IEC 

Avoid conflict with symbols 12.1.1 and 21.5.1 if used on the same diagram.

OR

13.1.2.1 Generator, direct-current

IEC 

13.1.2.2 Generator, alternating-current

IEC 

13.1.2.3 Generator, synchronous

IEC 

13.1.3 Motor (general)

IEC 

OR

13.1.3.1 Motor, direct-current

IEC 

13.1.3.2 Motor, alternating-current

IEC 

13.1.3.3 Motor, synchronous

IEC 

13.1.4 Motor, multispeed

USE SYMBOLS 13.1.3 AND NOTE SPEEDS

13.1.5 [14] Rotating armature with commutator and brushes

13.1.6 Hand generator

IEC 

13.2 Field, Generator or Motor

Either symbol of item 6.2.1 may be used in the following items.

13.2.1 Compensating or commutating

IEC 

13.2.2 Series

IEC 

[14]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.2.3 Shunt, or separately excited

IEC 

13.2.4 Permanent magnet

USE SYMBOL 2.8

13.3 Winding Connection Symbols

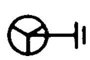
Motor and generator winding connection symbols may be shown in the basic circle using the following representations.

13.3.1 1-phase

13.3.2 2-phase

13.3.3 3-phase wye (ungrounded)

13.3.4 3-phase wye (ungrounded)



13.3.5 3-phase delta

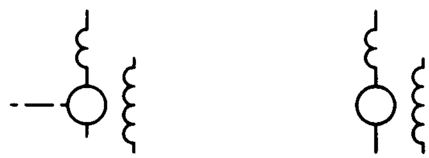
13.3.6 6-phase diametrical

13.3.7 6-phase double-delta

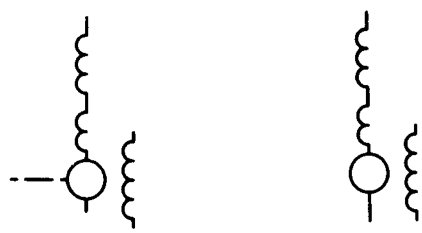
13.4 Applications: Direct-Current Machines

13.4.1 [15] Separately excited direct-current generator or motor

13.4.2 [15] Separately excited direct-current generator or motor; with commutating or compensating field winding, or both



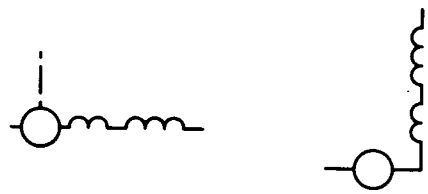
13.4.3 [15] Compositely excited direct-current generator or motor; with commutating or compensating field winding, or both



13.4.4 [15] Direct-current series motor or 2-wire generator

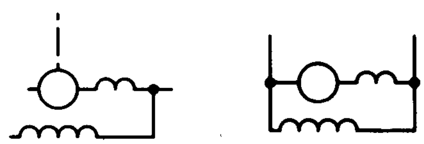
[15]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.4.5 [16] Direct-current series motor or 2-wire generator; with commutating or compensating field winding, or both



13.4.6 [16] Direct-current shunt motor or 2-wire generator

13.4.7 [16] Direct-current shunt motor or 2-wire generator; with commutating or compensating field winding, or both

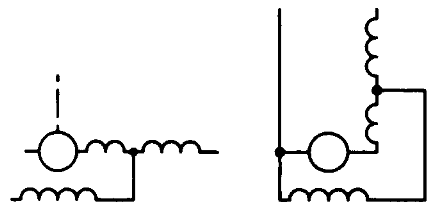


13.4.8 [16] Direct-current permanent-magnet-field generator or motor

13.4.9 [16] Direct-current compound motor or 2-wire generator or stabilized shunt motor

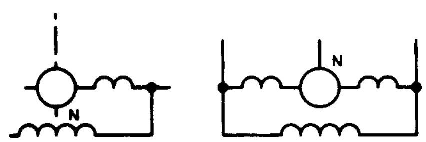
[16]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.4.10 [17] Direct-current compound motor or 2-wire generator or stabilized shunt motor; with commutating or compensating field winding, or both

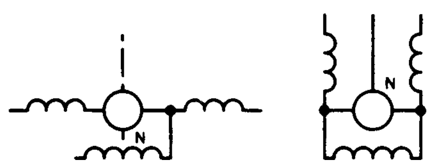


13.4.11 [17] Direct-current 3-wire shunt generator

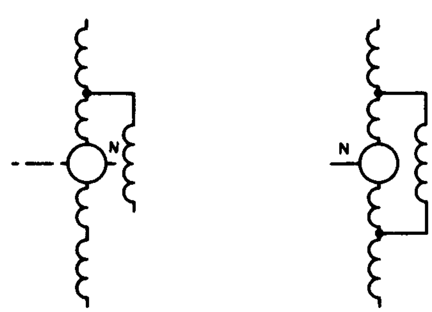
13.4.12 [17] Direct-current 3-wire shunt generator; with commutating or compensating field winding, or both



13.4.13 [17] Direct-current 3-wire compound generator

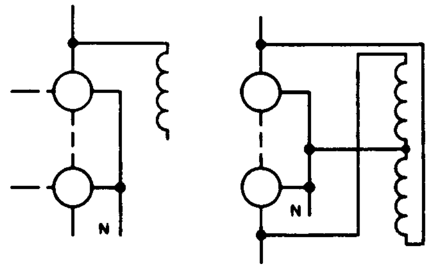


13.4.14 [17] Direct-current 3-wire compound generator; with commutating or compensating field winding, or both

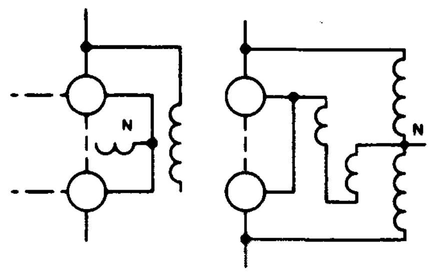


[17] The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.4.15 [18] Direct-current balancer, shunt wound



13.4.16 [18] Direct-current balancer, compound wound



13.4.17 [18] Dynamotor

13.4.18 [18] Double-current generator

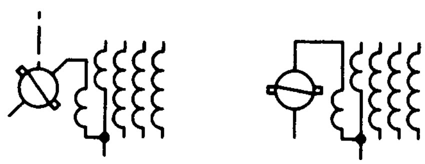
13.4.19 [18] Acyclic generator, separately excited

[18] The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

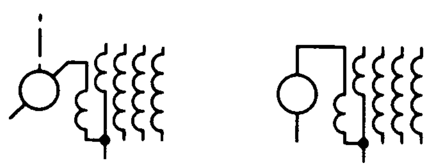
13.4.20 [19] Regulating generator (rotary amplifier), shunt wound with short-circuited brushes

13.4.21 [19] Regulating generator (rotary amplifier), shunt wound without short-circuited brushes

13.4.22 [19] Regulating generator (rotary amplifier), shunt wound with compensating field winding and short-circuited brushes



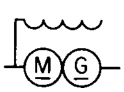
13.4.23 [19] Regulating generator (rotary amplifier), shunt woud with compensating field winding, without short-circuited brushes



13.4.24 DC-to-dc rotary converter with common permanent magnetic field

IEC

13.4.25 DC-to-dc rotary converter with common field winding



IEC

[19]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

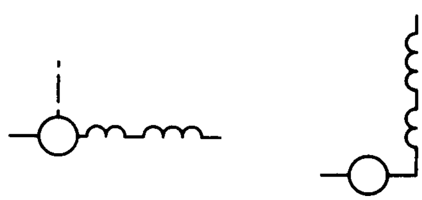
13.5 Applications: Alternating-Current Machines

13.5.1 [20] Squirrel-cage induction motor or generator, split-phase induction motor or generator, rotary phase converter, or repulsion motor

13.5.2 [20] Wound-rotor induction motor, synchronous induction motor, induction generator, or induction frequency converter

13.5.3 [20] Alternating-current series motor

13.5.4 [20] Alternating-current series motor, with commutating or compensating field winding, or both



13.5.5 [20] 1-phase shaded-pole motor

13.5.6 [20] 1-phase repulsion-start induction motor

[20]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.5.7 [21] 1-phase hysteresis motor

13.5.8 [21] Reluctance motor

13.5.9 [21] 1-phase subsynchronous reluctance motor

13.5.10 [21] Magnetoelectric generator, 1-phase; telephone magneto

13.5.11 [21] Shunt-characteristic brush-shifting motor

13.5.12 [21] Series-characteristic brush-shifting motor with 3-phase rotor

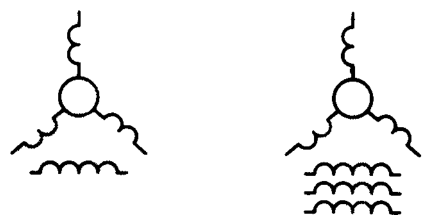
13.5.13 Series-characteristic brush-shifting motor with 6- or 8-phase rotor

[21] The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.5.14 Ohmic-drop exciter with 3- or 6-phase input

13.5.15 Ohmic-drop exciter with 3- or 6-phase input, with output leads

13.5.16 3-phase regulating machine



13.5.17 Phase shifter with 1-phase output

See PHASE SHIFTER (item 16.6) and TRANSFORMER (item 6.4)

13.5.18 Phase shifter with 3-phase output

See PHASE SHIFTER (item 16.6) and TRANSFORMER (item 6.4)

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

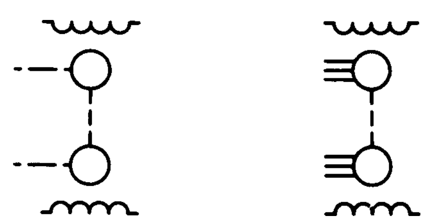
13.6.1 [22] Synchronous motor, generator, or condenser

13.6.2 [22] Synchronous motor, generator, or condenser with neutral brought out

13.6.3 [22] Synchronous motor, generator, or condenser with both ends of each phase brought out

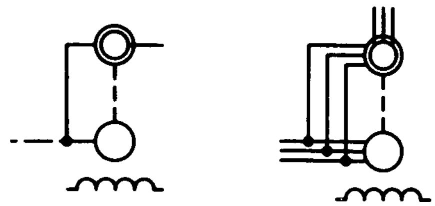
13.6.4 [22] Double-winding synchronous generator, motor, or condenser

13.6.5 [22] Synchronous-synchronous frequency changer



[22]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

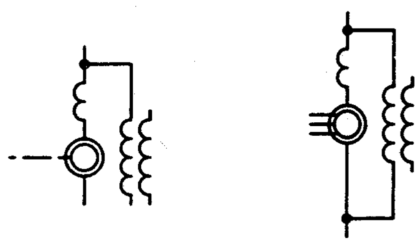
13.6.6 [23] Synchronous-induction frequency changer



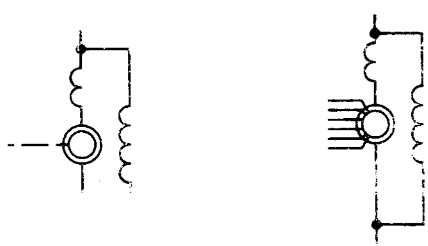
13.7 Applications: Alternating- and Direct-Current Composite

13.7.1 [23] Synchronous or regulating-pole converter

13.7.2 [23] Synchronous booster or regulating-pole converter; with commutating or compensating field windings, or both

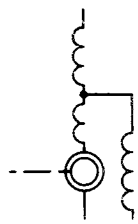


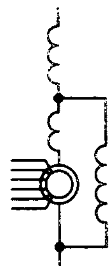
13.7.3 [23] Synchronous converter, shunt-wound with commutating or compensating field windings, or both



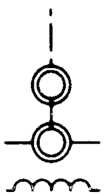
[23]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

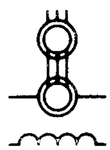
13.7.4 [24] Synchronous converter, compound-wound with commutating or compensating field windings, or both





13.7.5 [24] Motor converter





13.8 Synchro F

If identification is required, a letter combination from the following list shall be placed adjacent to the symbol to indicate the type of synchro.

CDX	Control-differential transmitter
CT	Control transformer
CX	Control transmitter
TDR	Torque-differential receiver
TDX	Torque-differential transmitter
TR	Torque receiver
TX	Torque transmitter
RS	Resolver

If the outer winding is rotatable in bearings, the suffix B shall be added to the above letter combinations.

13.8.1 General

Complete symbols may also be formed by using the winding symbol 6.2.1.

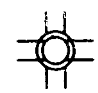
[24]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

13.8.2 Synchro, control transformer; synchro, receiver F synchro, transmitter F

13.8.3 Synchro, differential receiver; synchro, differential transmitter F

13.8.4 Synchro, resolver F

Type shown: 2-phase rotor and 2-phase stator



Cross References

14. Graphic Symbols for Mechanical Functions

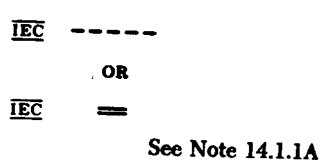
14.1 Mechanical Connection
Mechanical Interlock

The preferred location of the mechanical connection is as shown in the various applications, but other locations may be equally acceptable.

14.1.1 Mechanical connection

The top symbol consists of short dashes.

NOTE — 14.1.1A: The short parallel lines should be used only where there is insufficient space for the short dashes in series. See symbol 4.9.3 for application.



14.1.2 Mechanical connection or interlock with fulcrum

These are short dashes.

14.1.3 Mechanical interlock, other

INDICATE BY A NOTE

14.2 Mechanical Motion

14.2.1 Translation, one direction

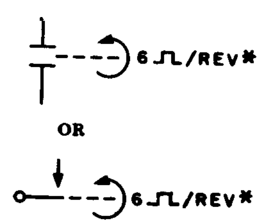
14.2.2 Translation, both directions

14.2.3 Rotation, one direction

IEC 

14.2.3.1 Application: angular motion, applied to open contact (make), symbol 4.3.2

NOTE — 14.2.3.1A: The asterisk is not part of the symbol. Explanatory information (similar to type shown) may be added if necessary to explain circuit operation.



* See Note 14.2.3.1A

14.2.4 Rotation, both directions

IEC 

14.2.4.1 Alternating or reciprocating

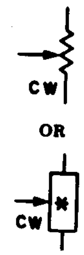
For application see symbol 2.3.7.7

IEC 

14.2.5 Rotation designation (applied to a resistor)

CW indicates position of adjustable contact at the limit of clockwise travel viewed from knob or actuator end unless otherwise indicated.

NOTE — 14.2.5A: The asterisk is not part of the symbol. Always add identification within or adjacent to the rectangle.



* See Note 14.2.5A

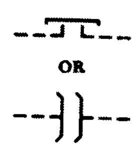
14.2.6 Rotational speed or angular velocity dependence, shown with rotational arrow

See symbol 4.24.4 for application

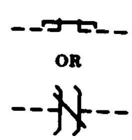
IEC 

14.3 Clutch Brake

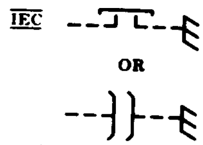
14.3.1 Clutch disengaged when operating means (not shown) is deenergized or nonoperated

IEC 

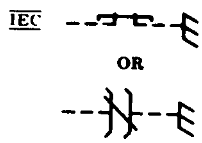
14.3.2 Clutch engaged when operating means (not shown) is deenergized or nonoperated

IEC 

14.3.3 Brake applied when operating means (not shown) is energized

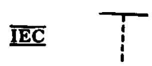


14.3.4 Brake released when operating means (not shown) is energized

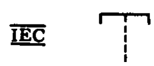


14.4 Manual Control

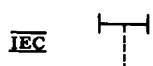
14.4.1 General



14.4.2 Operated by pushing



14.4.3 Operated by pushing and pulling (push-pull)



Cross References

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.

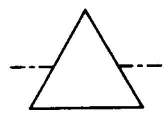
15. Graphic Symbols Commonly Used in Connection with VHF, UHF, SHF Circuits

15.1 Discontinuity (Introducing intentional wave reflection)

A component that exhibits throughout the frequency range of interest the properties of the type of circuit element indicated by the symbol within the triangle.

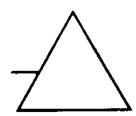
Commonly used for coaxial and waveguide transmission.

15.1.1 [25] General



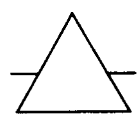
15.1.1.1 Terminal discontinuity (one-port)

IEC



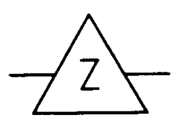
15.1.1.2 Discontinuity (two-port)

IEC



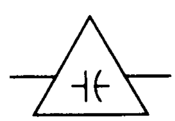
15.1.2 Equivalent series element, general, in series with guided transmission path

IEC



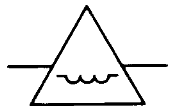
15.1.2.1 Capacitive reactance

IEC

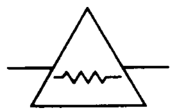


[25] The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

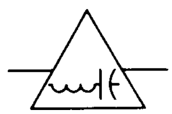
15.1.2.2 Inductive reactance

IEC 

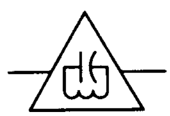
15.1.2.3 Resistance

IEC 

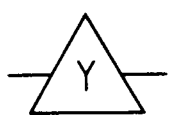
15.1.2.4 Inductance-capacitance circuit with zero reactance at resonance

IEC 

15.1.2.5 Inductance-capacitance circuit with infinite reactance at resonance

IEC 

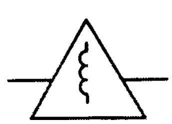
15.1.3 Equivalent shunt element, general, in parallel with guided transmission path

IEC 

15.1.3.1 Capacitive susceptance

IEC 

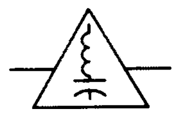
15.1.3.2 Inductive susceptance

IEC 

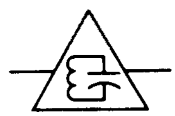
15.1.3.3 Conductance

IEC 

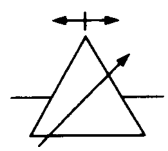
15.1.3.4 Inductance-capacitance circuit having zero reactance, infinite susceptance at resonance

IEC 

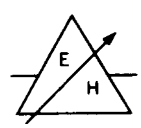
15.1.3.5 Inductance-capacitance circuit having infinite reactance, zero susceptance at resonance

IEC 

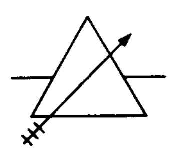
15.1.4 Slide-screw tuner



15.1.5 E-H tuner

IEC 

15.1.6 Multistub tuner with 3 stubs

IEC 

15.2 Coupling

Commonly used in coaxial and waveguide diagrams.

15.2.1 Coupling by aperture with an opening of less than full waveguide size

Transmission loss may be indicated.

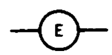
NOTE — 15.2.1A: The asterisk is not part of the symbol. Always replace the asterisk by E, H, or HE, depending on the type of coupling.

E	indicates that the physical plane of the aperture is perpendicular to the transverse component of the major E lines.
H	indicates that the physical plane of the aperture is parallel to the transverse component of the major E lines.
HE	indicates coupling by all other kinds of apertures.

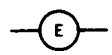
IEC 

* See Note 15.2.1A

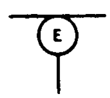
15.2.1.1 Application: E-plane coupling by aperture to space

IEC 

15.2.1.2 Application: E-plane coupling by aperture; 2 ends of transmission path available

IEC 

15.2.1.3 Application: E-plane coupling by aperture; 3 ends of transmission path available

IEC 

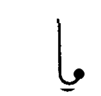
15.2.1.4 Application: E-plane coupling by aperture; 4 ends of transmission path available

IEC 

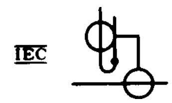
15.2.2 Coupling by loop to space

IEC 

15.2.3 Coupling by loop to guided transmission path

IEC 

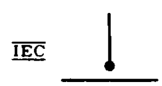
15.2.4 Coupling by loop from coaxial to circular waveguide with direct-current grounds connected



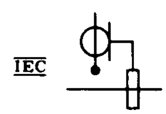
15.2.5 Coupling by probe to space

See OPEN CIRCUIT (item 3.8.1)

15.2.6 Coupling by probe to guided transmission path



15.2.7 Coupling by probe from coaxial to rectangular waveguide with direct-current grounds connected



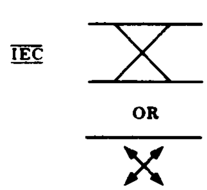
15.3 Directional Coupler F

Commonly used in coaxial and waveguide diagrams.

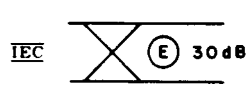
The arrows indicate the directions of power flow.

Number of coupling paths, type of coupling, and transmission loss may be indicated.

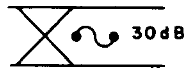
15.3.1 General



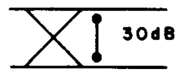
15.3.2 Application: E-plane aperture coupling, 30-decibel transmission loss



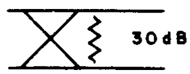
15.3.3 Application: loop coupling, 30-decibel transmission loss

IEC 

15.3.4 Application: probe coupling, 30-decibel transmission loss

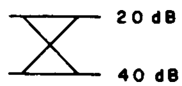
IEC 

15.3.5 Application: resistance coupling, 30-decibel transmission loss

IEC 

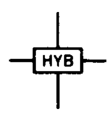
15.3.6 Application: directional coupler showing coupling loss and directivity

First value is coupling loss; second value is directivity.

IEC 

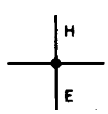
15.4 Hybrid Directionally Selective Transmission Devices

15.4.1 Hybrid (general)

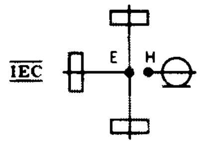


15.4.2 Hybrid, junction (magic T)

Commonly used in coaxial and waveguide transmission

IEC 

15.4.3 Application: rectangular waveguide and coaxial coupling

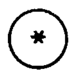


15.4.4 Hybrid, circular (basic)

NOTE — 15.4.4A: The asterisk is not part of the symbol. Always replace the asterisk by E, H, or HE. E indicates there is a principal E transverse field in the plane of the ring. H indicates that there is a principal H transverse field in the plane of the ring. HE shall be used for all other cases.

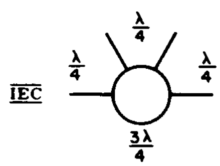
An arm that has coupling of a different type from that designated above shall be marked according to COUPLING (item 15.2.1).

Critical distances should be labeled in terms of guide wavelengths.

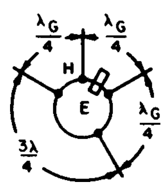


* See Note 15.4.4A

15.4.4.1 Application: 4-arm circular hybrid



15.4.4.2 Application: rectangular waveguide circular hybrid with 3 arms coupling in the E plane and a fourth arm coupling in the H plane



15.5 Mode Transducer

Commonly used in coaxial and waveguide diagrams.

If it is desired to specify the type of transmission, appropriate indications may be added.

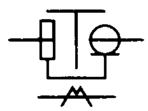
15.5.1 General

IEC 

15.5.2 Application: transition from rectangular to circular waveguide

IEC 

15.5.3 Application: transition from rectangular waveguide to coaxial cable with mode suppression and direct-current grounds connected

IEC 

15.6 Mode Suppressor

Commonly used in coaxial and waveguide transmission.

15.6.1 General

IEC 

15.7 Rotary Joint (radio-frequency rotary coupler F)

15.7.1 General: with rectangular waveguide system

NOTE — 15.7.1A: The asterisk is not part of the symbol. If necessary, a transmission path recognition symbol may be added. See symbol 3.6.

 IEC

* See Note 15.7.1A

15.7.1.1 Application: coaxial type in rectangular waveguide system

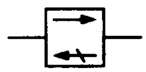
 IEC

15.7.1.2 Application: circular waveguide type in rectangular waveguide system

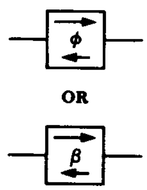
15.8 Nonreciprocal Devices

15.8.1 Isolator

See also symbol 8.10

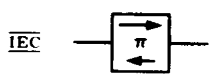


15.8.2 Nonreciprocal directional phase shifter



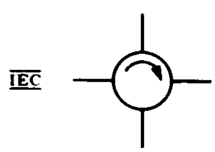
15.8.3 Gyrator

The longer arrow indicates the direction of propagation in which the required phase change occurs.



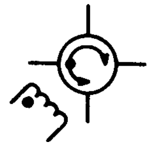
15.8.4 Circulator, fixed direction

Arrowhead indicates direction of power flow from any input to next adjacent arm but not to any other arm. Circulator may have three or more ports.



15.8.4.1 Reversible direction

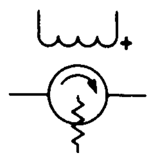
Current entering the coil at the end marked with the dot causes the energy in the circulator to flow in the direction of the arrowhead marked with the dot.



15.8.5 Field-polarization rotator

Arrow indicates direction of rotation of electric field when viewed in direction of signal flow.

15.8.6 Field-polarization amplitude modulator



15.9 Resonator
Tuned Cavity F

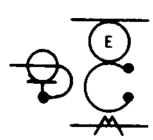
Excluding piezoelectric and magnetostriction devices.

15.9.1 General

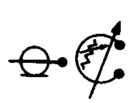
Commonly used for coaxial and waveguide transmission.

IEC 

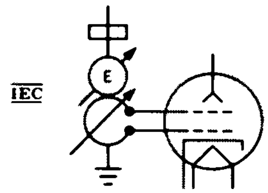
15.9.2 Application: resonator with mode suppression coupled by an E-plane aperture to a guided transmission path and by a loop to a coaxial path

IEC 

15.9.3 Application: tunable resonator having adjustable Q coupled by a probe to a coaxial system

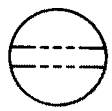


15.9.4 Application: tunable resonator with direct-current ground connected to an electron device and adjustably coupled by an E-plane aperture to a rectangular waveguide

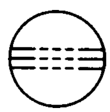


15.10 Resonator (cavity-type) Tube

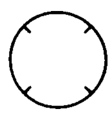
15.10.1 Single-cavity envelope and grid-type associated electrodes



15.10.2 Double-cavity envelope and grid-type associated electrodes

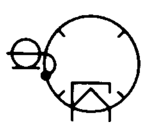


15.10.3 Multicavity magnetron anode and envelope

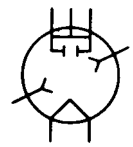


15.11 Magnetron

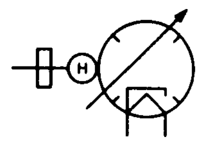
15.11.1 Resonant type with coaxial output



15.11.2 Transit-time split-plate type with stabilizing deflecting electrodes and internal circuit

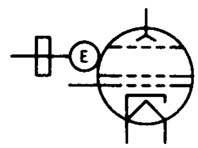


15.11.3 Tunable, aperture coupled



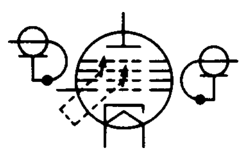
15.12 Velocity-Modulation (velocity-variation) Tube

15.12.1 Reflex klystron, integral cavity, aperture coupled



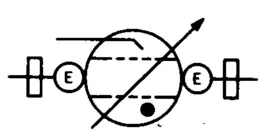
15.12.2 Double-cavity klystron, integral cavity, permanent externally ganged tuning, loop coupled (coupling loop may be shown inside if desired).

See symbol 15.2.2



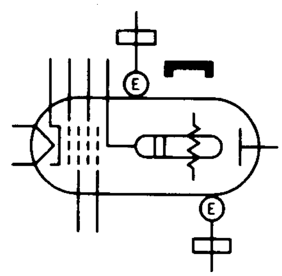
15.13 Transmit-Receive (TR) Tube

Gas-filled, tunable integral cavity, aperture coupled, with starter.

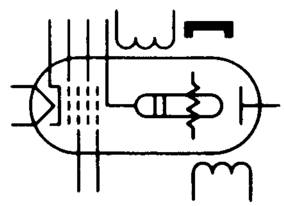


15.14 Traveling-Wave-Tube

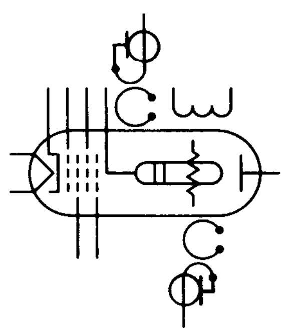
15.14.1 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide.



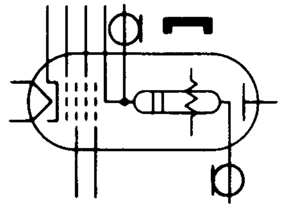
15.14.2 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by inductive coupling



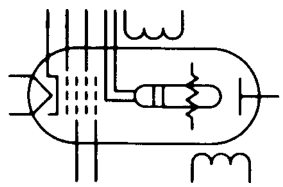
15.14.3 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, external electromagnetic focusing, rf input and rf output coupling, even by external cavity and loop coupling to a coaxial path



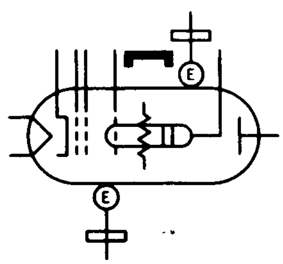
15.14.4 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by direct connection from slow-wave structure to a coaxial path



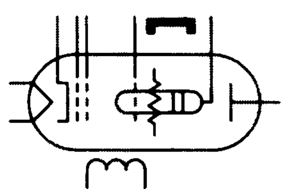
15.14.5 Forward-wave traveling-wave-tube amplifier shown with four grids, having bifilar slow-wave structure with attenuation, electrostatic focusing, rf input and rf output coupling, each by inductive coupling



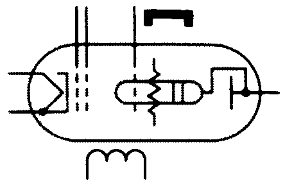
15.14.6 Backward-wave traveling-wave-tube amplifier shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide



15.14.7 Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling

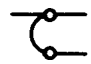


15.14.8 Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling, with slow-wave structure connected internally to collector

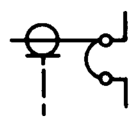


15.15 Balun

15.15.1 General

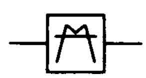
IEC 

15.15.2 [26] Application: balun connected between a balanced dipole and unbalanced coaxial cable

IEC 

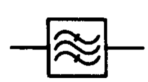
15.16 Filter

15.16.1 Mode filter

IEC 

15.16.2 Frequency filter (bandpass)

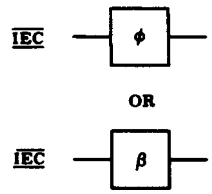
See also symbol 16.1.1.2

IEC 

15.17 Phase Shifter (matched)

See also symbols 15.8.2 and 16.6

[26]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.



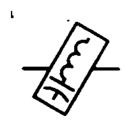
15.18 Ferrite Bead Ring

See also symbol 6.1.4

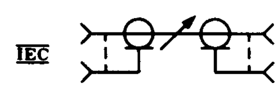
NOTE — 15.18A: If equivalent circuits must be shown within the symbol, the size or the aspect ratio of the original symbol may be altered providing its distinctive shape is retained.

15.18.1 General

15.18.2 Application: with equivalent circuit (LC network) shown



15.19 Line Stretcher (with female connectors shown)



Cross References

Bifilar Slow-Wave Structure (item 2.6.4)
Capacitive Termination (item 2.2.10)
Coaxial Cable, Recognition Symbol (item 3.1.9)
Inductive Termination (item 6.2.7)
Intentional Isolation of DC Path in Coaxial or Waveguide Applications (item 3.5)
Permanent Magnet (item 2.8)
Resistive Termination (item 2.1.11)
Shunt Capacitor (item 2.2.11)
Shunt Inductor (item 6.2.6)
Shunt Resistor (item 2.1.10)
Strip-Type Transmission Line (item 3.7)
Termination (item 3.8)
Waveguide (item 3.6)

Waveguide Flanges (item 5.7)

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.

16. Graphic Symbols for Composite Assemblies

16.1 Circuit Assembly
Circuit Subassembly
Circuit Element

NOTES:

16.1A — The asterisk is not part of the symbol. Always indicate the type of apparatus by appropriate words or letters in the rectangle.

16.1B — If identification, electrical values, location data, and similar information must be noted within a symbol, the size or the aspect ratio of the original symbol may be altered providing its distinctive shape is retained.

16.1C — The use of a general circuit-element symbol is restricted to the following:

a) Diagrams drawn in block form.
b) A substitute for complex circuit elements when the internal operation of the circuit element is not important to the purpose of the diagram.
c) Applications where a specific graphic symbol, or the parts to devise a suitable build-up, do not appear elsewhere in this standard.

16.1.1 General

* See Note 16.1A

16.1.1.1 Accepted abbreviations from ANSI Z32.13-1950 may be used in the rectangle.

16.1.1.2 The following letter combinations may be used in the rectangle:

CLK	Clock
EQ	Equalizer
FAX	Facsimile set $\boxed{F}$
FL	Filter
FL-BE	Filter, band-elimination
FL-BP	Filter, bandpass $\boxed{F}$
FL-HP	Filter, high-pass $\boxed{F}$
FL-LP	Filter, low-pass $\boxed{F}$
IND	Indicator
PS	Power supply $\boxed{F}$
RG	Recording unit

RU Reproducing unit
ST-INV Static inverter
DIAL Telephone dial
TEL Telephone station
TPR Teleprinter F
TTY Teletypewriter F

16.2 Amplifier

See also DIRECT-CURRENT MACHINES (symbols 13.4.20 to 13.4.23)

16.2.1 General

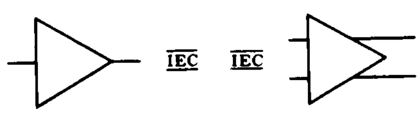
The triangle is pointed in the direction of transmission.

The symbol represents any method of amplification (electron tube, solid-state device, magnetic device, etc).

NOTE — 16.2.1A: If identification, electrical values, location data, and similar information must be noted within a symbol, the size or aspect ratio of the original symbol may be altered providing its distinctive shape is retained.

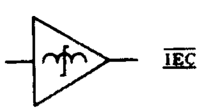
Amplifier use may be indicated in the triangle by words, standard abbreviations, or a letter combination from the following list:

BDG Bridging
BST Booster
CMP Compression
DC Direct-current
EXP Expansion
LIM Limiting
MON Monitoring
PGM Program
PRE Preliminary
PWR Power
TRQ Torque



See Note 16.2.1A

16.2.2 Magnetic amplifier



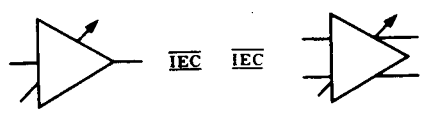
16.2.3 Application: amplifier with two inputs

See Note 16.2.1A

16.2.4 Application: amplifier with two outputs

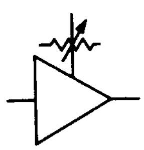
See Note 16.2.1A

16.2.5 Application: amplifier with adjustable gain



See Note 16.2.1A

16.2.6 Application: amplifier with associated attenuator

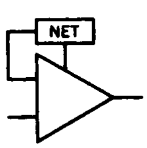


See Note 16.2.1A

16.2.7 Application: amplifier with associated power supply

See Note 16.2.1A

16.2.8 Application: amplifier with external feedback path



See Note 16.2.1A

16.3 Rectifier

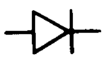
See ELECTRON TUBE (item 7.1), SEMICONDUCTOR DIODE (symbol 8.5.1), and SEMICONDUCTOR DEVICE (item 8.1)

16.3.1 General

NOTES:

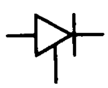
16.3.1A — Triangle points in direction of forward (easy) current as indicated by a direct-current ammeter, unless otherwise noted adjacent to the symbol. Electron flow is in the opposite direction.

16.3.1B — This symbol represents any method of rectification (electron tube, solid-state device, electrochemical device, etc).



See Notes 16.3.1A and B

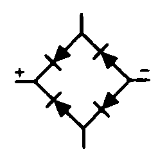
16.3.2 Controlled



See Notes 16.3.1A and B

16.3.3 Bridge-type rectifier

See item 8.5.1

IEC 

16.3.4 On connection or wiring diagrams, rectifier may be shown with terminals and polarity marking. Heavy line may be used to indicate nameplate or positive-polarity end.

For connection or wiring diagram

16.4 Repeater (includes Telephone Repeater )

16.4.1 1-way repeater

Triangle points in the direction of transmission.

16.4.2 2-wire, 2-way repeater

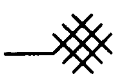
16.4.3 2-wire, 2-way repeater with low-frequency bypass

16.4.4 4-wire, 2-way repeater

16.5 Network
Artificial Line (other than delay line)

16.5.1 General

16.5.2 Network, low-voltage power

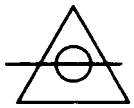


16.6 Phase Shifter
Phase-Changing Network

For power circuits see ALTERNATING-CURRENT MACHINES (symbols 13.5.17 and 13.5.18)

See also symbol 15.17

16.6.1 General

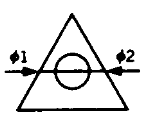


16.6.2 3-wire or 3-phase

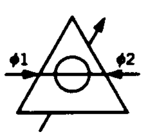
16.6.3 Application: adjustable

16.6.4 Differential phase shifter

Phase shift ϕ in direction of arrowhead; magnitudes shall be indicated.



16.6.5 Application: adjustable

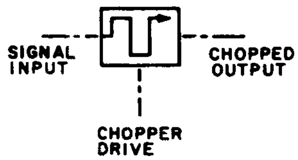


16.7 Chopper F

NOTES:

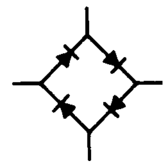
16.7A — The explanatory words are not part of the symbol.

16.7B — When diagram is other than single line, show connections as required for a specific device.

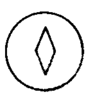


16.8 Diode-Type Ring Demodulator
Diode-Type Ring Modulator

IEC



16.9 Gyro
Gyroscope
Gyrocompass



IEC

16.10 Position Indicator

16.10.1 DC synchro type

IEC

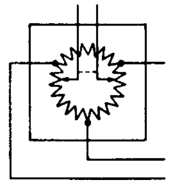
16.10.2 Inductor type

IEC

16.11 Position Transmitter

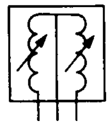
16.11.1 Desynn type (dc synchro type)

IEC



16.11.2 Inductor type

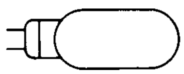
IEC



16.12 Fire Extinguisher Actuator Heads

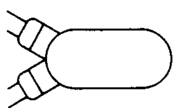
16.12.1 Single head with connectors

IEC



16.12.2 Double head with connectors

IEC



Cross References

Oscillator (item 2.9)

NOTES:

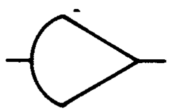
1 — See Introduction for general information (note especially A3.1).

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.

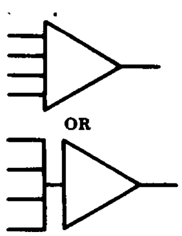
17. Graphic Symbols for Analog and Digital Logic Functions

17.1 Operational Amplifier



17.2 Summing Amplifier

(4 inputs and 1 output shown)



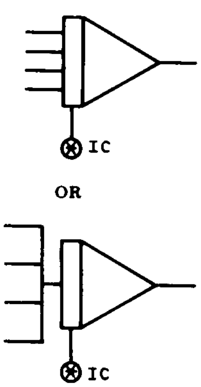
17.3 Integrator (Amplifier)

(4 inputs and 1 output shown)

NOTES:

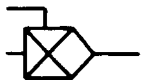
17.3A — The asterisk is not part of the symbol. Always add identification within or adjacent to the circle.

17.3B — The letters IC mean Initial Conditions.

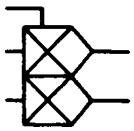


* See Note 17.3A

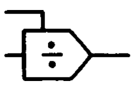
17.4 Electronic Multiplier



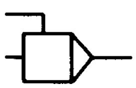
17.4.1 Two dependent multipliers



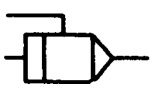
17.5 Electronic Divider



17.6 Electronic Function Generator



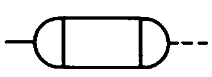
17.7 Generalized Integrator



17.8 Positional Servomechanism

Avoid conflict with item 2.6 if used on the same diagram.

NOTE — 17.8A: Dashed line indicates positioned in accordance with an input signal.



17.9 Function Potentiometer

Cross References

18. Graphic Symbols for Digital Logic Functions

18.1 Digital Logic Functions

(See cross references)

Cross References

The following standards do not constitute a part of this standard; they are listed for reference purposes only:

American National Standard Graphic Symbols for Logic Diagrams (Two-State Devices), Y32.14-1973 (IEEE Std 91-1973)

NEMA Standard, Industrial Controls and Systems ICS-1970 with Revision 5, July 1975

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.

19. Graphic Symbols for Special-Purpose Maintenance Diagrams

19.0 Introduction

The graphic symbols shown in this section were developed primarily for use on special-purpose maintenance diagrams, such as symbolic integrated maintenance-type diagrams, to provide detailed maintenance and operating information. See also item 23.1(3) for reference document. Use on other types of diagrams, however, is recommended if necessary to emphasize particular functions as defined in this section.[27]

See paragraph A4.5 of the Introduction

[27]The symbols shown in this section have comparable meanings or applications when used for drawings in mechanical, medical, or other disciplines or fields.

19.1 Data-Flow Code Signals

NOTE — 19.1A: Use only if essential to provide detailed maintenance and operation information (such as symbolic integrated maintenance manual diagrams).

19.1.1 Functional flow path

NOTE — 19.1.1A: Emphasis is required when it is necessary to differentiate between two relatively significant functional flow paths.

19.1.1.1 Major (most significant)

19.1.1.2 Minor (least significant)

19.1.2 Signal code

NOTE — 19.1.2A: All signal-code symbols shall be drawn on the functional flow path lines, e.g.,

19.1.2.1 Normal

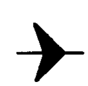
NOTE — 19.1.2.1A: The asterisk is not part of the symbol. Add an identification code letter when necessary for clarity.

*See Note 19.1.2.1A

19.1.2.1.1 Application: emergency mode

19.1.2.1.2 Application: automatic mode

19.1.2.2 Secondary flow; power distribution



19.1.2.3 Reference signal voltage; reference frequency

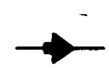
19.1.2.4 Signal to energize relay

19.1.2.5 Transmitter pulse; pulse-forming network, discharge path, or subsequent high-level modulation pulse

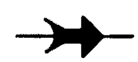
NOTE — 19.1.2.5A: This symbol shall be used only on a major (most significant) functional flow path.

19.1.2.6 Gating; synchronizing signal; low-level modulating signal

NOTE — 19.1.2.6A: This symbol shall be used only on a minor (least significant) functional flow path.



19.1.2.7 Test signal; signal used to light a lamp or provide a meter reading



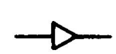
19.1.2.8 Feedback

NOTE — 19.1.2.8A: The arrowheads shall be placed close together.

19.1.3 Fault-signal code

NOTE — 19.1.3A: All fault signals shall use the signal-code symbols shown in items 19.1.2 through 19.1.2.6, except that they are not to be filled in.

19.1.3.1 Application: fault-isolation signal to relay



19.2 Functional Circuits

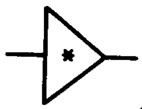
See Note 19.1A

19.2.1 Amplifier circuit (such as voltage amplifier, power amplifier etc.)

NOTES:

19.2.1A — This symbol represents an active circuit (of one or more stages) which changes the voltage or power level of the incoming signal, and contains one or more non-linear active elements, such as an electron tube, transistor, or diode.

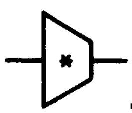
19.2.1B — The asterisk is not part of the symbol. A circuit identifier code should be added for proper identification of the basic symbol.



*See Note 19.2.1B

19.2.2 Signal generator; signal processor

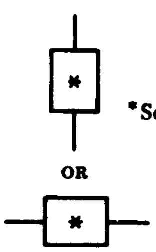
NOTE — 19.2.2A: This symbol represents an active circuit (of one or more stages) which generates a signal or processes an incoming signal in a manner other than to change the signal voltage or power level, e.g., oscillator, multivibrator, mixer, etc. Such circuits contain one or more active elements, such as an electron tube, transistor, or diode.



*See Note 19.2.1B

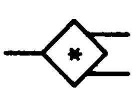
19.2.3 Linear element; linear network

NOTE — 19.2.3A: This symbol represents a resistor, a capacitor, or a network consisting of any combination of these linear elements, such as a filter network, voltage divider, pulse-forming network, etc.



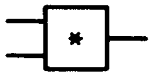
*See Note 19.2.1B

19.2.4 Relay contacts



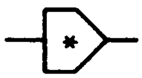
*See Note 19.2.1B

19.2.5 Relay coil or operating coil



*See Note 19.2.1B

19.2.6 Switch



*See Note 19.2.1B

19.2.7 Digital logic elements

See Section 18

19.2.8 Composite circuit (other than those covered by symbols **19.2.1** through **19.2.6**)

*See Note 19.2.1B

Cross References

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.

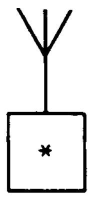
20. Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts

20.1 Radio Station

Other antenna symbols may be used to indicate specific types.

NOTE — 20.1A: The asterisk is not part of the symbol; identification of the type of station may be added within or adjacent to the symbol.

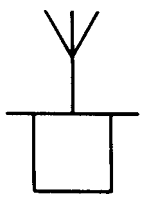
20.1.1 General



IEC

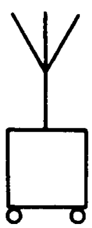
* See Note 20.1A

20.1.2 Portable



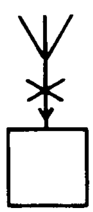
IEC

20.1.3 Mobile



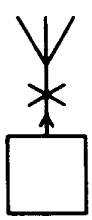
IEC

20.1.4 Direction-finding



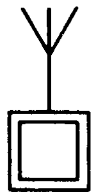
IEC

20.1.5 Radio beacon



IEC

20.1.6 Controlling



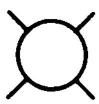
IEC

20.1.7 Passive relay

IEC

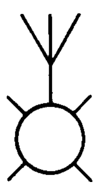
20.2 Space Station

20.2.1 General



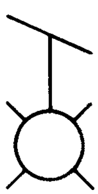
IEC

20.2.2 Active space station



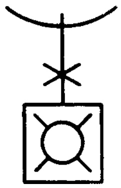
IEC

20.2.3 Passive space station



IEC

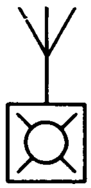
20.2.4 Earth station used for tracking a space station (shown with a paraboloidal antenna)



IEC

20.2.5

Application: earth station of a communication service via space station

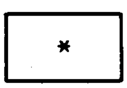


IEC

20.3 Exchange Equipment

20.3.1 General

NOTE — 20.3.1A: The asterisk is not part of the symbol. Replace the asterisk with information to specify a particular application.



IEC

* See Note 20.3.1A

20.3.2 Automatic switching

IEC

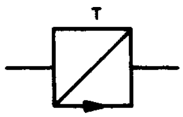
20.3.3 Manual switchboard

IEC

20.4 Telegraph Repeater

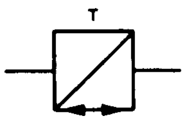
The letter “T” may be omitted if no confusion will result.

20.4.1 One-way simplex operation



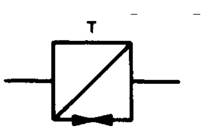
IEC

20.4.2 Two-way simplex operation



IEC

20.4.3 Duplex operation



IEC

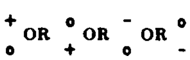
20.4.4 Qualifying symbols

The following symbols are restricted to use with the symbols in item 20.4 of this standard.

20.4.4.1 Polar direct-current (double current)

IEC

20.4.4.2 Neutral direct-current (single current)



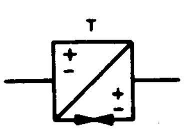
IEC

20.4.4.3 Alternating-current

IEC

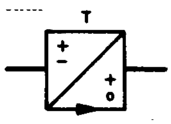
20.4.5 Applications:

20.4.5.1 Polar direct-current for duplex operation



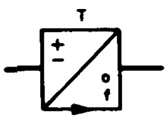
IEC

20.4.5.2 Polar direct-current/neutral direct-current for one-way simplex operation



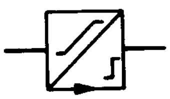
IEC

20.4.5.3 Polar direct-current/alternating-current for one-way simplex operation



IEC

20.4.5.4 Regenerative type for one-way simplex operation

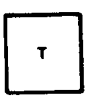


IEC

20.5 Telegraph Equipment

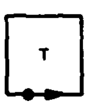
20.5.1 General

NOTE — 20.5.1A: The letter “T” may be replaced by a suitable qualifying symbol from item 20.5.6.



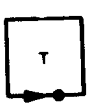
IEC

20.5.2 Transmitter



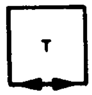
IEC

20.5.3 Receiver



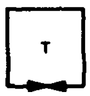
IEC

20.5.4 Two-way simplex



IEC

20.5.5 Duplex



IEC

20.5.6 Qualifying symbols

The following symbols are restricted to use with the symbols in Section 20.5 of this standard.

20.5.6.1 Tape printing

IEC

20.5.6.2 Tape perforating; perforated tape

IEC

20.5.6.3 Simultaneous printing on and perforating of one tape

IEC

20.5.6.4 Page printing

IEC

20.5.6.5 Keyboard

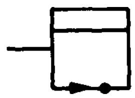
IEC

20.5.6.6 Facsimile

IEC

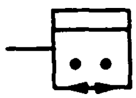
20.5.7 Applications:

20.5.7.1 Tape-printing receiver



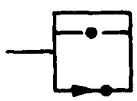
IEC

20.5.7.2 Tape-printing receiver with keyboard transmitter



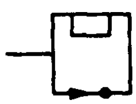
IEC

20.5.7.3 Printing reperforator



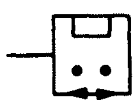
IEC

20.5.7.4 Page-printing receiver



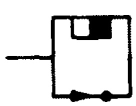
IEC

20.5.7.5 Page-printing receiver with keyboard transmitter



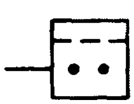
IEC

20.5.7.6 Facsimile receiver



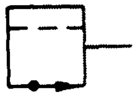
IEC

20.5.7.7 Keyboard perforator



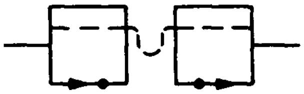
IEC

20.5.7.8 Automatic transmitter using perforated tape



IEC

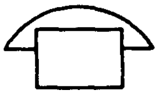
20.5.7.9 Separate reperforator and automatic transmitter with continuous tape feed



IEC

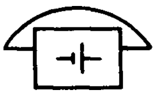
20.6 Telephone Set

20.6.1 General



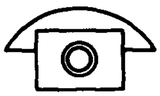
IEC

20.6.2 Local-battery



IEC

20.6.3 Common-battery



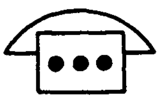
IEC

20.6.4 Dial-type

NOTE — 20.6.4A: The dots may be omitted if no confusion would result.

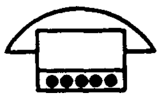
IEC

20.6.5 Pushbutton dialing



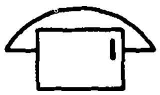
IEC

20.6.6 With two or more extension lines



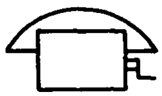
IEC

20.6.7 With coin box



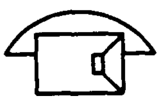
IEC

20.6.8 With ringing generator



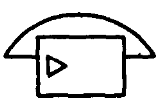
IEC

20.6.9 Loudspeaker-type



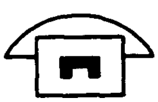
IEC

20.6.10 Amplifier-type



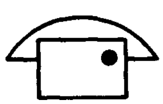
IEC

20.6.11 Sound-powered



IEC

20.6.12 Key or pushbutton type with special facilities (other than dialing or multiline operation)



IEC

Cross References

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.

21. Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts

21.1 Generating Station

NOTES:

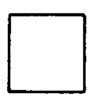
21.1A — Symbols for "planned" applications appear on the left; symbols for "in service" applications appear on the right.

21.1B — The preferred symbol is the square, but if necessary, a rectangle may be used.

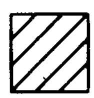
21.1C — Relative sizes of symbols are shown. Symbol size may be reduced for small-size diagrams. See also paragraph A4.5 of the Introduction.

21.1.1 General

See note 21.1A



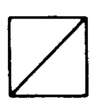
IEC IEC



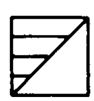
21.2 Hydroelectric Generating Station

See Note 21.1A

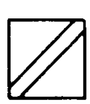
21.2.1 General



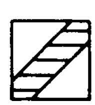
IEC IEC



21.2.2 Run of river



IEC IEC



21.2.3 With storage

21.2.4 With pumped storage

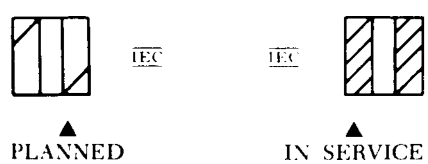
21.3 Thermoelectric Generating Station

See Note 21.1A

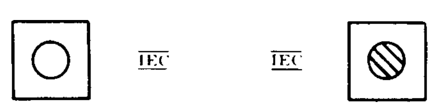
21.3.1 General

21.3.2 Coal or lignite fueled

21.3.3 Oil or gas fueled



21.3.4 Nuclear energy fueled



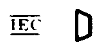
21.3.5 Geothermic

21.4 Prime Mover (qualifying symbols)

Use if essential to show the type of prime mover in a generating station.

See Note 21.1A

21.4.1 Gas turbine



21.4.1.1 Application: shown for oil- or gas-fueled generating station

21.4.2 Reciprocating engine

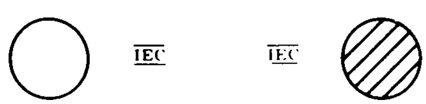
21.4.2.1 Application: shown for oil- or gas-fueled generating station

21.5 Substation

See Note 21.1A

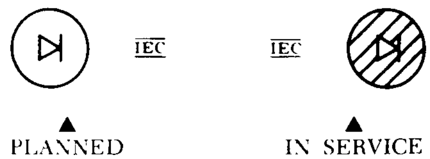
21.5.1 General

Avoid conflict with symbol 13.1.1 if used on the same diagram.



21.5.2 Rectifier substation

Use if essential to show type of equipment.



Cross References

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.

22. Class Designation Letters [28]

for use in assignment of reference designations for electrical and electronics parts and equipments as described in ANSI Y32.16-1975, Reference Designations for Electrical and Electronics Parts and Equipments

22.1 Class Designation Letter

The letters identifying the class of an item shall be selected in accordance with the list in paragraph 22.4.

For reference purposes, see also alphabetical listings of the items and other common and colloquial names in the index.

Graphic symbols do not appear in this standard for H, HP, N, WT, and some MP (listed in paragraph 22.4) because they apply to items beyond the scope of this standard.

Certain item names and designating letters may apply to either a part or an assembly.

22.2 Special Considerations for Class Designation Letter Assignment

22.2.1 Actual versus intended function

If a part serves a purpose other than its generally intended one, the function actually performed shall be represented by the graphic symbol used on the schematic diagram; the class letter shall be chosen from the list in paragraph 22.4 and shall be indicative of its physical characteristics. For example, a semiconductor diode used as a fuse would be

[28]Device function designations for power switchgear, industrial control, and industrial equipment use are not covered by this standard. For typical application of these device function designations, see:
a) American national Standard Maual and Automatic Station Control, Supervisory, and Associated Telemetering Equipments, C37.2-1970.
b) NEMA Standard, Industrial Controls and Systems ICS-1970 (R1975).
c) Joint Industrial Council Electrical Standards for Mass Production Equipment, EMP-1-1967, and General Purpose Machine Tools, EGP-1-1967.
d) Military Standard, Designations for Electric Power Switchgear Devices and Industrial Control Devices, MIL-STD-27.

represented by the graphic symbol for a fuse (actual function), but the class letter would be D or CR (class of part). If a part has a dual function, the class letter for the principal physical characteristic of the part shall apply.

22.2.2 Assembly versus subassembly

The term subassembly as used herein shall apply equally to an assembly.

22.2.3 Subassembly versus individual part

A group of parts shall not be treated as a subassembly unless it is one or more of the following:

a) A plug-in item.
b) A significant item covered by a separate schematic.
c) A multiapplication item.
d) Likely to be handled as a replaceable item for maintenance purposes.

22.2.4 Specific versus general

The letters A and U (for assembly) shall not be used if more specific class letters are listed in paragraph 22.4 for a particular item.

22.2.5 Inseparable subassemblies

Potted, embedded, riveted, or hermetically sealed subassemblies, modular assemblies, printed circuit boards, and integrated circuit packages and similar items which are ordinarily replaced as a single item of supply shall be treated as parts. They shall be assigned the class letter U, unless a more specific class letter is applicable.

22.3 Item Names

In the alphabetically arranged class letter list of paragraph 22.4, item names approved in the Federal Item Identification Guide, Cataloging Handbook H6-1, as of the date of this edition (though additional modifiers may be necessary), are indicated by the symbol $\boxed{\text{F}}$. For definitions which are not contained in Handbook H6-1, see American National Standard C42.100.

22.4 Class Designation Letters: Alphabetical List

Parts not specifically included in this list shall be assigned a letter or letters from the list below for the part or class most similar in function.

Designations for general classes of parts are marked with an asterisk (*) to facilitate designation of parts not specifically included in this standard.

A[*†] (see also U and 22.2.4)	electronic divider electronic function generator (other than rotating) electronic multiplier facsimile set $\boxed{F}$ field-polarization amplitude modulator field-polarization rotator general circuit element gyroscope integrator positional servomechanism sensor (transducer to electric power) separable assembly[‡] separable subassembly telephone set telephone station teleprinter $\boxed{F}$ teletypewriter $\boxed{F}$
AR	amplifier (other than rotating) repeater
AT	bolometer capacitive termination fixed attenuator $\boxed{F}$ inductive termination isolator (nonreciprocal device) pad resistive termination
B	blower motor $\boxed{F}$ synchro $\boxed{F}$
BT	barrier photocell battery $\boxed{F}$ battery cell blocking layer cell photovoltaic transducer solar cell
C	capacitor bushing capacitor $\boxed{F}$
CB	circuit breaker $\boxed{F}$ network protector
CP	connector adapter $\boxed{F}$ coupling (aperture, loop, or probe) junction (coaxial or waveguide)

D or CR	asymmetrical varistor crystal diode current regulator (semiconductor device) diode (semiconductor type) diode rectifier (semiconductor type) diode-type ring demodulator diode-type ring modulator metallic rectifier $\boxed{F}$ photodiode (photosensitive type) stabistor thyristor (semiconductor diode type) varactor
D or VR	breakdown diode (voltage regulator) overvoltage absorber $\boxed{F}$
DC	directional coupler
DL	delay function delay line $\boxed{F}$ slow-wave structure
DS	alphanumeric display device annunciator electrically restored drop general light source indicator (excluding meter or thermometer) $\boxed{F}$ lamp (excluding heating lamp) light-emitting solid-state device manually restored drop photodiode (photoemissive type) signal light visual alarm visual indicator visual signaling device

E*	aluminum cell
	antenna
	armature
	binding post $\boxed{F}$
	cable termination
	carbon block
	circuit terminal
	conductivity cell
	electrical contact $\boxed{F}$
	electrical contact brush $\boxed{F}$
	electrical shield
	electrolytic cell
	ferrite bead rings
	film element
	gap (horn, protective, or sphere)
	Hall element
	ignitor gap
	insulator $\boxed{F}$
	lightning arrester $\boxed{F}$
	magnetic core
	miscellaneous electrical part
	optical shield
	permanent magnet $\boxed{F}$
	rotary joint (microwave)
	short circuit (termination)
	spark gap
	splice
	telephone protector $\boxed{F}$
	telephone protector block $\boxed{F}$
	terminal (individual) $\boxed{F}$
	valve element
	vibrating reed
EQ	equalizer
	equalizing network
F	current limiter (for power cable)
	fuse $\boxed{F}$
	fuse cutout
FL	filter $\boxed{F}$
G	electronic chopper $\boxed{F}$
	generator $\boxed{F}$
	ignition magneto $\boxed{F}$
	interrupter vibrator $\boxed{F}$
	oscillator
	rotating amplifier (regulating generator)
	telephone magneto
H*	hardware (common fasteners, etc)
HP*	hydraulic part
HR	heater $\boxed{F}$
	heating lamp
	heating resistor
	infrared lamp $\boxed{F}$
	thermomechanical transducer
HS	handset $\boxed{F}$
	operator's set

HT	earphone $\boxed{F}$ electrical headset $\boxed{F}$ receiver (excluding radio receiver) telephone receiver
HY	circulator directionally selective transmission device hybrid circuit network $\boxed{F}$ hybrid coil (telephone usage) hybrid junction (magic T)
J	disconnecting device (receptacle connector) electrical receptacle connector $\boxed{F}$ jack receptacle (connector, stationary portion) waveguide flange (choke) $\boxed{F}$
K	contactor (magnetically operated) relay $\boxed{F}$
L	coil (all not classified as transformers) $\boxed{F}$ electrical solenoid $\boxed{F}$ field winding generator field inductor lamp ballast motor field reactor $\boxed{F}$ winding $\boxed{F}$
LS	audible alarm audible signaling device buzzer $\boxed{F}$ electric bell $\boxed{F}$ electric horn $\boxed{F}$ loudspeaker $\boxed{F}$ loudspeaker-microphone siren $\boxed{F}$ telephone ringer $\boxed{F}$ telephone sounder $\boxed{F}$ underwater sound transducer
M	clock $\boxed{F}$ coulomb accumulator elapsed time recorder electric timer electrical counter $\boxed{F}$ electrochemical step-function device instrument message register meter meter-type level pressure gage oscillograph $\boxed{F}$ oscilloscope $\boxed{F}$ position indicator thermometer

MG	converter (rotating machine) dynamotor $\boxed{F}$ inverter (motor-generator) motor-generator $\boxed{F}$
MK	hydrophone microphone $\boxed{F}$ telephone transmitter
MP*	brake clutch mechanical interlock mechanical part miscellaneous mechanical part (bearing, coupling, gear, shaft)
MT	accelerometer measuring transducer mode transducer motional pickup transducer primary detector
N**	equipment subdivision
P	disconnecting device (plug connector) electrical plug connector $\boxed{F}$ plug (connector, movable portion) waveguide flange (plain) $\boxed{F}$
PS	power supply $\boxed{F}$ rectifier (complete power-supply assembly)
PU	head (with various modifiers) sound reproducer $\boxed{F}$
Q	semiconductor controlled rectifier semiconductor controlled switch phototransistor (3 terminal) thyratron (semiconductor device) thyratron (semiconductor triode type) transistor $\boxed{F}$
R	function potentiometer instrument shunt magnetoresistor potentiometer relay shunt resistor $\boxed{F}$ rheostat $\boxed{F}$
RE	radio receiver $\boxed{F}$
RT	ballast lamp ballast tube current-regulating resistor $\boxed{F}$ resistance lamp temperature-sensing element thermal resistor $\boxed{F}$ thermistor
RV	symmetrical varistor voltage-sensitive resistor $\boxed{F}$

S	contactor (manually, mechanically, or thermally operated) disconnecting device (switch) electrical safety interlock flasher (circuit interrupter) governor (electrical contact type) $\boxed{F}$ speed regulator (electrical contact type) switch $\boxed{F}$ telegraph key telephone dial $\boxed{F}$ thermal cutout (circuit interrupter) (not visual) thermostat
SQ	electric squib $\boxed{F}$ explosive squib fusible link igniter squib sensing link
SR	electrical contact ring $\boxed{F}$ rotating contact slip ring
T	autotransformer coaxial taper linear coupler telephone induction coil $\boxed{F}$ telephone repeating coil $\boxed{F}$ transformer $\boxed{F}$ waveguide taper
TB	connecting strip terminal board $\boxed{F}$ terminal strip test block
TC	semiconductor thermocouple thermocouple $\boxed{F}$ thermopile
TP††	test point
TR	radio transmitter $\boxed{F}$
U*† (see also A* and 22.2.4)	inseparable assembly integrated-circuit package microcircuit micromodule photon-coupled isolator
V	electron tube $\boxed{F}$ Geiger-Muller counter tube ionization chamber klystron magnetron phototube proportional counter tube resonator tube (cavity type) solion thyratron (electron tube) traveling-wave tube voltage regulator (electron tube)

VR	induction voltage regulator
(see also D)	voltage regulator (excluding electron tube) $\boxed{F}$
W	bus bar $\boxed{F}$
	cable
	cable assembly (with connectors)
	coaxial cable
	conductor
	distribution line
	distribution path
	Goubau line
	strip-type transmission line
	transmission line
	transmission path
	waveguide $\boxed{F}$
	wire $\boxed{F}$
WT‡‡	wiring tiepoint
X	fuseholder $\boxed{F}$
	lampholder $\boxed{F}$
	socket $\boxed{F}$
Y	magnetostriction oscillator
	piezoelectric crystal unit
	quartz crystal unit $\boxed{F}$
	tuning-fork resonator $\boxed{F}$
Z	artificial line (other than delay line)
	balun
	carrier-line trap
	coupled tunable resonator
	directional phase shifter (non-reciprocal)
	discontinuity (usually coaxial or waveguide transmission use)
	E-H tuner
	general network (where specific class letters do not fit)
	gyrator
	mode suppressor
	multistub tuner
	phase shifter
	phase-changing network $\boxed{F}$
	resonator (tuned cavity)
	slide-screw tuner

*Device function designations for power switchgear, industrial control, and industrial equipment use are not covered by this standard. For typical application of these device function designations, see:

American National Standard Manual and Automatic Station Control, Supervisory, and Associated Telemetering Equipments, C37.2-1970.

NEMA Standard, Industrial Controls and Systems ICS-1970 (R1975).

Joint Industrial Council Electrical Standards for Mass Production Equipment, EMP-1-1967, and General Purpose Machine Tools, EGP-1-1967.

Military Standard, Designations for Electric Power Switchgear Devices and Industrial Control Devices, MIL-STD-27.

†The class letter A is assigned on the basis that the item is separable. The class letter U shall be used if the item is inseparable.

‡For economic reasons, assemblies which are fundamentally separable may not be so provisioned but may be supplied as complete assemblies. However, the class letter A shall be retained.

**Not a class letter, but used to identify a subdivision of an equipment in the Location Numbering Method.

††Not a class letter, but commonly used to designate test points for maintenance purposes. See American National Standard Y14.15-1966 (R1973).
‡‡Not a class letter, but commonly used to designate a tiepoint on connection diagrams. See American National Standard Y14.15-1966 (R1973).

22.5 Item Names: Alphabetical List

The index to this standard shows the class designation letter as applicable under the general rules, together with the item number of the representative graphic symbol.

22.6 Item Designations, IEC 113-2

For reference purposes, Appendix F shows a comparison of the class letters used to identify parts and equipment according to International Electrotechnical Commission (IEC) Publication 113-2 and those assigned in American National Standard Y32.2-1975.

23. Referenced Standards and Canadian Standard Z99 Modifications

23.1 Referenced Standards [29]

When the following American National Standards are superseded by a revision approved by the American National Standards Institute, the revision shall apply:

American National Standard Reference Designations for Electrical and Electronics Parts and Equipment, Y32.16-1975 (IEEE Std 200-1975) (1)

American National Standard Graphic Symbols for Logic Diagrams, Y32.14-1973 (IEEE Std 91-1973) (1)

American National Standard Drafting Practices (Electrical and Electronics Diagrams), Y14.15-1966 (R1973) and Supplements Y14.15a-1970 (R1973) and Y14.15b-1973.

American National Standard Abbreviations for Use on Drawings, Y1.1-1972 (2)

American National Standard Manual and Automatic Station Control, Supervisory, and Associated Telemetering Equipments, C37.2-1970 (2)

American National Standard Dimensions of Caps, Plugs, and Receptacles, C73.10-1966 (R1972) through C73.44-1966 (R1972)

American National Standard Dictionary of Electrical and Electronics Terms, C42.100-1972 (IEEE Std 100-1972)

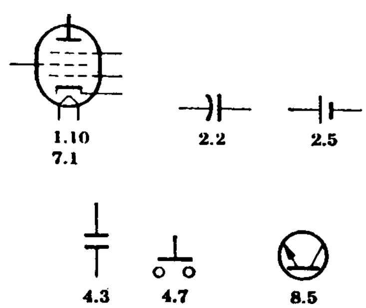
[29]For Military Applications:
(1) Refer to the latest edition adopted for mandatory use by the Department of Defense.
(2) Refer to the following military standards (latest edition at time of invitation to bid) in lieu of the American National Standards:
ANSI C37.2-1970 (in part): use MIL-STD-27 Designations for Electric Power Switchgear Devices and Industrial Control Devices.
ANSI Y1.1-1972: use MIL-STD-12 Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents.
(3) The following documents are listed for purposes of information only:
MIL-STD-100 Engineering Drawing Practices.
MIL-M-24100 Manuals, Technicals: Functionally Oriented Maintenance Manual (FOMM)
Federal Cataloging Handbook H6-1, Section A.

100. Canadian Standard Z99 Modifications to American National Standard Y32.2-1975 (IEEE Std 315-1975)

While not illustrated in the Standard itself, the widespread practice of using heavier lines in drawing certain symbols can, if followed, result in improved drawing readability. The practice is consistent with Clause A4.3. It is therefore recommended that heavier lines be used to show:

1.10	Envelopes
2.2	Capacitors
2.5	The negative plates of batteries and cells
4.3	The parallel lines in the (4.29 and 4.30) parallel contact symbols
4.7	The moving contact in the push button symbol
7.1	Indirectly heated cathode, anode and combinations including these
8.5	Base symbol as used for semiconductors

These items are illustrated below:



Additionally, it is recommended that the last symbol of Section 3.1.6.3 be avoided in all cases. Where space is at a premium, the possibility of misreading it as a crossover will usually be greater.

Cross References

For Graphical Electrical Symbols for Architectural Plans see Appendix F of CSA Standard C22.1-1975.

Annex A

Cross Reference List of Changed Item Numbers

(Informative)

(These appendixes are not part of American National Standard Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Class Designation Letters) Y32.2-1975 (IEEE Std 315-1975), but are included to facilitate its use.)

ANSI Y32.2-1970	ANSI Y32.2-1975	ANSI Y32.2-1970	ANSI Y32.2-1975
1.3.1.1	1.3.1	2.2.14	2.2.13
1.3.1.2	1.3.1	2.2.15	2.2.14
1.3.2.1	1.3.2	2.2.16	2.2.15
1.3.2.2	1.3.2	2.2.17	2.2.16
1.3.3	1.3.2	2.3.6.8	14.2.4.1
1.3.3.1	1.3.2	2.6.1 (top)	2.6.4
1.3.3.2	1.3.2	2.6.3	2.6.4
2.2.9	2.2.11	4.2.1.1 (bottom)	4.2.1.2
2.2.11	2.2.12	4.2.1.2	4.2.1.1
2.2.12	2.2.9	4.2.1.3	4.2.1.2
2.2.13	2.2.9.1	4.2.1.4	4.2.1.3

Annex B

Reference Data

International Electrotechnical Commission (IEC)

Publication 117: Recommended Graphical Symbols

(Informative)

The following documents were used for the listing of the IEC symbols (IEC) next to those graphic symbols in this standard that are considered to be in accordance with the graphic symbols in Publication 117.

Publication 117

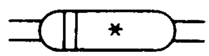
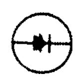
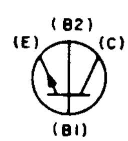
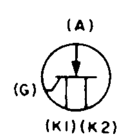
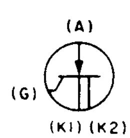
Part No.	
0	General Index (1973)
1	Kind of current, distribution systems, methods of connection and circuit elements (1960) Amendments: 1 (August 1966), 2 (August 1967), 3 (August 1973)
2	Machines, transformers, primary cells, and accumulators, transductors and magnetic amplifiers, inductors (1960) Amendments: 1 (August 1966), 2 (October 1971), 3 (August 1973) Supplement A (April 1974)
3	Contacts, switchgear, mechanical controls, starters, and elements of electromechanical relays (1963) Amendments: 1 (August 1966), 2 (March 1972), 3 (August 1973), 4 (May 1974) Supplements: A (April 1970), Second (1972)
4	Indicating instruments and electric clocks (1963) Amendments: 1 (October 1971), 2 August 1973), 3 (May 1974)
5	Generating stations and substations, lines for transmission and distribution (1963) Amendment 1 (August 1973)
6	Variability, examples of resistors, elements of electronic tubes, values and rectifiers (1964) Amendments: 1 (August 1966), 2 (December 1967), 3 (August 1973)
7	Semiconductor devices, capacitors (Second edition, 1971)
8	Architectural diagrams (1967)
9	Telephony, telegraphy, and transducers (1968) Supplements: First (1969), B (April 1971)

10	Aerials (antennas) and radio stations (1968) Supplement A (Nov 1969)
11	Microwave technology (1968) First supplement (1971)
12	Frequency spectrum diagrams (1968)
13	Block symbols for transmission and miscellaneous applications (1969) Supplements: First (1971), Second (1972), C (April 1974)
14	Telecommunication lines and accessories (1971) Supplement A (May 1974)
15	Binary logic elements (1972)
16	Ferrite Cores and magnetic storage matrices (1972)

Annex C

Revised or Deleted Symbols

(Informative)

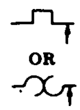
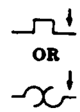
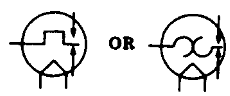
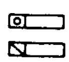
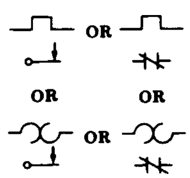
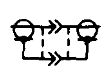
Symbols Formerly in ANSI Y32.2-1970	Recommended Symbols in ANSI Y32.2-1975
Revised 2.6.3 Bifilar slow-wave structure Commonly used in traveling-wave tubes.  *See Note 2.6.1A	See item 2.6.4
Deleted Alternate 8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier OR 	See item 8.5.1
Revised Alternate 8.5.2 Capacitive diode (varactor) Style 2 	See item 8.5.2 Style 2
Deleted Alternate 8.6.3 NPN transistor with transverse-biased base IEC 	See item 8.6.3
Revised 8.11 **Solid-State Thyratron (replacement type)** 8.11.1 Balanced  8.11.2 Unbalanced 	See item 8.11.1 See item 8.11.2

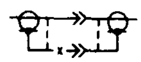
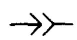
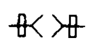
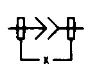
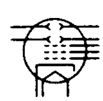
Annex D

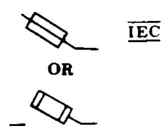
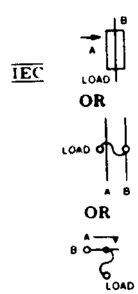
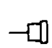
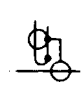
Revised or Deleted Symbols

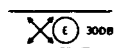
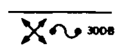
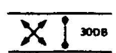
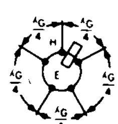
(Informative)

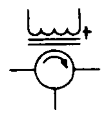
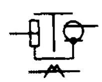
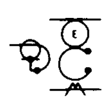
Symbols Formerly in USAS Y32.2-1967	**Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified**
Modified **1.7.2 Both ways** **IEC** **OR** **See Note 1.7.1A**	See item 1.7.2
Expanded **2.1.12 Thermistor** **Thermal resistor** F **2.1.12.1 General**  **2.1.12.2 With independent integral heater** 	See item 2.1.12
Revised **2.8 Permanent Magnet** F 	See item 2.8
Revised **3.1.9* Coaxial cable, recognition symbol** **Coaxial transmission path** **Radio-frequency cable** F **(coaxial)** NOTE — 3.1.9A: If necessary for clarity, an outer-conductor connection to the symbol shall be made where the broken line - — - is shown.  **See Note 3.1.9A**	See item 3.1.9

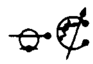
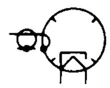
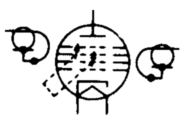
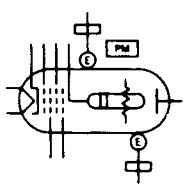
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Revised and Expanded **4.21 Thermostat** Ambient-temperature-operated device. Operates on rising temperature. **4.21.1 With break contact** See also item 4.20.2  **4.21.2 With make contact** See also item 4.20.2  **4.21.3 With integral heater and transfer contacts**  	See items 4.21 through 4.21.7
Deleted **4.30 Relay** F  †FO **Fast-operate** †FR **Fast-release**	See item 4.30
Revised and Expanded **4.30.5 Thermal relay** F  	See items 4.30.5 through 4.30.6
Revised **5.6.2 Coaxial with the outside conductor shown carried through** 	See item 5.6.2

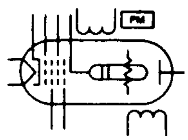
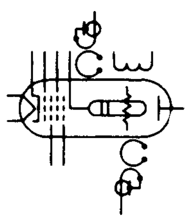
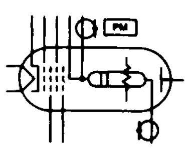
Symbols Formerly in USAS Y32.2-1967	**Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified**
Revised **5.6.3 Application: Coaxial with outside conductor shown carried through; with outside conductor terminated on chassis** 	See item 5.6.3
Revised **5.6.4 Application: Coaxial with center conductor shown carried through; outside conductor not carried through** 	See item 5.6.4
Revised **5.7.1 Mated (general)**  See Note 5.7A	See item 5.7.1
Deleted **5.7.4 Application: mated choke flanges in rectangular waveguide line** 	See item 5.7.4
Revised **5.7.5 Application: rectangular waveguide with mated plain and choke flanges with direct-current isolation (insulation) between sections of waveguide.** 	See item 5.7.5
Revised **7.3.6 Cathode-ray tube** **7.3.6.1 With electric-field deflection**  **7.3.6.2 For magnetic deflection** 	See items 7.3.6 through 7.3.6.2.2

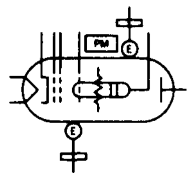
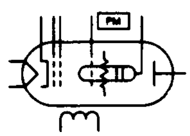
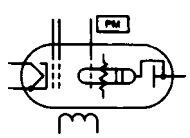
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Revised **8.6.15 Thyristor, bidirectional triodetype; triac; gated switch** Style 3 	See item 8.6.15
Revised and Expanded **9.1.2 High-voltage primary fuse cut-out, dry** 	See item 9.1.3
Revised and Expanded **9.1.4 With alarm contact** When fuse blows, alarm bus A is connected to power bus B. Letters are for explanation and are not part of the symbol. 	See item 9.1.2
Revised **10.4.1 General**  	See item 10.4.1
Revised **15.2.4 Coupling by loop from coaxial to circular waveguide with direct-current grounds connected** 	See item 15.2.4

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Revised **15.2.7 Coupling by probe from coaxial to rectangular waveguide with direct-current grounds connected** 	See item 15.2.7
Revised **15.3.2** Application: E-plane aperture coupling, 30-decibel transmission loss  15.3.3 Application: loop coupling, 30-decibel transmission loss  15.3.4 Application: probe coupling, 30-decibel transmission loss  15.3.5 Application: resistance coupling, 30-decibel transmission loss 	See items 15.3.2 through 15.3.6
Revised **15.4.4.1 Application: 5-arm circular hybrid with principal coupling in the E plane and with 1-arm H coupling using rectangular waveguide** 	See item 15.4.4

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Deleted **15.4.5.1 Application: circulator, reversible direction** The polarity symbol (item 1.6) must be used with electromagnet symbol to indicate proper direction flow. 	See item 15.8.4.1
Revised **15.5.3 Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected.** 	See item 15.5.3
Revised **15.7.1.1 Application: coaxial type in rectangular waveguide system** 	See item 15.7.1.1
Deleted **15.8.3 Unidirectional (isolator) Power flowing in direction of arrow is not intentionally attenuated.** 	See item 15.8.1
Revised **15.9.2 Application: resonator with mode suppression coupled by an E-plane aperture to a guided transmission path and by a loop to a coaxial path** 	See item 15.9.2

Symbols Formerly in USAS Y32.2-1967	**Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified**
Revised **15.9.3 Application: tunable resonator having adjustable Q coupled by a probe to a coaxial system** 	See item 15.9.3
Revised **15.11.1 Resonant type with coaxial output** 	See item 15.11.1
Revised **15.12.2 Double-cavity klystron, integral cavity, permanent externally-ganged tuning, loop coupled (coupling loop may be shown inside if desired) See item 7.1.7.1.** 	See item 15.12.2
Revised **15.14.1 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide** 	See item 15.14.1

Symbols Formerly in USAS Y32.2-1967	**Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified**
Revised **15.14.2 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by inductive coupling** 	See item 15.14.2
Revised **15.14.3 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, external electromagnetic focusing rf input and rf output coupling-each by external cavity and loop coupling, to a coaxial path** 	See item 15.14.3
Revised **15.14.4 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by direct connection from slow-wave structure to a coaxial path** 	See item 15.14.4

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Revised 15.14.6 Backward-wave traveling-wave-tube amplifier shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing be external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide 	See item 15.14.6
Revised **15.14.7 Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling** 	See item 15.14.7
Revised **15.14.8 Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling, with slow-wave structure connected internally to collector** 	See item 15.14.8

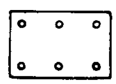
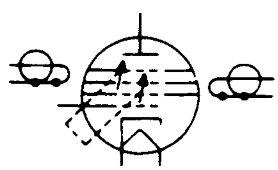
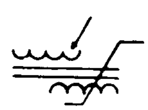
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified
Deleted	See item 16.1.1
16.1.1.3 Additional letter combinations, as follows, may be employed, but the use of specific graphic symbols included elsewhere in this standard is preferred AR Amplifier F AT Attenuator C Capacitor F CB Circuit breaker F HS Handset F I Indicating or switchboard lamp L Inductor J Jack LS Loudspeaker F MIC Microphone F OSC Oscillator PAD Pad P Plug HT Receiver, headset K Relay F R Resistor F S Switch F or key switch T Transformer F WR Wall receptacle	

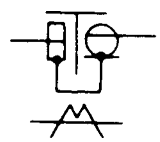
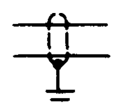
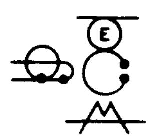
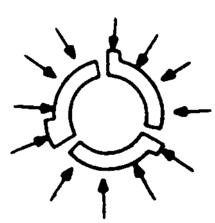
*The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

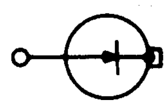
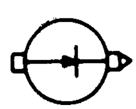
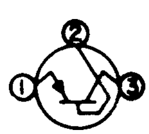
Annex E

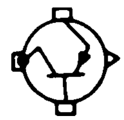
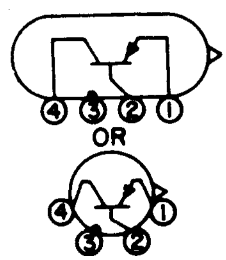
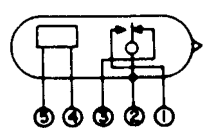
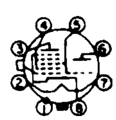
Revised or Deleted Symbols

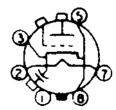
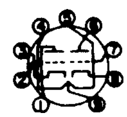
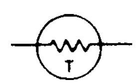
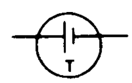
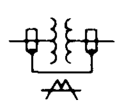
(Informative)

Symbols Formerly in USA Standard Y32.2-1962 & Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)	**Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified**
Deleted **11.3.1** On a connection or wiring diagram, a 3-pole single-throw circuit breaker (with terminals shown) may be drawn as shown below  **See Note 11.3A FOR CONNECTION OR WIRING DIAGRAM**	See ANSI Y14.15-1966
Corrected **34.11.10.2** Double-cavity klystron, integral cavity, permanent external-ganged tuning, loop coupled (coupling loop may be shown inside if desired) See item 34.8.1 	See item 15.12.2
Revised and Expanded **42.7** Saturable-core inductor (reactor) Polarity marks may be added to direct-current winding. Explanatory words and arrow are not part of the symbols shown. 	See item 6.3
Revised **48 Meter** **Instrument** T Temperature meter	See item 12.1

Symbols Formerly in USA Standard Y32.2-1962 & Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)	**Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified**
Corrected **53.3** Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected 	See item 15.5.3
Corrected **58.8.2** Coaxial cable, recognition sym- Coaxial transmission path Cable, radio frequency $\boxed{\text{F}}$, (Coaxial) See item 58.1. 	See item 3.1.9
Corrected **58.8.4** Shielded 2-conductor cable with shield grounded 	See item 3.1.8.4
Corrected **71.2.1** Resonator with mode suppression coupled by an E-plane aperture to a guided transmission path and by a loop to a coaxial path. 	See item 15.9.2
Revised **76.12.7 Wafer, 3-pole 3-circuit with 2 nonshorting and 1 shorting moving contacts** **Viewed from end opposite control knob or actuator unless otherwise indicated.** **For more than one section, section No. 1 is nearest control knob.** **When contacts are on both sides, front contacts are nearest control knob.** 	See item 4.13.7

Symbols Formerly in USA Standard Y32.2-1962 & Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)	**Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified**
Deleted **81.5** Applications NOTES: 81.5A — If the device terminals are in a circular arrangement, the actual angular spacing between the terminals should be approximated on the terminal diagram. 81.5B — If the terminals are in an essentially linear arrangement the terminal diagram may show the terminals in either a linear array along one side of the elongated envelope symbol (preferable), or within a maximum angle of 150 degrees around the circular envelope symbol. 81.5C — If pins are omitted in an otherwise standard terminal arrangement, do not respace the remaining pins. 81.5D — A terminal at the center of the terminal arrangement shall be identified as the CENTER terminal lead or pin. 81.5E — The typical examples show pin numbering in accordance with standard industry practice, i.e., with the terminals viewed from outside the terminal face of the device.	See ANSI Y14.15-1966
81.5.1 Two-terminal device with one flexible lead and one rigid terminal connected to a metallic envelope (typical semiconductor diode shown). 	
81.5.2 Two-terminal device with rigid terminals and reference point located at one of the terminals (typical semiconductor diode shown). 	
81.5.3 Three-terminal device with circular arrangement of pin terminals with base orientation determined by gap in pin spacing (typical transistor shown). 	

Symbols Formerly in USA Standard Y32.2-1962 & Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)	**Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified**
Deleted (continued) **81.5.4** Three-terminal device with rigid terminals, one connected to the metallic enclosure, and index pin (typical transistor shown).  **81.5.5** Four-terminal device with in-line pin terminals, one connected to metallic envelope, and reference point (typical transistor shown).  **81.5.6** Five-terminal device with in-line terminal leads, one connected to metallic enclosure and reference point (typical relay shown).  **81.5.7** Device with 8-terminal keyed (such as octal) base, rigid envelope terminal, and magnetic envelope connected to base terminal (typical triode-heptode shown). 	See ANSI Y14.15-1966

Symbols Formerly in USA Standard Y32.2-1962 & Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)	**Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified**
Deleted (continued) **81.5.8** Device with keyed (such as octal) base having design capability of 8 pins but with 2 pins omitted, and with 3 rigid envelope terminals (typical disc-seal triode shown).  **81.5.9** Device with 9-terminal (such as noval) base utilizing gap in pin spacing to establish base orientation (typical twin triode shown). 	
Revised **84 Thermistor** **Resistor, Thermal** F "T" indicates that the primary characteristic of the element within the circle is a function of temperature.	See items 1.2.1 and 2.1.12
Revised **84.1** General 	See item 2.1.12.1
Revised **85.2.1** Temperature-measuring semiconductor thermocouple 	See item 8.8.1
Corrected **86.1.1** Application: transformer with direct-current connections and mode suppression between two rectangular waveguides 	See item 6.4.1.1

Annex F

Cross-Reference List of Class Designation Letters

(Informative)

IEC Publication 113-2 (1971) Item Designations, Letter Codes
ANSI Y32.2-1975 (IEEE Std 315-1975), Section 22, Class Designation Letters

*	No conflict between ANSI Y32.2 and IEC.
#	ANSI Y32.2 not in agreement with IEC, but no conflict if used.
@	ANSI Y32.2 conflicts with IEC as IEC uses class letter to represent other devices.

IEC Publication 113-2		Letter Code	
	Terminology	**IEC**	**Y32.2**
#	Acoustical indicator	H	LS
*	Adjustable resistor	R	R
@	Aerial	W	E
#	Amplifier	A	AR
#	Amplifier (with tubes)	A	AR
@	Arrester	F	E
*	Assemblies	A	A,U
*	Auxiliary switch	S	S
#	Battery	G	BT
#	Bistable element	D	U,A
#	Brake	Y	MP
*	Busbar	W	W
*	Cable	W	W
*	Cable balancing network	Z	Z
*	Capacitor	C	C
#	Changer	U	A,B,G,MT
#	Circuit breaker	Q	CB
#	Clutch	Y	MP
*	Coder	U	U,A
#	Compander	Z	A
*	Connecting stage	S	S
*	Contactors	K	K
*	Control switch	S	S
*	Converter	U	A,U,MG
@	Core, storage	D	E

IEC Publication 113-2		Letter Code	
	Terminology	**IEC**	**Y32.2**
#	Crystal filter	Z	FL
@	Crystal transducer	B	Y
*	Current transformer	T	T
#	Delay device	D	DL
#	Delay line	D	DL
#	Demodulator	U	A
*	Dial contact	S	S
@	Diode	V	D
@	Dipole	W	E
@	Disconnecting plug	X	P
*	Disconnecting socket	X	X
#	Discriminator	U	A
#	Disk recorder	D	A
#	Dynamotor	B	MG
#	Electrically operated mechanical device	Y	MT
*	Electronic tube	V	V
#	Equalizer	Z	EQ
#	Filter	Z	FL
#	Frequency changer	U	A,B,G
*	Fuse	F	F
*	Gas discharge tube	V	V
*	Generator	G	G
#	Heating device	E	HR
*	Hybrid	Z	Z
#	Indicating device	P	DS
*	Induction coil	L	L
*	Inductors	L	L
#	Integrating measuring device	P	M,MT,Z
#	Inverter	U	A,U,PS,MG
#	Isolator	Q	AT
*	Jumper wire	W	W
#	Laser	A	MT,A
#	Lighting device	E	DS
*	Limit switch	S	S

IEC Publication 113-2		Letter Code	
	Terminology	**IEC**	**Y32.2**
#	Limiter	Z	MT,RE
@	Line trap	L	FL,MP,V
#	Loudspeaker	B	LS
#	Magnetic amplifier	A	AR
#	Magnetic tape recorder	D	A
*	Maser	A	A
@	Measuring equipment	P	M
#	Microphone	B	MK
*	Miscellaneous	E	E
#	Modulator	U	A
#	Monostable element	D	A,U
@	Motor	M	B
#	Optical indicator	H	DS
@	Oscillator	G	Y,G
*	Overvoltage discharge device	F	F,E
@	Parabolic aerial	W	E
@	Photoelectric cell	B	V
#	Pickup	B	PU
@	Plug	X	P
#	Pneumatic value	Y	MP
*	Potentiometer	R	R
@	Power switchgear	Q	CB,S
*	Protective device	F	F
*	Pushbutton	S	S
@	Quartz-oscillator	G	Y
#	Recording device	P	A,M
#	Register	D	A,U,M
*	Relay	K	K
*	Resistor	R	R
*	Resolver	B	B
*	Rheostat	R	R
*	Rotating frequency generator	G	G,MG
*	Rotating generator	G	G
*	Selector	S	S

IEC Publication 113-2		Letter Code	
	Terminology	**IEC**	**Y32.2**
*	Selector switch	S	S
#, @	Semiconductor	V	D,CR,Q
*	Shunt (resistor)	R	R
#	Signal generator	P	A
#	Signaling device	H	DS
*	Socket	X	X
#	Soldering terminal strip	X	E,TB
#	Static frequency changer	U	A
#	Storage device	D	A,U
*	Subassembly	A	A
#	Supply	G	A,PS
#	Supply device	G	A,PS
*	Sychro	B	B
#	Telegraph translator	U	A
@	Terminal	X	E
#	Terminal board	X	TB
#	Termination	Z	AT
#	Test jack	X	E,J
#	Testing equipment	P	A
#	Thermistor	R	RT
#	Thermo cell	B	A,TC
#	Thermoelectric sensor	B	A
#	Thyristor	V	Q
#	Transducer (nonelectrical quantity to electrical quantity)	B	A,BT
*	Transformer	T	T
*	Transmission path	W	W
@	Transistor	V	Q
*	Tube (electron)	V	V
*	Voltage transformer (potential)	T	T
*	Waveguide	W	W
#	Waveguide directional coupler	W	DC

IEEE Std 315A-1986
(Supplement to IEEE Std 315-1975 and
ANSI Y32.2-1975

IEEE Standard
American National Standard

Supplement to Graphic Symbols for Electrical and Electronics Diagrams

Sponsor

IEEE Standards Coordinating Committee 11, Graphic Symbols
Institute of Electrical and Electronics Engineers, Inc.

Approved September 19, 1985
Reaffirmed December 2, 1993

IEEE Standards Board

Approved November 15, 1985

American National Standards Institute

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Foreword

(This Foreword is not a part of ANSI/IEEE Std 315A-1986, Supplement to Graphic Symbols for Electrical and Electronics Diagrams.)

This standard supplements ANSI/IEEE Std 315-1975 by providing symbols approved by the International Electrotechnical Commission since 1975, or for which there is now a greater need in the United States arising from international commerce. It is believed that immediate issue of this supplement is preferable to the inevitable delay that would occur if a complete and proper revision of ANSI/IEEE Std 315-1975 were undertaken.

Besides adding new symbols, some updating of the information in ANSI/IEEE Std 315-1975 has been undertaken. The updating includes references to other standards, IEC labels on symbols where a change has occured, and correction of errors.

This supplement is based on IEC Publication 617, Parts 2 through 11 and Part 13 as published in 1983. IEC Publication 617, Part 12 is included in full in ANSI/IEEE Std 91-1984, IEEE Standard Graphic Symbols for Logic Functions.

When this standard was approved the Subcommittee on Graphic Symbols SCC 11.1 had the following membership:

C. J. Andrasco	G. A. Knapp	H. H. Seaman
I. M. Berger	J. M. Kreher	G. Shapiro
L. Burns	F. R. Misiewicz	J. W. Siefert
R. Coel	C. R. Muller	S. V. Soanes
J. B. Deam	C. McCarthy	R. M. Stern
L. Davis	R. Pinger	M. E. Taylor
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	L. Schulz	

When this standard was approved the IEEE Standards Coordinating Committee on Graphic Symbols and Designations SCC 11 had the following membership:

Robert B. Angus, Jr.	Conrad R. Muller	S. V. Soanes
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Gordon A. Knapp	Thomas R. Smith	Steven A. Wasserman

When the IEEE Standards Board approved this standard on September 19, 1985, it had the following membership:

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No changes

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No changes

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No changes

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American National Standard

IEEE Standard

Supplement to Graphic Symbols for Electrical and Electronics Diagrams

AA1. Purpose

This supplement is intended to provide additional graphic symbols and information on internationally approved graphic symbols needed for use for electrical and electronics diagrams.

AA2. Scope

This supplement provides graphic symbols for use of all electrical or electronics diagrams except for those required for

1) Logic circuit diagrams. See ANSI/IEEE Std 91-1984 [4].[30]
2) Architectural plans. See ANSI Y32.9-1972 [2] and IEC Publication 617 (1983) [22] Part 11, ch IV.
3) Street maps and building system layouts for cable TV application. See ANSI/IEEE Std 623-1976 [8] and IEC Publication 617 (1983) [22], Part 11, ch III.

AA3. Organization

This supplement places the IEC Publication 617 new material in a practical sequence with related material in ANSI/IEEE Std 315-1975 [7]. Except where the nature of the revisions dictate otherwise (for reasons of clarity) existing ANSI/IEEE Std 315-1975 [7] text is not repeated.

AA4. References

This standard shall be used in conjunction with the following publications:

[1] ANSI Y1.1-1972 (R 1984), Abbreviations for Use On the Drawings and In Text.[31]

[2] ANSI Y32.9-1972, American National Standard Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction.

[3] ANSI/IEEE Std C37.2-1979, IEEE Standard Electrical Power System Device Function Numbers.[32]

[4] ANSI/IEEE Std 91-1984, IEEE Standard Graphic Symbols for Logic Functions.

[30]Numbers in brackets correspond to those of the references listed in Section AA4.
[31]ANSI publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.
[32]IEEE publications are available from IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

[5] ANSI/IEEE Std 260-1978, IEEE Standard Letter Symbols for Units of Measurement.

[6] ANSI/IEEE Std 280-1985, IEEE Standard Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

[7] ANSI/IEEE Std 315-1975, Graphic Symbols for Electrical and Electronics Diagrams.

[8] ANSI/IEEE Std 623-1976, Graphic Symbols for Grid and Mapping Diagrams Used in Cable Television Systems.

[9] IEC Publication 27-1 (1971) Part 1: General. Letter Symbols to be Used in Electrical Technology.[33]

[10] IEC Publication 417 (1973), Graphic Symbols for Use on Equipment.

[11] IEC Publication 445 (1973), Identification of Apparatus Terminals and General Rules for a Uniform System of Terminal Marking, Using an Alphanumeric Notation.

[12] IEC Publication 617-1 (1985) Part 1: General Information, General Index. Cross-Reference Tables.

[13] IEC Publication 617-2 (1983) Part 2: Symbol Elements, Qualifying Symbols and Other Symbols Having General Application.

[14] IEC Publication 617-3 (1983) Part 3: Conductors and Connecting Devices.

[15] IEC Publication 617-4 (1983) Part 4: Passive Components.

[16] IEC Publication 617-5 (1983) Part 5: Semiconductors and Tubes.

[17] IEC Publication 617-6 (1983) Part 6: Production and Conversion of Electrical Energy.

[18] IEC Publication 617-7 (1983) Part 7: Switchgear, Controlgear, and Protective Devices.

[19] IEC Publication 617-8 (1983) Part 8: Measuring Instruments, Lamps, and Signaling Devices.

[20] IEC Publication 617-9 (1983) Part 9: Telecommunications: Switching and Peripheral Equipment.

[21] IEC Publication 617-10 (1983) Part 10: Telecommunications: Transmission.

[22] IEC Publication 617-11 (1983) Part 11: Architectural and Topographical Installation Plans and Diagrams.

[23] IEC Publication 617-12 (1983) Part 12: Binary Logic Elements.

[24] IEC Publication 617-13 (1978) Part 13: Analog Elements.

[25] ISO 31, Parts 0-11 (1974-1980), Quantities, Units, Symbols, Conversion Factors, and Conversion Tables.[34]

[33]IEC Publications are available in the United States from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018, USA. The IEC publications are also available from International Electrotechnical Commission, 3, rue de varembé, Case postale 131, CH 1211-Geneva 20, Switzerland.

[34]ISO publications are available in the United States from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018, USA. ISO publications are also available from the International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH 1211, Geneva 20, Switzerland.

1. Qualifying Symbols

1.1.1.2 Preset, general

IEC


Add:

Information on the conditions under which adjustment is permitted may be shown near the symbol.

1.1.1.2.1 Application: preset adjustment permitted only at zero current.

IEC


After **1.1.4.2**

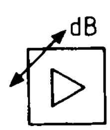
Add:

1.1.5 Automatic (inherent) control

The controlled quantity may be indicated adjacent to the symbol.

IEC


1.1.5.1 Application: Amplifier with automatic gain control

IEC


1.2.1 Temperature dependence

IEC $t°$

Add:

OR

IEC θ

After **1.2.5**

Add:

1.2.6 Thermal effect

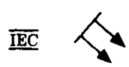
1.2.7 Electromagnetic effect

1.2.8 Magnetostrictive effect

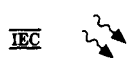
After **1.3.1**

Add:

1.3.1.1 Coherent radiation, non-ionizing (for example coherent light)



1.3.2 Radiation, ionizing



Revise the NOTE to read as follows:

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

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

Add:

IEC Designations

α = alpha particle

β = beta particle
γ = gamma ray
δ = deuteron
ρ = proton
η = neutron
π = pion
κ = K meson
μ = muon
X = X ray

1.4.3 Solid

Add:

OR

IEC 

See NOTE 1.4A

After **1.4.5**

Add:

1.4.6 Material, semiconducting

IEC 

1.4.7 Material, insulating

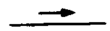
IEC 

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.



OR

Add:

OR

IEC 

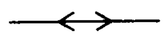
See NOTE 1.7.1A

1.7.2 Either way (but not simultaneously)

OR

Add:

OR

IEC 

See NOTE 1.7.1A

1.7.3 Both ways, simultaneously

OR

Add:

OR

IEC 

See NOTE 1.7.1A

Avoid conflict with symbol 9.2 if used on the same diagram

After **1.7.5**

Add:

1.7.6 Transmission

NOTE — 1.7.6A: The dot may be omitted if the sense is unambiguously given by the arrowhead in combination with the symbol to which it is applied.

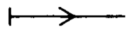
IEC 

1.7.7 Reception

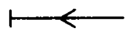
See NOTE 1.7.6A

IEC 

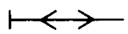
1.7.8 Energy flow from the busbars

IEC 

1.7.9 Energy flow towards the busbars

IEC 

1.7.10 Bidirectional energy flow

IEC 

1.8.1

Add:

The voltage may be indicated at the right of the symbol and the type of system at the left.

1.8.1.1 Application: Direct current, three conductors including midwire, 220 V (110 V between each outer conductor and midwire)

2M may be replaced by 2 + M

IEC 2M —— 220/110 V

1.8.2 Alternating current

IEC ~

Add:

The numerical value of the frequency or the frequency range may be added at the right-hand side of the symbol.

The voltage may also be indicated to the right of the symbol.

The number of phases and the presence of a neutral may be indicated at the left-hand side of the symbol.

1.8.2.1 Application: Alternating current of 60 Hz

IEC ~ 60 Hz

1.8.2.2 Application: Alternating current frequency range 100 kHz to 600 kHz

IEC ∼ 100...600 kHz

1.8.2.3 Application: Alternating current: three-phase with neutral, 60 Hz, 480 V (277 V between phase and neutral).

3N may be replaced by 3 + N

IEC 3N ∼ 60 Hz 480/277 V

1.8.2.4 Neutral

This symbol for neutral is given in IEC Publication 445 (1973) [11].

IEC N

1.8.2.5 Midwire

This symbol for midwire is given in IEC Publication 445 (1973) [11].

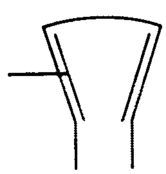
IEC M

After **1.10.4**

Add:

1.10.5 Conductive coating on internal surface of envelope

IEC



Add:

1.14 Operational Dependence On a Characteristic Qauntity

1.14.1 Operating when the characteristic quantity is higher than the setting value

IEC >

1.14.2 Operating when the characteristic quantity is lower than the setting value

IEC <

1.14.3 Operating when the characteristic quantity is either higher than a given high setting or lower than a given low setting

IEC $\gtrless$

1.14.4 Operating when value of the characteristic quantity becomes zero

IEC $= 0$

1.14.5 Operating when the value of the characteristic quantity differs from zero by an amount which is very small compared to with the normal value

IEC ≈ 0

1.15 Signal Identifiers

The symbol shall be used only when it is necessary to distinguish between analog and digital signals.

1.15.1 Identifier of analog signals

IEC $\cap$

1.15.2 Identifier of digital signals

IEC #

A time-sequence number (m) of bits may be denoted m #.

1.16 Signal Waveforms

Each symbol represents an idealized shape of the waveform.

1.16.1 Positive-going pulse

IEC 

1.16.2 Negative-going pulse

IEC 

1.16.3 Pulse of alternating current

IEC 

1.16.4 Positive-going step function

IEC 

1.16.5 Negative-going step function

IEC 

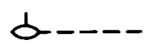
1.16.6 Sawtooth

IEC 

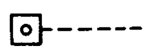
1.17 Control by Nonelectrical Quantities

Letter symbols from ANSI/IEEE Std 280-1985 [6], may be used to denote other operating quantities than those shown below (for example pressure or speed). They should be enclosed in a rectangle if ambiguity could otherwise arise.

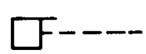
1.17.1 Control by fluid level

IEC 

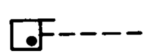
1.17.2 Control by number of events
Control by a counter

IEC 

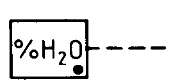
1.17.3 Control by flow

IEC 

1.17.3.1 Application: Control by gas flow

IEC 

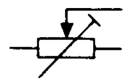
1.17.4 Control by relative humidity

IEC 

After **2.1.4**

Add:

2.1.4.1 Application: preset adjustable resistor

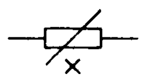
IEC 

2.1.7 Magnetoresistor (intrinsic) (linear type shown)

IEC 

Add:

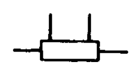
OR

IEC 

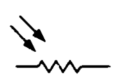
After **2.1.9**

Add:

2.1.9.1 Shunt
Resistor with separate current and voltage terminals

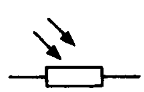
IEC 

2.1.13 Symmetrical photoconductive transducer (resistive)

IEC 

Add:

OR

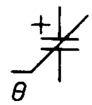
IEC 

After **2.2.2**

Add:

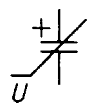
2.2.2.1 Temperature dependent polarized capacitor, where deliberate use is made of the temperature coefficient, for example, ceramic capacitor.

NOTE — 2.2.2.1A: θ may be replaced by $t°$.

IEC 

2.2.2.2 Voltage dependent polarized capacitor, where deliberate use is made of the voltage dependent characteristic, for example, semiconductor capacitor

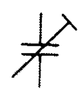
NOTE — 2.2.2.2A: U may be replaced by V.

IEC 

After **2.2.4**

Add:

2.2.4A Capacitor with preset adjustment

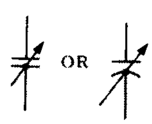
IEC 

2.2.4.1 With moving element indicated

Revise NOTE 2.2.4.1A *to read as follows:*

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.

See General Symbols 2.2.1 and NOTE 2.2B

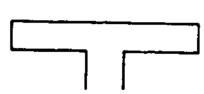
Style 1 

Style 2

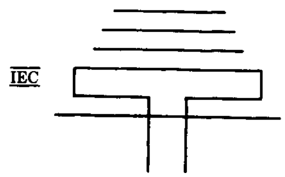
After 2.3.2

Add:

2.3.2.1 Folded dipole

IEC 

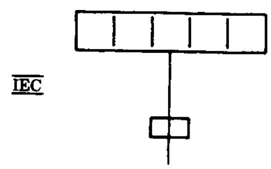
2.3.2.2 Folded dipole, shown with three directors and one reflector



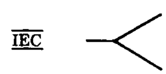
After **2.3.3**

Add:

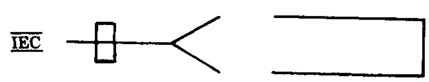
2.3.3.1 Slot antenna, shown with rectangular waveguide feeder



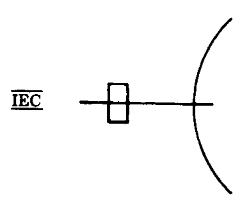
2.3.3.2 Horn antenna
Horn feed



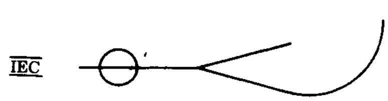
2.3.3.3 Cheese (box) reflector with horn feed, shown with rectangular waveguide feeder



2.3.3.4 Paraboloidal antenna, shown with retangular waveguide feeder

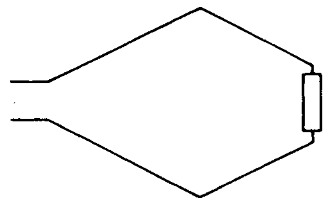


2.3.3.5 Horn-reflector antenna, shown with circular waveguide feeder



2.3.3.6 Rhombic antenna, shown terminated by a resistor

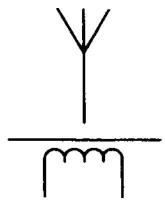
IEC



2.3.3.7 Magnetic rod antenna, for example ferrite.

If there is no risk of confusion, the general antenna symbol may be omitted.

IEC



2.4 Attenuator

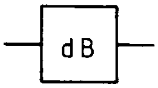
2.4.1 Fixed attenuator F; pad (general)

IEC

Add:

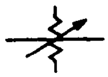
OR

IEC



2.4.4 Variable attenuator F (general)

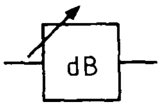
IEC



Add:

OR

IEC

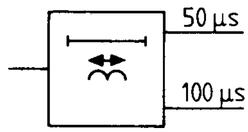


After **2.6.1**

Add:

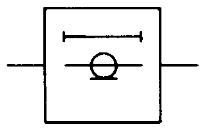
2.6.1.1 Magnetostrictive delay line shown with one input and two outputs giving delays of 50 μs and 100 μs

IEC



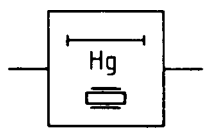
2.6.1.2 Coaxial delay line

IEC



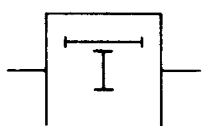
2.6.1.3 Mercury delay line with piezoelectric transducers

IEC



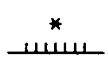
2.6.1.4 Delay line comprising an artificial line

IEC

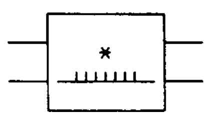


2.6.4 Slow-wave structure

IEC



IEC



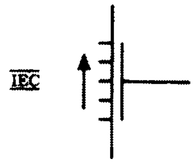
*See NOTE 2.6.1A

Add:

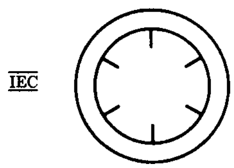
2.6.4.1 Open slow-wave structure (arrow indicates direction of energy flow)

IEC

2.6.4.2 Single electrode for electrostatic focusing along open slow-wave structure



2.6.4.3 Closed slow-wave structure, shown with envelope

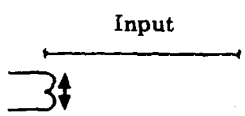


2.6.5 Delay Line Circuits

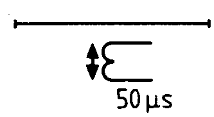
2.6.5.1 Magnetostrictive delay line with windings; three windings shown in assembled representation

NOTE — 2.6.5.1A: The winding symbols may be oriented as required

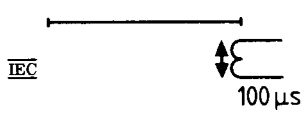
2.6.5.2 Magnetostrictive delay line with windings; one input and two outputs shown in detached representation



Intermediate output with 50 µs delay

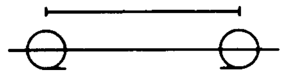


Final output with 100 µs delay



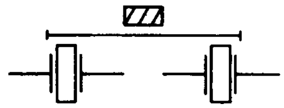
2.6.5.3 Coaxial delay line

IEC

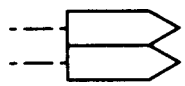


2.6.5.4 Solid material delay line with piezoelectric transducers

IEC



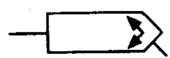
2.9.6 [4] Stereo



Add:

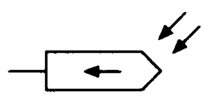
2.9.6.1 Stylus-operated stereo-phonic head

IEC



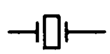
2.9.7 Light sensitive reproducing (reading, playback) head, monophonic

IEC



2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz F)

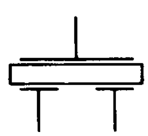
IEC



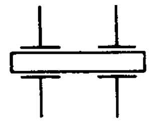
Add:

2.10.1 Piezoelectric crystal with three electrodes

IEC

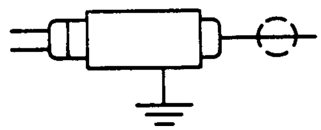


2.10.2 Piezoelectric crystal with two pairs of electrodes

IEC 

Add:

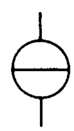
2.17.1 Ignition unit, high energy

IEC 

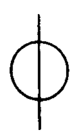
Add:

2.18 Ideal Circuit Elements

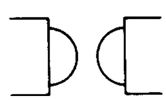
2.18.1 Ideal current source

IEC 

2.18.2 Ideal voltage source

IEC 

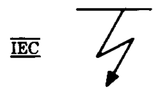
2.18.3 Ideal gyrator

IEC 

2.19 Faults

2.19.1 Fault (indication of assumed fault location)

2.19.2 Flashover
Breakthrough



After **3.1.2.3**

Add:

3.1.2.4 Flexible conductor

3.1.6 Junction of paths or conductors

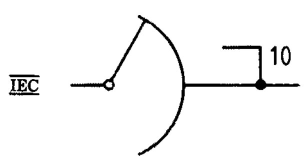
After **3.1.6.3**

Add:

3.1.6.3A Connection common to a group of similar items

The total number of similar items may be indicated by a figure near the common connection symbol.

3.1.6.3A.1 *EXAMPLE:* Multiple uniselector banks show for 10 banks



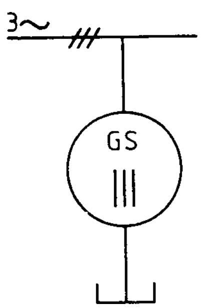
After **3.1.6.5**

Add:

3.1.6.6 Neutral point in multiphase system, shown in single-line representation

IEC

3.1.6.6.1 *EXAMPLE:* Synchronous generator, three-phase; both leads of each phase brought out, shown with external neutral point



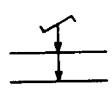
IEC

3.1.7.2 Twisted (shown with two twisted conductors)

NOTE — 3.1.7.2A: The asterisk is not part of the symbol. Always replace the asterisk by one of the following letters:

P = Pair
T = Triple

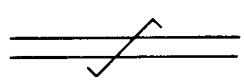
IEC



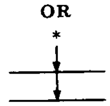
Add:

OR

IEC



OR



***See NOTE 3.1.7.2A**

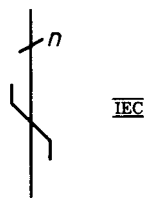
After **3.1.8.6**

Add:

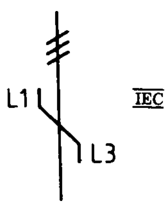
3.1.8.7 Interchange of conductors; change of phase sequence or inversion of polarity, shown for ***n*** conductors in single-line representation.

The interchanged conductors may be indicated.

For the identification of the conductors, IEC Publication 445 (1973) [11] applies.



3.1.8.7.1 *EXAMPLE:* Change of phase sequence



After **3.2.6.2**

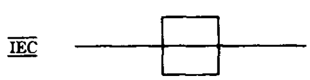
Add:

3.2.7 Duct or pipe

NOTE — 3.2.7A: The number of ducts, the crosse-section dimensions or other prticulars, such as duct occupancy, may be shown above the line representing the duct route.

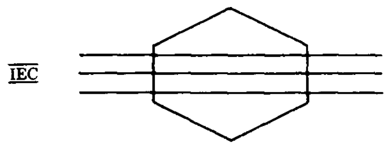
3.2.7.1 *EXAMPLE:* Line of six-way duct

3.2.8 Line with manhole, giving access to jointing chamber

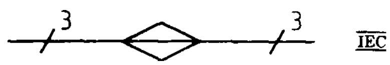


3.2.9 Straight-through joint box, shown with three conductors:

Multiline representation

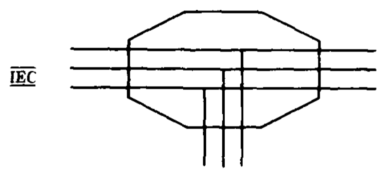


3.2.9.1 Single-line representation

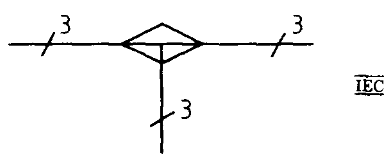


3.2.10 Junction box, shown with three conductors with T-connections:

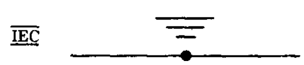
Multiline representation



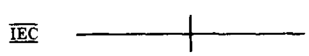
3.2.10.1 Single-line representation



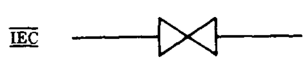
3.2.11 Line with buried jointing point



3.2.12 Line with gas or oil block



3.2.13 Line with gas or oil stop valve

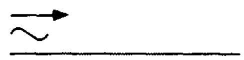


3.2.14 Line with gas or oil block bypass

IEC 

3.2.15 Power feeding

3.2.15.1 Power feeding (ac) on telecommunication lines

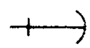
IEC 

3.2.15.2 Power feeding (dc) on telecommunication lines

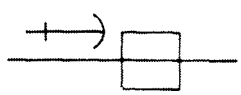
3.2.16 Anticreepage device

Anticreepage device for cable

NOTE — 3.2.16A: The symbol should be shown on the *creepout* side of the manhole.

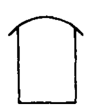
IEC 

3.2.16.1 *EXAMPLE:* Manhole equipped with anticreepage device for cable (Creepage to the left is prevented)

IEC 

3.2.17 Overground, weatherproof enclosure, general symbol

NOTE — 3.2.17A: Qualifying symbols or designations may be used to indicate the apparatus contained in the enclosure.

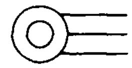
IEC 

3.2.17.1 *EXAMPLE:* Amplifying point in a weatherproof enclosure

IEC 

3.2.18 Crossconnection point

NOTE — 3.2.18A: Inlets and outlets may be oriented as required.

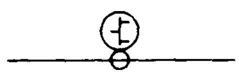
IEC 

3.2.19 Line concentrator

Automatic line connector

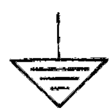
IEC 

3.2.19.1 *EXAMPLE:* Line concentrator on a pole

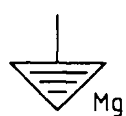
IEC 

3.2.20 Protective anode

NOTE — 3.2.20A: The type of anode material may be indicated by adding its chemical letter symbol.

IEC 

3.2.20.1 *EXAMPLE:* Magnesium protective anode

IEC 

After **3.6.7**

Add:

3.6.8 Optical fiber

IEC 

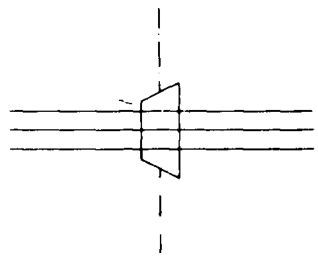
After **3.10**

Add:

3.10.1 Pressure-tight bulkhead cable gland; shown with three cables

NOTE — 3.10.1A: The high-pressure side is the longer side of the trapezoid thus retaining gland in bulkhead.

IEC



4. Graphics Symbols for Contacts, Switches, Contactors, and Relays

4.1 Switching Function

NOTE — 4.1A: Switching function symbols are suitable for use on *detached contact* diagrams, but may be used in other applications.

Add:

4.1A Qualifying Symbols for Contacts (IEC Publication 617-7 (1983) [18])

4.1A.1 Contactor functions

IEC 

4.1A.2 Circuit-breaker function

IEC 

4.1A.3 Disconnector (isolator) function

IEC

4.1A.4 Switch-disconnector (isolating-switch) function

IEC 

4.1A.5 Automatic release function

IEC 

4.1A.6 Position switch function
Limit switch function

NOTES:

4.1A.6A — This qualifying symbol can be applied to simple contact symbols to indicate position or limit switches if there is no need to show the means of operating the contact. In complicated cases, where it is desirable to show the means of operation, symbols 14.4.16 to 14.4.16.3 should be used instead.

4.1A.6B — This symbol is placed on both sides of the contact symbol when the contact is mechanically operated in both directions.

IEC 

4.1A.7 Spring return function

NOTES:

4.1A.7A — This symbol may be used to indicate spring return function. When this convention is invoked its use should be appropriately referenced.

4.1A.7B — This symbol should not be used together with qualifying symbols 4.1A.1, 4.1A.2, 4.1A.3, and 4.1A.4. In many cases, symbol 14.5.1 may be used.

IEC 

4.1A.8 Nonspring return (stay put) function

NOTES:

4.1A.8A — This symbol may be used to indicate nonspring return function. When this convention is invoked, its use should be appropriately referenced.

4.1A.8B — This symbol should not be used together with qualifying symbols 4.1A.1, 4.1A.2, 4.1A.3, and 4.1A.4. In many cases, symbol 14.5.2 may be used.

IEC 

4.3 Basic Contact Assemblies

The standard method of showing a contact is by a symbol indicating the circuit condition it produces when the actuating device is in the de-energized or nonoperated position. The actuating device may be of a mechanical, electrical, or other nature, and a clarifying note may be necessary with the symbol to explain the proper point at which the contact functions; for example, the point where a contact closes or opens as a function of changing pressure, level, flow, voltage, current, etc. In cases where it is desirable to show contacts in the energized or operated condition and where confusion may result, a clarifying note shall be added to the drawing.

For designations of auxiliary switches or contacts for circuit breakers, etc, see ANSI/IEEE C37.2-1979 [3].

Add:

4.3A IEC Publication 617-7 (1983) [18] Coordinated System

This section provides preferred symbols for contact units and switchgear. Each symbol depicts the function of a contact or a switching device, without necessarily being related to the construction of the device it represents.

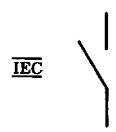
A small circle, open or filled in, representing the hinge-point may be added to most of the symbols for contacts, switches, and controlgear. See for example 4.3A.1.1.1.

For clarity this symbol must be shown on some symbols, see for example 4.3A.1.4.

4.3A.1 Contacts with two or three positions

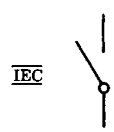
4.3A.1.1 Make contact

NOTE — 4.3A.1.1A: This symbol is also used as the general symbol for a switch.



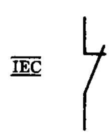
Form 1

4.3A.1.1.1

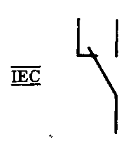


Form 2

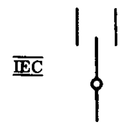
4.3A.1.2 Break contact



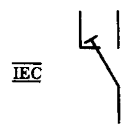
4.3A.1.3 Change-over break before make contact



4.3A.1.4 Two-way contact with center-off position

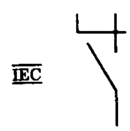


4.3A.1.5 Changeover make before break contact (bridging)



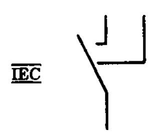
Form 1

4.3A.1.5.1

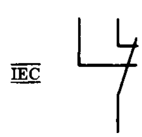


Form 2

4.3A.1.6 Contact with two makes

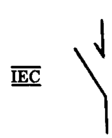


4.3A.1.7 Contact with two breaks



4.3A.2 Passing contacts with two positions

4.3A.2.1 Passing make contact closing momentarily when its operating device is actuated.



4.3A.2.2 Passing make contact closing momentarily when its operating device is released

IEC 

4.3A.2.3 Passing make contact closing momentarily when its operating device is actuated or released

IEC 

4.3A.3 Early and late operating contacts

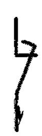
4.3A.3.1 Make contact (of a multiple contact assembly) which is early to close relative to the other contacts of the assembly

IEC 

4.3A.3.2 Make contact (of a multiple contact assembly) which is late to close relative to the other contacts of the assembly

IEC 

4.3A.3.3 Break contact (of a multiple contact assembly) which is late to open relative to the other contacts of the assembly

IEC 

4.3A.3.4 Break contact (of a multiple contact assembly) which is early to open relative to the other contacts of the assembly

IEC 

4.3A.4 Examples of contacts with intentional delay

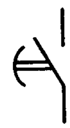
4.3A.4.1 Make contact delayed when closing (operating device actuated)

IEC

Form 1

4.3A.4.2

IEC



Form 2

4.3A.4.3 Break contact delayed when reclosing (operating device released)

IEC

Form 1

4.3A.4.4

IEC

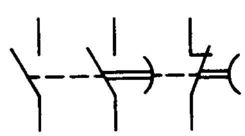
Form 2

4.3A.4.5 Make contact delayed when closing and opening

IEC

4.3A.4.6 Contact assembly with one make contact not delayed, one make contact delayed when reopening and one break contact delayed when opening

IEC



4.3A.5 Examples of spring return and nonspring return (stay put) contacts

4.3A.5.1 Make contact with spring return

IEC 

4.3A.5.2 Make contact without spring return (stay put)

IEC 

4.3A.5.3 Break contact with spring return

IEC 

4.3A.5.4 Two-way contact with center-off position with spring return from the left-hand position but not from the right-hand one (stay put)

IEC 

Add:

4.3B ANSI/IEEE Std 315-1975 [7] System

4.3.1 Closed contact (break)

.

.

. No change in existing symbols but IEC approval will be withdrawn in the future.

.

.

4.3.8.3

Add:

4.6.3

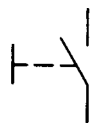
Indication of operating method

Former **4.6.3** *is now* **4.6.3.5**

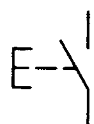
Devices with *push* or *pull* operation normally have spring return. It is therefore not necessary to show the automatic return symbol (14.5.1). On the other hand, a detent symbol (14.5.2) should be shown in the exceptional cases where locking exists.

Devices operated by turning do not usually have automatic return. It is therefore not necessary for the detent symbol (14.5.2) to be shown. On the other hand, the automatic return symbol (14.5.1) should be shown in those cases where an automatic return exists.

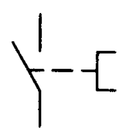
4.6.3.1 Manually operated switch; general symbol

IEC 

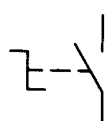
4.6.3.2 Push-button switch (nonlocking)

IEC 

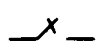
4.6.3.3 Pull-switch (nonlocking)

IEC 

4.6.3.4 Turn-switch (locking)

IEC 

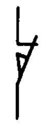
4.6.3.5 Knife switch F, general



4.14.5.3 Normally closed

Add:

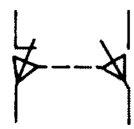
OR

IEC 

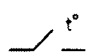
After **4.14.5.4**

Add:

4.14.5.5 Position or limit switch mechanically operated in both directions with two separate circuits

IEC 

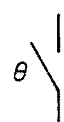
4.21.1 Closes on rising temperature



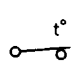
See NOTE 4.21A

Add:

OR

IEC 

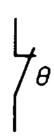
4.21.2 Opens on rising temperature



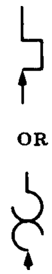
See NOTE 4.21A

Add:

OR

IEC 

4.22 Flasher
Self-Interrupting Switch

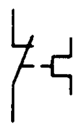


Add:

4.22.1 Self-operating thermal switch, break contact

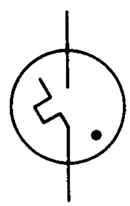
IEC

NOTE — 4.22.1A: It is important to distinguish between a contact as shown and a contact of a thermal relay, which in detached representation may be shown as follows:



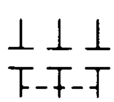
4.22.2 Gas discharge tube with thermal element
Starter for fluorescent lamp

IEC



Revise **4.29.1** *to read as follows:*

4.29.1 Manually operated 3-pole contactor



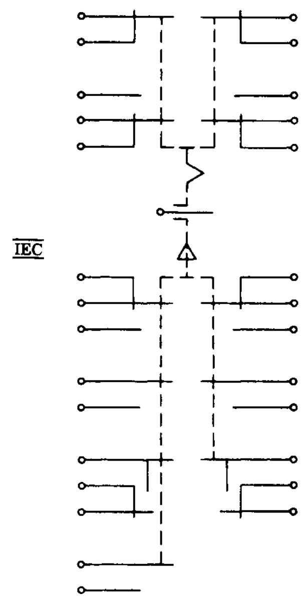
After **4.33**

Add:

4.34 Multipole and Multiposition Switches (IEC Publication 617-7 (1983) [18]

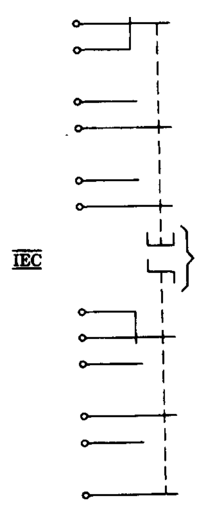
4.34.1 Key operated lever or turn switches (compare with 4.12 items)

4.34.1.1 Three position lever-operated switch, locking in the upper position and with spring return from the lower position to the middle one, shown with terminals

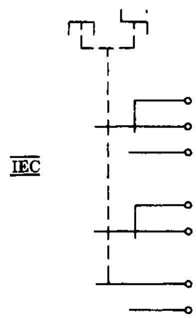


4.34.1.2 Button-operated switch in which one set of contacts is operated by pushing the button (nonlocking) and another set by turning it (locking), shown with terminals

The bracket indicates that there is only one actuator

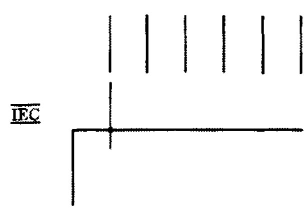


4.34.1.3 Button-operated switch in which the same set of contacts may be operated in two different ways; either by turning (with locking) or pushing (with spring return), shown with terminals

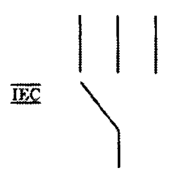


4.34.2 Multiposition Switches

4.34.2.1 Single-pole n-position switch, shown for $n = 6$

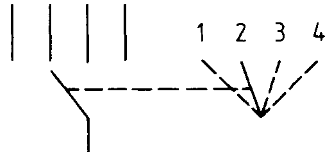


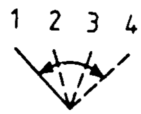
4.34.2.2 Single-pole n-position switch, alternative for use when n is small, shown for $n = 4$



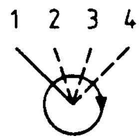
4.34.2.3 Example with position diagram

NOTE — 4.34.2.3A: It is sometimes convenient to indicate the purpose of each switch position by adding text to the position diagram. It is also possible to indicate limitations of movement of the operating device as in the examples which follow:

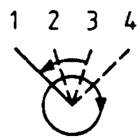




The operating device (for example handwheel) can be turned only from positions 1 to 4 and back.



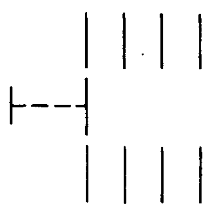
The operating device can be turned in the clockwise direction only.



The operating device can be turned in the clockwise direction without limitation and may be turned in the counter-clockwise direction only between positions 3 and 1.

4.34.2.4 Four-position switch, manually operated, having four independent circuits

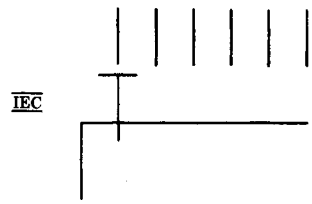
IEC



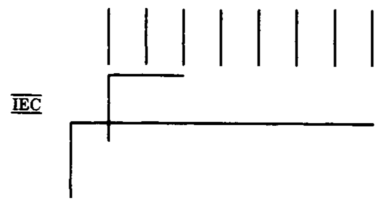
4.34.2.5 Single-pole, four-position switch in which position 2 cannot be connected

IEC

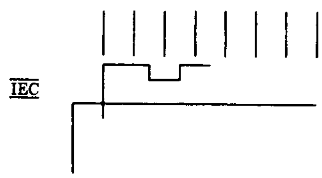
4.34.2.6 Single-pole, six-position switch with a wiper that bridges only while passing from one position to the next



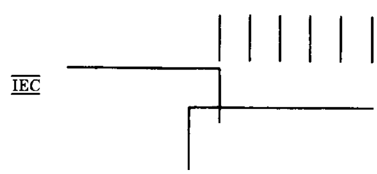
4.34.2.7 Single-pole multiposition switch with a wiper that bridges three consecutive terminals in each switch position



4.34.2.8 Single-pole multiposition switch with a wiper that bridges four terminals but omits one intermediate terminal in each switch position



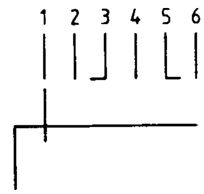
4.34.2.9 Single-pole multiposition switch for cumulative parallel switching



4.34.2.10 One pole of a six-position multipole switch

The pole shown makes earlier than the other poles when the wiper moves from position 2 to 3 and breaks later than the other poles when the wiper moves from position 5 to 6. When the wiper moves in the opposite direction the early make becomes a later break and vice versa.

IEC

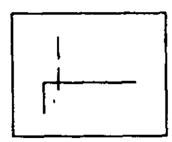


4.34.3 Block Symbols for Complex Switches

There are many ways in which complex switching functions can be achieved mechanically, for example by rotary wafer switches, slide switches, drum controllers, cam-operated contact assemblies, etc. There are also many ways in which the switching functions may be symbolized on circuit diagrams. Study has shown that there is no unique system of symbolization which is superior in every application. The system employed should be chosen with due regard to the purpose of the diagram and the degree of complexity of the switching device it is desired to symbolize. This section therefore presents one possible method of symbolizing complex switches. To facilitate understanding each example includes a contructional drawing of the device symbolized. The method shown here uses a general symbol for a complex switch which must be supplemented by a table of connections. Two examples are shown.

4.34.3.1 Complex switch, general symbol

IEC



4.34.3.2 *EXAMPLE:* 18-position rotary wafer switch with six terminals, here designated A to F, contructed as shown in the bottom diagram (switch shown in position 1)

IEC

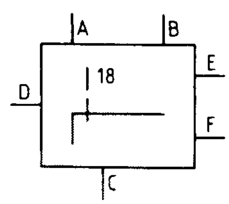
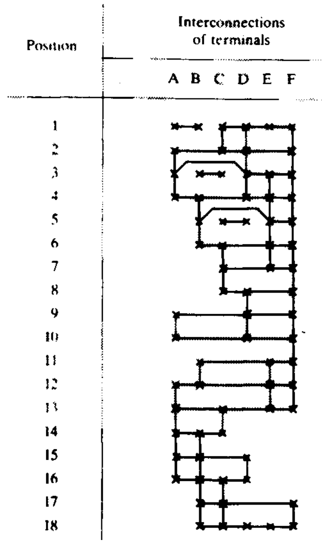
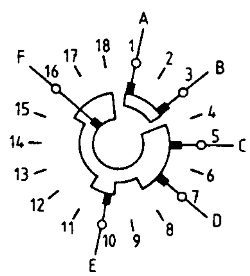


Table of connections





4.34.3.3 *EXAMPLE:* Six-position rotary drum switch with five terminals, constructed as shown in the bottom diagram

IEC

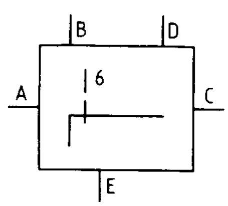
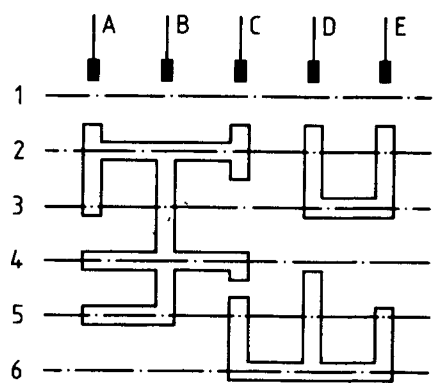


Table of connections

Position	Interconnections of terminals				
	A	B	C	D	E
1					
	+		+	O	O
2	+	+	+	O	O
	+	+	+	O	O
3	+	+		O	O
		+			
4	+	+	+		
		+	+ –	–	
5	+	+	–	–	–
			–	–	–
6			–	–	–

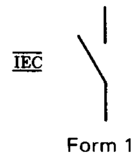


The symbols + - and O indicate the terminals that are connected together at any position (rest-position or intermediate position) of the switch, that is, terminals having the same indicating symbol for example, + are interconnected

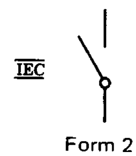
NOTE — 4.34.3.3A: Where additional symbols are required, the characters available on a typewriter should be used, for example, x, =.

4.35 Switchgear and Controlgear

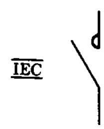
4.35.1 Switch (mechanical)



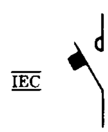
OR



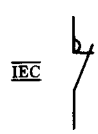
4.35.2 Contactor (contact open in the unoperated position)



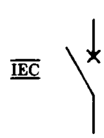
4.35.3 Contactor with automatic release



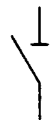
4.35.4 Contactor (contact closed in the unoperated position)



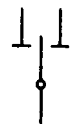
4.35.5 Circuit breaker



4.35.6 Disconnector (isolator)

IEC 

4.35.7 Two-way disonnector (isolator) with center-off position

IEC 

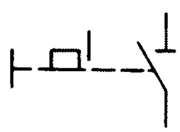
4.35.8 Switch-disconnector (on-load isolating switch)

IEC 

4.35.9 Switch-disconnector with automatic release

IEC 

4.35.10 Disconnector (isolator) with blocking device, manually operated

IEC 

4.36 Block Symbols for Motor Starters

4.36.1 Motor starter, general symbol

NOTE — 4.36.1A: Qualifying symbols may be shown inside the general symbol to indicate particular types of starters. See symbols 4.36.5, 4.36.7, and 4.36.8.

IEC 

4.36.2 Starter operated in steps

NOTE — 4.36.2A: The number of steps may be indicated.

IEC 

4.36.3 Starter-regulator

IEC 

4.36.4 Starter with automatic release

IEC 

4.36.5 Direct on line contactor starter for reversing motor

Full voltage contactor starter for reversing motor

IEC 

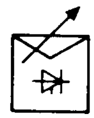
4.36.6 Star-delta starter

IEC 

4.36.7 Autotransformer starter

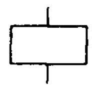
IEC 

4.36.8 Starter-regulator with thyristors

IEC 

4.37 Operating Devices for Electromechanical (all or nothing) Relays

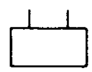
4.37.1 Operating device, general symbol

IEC 

Form 1

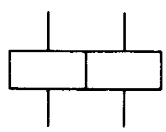
4.37.2

NOTE — 4.37.2A: Operating devices with several windings may be indicated by inclusion of the appropriate number of inclined strokes or by repeating symbol 4.37.1 or 4.37.2.

IEC 

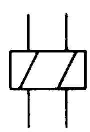
Form 2

4.37.3 *EXAMPLES:* Operating device with two separate windings assembled representation

IEC 

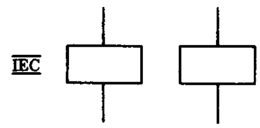
Form 1

4.37.4

IEC 

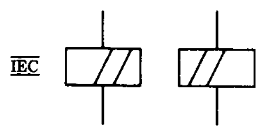
Form 2

4.37.5 Operating device with two separate windings, detached representation



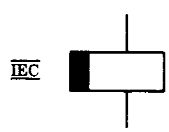
Form 1

4.37.6

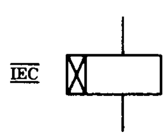


Form 2

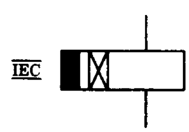
4.37.7 Relay coil of a slow-releasing relay



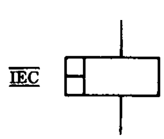
4.37.8 Relay coil of a slow-operating relay



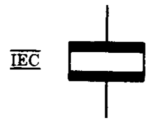
4.37.9 Relay coil of a slow-operating and slow-releasing relay



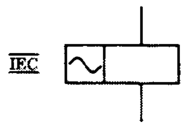
4.37.10 Relay coil of a high-speed relay (fast operating and fast releasing)



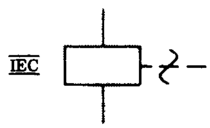
4.37.11 Relay coil of a relay unaffected by alternating current



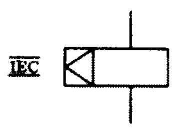
4.37.12 Relay coil of an alternating current relay



4.37.13 Relay coil of a mechanically resonant relay



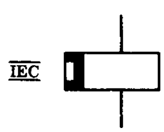
4.37.14 Relay coil of a mechanically latched relay



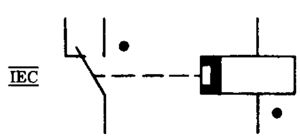
4.37.15 Relay coil of a polarized relay

NOTE — 4.37.15A: Dots may be used to indicate the relationship between the direction of the current through the winding of a polarized relay and the movement of the contact arm.

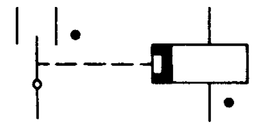
When the winding terminal identified by the polarity dot is positive with respect to the other winding terminals, the contact arm moves or tends to move towards the position marked with the dot.



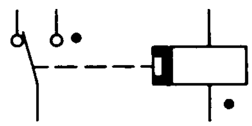
4.37.16 *EXAMPLES:* Polarized relay, self restoring, operating for only one direction of current in the winding



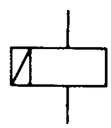
4.37.17 Polarized relay with neutral position, self restoring, operating for either direction of current in the winding

IEC 

4.37.18 Polarized relay with two stable positions

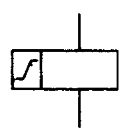
IEC 

4.37.19 Relay coil of a remanent relay

IEC 

Form 1

4.37.20

IEC 

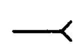
Form 2

5. Graphic Symbols for Terminals and Connectors

5.3 Connector
Disconnecting Device
Jack
Plug

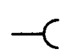
The contact symbol is not an arrowhead. It is larger and the lines are drawn at a 90° angle.

5.3.1 Female contact

IEC 

Add:

OR

IEC 

5.3.2 Male contact

IEC 

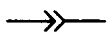
Add:

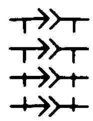
OR

IEC

Revise **5.3.4.1** *to read as follows:*

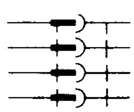
5.3.4.1 Application: engaged 4-conductors (male plug - female receptacle shown)

 IEC

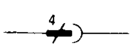
IEC 

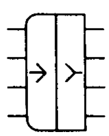
OR

OR

IEC 

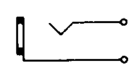
OR

 IEC

IEC 

5.3.5.1 2-conductor (jack)

OR

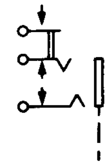
IEC 

5.3.5.2 2-conductor (plug)

Add:

OR

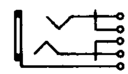
5.3.5.3 [35] 3-conductor (jack) with 2 break contacts (normals) and 1 auxiliary make contact



Add:

OR

IEC



5.3.5.4 3-conductor (plug)

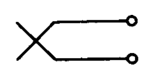
Add:

OR

IEC

5.3.5.5 Break or isolating jack, telephone type

IEC



After **5.3.6.4**

Add:

5.3.7 Adapter

5.7.3.1 Plug and socket-type connector, for example U-link: male-male

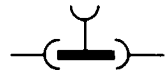
IEC

5.3.7.2 Male-female

IEC

[35]The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.

5.3.7.3 Male-male with socket access

IEC 

5.3.8 Butt-connector

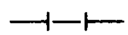
IEC

5.3.9 Connecting link, closed

IEC

Form 1

5.3.9.1

IEC 

Form 2

5.3.9.2 Connecting link, open

IEC 

After **5.6.1**

Add:

5.6.1A Coaxial plug and socket

NOTE — 5.6.1A: If the coaxial plug or socket is connected to a coaxial pair, the tangential line(s) should be appropriately extended.

IEC 

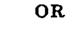
6. Graphic Symbols for Transformers, Inductors, and Windings

6.1.2 Magnetic core of inductor or transformer

Not to be used unless it is necessary to identify a magnetic core.

Add:

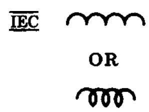
OR

IEC 

Revise **6.2.1** *to read as follows:*

6.2.1 General

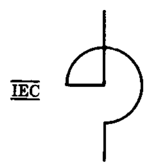
NOTE — 6.2.1A: This symbol is deprecated and should not be used on a new schematics.



See NOTE 6.2.1A

Add:

6.2.1A Choke
Reactor



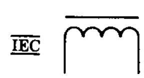
See NOTE 6.4.1A

6.2.2 Magnetic-core inductor
Telephone loading coil

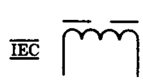
If necessary to show a magnetic core.

Add:

OR



6.2.2.1 Inductor with gap in magnetic core



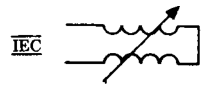
Add:

6.2.4.1 Inductor with moving contact, variable in steps

After **6.2.5**

Add:

6.2.5A Variometer



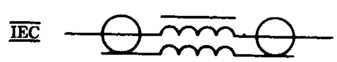
6.2.9

See new 11.3.3

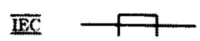
After **6.2.9**

Add:

6.2.10 Coaxial choke with magnetic core



6.2.11 Ferrite bead, shown on a conductor

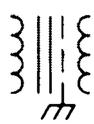


See also 15.18.1

Revise NOTE 6.4.1A to read as follows:

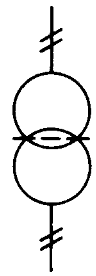
NOTE — 6.4.1A: This symbol is the preferred single-line symbol in IEC Publication 617-6 (1983) [17]. It should be used on schematics for equipments having international usage, especially when the equipment will be marked using this symbol (in accordance with IEC Publication 417 (1973) [10].

6.4.2.3 Application: transformer with magnetic core shown and with an electrostatic shield between windings. The shield is shown connected to the frame.



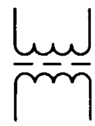
Add:

6.4.2.3A Single-phase transformer with two windings and screen.



IEC

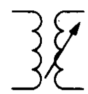
IEC



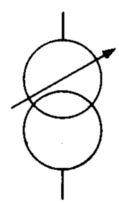
Revise **6.4.4** *to read as follows:*

6.4.4 One winding with adjustable inductance

IEC



OR

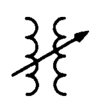


IEC

See NOTE 6.4.4A

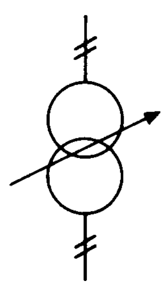
NOTE — 6.4.4A: The former right-hand symbol has been deleted. It is no longer recommended for use on complete diagrams.

6.4.6 Adjustable mutual inductor; constant-current transformer



Add:

OR

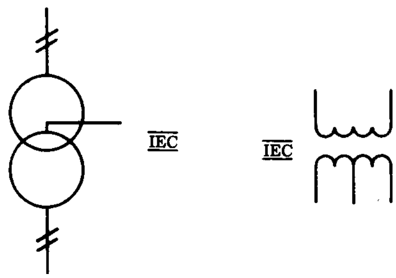


IEC

6.4.7 With taps, 1-phase

Add:

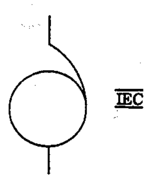
6.4.7A Transformer with center tapping on one winding



Revise **6.4.8** *to read as follows:*

6.4.8 Autotransformer, 1-phase

OR

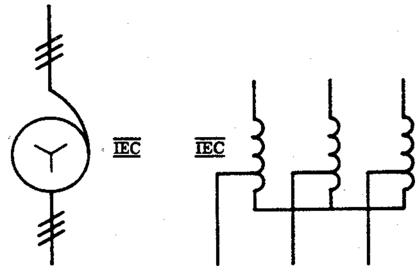


See NOTE 6.4.4A

See NOTE 6.4.1A

Add:

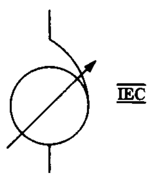
6.4.8A Autotransformer, three-phase, star connection



Revise **6.4.9** *to read as follows*:

6.4.9 Adjustable

OR



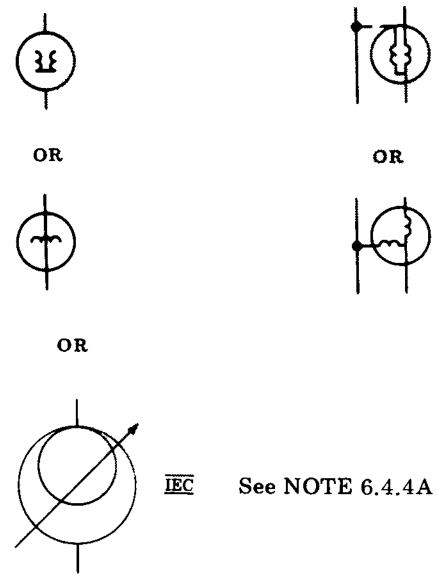
See NOTE 6.4.4A

See NOTE 6.4.1A

Revise **6.4.12** *to read as follows:*

6.4.12 1-phase induction voltage regulator(s)

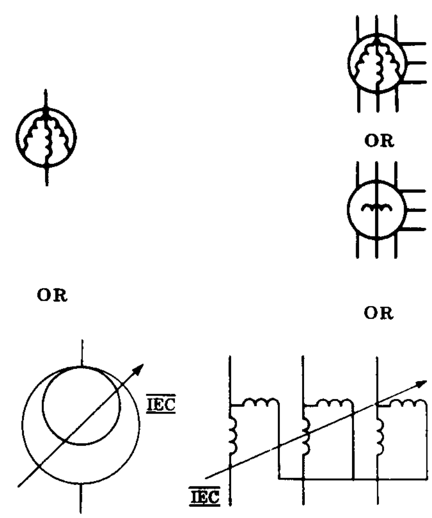
Number of regulators may be written adjacent to the symbol.



See NOTE 6.4.1A

Revise **6.4.14** *to read as follows:*

6.4.14 3-phase induction voltage regulator

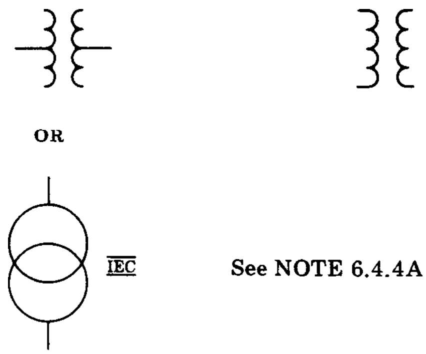


See NOTE 6.4.4A

See NOTE 6.4.1A

Revise **6.4.15** *to read as follows:*

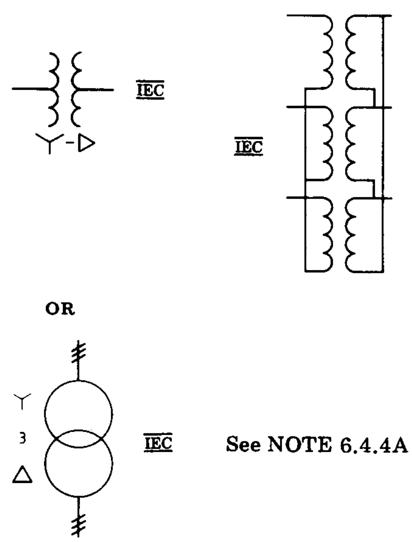
6.4.15 1-phase, 2-winding transformer



See NOTE 6.4.1A

Revise **6.4.15.1** *to read as follows:*

6.4.15.1 Application: 3-phase bank of 1-phase, 2 winding transformers with wye-delta connections

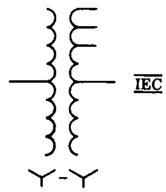


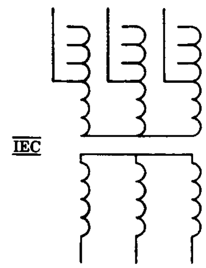
See NOTE 6.4.1A

The alternate symbol has been corrected to conform to IEC Publication 617-6 (1983) [17]. Shown outside the symbol is Y. *Reason:* Three separate transformers.

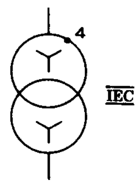
Revise **6.4.15.2** *to read as follows:*

6.4.15.2 Three-phase transformer with 4 taps with wye-wye connections





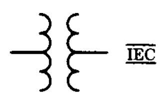
OR



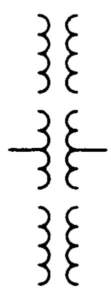
See NOTE 6.4.4A

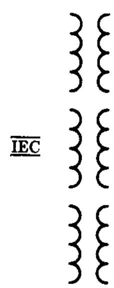
See NOTE 6.4.1A

6.4.16 Polyphase transformer



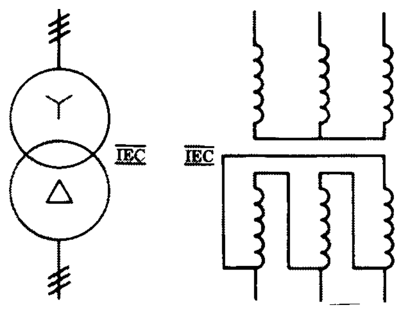
OR





Add:

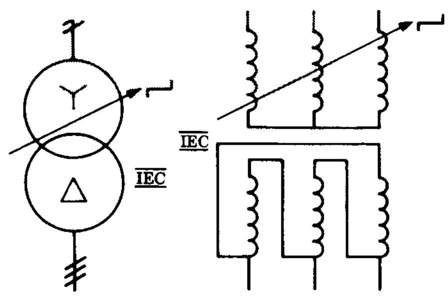
6.4.16A.1 Three-phase transformer, connection star-delta



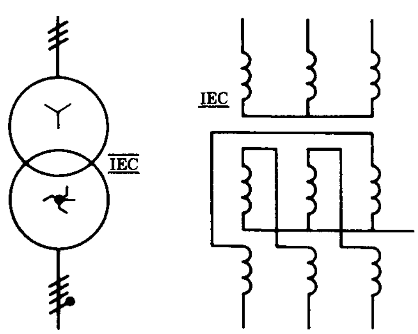
6.4.16A.2

See 6.4.15.2

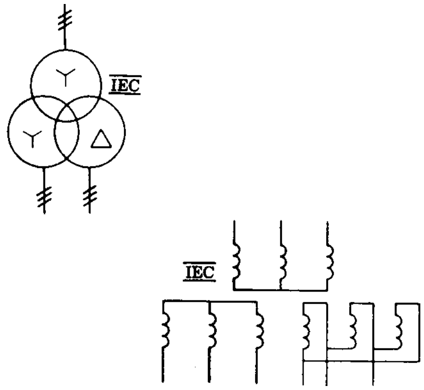
6.4.16A.3 Three-phase transformer with on-load tap changer, connection star-delta



6.4.16A.4 Three-phase transformer, connection star-zigzag

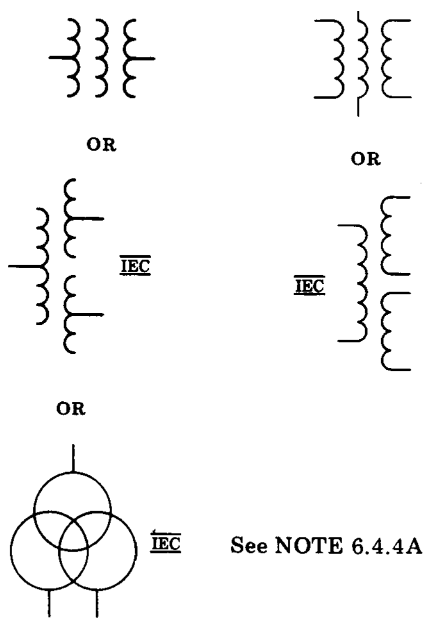


6.4.16A.5 Three-phase transformer, connection star-star-delta



Revise **6.4.17** *to read as follows:*

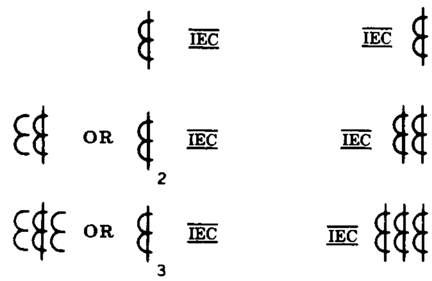
6.4.17 1-phase, 3-winding transformer



See NOTE 6.4.1A

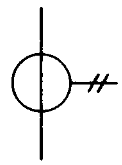
6.4.18 Current transformer(s)

Avoid conflict with symbol 3.2.5 if used on the same diagram.



Add:

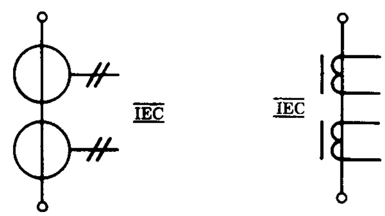
OR



6.4.18.1 Current transformer with two cores and two secondary windings

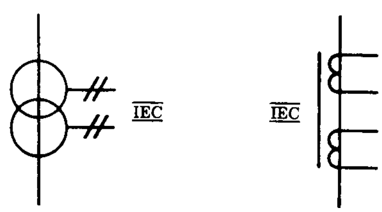
The terminal symbols shown at each end of the primary circuit indicate that only a single device is represented.

NOTE — 6.4.18.1A: In the right-hand symbol core symbols my be omitted.

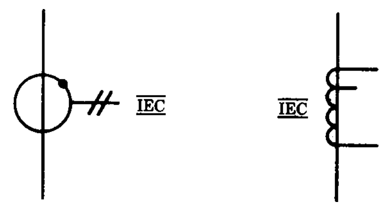


6.4.18.2 Current transformer with two secondary windings on one core.

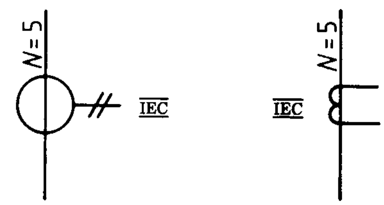
NOTE — 6.4.18.2A: In the right-hand symbol the core symbol shall be drawn.



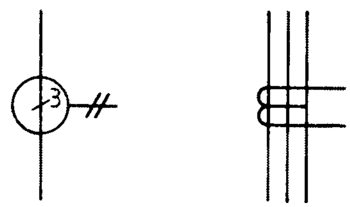
6.4.18.3 Current transformer with one secondary winding with three tappings



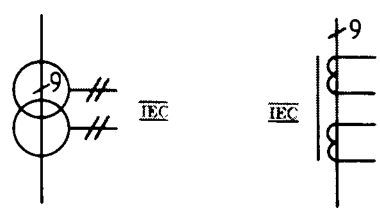
6.4.18.4 Current transformer where the primary conductor forms five winding turns



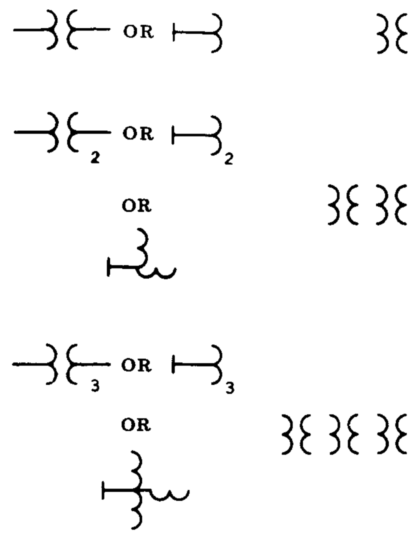
6.4.18.5 Pulse or current transformer with one permanent winding and three threaded windings



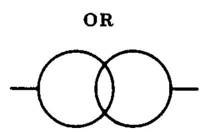
6.4.18.6 Pulse or current transformer with two permanent windings on the same core and with nine threaded windings



6.4.20 Potential transformer(s)



Add:



After **6.5**

Add:

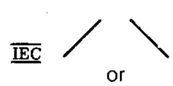
6.6 Ferrite Cores—Symbol Elements (IEC Publication 617-4 (1983) [15])

6.6.1 Ferrite core

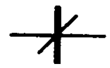
6.6.2 Flux/current direction indicator

This symbol indicates that a horizontal line drawn at a right angle through a core symbol represents a core winding, and it also gives the relative directions of current and flux.

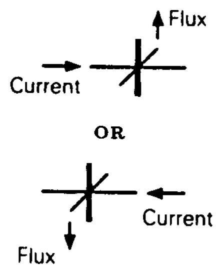
NOTE — 6.6.2A: This symbol is not applicable for topographical representation.



6.6.3 Ferrite core with one winding

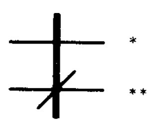


The oblique line may be regarded as a reflector that relates the directions of current and flux as shown below.



For drawing convenience, lines representing conductors are often shown crossing core symbols even though there is no winding on the magnetic circuit. Except in topographical representation the use of the oblique stroke is mandatory in all cases where a line through the core symbol represents a winding.

EXAMPLE:



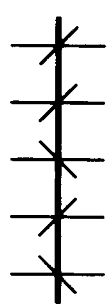
* Conductor crossing the core symbol
** Winding on the core

6.7 Ferrite Cores (IEC Publication 617-4 (1983) [15])

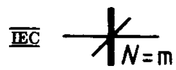
6.7.1 Ferrite core with five windings

NOTE — 6.7.1A: Information on the direction of current, its relative amplitude and the logic conditions imposed by the state of the magnetic remanence may be added.

IEC

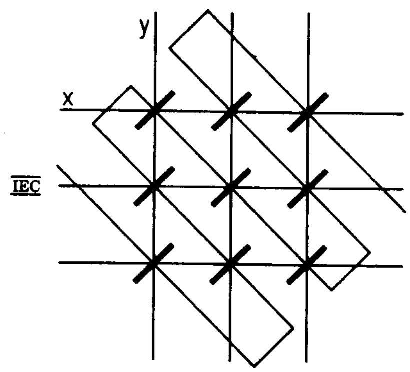


6.7.2 Ferrite core with one winding of m turns

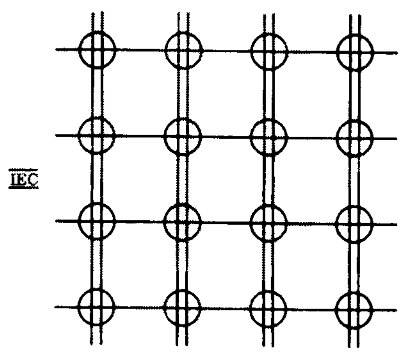


6.8 Magnetic Storage Matrices (Topographical Representation)

6.8.1 Ferrite core matrix with *x* and *y* windings and a readout winding. The symbol of a ferrite core, 6.6.1, is shown at 45° to the horizontal.



6.8.2 Matrix arrangement comprising thin sheet magnetic stores, located between thin sheet wiring layers.



7. Graphic Symbols for Electron Tubes and Related Devices

7.1.1.1 Directly heated (filamentary) cathode

NOTE — 7.1.1.1A: Leads may be connected in any convenient manner to ends of the ∧ provided the identity of the ∧ is retained.

IEC 

See NOTE 7.1.1.1A

Add:

OR

IEC 

7.1.1.2 Indirectly heated cathode

Lead may be connected to either extreme end of the or, if required, to both ends, in any convenient manner.

IEC

Add:

OR

IEC 

After **7.1.1.6**

Add:

7.1.1.7 Photoemissive electrode

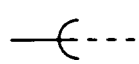
IEC 

7.1.2.1 Grid IEC
Beam-confining or beam-forming electrodes

IEC

Add:

7.1.2.1.1 Grid with secondary emission

IEC 

Revise **7.1.2.2** *to read as follows:*

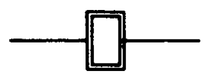
7.1.2.2 Deflecting electrodes (used in pairs)

IEC 

OR

IEC 

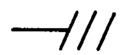
7.1.2.2A Radial deflecting electrodes, one pair of electrodes shown

IEC 

After **7.1.2.4**

Add:

7.1.2.5 Ion diffusion barrier

IEC 

7.1.2.6 Intensity modulating electrode

NOTE — 7.1.2.6A: Symbol 7.1.2.1 may be used if no confusion will arise:

IEC 

7.1.2.7 Focusing electrode with aperture

Beam-forming plate

See NOTE 7.1.2.6A

IEC

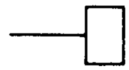
7.1.2.8 Beam-splitting electrode internally connected to the final focusing electrode of the electron gun

IEC 

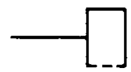
7.1.2.9 Cylindrical focusing electrode
Drift space electrode

Electronic lens element

See NOTE 7.1.2.6A

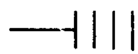
IEC 

7.1.2.10 Cylindrical focusing electrode with grid

IEC 

7.1.2.11 Multiaperture electrode

See NOTE 7.1.2.6A

IEC 

7.1.2.12 Quantizing electrode

Sampling electrode

IEC

7.1.5 Heater

IEC 

See NOTE 7.1.1.1A

Add:

OR

IEC 

After **7.1.8**

Add:

7.1.9 Storage electrodes

7.1.9.1 Storage electrode

IEC 

7.1.9.2 Photoemissive storage electrode

IEC 

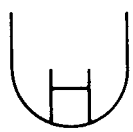
7.1.9.3 Storage electrode with secondary emission in the direction of the arrow

IEC 

7.1.9.4 Photoconductive storage electrode

7.1.10 Symbol elements for microwave tubes

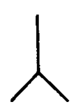
7.1.10.1 Electron gun assembly, shown with envelope

IEC 

Simplified Form

7.1.10.2 Reflector

Repelling electrode (used in velocity modulated tubes)

IEC 

7.1.10.3 Nonemitting sole for open slow-wave structure

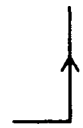
IEC

7.1.10.4 Nonemitting sole for closed slow-wave structure

IEC 

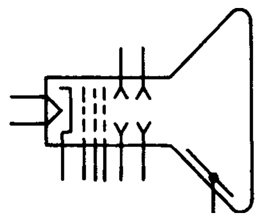
7.1.10.5 Emitting sole (arrow indicates direction of electron flow)

IEC



7.3.6.1 With electric-field (electrostatic) deflection

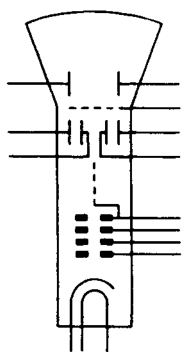
IEC



Add:

7.3.6.1.1 Double-beam cathode-ray tube, split-beam type with:
Electrostatic deflection
Indirectly heated cathode

IEC

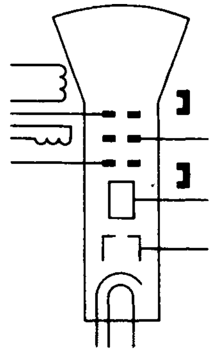


Add:

7.3.6.2.3 Cathode-ray tube with electromagnetic deviation, with:

— Permanent magnet focusing and ion trap
— Intensity modulating electrode
— Indirectly heated cathode

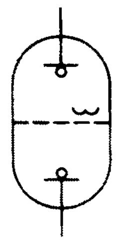
For example, television picture tube



IEC

7.4 Solion Ion-Diffusion Device

7.4.1 Diode solion



Add:

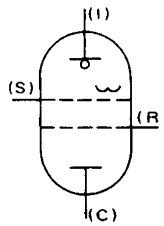
OR

IEC

7.4.2 Tetrode solion

NOTE — 7.4.2A: Letters in parentheses are not part of the symbol.

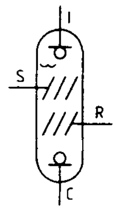
I	Input
S	Shield
R	Readout
C	Common



Add:

OR

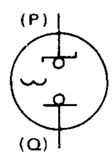
IEC



See NOTE 7.4.2A

7.5 Coulomb Accumulator Electrochemical Step-Function Device

NOTE — 7.5A: Letters in parentheses are not part of the symbol, but are for explanation only. For a precharged cell, with + polarity applied to P, the cell internal resistance and voltage drop will remain low until the designed coulomb quantity has passed; then the internal resistance will rise to its high value.

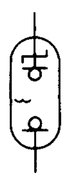


See NOTE 7.5A

Add:

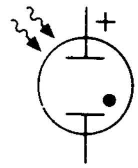
OR

IEC



Revise **7.7.1** *to read as follows:*

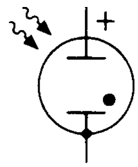
7.7.1 General



See NOTE 7.7A

Revise **7.7.2** *to read as follows:*

7.7.2 Application: metal enclosure, having one collector connected to the enclosure



See NOTE 7.7A

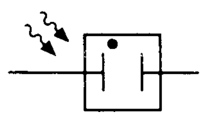
After **7.7.2**

Add:

7.7.3 Ionizing radiation detectors

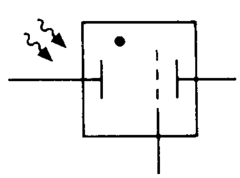
7.7.3.1 Ionization chamber

IEC

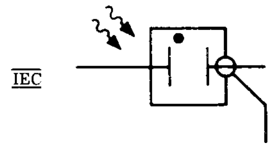


7.7.3.2 Ionization chamber with grid

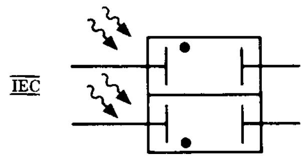
IEC



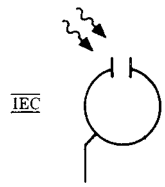
7.7.3.3 Ionization chamber with guard ring



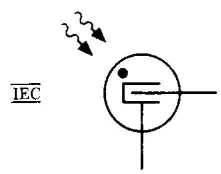
7.7.3.4 Ionization chamber, compensated type



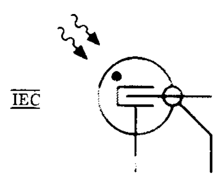
7.7.3.5 Faraday cup



7.7.3.6 Counter tube



7.7.3.7 Counter tube with guard ring



8. Graphic Symbols for Semiconductor Devices

Revise **8.2.2** *to read as follows:*

8.2.2 Rectifying junction or junction which influences a depletion layer

Arrowheads (→|) shall be half the length of the arrow away from the semiconductor base region.

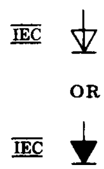
See item 8.6

The equilateral ( ) triangle shall be filled and shall touch the semiconductor base-region symbol.

NOTE — 8.2.2A: The triangle points in the direction of the forward (easy) current as indicated by a direct-current ammeter, unless otherwise noted adjacent to the symbol. Electron flow is in the opposite direction.

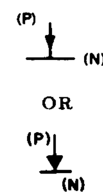
Add:

8.2.2A Rectifying junction

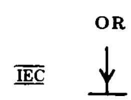


Revise:

8.2.2.1 P region on N region

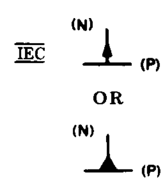


Add:

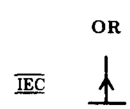


Revise:

8.2.2.2 N region on P region



Add:



8.2.3 Enhancement-type semiconductor region with plurality of ohmic connections and a rectifying junction

Portions of the interrupted channel line having ohmic contacts shall be of equal length and drawn significantly longer than the center-channel section. Channel gaps shall be of equal length and approximately equal to the center-channel length.

Add:

8.2.3A Indication of the conductivity type of the channel for insulated gate field effect transistors (IGFET)

8.2.3A.1 N-type channel on P-type substrate, shown for a depletion type IGFET

IEC 

8.2.3A.2 P-type channel on an N-type substrate, shown for an enhancement type IGFET

IEC 

8.2.4.1 P emitter on N region

Add:

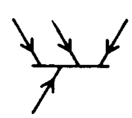
OR

IEC 

8.2.4.1.1 Plurality of P emitters on N region

Add:

OR

IEC 

8.2.4.2 N emitter on P region

Add:

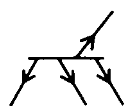
OR

IEC 

8.2.4.2.1 Plurality of N emitters on P region

Add:

OR

IEC 

CORRECTION: *Symbol was omitted in some printings.*

8.2.9.2 Gate (no external connection)

For application, see symbol 8.5.9

Because there is no external connection to the gate, this lead shall not extend to the envelope symbol, if any.

Style 3

See NOTE 8.2.9A

8.3.1 Breakdown

Do not rotate or show in mirror-image form.

Style 1 IEC

Add:

8.3.1A Bidirectional breakdown effect

IEC 

8.3.3 Backward

Style 1 IEC 

Add:

OR

IEC

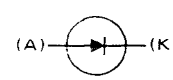
After **8.3.4**

Add:

8.3.5 Schottky effect

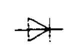
IEC 

8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier

IEC 

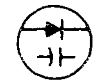
Add:

OR

IEC 

8.5.2 Capacitive diode (varactor)

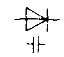
Style 1 IEC



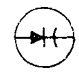
Add:

OR

IEC

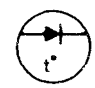


Style 2



8.5.3 Temperature-dependent diode

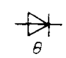
IEC



Add:

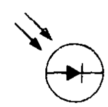
OR

IEC



8.5.4.1 Photosensitive type

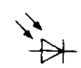
IEC



Add:

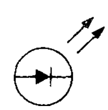
OR

IEC



8.5.4.2 Photoemissive type

See also item 11.1.1

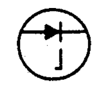


Add:

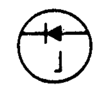
OR

IEC 

8.5.6.1 Unidirectional diode; voltage regulator

Style 1 

OR

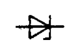


*Style 2 

Add:

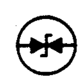
*Note conflict with 8.3.1A

OR

IEC 

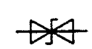
8.5.6.2 Bidirectional diode

Style 1 

Style 2 IEC 

Add:

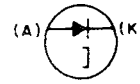
OR

IEC 

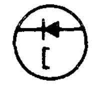
8.5.7 Tunnel and backward diodes

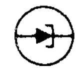
8.5.7.1 Tunnel diode

For this application, NOTE 8.2.2A does not apply.

Style 1 

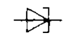
OR



Style 2 

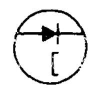
Add:

OR

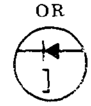
IEC 

8.5.7.2 Backward diode; tunnel rectifier

For this application, NOTE 8.2.2A does not apply.

Style 1 

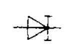
OR



Style 2 

Add:

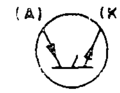
OR

IEC 

8.5.8 Thyristor, reverse-blocking diode-type

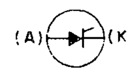
8.5.8.1 General

Style 1



OR

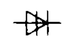
Style 3



Add:

OR

IEC

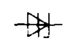


After **8.5.8.2**

Add:

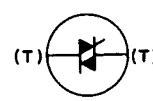
8.5.8.3 Reverse conducting diode thyristor

IEC



8.5.9 Thyristor, bidirectional diode type; bi-switch

See also symbol 8.6.15



Add:

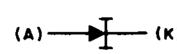
OR

IEC

Add:

8.5.11 Current regulator

*

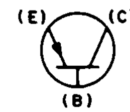


*Note conflict with 8.3.3

8.6 Typical Applications, Three- (or more) Terminal Devices

8.6.1 PNP transistor (also PNIP transistor, if omitting the intrinsic region will not result in ambiguity)

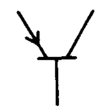
NOTE — 8.6.1A: See ANSI/IEEE Std 315-1975 [7], paragraph A4.11 of the Introduction.



Add:

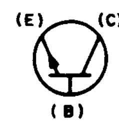
OR

IEC



8.6.2 NPN transistor (also NPIN transistor, if omitting the intrinsic region will not result in ambiguity)

See NOTE 8.6.1A



Add:

8.6.2A NPN transistor with collector connected to the envelope

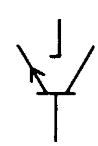
IEC

After **8.6.2.1**

Add:

8.6.2.2 NPN avalanche transistor

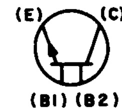
IEC



8.6.3 NPN transistor with transverse-biased base

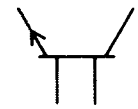
See NOTE 8.6.1A

Add:



OR

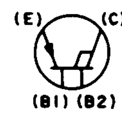
IEC



8.6.4 PNIP transistor with ohmic connection to the intrinsic region

See NOTE 8.6.1A

Add:



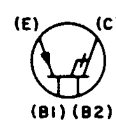
OR

IEC

8.6.6 PNIN transistor with ohmic connection to the intrinsic region

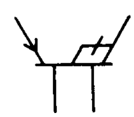
See NOTE 8.6.1A

Add:



OR

IEC



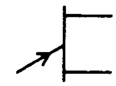
8.6.8 Unijunction transistor with N-type base

See NOTE 8.6.1A

Add:

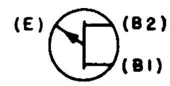
OR

IEC



8.6.9 Unijunction transistor with P-type base

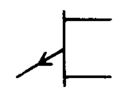
See NOTE 8.6.1A



Add:

OR

IEC

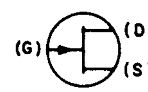


8.6.10 Field-effect transistor with N-channel (junction gate and insulated gate)

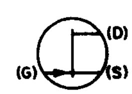
8.6.10.1 N-channel junction gate

If desired, the junction-gate symbol element may be drawn opposite the preferred source.

See NOTE 8.6.1A



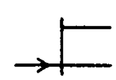
OR



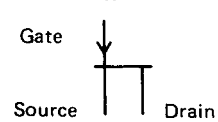
Add:

OR

IEC



NOTE 8.6.10.1A: The gate and source connections shall be drawn in line.



8.6.10.2 N-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate), three-terminal device

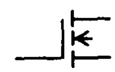
IEC 

Add:

OR

IEC 

8.6.10.2A IGFET enhancement-type, single-gate, N-type channel without substrate connection

IEC 

8.3.10.3 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) internally terminated to source, three-terminal device

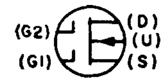
Add:

8.6.10.3A IGFET enhancement-type, single-gate, N-type channel with substrate internally connected to source

IEC 

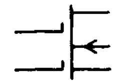
8.6.10.4 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

8.6.10.4.1 Application: N-channel insulated-gate, depletion-type, two-gate, five-terminal device



Add:

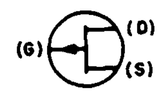
OR

IEC 

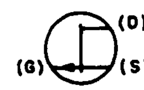
8.6.11 Field-effect transistor with P-channel (junction gate and insulated gate)

8.6.11.1 P-channel junction gate

See NOTE 8.6.1A

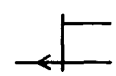


OR



Add:

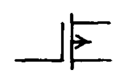
OR

IEC 

8.6.11.2 P-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate), three-terminal device

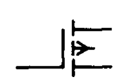
Add:

OR

IEC 

8.6.11.2A Insulated-gate field-effect transistor (abridged IGFET) enhancement type, single gate. P-type channel without substrate connection

NOTE — 8.6.11.2A: For an example with multiple gates, see symbol 8.6.10.4.1.

IEC 

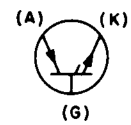
8.6.11.5 P-channel insulated-gate, enhancement-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

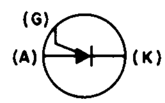
Add:

OR

IEC 

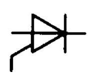
8.6.12.1 General

Style 1 

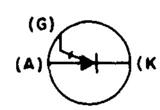
Style 3 

Add:

OR

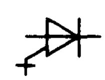
IEC 

8.6.12.2 Gate turn-off type

Style 3 

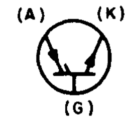
Add:

OR

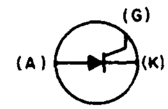
IEC 

8.6.13.1 General

Style 1



Style 3



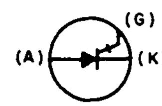
Add:

OR

IEC

8.6.13.2 Gate turn-off type

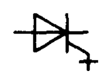
Style 3



Add:

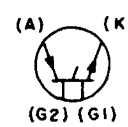
OR

IEC

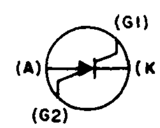


8.6.14 Thyristor, reverse-blocking tetrode-type; semiconductor controlled switch

Style 1



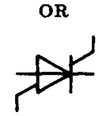
Style 3



Add:

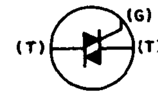
OR

IEC



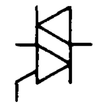
8.6.15 Thyristor, bidirectional triode-type; triac; gated switch

See also symbol 8.5.9

Style 3 

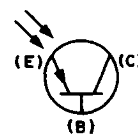
Add:

OR

IEC 

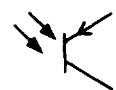
8.6.16 Phototransistor (PNP-type)

See also symbol 8.5.10, for 2-terminal device



Add:

OR

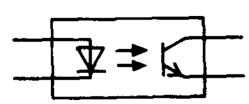
IEC 

After **8.10.4**

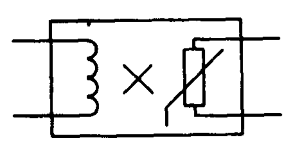
Add:

8.10.5 Optical coupling device
Opto isolator

Shown with light emitting diode and phototransistor

IEC 

8.10.6 Magnetic coupling device
Magnetic isolator

IEC 

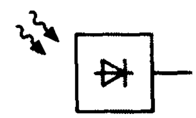
After **8.11.2**

Add:

8.12 Ionizing Radiation Detectors

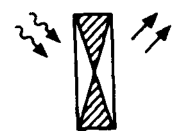
8.12.1 Detector, semiconductor type

IEC



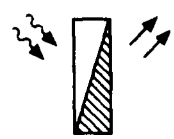
8.12.2 Scintillator detector

IEC



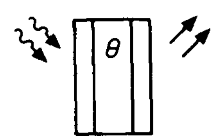
8.12.3 Cerenkov detector

IEC



8.12.4 Thermoluminescence detector

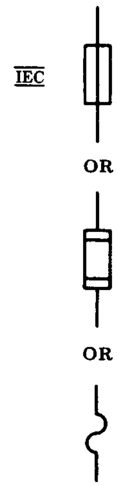
IEC



9. Graphic Symbols for Circuit Protectors

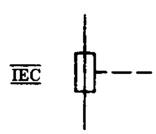
9.1 Fuse (one-time thermal current-overload device)

9.1.1 General



Add:

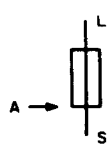
9.1.1A Fuse with mechanical linkage (striker fuse)



Revise:

9.1.2 Fuse with alarm contact

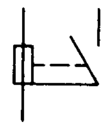
NOTE — 9.1.2A: When fuse blows, alarm bus A is connected to power supply bus S. The letters S (supply), L (load), and A (alarm circuit) are for explanation only, and are not part of the symbol.



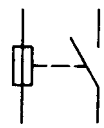
See NOTE 9.1.2A

Add:

9.1.2.1 Fuse with alarm contact, three terminals

IEC


9.1.2.2 Fuse with separate alarm circuit

IEC


Add:

9.1.3.1 Fuse-switch

IEC


9.3 Lightning Arrester $\boxed{F}$ Arrester (electric surge, etc) Gap

See also symbol 8.5.6

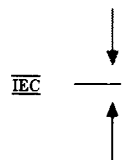
9.3.1 General

Add:

OR

IEC

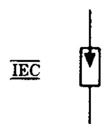

9.3.1.1 Double spark-gap



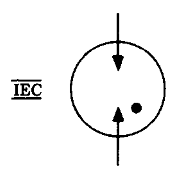
After **9.3.9**

Add:

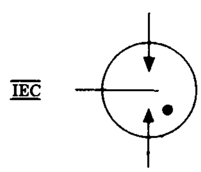
9.3.10 Surge arrester
(Lightning arrester)



9.3.11 Protective gas discharge tube



9.3.12 Symmetric protective gas discharge tube

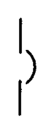


Revise **9.4** *to read as follows:*

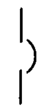
9.4 Circuit Breaker F

If it is desired to show the condition causing the breaker to trip, the relay protective-function symbols in item 9.5.1 may be used alongside the breaker symbol.

9.4.1 General



9.4.2 Air circuit breaker, if distinction is needed; for alternating-current circuit breakers rated at 1500 volts or less and for all direct-current circuit breakers.



9.4.3 Network protector

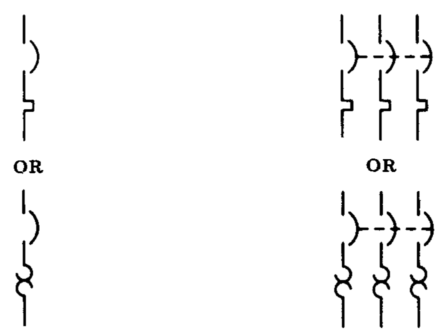
9.4.4 Circuit breaker, other than covered by symbol **9.4.1**

The symbol in the right column is for a 3-pole breaker.

NOTE — 9.4.4A: On a power diagram, the symbol may be used without other identification. On a composite drawing where confusion with the general circuit element symbol (item 16.1) may result, add the identifying letters CB inside or adjacent to the square.

See NOTE 9.4.4A

9.4.5 Application: 3-pole circuit breaker with thermal-overload device in all 3 poles



9.4.6 Application: 3-pole circuit breaker with magnetic-overload device in all 3 poles

9.4.7 Application: 3-pole circuit breaker, drawout type

After **9.5.12.20**

Add:

9.6 Protective Relays (IEC Publication 617-7 (1983 [18]) Block Symbol and Qualifying Symbol

9.6.1 Measuring relay or related device

The asterisk must be replaced by one or more letters or qualifying symbols indicating the parameters of the device, in the following order; characteristic quantity and its mode of variation; direction of energy flow; setting range, resetting ratio; delayed action; value of time delay

NOTE — 9.6.1A: Letter symbols for characteristic quantities should be in accordance with established standards, for example ISO 31 , 0-11 (1974-1980) [25], IEC Publication 27 [9], ANSI/IEEE Std 260-1978 [5], and ANSI/IEEE Std 280-1985 [6].

Symbols 9.6.2, 9.6.4, and 9.6.7 show how letter and qualifying symbols may be combined.

NOTES:

9.6.1B — A figure giving the number of similar measuring elements may be included in the symbol as shown in example 9.7.5.

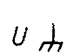
9.6.1C — The symbol may be used as a functional symbol representing the whole of the device, or as a symbol representing only the actuating element of the device.

IEC

9.6.2 Voltage failure to frame (frame potential in case of fault)

NOTE — 9.6.2A: *U* may be replaced by V.

IEC



9.6.3 Residual voltage

The NOTE with symbol 9.6.2 is applicable

IEC U_{rsd}

9.6.4 Reverse current

IEC $I \leftarrow$

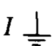
9.6.5 Differential current

IEC I_{d}

9.6.6 Percentage differential current

IEC I_{d}/I

9.6.7 Earth fault current

IEC I 

9.6.8 Current in the neutral conductor

IEC I_{N}

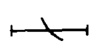
9.6.9 Current between neutrals of two polyphase systems

IEC $I_{\mathrm{N-N}}$

9.6.10 Power at phase angle *a*

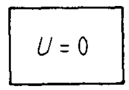
IEC P_{α}

9.6.11 Inverse time-lag characteristic

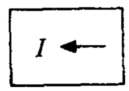
IEC 

9.7 Examples of Protective Relays (IEC Publication 617-7 (1983) [18])

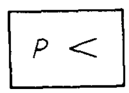
9.7.1 No voltage relay

IEC 

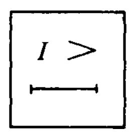
9.7.2 Reverse current relay

IEC 

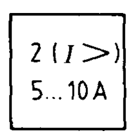
9.7.3 Underpower relay

IEC 

9.7.4 Delayed overcurrent relay

IEC 

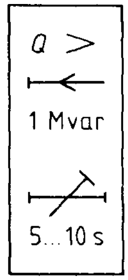
9.7.5 Overcurrent relay with two current elements and a setting range from 5 A to 10 A

IEC 

9.7.6 Maximum reactive power relay:

- Energy-flow towards the busbars
- Operating value 1 Mvar
- Time-lag adjustable from 5 s to 10 s

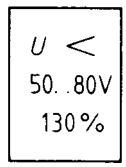
IEC



9.7.7 Undervoltage relay:

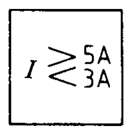
- Setting range from 50 V to 80 V
- Resetting ratio 130%

IEC



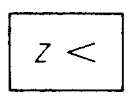
9.7.8 Current relay operating above 5 A and below 3 A

IEC



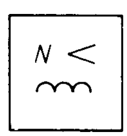
9.7.9 Under-impedance relay

IEC



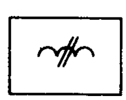
9.7.10 Relay detecting interturn short-circuits

IEC

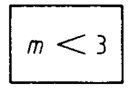


9.7.11 Divided-conductor detection relay

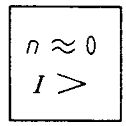
IEC



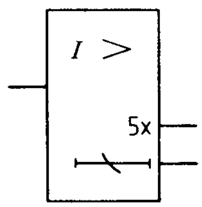
9.7.12 Phase-failure detection relay in a three-phase system

IEC


9.7.13 Locked-rotor detection relay operating by current sensing

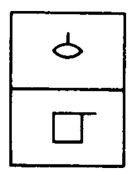
IEC


9.7.14 Overcurrent relay with two outputs, one active at current above five times the setting value, the other with inverse time-lag characteristic

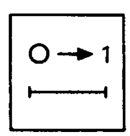
IEC


9.8 Other Relay Devices

9.8.1 Buchholz protective device (gas relay)

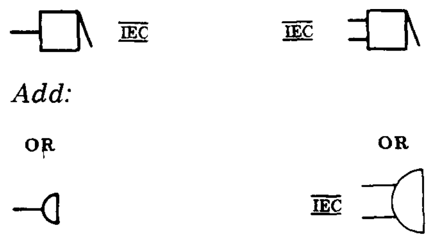
IEC


9.8.2 Auto-reclose device

IEC


10. Graphic Symbols for Acoustic Devices

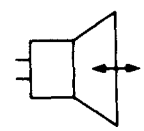
10.1.2 Buzzer F



See NOTE 10.1.1A

Revise:

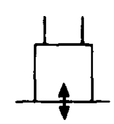
10.1.3.3 Loudspeaker-microphone IEC
Underwater sound transducer, two-way



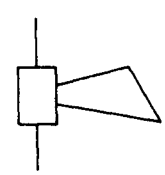
After **10.1.4**

Add:

10.1.5 Hydrophone (supersonic transmitter-receiver)

IEC 

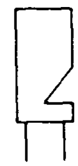
10.1.6 Horn

IEC 

10.1.7 Siren

IEC 

10.1.8 Whistle, electrically operated

IEC 

11. Graphic Symbols for Lamps and Visual-Signaling Devices

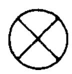
After NOTE 11.1.1C

Add:

11.1.1A Lamp (IEC Publication 617-8 (1983) [19])

11.1.1A.1 Lamp, general symbol

Signal lamp, general symbol

IEC 

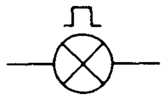
If it is desired to indicate the color, a notation according to the following code is placed adjacent to the symbol:

RD	= red
YE	= yellow
GN	= green
BU	= blue
WH	= white

If it is desired to indicate the type of lamp, a notation according to the following code is placed adjacent to the symbol:

Nc	=neon
Xe	= xenon
Na	= sodium vapor
Hg	= mercury
I	= iodine
IN	= incandescent
EL	= electroluminescent
ARC	= arc
FL	= fluorescent
IR	= infrared
UV	= ultraviolet
LED	= light-emitting diode

11.1.1A.2 Signal lamp, flashing type

IEC


After **11.2.8**

Add:

11.3 Electromechanical Signal

11.3.1 Indicator, electromechanical
Annunciator, element

IEC


11.3.2 Electromechanical position indicator with one de-energized (shown) and two operated positions

IEC


11.3.3 Coil operated flag indicator

IEC


(Relocated from 6.2.9)

12. Graphic Symbols for Readout Devices

12.1 Meter
Instrument

Add:

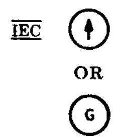
Note that IEC Publication 617-8 (1983) [19]

- — Distinguishes symbolwise between indicating, recording, and integrating instruments (see 12.3)
- — Carefully follows the lettering style (uppercase, lowercase) specified for the SI system of measurement (see 12.4 through 12.6)

NOTE — 12.1A: The asterisk is not part of the symbol. Always replace the asterisk by one of the following letter combinations, depending on the function of the meter or instrument, unless some other identification is provided in the circle and explained on the diagram.

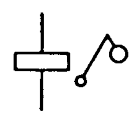
12.1.1 Galvanometer F

Avoid conflict with symbols 4.5 and 13.1.2 if used on the same diagram.

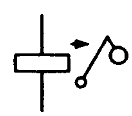


12.2 Electromagnetically Operated Counter Message Register See also 12.7

12.2.1 General



12.2.2 With make contact



Add:

12.3 Indicating, Recording and Integrating Instruments, General Symbols (IEC Publication 617-8 (1983) [19]

NOTE — 12.3A: The asterisk within the symbols of this section shall be replaced with one of the following:

- — The letter symbol for the *unit* of the quantity measured, or a multiple or sub-multiple thereof (see examples 12.4.1 and 12.4.7)
- — The letter symbol for the *quantity* measured (see examples 12.4.5 and 12.4.6)
- — A chemical formula (see example 12.4.13)
- — A graphic symbol (see example 12.4.8)

The symbol or formula used should be related to the information displayed by the instrument regardless of the means used to obtain the information.

NOTE — 12.3B: Letter symbols for *units* and for *quantities* shall be selected from one of the parts of IEC Publication 27 [9], ANSI/IEEE Std 260-1978 [5], and ANSI/IEEE Std 280-1985 [6].

Provided IEC Publication 27 [9], ANSI/IEEE Std 260-1978 [5], ANSI/IEEE Std 280-1985 [6], or the letter symbols for chemical elements, do not apply, other letter symbols may be used, if they are explained on the diagram or in referenced documents.

NOTE — 12.3C: If the letter symbol for the *unit* of the quantity measured is used, it may be necessary to show the letter symbol for the *quantity* as supplementary information. It should be placed below the unit letter symbol (see example 12.4.2).

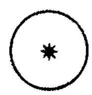
Supplementary information concerning the quantity measured, and any necessary qualifying symbol may be shown below the quantity letter symbol.

NOTE — 12.3D: If more than one quantity is indicated or recorded by an instrument, the appropriate symbol outlines shall be placed attached in line, horizontally or vertically (see examples 12.5.2 and 12.6.14).

12.3.1 Indicating instrument

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

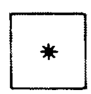
IEC



12.3.2 Recording instrument

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

IEC



12.3.3 Integrating instrument
Energy meter

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

NOTES:

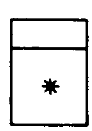
12.3.3A — The symbol may also be used for a remote instrument which repeats a reading transmitted from an integrating meter. For example, see symbol 12.6.11.

12.3.3B — The outline may be combined with that for a recording instrument to represent a combined instrument. For example, see symbol 12.6.14.

12.3.3C — Symbols from 1.7 may be used to specify the direction of energy flow. For examples, see symbols 12.6.4 to 12.6.7.

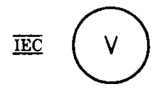
12.3.3D — The number of rectangles at the top of the symbol indicates the number of different summations by a multirate meter. For example, see symbol 12.4.8.

IEC

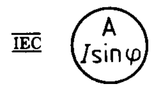


12.4 Examples of Indicating Instruments (IEC Publication 617-8 (1983) [19])

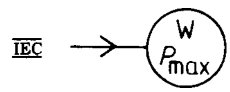
12.4.1 Voltmeter



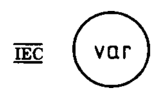
12.4.2 Reactive current ammeter



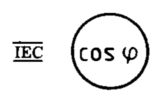
12.4.3 Maximum demand indicator actuated by an integrating meter



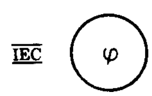
12.4.4 Varmeter



12.4.5 Power-factor meter

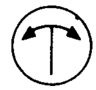


12.4.6 Phase meter

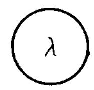


12.4.7 Frequency meter

12.4.8 Synchronoscope

IEC 

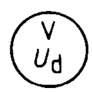
12.4.9 Wavemeter

IEC 

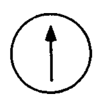
12.4.10 Oscilloscope

IEC 

12.4.11 Differential voltmeter

IEC 

12.4.12 Galvanometer

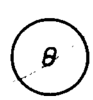
IEC 

12.4.13 Salinity meter

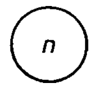
IEC 

12.4.14 Thermometer
Pyrometer

NOTE — 12.4.14A: θ may be replaced by *t*°.

IEC 

12.4.15 Tachometer

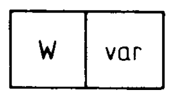
IEC


12.5 Examples of Recording Instruments (IEC Publication 617-8 (1983) [19]

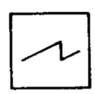
12.5.1 Recording wattmeter

IEC


12.5.2 Combined recording wattmeter and varmeter

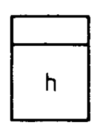
IEC


12.5.3 Oscillograph

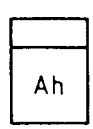
IEC


12.6 Examples of Integrating Instruments (IEC Publication 617-8 (1983) [19])

12.6.1 Hour meter

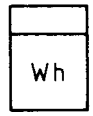
IEC


12.6.2 Ampere-hour meter

IEC


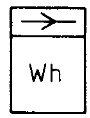
12.6.3 Watthour meter

IEC



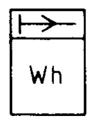
12.6.4 Watthour meter, measuring energy transmitted in one direction only

IEC



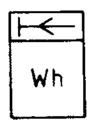
12.6.5 Watthour meter, measuring the energy flow from the busbars

IEC



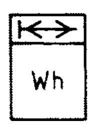
12.6.6 Watthour meter, measuring the energy flow towards the busbars

IEC



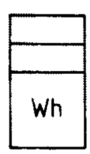
12.6.7 Import-export watthour meter

IEC



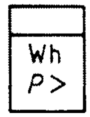
12.6.8 Multirate watthour meter, two-rate shown

IEC



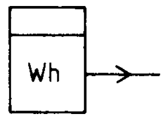
12.6.9 Excess watthour meter

IEC



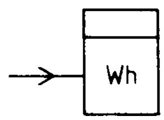
12.6.10 Watthour meter with transmitter

IEC



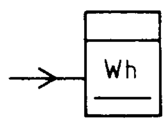
12.6.11 Remote meter (repeater) actuated by a watthour meter

IEC



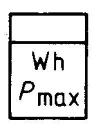
12.6.12 Remote meter (repeater) with printing device, actuated by a watthour meter

IEC



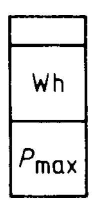
12.6.13 Watthour meter with maximum demand indicator

IEC

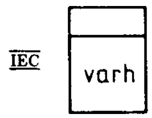


12.6.14 Watthour meter with maximum demand recorder

IEC



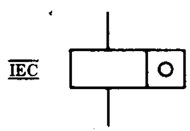
12.6.15 Varhour meter



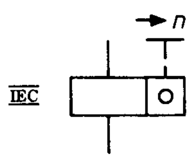
12.7 Counting Devices (IEC Publication 617-8 (1983) [19])

12.7.1 Counting function of a number of events, qualifying symbol

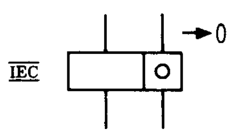
12.7.2 Pulse meter (electrically-operated counting device)



12.7.3 Pulse meter manually preset to ***n*** (reset if ***n***-0)

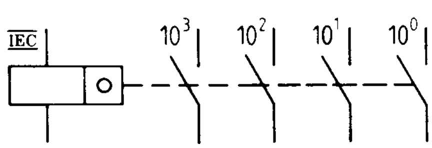


12.7.4 Pulse meter electrically reset to 0



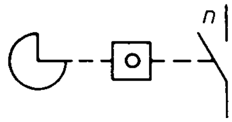
12.7.5 Pulse meter with multiple contacts

Respective contacts close once at every unit (10^0), ten (10^1), hundred (10^2), thousand (10^3) events registered by the counter



12.7.6 Counting device, cam driven and closing a contact for each ***n*** events

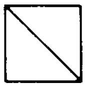
IEC



12.8 Telemetering Devices

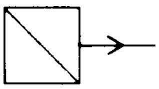
12.8.1 Signal translator, general symbol

IEC



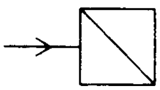
12.8.2 Telemetering transmitter

IEC



12.8.3 Telemetering receiver

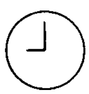
IEC



12.9 Electric Clocks

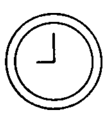
12.9.1 Clock, general symbol
Secondary clock

IEC



12.9.2 Master clock

IEC



12.9.3 Clock with switch

IEC 

13. Graphic Symbols for Rotating Machinery

Add:

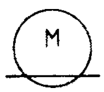
13.1.5A Brush (onslip-ring or commutator)

NOTE — 13.1.5A: Brushes are shown only if necessary.

IEC 

Add:

13.1.7 Linear motor, general symbol

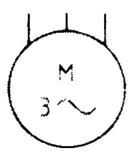
IEC 

13.1.8 Stepping motor, general symbol

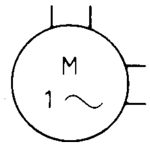
IEC 

Add:

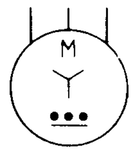
13.5.1.1 Induction motor, three-phase, squirrel cage

IEC 

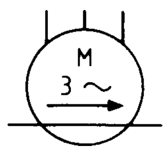
13.5.1.2 Induction motor, single-phase, squirrel cage, leads of split phase brought out

IEC 

13.5.1.3 Induction motor, three-phase, star-connected, with automatic starter in the rotor

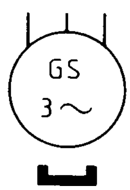
IEC 

13.5.1.4 Linear induction motor, three-phase, movement limited to one direction

IEC 

Add:

13.6.1.1 Synchronous generator, three-phase, permanent magnet

IEC 

14. Graphic Symbols for Mechanical Functions

14.2 Mechanical Motion

14.2.1 Translation, one direction

Add:

14.2.1A Rectilinear force or motion in the direction of the arrow

IEC

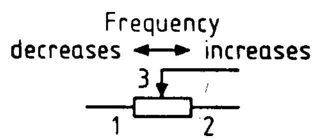
14.2.2 Translation, both directions

Add:

14.2.2A Bidirectional rectilinear forces or motion

IEC

EXAMPLE: Frequency is increased when wiper 3 is moved towards terminal 2



After **14.2.4**

Add:

14.2.4A Bidirectional rotation, limited in both directions

14.2.4.1 Alternating or reciprocating

For application see symbol 2.3.7.7

IEC 

Add:

OR

IEC 

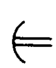
After **14.2.6**

Add:

14.2.7 Delayed action

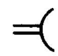
14.2.7.1 Delayed action

NOTE — 14.2.7.1A: Delayed action in the direction of movement from the arc towards its center

IEC 

Form 1

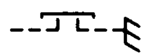
14.2.7.2

IEC 

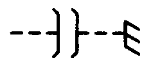
Form 2

Revise **14.3.3** *to read as follows:*

14.3.3 Brake applied when operating means (not shown) is energized



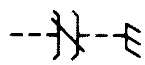
OR



Revise **14.3.4** *to read as follows:*

14.3.4 Brake released when operating means (not shown) is energized

OR

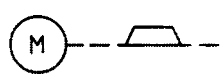


Add:

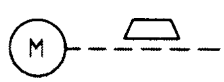
14.3.5 Brake (IEC Publication 617 (1983) [13])

IEC 

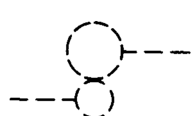
14.3.5.1 EXAMPLE: Electric motor with brake applied.

IEC 

14.3.5.2 EXAMPLE: Electric motor with brake released.

IEC 

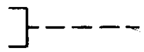
14.3.6 Gearing

IEC 

After **14.4.2**

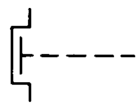
Add:

14.4.2A Operating by pulling.

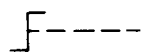
IEC 

Add:

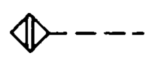
14.4.4 Manually operated control with restricted access

IEC 

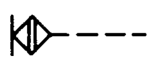
14.4.5 Operated by turning

IEC 

14.4.6 Operated by proximity effect

IEC 

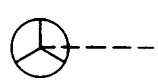
14.4.7 Operated by touching

IEC 

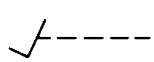
14.4.8 Emergency switch (mushroom-head safety feature)

IEC 

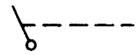
14.4.9 Operated by handwheel

IEC 

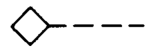
14.4.10 Operated by pedal

IEC 

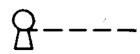
14.4.11 Operated by lever

IEC 

14.4.12 Operated by removable handle

IEC 

14.4.13 Operated by key

IEC 

14.4.14 Operated by crank

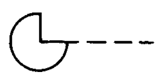
IEC 

14.4.15 Operated by roller

IEC 

14.4.16 Operated by cam

NOTE — 14.4.16A: If desired, a more detailed drawing of the cam may be shown. This applies also to a profile plate.

IEC 

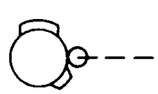
14.4.16.1 EXAMPLE: Cam profile

IEC 

14.4.16.2 Profile plate
Cam profile (developed representation)

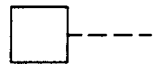
IEC 

14.4.16.3 Operated by cam and roller

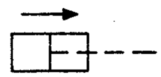
IEC 

14.4.17 Operated by stored mechanical energy

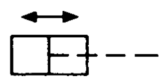
NOTE — 14.4.17A: Information showing the form of stored energy may be added in the square.

IEC 

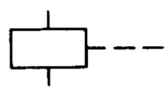
14.4.18 Operated by pneumatic or hydraulic control, single acting

IEC 

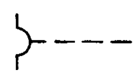
14.4.19 Operated by pneumatic or hydraulic control, double acting

IEC 

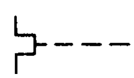
14.4.20 Operated by electromagnetic actuator

IEC 

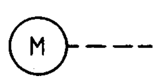
14.4.21 Operated by electromagnetic overcurrent protection

IEC 

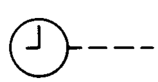
14.4.22 Operated by thermal actuator, for example thermal relay, thermal overcurrent protection

IEC 

14.4.23 Operated by electric motor

IEC 

14.4.24 Operated by electric clock

IEC 

14.5 Detents, Latching, and Blocking

14.5.1 Automatic return

NOTE — 14.5.1A: The triangle is pointed in the return direction.

IEC 

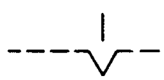
14.5.2 Detent
Nonautomatic return
Device for maintaining a given position

IEC 

14.5.3 Detent, disengaged

IEC 

14.5.4 Detent, engaged

IEC 

14.5.5 Mechanical interlock between two devices

IEC 

14.5.6 Latching device, disengaged

IEC 

14.5.7 Latching device, engaged

IEC 

14.5.8 Blocking device

IEC 

14.5.9 Blocking device engaged, movement to the left is blocked

IEC 

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

15.2 Coupling

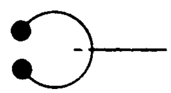
Commonly used in coaxial and waveguide diagrams.

Add:

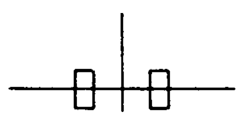
15.2A Coupler (or feed) type unspecified, general symbol

IEC

15.2A.1 EXAMPLE: Coupler to a cavity resonator

IEC 

15.2A.2 EXAMPLE: Coupler to a rectangular waveguide

IEC 

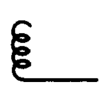
After **15.2.7**

Add:

15.2.8 Slow-wave coupler

IEC 

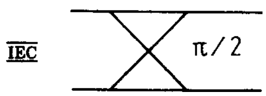
15.2.9 Helical coupler

IEC 

After **15.4.4.2**

Add:

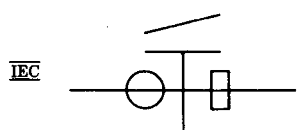
15.4.4.3 Quadrature hybrid junction



After **15.5.3**

Add:

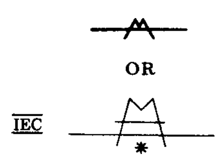
15.5.4 Taper transition from circular rectangular waveguide



15.6 Mode Suppressor

Commonly used in coaxial and waveguide transmission

15.6.1 General



The asterisk shall be replaced by the indication of the mode suppressed

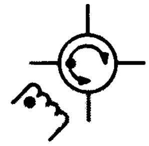
15.7 Rotary Joint (radio-frequency rotary coupler)

Add:

15.7A Rotatable, with symmetrical connectors

15.8.4.1 Reversible direction

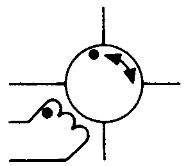
Current entering the coil at the end marked with the dot causes the energy in the circulator to flow in the direction of the arrowhead marked with the dot.



Add:

OR

IEC



15.9.1 General

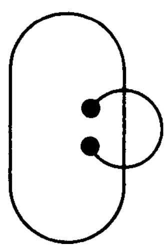
Commonly used for coaxial and waveguide transmission.

IEC

Add:

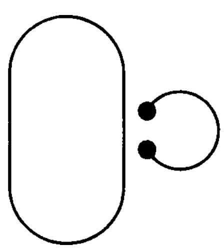
15.9.1.1 Cavity resonator forming an integral part of tube

IEC



15.9.1.2 Cavity resonator, partly or wholly external to tube

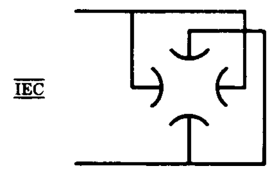
IEC



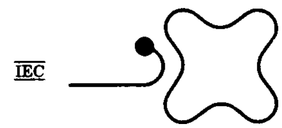
After **15.9.4**

Add:

15.9.5 Tetrapole



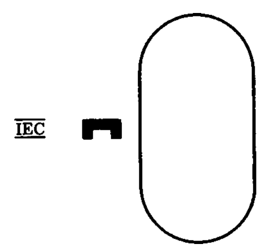
15.9.5.1 Tetrapole with loop coupler



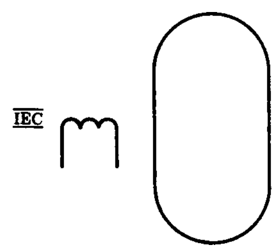
After **5.10.3**

Add:

15.10.4 Permanent magnet producing a transverse field (in a crossed field or magnetron type tube)

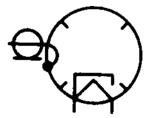


15.10.5 Electromagnet producing a transverse field (in a crossed field or magnetron type tube)



15.11 Magnetron

15.11.1 Resonant type with coaxial output

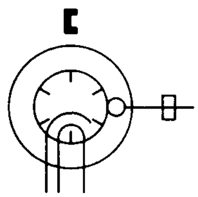


Add:

15.11.1A Magnetron oscillator tube with:

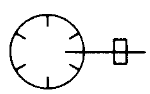
- Indirectly heated cathode
- Closed slow-wave structure with dc connection by way of a waveguide
- Permanent field magnet
- Window-coupler to rectangular waveguide

IEC



15.11.1A.1

IEC



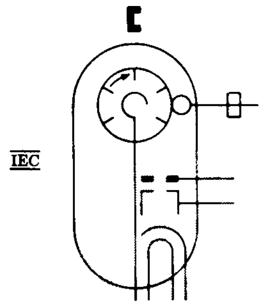
Simplified form

After **15.11.3**

Add:

15.11.4 Backward (traveling) wave oscillator tube (voltage tunable magnetron) with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Closed slow-wave structure with dc connection by way of waveguide
- Nonemitting sole
- Permanent field magnet
- Window-coupler to rectangular waveguide



15.11.4.1

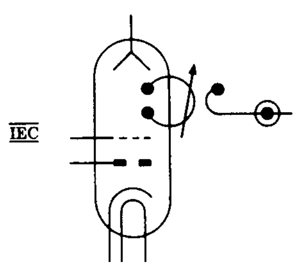
Simplified form

After **15.12.1**

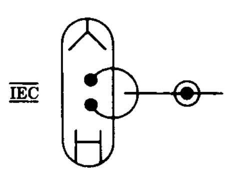
Add:

15.12.1A Reflex klystron with:

— Indirectly heated cathode
— Beam-forming plate
— Grid
— Tunable integral cavity resonator
— Reflector
— Loop coupler to coaxial output



15.12.1A.1



Simplified form

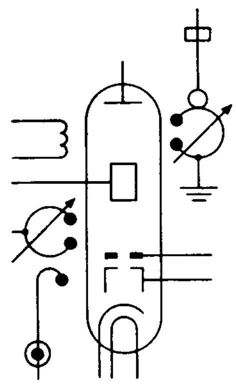
After **15.12.2**

Add:

15.12.3 Klystron with:

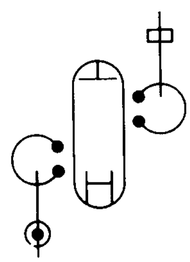
- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- External tunable input cavity resonator
- Drift space electrode
- External tunable output cavity resonator with dc connection
- Collector
- Focusing coil
- Input loop coupler to coaxial waveguide
- Output window coupler to rectangular waveguide

IEC



15.12.3.1

IEC



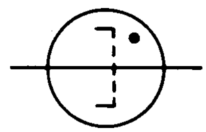
Simplified form

After **15.13**

Add:

15.13.1 T-R tube

IEC



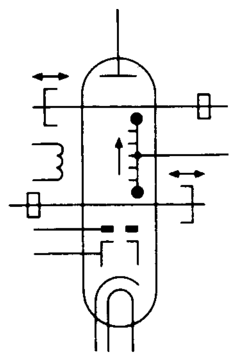
After **15.14.8**

Add:

15.14.9 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Collector
- Focusing coil
- Probe-couplers to rectangular waveguides each with sliding short

IEC

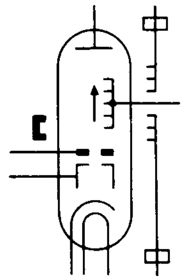


For a simplified form see symbol 15.14.11.1.

15.14.10 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Collector
- Permanent focusing-magnet
- Slow-wave couplers to rectangular waveguides

IEC

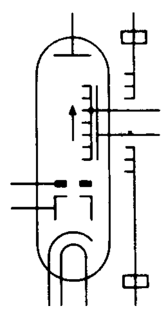


For a simplified form see symbol 15.14.11.1.

15.14.11 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulation electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Electrostatic focusing electrode
- Collector
- Slow-wave couplers to rectangular waveguides

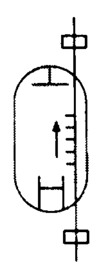
IEC



For a simplified form see symbol 15.14.11.1.

15.14.11.1 O-type forward traveling wave amplifier tube, simplified representation (simplified form for symbols **15.14.9**, **15.14.10**, and **15.14.11**)

IEC



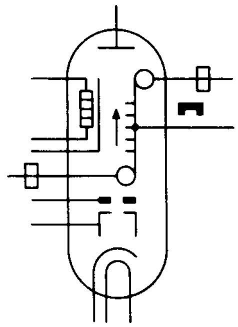
Simplified Form

15.14.12 M-type forward traveling wave amplifier tube with:

- Indirectly heated cathode

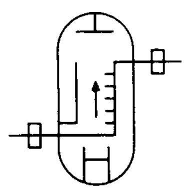
- Intensity modulating electrode
- Beam-forming plate
- Preheated nonemitting sole
- Slow-wave structure with dc connection
- Collector
- Permanent transverse field magnet
- Window couplers to rectangular waveguides

IEC



15.14.12.1

IEC

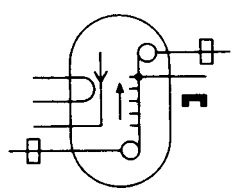


Simplified form

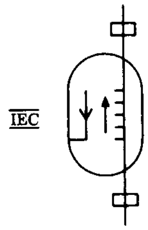
15.14.13 M-type backward (traveling) wave amplifier tube with:

- Filament-heated emitting sole
- Slow-wave structure with dc connection
- Permanent transverse field magnet
- Window-couplers to rectangular waveguides

IEC



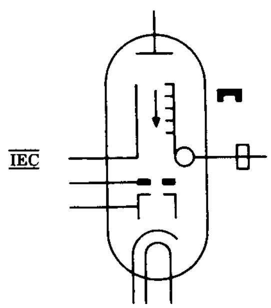
15.14.13.1



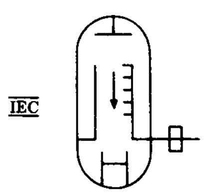
Simplified form

15.14.14 M-type backward (traveling) wave oscillator tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Nonemitting sole
- Slow-wave structure with dc connection by way of waveguide
- Collector
- Permanent transverse field magnet
- Window-coupler to rectangular waveguide



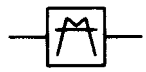
15.14.14.1



Simplified form

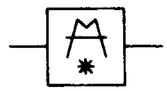
15.16 Filter

15.16.1 Mode filter

IEC 

Add:

OR

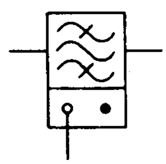
IEC 

The asterisk shall be replaced by the indication of the mode suppressed.

After **15.16.2**

Add:

15.16.3 Bandpass filter switched by gas discharge

IEC 

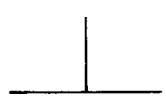
After **15.19**

Add:

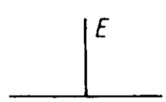
15.20 Multiport Devices

15.20.1 Three-port junction

NOTE — 14.20.1A: The type of coupling, power division proportions, reflection coefficients, etc, may be indicated as shown below. The angles between the ports may be drawn as convenient.

IEC 

15.20.1.1 EXAMPLE: Series T, *E*-plane T

IEC 

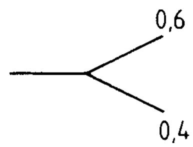
15.20.1.2 EXAMPLE: Shunt T, *H*-plane T

IEC

15.20.1.3 EXAMPLE: Power divider:

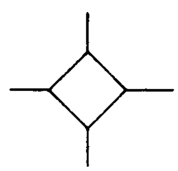
Power divided into ratio 6:4

IEC



15.20.2 Four-port junction

IEC

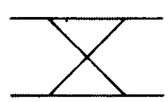


Form 1

15.20.2.1

NOTE — 15.20.2.1A: The convention is that the power entering at one port is conveyed only to the two directly connected ports and thence away from the device.

IEC



Form 2

15.21 Lasers and Masers

15.21.1 Maser, general symbol

NOTES:

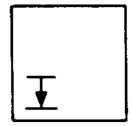
15.21.1A — The symbol represents the transition from one energy level to a lower one. It is drawn preferably in the lower left-hand quarter of the square.

15.21.1B — Pumping by light may be shown by placing symbol 1.3.1 () above

a) An appropriate symbol chosen from 1.4, or
b) The chemical symbol for the material

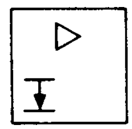
For example of application, see symbol 15.21.2.2

IEC



15.21.1.1 EXAMPLE: Maser used as an amplifier

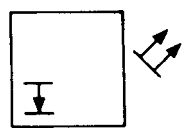
IEC



15.21.2 Laser (optical maser), general symbol

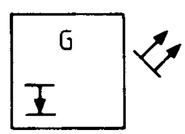
The NOTES with symbol 15.21.1 apply.

IEC

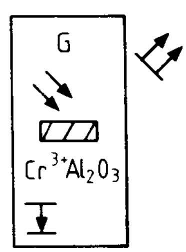


15.21.2.1 EXAMPLES: Laser used as a generator

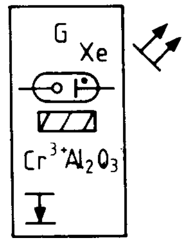
IEC



15.21.2.2 Ruby laser generator



15.21.2.3 Ruby laser generator, shown with xenon lamp as pumping source



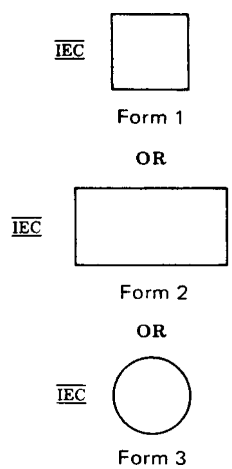
16. Graphic Symbol for Composite Assemblies

After **16.1.1**

Add:

16.1.1A Item
Equipment
Functional unit

NOTE — 16.1.1A: Suitable symbols or legends shall be inserted in or added to the symbol outline to indicate the item, equipment, or function.



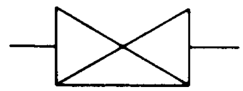
Revise **16.1.1.1** *to read as follows:*

16.1.1.1 Accepted abbreviations from ANSI Y1.1-1972 (R 1984) [1] may be used in the rectangle.

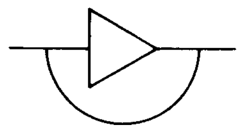
After **16.2.8**

Add:

16.2.9 Negative impedance both-way amplifier

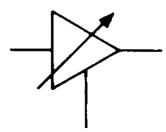
IEC


16.2.10 Amplifier with bypass used for signaling or power feeding, or both

IEC


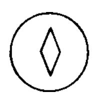
16.2.11 Amplifier with external direct-current control

NOTE — 16.2.11A: The controlled quantity may be indicated beside the arrowhead.

IEC


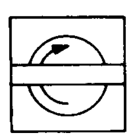
Revise **16.9** *to read as follows:*

16.9 Gyro
Gyroscope
Gyrocompass



Add:

16.9.1 Gyro

IEC


Add:

16.13 Changer, General Symbol Converter, General Symbol

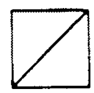
If the direction of change is not obvious, it may be indicated by an arrowhead on the outline of the symbol.

A symbol or legend indicating the input or output quantity, waveform, etc may be inserted in each half of the general symbol to show the nature of the change.

See IEC Publication 617-6 (1983) [17], Production and Conversion of Electrical Energy, and IEC Publication 617-10 (1983) [21], Telecommunications: Transmission.

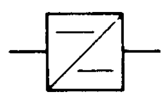
The diagonal line from this symbol is used in the form of a solidus to show a converting function.

IEC



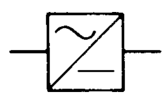
16.13.1 DC converter

IEC



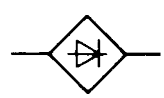
16.13.2 Rectifier

IEC



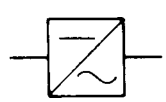
16.13.3 Rectifier in full wave (bridge) connection

IEC



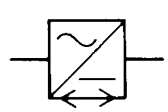
16.13.4 Inverter

IEC

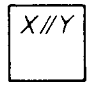


16.13.5 Rectifier/inverter

IEC



16.14 Galvanic Separator

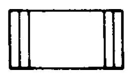
IEC 

NOTE — 16.14A: If necessary, indication of the way of separation may be given below the qualifying symbol.

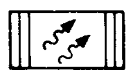
For example:

Galvanic separation by opto-coupler

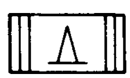
16.15 Heat Source, General Symbol

IEC 

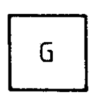
16.15.1 Radioisotope heat source

IEC 

16.15.2 Combustion heat source

IEC 

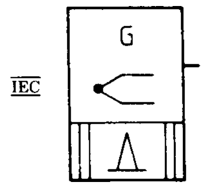
16.16 Generator, General Symbol

IEC 

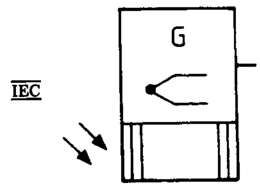
NOTE — 16.16A: For a rotating generator, use symbol *

See 13.1

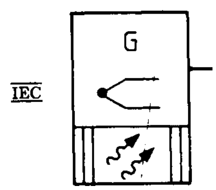
16.16.1 Thermoelectric generator, with combustion heat source



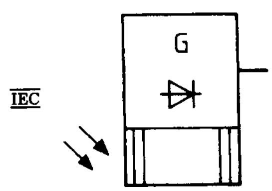
16.16.2 Thermoelectric generator with nonionizing radiation heat source



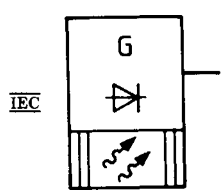
16.16.3 Thermoelectric generator with radioisotope heat source



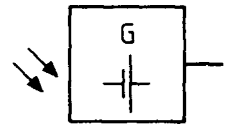
16.16.4 Thermionic diode generator with nonionizing radiation heat source



16.16.5 Thermionic diode generator with radioisotope heat source



16.16.6 Photovoltaic generator

IEC 

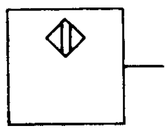
16.17 Sensors and Detectors

16.17.1 Proximity sensor

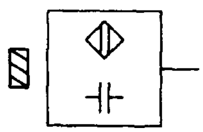
IEC 

16.17.2 Proximity sensing device, block symbol

NOTE — 16.17.2A: The method of operating may be indicated.

IEC 

16.17.2.1 EXAMPLE: Capacitive proximity detector operating on the approach of solid material

IEC 

16.17.3 Touch sensor

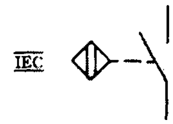
IEC 

16.18 Applications of Sensors

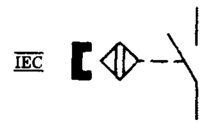
16.18.1 Touch sensitive switch, make contact

IEC 

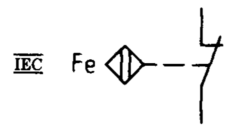
16.18.2 Proximity switch, make contact



16.18.3 Proximity switch, operated on the approach of a magnet, make contact



16.18.4 Proximity switch, operated on the approach of iron, break contact



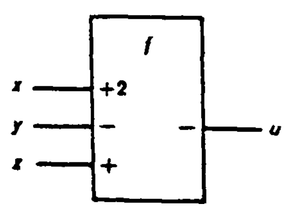
17. Graphic Symbols for Analog and Digital Logic Functions

NOTE — 17A: The existing Section 17, symbols 17.1 through 17.9 (inclusive) filled a need for programming operations using general purpose computers equipped with removable programming (patch) panels. IEC Publication 617-13 (1978) [24] provides a more sophisticated system.

17.10 Analog Elements (IEC Publication 617-13 (1978) [24]) for Computation and Control

17.10.1 General Rules

1) In many figures lowercase letters appear that are not part of the symbols and are added only for the purpose of identification of inputs and outputs as referenced in the description.
2) The symbols for sign indication are + and -. They are placed inside the outline of the symbol adjacent to each relevant input and output.
3) Weighting factors applied to the input signals are each indicated by a sign indicator in combination with a numerical value placed inside the outline of the symbol adjacent to the relevant input.
   In this standard w_1, w_2, ... *w*n which are understood to include the proper sign, will be used to denote the values of the weighting factors. When the weighting factor is +1 or -1, the number 1 may be omitted.
4) The symbol *f* is used to denote the function of an anolog element. *f* may be replaced by a symbol or a graph denoting the actual function.
5) *EXAMPLE:*



Element in which:

$u = -f(2x, -y, z)$

17.10.2 Qualifying symbols for signal identification

See **1.15**

17.10.3 Qualifying symbols for amplifiers

1) When an element performs a specific function in addition to amplification, *f* may be replaced by the appropriate qualifying symbol (see symbols 17.10.3.1 to 17.10.3.4) or may be omitted if no confusion can arise.
2) In particular cases, for example integrating amplifiers, special purpose inputs may be defined using symbols 17.10.3.5 to 17.10.3.11. If these symbols are not sufficient, controlling inputs should be labelled C_1, C_2 ... etc, and the effects of these should be defined in an associated table.

17.10.3.1 Summing

IEC $\sum$

17.10.3.2 Integrating

IEC $\int$

17.10.3.3 Differentiating

IEC $\frac{d}{dt}$

17.10.3.4 Logarithmic

IEC **log**

17.10.3.5 Frequency compensation

IEC **F**

17.10.3.6 Initial condition, analog value of integration

IEC **I**

17.10.3.7 Control: the defined 1-state allows integration

IEC C

17.10.3.8 Hold: the defined 1-state holds last value

IEC H

17.10.3.9 Reset: the defined 1-state resets the output condition to zero

IEC R

17.10.3.10 Set: the defined 1-state sets to initial condition

IEC S

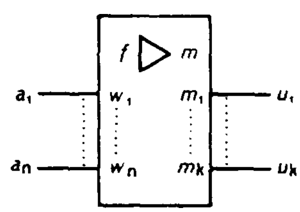
17.10.3.11 Supply voltage (to be used if special requirements exist). Any necessary identification of the supply (numeric) or polarity (+ or -) follows the letter *U*

IEC *U*

17.10.4 Amplifiers

17.10.4.1 Amplifier for analog computation. General symbol.

IEC



$w_1 \ldots w_n$ represent the signed values of the weighting factors.

$m_1 \ldots m_k$ represent the signed values of the amplification factors.

$u_1 = m \cdot m_1 \cdot f(w_1 \cdot a_1, w_2 \cdot a_2, \ldots, w_n \cdot a_n)$

where:

$i = 1, 2, \ldots, k$

The sign of the amplification factor is to be maintained at each of the outputs, except for those being digital in nature.

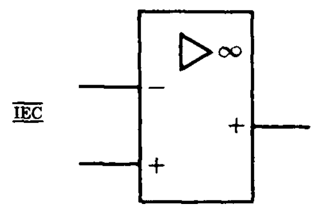
When there is only one amplification factor for the whole element, or there is a common factor resulting from weighting factors and amplification factors, the *m* in the qualifying symbol may be replaced by the absolute value.

When $m = 1$, the number 1 may be omitted. Signs should always be maintained at analog outputs.

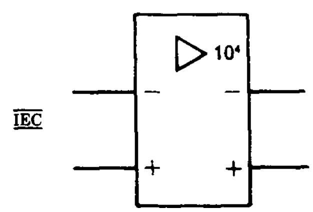
The use of the sign ∞ as an amplification factor is recommended where the nominal open loop gain is very high and the knowledge of its exact value is not of particular concern.

EXAMPLES:

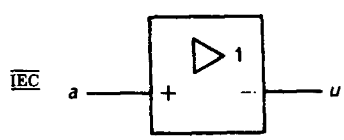
17.10.4.2 High gain differential amplifier (operational amplifier)



17.10.4.3 High gain amplifier with a nominal amplification of 10 000 and two complementary outputs

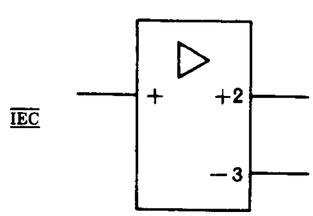


17.10.4.4 Inverting amplifier with an amplification of 1

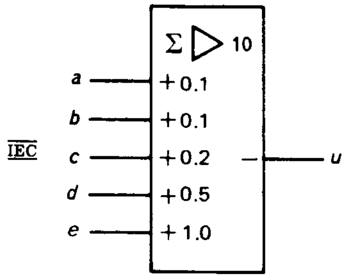


$u = -1 \cdot a$

17.10.4.5 Amplifier with two outputs, the upper, noninverting, has an amplification of 2, the lower, inverting output, has an amplification of 3



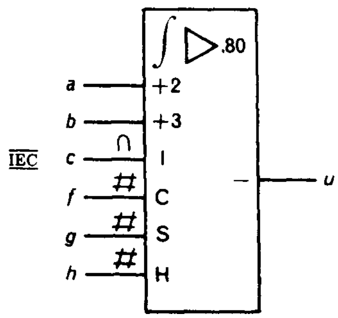
17.10.4.6



Summing amplifier

$$u = -10\,(0.1a + 0.1b + 0.2c + 0.5d + 1.0c)$$
$$= -(a + b + 2c + 5d + 10e)$$

17.10.4.7 Integrating amplifier (integrator)



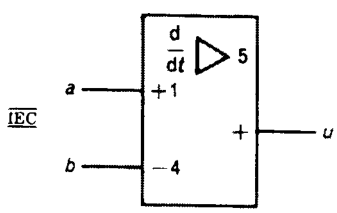
If $f = 1$, $g = 0$, and $h = 0$.

then

$$u = -80\left[c_{(t=0)} + \int_0^t (2a + 3b)\mathrm{d}t\right]$$

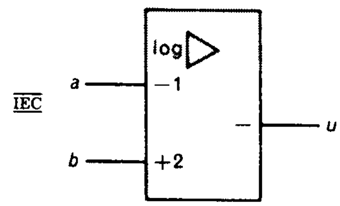
NOTE — The symbols for signal identification (∩ and #) may be omitted if no ambiguity arises.

17.10.4.8 Differentiating amplifier (differentiator)



$$u = 5\,\frac{\mathrm{d}}{\mathrm{d}t}\,(a - 4b)$$

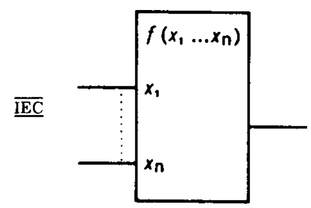
17.10.4.9 Logarithmic amplifier



$u = -\log(-a + 2b)$

17.10.5 Function generators

17.10.5.1 Function generator, general symbol



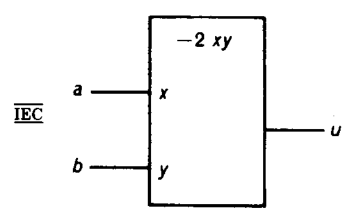
$x_1 \ldots x_n$ represent the arguments of the function and may each be replaced by an appropriate indication, provided that no ambiguity can arise. All weighting factors are assigned the value +1 and are therefore omitted.

$f(x_1 \ldots x_n)$ shall be replaced by an appropriate indication of, or reference to, the function (see for example, IEC Publication 27-1 (1971) [9]).

NOTE — 17.10.5.1A: the graphic "/" shall not be used for the indication of the division because of ambiguity with the symbols for the level converter and the code converter.

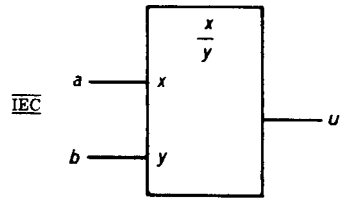
EXAMPLES:

17.10.5.2 Multiplier with weighting factor of -2



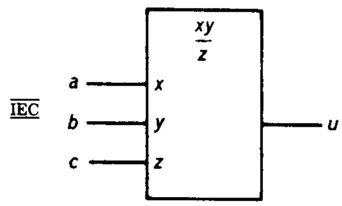
$u = -2ab$

17.10.5.3 Divider



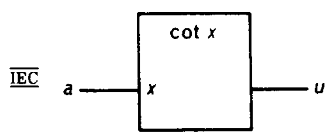
$u = \frac{a}{b}$

17.10.5.4 Multiplier-divider



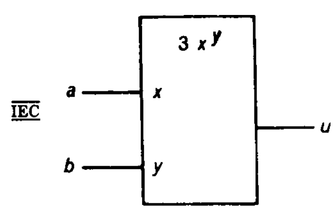
$u = \frac{ab}{c}$

17.10.5.5 Cotangent function



$u = \cot a$

17.10.5.6 Exponential function

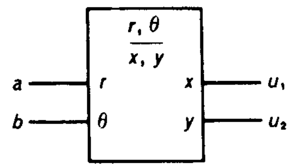


$u = 3a^b$

17.10.6 Coordinate converters

17.10.6.1 Coordinate converter, polar to rectangular

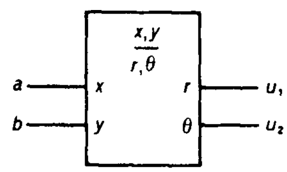
IEC



$$u_1 = a \cdot \cos b$$
$$u_2 = a \cdot \sin b$$

17.10.6.2 Coordinate converter, rectangular to polar

IEC



$$u_1 = \sqrt{a^2 + b^2}$$

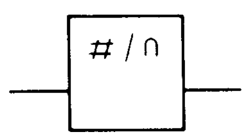
$$u_2 = \arctan \frac{b}{a}$$

17.10.7 Signal convertors

1) The indication of the specific relation between inputs and outputs may be shown inside the outline.
2) If the digital information is serial, the most significant bit is presented first unless otherwise indicated.

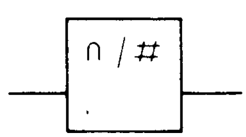
17.10.7.1 Digital to analog converter. General symbol.

IEC

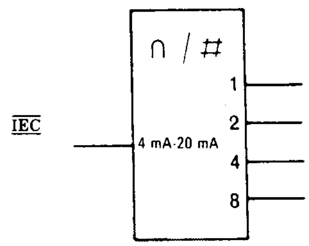


17.10.7.2 Analog to digital converter. General symbol.

IEC



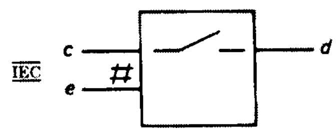
17.10.7.3 Analog to digital converter that converts the input range 4 mA-20 mA into a 4-bit weighted binary code.



17.10.8 Electronic switches

NOTE — Electronic switches are being considered in connection with binary logic elements. The results of this work may be published as a supplement to IEC Publciation 617-12 (1983) [23]. See ANSI/IEEE Std 91-1984 [4].

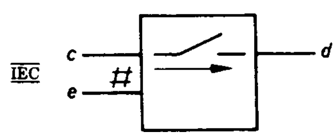
17.10.8.1 Bidirectional switch (make), general symbol



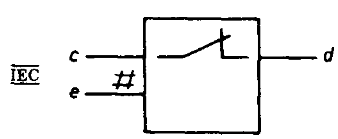
The analog signal can pass in either direction between *c* and *d* as long as the digital input *e* stands at its defined 1-state.

NOTE — 17.10.8.1A: An arrow may be added to indicate an unidirectional switch (make).

17.10.8.2 *EXAMPLE:* The analog signal can pass only in the direction indicated by the arrow as long as the digital input *e* stands at its defined 1-state.



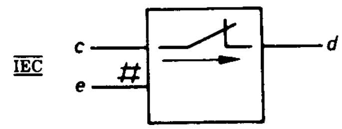
17.10.8.3 Bidirectional switch (break), general symbol



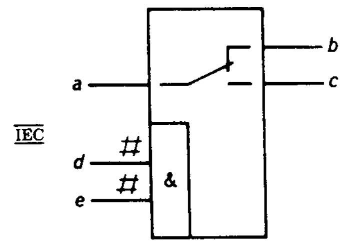
The analog signal can pass in either direction between *c* and *d* as long as the digital input *e* stands at its defined 0-state.

NOTE — 17.10.8.3A: An arrow may be added to indicate an unidirectional switch (break).

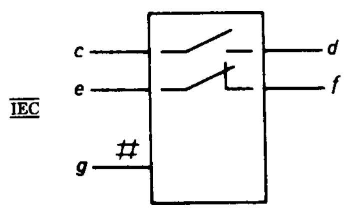
17.10.8.4 *EXAMPLE:* The analog signal can pass only in the direction indicated by the arrow as long as the digital input *e* stands at its defined 0-state.



17.10.8.5 Bidirectional transfer switch operated by the AND function of two digital inputs.

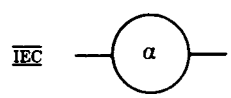


17.10.8.6 Two independent bidirectional switches (one make and one break), both operated by the same binary input.



17.10.9 Coefficient scaler

NOTE — 17.10.9A: The value of the coefficient may be shown adjacent to and outside the outline of the symbol.



20. Communications Equipment

Relocate:

20.3.2 *Relocate to* **24.2.1**

20.3.3 *Relocate to* **24.2.2**

21. Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts

21.1 Generating Station

NOTES:

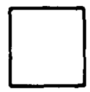
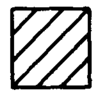
21.1A — Symbols for “planned” applications appear to the left; symbols for “in service” applications appear to the right.

21.1B — The preferred symbol is the square, but if necessary, a rectangle may be used.

21.1C — Relative sizes of symbols are shown. Symbol size may be reduced for small-size diagrams. See also paragraph A4.5 of the Introduction.

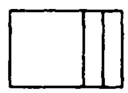
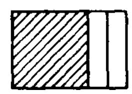
21.1.1 General

See NOTE 21.1A

 IEC IEC 

Add:

21.1.2 Combined electric and heat generating station

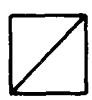
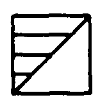
 IEC IEC 

Revise to read as follows:

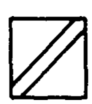
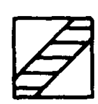
21.2 Hydroelectric Generating Station

See NOTE 21.1A

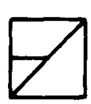
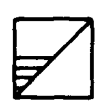
21.2.1 General

 IEC IEC 

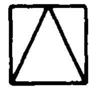
21.2.2 Run of river

21.2.3 With storage

21.2.4 With pumped storage

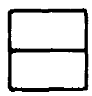
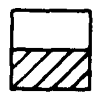
 

PLANNED IN SERVICE

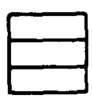
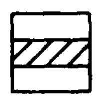
21.3 Thermoelectric Generating Station

See NOTE 21.1A

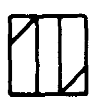
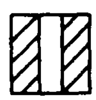
21.3.1 General

 IEC IEC 

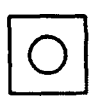
21.3.2 Coal or lignite fueled

21.3.3 Oil or gas fueled

21.3.4 Nuclear-energy fueled

 IEC IEC 

21.3.5 Geothermic

Add:

21.3.6 Solar generating station

Revise to read as follows:

21.4 Prime Mover (qualifying symbols)

Use if essential to show the type of prime mover in a generating station.

See NOTE 21.1A

21.4.1 Gas turbine

21.4.1.1 Application: shown for oil- or gas-fueled generating station

21.4.2 Reciprocating engine

PLANNED IN SERVICE

21.4.2.1 Application: shown for oil- or gas-fueled generation station

21.5 Substation

See NOTE 21.1A

21.5.1 General

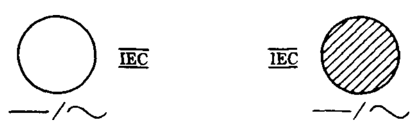
Avoid conflict with symbol 13.1.1 if used on the same diagram.

21.5.2 Rectifier substation

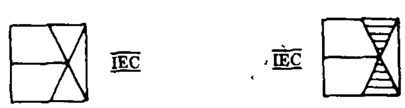
Use if essential to show type of equipment.

Add:

21.5.3 Converting substation, dc to ac shown



21.6 Wind Generating Station



21.7 Plasma Generating Station MHD (magneto-hydrodynamic)

PLANNED IN SERVICE

24. Telecommunications Switching and Peripheral Equipment

24.1 Switching Systems

The symbols in this section may be used to represent switching systems without regard to the type of equipment used as shown in the examples of trunking diagrams in the Appendix to this section.

The following terms are used in this section with the meaning as given below.

Connecting stage:

An arrangement of inlets and outlets so that only one switching point is used to connect one inlet to an outlet. A number of connections may exist at any time in one connecting stage.

Marking stage:

In a common-control system, that sequence of connecting stages that is controlled by one marking process. A marking stage may consist of one or more connecting stages.

Switching stage:

A sequence of connecting stages that jointly perform a specified switching function, for example preselection or route selection.

Highway-group:

The maximum number of circuits that have access to one highway.

24.1.1 Connecting stage

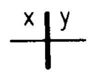
24.1.1.1

Connecting stage, shown with inlets and outlets, general symbol

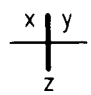
Circuits on one side can be connected individually to circuits on the other side

IEC 

24.1.1.2 Connecting stage with ***x*** inlets and ***y*** outlets

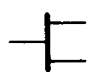
IEC 

24.1.1.3 Connecting stage composed of ***z*** grading groups, each consisting of ***x*** inlets and ***y*** outlets

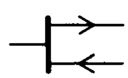
IEC 

24.1.1.4 Connecting stage with one group of inlets and two groups of outlets

NOTE — 24.1.1.4A: The number of inlets or outlets in each group may be indicated by a figure on the relevant line.

IEC 

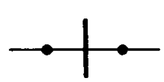
24.1.1.5 Connecting stage interconnecting one group of bothway trunks with two groups of unidirectional trunks of opposite sense

IEC 

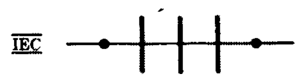
24.1.2 Marking stage

24.1.2.1 Marking stage consisting of only one connecting stage

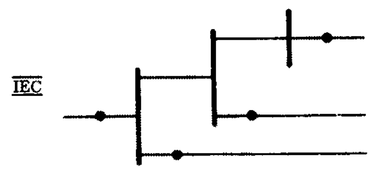
NOTE — 24.1.2.1A: The qualifying symbol indicating a marking stage is a dot. It should be added to the inlets of the first connecting stage and to the outlets of the last connecting stage of that marking stage.

IEC 

24.1.2.2 *EXAMPLES:* Marking stage consisting of three connecting stages



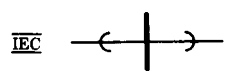
24.1.2.3 Mixed marking stage consisting of one, two, and three connecting stages



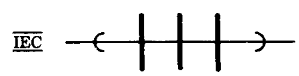
24.1.3 Switching stage

24.1.3.1 Switching stage consisting of one connecting stage

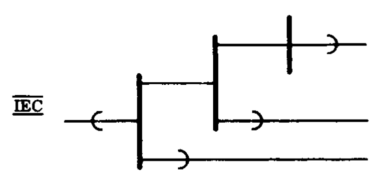
NOTE — 24.1.3.1A: The qualifying symbol indicating a switching stage is an arc. It should be added to the inlets of the first connecting stage and to the outlets of the last connecting stage of that switching stage.



24.1.3.2 *EXAMPLES:* Switching stage consisting of three connecting stages



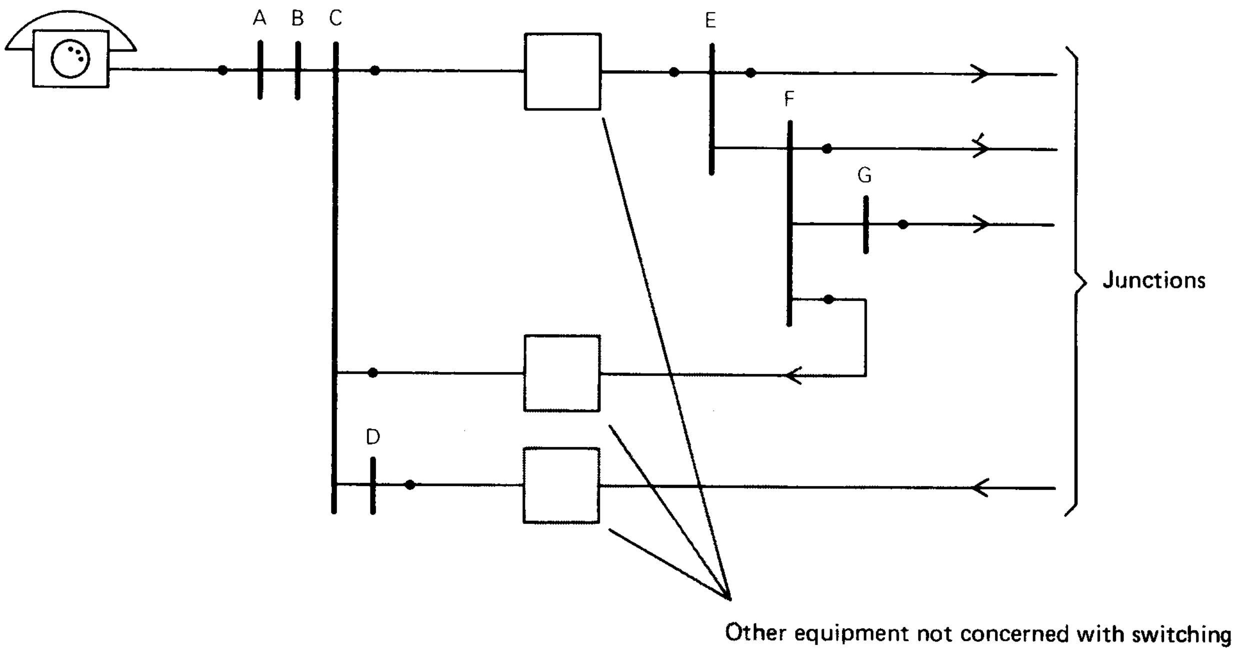
24.1.3.3 Mixed switching stage consisting of one, two, and three connecting stages



24.1.4 Examples of trunking diagrams

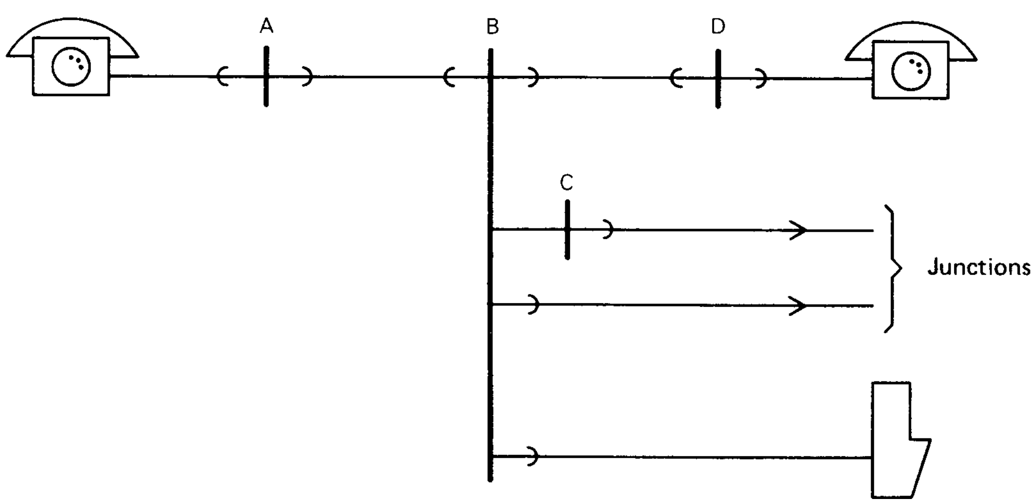
24.1.4.1 Trunking diagram for a switching system that consists of two marking stages, ABC or ABCD and E, EF or EFG, interconnected by other equipment represented by the squares. Calls are routed as follows:

1) Incoming calls by way of DCBA
2) Calls between subscribers connected to the same exchange by way of ABC, EF, and CBA
3) Outgoing calls by way of ABC and either E, EF, or EFG



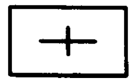
24.1.4.2 Trunking diagram of a switching system showing three switching stages

1) Preselection stage A
2) Route selection stage B or BC
3) Final selection stage D



24.2 Block Symbols for Switching Equipment

24.2.1 Automatic switching*

IEC 

*Relocated from 20.3.2

24.2.2 Manual switchboard*

IEC 

*Relocated from 20.3.3

24.3 Qualifying Symbols for Transducers, Recorders, and Reproducers

24.3.1 Magnetic type

IEC 

24.3.2 Moving coil or ribbon type

IEC

24.3.3 Moving iron type

IEC 

24.3.4 Stereo type

IEC 

24.3.5 Disc type

IEC 

24.3.6 Tape or film type

IEC 

24.3.7 Drum type

IEC 

24.3.8 Recording or reproducing (the arrow points in the direction of energy transfer)

IEC

24.3.9 Recording and reproducing

IEC

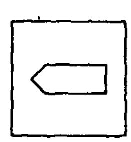
24.3.10 Erasing

IEC 

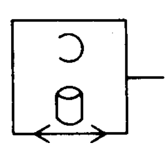
24.4 Recorders and Reproducers

24.4.1 Recorder or reproducer, or both, general symbol

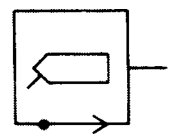
NOTE — 24.4.1A: The qualifying symbol depicting a transducer head may be replaced by other qualifying symbols.

IEC 

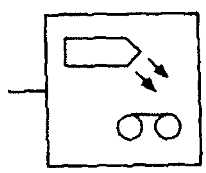
24.4.1.1 *EXAMPLE:* Recorder and reproducer, magnetic drum type

IEC 

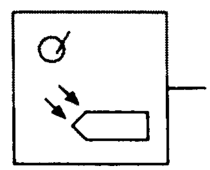
24.4.2 Reproducer with a stylus operated head

IEC


24.4.3 Recorder, film-type, with a head producing modulated light

IEC


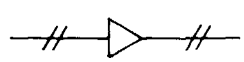
24.4.4 Reproducer, disc-type, with a light-operated head

IEC


25. Telecommunications Transmission

25.1 Amplified Circuits

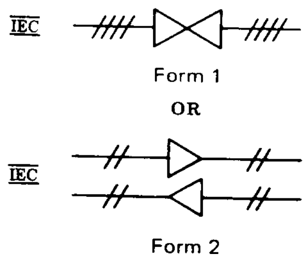
25.1.1 Two-wire line with unidirectional amplification

IEC


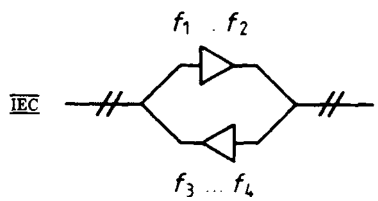
25.1.2 Two-wire line with both-way amplification

IEC

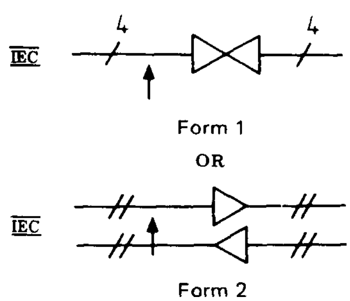

25.1.3 Four-wire circuit with both-way amplification



25.1.4 Four-wire type circuit with frequency separation

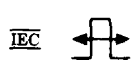


25.1.5 Four-wire circuit with both-way terminal amplification with echo suppression

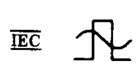


25.2 Qualifying Symbols for Pulse Modulation

25.2.1 Pulse-position or pulse-phase modulation



25.2.2 Pulse-frequency modulation



25.2.3 Pulse-amplitude modulation

IEC 

25.2.4 Pulse-interval modulation

IEC 

25.2.5 Pulse-duration modulation

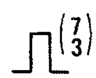
IEC 

25.2.6 Pulse-code modulation

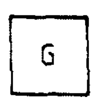
NOTE — 25.2.6A: The * must be replaced by details of the code.

IEC 

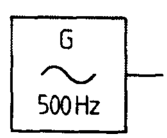
25.2.6.1 *EXAMPLE:* 3-out-of-7 code

IEC 

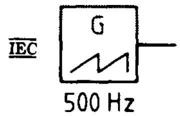
25.3 Signal Generator Waveform Generator

IEC 

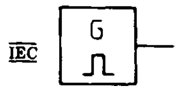
25.3.1 Sine-wave generator, 500 Hz

IEC 

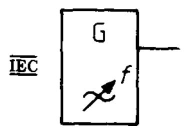
25.3.2 Sawtooth generator, 500 Hz



25.3.3 Pulse generator

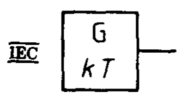


25.3.4 Variable frequency sine-wave generator

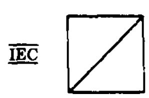


25.3.5 Noise generator

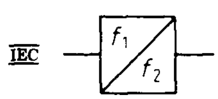
k = Boltzmann's constant
T = absolute temperature



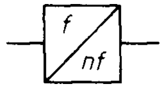
25.4 Changers
Converter, General Symbol



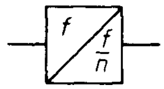
25.4.1 Frequency changer, changing from f_1 to f_2



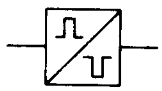
25.4.2 Frequency multiplier

IEC


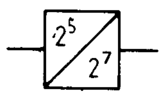
25.4.3 Frequency divider

IEC


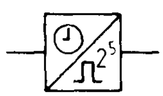
25.4.4 Pulse inverter

IEC


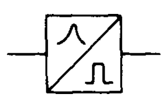
25.4.5 Code converter, five-unit binary code to seven-unit binary code

IEC


25.4.6 Changer giving clock-time indication in five-unit binary code

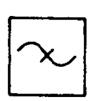
IEC


25.4.7 Pulse regenerator

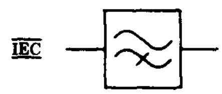
IEC


25.5 Filters

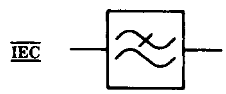
25.5.1 Filter, general symbol

IEC


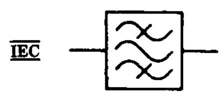
25.5.2 High-pass filter



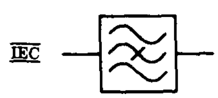
25.5.3 Low-pass filter



25.5.4 Band-pass filter

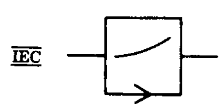


25.5.5 Band-stop filter

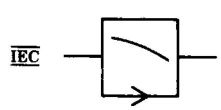


25.6 Networks

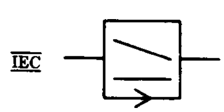
25.6.1 Device for pre-emphasis of higher frequencies



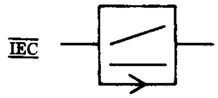
25.6.2 Device for de-emphasis of higher frequencies



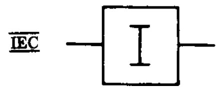
25.6.3 Compressor



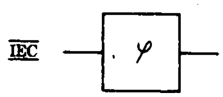
25.6.4 Expander



25.6.5 Artificial line



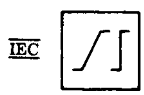
25.6.6 Phase-changing network



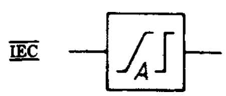
NOTE — φ may be replaced by *B* if no confusion arises

*Coordinate with symbol 15.17

25.6.7 Distortion corrector, general symbol

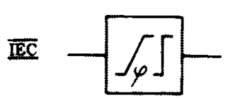


25.6.8 Amplitude/frequency distortion corrector, for example, equalizer

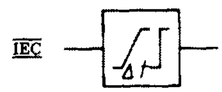


25.6.9 Phase/frequency distortion corrector

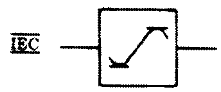
NOTE — 25.6.9A: If it is desirable to indicate that the equalization refers to the time derivative of φ, φ may be replaced by Φ.



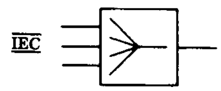
25.6.10 Delay/frequency distortion corrector



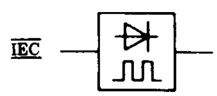
25.6.11 Nondistorting amplitude controller



25.6.12 Mixing network



25.7 Electronic Chopping Device

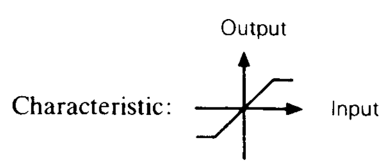


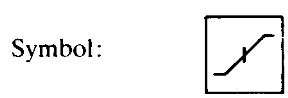
25.8 Threshold Devices

There are two ways of showing details of the operation carried out by a threshold device. The first is the use of the symbol 25.8.1 supplemented by appropriate waveform symbols on the input and output lines. The second is the use of a specific symbol consisting of a rectangle containing a figure derived from the input/output characteristic in the following manner:

The axes are deleted, but the origin is indicated by a short vertical stroke representing the y-axis

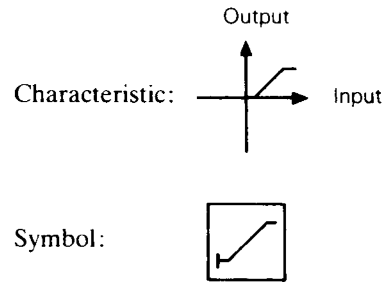
EXAMPLE:



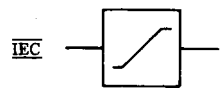


The origin may be located in the rectangle in such a position that the characteristic makes the maximum use of the available space

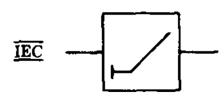
EXAMPLE:



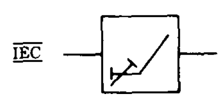
25.8.1 Threshold device, type unspecified (for example clipper)



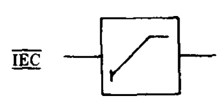
25.8.2 Device having a linear input/output characteristic for all signals that exceed a given threshold value and which has no output for input signals having an instantaneous amplitude between zero and that threshold



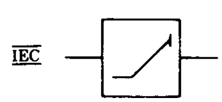
25.8.3 Device having a linear input/output characteristic for all signals that exceed a preset threshold value and that has no output for input signals having an instantaneous amplitude between zero and that threshold



25.8.4 Positive peak clipper



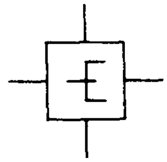
25.8.5 Negative peak clipper



25.9 Terminating Sets

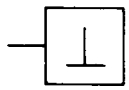
25.9.1 Terminating set

IEC



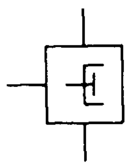
25.9.2 Balancing network

IEC



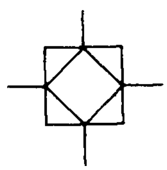
25.9.3 Terminating set with balancing network

IEC



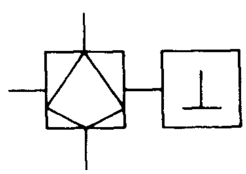
25.9.4 Hybrid transformer

IEC



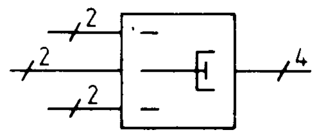
25.9.5 Asymmetric (skew) hybrid transformer, shown with balancing network

IEC



25.9.6 Equipment for connecting a four-wire circuit to either a two-wire circuit or a four-wire circuit depending upon the reception of a control signal

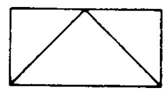
IEC



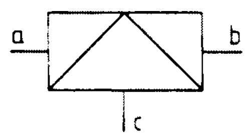
25.10 Modulator Demodulator Discriminator

25.10.1 General symbol

IEC



NOTE — 25.10.1A: This symbol is used as follows: (Letters and input and output lines have been added in the figure for the purpose of explanation.)

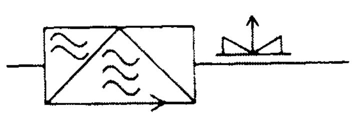


a and b represent the modulating or modulated signal input and the modulated or demodulated signal output
c represents the input of the carrier-wave if required

Qualifying symbols may be placed inside or outside the symbol as shown below

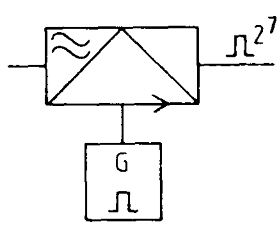
25.10.1.1 Modulator, double side-band output

IEC

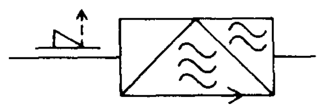


25.10.1.2 Pulse code modulator (seven-unit binary code output)

IEC



25.10.2 Demodulator, single side-band with suppressed carrier to audio

IEC 

25.11 Concentrators Multiplexers

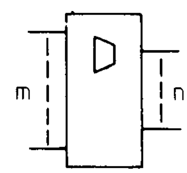
25.11.1 Concentrating switching function from left to right, qualifying symbol

IEC 

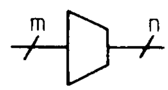
25.11.2 Expanding switching function from left to right, qualifying symbol

IEC 

25.11.3 *EXAMPLES:* Concentrator with m input circuits and n output circuits

IEC 

Form 1



IEC

Form 2

25.11.4 Multiplexing function, qualifying symbol

IEC MUX

25.11.5 Demultiplexing function, qualifying symbol

NOTE — 25.11.5A: If confusion can arise, DX may be replaced by DMUX.

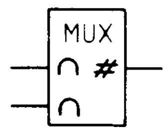
IEC DX

25.11.6 Multiplexing and demultiplexing function, qualifying symbol

IEC MULDEX

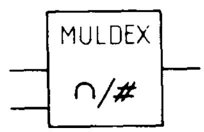
25.11.7 Multiplexer with analog/digital conversion

IEC



25.11.8 Multiplexer/demultiplexer with analog/digital conversion

IEC



25.12 Frequency Spectrum Diagram Symbol Elements

A frequency spectrum is represented on a diagram by means of symbols on a horizontal frequency axis. The symbols show the functions of the various frequencies and frequency bands used in the transmission system as well as their relative positions in the spectrum.

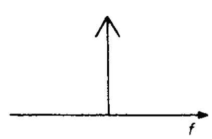
25.12.1 Carrier frequency

NOTES:

25.12.1A — When this symbol is used to represent a carrier that is modulated in frequency or phase the *f* or φ is added. See, for example, symbol 25.13.2.

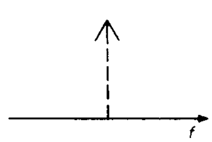
25.12.1B — The arrowhead on the vertical line representing the carrier (and the arrowhead on the frequency axis) may be omitted if no confusion will result.

IEC

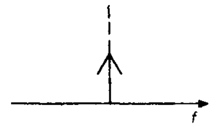


25.12.1.1 Suppressed-carrier frequency

IEC

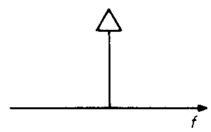


25.12.1.2 Reduced-carrier frequency

IEC


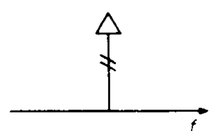
25.12.2 Pilot frequency

NOTE — 25.12.2A: For FDM transmission systems the order of the group to which the pilot refers, that is, group, supergroup, mastergroup, or supermastergroup may be indicated by adding the respective number 1, 2, 3, or 4 of oblique strokes.

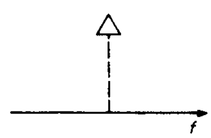
IEC


EXAMPLE: Supergroup pilot frequency

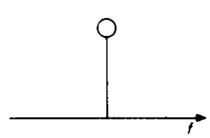
25.12.2.1

IEC


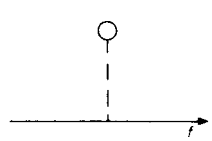
25.12.2.2 Suppressed pilot frequency

IEC


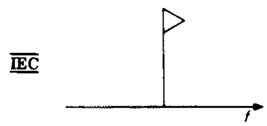
25.12.3 Additional measuring frequency

IEC


25.12.3.1 Additional measuring frequency, transmitted or measured on request

IEC


25.12.4 Signaling frequency

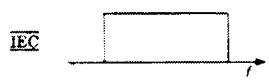


25.12.5 Frequency band

NOTES:

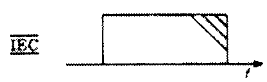
25.12.5A — If it is desired to show whether a particular band of frequencies is erect or inverted, symbol 25.12.6 or 25.12.7 should be used.

25.12.5B — The order of a band of frequencies forming part of a transmission system may be indicated by adding oblique strokes according to NOTE 25.12.2A of symbol 25.12.2.

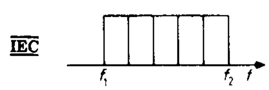


24.12.5.1 *EXAMPLE:* Mastergroup

NOTE — 25.12.5.1A: The division of a band into channels, groups, etc, may be shown by adding vertical lines.



25.12.5.2 *EXAMPLE:* Band of frequencies from f_1 to f_2 divided into five channels, groups, etc.



25.12.6 Erect band of frequencies

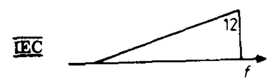
NOTES:

25.12.6A — There is no indication of how much of the bandwidth shown by the symbol is actually used.

25.12.6B — This symbol may be used to represent a single channel, group, etc, or a number of channels, groups, etc, providing they are all erect.

25.12.6.1 *EXAMPLE:* Band of frequencies consisting of a group of 12 erect channels

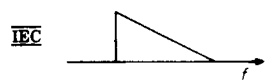
25.12.6.2



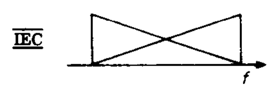
Simplified form

25.12.7 Inverted band of frequencies

NOTE — 25.12.6A and 25.12.6B apply.

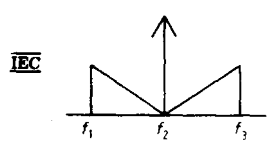


25.12.8 Band of mixed channels, groups, etc, some erect, remainder inverted



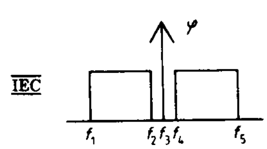
25.13 Examples of Frequency Spectrum Diagrams

25.13.1 Amplitude-modulated carrier with both sidebands



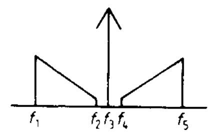
25.13.2 Phase modulated carrier with both sidebands

NOTE — 25.13.2A: For frequency modulation, replace φ with *f*.



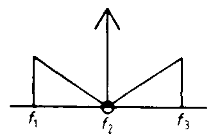
25.13.3 Amplitude-modulated carrier with both sidebands, lower modulating frequencies not being transmitted

IEC



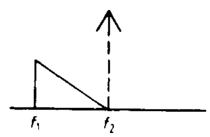
25.13.4 Amplitude-modulated carrier with both sidebands, modulating frequencies down to zero being transmitted

IEC



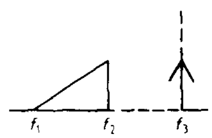
25.13.5 Single-sideband suppressed carrier

IEC



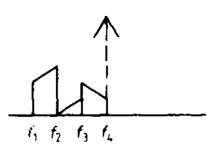
25.13.6 Reduced-carrier with single, lower, erect sideband

IEC



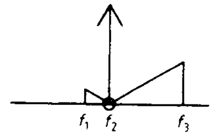
25.13.7 Suppressed-carrier with single-sideband scrambled for secrecy

IEC



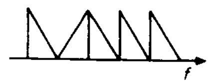
25.13.8 Amplitude-modulated carrier with upper sideband and lower vestigial sideband, modulating frequencies down to zero being transmitted

IEC



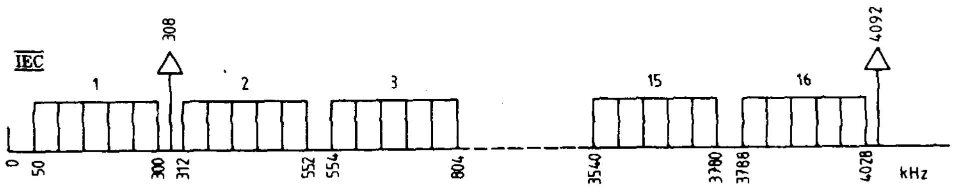
25.13.9 Band of five channels, groups, etc, four of which are inverted and one erect

IEC



25.13.10 4 MHz transmission system showing supergroups and pilot frequencies

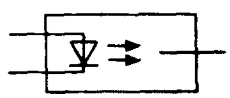
IEC



25.14 Fiber Optic Devices

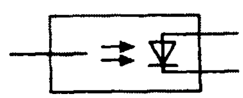
25.14.1 Guided light transmitter

IEC



25.14.2 Guided light receiver

IEC



ANSI/IEEE Std 315A-1986
24 December, 1986
(Supplement to ANSI Y32.2-1975,
ANSI/IEEE Std 315-1975)

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