

ANSI Y32.2-1975
CSA Z99-1975
IEEE Std 315-1975

Adopted by the
**DEPARTMENT
OF DEFENSE**
United States of America

see inside front cover
for acceptance notice

American National Standard
Canadian Standard
IEEE Standard

**Graphic Symbols for
Electrical and Electronics
Diagrams**

(Including Reference Designation
Class Designation Letters)

Published by
The Institute of Electrical and Electronics Engineers
345 East 47th Street, New York, NY 10017, USA

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)

Document No. (a) IEEE Std 315-1975
(b) ANSI Y32.2-1975

Date of Specific Issue Adopted: (a) 4 September, 1975
(b) 31 October, 1975

Releasing Industry Group: (a) The Institute of Electrical and
Electronics Engineers, Inc.
(b) American National Standards Institute, Inc.

Supersedes: IEEE Std 315-1971
(ANSI Y32.2-1970)

Custodians:
Army - EL
Navy - SH
Air Force - 16

Military Coordinating Activity:
Army - EL

Review Activities:
Army - AV, MI, MU
Navy AS, OS, SH, YD

User Activities:
Army - ME
Navy - EC, MC

Project Number: DRPR-0176

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 reaffirmation, amendment, revision, or cancellation of this standard is proposed which will effect or violate the international agreement concerned, the Military Coordinating Activity will take appropriate reconciliation action through military international standardization channels including departmental standardization offices, if required.

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 formally 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.

**ANSI Y32.2-1975
CSA Z99-1975
IEEE Std 315-1975**

**Revision of
ANSI Y32.2-1972
CSA Z99-1972
IEEE Std 315-1971**

**American National Standard
Canadian Standard
IEEE 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**

**Approved October 31, 1975
American National Standards Institute**

**Approved October 9, 1975
Canadian Standards Association**

**Approved September 4, 1975
Institute of Electrical and Electronics Engineers**

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

Approved September 4, 1975

IEEE Standards Board

Joseph L. Koepfinger, *Chairman*

Warren H. Cook, *Vice Chairman*

Sava I. Sherr, *Secretary*

Jean Jacques Archambault
Robert D. Briskman
Dale R. Cochran
Louis Costrell
Frank Davidoff
Jay Forster
Irvin N. Howell, Jr

Stuart P. Jackson
Irving Kolodny
William R. Kruesi
Benjamin J. Leon
Anthony C. Lordi
Donald T. Michael
Voss A. Moore
William S. Morgan

William J. Neiswender
Gustave Shapiro
Ralph M. Showers
Robert A. Soderman
Leonard Thomas
Charles L. Wagner
William T. Wintringham

The individual symbols contained in this standard may be copied, reproduced, or employed in any fashion without permission of the IEEE. Any statement that the symbols used are in conformance with this standard shall be on the user's own responsibility.

© Copyright 1975 by the Institute of Electrical and Electronics Engineers, Inc. No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

September 1988 Printing

Foreword

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

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

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

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

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

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

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

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

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

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

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

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

Charles A. Fricke, *Chairman*

Conrad R. Muller, *Vice Chairman, Electrical and Electronics*

James L. Fisher, Jr., *Vice Chairman, Pictographic Symbols*

James R. Couper, *Vice Chairman, Chemical and Process*

George Platt, *Vice Chairman, Mechanical*

Alvin Lai, *Secretary*

<i>Organization Represented</i>	<i>Name of Representative</i>
Acoustical Society of America	Laurence Batchelder Harry F. Olson
American Chemical Society	Robert F. Schuerer
American Gear Manufacturers Association	Gerald L. Scott
American Institute of Chemical Engineers	James R. Couper
American Institute for Design and Drafting	Francis Saint
American Institute of Industrial Engineers	Irving Goldstein
American Institute of Mining, Metallurgical and Petroleum Engineers	<i>Vacant</i>
American Society of Agricultural Engineers	James A. Basselman
American Society of Civil Engineers	<i>Vacant</i>
American Society for Engineering Education	I. L. Hill R. T. Northrup
American Society of Heating, Refrigerating and Air Conditioning Engineers	N. LaCourte C. W. MacPhee (<i>Alt</i>)
American Society of Mechanical Engineers	R. W. Cockrell A. R. Machell, Jr. O. J. Maha H. E. Walchli
American Society of Sanitary Engineering	James C. Church
American Welding Society	A. P. Arndt Frank Speight (<i>Alt</i>)
Association of American Railroads	M. F. McCorcle P. H. Foley
Association for Computing Machinery	Patrick G. Skelly Arthur C. Gannet (<i>Alt</i>)
Canadian Standards Association	A. Hendry
Illuminating Engineering Society	L. E. Barbrow John E. Kaufman (<i>Alt</i>)
Individual Member	Charles A. Fricke
Institute of Electrical and Electronics Engineers	G. A. Knapp Sidney V. Soanes Steven A. Wassermann
Instrument Society of America	George Platt Louis Costea (<i>Alt</i>)
Mechanical Contractors Association of America	J. R. Mance
National Association of Plumbing, Heating, Cooling Contractors	R. E. White
National Electrical Contractors Association	William H. Paules
National Electrical Manufacturers Association	Walter F. Huette F. V. Kupchak R. F. Franciose (<i>Alt</i>) Roland Russo (<i>Alt</i>) Mrs. R. L. Mancini (<i>Alt</i>)
National Fluid Power Association	James L. Fisher, Jr.
Society of Automotive Engineers	H. L. Dubocq
Technical Drawing Associates	W. D. Zbinder
Telephone Group	H. A. Spielman R. E. Thierner (<i>Alt</i>)
US Department of the Army, Ordnance	C. A. Nazian
US Department of Commerce, National Bureau of Standards	Gustave Shapiro
US Department of Commerce, Patent Office	D. M. Mills
US Department of the Interior	Ray Freeman
US Department of the Navy	<i>Vacant</i>
Western Union Telegraph Company	<i>Vacant</i>

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

C. A. Fricke*, *Chairman*
S. A. Wassermann, *Secretary*

S. J. Balke
L. Batchelder
L. E. Barbrow
V. W. Bennett
H. L. Cook
D. Drusdow
S. K. Ghandi

W. Grasson
C. J. Hart
A. Hendry, *Canadian Liaison*
G. A. Knapp
R. Legg*
L. A. Meadows†
C. R. Muller*

C. A. Nazian
R. V. Rice
E. F. V. Robinson†, *Canadian Liaison*
J. W. Siefert
R. M. Stern*
J. Zeno

The IEEE Standards Coordinating Committee on Letter and Graphic Symbols, SCC 11, had the following membership:

C. A. Fricke, *Chairman*
C. R. Muller, *Secretary*

R. B. Augus, Jr.
F. K. Becker
J. C. Brown
J. M. Carroll
H. L. Cook
E. T. B. Gross

G. A. Knapp
L. A. Meadows†
R. V. Rice
G. Shapiro
J. W. Siefert

S. V. Soanes
R. M. Stern
L. H. Warren
S. A. Wassermann
J. C. White

The IEEE Subcommittee on Graphic Symbols, SCC 11.1, and the IEC Experts Subcommittee, SCC 11.6, had the following membership:

C. A. Fricke, *Chairman SCC 11.1*
C. A. Fricke, *Chairman pro tem, SCC 11.6*

V. W. Bennett
I. M. Berger (*SCC 11.1*)
T. L. Bisbee
V. Condello
H. L. Cook
D. Drusdow
A. C. Gannett
G. A. Knapp
E. J. Lombardi (*SCC 11.6*)

R. Legg
J. Lusti (*SCC 11.6*)
L. A. Meadows†
C. R. Muller
G. Panula (*SCC 11.6*)
R. V. Rice (*SCC 11.1*)
A. I. Rubin (*SCC 11.1*)
F. A. Saint
G. Shapiro

J. W. Siefert (*SCC 11.1*)
H. Seaman
P. G. Skelly (*SCC 11.6*)
S. V. Soanes (*SCC 11.1*)
R. M. Stern
S. A. Wassermann
R. Rondinelli (*Alt*)
W. W. Varnedoe (*SCC 11.6*)
J. Zeno (*SCC 11.1*)

* Member of Y32.2 Editorial Committee.

† Retired.

Contents

SECTION	PAGE	SECTION	PAGE
Quick Reference to Symbols	11	Section 4 Graphic Symbols for Contacts, Switches, Contactors, and Relays	
Introduction	19	4.1 Switching Function	36
Section 1 Qualifying Symbols		4.2 Electrical Contact	36
1.1 Adjustability		4.3 Basic Contact Assemblies	36
Variability	23	4.4 Magnetic Blowout Coil	37
1.2 Special-Property Indicators	23	4.5 Operating Coil	
1.3 Radiation Indicators (electromagnetic and particulate)	23	Relay Coil	37
1.4 Physical-State Recognition Symbols	23	4.6 Switch	37
1.5 Test-Point Recognition Symbol	24	4.7 Pushbutton, Momentary or Spring-Return	38
1.6 Polarity Markings	24	4.8 Two-Circuit, Maintained or Not Spring- Return	38
1.7 Direction of Flow of Power, Signal, or Information	24	4.9 Nonlocking Switch, Momentary or Spring-Return	38
1.8 Kind of Current	25	4.10 Locking Switch	38
1.9 Connection Symbols	25	4.11 Combination Locking and Nonlocking Switch	38
1.10 Envelope		4.12 Key-Type Switch	
Enclosure	25	Lever Switch	38
1.11 Shield		4.13 Selector or Multiposition Switch	38
Shielding	26	4.14 Limit Switch	
1.12 Special Connector or Cable Indicator	26	Sensitive Switch	39
1.13 Electret	26	4.15 Safety Interlock	39
Section 2 Graphic Symbols for Fundamental Items (not included in other sections)		4.16 Switches with Time-Delay Feature	40
2.1 Resistor	27	4.17 Flow-Actuated Switch	40
2.2 Capacitor	28	4.18 Liquid-Level-Actuated Switch	40
2.3 Antenna	29	4.19 Pressure- or Vacuum-Actuated Switch	40
2.4 Attenuator	30	4.20 Temperature-Actuated Switch	40
2.5 Battery	30	4.21 Thermostat	40
2.6 Delay Function		4.22 Flasher	
Delay Line		Self-Interrupting Switch	40
Slow-Wave Structure	30	4.23 Foot-Operated Switch	
2.7 Oscillator		Foot Switch	41
Generalized Alternating-Current Source	31	4.24 Switch Operated by Shaft Rotation and Responsive to Speed or Direction	41
2.8 Permanent Magnet	31	4.25 Switches with Specific Features	41
2.9 Pickup		4.26 Telegraph Key	41
Head	31	4.27 Governor	
2.10 Piezoelectric Crystal Unit	31	Speed Regulator	41
2.11 Transducer		4.28 Vibrator, Interrupter	41
Accelerometer		4.29 Contactor	41
Motional Pickup Transducer	31	4.30 Relay	42
2.12 Squib, Electric	31	4.31 Inertia Switch	42
2.13 Thermocouple	31	4.32 Mercury Switch	42
2.14 Thermal Element		4.33 Aneroid Capsule (air pressure) Operated Switch	43
Thermomechanical Transducer	31	Section 5 Graphic Symbols for Terminals and Connectors	
2.15 Spark Gap		5.1 Terminals	44
Igniter Gap	31	5.2 Cable Termination	44
2.16 Continuous Loop Fire Detector	31	5.3 Connector	
2.17 Igniter Plug	31	Disconnecting Device	
Section 3 Graphic Symbols for Transmission Path		Jack	
3.1 Transmission Path		Plug	44
Conductor		5.4 Connectors of the Type Commonly Used for Power-Supply Purposes	45
Cable		5.5 Test Block	45
Wiring	32	5.6 Coaxial Connector	
3.2 Distribution Lines		Coaxial Junction	45
Transmission Lines	33	5.7 Waveguide Flanges	
3.3 Alternative or Conditional Wiring	34	Waveguide Junction	45
3.4 Associated or Future	34	Section 6 Graphic Symbols for Transformers, Inductors, and Windings	
3.5 Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications	34	6.1 Core	47
3.6 Waveguide	34	6.2 Inductor	
3.7 Strip-Type Transmission Line	34	Winding	
3.8 Termination	34	Reactor	
3.9 Circuit Return	34	Radio-Frequency Coil	
3.10 Pressure Tight Bulkhead Cable Gland Cable Sealing End	35	Telephone Retardation Coil	47

SECTION	PAGE
6.3 Transductor	
Saturable-Core Inductor	
Saturable-Core Reactor	47
6.4 Transformer	
Telephone Induction Coil	
Telephone Repeating Coil	48
6.5 Linear Coupler	50

Section 7 Graphic Symbols for Electron Tubes and Related Devices

7.1 Electron Tube	51
7.2 General Notes	51
7.3 Typical Applications	52
7.4 Solion	
Ion-Diffusion Device	53
7.5 Coulomb Accumulator	
Electrochemical Step-Function Device ...	53
7.6 Conductivity Cell	53
7.7 Nuclear-Radiation Detector	
Ionization Chamber	
Proportional Counter Tube	
Geiger-Müller County Tube	53

Section 8 Graphic Symbols for Semiconductor Devices

8.1 Semiconductor Device	
Transistor	
Diode	54
8.2 Element Symbols	54
8.3 Special-Property Indicators	55
8.4 Rules for Drawing Style 1 Symbols	55
8.5 Typical Applications, Two-Terminal	
Devices	55
8.6 Typical Applications, Three- (or more)	
Terminal Devices	57
8.7 Photosensitive Cell	58
8.8 Semiconductor Thermocouple	58
8.9 Hall Element	
Hall Generator	58
8.10 Photon-Coupled Isolator	59
8.11 Solid-State Thyatron	59

Section 9 Graphic Symbols for Circuit Protectors

9.1 Fuse	60
9.2 Current Limiter	60
9.3 Lightning Arrester	
Arrester (electric surge)	
Gap	60
9.4 Circuit Breaker	60
9.5 Protective Relay	61

Section 10 Graphic Symbols for Acoustic Devices

10.1 Audible-Signaling Device	62
10.2 Microphone	
Telephone Transmitter	62
10.3 Handset	
Operator's Set	62
10.4 Telephone Receiver	
Earphone	
Hearing-Aid Receiver	62

Section 11 Graphic Symbols for Lamps and Visual-Signaling Devices

11.1 Lamp	63
11.2 Visual-Signaling Device	63

SECTION PAGE

Section 12 Graphic Symbols for Readout Devices

12.1 Meter	
Instrument	64
12.2 Electromagnetically Operated Counter	
Message Register	64

Section 13 Graphic Symbols for Rotating Machinery

13.1 Rotating Machine	65
13.2 Field, Generator or Motor	65
13.3 Winding Connection Symbols	65
13.4 Applications: Direct-Current Machines ...	65
13.5 Applications: Alternating-Current	
Machines	66
13.6 Applications: Alternating-Current	
Machines with Direct-Current Field	
Excitation	67
13.7 Applications: Alternating- and Direct-	
Current Composite	67
13.8 Synchro	68

Section 14 Graphic Symbols for Mechanical Functions

14.1 Mechanical Connection	
Mechanical Interlock	69
14.2 Mechanical Motion	69
14.3 Clutch	
Brake	69
14.4 Manual Control	69

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

15.1 Discontinuity	70
15.2 Coupling	70
15.3 Directional Coupler	71
15.4 Hybrid	
Directionally Selective Transmission	
Devices	71
15.5 Mode Transducer	71
15.6 Mode Suppressor	71
15.7 Rotary Joint	71
15.8 Nonreciprocal Devices	71
15.9 Resonator	
Tuned Cavity	72
15.10 Resonator (Cavity-Type) Tube	72
15.11 Magnetron	72
15.12 Velocity-Modulation (Velocity-	
Variation) Tube	72
15.13 Transmit-Receive (TR) Tube	72
15.14 Traveling-Wave-Tube	72
15.15 Balun	73
15.16 Filter	73
15.17 Phase Shifter	73
15.18 Ferrite Bead Ring	73
15.19 Line Stretcher	73

Section 16 Graphic Symbols for Composite Assemblies

16.1 Circuit Assembly	
Circuit Subassembly	
Circuit Element	74
16.2 Amplifier	74
16.3 Rectifier	74
16.4 Repeater	75
16.5 Network	
Artificial Line (other than delay line) ...	75

SECTION	PAGE	SECTION	PAGE
16.6 Phase Shifter		21.3 Thermoelectric Generating Station	80
Phase Changing Network	75	21.4 Prime Mover	80
16.7 Chopper	75	21.5 Substation	80
16.8 Diode-Type Ring Demodulator			
Diode-Type Ring Modulator	75	Section 22 Class Designation Letter	
16.9 Gyro		22.1 Class Designation Letter	81
Gyroscope		22.2 Special Considerations for Class	
Gyrocompass	75	Designation Letter Assignment	81
16.10 Position Indicator	75	22.3 Item Names	81
16.11 Position Transmitter	75	22.4 Class Designation Letters (alphabetical	
16.12 Fire Extinguisher Actuator Heads	75	list)	81
Section 17 Graphic Symbols for		22.5 Item Names (alphabetical list)	83
Analog Functions		22.6 Item Designations, IEC 113-2	83
17.1 Operational Amplifier	76		
17.2 Summing Amplifier	76	Section 23 Referenced Standards	84
17.3 Integrator (Amplifier)	76		
17.4 Electronic Multiplier	76	Section 100 Canadian Standard Z99	
17.5 Electronic Divider	76	Modifications to American National	
17.6 Electronic Function Generator	76	Standard Y32.2-1975	84
17.7 Generalized Integrator	76		
17.8 Positional Servomechanism	76	Appendix A Cross Reference List of	
17.9 Function Potentiometer	76	Changed Item Numbers	85
Section 18 Graphic Symbols for			
Digital Logic Functions		Appendix B Reference Data—IEC Publica-	
18.1 Digital Logic Functions	76	tion 117 Recommended Graphical	
Section 19 Graphic Symbols for Special-		Symbols	85
Purpose Maintenance Diagrams			
19.0 Introduction	77	Appendix C Revised or Deleted Symbols	
19.1 Data-Flow Code Signals	77	(ANSI Y32.2-1970)	86
19.2 Functional Circuits	77		
Section 20 Graphic Symbols Commonly		Appendix D Revised or Deleted Symbols	
Used on System Diagrams, Maps, and		(USAS Y32.2-1967)	87
Charts (Communications Equipment)			
20.1 Radio Station	78	Appendix E Revised or Deleted Symbols	
20.2 Space Station	78	(USAS Y32.2-1962 & Supplement	
20.3 Exchange Equipment	78	USAS Y32.2a-1964 or MIL-STD-15-	
20.4 Telegraph Repeater	78	1A)	92
20.5 Telegraph Equipment	79		
20.6 Telephone Set	79	Appendix F Cross-Reference List of Class	
Section 21 Graphic Symbols Commonly		Designation Letters. IEC 113-2 vs. ANSI	
Used on System Diagrams, Maps, and		Y32.2	94
Charts (Generating Stations and			
Substations)		Index follows page	97
21.1 Generating Station	80		
21.2 Hydroelectric Generating Station	80		

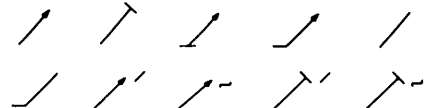
Contents Arranged by Subject

SUBJECT	SECTION	SUBJECT	SECTION
Acoustic devices	10	Mechanical functions	14
Analog computers	17	Meters	12
Antennas	2	Microwave devices	15
Assemblies, composite	16	Motors	13
Attenuators	2	Path, transmission	3
Basic items	2	Permanent magnets	2
Batteries	2	Pickups	2
Block symbols for charts	20	Piezoelectric crystals	2
Block symbols for maps	20	Plugs	5
Capacitors	2	Primary detectors	2
Circuit breakers	9	Protectors, circuit	9
Circuit protectors	9	Qualifiers	1, 8, 20
Circuit returns	3	Readout devices	12
Class designation letters	22	Reference designations	22
Coils	4, 6	Reference standards	23
Composite assemblies	16	Relays	4
Computers, analog	17	Resistors	2
Computers, digital	18	Rotating machinery	13
Connectors	5	Semiconductor devices	8
Contacts	4	SHF circuit devices	15
Contactors	4	Signaling devices, audible	10
Data flow code signals	19	Signaling devices, visual	11
Delay lines	2	Spark gaps	2
Digital computer logic	18	Special-property indicators	1, 8
Diodes	8	Squibs, electric	2
Distribution lines	3	Switches	4
Electron tubes	7	Synchros	13
Functional symbols	19	System diagrams	20
Fundamental items	2	Terminals	5
Fuses	9	Thermal elements	2
Generating stations	21	Thermocouples	2
Generators	13	Transformers	6
Grounds	3	Transistors	8
High-frequency devices	15	Transmission path	3
Indicators, special-property	1, 8	Tubes, electron	7
Inductors	6	UHF circuit devices	15
Instruments	12	Visual-signaling devices	11
Jacks	5	VHF circuit devices	15
Lamps	11	Waveguides	3
Logic diagrams	18	Windings	6, 13

Quick Reference to Symbols

1. Qualifying Symbols

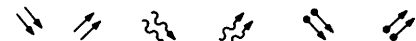
1.1 Adjustability Variability



1.2 Special-Property Indicators



1.3 Radiation Indicators



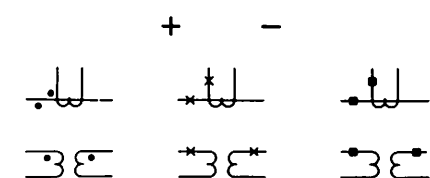
1.4 Physical State Recognition Symbols



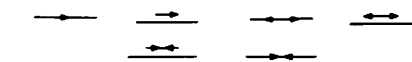
1.5 Test-Point Recognition Symbol



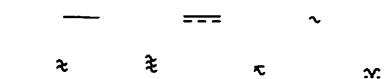
1.6 Polarity Markings



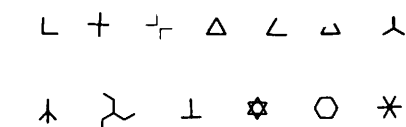
1.7 Direction of Flow of Power, Signal, or Information



1.8 Kind of Current



1.9 Connection Symbols



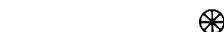
1.10 Envelope Enclosure



1.11 Shield Shielding



1.12 Special Connector or Cable Indicator



1.13 Electret

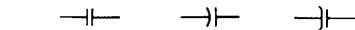


2. Fundamental Items

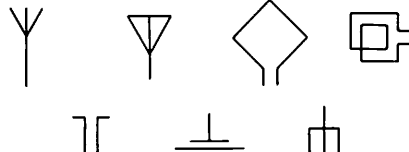
2.1 Resistor



2.2 Capacitor



2.3 Antenna



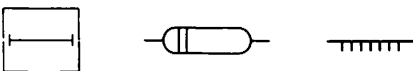
2.4 Attenuator



2.5 Battery



2.6 Delay Function Delay Line Slow-Wave Structure



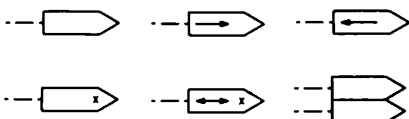
2.7 Oscillator Generalized Alternating-Current Source



2.8 Permanent Magnet



2.9 Pickup Head



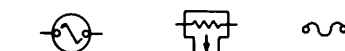
2.10 Piezoelectric Crystal Unit



2.11 Primary Detector Measuring Transducer



2.12 Squib, Electrical



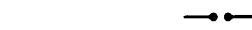
2.13 Thermocouple



2.14 Thermal Element Thermomechanical Transducer



2.15 Spark gap Igniter gap



2.16 Continuous Loop Fire Detector (temperature sensor)

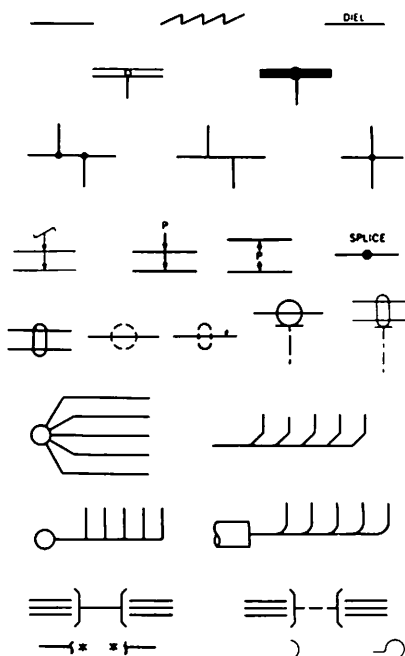


2.17 Ignitor Plug

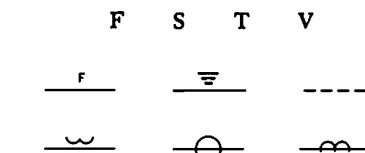


3. Transmission Path

3.1 Transmission Path Conductor Cable Wiring



3.2 Distribution lines Transmission lines



3.3 Alternative or Conditioned Wiring



3.4 Associated or Future

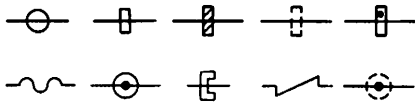


3.5 Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications

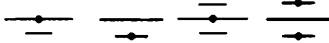


Quick Reference to Symbols

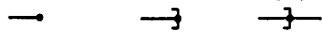
3.6 Waveguide



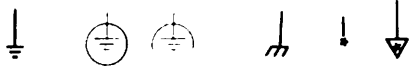
3.7 Strip-Type Transmission Line



3.8 Termination



3.9 Circuit Return



3.10 Pressure-Tight Bulkhead Cable Gland Cable Sealing End

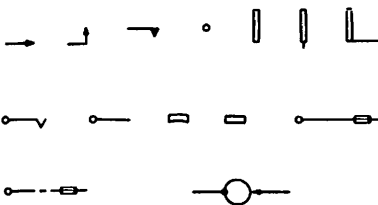


4. Contacts, Switches, Contactors, and Relays

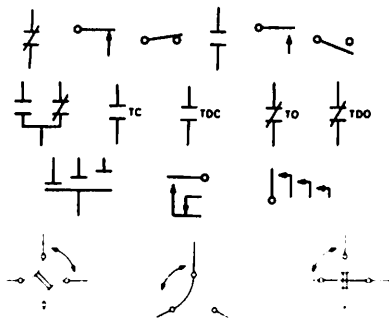
4.1 Switching Function



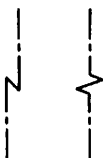
4.2 Electrical Contact



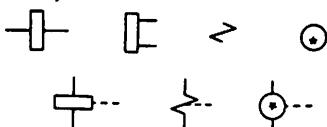
4.3 Basic Contact Assemblies



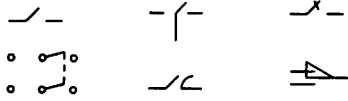
4.4 Magnetic Blowout Coil



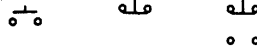
4.5 Operating Coil Relay Coil



4.6 Switch



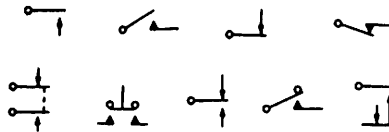
4.7 Pushbutton, Momentary or Spring-Return



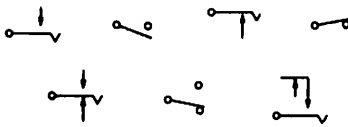
4.8 Two-Circuit, Maintained or Not Spring-Return



4.9 Nonlocking Switch, Momentary or Spring-Return



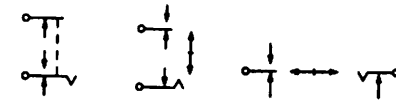
4.10 Locking Switch



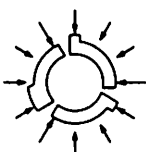
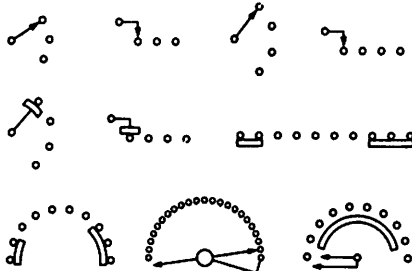
4.11 Combination Locking and Non-locking Switch



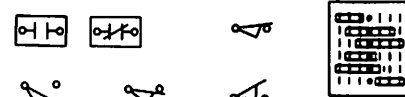
4.12 Key-Type Switch Lever Switch



4.13 Selector or Multiposition Switch



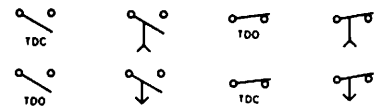
4.14 Limit Switch Sensitive Switch



4.15 Safety Interlock



4.16 Switches with Time-Delay Feature



4.17 Flow-Actuated Switch



4.18 Liquid-Level-Actuated Switch



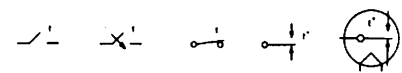
4.19 Pressure- or Vacuum-Actuated Switch



4.20 Temperature-Actuated Switch



4.21 Thermostat



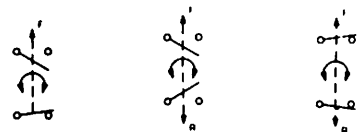
4.22 Flasher Self-interrupting switch



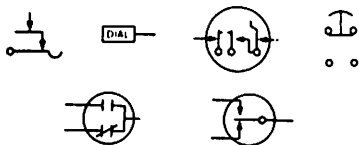
4.23 Foot-Operated Switch Foot Switch



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



4.25 Switches with Specific Features



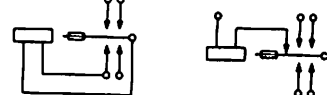
4.26 Telegraph Key



4.27 Governor Speed Regulator

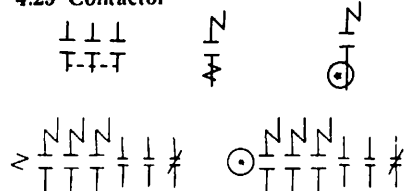


4.28 Vibrator Interrupter

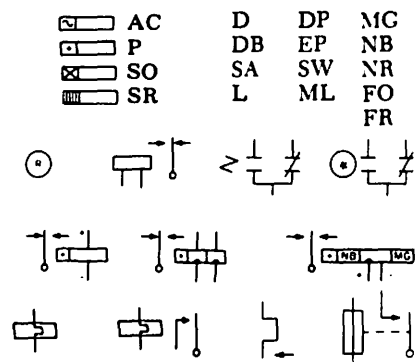


Quick Reference to Symbols

4.29 Contactor



4.30 Relay



4.31 Inertia Switch



4.32 Mercury Switch

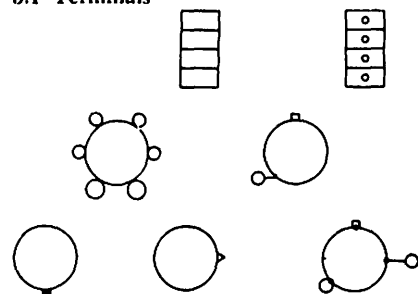


4.33 Aneroid Capsule



5. Terminals and Connectors

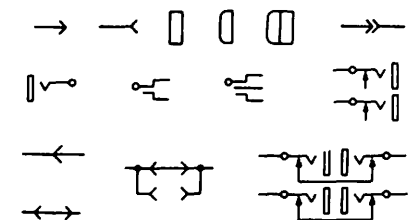
5.1 Terminals



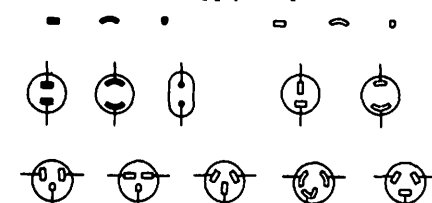
5.2 Cable Termination



5.3 Connector
Disconnecting Device



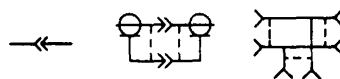
5.4 Connectors of the Type Commonly
Used for Power-Supply Purposes



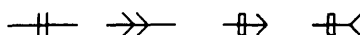
5.5 Test Blocks



5.6 Coaxial Connector



5.7 Waveguide Flanges
Waveguide junction



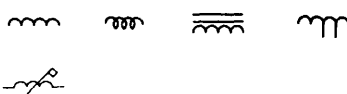
6. Transformers, Inductors, and Windings

6.1 Core



6.2 Inductor
Winding
Reactor

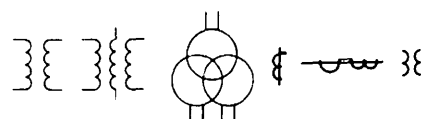
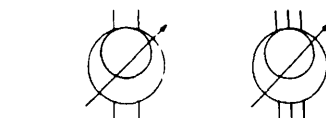
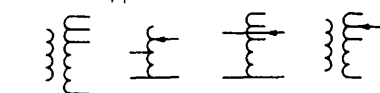
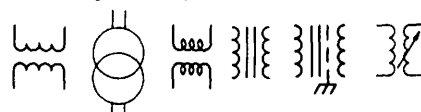
Radio frequency coil
Telephone retardation coil



6.3 Transductor



6.4 Transformer
Telephone induction coil
Telephone repeating coil

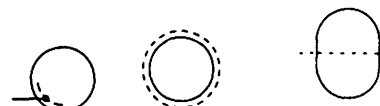
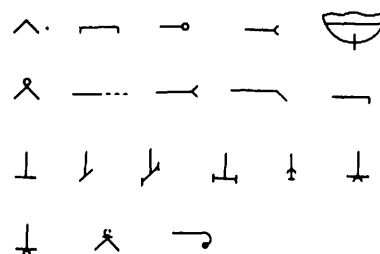


6.5 Linear Coupler



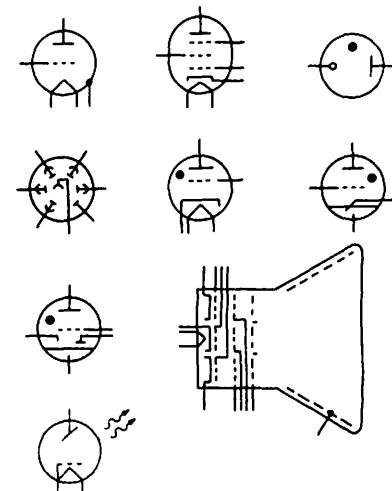
7. Electron Tubes and Related Devices

7.1 Electron Tube



7.2 General Notes

7.3 Typical Applications



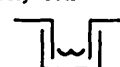
7.4 Solion
Ion-Diffusion Device



7.5 Coulomb Accumulator
Electrochemical Step-
Function Device



7.6 Conductivity cell



Quick Reference to Symbols

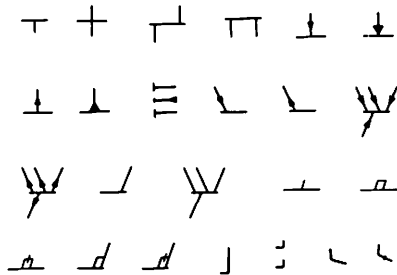
7.7 Nuclear-Radiation Detector Ionization Chamber Proportional Counter Tube Geiger-Müller Counter Tube



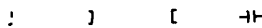
8. Semiconductor Devices

8.1 Semiconductor Device Transistor Diode

8.2 Element Symbols

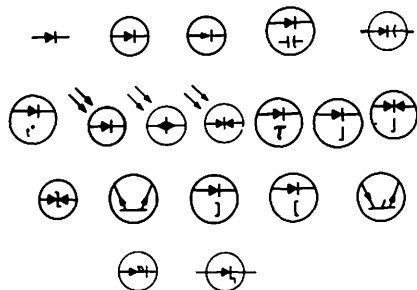


8.3 Special Property Indicators

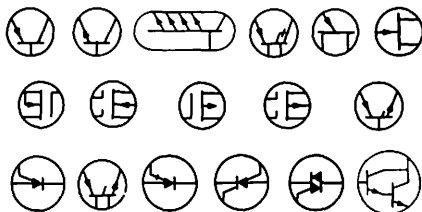


8.4 Rules for Drawing Style 1 Symbols

8.5 Typical Applications: Two-Terminal Devices



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



8.7 Photosensitive Cell



8.8 Semiconductor Thermocouple



8.9 Hall Element Hall Generator



8.10 Photon-coupled isolator

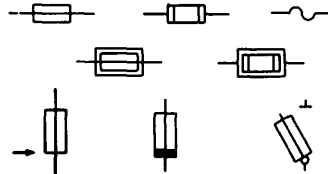


8.11 Solid-state-thyatron



9. Circuit Protectors

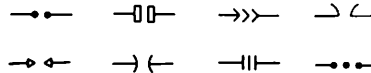
9.1 Fuse



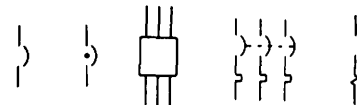
9.2 Current Arrester



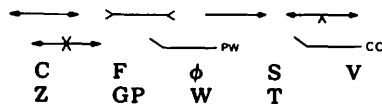
9.3 Lightning Arrester Arrester Gap



9.4 Circuit Breaker

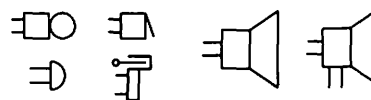


9.5 Protective Relay



10. Acoustic Devices

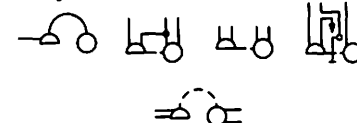
10.1 Audible-Signaling Device



10.2 Microphone



10.3 Handset Operator's Set

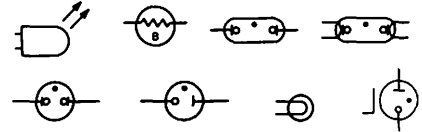


10.4 Telephone Receiver Earphone Hearing-Aid Receivers

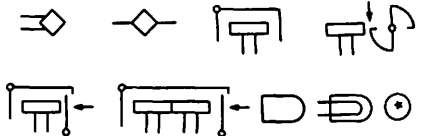


11. Lamps and Visual-Signaling Devices

11.1 Lamp



11.2 Visual-Signaling Device



12. Readout Devices

12.1 Meter Instrument

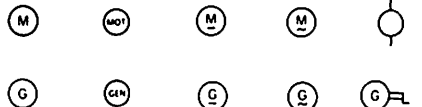
A	DB	I	OP	RF	VA
AH	DBM	INT	OSCG	SY	VAR
C	DM	μ A	PH	TLM	VARH
CMA	DTR	UA	PI	t°	VI
CMC	F	MA	PF	THC	VU
CMV	G	NM	RD	TT	W
CRO	GD	OHM	REC	V	WH

12.2 Electromagnetically Operated Counter Message Register



13. Rotating Machinery

13.1 Rotating Machine



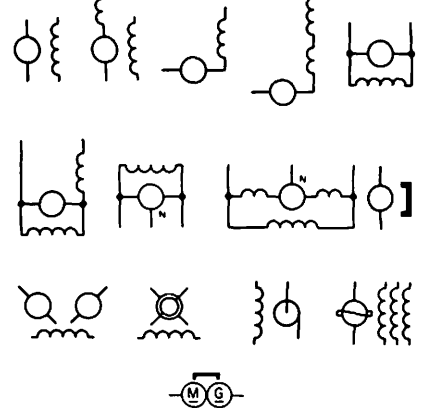
13.2 Field, Generator or Motor



13.3 Winding Connection Symbols

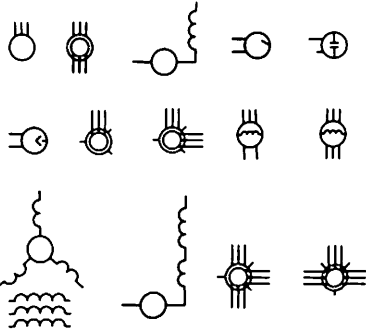


13.4 Applications: Direct-Current Machines

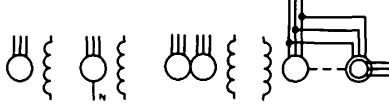


Quick Reference to Symbols

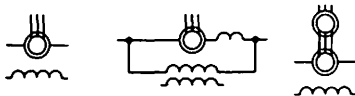
13.5 Applications: Alternating-Current Machines



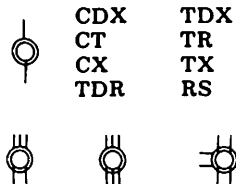
13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation



13.7 Applications: Alternating- and Direct-Current Composite

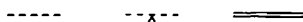


13.8 Synchro

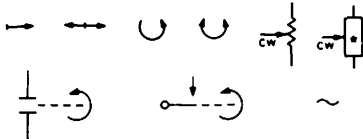


14. Mechanical Functions

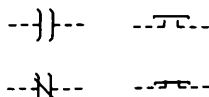
14.1 Mechanical Connection Mechanical Interlock



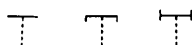
14.2 Mechanical Motion



14.3 Clutch Brake

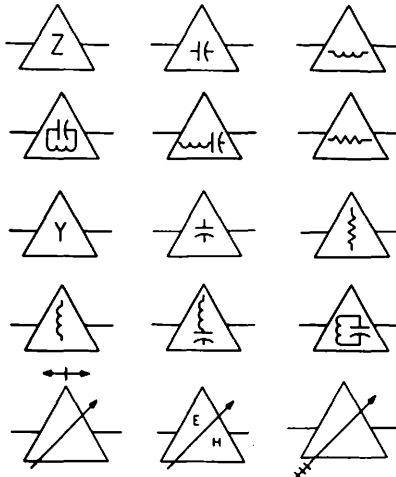


14.4 Manual Control

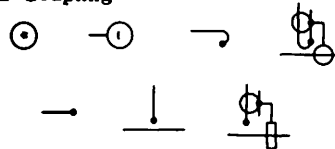


15. Commonly Used in Connection with VHF, UHF, SHF Circuits

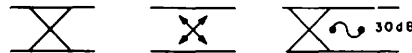
15.1 Discontinuity



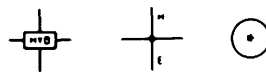
15.2 Coupling



15.3 Directional Coupler



15.4 Hybrid Directionally Selective Transmission Devices



15.5 Mode Transducer



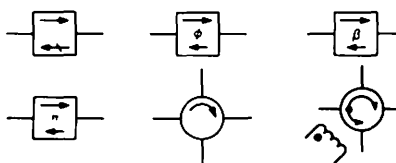
15.6 Mode Suppression



15.7 Rotary Joint



15.8 Non-reciprocal devices



15.9 Resonator Tuned Cavity



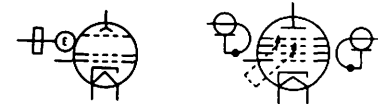
15.10 Resonator (Cavity Type) Tube



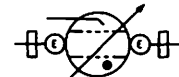
15.11 Magnetron



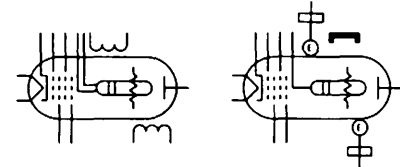
15.12 Velocity-Modulation (Velocity-Variation) Tube



15.13 Transmit-Receive (TR) Tube



15.14 Traveling-Wave-Tube



15.15 Balun



15.16 Filter



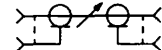
15.17 Phase shifter



15.18 Ferrite bead rings



15.19 Line stretcher



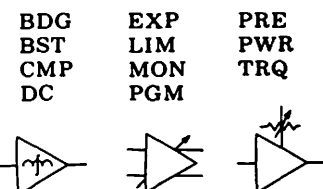
16. Composite Assemblies

16.1 Circuit assembly Circuit subassembly Circuit element



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

16.2 Amplifier

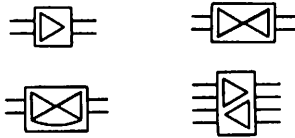


Quick Reference to Symbols

16.3 Rectifier



16.4 Repeater



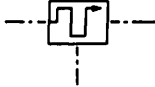
16.5 Network



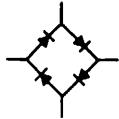
16.6 Phase Shifter Phase-Changing Network



16.7 Chopper



16.8 Diode-type ring demodulator Diode-type ring modulator



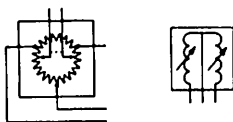
16.9 Gyro Gyroscope Gyrocompass



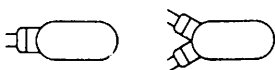
16.10 Position Indicator



16.11 Position Transmitter



16.12 Fire Extinguisher Actuator Head

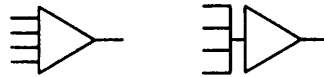


17. Analog Functions

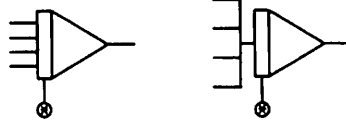
17.1 Operational Amplifier



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

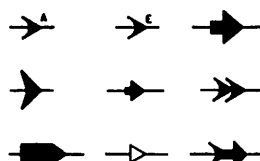


18. Digital Logic Functions

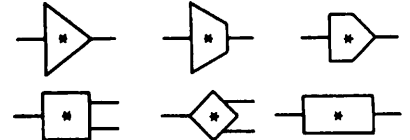
18.1 Digital Logic Functions (See cross references)

19. Special Purpose Maintenance Diagrams

19.1 Data flow code signals

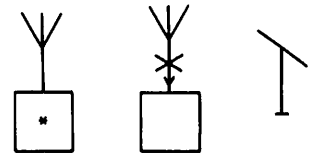


19.2 Functional Circuits

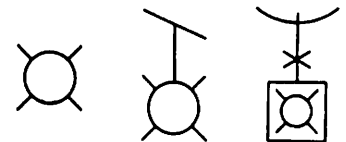


20. System Diagrams, Maps and Charts

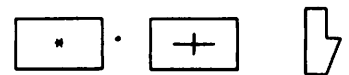
20.1 Radio station



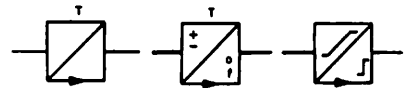
20.2 Space station



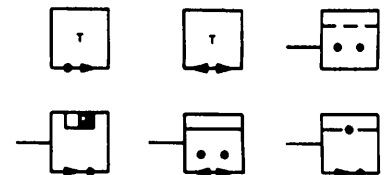
20.3 Exchange equipment



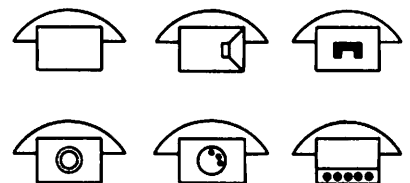
20.4 Telegraph repeater



20.5 Telegraph equipment



20.6 Telephone set



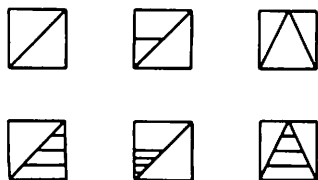
21. System Diagrams, Maps and Charts

21.1 Generating station

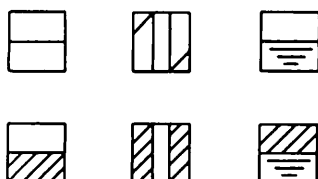


Quick Reference to Symbols

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	

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 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. \square 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.

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.

A2.3 IEC Identification. Symbols and buildups using symbols that have been recommended by the International Electrotechnical Commission are indicated by $\overline{\text{IEC}}$.

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 $\overline{\text{IEC}}$ 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 \rightarrow or open \rightarrow unless otherwise noted in this standard.

A4.7 Terminal Symbols. The standard symbol for a TERMINAL (o) may be added to each point of attachment of connecting lines to any one of the graphic symbols. Such added terminal symbols should not be considered as part of the individual graphic symbol, unless the terminal symbol is included in the symbol shown in this standard.

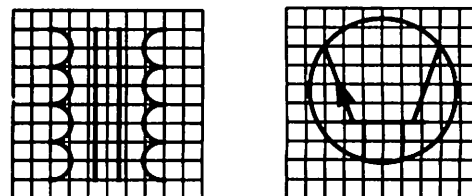
A4.8 Correlation of Symbol Parts. For simplification of a diagram, parts of a symbol for a device, such as a relay or contactor, may be separated. If this is done, provide suitable designations to show proper correlation of the parts.

A4.9 Angle of Connecting Lines. In general, the angle at which a connecting line is brought to a graphic symbol has no particular significance unless otherwise noted or shown in this standard.

A4.10 Future or Associated Paths and Equipment. Associated or future paths and equipment shall be shown by lines composed of short dashes:---. For example:



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.



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.
- (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

Qualifying Symbols

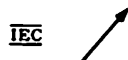
1.1 Adjustability
Variability

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

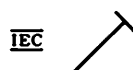
Use only if essential to indicate special property.

1.1.1 Adjustability (extrinsic adjustability)

1.1.1.1 General



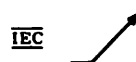
1.1.1.2 Preset, general



1.1.1.3 Linear (shown applied to 1.1.1.1)

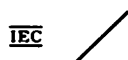


1.1.1.4 Nonlinear (shown applied to 1.1.1.1)

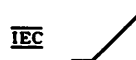


1.1.2 Inherent variability (intrinsic variability)

1.1.2.1 Linear

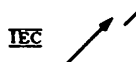


1.1.2.2 Nonlinear

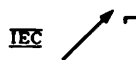


1.1.3 Special features (shown applied to the general adjustability symbol)

1.1.3.1 Continuous



1.1.3.2 In steps

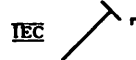


1.1.4 Special features (shown applied to the general preset symbol)

1.1.4.1 Continuous



1.1.4.2 In steps

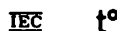


1.2 Special-Property Indicators

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

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

1.2.1 Temperature dependence



1.2.2 Magnetic-field dependence



1.2.3 Storage (Greek letter tau)

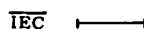


1.2.4 Saturable properties (general)

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



1.2.5 Delay



1.3 Radiation Indicators (electromagnetic and particulate)

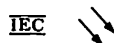
Use only if essential to indicate special property.

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

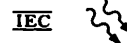
NOTE 1.3B: Arrows pointing away from a symbol denote the emission of the indicated type of radiation by the device symbolized.

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

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



1.3.2 Radiation, ionizing



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

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



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



See Note 1.4A

1.4.3 Solid



See Note 1.4A

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.

1.4.4 Showing two or more states

Use only if essential to indicate special condition.

NOTE 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.

NOTE 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 1.4.4A 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



OR

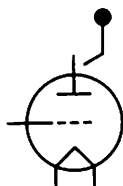


Avoid conflict with symbol 1.4.1 or 1.6.3 if used on the same diagram

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.

NOTE 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.

NOTE 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:



INCORRECT

Avoid conflict with symbol 1.4.1 or 1.5.1 if used on the same diagram



OR



OR



CORRECT



OR



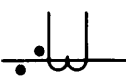
OR



1.6.3.1 Application: instantaneous polarity markings with current transformer shown

See Note 1.6.3B

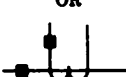
IEC



OR



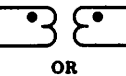
OR



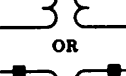
1.6.3.2 Application: instantaneous polarity markings with potential transformer shown

See Note 1.6.3B

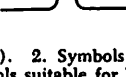
IEC



OR



OR



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.

IEC →

OR

IEC →

See Note 1.7.1A

1.7.2 Either way (but not simultaneously)

IEC ↔

OR

IEC ↔

See Note 1.7.1A

1.7.3 Both ways, simultaneously

IEC ↔

OR

IEC ↔

See Note 1.7.1A

Avoid conflict with symbol 9.2 if used on the same diagram

1.7.4 Application: one-way, general

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

n →

OR

→ n

OR

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.

→

OR

→

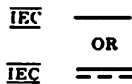
See Note 1.7.5A

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.

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



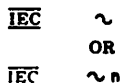
1.8.3 Alternating current, frequency ranges

Use only if necessary to distinguish among different frequency bands.

NOTE 1.8.3A: The "n" is not part of the symbol. The frequency range shall be substituted for "n."

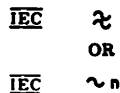
NOTE 1.8.3B: Only one name for the unit of frequency (hertz or cycle per second) should be used on any one diagram.

1.8.3.1 Power frequencies



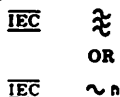
See Notes 1.8.3.A and B

1.8.3.2 Audio frequencies



See Notes 1.8.3.A and B

1.8.3.3 Superaudio, carrier, and radio frequencies



See Notes 1.8.3.A and B

1.8.4 Direct or alternating current (universal)



1.8.5 Undulating or rectified current



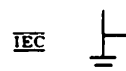
1.9 Connection Symbol

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



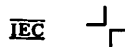
1.9.1.1 2-phase 3-wire, grounded



1.9.2 2-phase 4-wire



OR



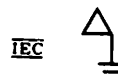
1.9.2.1 2-phase 5-wire, grounded



1.9.3 3-phase 3-wire, delta or mesh



1.9.3.1 3-phase 3-wire, delta, grounded



1.9.4 3-phase 4-wire, delta, ungrounded



1.9.4.1 3-phase 4-wire, delta, grounded



1.9.5 3-phase, open-delta



1.9.5.1 3-phase, open-delta, grounded at common point



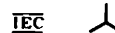
1.9.5.2 3-phase, open-delta, grounded at middle point of one winding



1.9.6 3-phase, broken-delta

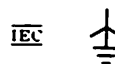


1.9.7 3-phase, wye or star, ungrounded

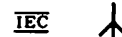


1.9.7.1 3-phase, wye, grounded neutral

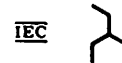
The direction of the stroke representing the neutral can be chosen arbitrarily.



1.9.8 3-phase 4-wire, ungrounded



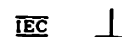
1.9.9 3-phase, zigzag, ungrounded



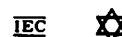
1.9.9.1 3-phase, zigzag, grounded



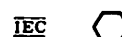
1.9.10 3-phase, Scott or T



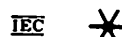
1.9.11 6-phase, double-delta



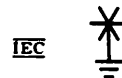
1.9.12 6-phase, hexagonal (or chordal)



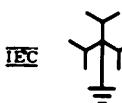
1.9.13 6-phase, star (or diametrical)



1.9.13.1 6-phase, star, with grounded neutral



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



1.10 Envelope Enclosure

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

See paragraph A4.11.1 of the Introduction

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

1.10.1 General

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

NOTE 1.12A: If it is essential to denote on a system-type interconnection wiring dia-

gram that the connector or cable is furnished with the equipment by the equipment manufacturer the following symbol shall be used.

NOTE 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.

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



OR



*See Note 2.1A

2.1.2 Tapped resistor



OR



*See Note 2.1A

2.1.3 Application: with adjustable contact. See also symbol 14.2.5



OR



*See Note 2.1A

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



OR



*See Note 2.1A

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



OR



*See Note 2.1A

2.1.5 Nonlinear resistor (intrinsic)



OR

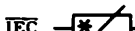


*See Note 2.1A

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



OR



*See Note 2.1A



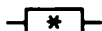
2.1.7 Magnetoresistor (intrinsic) (linear type shown)



2.1.8 Heating resistor



OR



*See Note 2.1A

2.1.9 Instrument or relay shunt

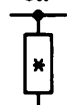
Connect instrument or relay to terminals in the rectangle



2.1.10 Shunt resistor



OR



*See Note 2.1A

2.1.11 Resistive termination

Commonly used in coaxial and waveguide diagrams.



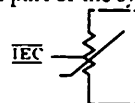
2.1.11.1 Application: series resistor and path open



2.1.11.2 Application: series resistor and path short-circuited



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



2.1.12 Thermistor; thermal resistor \square ; temperature-sensing element

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

2.1.12.1 General



2.1.12.1.1 Linear



See Note 2.1.12A

2.1.12.1.2 Nonlinear



See Note 2.1.12A

2.1.12.1.3 Positive temperature coefficient



See Note 2.1.12A

2.1.12.1.4 Negative temperature coefficient



See Note 2.1.12A

2.1.12.2 With independent integral heater



2.1.12.2.1 Nonlinear



See Note 2.1.12A

2.1.13 Symmetrical photoconductive transducer (resistive)



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.

2.2 Capacitor

NOTE 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.


NOTE 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.

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

2.2.1 General

Style 1  IEC

OR

Style 2  IEC

2.2.1.1 With identified electrode

NOTE 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


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

(a) The outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors;

(b) The moving element in adjustable and variable capacitors;

(c) The low-potential element in feed-through capacitors. IEC

See General Symbols 2.2.1 and Note 2.2B

Style 1  IEC


OR

Style 2  IEC


See Note 2.2.1.1B

2.2.2 Polarized capacitor

See General Symbols 2.2.1 and Note 2.2B

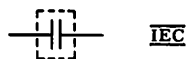
Style 1  IEC

OR

Style 2  IEC

2.2.3 Shielded capacitor

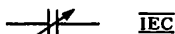
See General Symbols 2.2.1 and Note 2.2B



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.

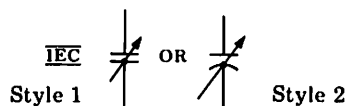
See General Symbols 2.2.1 and Note 2.2B



2.2.4.1 With moving element indicated

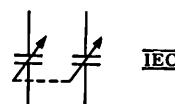
NOTE 2.2.4.1A: If it is desired to indicate the moving element, the common intersection of the moving element with the symbol for variability and the connecting line is marked with a dot. IEC

See General Symbols 2.2.1 and Note 2.2B



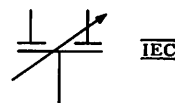
2.2.5 Application: adjustable or variable capacitors with mechanical linkage of units

See General Symbols 2.2.1 and Note 2.2B



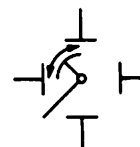
2.2.6 Continuously adjustable or variable differential capacitor

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



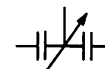
2.2.7 Phase-shifter capacitor

See General Symbols 2.2.1 and Note 2.2B



2.2.8 Split-stator capacitor

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

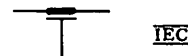


2.2.9 Feed-through capacitor

Commonly used for bypassing high-frequency currents to chassis.

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

See General Symbols 2.2.1 and Note 2.2B



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

See General Symbols 2.2.1 and Note 2.2B

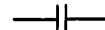


2.2.10 Capacitive termination

Commonly used on coaxial and waveguide diagrams.

2.2.10.1 Application: series capacitor and path open

See General Symbols 2.2.1 and Note 2.2B

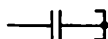


NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

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

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

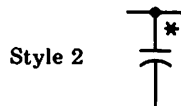


Style 2

2.2.12 Coupling capacitor (for power-line carrier)

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

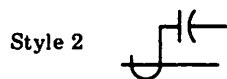
COM	Carrier communication
LC	Carrier load control
REL	Carrier relaying
SUP	Carrier supervisory
TLM	Carrier telemetering
TT	Carrier transferred trip



Style 2

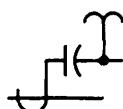
*See Note 2.2.12

2.2.13 Capacitor bushing for circuit breaker or transformer



Style 2

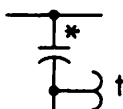
2.2.14 Application: capacitor-bushing potential device



Style 2

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

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



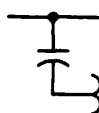
IEC

Style 2

*See Note 2.2.12A

†See Note 2.2.15A

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



IEC

Style 2

†See Note 2.2.15

2.3 Antenna

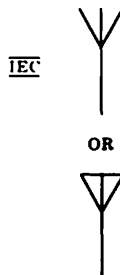
2.3.1 General

Types or 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.

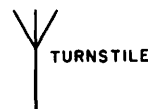


IEC

OR



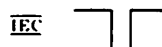
2.3.1.1 Application: turnstile antenna



TURNSTILE

IEC

2.3.2 Dipole

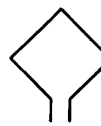


IEC

2.3.3 Loop



IEC

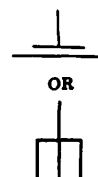


OR



2.3.4 Antenna counterpoise

IEC



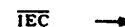
OR



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



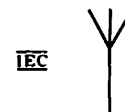
IEC

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

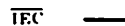
2.3.6 Qualifying symbols to indicate direction of radiation

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

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

NOTE 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

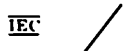


IEC

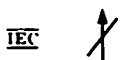
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

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

2.3.6.3 Fixed in elevation



2.3.6.4 Adjustable in elevation



2.3.6.5 Fixed in azimuth and elevation



2.3.6.6 Direction finder, radio goniometer or beacon

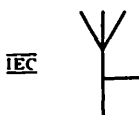


2.3.6.7 Rotation

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

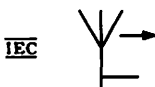
2.3.7.1 Antenna with direction of radiation fixed in azimuth



2.3.7.2 Antenna with direction of radiation adjustable in azimuth



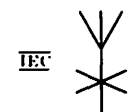
2.3.7.3 Antenna with direction of radiation fixed in azimuth, horizontal polarization



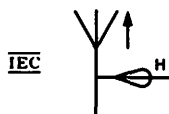
2.3.7.4 Antenna with adjustable directivity in elevation



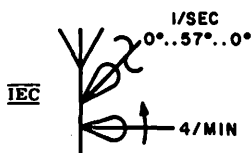
2.3.7.5 Direction finding, radio goniometer, or radio beacon antenna



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 \square ; pad (general)



2.4.2 Balanced, general



2.4.3 Unbalanced, general



2.4.4 Variable attenuator \square (general)



2.4.5 Balanced, general

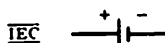


2.4.6 Unbalanced, general



2.5 Battery

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



2.5.1 Generalized direct-current source



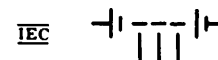
2.5.2 One cell



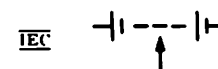
2.5.3 Multicell



2.5.4 Multicell battery with 3 taps



2.5.5 Multicell battery with adjustable tap

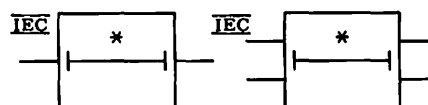


2.6 Delay Function Delay Line \square Slow-Wave Structure

2.6.1 Delay element, general

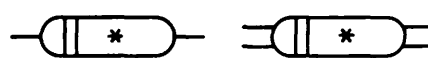
NOTE 2.6.1A: Length of delay may be indicated. Asterisk is not part of symbol.

NOTE 2.6.1B: The two vertical lines indicate input side.



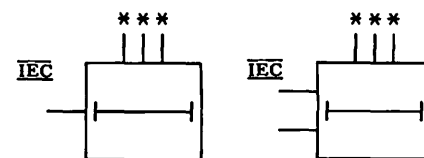
OR

OR



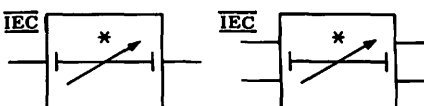
*See Note 2.6.1A

2.6.2 Tapped delay element



*See Note 2.6.1A and general symbols 2.6.1

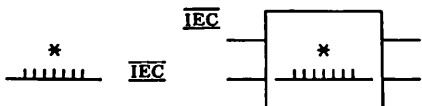
2.6.3 Variable delay element



*See Note 2.6.1A and general symbols 2.6.1

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.

2.6.4 Slow-wave structure

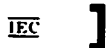


*See Note 2.6.1 A

2.7 Oscillator
Generalized Alternating-Current
Source

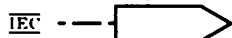


2.8 Permanent Magnet [F]

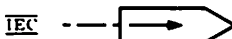


2.9 Pickup
Head

2.9.1† General



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



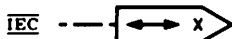
2.9.3† Reading; playback; head, sound-
reproducer [F]



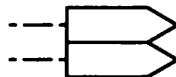
2.9.4† Erasing; magnetic eraser [F]



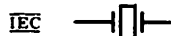
2.9.5† Application: writing, reading,
and erasing



2.9.6† Stereo



2.10 Piezoelectric Crystal Unit (includ-
ing Crystal Unit, Quartz [F])



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



2.12 Squib, Electric [F]

2.12.1 Explosive



2.12.2 Igniter



2.12.3 Sensing link; fusible link, am-
bient-temperature operated

Avoid conflict with symbol 3.6.4 if used on the same diagram



2.13 Thermocouple (dissimilar-metals
device)

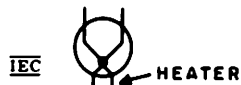
2.13.1 Temperature-measuring



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



See Note 2.13.2A

2.13.2.2 With integral insulated heater

See paragraph A4.11 of the introduction



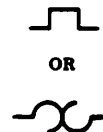
See Note 2.13.2A

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.



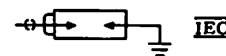
2.15 Spark Gap
Igniter Gap

USE SYMBOL 9.3.1

2.16 Continuous Loop Fire Detector
(temperature sensor)



2.17 Ignitor Plug



Cross References

Semiconductor Thermocouple
(item 8.8)

Graphic Symbols for
Transmission Path3.1 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

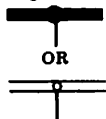
When required, details of structure (e.g., elbow), type, impedance, ratings, etc., may be added adjacent to or within any symbol or in a note. IEC

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

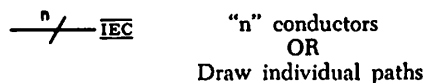


3.1.2.2 Three conductors or conductive paths



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".



See Note 3.1.2.3A

3.1.3 Air or space path

See also symbol 3.2.6



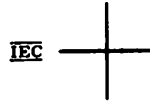
3.1.4 Dielectric path other than air

Commonly used for coaxial and waveguide transmission.

IEC 

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

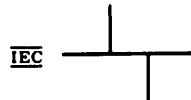
3.1.6.1 Junction (if desired)

IEC 

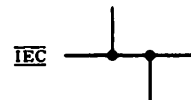
3.1.6.2 Application: junction of paths, conductors, or cables. If desired, indicate path type, or size

IEC 

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



OR



OR ONLY IF REQUIRED
BY LAYOUT CONSIDERATIONS




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

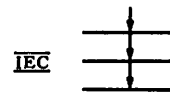
IEC 

3.1.6.5 Conductor junction (such as hermaphroditic connectors)

IEC 

3.1.7 Associated conductors

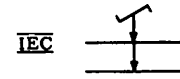
3.1.7.1 General (shown with 3 conductors)



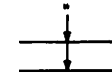
3.1.7.2 Twisted (shown with 2 twisted conductors)

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

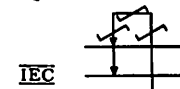


OR

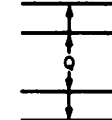


*See Note 3.1.7.2A

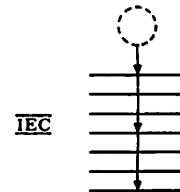
3.1.7.3 Quad



OR



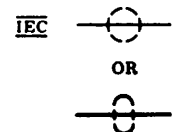
3.1.7.4 Shielded (shown with 3 conductors out of 7 within 1 shield)



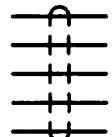
3.1.8 Assembled conductors; cable

Commonly used in communication diagrams.

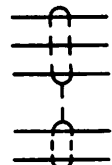
3.1.8.1 Shielded single conductor



3.1.8.2 Application: shielded 5-conductor cable

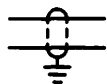


3.1.8.3 Application: shielded 5-conductor cable with conductors separated on the diagram for convenience

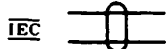


NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

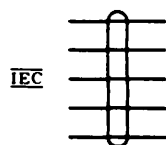
3.1.8.4 Application: shielded 2-conductor cable with shield grounded



3.1.8.5 2-conductor cable



3.1.8.6 Application: 5-conductor cable

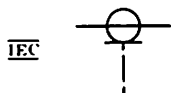


3.1.9† Coaxial cable, recognition symbol; coaxial transmission path; radio-frequency cable $\overline{\text{IEC}}$ (coaxial)

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

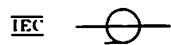
NOTE 3.1.9B: If the coaxial structure is not maintained, the tangential line shall be drawn only on the coaxial side.

3.1.9.1† General



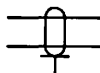
See Note 3.1.9A

3.1.9.2 Application: coaxial structure not maintained on the right



See Note 3.1.9B

3.1.9.3† Two conductors (balanced) with one outer-conductor connection (twinax)



See Note 3.1.9A

3.1.9.4† One conductor with one outer-conductor connection and one shielded connection (triax)



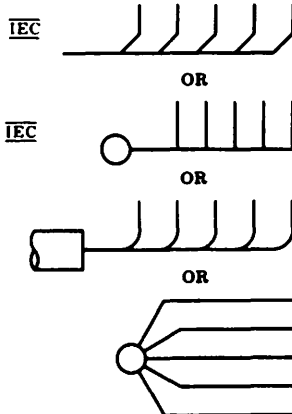
See Note 3.1.9A

† The broken line - - - indicates where the outer conductor connection to a symbol is made and is not part of the symbol.

3.1.10 Grouping of leads

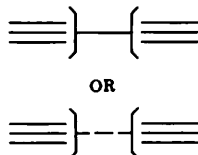
3.1.10.1 General

Bend of line indicates direction in which other end 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.

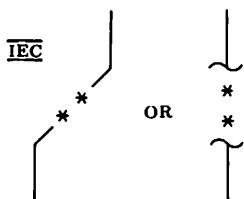


3.1.11 Interrupted path

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

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

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



* See Note 3.1.11B

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

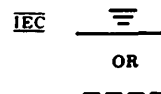
The following letters may be used to indicate type of transmission:

F telephony $\overline{\text{IEC}}$
S sound (television) $\overline{\text{IEC}}$
T telegraphy $\overline{\text{IEC}}$
transmission of data $\overline{\text{IEC}}$
V video (television) $\overline{\text{IEC}}$

3.2.1.1 Application: telephone line



3.2.2 Cable underground; underground line



These are long dashes.

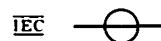
Avoid conflict with symbol 3.2.6 if used on the same diagram.

3.2.3 Submarine line; underwater line



3.2.4 Overhead line

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



3.2.5 Loaded line

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



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.

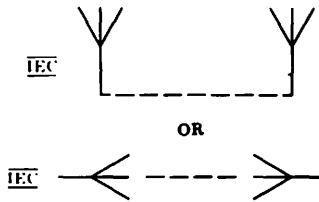
These are long dashes.



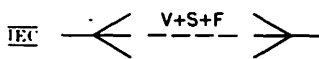
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

Graphic Symbols for Transmission Path

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

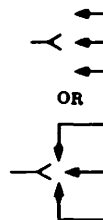
The arrowheads in this case shall be solid.

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

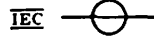


3.6 Waveguide \overline{F}

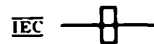
The mode of propagation or other special characteristics may be shown at the side of the waveguide symbol.

3.6.1 Circular, recognition symbol

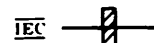
Avoid conflict with symbol 3.2.4 if used on the same diagram.



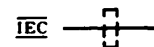
3.6.2 Rectangular, recognition symbol



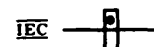
3.6.2.1 Dielectric-filled metallic rectangular waveguide



3.6.2.2 Solid-dielectric rectangular waveguide

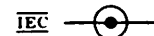


3.6.2.3 Gas-filled rectangular waveguide



3.6.3 Coaxial waveguide

See also item 3.1.9



3.6.4 Flexible waveguide

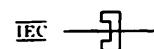
Avoid conflict with symbol 2.12.3 if used on the same diagram.



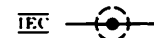
3.6.5 Twisted waveguide



3.6.6 Ridged waveguide

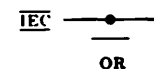


3.6.7 Goubau line (single-wire transmission line within solid dielectric)

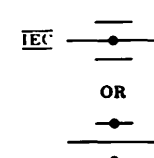


3.7 Strip-Type Transmission Line

3.7.1 Unbalanced stripline



3.7.2 Balanced stripline



3.8 Termination

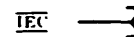
Commonly used on coaxial and waveguide diagrams.

3.8.1 Open circuit (open). Not a fault.



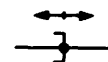
3.8.2 Short circuit (short). Not a fault.

NOTE 3.8.2A: Use of the dot is optional.



See Note 3.8.2A

3.8.3 Application: movable short circuit



See Note 3.8.2A

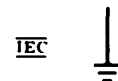
3.9 Circuit Return

3.9.1 Ground, general symbol

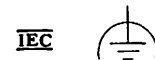
NOTE 3.9.1A: Supplementary information may be added to define the status or purpose of the earth if this is not readily apparent.

(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).

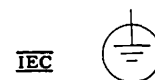


3.9.1.1 Low-noise ground (IEC noiseless, clean earth)



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).



Cross References

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.



* See Note 3.9.3A

3.9.3.2 Potential level not specified by a numerical value

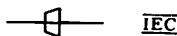
To be used when identically annotated common-return connections are at the same potential level.



* See Note 3.9.3A

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.

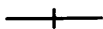


Graphic Symbols for Contacts, Switches, Contactors, and Relays

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.

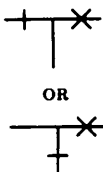
4.1.1 Conducting, closed contact (break)



4.1.2 Nonconducting, open contact (make)



4.1.3 Application: transfer



4.2 Electrical Contact

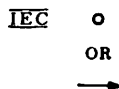
For buildups or forms using electrical contacts, see applications under 5.3.5 and 5.3.6.

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



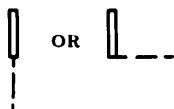
4.2.1.2 Fixed contact with momentary contact (automatic return)

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† Sleeve



4.2.2 Moving Contact

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

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



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.

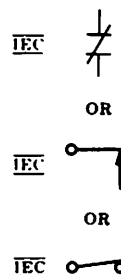
(bb) Closed when operated mechanism of main device is in deenergized or nonoperated position.

See American National Standard Manual and Automatic Station Control, Supervisory, and Associated Telemetering

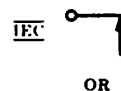
Equipment, C37.2-1970, for further details.

In the parallel-line contact symbols shown below, the length of the parallel lines shall be approximately 1½ times the width of the gap (except for symbol 4.3.7).

4.3.1 Closed contact (break)



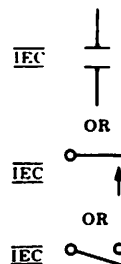
OR



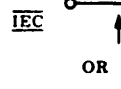
OR



4.3.2 Open contact (make)



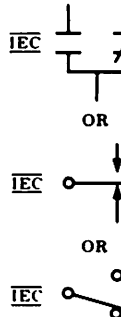
OR



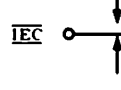
OR



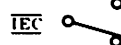
4.3.3 Transfer



OR



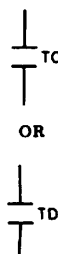
OR



4.3.4 Make-before-break



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



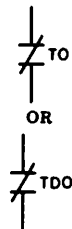
OR



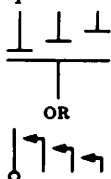
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

Graphic Symbols for Contacts, Switches, Contactors, and Relays

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

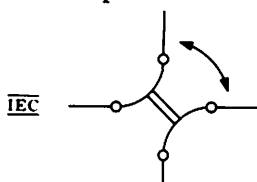


4.3.7 Time sequential closing

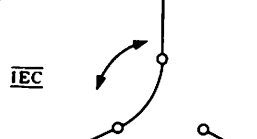


4.3.8 Multiway transfer switch

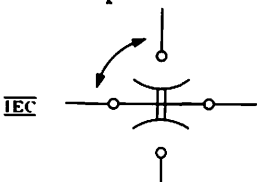
4.3.8.1 Two-position switch (90° step)



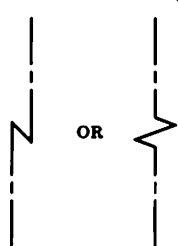
4.3.8.2 Three-position switch (120° step)



4.3.8.3 Four-position switch (45° step)



4.4† Magnetic Blowout Coil \overline{F}

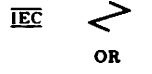
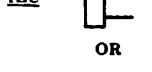
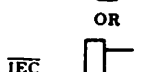
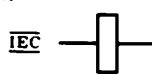


4.5 Operating Coil
Relay Coil \overline{F}

See also INDUCTOR; WINDING; etc (item 6.2)

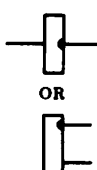
† The broken line --- indicates where line connection to a symbol is made and is not part of the symbol.

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.



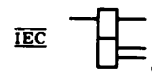
* See Note 4.5A

4.5.1 Semicircular dot indicates inner end of winding



4.5.2 Application: multiwinding coil (2 windings shown)

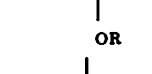
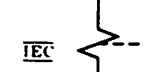
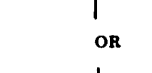
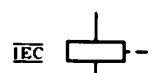
NOTE 4.5.2A: The ends of a given winding shall be shown directly opposite each other on opposite sides of the core, or adjacent to each other on the same side of the core.



See Note 4.5.2A

4.5.3 Electromagnetic actuator \overline{F} (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

Fundamental 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.

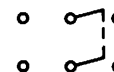
4.6.1 Single-throw, general



4.6.2 Double-throw, general



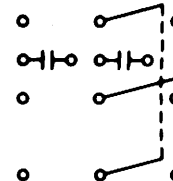
4.6.2.1 Application: 2-pole double-throw switch with terminals shown



4.6.3 Knife switch \overline{F} , general

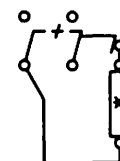


4.6.4 Application: 3-pole double-throw knife switch with auxiliary contacts and terminals



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.

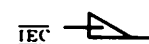


* See Note 4.6.5A

4.6.6 Switch with horn gap



4.6.7 Sector switch \overline{F}



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.

Graphic Symbols for Contacts, Switches, Contactors, and Relays

4.7 Pushbutton , Momentary or Spring-Return

4.7.1 Circuit closing (make)



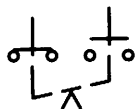
4.7.2 Circuit opening (break)



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)

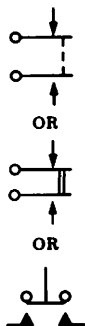


4.9.2 Circuit opening (break)

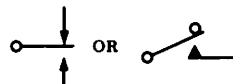


4.9.3 Two-circuit

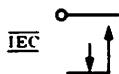
See Note 14.1.1A



4.9.4 Transfer



4.9.5 Make-before-break

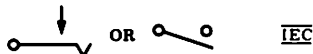


4.10 Locking Switch

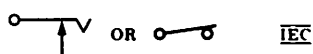
The symbols to the left are commonly used for spring buildups in key switches and jacks.

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

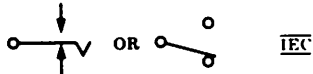
4.10.1 Circuit closing (make)



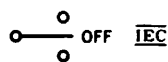
4.10.2 Circuit opening (break)



4.10.3 Transfer, 2-position



4.10.4 Transfer, 3-position



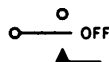
4.10.5 Make-before-break



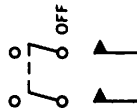
4.11 Combination Locking and Nonlocking Switch

Commonly used for toggle switches

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

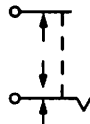


4.11.2 3-position, 2-pole: circuit closing (make), off, momentary circuit closing (make)

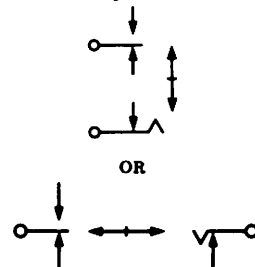


4.12 Key-Type Switch Lever Switch

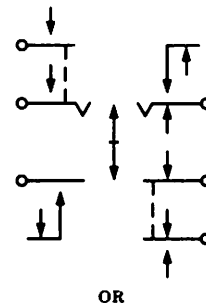
4.12.1 2-position with locking transfer and break contacts



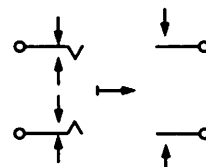
4.12.2 3-position with nonlocking transfer and locking break contacts



4.12.3 3-position, multicontact combination



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

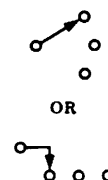


4.13 Selector or Multiposition Switch

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

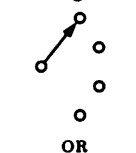
4.13.1 General (for power and control diagrams)

Any number of transmission paths may be shown.



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.

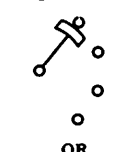
4.13.2 Break-before-make, nonshorting (nonbridging) during contact transfer



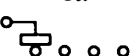
OR



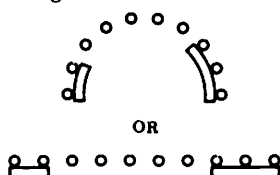
4.13.3 Make-before-break, shorting (bridging) during contact transfer



OR



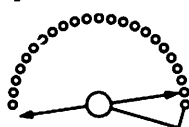
4.13.4 Segmental contact



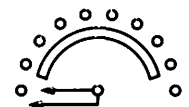
OR



4.13.5 22-point selector switch

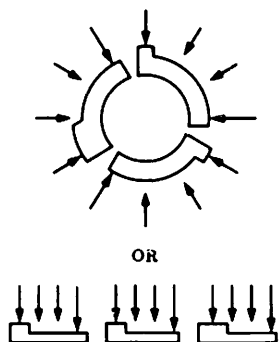


4.13.6 10-point selector switch with fixed segment

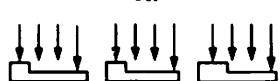


4.13.7 Rotary (section-, deck-, or wafer-type) switch

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.



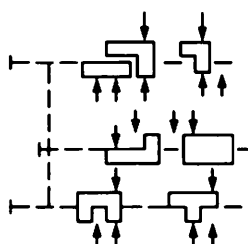
OR



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			

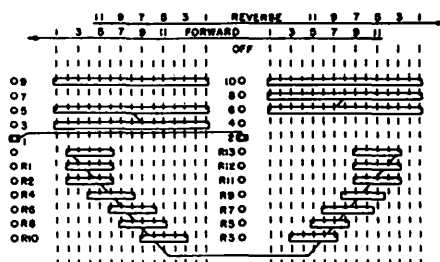
4.13.10 Master or control switch (cam-operated contact assembly), 6-circuit 3-point reversing switch

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

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			

4.13.11 Drum switch, sliding-contact type, typical example



4.14 Limit Switch Sensitive Switch

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

4.14.1 Track-type, circuit-closing contact



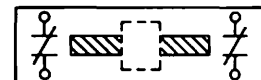
See Note 4.14A

4.14.2 Track-type, circuit-opening contact



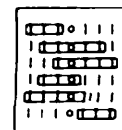
See Note 4.14A

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



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.

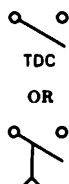
4.15.2 If specific type identification is required: circuit closing



4.16 Switches with Time-Delay Feature

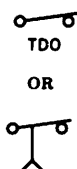
NOTE 4.16A: The point of the arrow indicates the direction of switch operation in which contact action is delayed.

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



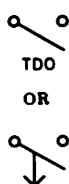
See Note 4.16A

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



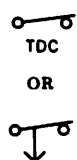
See Note 4.16A

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

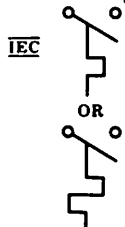


4.19.2 Opens on rising pressure

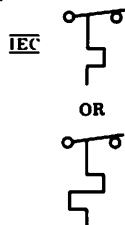


4.20 Temperature-Actuated Switch

4.20.1 Closes on rising temperature



4.20.2 Opens on rising temperature



4.21 Thermostat

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

NOTE 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



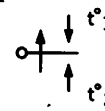
See Note 4.21A

4.21.3 Transfers on rising temperature



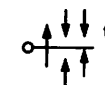
See Note 4.21A

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



See Notes 4.21A and B

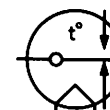
4.21.5 Application: multifunction, typical



See Notes 4.21A and B

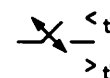
4.21.6 With integral heater and transfer contacts

Use only if essential to indicate integral heater details.



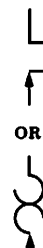
See Notes 4.21A and B

4.21.7 Application: with operating temperatures indicated



See Notes 4.21A and B

4.22 Flasher Self-Interrupting Switch



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.

Graphic Symbols for Contacts, Switches, Contactors, and Relays

4.23 Foot-Operated Switch Foot Switch

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

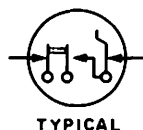
4.25 Switches with Specific Features

4.25.1 Hook switch 



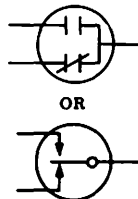
4.25.2 Telephone dial  (switch)

 DIAL



TYPICAL

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



4.25.4 Mushroom-head safety feature

Application to 2-circuit pushbutton switch.

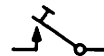


4.25.5 Key-operated lock switch

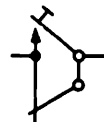
Use appropriate standard symbol and add key designation or other information in note.

4.26 Telegraph Key 

4.26.1 Simple




4.26.2 Simple with shorting switch




4.26.3 Open-circuit or pole-changing



4.27 Governor  (Contact-making)
Speed Regulator

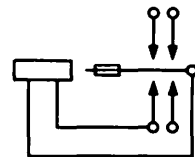
Contacts open or closed as required
(shown here as closed).



4.28 Vibrator, Interrupter 

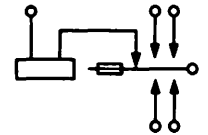
4.28.1 Typical shunt drive (with terminals shown)

Show contacts as required.



4.28.2 Typical separate drive (with terminals shown)

Show contacts as required.

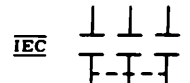


4.29 Contactor

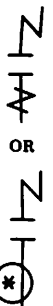
See also CIRCUIT BREAKER (item 9.4)

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

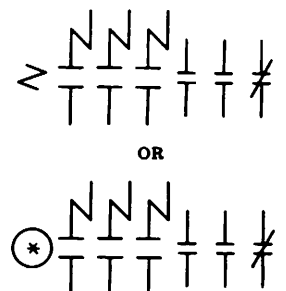


4.29.2 Electrically operated 1-pole contactor with series blowout coil



* See Note 4.5A

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)

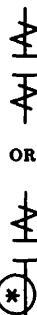


* See Note 4.5A

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.

Graphic Symbols for Contacts, Switches, Contactors, and Relays

4.29.4 Electrically operated 1-pole contactor with shunt blowout coil



OR

* See Note 4.5A

4.30 Relay F

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

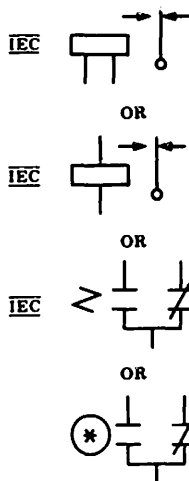
The proper poling for a polarized relay shall be shown by the use of + and - designations applied to the winding leads. The interpretation of this shall be

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

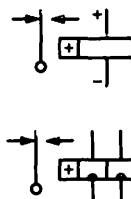


4.30.2 Application: relay with transfer contacts



* See Note 4.5A

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



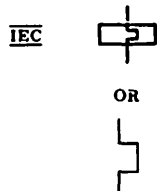
4.30.5 Relay, thermally operated

4.30.5.1 Activating device for thermally operated relay

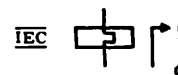
Time of delay may be shown.

Contacts may be shown separately from the operating device.

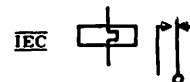
See also item 2.14



4.30.5.2 With normally open contacts shown (two typical types)

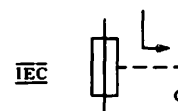


4.30.5.3 With transfer contacts shown

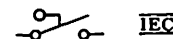


4.30.6 Thermal relay, one-time type, not reusable

Normally open contact type shown.



4.31 Inertia Switch (operated by sudden deceleration)

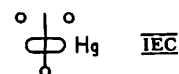


NOTE 4.31A: This symbol is commonly used on diagrams for aerospace applications.

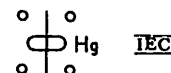
4.32 Mercury Switch

4.32.1 Leveling

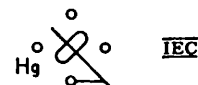
4.32.1.1 Three terminal



4.32.1.2 Four terminal



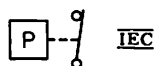
4.32.2 With acceleration cutoff (four terminal)



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.

**Graphic Symbols for
Contacts, Switches, Contactors, and Relays**

4.33 Aneroid Capsule (air pressure)
Operated Switch



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.

Graphic Symbols for Terminals and Connectors

5.1 Terminals

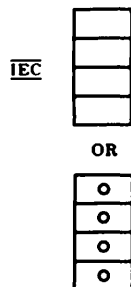
5.1.1 Circuit terminal

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.



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.

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

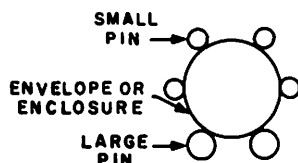
NOTE 5.1.2B: The following letter combinations, if shown adjacent to terminal symbols requiring special attention, shall signify the following:

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.

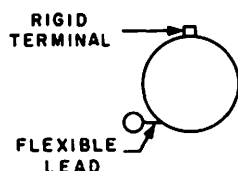
IS Internal shield not depicted in terminal diagram.

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



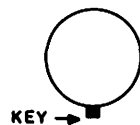
See Note 5.1.2A

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).

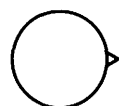
(2) Mounting flange or stud when it serves as a terminal.

5.1.2.3 Device with base-orientation key

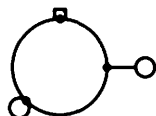


See Note 5.1.2A

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.



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-degree angle.

5.3.1 Female contact



5.3.2 Male contact

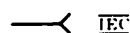


5.3.3 Connector assembly, movable or stationary portion; jack, plug, or receptacle

NOTE 5.3.3A: Use appropriate number of contact symbols.



OR



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 (←).



OR



See Note 5.3.3A
OR

*See Note 5.3.3.1A

5.3.3.2 Plug (usually movable)

See Note 5.3.3A



OR



*See Note 5.3.3.1A

5.3.4 Separable connectors (engaged)

See Note 5.3.3A

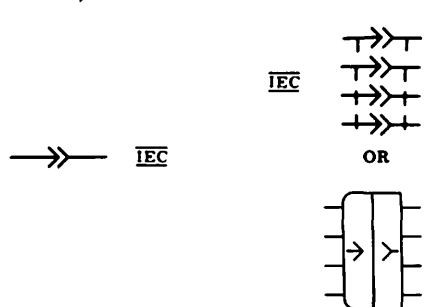


OR

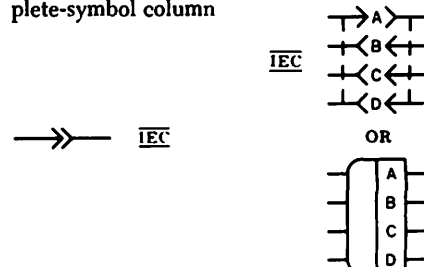


*See Note 5.3.3.1A

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



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



5.3.5 Communication switchboard-type connector

See also symbol 4.2.1.4

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.

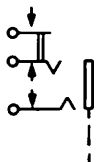
5.3.5.1 2-conductor (jack)



5.3.5.2 2-conductor (plug)



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



5.3.5.4 3-conductor (plug)



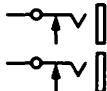
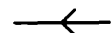
5.3.6 Communication switchboard-type connector with circuit normalled through "Normalled" indicates that a through circuit may be interrupted by an inserted connector. As shown here, the inserted connector opens the through circuit and connects to the circuit towards the left.

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

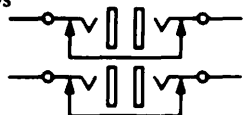
See also symbol 4.2.1.3



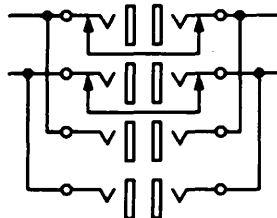
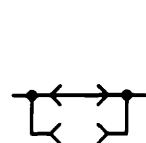
5.3.6.1 Jacks with circuit normalled through one way



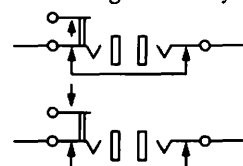
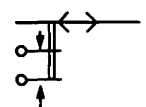
5.3.6.2 Jacks with circuit normalled through both ways



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



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

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)

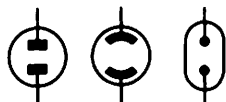


5.4.2 Female contact

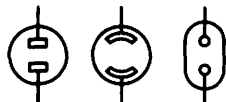
Open outline, approximating limiting shape of mating male contact (3 typical forms are shown)



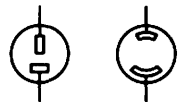
5.4.3 Application: 2-conductor nonpolarized connector with male contacts (3 typical forms are shown)



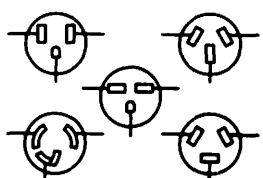
5.4.4 Application: 2-conductor nonpolarized connector with female contacts (3 typical forms are shown)



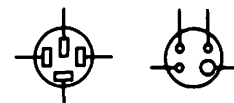
5.4.5 Application: 2-conductor polarized connector (2 typical forms with female contacts are shown)



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)



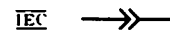
5.5.2 Male portion (with terminals shown)



5.6 Coaxial Connector
Coaxial Junction

5.6.1 Engaged coaxial connectors

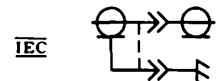
Coaxial recognition symbol may be added if necessary. See COAXIAL TRANSMISSION PATH (item 3.1.9)



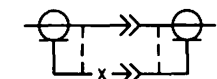
5.6.2 Application: coaxial with the outside conductor shown carried through



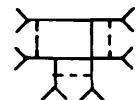
5.6.3 Application: coaxial with center conductor shown carried through; with outside conductor terminated on chassis



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

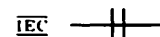


5.6.5 Application: T or Y adapter with outer conductor carried through



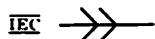
5.7 Waveguide Flanges
Waveguide Junction

5.7.1 Mated pair of symmetrical waveguide connectors

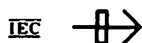


NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

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.



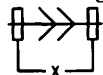
5.7.3 Plain (rectangular waveguide)



5.7.4 Choke (rectangular waveguide)



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.

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)

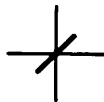


6.1.4 Magnetic-memory core

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

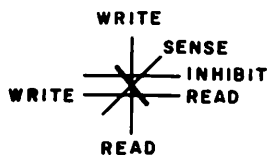
See also item 15.18.

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.



See Note 6.2.1A

6.2.2 Magnetic-core inductor Telephone loading coil

If necessary to show a magnetic core.



6.2.3 Tapped



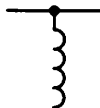
6.2.4 Adjustable inductor



6.2.5 Adjustable or continuously adjustable inductor



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

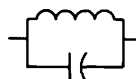


6.2.7.2 Application: series inductor and path short-circuited



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 Transducer Saturable-Core Inductor Saturable-Core Reactor

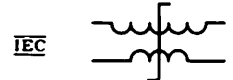
NOTE 6.3A: If essential for clarity, the magnetic core symbol, 6.1.2, may be added where applicable.

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

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

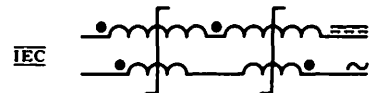
6.3.1 Transducer element, assembled

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



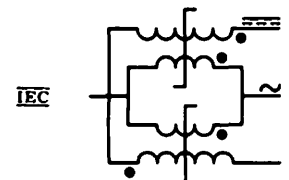
6.3.2 Application: single-phase series transducer with winding-polarity and kind-of-current markings shown

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.



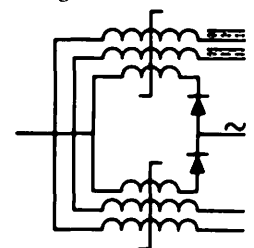
See Notes 6.3B and C

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



See Notes 6.3B, 6.3C, and 6.3.2A

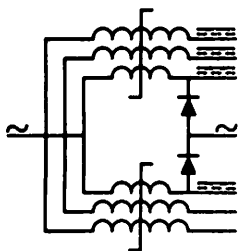
6.3.4 Application: self-exciting transducer with two control circuits and kind-of-current markings shown



See Note 6.3B

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.

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



See Note 6.3B

6.4 Transformer

Telephone Induction Coil Telephone Repeating Coil

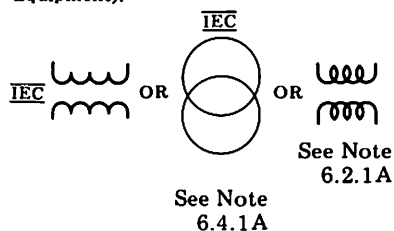
6.4.1 General

Additional windings may be shown or indicated by a note.

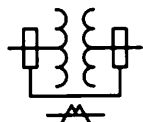
For polarity markings on current and potential transformers, see symbol 1.6.3.

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

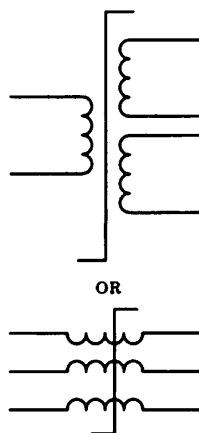


6.4.2.3 Application: transformer with magnetic core shown and with an electrostatic shield between windings. The shield is shown connected to the frame.

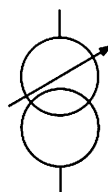
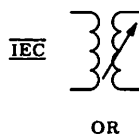


6.4.3 Saturating transformer

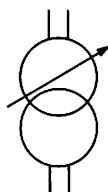
See SATURABLE-PROPERTIES INDICATOR (symbol 1.2.4)



6.4.4 One winding with adjustable inductance

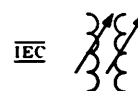


See Note 6.4.1A



See Note 6.4.1A

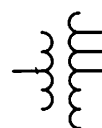
6.4.5 Each winding with separately adjustable inductance



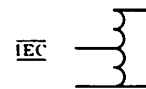
6.4.6 Adjustable mutual inductor; constant-current transformer



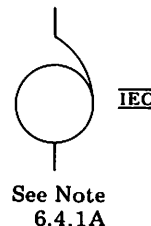
6.4.7 With taps, 1-phase



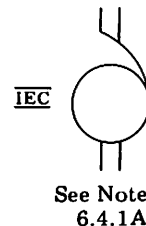
6.4.8 Autotransformer, 1-phase



OR



See Note 6.4.1A

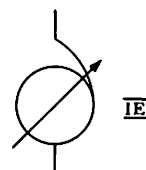


See Note 6.4.1A

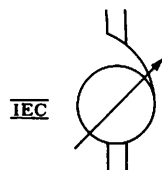
6.4.9 Adjustable



OR

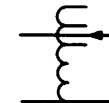
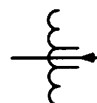


See Note 6.4.1A

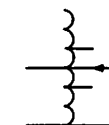
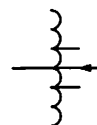


See Note 6.4.1A

6.4.10 Step-voltage regulator or load-ratio control autotransformer



6.4.10.1 Step-voltage regulator



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.

6.4.10.2 Load-ratio control auto-transformer



6.4.11 Load-ratio control transformer with taps

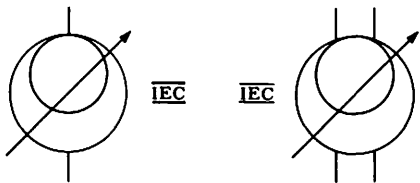


6.4.12 1-phase induction voltage regulator(s)

Number of regulators may be written adjacent to the symbol.



OR



See Note
6.4.1A

See Note
6.4.1A

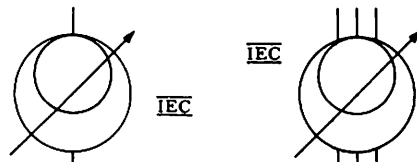
6.4.13 Triplex induction voltage regulator



6.4.14 3-phase induction voltage regulator



OR



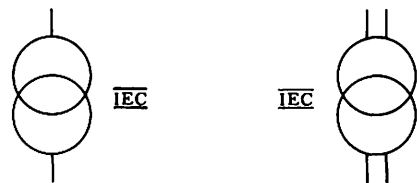
See Note
6.4.1A

See Note
6.4.1A

6.4.15 1-phase, 2-winding transformer



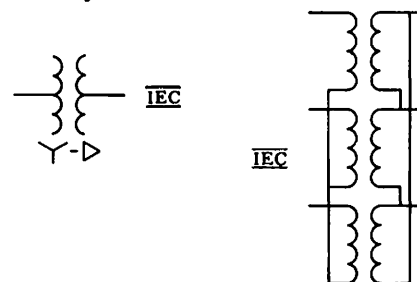
OR



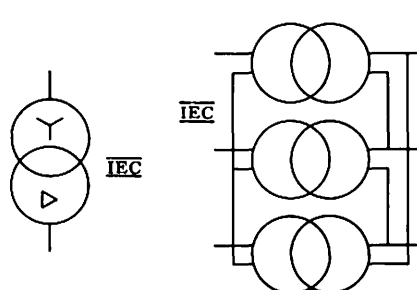
See Note
6.4.1A

See Note
6.4.1A

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



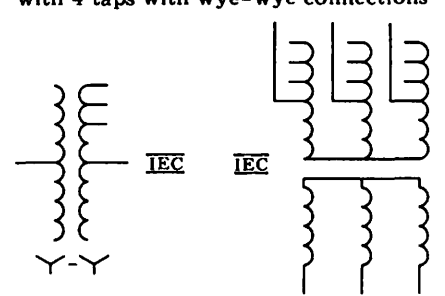
OR



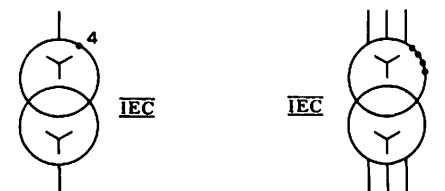
See Note
6.4.1A

See Note
6.4.1A

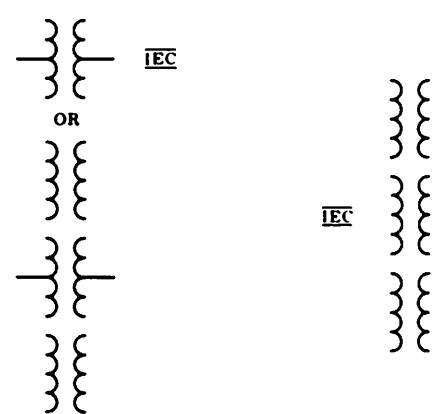
6.4.15.2 Three phase transformer with 4 taps with wye-wye connections



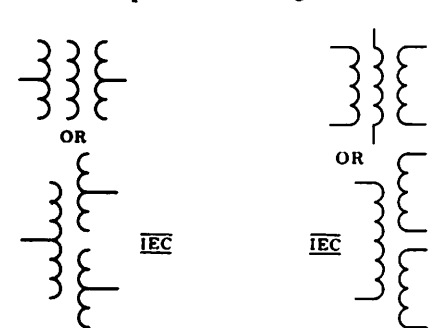
OR



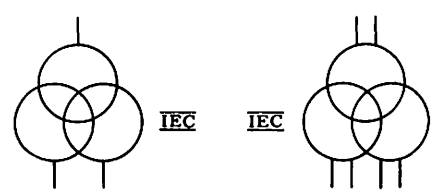
6.4.16 Polyphase transformer



6.4.17 1-phase, 3-winding transformer



OR



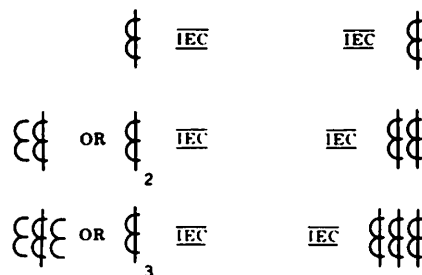
See Note
6.4.1A

See Note
6.4.1A

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.

6.4.18 Current transformer(s)

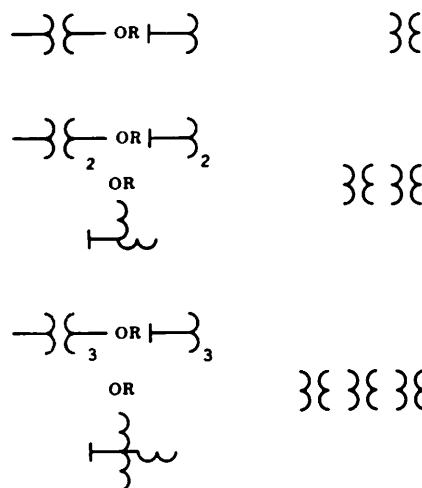
Avoid conflict with symbol 3.2.5 if used on the same diagram.



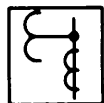
6.4.19† Bushing-type current transformer



6.4.20 Potential transformer(s)



6.4.21 Outdoor metering device



SHOW ACTUAL
CONNECTION
INSIDE BORDER

6.5‡ Linear Coupler



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

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.

7.1 Electron Tube

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.

 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.



7.1.1.3 Cold cathode (including ionically heated cathode)



7.1.1.4 Photocathode



7.1.1.5 Pool cathode



7.1.1.6 Ionically heated cathode with provision for supplementary heating


 See Note 7.1.1.1A

7.1.2 Controlling electrode


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



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



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




7.1.2.4 Excitor (contactor type)




7.1.3 Collecting electrode

7.1.3.1 Anode or plate




7.1.3.2 Target or x-ray anode

Drawn at about a 45-degree angle.



7.1.3.3 Fluorescent target

Drawn at about a 45-degree angle.




7.1.3.4 Collector




7.1.4 Collecting and emitting electrode

7.1.4.1 Dynode



7.1.4.2 Alternately collecting and emitting electrode


7.1.4.2.1 Composite anode-photocathode



7.1.4.2.2 Composite anode-cold cathode



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

 See Note 7.1.1.1A

7.1.5 Heater



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



7.1.7 Coupling

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

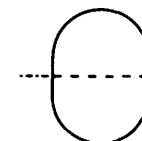
7.1.7.1 Coupling by loop (electromagnetic type)

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



7.1.8† Ion-diffusion barrier, shown with envelope

Commonly used with liquid-filled tubes.



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.

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

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.

Graphic Symbols for Electron Tubes and Related Devices

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.

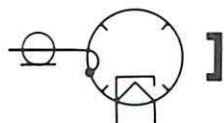
7.2.5 Electric components, such as resistors, capacitors, or inductors, which are integral parts of the tube and are important to its functional operation, shall be shown in the standard manner.

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):

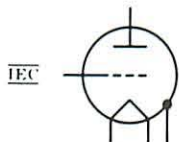


7.2.10 External and internal shields, whether integral parts of tubes or not, shall be omitted from the circuit diagram unless the circuit diagram requires their inclusion.

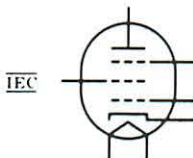
7.2.11 In line with standard drafting practice, straight-line crossovers are recommended.

7.3 Typical Applications

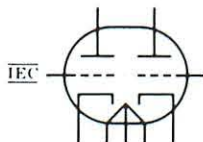
7.3.1 Triode with directly heated filamentary cathode and envelope connection to base terminal



7.3.2 Equipotential-cathode pentode showing use of elongated envelope

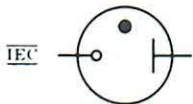


7.3.3 Equipotential-cathode twin triode showing use of elongated envelope and rule of item 7.2.3



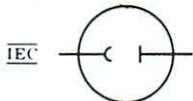
7.3.4 Cold-cathode gas-filled tube

7.3.4.1 Rectifier; voltage regulator for direct-current operation
See also symbol 11.1.3.2

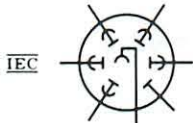


7.3.5 Phototube

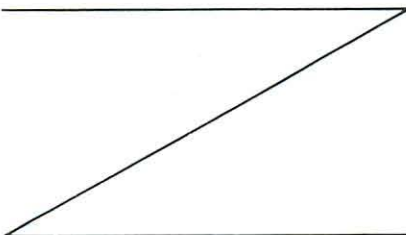
7.3.5.1 Single-unit, vacuum-type



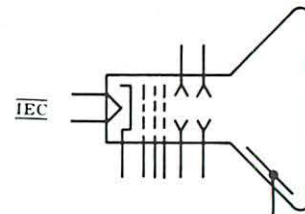
7.3.5.2 Multiplier-type



7.3.6 Cathode-ray tube
See Note 1.10A

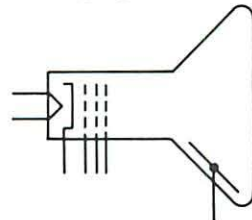


7.3.6.1 With electric-field (electrostatic) deflection

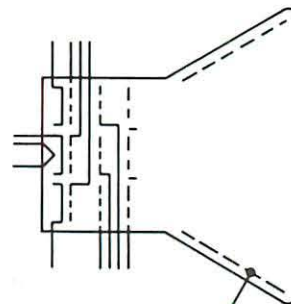


7.3.6.2 For electromagnetic deflection

7.3.6.2.1 Single-gun



7.3.6.2.2 Multiple-gun (three-gun shown)

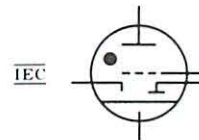


7.3.7 Mercury-pool tube

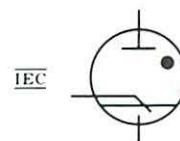
7.3.7.1 With ignitor and control grid



7.3.7.2 With excitor, control grid, and holding anode



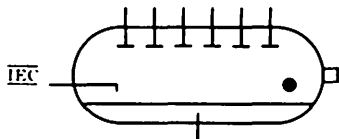
7.3.7.3 Single-anode pool-type vapor rectifier with ignitor



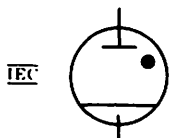
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

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.



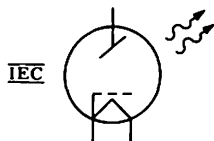
7.3.7.5 Pool-type cathode power rectifier



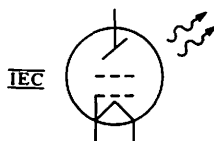
7.3.8 X-ray tube

7.3.8.1 With filamentary cathode and focusing grid (cup)

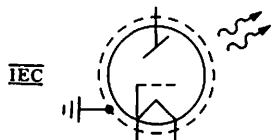
The anode may be cooled by fluid or radiation.



7.3.8.2 With control grid, filamentary cathode, and focusing cup

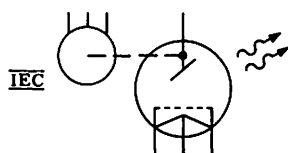


7.3.8.3 With grounded electrostatic shield



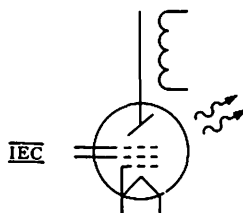
7.3.8.4 Double focus with rotating anode

See item 7.2.9



7.3.8.5 With multiple accelerating electrode electrostatically and electro-magnetically focused

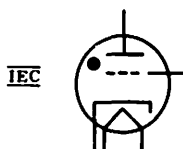
See item 7.2.9



7.3.9 Thyatron

See also symbol 8.11

7.3.9.1 With indirectly heated cathode



7.4 Solion
Ion-Diffusion Device

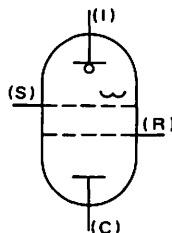
7.4.1 Diode solion



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

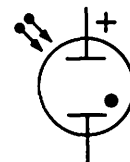
7.6 Conductivity Cell



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.

Graphic Symbols for Semiconductor Devices

8.1 Semiconductor Device Transistor Diode

See paragraph A4.11 of the Introduction

NOTE 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.

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

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

NOTE 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.

NOTE 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

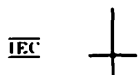
As shown, the horizontal line is the semiconductor region and the vertical line is an ohmic connection.

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



8.2.1.1 Semiconductor region with a plurality of ohmic connections

Examples show 2 ohmic connections.



OR



OR



8.2.2 Rectifying junction or junction which influences a depletion layer

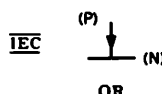
Arrowheads (\rightarrow) shall be half the length of the arrow away from the semiconductor base region. IEC

See item 8.6

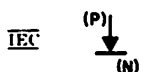
The equilateral (\rightarrow) triangle shall be filled and shall touch the semiconductor base-region symbol. IEC

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.

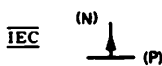
8.2.2.1 P region on N region



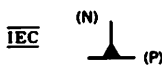
OR



8.2.2.2 N region on P region



OR



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.

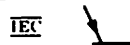


8.2.4 Emitter on region of dissimilar-conductivity type

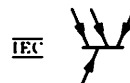
As shown, the slant line with arrow represents the emitter. Arrowheads on both the N and P emitter symbols shall be half the length of the arrow away from the semiconductor base-region symbol. IEC

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

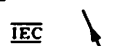
8.2.4.1 P emitter on N region



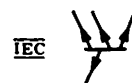
8.2.4.1.1 Plurality of P emitters on N region



8.2.4.2 N emitter on P region



8.2.4.2.1 Plurality of N emitters on P region



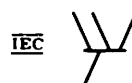
8.2.5 Collector on region of dissimilar-conductivity type

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



8.2.5.1 Plurality of collectors on region of dissimilar-conductivity type



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

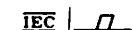
The short lines used in transition symbols shall be appreciably shorter than collector or emitter symbols. IEC



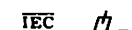
8.2.7 Intrinsic region between 2 regions

The intrinsic region lies between the linked slant lines. IEC

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

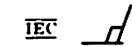


8.2.7.2 Between regions of similar-conductivity type, either PIP or NIN



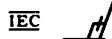
8.2.7.3 Between a collector and a region of dissimilar-conductivity type, either PIN or NIP

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



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



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

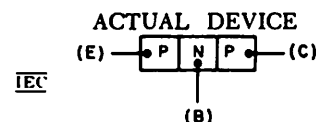
To draw a device symbol, start at an electrode whose polarity is known (usually an emitter) and proceed along the device, showing all of its regions individually. Finally, indicate ohmic connections where required.

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.

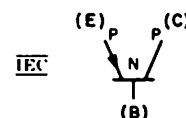
Name of Terminal	Letter
Anode	A
Base	B
Collector	C
Drain	D
Emitter	E
Gate	G
Cathode	K
Source	S
Main terminal*	T
Substrate (bulk)	U

* Used with bidirectional thyristors. The terminals are differentiated by numerical subscripts 1 and 2, T₁ being the terminal to which the gate trigger signal is referenced, if applicable.

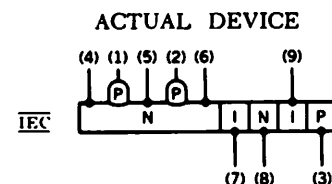
8.4.1 PNP transistor (example of a three-element device)



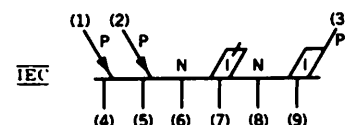
Construction of symbol by successively using symbols 8.2.4.1, 8.2.5, and 8.2.1.



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.

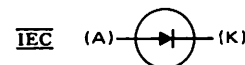


8.5 Typical Applications, Two-Terminal Devices

See paragraph A4.11 of the Introduction

See Note 8.4A

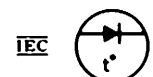
8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier



8.5.2 Capacitive diode (varactor)



8.5.3 Temperature-dependent diode

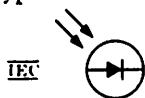


8.5.4 Photodiode

See item 1.3

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.

8.5.4.1 Photosensitive type



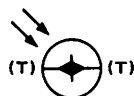
8.5.4.2 Photoemissive type

See also item 11.1.1

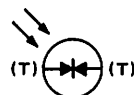


8.5.4.3 Bidirectional photodiode; photo-duo-diode (photosensitive type)

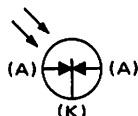
8.5.4.3.1 NPN-type



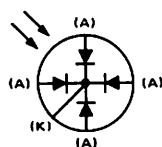
8.5.4.3.2 PNP-type



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

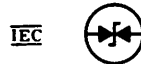


8.5.6.2 Bidirectional diode

Style 1

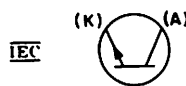


Style 2

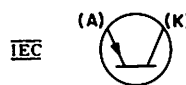


8.5.6.3 Unidirectional negative-resistance breakdown diode; trigger diac

8.5.6.3.1 NPN-type



8.5.6.3.2 PNP-type



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



OR



Style 2



8.5.7.2 Backward diode; tunnel rectifier

For this application, Note 8.2.2A does not apply.

Style 1



OR



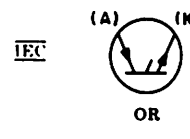
Style 2



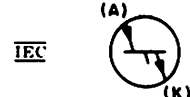
8.5.8 Thyristor, reverse-blocking diode-type

8.5.8.1 General

Style 1



OR

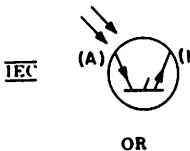


Style 3

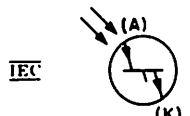


8.5.8.2 Light-activated type

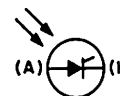
Style 1



OR

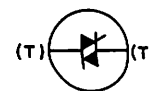


Style 3



8.5.9 Thyristor, bidirectional diode type; bi-switch

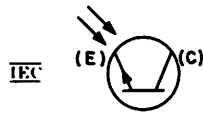
See also symbol 8.6.15



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.

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

See also symbol 8.6.16, for 3-terminal device

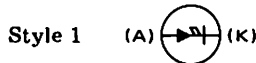


8.5.11 Current regulator

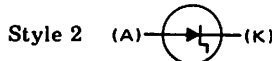


8.5.12 PIN-type diode

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



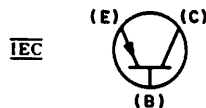
8.5.13 Step recovery diode



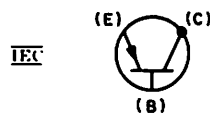
8.6 Typical Applications, Three- (or more) Terminal Devices

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

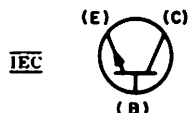


8.6.1.1 Application: PNP transistor with one electrode connected to envelope (in this case, the collector electrode)

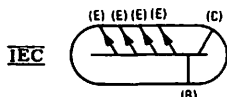


8.6.2 NPN transistor (also NPIN transistor, if omitting the intrinsic region will not result in ambiguity)

See paragraph A4.11 of the Introduction

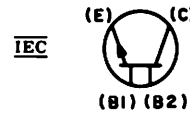


8.6.2.1 Application: NPN transistor with multiple emitters (with 4 emitters shown)



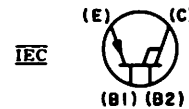
8.6.3 NPN transistor with transverse-biased base

See paragraph A4.11 of the Introduction



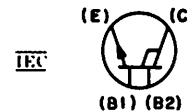
8.6.4 PNIP transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction



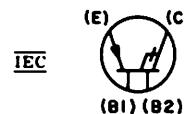
8.6.5 NPIN transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction



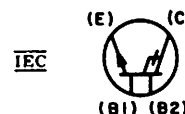
8.6.6 PNIN transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction



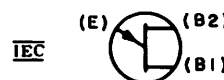
8.6.7 NPIN transistor with ohmic connection to the intrinsic region

See paragraph A4.11 of the Introduction



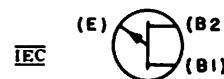
8.6.8 Unijunction transistor with N-type base

See paragraph A4.11 of the Introduction



8.6.9 Unijunction transistor with P-type base

See paragraph A4.11 of the Introduction



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.

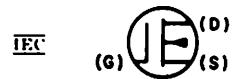
See paragraph A4.11 of the Introduction



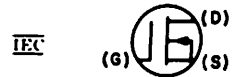
OR



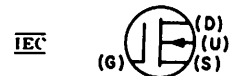
8.6.10.2 N-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate), three-terminal device



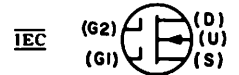
8.6.10.3 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) internally terminated to source, three-terminal device



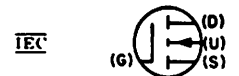
8.6.10.4 N-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device



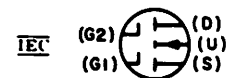
8.6.10.4.1 Application: N-channel insulated-gate, depletion-type, two-gate, five-terminal device



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



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

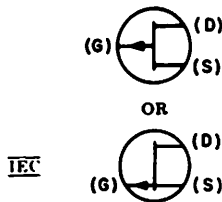


8.6.11 Field-effect transistor with P-channel (junction gate and insulated gate)

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.

8.6.11.1 P-channel junction gate

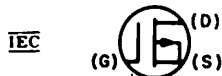
See paragraph A4.11 of the Introduction



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



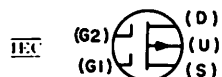
8.6.11.3 P-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) internally terminated to source, three-terminal device



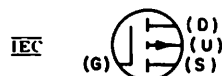
8.6.11.4 P-channel insulated-gate, depletion-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device



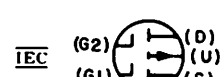
8.6.11.4.1 Application: P-channel insulated-gate, depletion-type, two-gate, five-terminal device



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



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

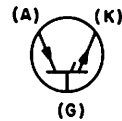


8.6.12 Thyristor, reverse-blocking triode-type, N-type gate; semiconductor controlled rectifier, N-type gate

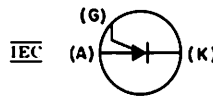
See paragraph A4.11 of the Introduction

8.6.12.1 General

Style 1

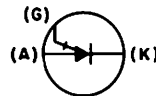


Style 3



8.6.12.2 Gate turn-off type

Style 3

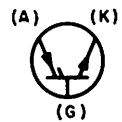


8.6.13 Thyristor, reverse-blocking triode-type, P-type gate; semiconductor controlled rectifier, P-type gate

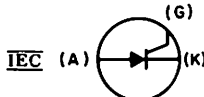
See paragraph A4.11 of the Introduction

8.6.13.1 General

Style 1

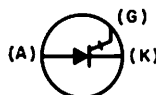


Style 3



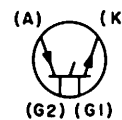
8.6.13.2 Gate turn-off type

Style 3

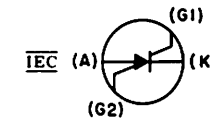


8.6.14 Thyristor, reverse-blocking tetrode-type; semiconductor controlled switch

Style 1



Style 3



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

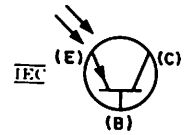
See also symbol 8.5.9

Style 3

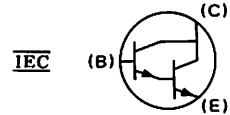


8.6.16 Phototransistor (PNP-type)

See also symbol 8.5.10, for 2-terminal device



8.6.17 Darlington transistor (NPN-type)



8.7 Photosensitive Cell

See paragraph A4.11 of the Introduction

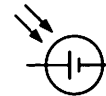
8.7.1 Asymmetrical photoconductive transducer

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

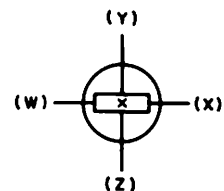


8.9 Hall Element Hall Generator

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

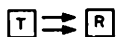
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

8.10 Photon-Coupled Isolator

See also symbol 15.8.1

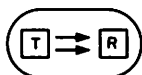
NOTE 8.10A: T is the transmitter; R is the receiver. The letters are for explanation and are not part of the symbol. Explanatory information should be added to explain circuit operation.

8.10.1 General



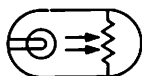
See Note 8.10A

8.10.2 Complete isolator (single-package type)

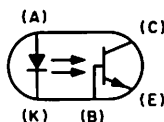


See Note 8.10A

8.10.3 Application: Incandescent lamp and symmetrical photoconductive transducer



8.10.4 Application: Photoemissive diode and phototransistor

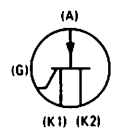


8.11 Solid-State Thyatron (replacement type)

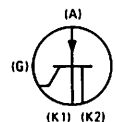
See symbol 7.3.9

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

8.11.1 Balanced



8.11.2 Unbalanced



Cross References

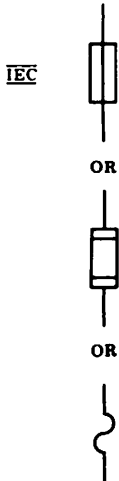
Bridge-Type Rectifier
(item 16.3.3)

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.

Graphic Symbols for Circuit Protectors

9.1 Fuse (one-time thermal current-over-load device)

9.1.1 General

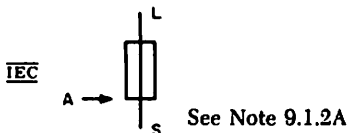


9.1.1.1 Fuse, supply side indicated by a thick line



9.1.2 Fuse with alarm contact

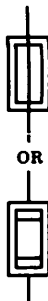
NOTE 9.1.2A: When fuse blows, alarm bus A is connected to power supply bus S. The letters S (supply), L (load), and A (alarm circuit) are for explanation only, and are not part of the symbol.



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



9.1.4 High-voltage primary fuse cut-out, 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 $\overline{\text{F}}$ Arrester (electric surge, etc) Gap

See also symbol 8.5.6

9.3.1 General



9.3.2 Carbon block; telephone protector block $\overline{\text{F}}$

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

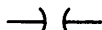


9.3.5 Protective gap

These triangles shall not be filled.



9.3.6 Sphere gap



9.3.7 Valve or film element



9.3.8 Multigap, general



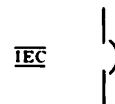
9.3.9 Application: gap plus valve plus ground, 2-pole



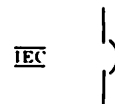
9.4 Circuit Breaker $\overline{\text{F}}$

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 1,500 volts or less and for all direct-current circuit breakers



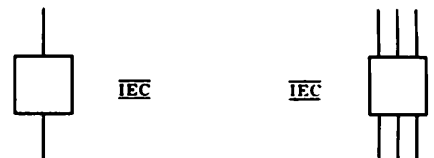
9.4.3 Network protector



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.

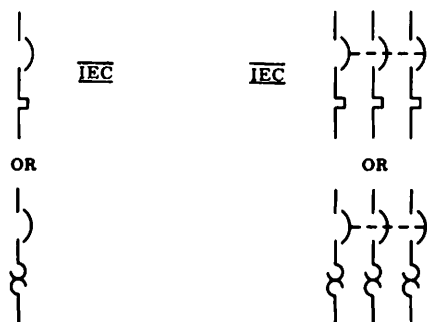


See Note 9.4.4A

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.

Graphic Symbols for Circuit Protectors

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



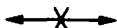
9.5.4 Direction, general; directional over



9.5.5 Balance, general



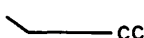
9.5.6 Differential, general



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

* 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.

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



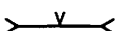
9.5.12.2 Directional overcurrent



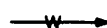
9.5.12.3 Directional residual overcurrent



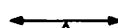
9.5.12.4 Undervoltage



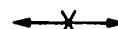
9.5.12.5 Power directional



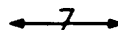
9.5.12.6 Balanced current



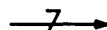
9.5.12.7 Differential current



9.5.12.8 Distance



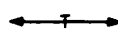
9.5.12.9 Directional distance



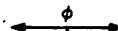
9.5.12.10 Overfrequency



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



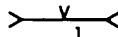
9.5.12.15 Pilot wire, directional-comparison



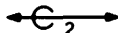
9.5.12.16 Carrier pilot



9.5.12.17 Positive phase-sequence undervoltage



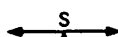
9.5.12.18 Negative phase-sequence overcurrent



9.5.12.19 Gas-pressure (Buchholz)



9.5.12.20 Out-of-step



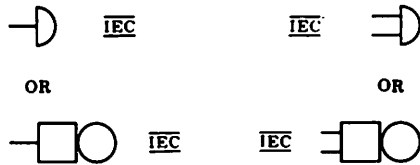
Cross References

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.

10.1 Audible-Signaling Device

10.1.1 Bell, electrical \overline{F} ; telephone ringer \overline{F}

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 \overline{F}



See Note 10.1.1A

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

10.1.3.1 General



10.1.3.2 Application: specific types

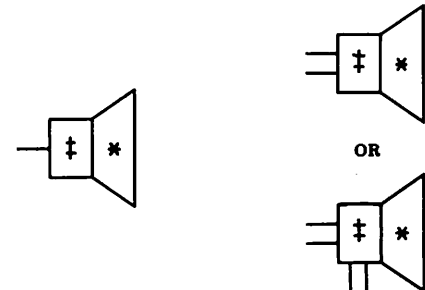
If specific identification of loudspeaker types is required, the following letter combinations may be added in the symbol at the locations indicated by the * and the †:

- *HN Horn, electrical \overline{F}
- *HW Howler
- *LS Loudspeaker \overline{F}
- *SN Siren \overline{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)

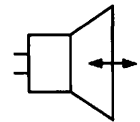
†MG Magnetic armature

†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

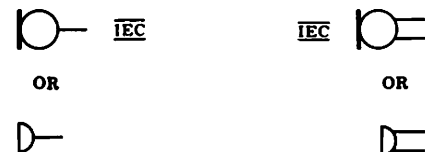


10.1.4 Telegraph sounder \overline{F}



10.2 Microphone \overline{F} Telephone Transmitter

10.2.1 General



10.3 Handset \overline{F} Operator's Set

10.3.1 General



10.3.2 With push-to-talk switch



10.3.3 3-conductor handset



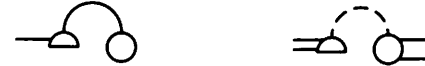
10.3.4 4-conductor handset



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



10.3.6 Operator's set



10.4 Telephone Receiver Earphone \overline{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). 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.

11.1 Lamp

See also item 8.5.4.2

11.1.1 Lamp, general; light source, general

See also item 11.2.7



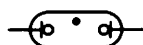
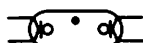
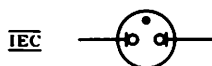
NOTE 11.1.1A: This symbol may be used to represent one or more lamps with or without operating auxiliaries.

NOTE 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.

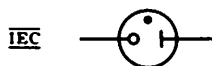
A	Amber
B	Blue
C	Clear
G	Green
O	Orange
OP	Opalescent
P	Purple
R	Red
W	White
Y	Yellow

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

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

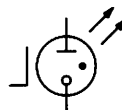
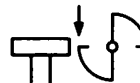
11.1.2 Fluorescent lamp**11.1.2.1 2-terminal****11.1.2.2 4-terminal****11.1.3 Glow lamp**, cold-cathode lamp; neon lamp**11.1.3.1 Alternating-current type****11.1.3.2 Direct-current type**

See also ELECTRON TUBE (symbol 7.3.4.1)

**11.1.4 Incandescent lamp** (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** (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.



OR



See Note 11.1.1B

OR



* 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

OR

**11.2.8 Jeweled signal light**

See Note 11.1.1B

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.

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.

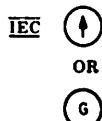


* See Note 12.1A

A	Ammeter $\boxed{\text{IEC}}$
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 $\boxed{\text{IEC}}$
	Cathode-ray oscillograph
DB	DB (decibel) meter
	Audio level/meter $\boxed{\text{IEC}}$
DBM	DBM (decibels referred to 1 milliwatt) meter
DM	Demand meter
DTR	Demand-totalizing relay
F	Frequency meter $\boxed{\text{IEC}}$
GD	Ground detector
I	Indicating meter
INT	Integrating meter
μA or UA	Microammeter
MA	Milliammeter
NM	Noise meter
OHM	Ohmmeter $\boxed{\text{IEC}}$
OP	Oil pressure meter
OSCG	Oscillograph, string
PF	Power factor meter
PH	Phasemeter $\boxed{\text{IEC}}$
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 $\boxed{\text{IEC}}$
VA	Volt-ammeter
VAR	Varmeter $\boxed{\text{IEC}}$
VARH	Varhour meter
VI	Volume indicator
	Audio-level meter $\boxed{\text{IEC}}$
VU	Standard volume indicator
	Audio-level meter $\boxed{\text{IEC}}$
W	Wattmeter $\boxed{\text{IEC}}$
WH	Watthour meter

12.1.1 Galvanometer $\boxed{\text{IEC}}$

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: 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.

13.1 Rotating Machine

13.1.1 Basic



13.1.2 Generator \overline{G} (general)



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



13.1.2.2 Generator, alternating-current



13.1.2.3 Generator, synchronous



13.1.3 Motor \overline{M} (general)



OR



13.1.3.1 Motor, direct-current



13.1.3.2 Motor, alternating-current



13.1.3.3 Motor, synchronous



13.1.4 Motor, multispeed

USE SYMBOLS 13.1.3 AND
NOTE SPEEDS

13.1.5 † Rotating armature with commutator and brushes



13.1.6 Hand generator



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

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



13.2.2 Series



13.2.3 Shunt, or separately excited



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 (grounded)



13.3.5 3-phase delta



13.3.6 6-phase diametrical



13.3.7 6-phase double-delta

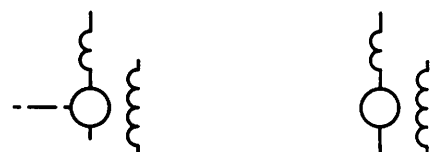


13.4 Applications: Direct-Current Machines

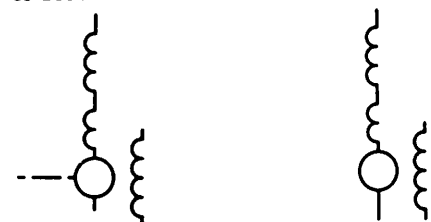
13.4.1 † Separately excited direct-current generator or motor



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



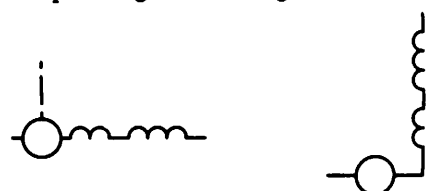
13.4.3 † Compositely excited direct-current generator or motor; with commutating or compensating field winding, or both



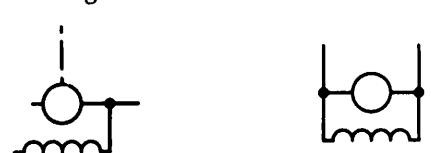
13.4.4 † Direct-current series motor or 2-wire generator



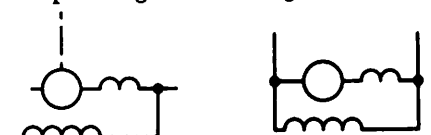
13.4.5 † Direct-current series motor or 2-wire generator; with commutating or compensating field winding, or both



13.4.6 † Direct-current shunt motor or 2-wire generator



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



13.4.8 † Direct-current permanent-magnet-field generator or motor



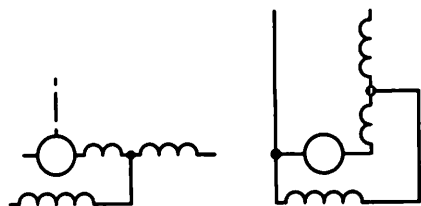
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

Graphic Symbols for
Rotating Machinery

13.4.9 † Direct-current compound motor or 2-wire generator or stabilized shunt motor



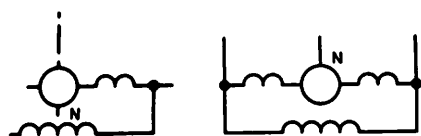
13.4.10 † Direct-current compound motor or 2-wire generator or stabilized shunt motor; with commutating or compensating field winding, or both



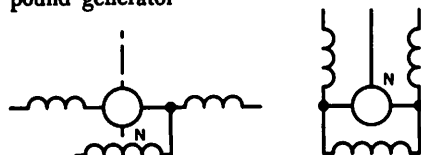
13.4.11 † Direct-current 3-wire shunt generator



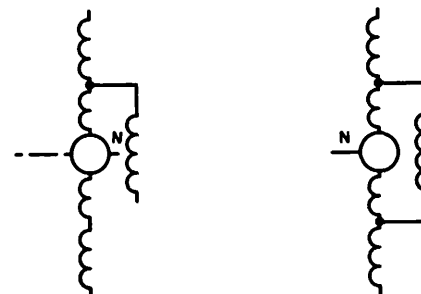
13.4.12 † Direct-current 3-wire shunt generator; with commutating or compensating field winding, or both



13.4.13 † Direct-current 3-wire compound generator

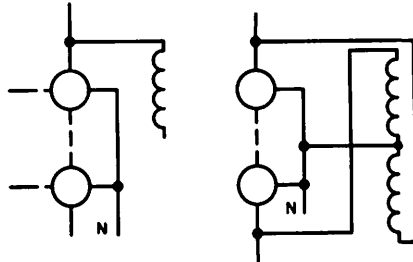


13.4.14 † Direct-current 3-wire compound generator; with commutating or compensating field winding, or both

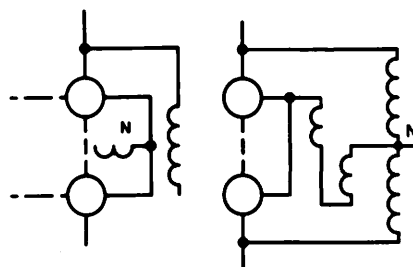


† The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.

13.4.15 † Direct-current balancer, shunt wound



13.4.16 † Direct-current balancer, compound wound



13.4.17 † Dynamotor



13.4.18 † Double-current generator



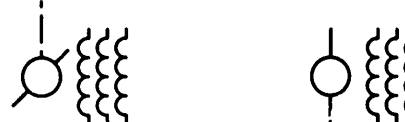
13.4.19 † Acyclic generator, separately excited



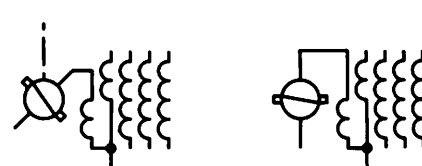
13.4.20 † Regulating generator (rotary amplifier), shunt wound with short-circuited brushes



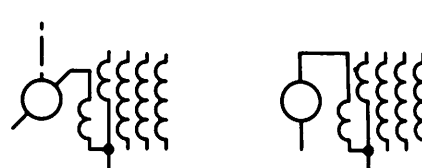
13.4.21 † Regulating generator (rotary amplifier), shunt wound without short-circuited brushes



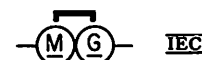
13.4.22 † Regulating generator (rotary amplifier), shunt wound with compensating field winding and short-circuited brushes



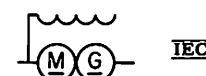
13.4.23 † Regulating generator (rotary amplifier), shunt wound with compensating field winding, without short-circuited brushes



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



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



13.5 Applications: Alternating-Current Machines

13.5.1 † Squirrel-cage induction motor or generator, split-phase induction motor or generator, rotary phase converter, or repulsion motor



13.5.2 † Wound-rotor induction motor, synchronous induction motor, induction generator, or induction frequency converter



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.

13.5.3 † Alternating-current series motor



13.5.4 † Alternating-current series motor, with commutating or compensating field winding, or both



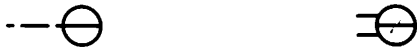
13.5.5 † 1-phase shaded-pole motor



13.5.6 † 1-phase repulsion-start induction motor



13.5.7 † 1-phase hysteresis motor



13.5.8 † Reluctance motor



13.5.9 † 1-phase subsynchronous reluctance motor



13.5.10 † Magnetolectric generator, 1-phase; telephone magneto



13.5.11 † Shunt-characteristic brush-shifting motor



13.5.12 † Series-characteristic brush-shifting motor with 3-phase rotor



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

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



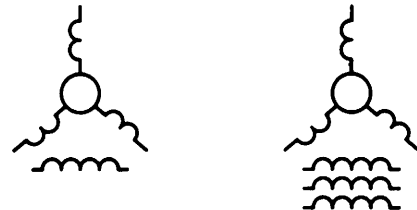
13.5.14 Ohmic-drop exciter with 3- or 6-phase input



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 † Synchronous motor, generator, or condenser



13.6.2 † Synchronous motor, generator, or condenser with neutral brought out



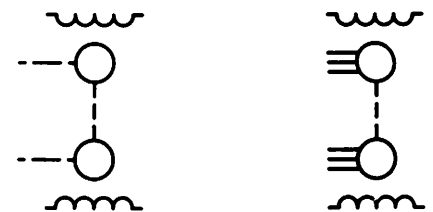
13.6.3 † Synchronous motor, generator, or condenser with both ends of each phase brought out



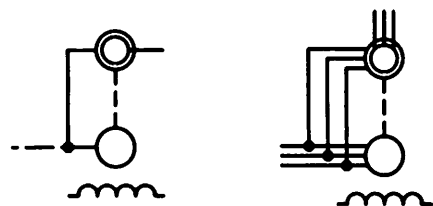
13.6.4 † Double-winding synchronous generator, motor, or condenser



13.6.5 † Synchronous-synchronous frequency changer

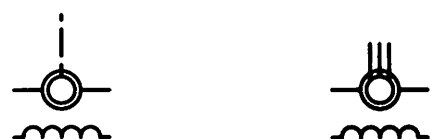


13.6.6 † Synchronous-induction frequency changer



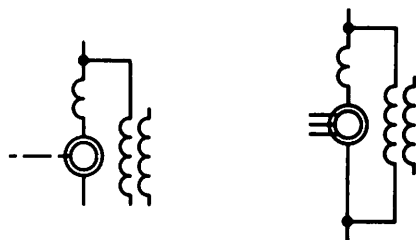
13.7 Applications: Alternating- and Direct-Current Composite

13.7.1 † Synchronous or regulating-pole converter

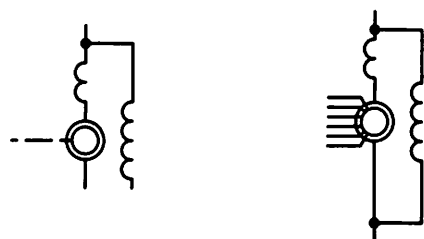


NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

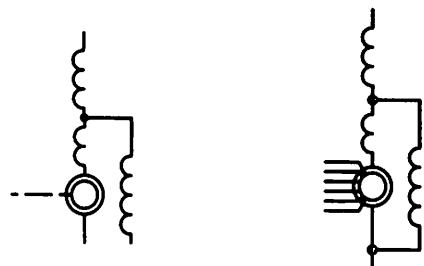
13.7.2 †Synchronous booster or regulating-pole converter; with commutating or compensating field windings, or both



13.7.3 †Synchronous converter, shunt-wound with commutating or compensating field windings, or both



13.7.4 †Synchronous converter, compound-wound with commutating or compensating field windings, or both



13.7.5 †Motor converter



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

13.8 Synchro $\overline{\text{E}}$

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.



13.8.2 Synchro, control transformer; synchro, receiver $\overline{\text{E}}$; synchro, transmitter $\overline{\text{E}}$



13.8.3 Synchro, differential receiver; synchro, differential transmitter $\overline{\text{E}}$



13.8.4 Synchro, resolver $\overline{\text{E}}$

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



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.

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.

IEC -----

OR

IEC =

See Note 14.1.1A

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.

IEC ↻ 6.2/REV*

OR

↻ 6.2/REV*

* 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.

CW ↻

OR

CW ↻

* 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 ↻ ω

14.3 Clutch Brake

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

IEC ---┐┐---

OR

---┐┐---

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

IEC ---┐┐---

OR

---┐┐---

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

IEC ---┐┐---

OR

---┐┐---

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

IEC ---┐┐---

OR

---┐┐---

14.4 Manual Control

14.4.1 General

IEC T

14.4.2 Operated by pushing

IEC T

14.4.3 Operated by pushing and pulling (push-pull)

IEC T

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.

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.

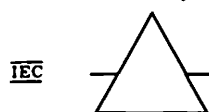
15.1.1 † General



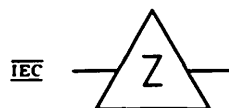
15.1.1.1 Terminal discontinuity (one-port)



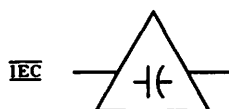
15.1.1.2 Discontinuity (two-port)



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



15.1.2.1 Capacitive reactance



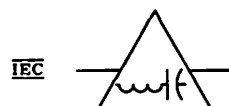
15.1.2.2 Inductive reactance



15.1.2.3 Resistance



15.1.2.4 Inductance-capacitance circuit with zero reactance at resonance



15.1.2.5 Inductance-capacitance circuit with infinite reactance at resonance



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



15.1.3.1 Capacitive susceptance



15.1.3.2 Inductive susceptance



15.1.3.3 Conductance



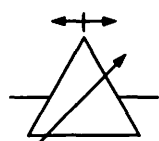
15.1.3.4 Inductance-capacitance circuit having zero reactance, infinite susceptance at resonance



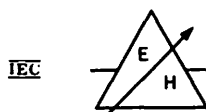
15.1.3.5 Inductance-capacitance circuit having infinite reactance, zero susceptance at resonance



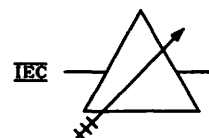
15.1.4 Slide-screw tuner



15.1.5 E-H tuner



15.1.6 Multistub tuner with 3 stubs



15.2 Coupling

Commonly used in coaxial and waveguide diagrams.

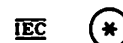
15.2.1 Coupling by aperture with an opening of less than full waveguide size

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.

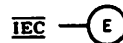
H indicates that the physical plane of the aperture is parallel to the transverse component of the major E lines.

HE indicates coupling by all other kinds of apertures.

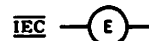


* See Note 15.2.1A

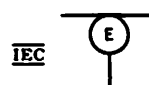
15.2.1.1 Application: E-plane coupling by aperture to space



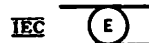
15.2.1.2 Application: E-plane coupling by aperture; 2 ends of transmission path available



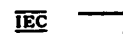
15.2.1.3 Application: E-plane coupling by aperture; 3 ends of transmission path available



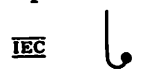
15.2.1.4 Application: E-plane coupling by aperture; 4 ends of transmission path available



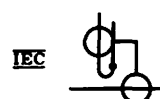
15.2.2 Coupling by loop to space



15.2.3 Coupling by loop to guided transmission path



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



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

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.

15.2.5 Coupling by probe to space

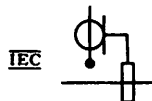
See OPEN CIRCUIT (item 3.8.1)



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



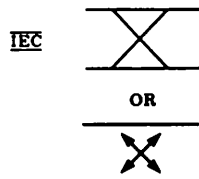
15.3 Directional Coupler F

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.

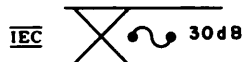
15.3.1 General



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



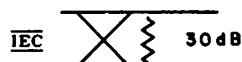
15.3.3 Application: loop coupling, 30-decibel transmission loss



15.3.4 Application: probe coupling, 30-decibel transmission loss

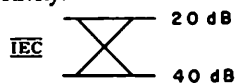


15.3.5 Application: resistance coupling, 30-decibel transmission loss



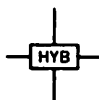
15.3.6 Application: directional coupler showing coupling loss and directivity

First value is coupling loss; second value is directivity.



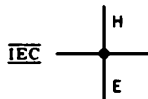
15.4 Hybrid Directionally Selective Transmission Devices

15.4.1 Hybrid (general)

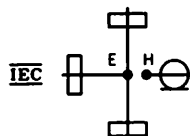


15.4.2 Hybrid, junction (magic T)

Commonly used in coaxial and waveguide transmission



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.

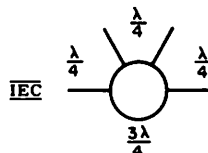
An arm that has coupling of a different type from that designated above shall be marked according to COUPLING (item 15.2.1).

Critical distances should be labeled in terms of guide wavelengths.

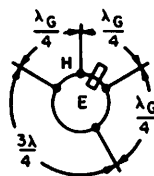


* See Note 15.4.4A

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

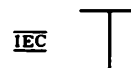


15.5 Mode Transducer

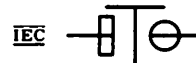
Commonly used in coaxial and waveguide diagrams.

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

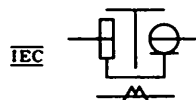
15.5.1 General



15.5.2 Application: transition from rectangular to circular waveguide



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



15.6 Mode Suppressor

Commonly used in coaxial and waveguide transmission.

15.6.1 General



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.



* See Note 15.7.1A

15.7.1.1 Application: coaxial type in rectangular waveguide system



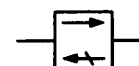
15.7.1.2 Application: circular waveguide type in rectangular waveguide system



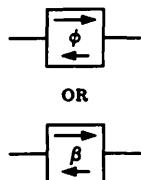
15.8 Nonreciprocal Devices

15.8.1 Isolator

See also symbol 8.10

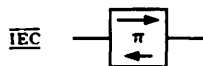


15.8.2 Nonreciprocal directional phase shifter



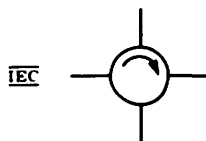
15.8.3 Gyrator

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.

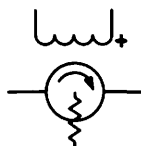


15.8.5 Field-polarization rotator

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



15.8.6 Field-polarization amplitude modulator

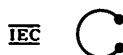


15.9 Resonator Tuned Cavity F

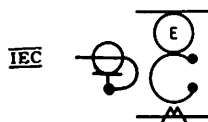
Excluding piezoelectric and magnetostriction devices.

15.9.1 General

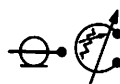
Commonly used for coaxial and waveguide transmission.



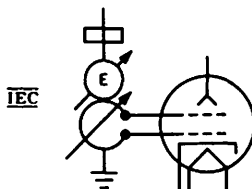
15.9.2 Application: resonator with mode suppression coupled by an E-plane aperture to a guided transmission path and by a loop to a coaxial path



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

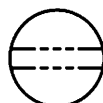


15.9.4 Application: tunable resonator with direct-current ground connected to an electron device and adjustably coupled by an E-plane aperture to a rectangular waveguide

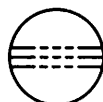


15.10 Resonator (cavity-type) Tube

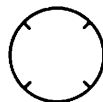
15.10.1 Single-cavity envelope and grid-type associated electrodes



15.10.2 Double-cavity envelope and grid-type associated electrodes



15.10.3 Multicavity magnetron anode and envelope



15.11 Magnetron

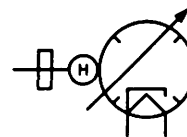
15.11.1 Resonant type with coaxial output



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

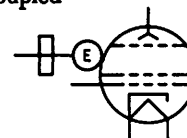


15.11.3 Tunable, aperture coupled



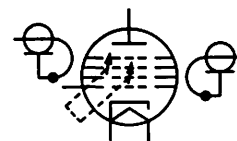
15.12 Velocity-Modulation (velocity-variation) Tube

15.12.1 Reflex klystron, integral cavity, aperture coupled



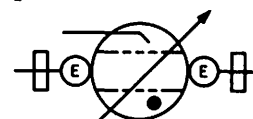
15.12.2 Double-cavity klystron, integral cavity, permanent externally ganged tuning, loop coupled (coupling loop may be shown inside if desired).

See symbol 15.2.2



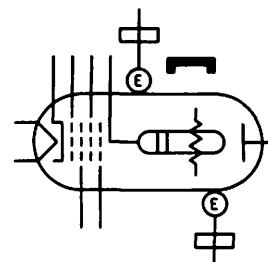
15.13 Transmit-Receive (TR) Tube

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

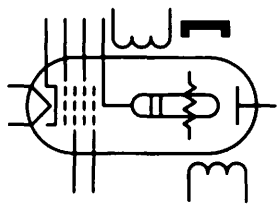


15.14 Traveling-Wave-Tube

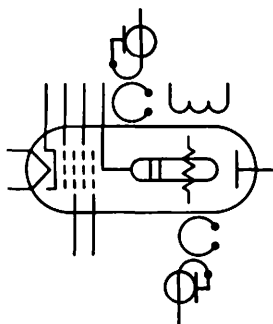
15.14.1 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide.



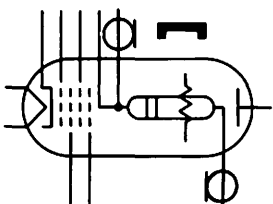
15.14.2 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by inductive coupling



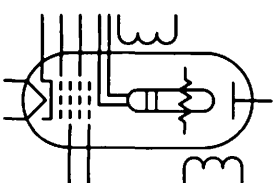
15.14.3 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, external electromagnetic focusing, rf input and rf output coupling, even by external cavity and loop coupling to a coaxial path



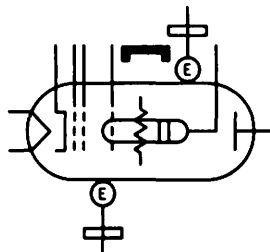
15.14.4 Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling, each by direct connection from slow-wave structure to a coaxial path



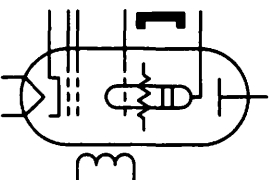
15.14.5 Forward-wave traveling-wave-tube amplifier shown with four grids, having bifilar slow-wave structure with attenuation, electrostatic focusing, rf input and rf output coupling, each by inductive coupling



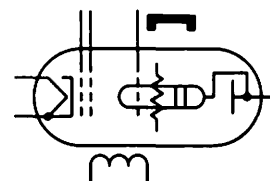
15.14.6 Backward-wave traveling-wave-tube amplifier shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf input and rf output coupling, each by E-plane aperture to external rectangular waveguide



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

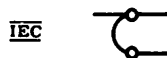


15.14.8 Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling, with slow-wave structure connected internally to collector

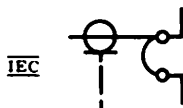


15.15 Balun

15.15.1 General



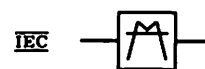
15.15.2† Application: balun connected between a balanced dipole and unbalanced coaxial cable



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

15.16 Filter

15.16.1 Mode filter



15.16.2 Frequency filter (bandpass)

See also symbol 16.1.1.2

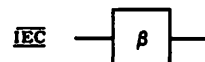


15.17 Phase Shifter (matched)

See also symbols 15.8.2 and 16.6



OR

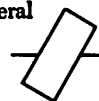


15.18 Ferrite Bead Ring

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.

16.1 Circuit Assembly Circuit Subassembly Circuit Element

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

NOTE 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.

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

- Diagrams drawn in block form.
- A substitute for complex circuit elements when the internal operation of the circuit element is not important to the purpose of the diagram.
- 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 \square
FL	Filter
FL-BE	Filter, band-elimination
FL-BP	Filter, bandpass \square
FL-HP	Filter, high-pass \square
FL-LP	Filter, low-pass \square
IND	Indicator
PS	Power supply \square
RC	Recording unit
RU	Reproducing unit
ST-INV	Static inverter
DIAL	Telephone dial
TEL	Telephone station
TPR	Teleprinter \square
TTY	Teletypewriter \square

16.2 Amplifier \square

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



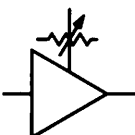
See Note 16.2.1A

16.2.5 Application: amplifier with adjustable gain



See Note 16.2.1A

16.2.6 Application: amplifier with associated attenuator



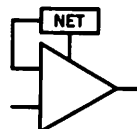
See Note 16.2.1A

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

NOTE 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.

NOTE 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

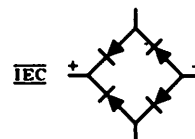
16.3.2 Controlled



See Notes 16.3.1A and B

16.3.3 Bridge-type rectifier

See item 8.5.1



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 \square)

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

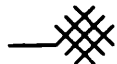


**16.5 Network
Artificial Line (other than delay line)**

16.5.1 General

NET

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

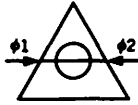


16.6.3 Application: adjustable



16.6.4 Differential phase shifter

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



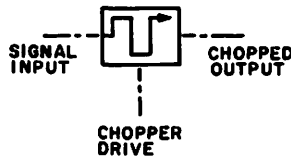
16.6.5 Application: adjustable



16.7 Chopper \square

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

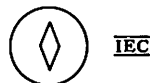
NOTE 16.7B: When diagram is other than single line, show connections as required for a specific device.



**16.8 Diode-Type Ring Demodulator
Diode-Type Ring Modulator**



**16.9 Gyro
Gyroscope
Gyrocompass**



16.10 Position Indicator

16.10.1 DC synchro type

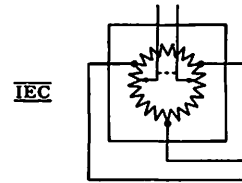


16.10.2 Inductor type

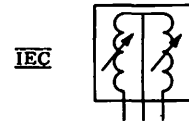


16.11 Position Transmitter

16.11.1 Desynn type (dc synchro type)



16.11.2 Inductor type



16.12 Fire Extinguisher Actuator Heads

16.12.1 Single head with connectors



16.12.2 Double head with connectors



Cross References

Oscillator (item 2.9)

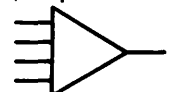
NOTES: 1. See Introduction for general information (note especially A3.1). 2. Symbols for single-line (one-line) diagrams appear at the left, symbols for complete diagrams at the right, and symbols suitable for both purposes are centered in each column.

17.1 Operational Amplifier

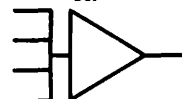


17.2 Summing Amplifier

(4 inputs and 1 output shown)



OR

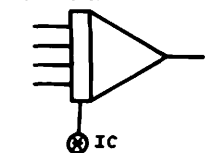


17.3 Integrator (Amplifier)

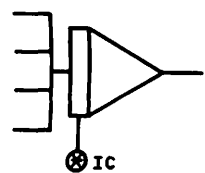
(4 inputs and 1 output shown)

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

NOTE 17.3B: The letters IC mean Initial Conditions.



OR

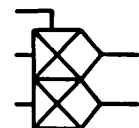


* See Note 17.3A

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.



See Note 17.8A

17.9 Function Potentiometer



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

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.

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.††

See paragraph A4.5 of the Introduction

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



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

19.1.2.3 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 19.1.2.8, except that they are not to be filled in.

19.1.3.1 Application: fault-isolation signal to relay



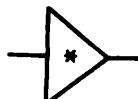
19.2 Functional Circuits

See Note 19.1A

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

NOTE 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.

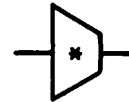
NOTE 19.2.1B: The asterisk is not part of the symbol. A circuit identifier code should be added for proper identification of the basic symbol.



*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

OR



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

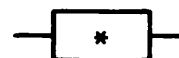


*See Note 19.2.1B

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.

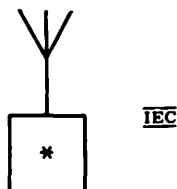
Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts

20.1 Radio Station

Other antenna symbols may be used to indicate specific types.

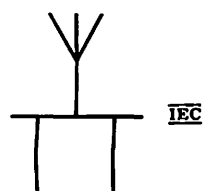
NOTE 20.1A: The asterisk is not part of the symbol; identification of the type of station may be added within or adjacent to the symbol.

20.1.1 General

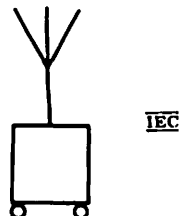


* See Note 20.1A

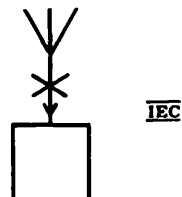
20.1.2 Portable



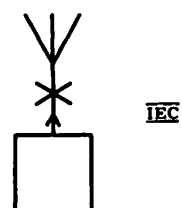
20.1.3 Mobile



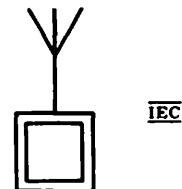
20.1.4 Direction-finding



20.1.5 Radio beacon



20.1.6 Controlling



20.1.7 Passive relay

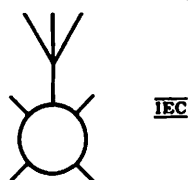


20.2 Space Station

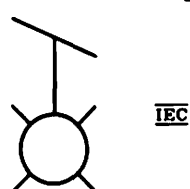
20.2.1 General



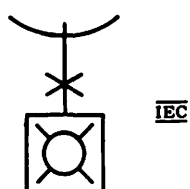
20.2.2 Active space station



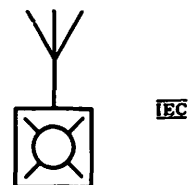
20.2.3 Passive space station



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



20.2.5 Application: earth station of a communication service via space station



20.3 Exchange Equipment

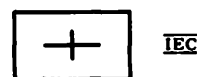
20.3.1 General

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



* See Note 20.3.1A

20.3.2 Automatic switching



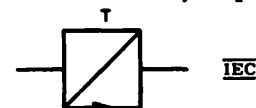
20.3.3 Manual switchboard



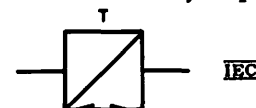
20.4 Telegraph Repeater

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

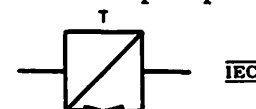
20.4.1 One-way simplex operation



20.4.2 Two-way simplex operation



20.4.3 Duplex operation



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)



20.4.4.2 Neutral direct-current (single current)

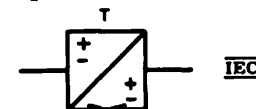


20.4.4.3 Alternating-current

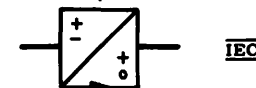


20.4.5 Applications:

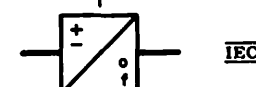
20.4.5.1 Polar direct-current for duplex operation



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



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



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.

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

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



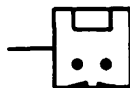
IEC

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



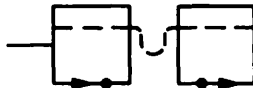
IEC

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

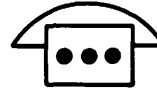
20.6.4 Dial-type

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.

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

21.1 Generating Station

NOTE 21.1A: Symbols for "planned" applications appear at the left; symbols for "in service" applications appear at the right.

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

NOTE 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



21.2 Hydroelectric Generating Station

See Note 21.1A

21.2.1 General



21.2.2 Run of river



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



▲
PLANNED

▲
IN SERVICE

21.3.4 Nuclear energy fueled



21.3.5 Geothermal



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.



▲
PLANNED

▲
IN SERVICE

Cross References

SECTION 22

22.1 to
22.4 A to E

Class Designation Letters*

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

SECTION 22

22.1 to
22.4 A to E

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

* 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 Manual 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.

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 $\overline{\square}$. 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*¹ electronic divider
(see electronic function generator
also (other than rotating)
U electronic multiplier
and facsimile set $\overline{\square}$
22.2.4) field-polarization amplitude
modulator
field-polarization rotator
general circuit element
gyroscope
integrator
positional servomechanism
sensor (transducer to electric
power)
separable assembly²
separable subassembly
telephone set
telephone station
teletypewriter $\overline{\square}$

AR amplifier (other than
rotating) $\overline{\square}$
repeater

¹ 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.

² 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.

AT	bolometer capacitive termination fixed attenuator $\overline{\square}$ inductive termination isolator (nonreciprocal device) pad resistive termination
B	blower motor $\overline{\square}$ synchro $\overline{\square}$
BT	barrier photocell battery $\overline{\square}$ battery cell blocking layer cell photovoltaic transducer solar cell
C	capacitor bushing capacitor $\overline{\square}$
CB	circuit breaker $\overline{\square}$ network protector
CP	connector adapter $\overline{\square}$ coupling (aperture, loop, or probe) junction (coaxial or waveguide)
D or CR	asymmetrical varistor crystal diode current regulator (semicon- ductor device) diode (semiconductor type) diode rectifier (semiconduc- tor type) diode-type ring demodulator diode-type ring modulator metallic rectifier $\overline{\square}$ photodiode (photosensitive type) stabistor thyristor (semiconductor diode type) varactor
D or VR	breakdown diode (voltage regulator) overvoltage absorber $\overline{\square}$
DC	directional coupler $\overline{\square}$
DL	delay function delay line $\overline{\square}$ slow-wave structure
DS	alphanumeric display device annunciator electrically restored drop general light source indicator (excluding meter or thermometer) $\overline{\square}$ 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 $\overline{\square}$

Class Designation Letters

	armature binding post $\overline{\text{E}}$ cable termination carbon block circuit terminal conductivity cell electrical contact $\overline{\text{E}}$ electrical contact brush $\overline{\text{E}}$ electrical shield electrolytic cell ferrite bead rings film element gap (horn, protective, or sphere) Hall element ignitor gap insulator $\overline{\text{E}}$ lightning arrester $\overline{\text{E}}$ magnetic core miscellaneous electrical part optical shield permanent magnet $\overline{\text{E}}$ rotary joint (microwave) short circuit (termination) spark gap splice telephone protector $\overline{\text{E}}$ telephone protector block $\overline{\text{E}}$ terminal (individual) $\overline{\text{E}}$ valve element vibrating reed		HY circulator directionally selective trans- mission device hybrid circuit network $\overline{\text{E}}$ hybrid coil (telephone usage) hybrid junction (magic T)		MP* brake clutch mechanical interlock mechanical part miscellaneous mechanical part (bearing, coupling, gear, shaft)
			J disconnecting device (receptacle connector) electrical receptacle connector $\overline{\text{E}}$ jack receptacle (connector, stationary portion) waveguide flange (choke) $\overline{\text{E}}$		MT accelerometer measuring transducer mode transducer motional pickup transducer primary detector
			K contactor (magnetically oper- ated) relay $\overline{\text{E}}$		N ³ equipment subdivision
			L coil (all not classified as transformers) $\overline{\text{E}}$ electrical solenoid $\overline{\text{E}}$ field winding generator field inductor lamp ballast motor field reactor $\overline{\text{E}}$ winding $\overline{\text{E}}$		P disconnecting device (plug connector) electrical plug connector $\overline{\text{E}}$ plug (connector, movable portion) waveguide flange (plain) $\overline{\text{E}}$
			LS audible alarm audible signaling device buzzer $\overline{\text{E}}$ electric bell $\overline{\text{E}}$ electric horn $\overline{\text{E}}$ loudspeaker $\overline{\text{E}}$ loudspeaker-microphone siren $\overline{\text{E}}$ telephone ringer $\overline{\text{E}}$ telephone sounder $\overline{\text{E}}$ underwater sound transducer		PS power supply $\overline{\text{E}}$ rectifier (complete power-sup- ply assembly)
EQ	equalizer equalizing network				PU head (with various modifiers) sound reproducer $\overline{\text{E}}$
F	current limiter (for power cable) fuse $\overline{\text{E}}$ fuse cutout		M clock $\overline{\text{E}}$ coulomb accumulator elapsed time recorder electric timer electrical counter $\overline{\text{E}}$ electrochemical step-function device instrument message register meter meter-type level pressure gage oscillograph $\overline{\text{E}}$ oscilloscope $\overline{\text{E}}$ position indicator thermometer		Q semiconductor controlled rectifier semiconductor controlled switch phototransistor (3 terminal) thyatron (semiconductor device) thyatron (semiconductor triode type) transistor $\overline{\text{E}}$
FL	filter $\overline{\text{E}}$		MG converter (rotating machine) dynamotor $\overline{\text{E}}$ inverter (motor-generator) motor-generator $\overline{\text{E}}$		R function potentiometer instrument shunt $\overline{\text{E}}$ magnetoresistor potentiometer relay shunt resistor $\overline{\text{E}}$ rheostat $\overline{\text{E}}$
G	electronic chopper $\overline{\text{E}}$ generator $\overline{\text{E}}$ ignition magneto $\overline{\text{E}}$ interrupter vibrator $\overline{\text{E}}$ oscillator rotating amplifier (regulating generator) telephone magneto		MK hydrophone microphone $\overline{\text{E}}$ telephone transmitter		RE radio receiver $\overline{\text{E}}$
H*	hardware (common fasteners, etc)				RT ballast lamp ballast tube current-regulating resistor $\overline{\text{E}}$ resistance lamp temperature-sensing element thermal resistor $\overline{\text{E}}$ thermistor
HP*	hydraulic part				RV symmetrical varistor voltage-sensitive resistor $\overline{\text{E}}$
HR	heater $\overline{\text{E}}$ heating lamp heating resistor infrared lamp $\overline{\text{E}}$ thermomechanical transducer				S contactor (manually, mechani- cally, or thermally operated) disconnecting device (switch) electrical safety interlock flasher (circuit interrupter)
HS	handset $\overline{\text{E}}$ operator's set				
HT	earphone $\overline{\text{E}}$ electrical headset $\overline{\text{E}}$ receiver (excluding radio receiver) telephone receiver				

¹ Not a class letter, but used to identify a subdivision of an equipment in the Location Numbering Method.

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

Class Designation Letters

	governor (electrical contact type) $\overline{\text{F}}$ speed regulator (electrical contact type) switch $\overline{\text{F}}$ telegraph key telephone dial $\overline{\text{F}}$ thermal cutout (circuit interrupter) (not visual) thermostat
SQ	electric squib $\overline{\text{F}}$ explosive squib fusible link igniter squib sensing link
SR	electrical contact ring $\overline{\text{F}}$ rotating contact slip ring
T	autotransformer coaxial taper linear coupler telephone induction coil $\overline{\text{F}}$ telephone repeating coil $\overline{\text{F}}$ transformer $\overline{\text{F}}$ waveguide taper
TB	connecting strip terminal board $\overline{\text{F}}$ terminal strip test block
TC	semiconductor thermocouple thermocouple $\overline{\text{F}}$ thermopile
TP ⁴	test point
TR	radio transmitter $\overline{\text{F}}$
U* ¹ (see also A* and 22.2.4)	inseparable assembly integrated-circuit package microcircuit micromodule photon-coupled isolator
V	electron tube $\overline{\text{F}}$ Geiger-Muller counter tube ionization chamber klystron magnetron phototube proportional counter tube resonator tube (cavity type) solion thyatron (electron tube) traveling-wave tube voltage regulator (electron tube)
VR (see also D)	induction voltage regulator voltage regulator (excluding electron tube) $\overline{\text{F}}$

⁴ Not a class letter, but commonly used to designate test points for maintenance purposes. See American National Standard Y14.15-1966 (R1973).

W	bus bar $\overline{\text{F}}$ cable cable assembly (with connectors) coaxial cable conductor distribution line distribution path Goubau line strip-type transmission line transmission line transmission path waveguide $\overline{\text{F}}$ wire $\overline{\text{F}}$
WT ⁵	wiring tiepoint
X	fuseholder $\overline{\text{F}}$ lampholder $\overline{\text{F}}$ socket $\overline{\text{F}}$
Y	magnetostriction oscillator piezoelectric crystal unit quartz crystal unit $\overline{\text{F}}$ tuning-fork resonator $\overline{\text{F}}$
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 $\overline{\text{F}}$ resonator (tuned cavity) slide-screw tuner

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.

⁵ Not a class letter, but commonly used to designate a tiepoint on connection diagrams. See American National Standard Y14.15-1966 (R1973).

23.1 Referenced Standards *

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)

* 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 Standard:

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, Technical: Functionally Oriented Maintenance Manual (FOMM)

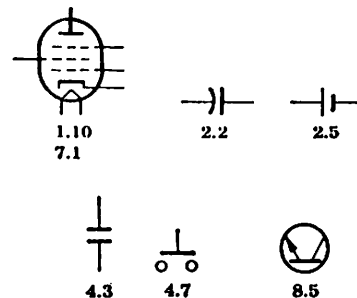
Federal Cataloging Handbook H6-1, Section A.

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 semi-conductors

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.

DO NOT USE



Cross References

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

Appendixes

(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.)

Appendix A Cross Reference List of Changed Item Numbers

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

Appendix B

Reference Data

International Electrotechnical Commission (IEC) Publication 117: Recommended Graphical Symbols

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





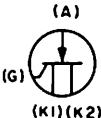
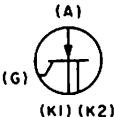
Publication 117 Part No.

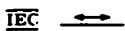







- 0 General Index (1973)
- 1 Kind of current, distribution systems, methods of connection and circuit elements (1960)
Amendments: 1 (August 1966), 2 (August 1967), 3 (August 1973)
- 2 Machines, transformers, primary cells, and accumulators, transducers and magnetic amplifiers, inductors (1960)
Amendments: 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)

















Publication 117 Part No.



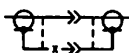


- 6 Variability, examples of resistors, elements of electronic tubes, valves and rectifiers (1964)
Amendments: 1 (August 1966), 2 (December 1967), 3 (August 1973)
- 7 Semiconductor devices, capacitors (Second edition, 1971)
- 8 Architectural diagrams (1967)
- 9 Telephony, telegraphy, and transducers (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)




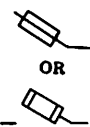

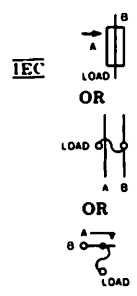
Appendix C Revised or Deleted Symbols


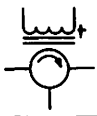




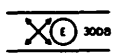
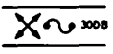
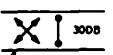
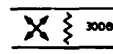

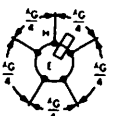

Symbols Formerly in ANSI Y32.2-1970	Recommended Symbols in ANSI Y32.2- 1975
<p>Revised</p> <p>2.6.3 Bifilar slow-wave structure</p> <p>Commonly used in traveling-wave tubes.</p>  <p>*See Note 2.6.1A</p>	<p>See item 2.6.4</p>
<p>Deleted Alternate</p> <p>8.5.1 Semiconductor diode; semiconductor rectifier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

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



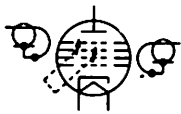
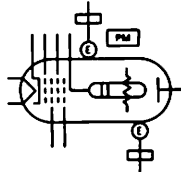
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
<p>Revised and Expanded</p> <p>4.21 Thermostat Ambient-temperature-operated device.</p> <p>Operates on rising temperature.</p> <p>4.21.1 With break contact See also item 4.20.2</p> <p></p> <p>OR</p> <p></p> <p>4.21.2 With make contact See also item 4.20.2</p> <p></p> <p>OR</p> <p></p> <p>4.21.3 With integral heater and trans- fer contacts</p> <p> OR </p>	<p>See items 4.21 through 4.21.7</p>
<p>Deleted</p> <p>4.30 Relay </p> <p> †FO Fast-operate  †FR Fast-release</p>	<p>See item 4.30</p>
<p>Revised and Expanded</p> <p>4.30.5 Thermal relay </p> <p> OR </p> <p>OR</p> <p> OR </p> <p>OR</p> <p> OR </p>	<p>See items 4.30.5 through 4.30.6</p>

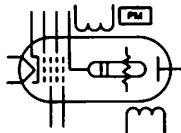
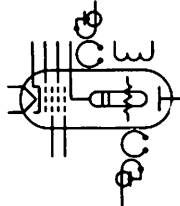
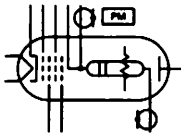
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
Revised 5.6.2 Coaxial with the outside con- ductor shown carried through 	See item 5.6.2
Revised 5.6.3 Application: Coaxial with out- side conductor shown carried through; with outside conductor terminated on chassis 	See item 5.6.3
Revised 5.6.4 Application: Coaxial with cen- ter 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 wave- guide with mated plain and choke flanges with direct-current isolation (in- sulation) between sections of wave- guide. 	See item 5.7.5

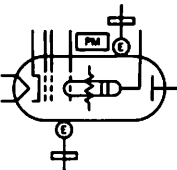










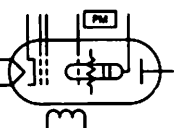
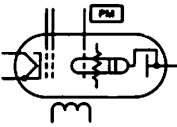
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
Revised 7.3.6 Cathode-ray tube 7.3.6.1 With electric-field deflection  7.3.6.2 For magnetic deflection 	See items 7.3.6 through 7.3.6.2.2
Revised 8.6.15 Thyristor, bidirectional triode- type; triac; gated switch Style 3 	See item 8.6.15
Revised and Expanded 9.1.2 High-voltage primary fuse cut- out, dry  IEC OR 	See item 9.1.3
Revised and Expanded 9.1.4 With alarm contact When fuse blows, alarm bus A is con- nected to power bus B. Letters are for explanation and are not part of the symbol. 	See item 9.1.2

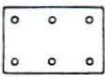

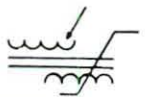
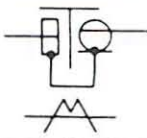

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified	Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
<p>Revised</p> <p>10.4.1 General</p> 	See item 10.4.1	<p>Deleted</p> <p>15.4.5.1 Application: circulator, reversible direction</p> <p>The polarity symbol (item 1.6) must be used with the electromagnet symbol to indicate proper direction flow.</p> 	See item 15.8.4.1
<p>Revised</p> <p>15.2.4 Coupling by loop from coaxial to circular waveguide with direct-current grounds connected</p> 	See item 15.2.4	<p>Revised</p> <p>15.5.3 Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected.</p> 	See item 15.5.3
<p>Revised</p> <p>15.2.7 Coupling by probe from coaxial to rectangular waveguide with direct-current grounds connected</p> 	See item 15.2.7	<p>Revised</p> <p>15.7.1.1 Application: coaxial type in rectangular waveguide system</p> 	See item 15.7.1.1
<p>Revised</p> <p>15.3.2 Application: E-plane aperture coupling, 30-decibel transmission loss</p>  <p>15.3.3 Application: loop coupling, 30-decibel transmission loss</p>  <p>15.3.4 Application: probe coupling, 30-decibel transmission loss</p>  <p>15.3.5 Application: resistance coupling, 30-decibel transmission loss</p> 	See items 15.3.2 through 15.3.6	<p>Deleted</p> <p>15.8.3 Unidirectional (isolator)</p> <p>Power flowing in direction of arrow is not intentionally attenuated.</p> 	See item 15.8.1
<p>Revised</p> <p>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</p> 	See item 15.4.4	<p>Revised</p> <p>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</p> 	See item 15.9.2

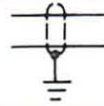
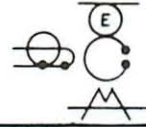
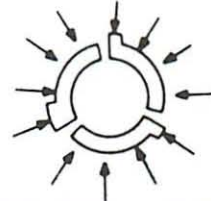
Revised or Deleted Symbols

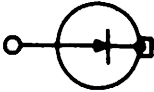



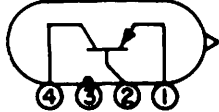

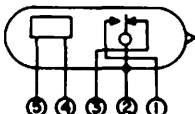
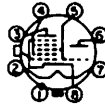
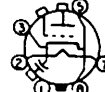



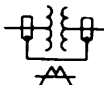
Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
<p>Revised</p> <p>15.9.3 Application: tunable resonator having adjustable Q coupled by a probe to a coaxial system</p> 	<p>See item 15.9.3</p>
<p>Revised</p> <p>15.11.1 Resonant type with coaxial output</p> 	<p>See item 15.11.1</p>
<p>Revised</p> <p>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.</p> 	<p>See item 15.12.2</p>
<p>Revised</p> <p>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</p> 	<p>See item 15.14.1</p>

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
<p>Revised</p> <p>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</p> 	<p>See item 15.14.2</p>
<p>Revised</p> <p>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</p> 	<p>See item 15.14.3</p>
<p>Revised</p> <p>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</p> 	<p>See item 15.14.4</p>

Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified	Symbols Formerly in USAS Y32.2-1967	Recommended Symbols in ANSI Y32.2- 1975, if Not Otherwise Specified
<p>Revised</p> <p>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</p> 	See item 15.14.6	<p>Deleted</p> <p>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</p> <p>AR Amplifier </p> <p>AT Attenuator</p> <p>C Capacitor </p> <p>CB Circuit breaker </p> <p>HS Handset </p> <p>I Indicating or switchboard lamp</p> <p>L Inductor</p> <p>J Jack</p> <p>LS Loudspeaker </p> <p>MIC Microphone </p> <p>OSC Oscillator</p> <p>PAD Pad</p> <p>P Plug</p> <p>HT Receiver, headset</p> <p>K Relay </p> <p>R Resistor </p> <p>S Switch  or key switch</p> <p>T Transformer </p> <p>WR Wall receptacle</p>	See item 16.1.1
<p>Revised</p> <p>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</p> 	See item 15.14.7		
<p>Revised</p> <p>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</p> 	See item 15.14.8		

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
<p>Deleted</p> <p>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</p>  <p>See Note 11.3A FOR CONNECTION OR WIRING DIAGRAM</p>	See ANSI Y14.15-1966
<p>Corrected</p> <p>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.</p> 	See item 15.12.2
<p>Revised and Expanded</p> <p>42.7 Saturable-core inductor (reactor) Polarity marks may be added to direct-current winding. Explanatory words and arrow are not part of the symbol shown. DC WINDING</p> 	See item 6.3
<p>Revised</p> <p>48 Meter Instrument T Temperature meter</p>	See item 12.1
<p>Corrected</p> <p>53.3 Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected</p> 	See item 15.5.3
<p>Corrected</p> <p>58.8.2 Coaxial cable, recognition sym- Coaxial transmission path Cable, radio frequency $\overline{\text{E}}$, (Co- axial) See item 58.1.</p> 	See item 3.1.9

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
<p>Corrected</p> <p>58.8.4 Shielded 2-conductor cable with shield grounded</p> 	See item 3.1.8.4
<p>Corrected</p> <p>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.</p> 	See item 15.9.2
<p>Revised</p> <p>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.</p> 	See item 4.13.7
<p>Deleted</p> <p>81.5 Applications</p> <p>NOTE 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.</p> <p>NOTE 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.</p> <p>NOTE 81.5C: If pins are omitted in an otherwise standard terminal arrangement, do not respace the remaining pins.</p> <p>NOTE 81.5D: A terminal at the center of the terminal arrangement shall be identified as the CENTER terminal lead or pin.</p> <p>NOTE 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.</p>	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	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
<p>Deleted (Continued)</p> <p>81.5.1 Two-terminal device with one flexible lead and one rigid terminal connected to a metallic envelope (typical semiconductor diode shown).</p>  <p>81.5.2 Two-terminal device with rigid terminals and reference point located at one of the terminals (typical semiconductor diode shown).</p>  <p>81.5.3 Three-terminal device with circular arrangement of pin terminals with base orientation determined by gap in pin spacing (typical transistor shown).</p>  <p>81.5.4 Three-terminal device with rigid terminals, one connected to the metallic enclosure, and index pin (typical transistor shown).</p>  <p>81.5.5 Four-terminal device with in-line pin terminals, one connected to metallic enclosure, and reference point (typical transistor shown).</p>  <p>OR</p>  <p>81.5.6 Five-terminal device with in-line terminal leads, one connected to metallic enclosure and reference point (typical relay shown).</p> 	<p>See ANSI Y14.15- 1966</p>	<p>Deleted (Continued)</p> <p>81.5.7 Device with 8-terminal keyed (such as octal) base, rigid envelope terminal, and metallic envelope connected to base terminal (typical triode-heptode shown).</p>  <p>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).</p>  <p>81.5.9 Device with 9-terminal (such as noval) base utilizing gap in pin spacing to establish base orientation (typical twin triode shown).</p> 	<p>See ANSI Y14.15- 1966</p>
		<p>Revised</p> <p>84 Thermistor Resistor, Thermal \square "T" indicates that the primary characteristic of the element within the circle is a function of temperature.</p>	<p>See items 1.2.1 and 2.1.12</p>
		<p>Revised</p> <p>84.1 General</p> 	<p>See item 2.1.12.1</p>
		<p>Revised</p> <p>85.2.1 Temperature-measuring semiconductor thermocouple</p> 	<p>See item 8.8.1</p>
		<p>Corrected</p> <p>86.1.1 Application: transformer with direct-current connections and mode suppression between two rectangular waveguides</p> 	<p>See item 6.4.1.1</p>

Appendix F Cross-Reference List of Class Designation Letters

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 Terminology	Letter Code 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
# 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

IEC Publication 113-2 Terminology	Letter Code IEC	Y32.2
# Lighting device	E	DS
* Limit switch	S	S
# 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 valve	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
* 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
* Synchro	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

Cross-Reference List of Class Designation Letters

IEC Publication 113-2 Terminology		Letter Code IEC Y32.2	
#	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

NOTE: This index contains commonly accepted or standard item names as used in the list of symbols, as well as some colloquial names. Certain of these names may not appear under the item listing.

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Absorber, overvoltage	8.5.6	D,VR	Applications		
AC (see alternating-current)			Semiconductor	8.5	—
Accelerometer	2.11	A, MT	Transistor	8.6	—
Active space-station	20.2.2	—	Armature (commutator and brushes)	13.1.5	E
Actuating device, thermal	2.14	—	Arrester		
Acyclic generator	13.4.19	G	Electric surge	9.3	E
Adapter, connector	5.6.5	CP	Lightning	9.3	E
Adjustability, extrinsic	1.1.1	—	Arrow (adjustable)	1.1	—
General	1.1.1.1	—	Associated		
Linear	1.1.1.3	—	Path	3.4	W
Nonlinear	1.1.1.4	—	Equipment	A4.10	—
Preset	1.1.1.2	—		3.4	—
Adjustable			Asymmetrical waveguide		
Contact	4.2.2.1	E	connectors	5.7.2	J, P
Gain amplifier	16.2.5	AR	Attenuator	2.4	AT
In steps	1.1.3.2	—	Fixed	2.4.1	AT
Inductance	6.2.4	L	Variable	2.4.4	AT
Nonlinear variability	1.1.1.4	—	Audible-signaling devices	10.1	LS
Phase shifter	16.6.3	Z	Audio		
Resistor	2.1.3	R	Amplifier	16.2	AR
Transformer	6.4.9	T	Level meter	12.1	M
Aerial	2.3	E	Meter	12.1	M
Air (recognition symbol)	1.4.1	—	Automatic switching	20.3.2	—
Air circuit breaker	9.4.2	CB	Automatic transmitter	20.5.7.8	—
Air core	6.1.1	—	Autotransformer	6.4.8	T
Air path	3.1.3	—	Load ratio control	6.4.10.2	T
Air transmission path	3.1.3	—	Avalanche diode	8.5.6.1	D,VR
Alarm			Backward diode	8.5.7.2	D,CR
Audible	10.1	LS	Backward-wave traveling-wave tube	15.14.6-8	V
Contact	9.1.2	F	Balance (relay protective function)	9.5.5	—
Visual	11.2	DS	Balanced attenuator	2.4.2	AT
Alligator clip	5.3.1	E	Variable	2.4.5	AT
Alternate wiring	3.3	—	Balanced current relay	9.5.12.6	K
Alternating-current			Balanced stripline	3.7.2	W
Generator	13.1.2.2	G	Balancer, dc	13.4.15,16	G
Machine	13.5	B,G	Ball-type annunciator	11.2.3	DS
DC field	13.6	B,G	Ballast, lamp	6.2	L
Motor	13.1.3.2	B	Ballast lamp or tube	11.1.5	RT
Source	2.7	—	Balun	15.15	Z
Alternating- and direct-current composite machines	13.7	MG	Band elimination filter	16.1.1.2	FL
Alternating current telegraph repeater	20.4.4.3	—	Bandpass filter	16.1.1.2	FL
Ambient-temperature - operated device	4.21	S	Frequency	15.16.2	FL
Ammeter	12.1	M	Barrier photocell	8.7.3	BT
Ampere-hour meter	12.1	M	Base-orientation device	5.1.2.3	—
Amplidyne	13.4.20-23	G	Base pin terminals	5.1.2.1	E
Amplifier			Basic contact assemblies	4.3	—
Operational	17.1	AR	Battery	2.5	BT
Rotating	13.4.20	G	Bead ring, ferrite	15.18	E
Summing	17.2	AR	Bell	10.1.1	LS
Amplifier-type telephone set	20.6.10	A	Bidirectional photodiode (photosensitive type)	8.5.4.3	D,CR
Analog functions	17.1	—	Two segment, with common cathode lead	8.5.4.4	D,CR
Aneroid capsule operated switch	4.33	S	Four quadrant, with common cathode lead	8.5.4.5	D,CR
Angular velocity dependence	14.2.6	—	Bifilar slow-wave structure	2.6.4	DL
Annunciator	11.2.1	DS	Bimetallic strip	2.14	—
Anode			Binding post	5.1.1	E
Electron tube	7.1.3.1	—	Bipolar voltage limiter	8.5.6.2	D,VR
Target	7.1.3.2	—	Block		
X-ray tube	7.1.3.2	—	Carbon	9.3.2	E
Antenna	2.3	E	Connecting	5.1.1.1	TB
Antenna-counterpoise	2.3.4	E			
Aperture coupling	15.2.1	CP			

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Telephone protector	9.3.2	E	Cathode		
Test	5.5	TB	Cold	7.1.1.3	—
Blocking layer cell	8.7.3	BT	Directly heated	7.1.1.1	—
Blowout coil	4.4	L	Electron tube	7.1.1	—
Board, terminal	5.1.1.1	TB	Indirectly heated	7.1.1.2	—
Bolometer	2.1.11.3	AT	Ionically heated	7.1.1.6	—
Booster amplifier	16.2.1	AR	Photo	7.1.1.4	—
Brake	14.3	MP	Pool	7.1.1.5	—
Break contact	4.3.1	S	Tapped	7.2.3	—
Break switch			Cathode ray tube	7.3.6	V
Locking	4.10.2	S	Cavity, tuned	15.9	Z
Nonlocking	4.9.2	S	Cavity resonator	15.10	V
Pushbutton	4.7.2	S	Cell		
Breakdown diode			Aluminum (Arrester)	9.3.3	E
Bidirectional	8.5.6.2	D,VR	Battery	2.5	BT
	8.5.6.4	D,VR	Blocking-Layer (Photosensitive)	8.7.3	BT
Unidirectional	8.5.6.1	D,VR	Conductivity	7.6	E
	8.5.6.3	D,VR	Electrolytic (Arrester)	9.3.3	E
	8.3.1	—	Photosensitive		
Breakdown indicator			Photoconductive		
Breaker (see circuit breaker)			Asymmetrical	8.7.1	CR,D
Bridge rectifier	16.3.3	D,CR	Symmetrical	8.7.2	R
Bridging amplifier	16.2.1	AR		2.1.13	R
Brush-shifting motor	13.5.11-13	B	Photovoltaic	8.7.3	BT
Brushes	13.1.5	E	Solar	8.7.3	BT
Buchholz relay (relay protective function)	9.5.12.19	—	Chassis	3.9.2	—
Bus bar	3.1.1.1	W	Chassis connection	3.9.2	—
Bushing, capacitor	2.2.14	C	Choke coil	6.2	L
Buzzer	10.1.2	LS	Choke waveguide flanges	5.7.4	J,P
			Chopper	16.7	G
Cable	3.1	W	Circuit		
Coaxial	3.1.9	W	Breaker	9.4	CB
Shielded			Air	9.4.2	CB
Multiple	3.1.8.3	W	Magnetic	9.4.6	CB
Single	3.1.8.1	W	Thermal	9.4.5	CB
Termination	5.2	E	Element (general)	16.1.1	—
Underground	3.2.2	W	Open	3.8.1	AT
Cable assembly	3.1.1	W	Return	3.9	—
Cable end, not connected	3.1.1.2	E	Short	3.8.2	AT
Cable gland	3.1.0	E	Terminal	5.1.1	E
Cable underground	3.2.2	W	Circuit-closing switch		
Cam-operated master switch	4.13.10	S	Locking	4.10.1	S
Capacitive			Nonlocking	4.9.1	S
Diode	8.5.2	D,CR	Pushbutton	4.7.1	S
Special property indicator	8.3.4	—	Circuit-opening switch		
Termination	2.2.10	AT	Nonlocking	4.9.2	S
Capacitor	2.2	C	Pushbutton	4.7.2	S
Bushing	2.2.14	C	Circular		
Coupling	2.2.12	C	Hybrid	15.4.4	HY
Differential	2.2.6	C	Waveguide	3.6.1	W
Electrolytic	2.2.2	C	Waveguide rotary joint	15.7.1.2	E
Feed-through	2.2.12	C	Circulator		
Fixed	2.2.1	C	Fixed direction	15.8.4	HY
Phase shifter	2.2.7	C	Reversible direction	15.8.4.1	HY
Polarized	2.2.2	C	Clean earth	3.9.1.1	—
Potential device	2.2.15-16	A,U	Clip		
Shielded	2.2.3	C	Alligator	5.3.1	E
Shunt	2.2.9	C	Test	5.3.1	E
Split stator	2.2.8	C	Clock	12.1	M
Terminating	2.2.10	C	Contact making	12.1	M
Variable	2.2.4	C	Clockwise rotation	14.2.5	—
Carbon block	9.3.2	E	Clutch	14.3	MP
Carrier-coupling capacitor	2.2.15	C	Coaxial		
Carrier current (relay protective function)	9.5.8	—	Cable	3.1.9	W
Carrier-line trap	6.2.8	Z	Connector	5.6	J,P
Carrier pilot (relay protective function)	9.5.12.16	—	Resonator	15.9.1	Z
			Rotary joint	15.7.1.1	E
			Waveguide	3.6.3	W
			Structure not maintained	3.1.9.1	—

<i>Name</i>	<i>Item Number</i>	<i>Class Letter</i>	<i>Name</i>	<i>Item Number</i>	<i>Class Letter</i>
Coil (see also inductor)			Disconnecting device	5.3	J,P
Choke	6.2	L	Symmetrical (waveguide)	5.7.1	J,P
Loading	6.2	L	Waveguide	5.7	J,P
Magnetic blowout	4.4	L	Connector adapter	5.6.5	CP
Multiwinding	4.5.2	L	Connector, coaxial	5.6	J,P
Operating	4.5	L	Constant-current transformer	6.4.6	T
Relay	4.5	L	Contact		
Repeating	6.4	L	Bridging	4.2.2.4	E
Retardation	6.2	L	Electrical	4.2	E
Coil operated flag indicator	6.2.9	L	Fixed	4.2.1	E
Cold cathode	7.1.1.3	—	Locking	4.2.2.2	E
Lamp	11.1.3	DS	Moving	4.2.2	E
Tube	7.3.4	V	Nonlocking	4.2.2.3	E
Collecting and emitting electrode	7.1.4	—	Rotating	4.2.2.7	E
Alternately collecting and emitting	7.1.4.2	—	Split Reed	4.2.2.6	E
Dynode	7.1.4.1	—	Vibrator Reed	4.2.2.5	E
Collecting electrode	7.1.3	—	Contact assembly, basic	4.3	S
Anode	7.1.3.1	—	Contact make-break ammeter	12.1	M
Collector	7.1.3.1	—	Contact make-break voltmeter	12.1	M
Fluorescent target	7.1.3.1	—	Contact	4.29	K,S
Plate	7.1.3.1	—	Continuous loop fire detector	2.16	E
Target	7.1.3.2	—	Continuously adjustable	1.1.3.1	—
X-ray anode	7.1.3.2	—	Inductor, inductance	6.2.5	L
Collector (semiconductor device)			Resistor	2.1.4	R
Plurality of	8.2.5.1	—	Control-differential		
Single	8.2.5	—	transmitter, synchro	13.8	B
Combination locking and nonlocking switch	4.11	S	Control transformer, synchro	13.8	B
Common-battery telephone set	20.6.3	A	Control transmitter, synchro	13.8	B
Common connections	3.9.3	—	Controlled rectifier	16.3.2	PS
Communication switchboard- type			N-type	8.6.12.1	Q
Connector	5.3.5	J,P	P-type	8.6.13.1	Q
Lamp	11.2.6	DS	Controlling electrode	7.1.2	—
Commutating field	13.2.1	L	Beam-confining or beam-forming	7.1.2.1	—
Commutator	13.1.5	—	Deflecting	7.1.2.2	—
Compensating field	13.2.1	L	Excitor	7.1.2.4	—
Composite machines	13.7	MG	Grid	7.1.2.1	—
Compound generator	13.4.13	G	Ignitor	7.1.2.3	—
	13.4.14	G	Reflecting or repelling	7.1.2.2	—
Compound motor	13.4.9	B	Controlling radio station	20.1.6	—
	13.4.10	B	Convenience outlets	5.4	J
Compression amplifier	16.2.1	AR	Converter, motor	13.7.5	MG
Condenser, synchronous	13.6.1-4	G	Core	6.1	—
Conditional wiring	3.3	W	Air	6.1.1	—
Conductance (VHH, VHF, SHF)	15.1.3.3	Z	Magnet	6.1.3	E
Conductive path	3.1.2	W	Magnetic	6.1.2	E
Conductivity cell	7.6	E	Magnetic memory	6.1.4	E
Conductor	3.1	W	Coulomb accumulator	7.5	M
Assembled	3.1.8	W	Counter, electromagnetically operated	12.2	M
Associated	3.1.7	W	Counterpoise, antenna	2.3.4	E
Junction	3.1.6.4	—	Coupled tunable resonator	15.9.2-4	Z
Hermaphroditic	3.1.6.5	J, P	Coupler		
Not connected	3.1.12	E	Directional	15.3	DC
Shielded	3.1.8.1	W	RF rotary	15.7	E
Underground Cable	3.2.2	W	Coupling	15.2	CP
Conductor junction	3.1.6.5	J, P	Coupling capacitor	2.2.11	C
Connection			Crossing of paths	3.1.5	—
Chassis	3.9.2	—	Crystal diode	8.5.1	CR,D
Common	3.9.3	—	Crystal rectifier	8.5.1	CR,D
Frame	3.9.2	—	Crystal unit	2.10	Y
Mechanical	14.1	—	Current		
Connector	5.3	J,P,X	Limiter	9.2	F
Asymmetrical (waveguide)	5.7.2	J,P	Kind (qualifying symbols)	1.8	—
Communication switchboard type	5.3.5	J,P	Measuring thermocouple		
			Dissimilar metals	2.13.2	TC
			Semiconductor	8.8.2	TC
			Regulator diode	8.5.11	CR,D

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Transformer	6.4.18	T	Light emitting	8.5.4.2	DS
Polarity markings	1.6.3.1	—	Photo	8.5.4	—
Cutout, primary fuse			Emissive type	8.5.4.2	D,CR
Dry	9.1.2	F	Sensitive type	8.5.4.1	D,CR
Oil	9.1.3	F	Bidirectional (photosensi- tive type)	8.5.4.3	D,CR
Cutout, thermal	4.20	S	PIN-type	8.5.12	D,CR
Element	2.14	HR	Rectifier (semiconductor)	8.5.1	D,CR
Flasher	4.22	S	Reverse blocking	8.5.8	D,CR
Darlington transistor	8.6.17	Q	Semiconductor	8.5.1	D,CR
Dashpot, relay	4.30	K	Step-recovery	8.5.9	D,CR
Data flow code signals	19.1	—	Storage	8.5.5	D,CR
DB meter	12.1	M	Temperature dependent	8.5.3	D,CR
DBM meter	12.1	M	Tunnel	8.5.7.1	D,CR
DC (see direct-current)			Voltage regulator	8.5.6.1	VR
DC to dc rotary converter			Diode-type ring demodulator	16.8	D,CR
With common permanent magnet field	13.4.24	MG	Diode-type ring modulator	16.8	D,CR
With common field winding	13.4.25	MG	Dipole antenna	2.3.2	E
Decibel meter	12.1	M	Direct current		
Deflecting electrode	7.1.2.2	—	Amplifier	16.2.1	AR
Delay	1.2.5	—	Generator	13.1.2.1	G
Delay function	2.6	DL	Isolation, intentional	3.5	—
	1.2.5	—	Machines	13.4	B,G
Delay line	2.6	DL	Generator	13.4.1-23	G
Delta connection	1.9.3	—	Motor	13.4.1-10	B
Delta winding	13.3.5	—	Motor	13.1.3.1	B
Demand meter	12.1	M	Source	2.5.1	BT
Demand totalizing relay meter	12.1	M	Direction-finding ratio station	20.1.4	—
Demodulator, diode-type ring	16.8	D,CR	Direction of flow of power, signals, or information	1.7	—
Detector			Directional coupler	15.3	DC
Continuous loop fire	2.16	E	Directional distance (relay protective function)	9.5.12.9	—
Crystal	8.5.1	D,CR	Directional overcurrent (relay protective function)	9.5.4	—
Primary	2.11	MT	Directional residual overcurrent (relay protective function)	9.5.12.3	—
Device			Directly heated cathode	7.1.1.1	—
Actuating, thermal	2.14	HR	Disconnecting device	5.3	J,P,X
Audible signaling	10.1	LS	Disconnecting fuse-switch	9.1.3	S
Disconnecting	5.3	J,P,X		9.1.5	S
Outdoor metering	6.4.21	T	Disconnecting switch	4.6	S
Semiconductor	8.1	—	Discontinuity	15.1	Z
Visual signaling	11.2	DS	Distance (protective relay function)	9.5.12.8	—
Diac, trigger	8.5.6.3	D,CR	Distribution line	3.2	—
Dial, switch, telephone	4.25.2	S	Divider, electronic	17.5	A
Dial telephone	16.1.1.2	S	Double		
Dial-type telephone set	20.6.4	A	Based diode		
Diametrical winding	13.3.6	—	N-type	8.6.8	Q
Dielectric-filled metallic waveguide	3.6.2.1	W	P-type	8.6.9	Q
Dielectric path	3.1.4	W	Headset	10.4.2	NT
Differential			Zig-zag connection	1.9.14	—
Capacitor	2.2.6	C	Double-biased relay	4.30	K
Current relay	9.5.12.7	K	Double-current (telegraph repeater)	20.4.4.1	—
Phase-shifter	16.6.4	Z	Double-current generator	13.4.18	G
Receiver (synchro)	13.8.3	B	Double-delta connection	1.9.11	—
Relay	4.30	K	Double-delta winding	13.3.7	—
Relay protective function	9.5.6	—	Double-throw switch	4.6.2	S
Transmitter	13.8.3	B	Drop (annunciator)	11.2.2-8	DS
Digital logic functions	18.1	—	Drum switch	4.13.11	S
Diode			Duplex (telegraph)	20.5.5	—
Avalanche	8.5.6.1	D,VR	Duplex telegraph repeater	20.4.3	—
Backward	8.5.7.2	D,CR	Dynamotor	13.4.17	MG
Breakdown					
Bidirectional	8.5.6.2	D,CR	E-H tuner	15.1.5	Z
	8.5.6.4	D,CR	E-plane coupling	15.2.1	CP
Unidirectional	8.5.6.1	D,CR			
	8.5.6.3	D,CR			
Capacitive	8.5.2	D,CR			
Crystal	8.5.1	D,CR			

Name	Item Number	Class Letter
Earphone	10.4	HT
Earth (see ground)		
Earth-station (satellite communication)	20.2.4	—
Elapsed time meter	12.1	M
Electret	1.14	E
Electret material	1.4.5	—
Electric bell	10.1.1	LS
Electric horn	10.1.3	LS
Electrical contact	4.2	E
Electrically polarized relay	4.30	K
Electrically restored drop	11.2.5	DS
Electrochemical step-function device	7.5	M
Electrochemical time-dependence cell	7.5	M
Electrode		
Anode	7.1.3	—
Cathode	7.1.1	—
Collecting	7.1.3	—
Collecting and emitting	7.1.4	—
Controlling	7.1.2	—
Deflecting	7.1.2.2	—
Emitting	7.1.1	—
Exit	7.1.2.4	—
Grid	7.1.2.1	—
Heater	7.1.5	—
Ignitor	7.1.2.3	—
Electrolytic capacitor	2.2.2	C
Electrolytic cell	9.3.3	E
Electromagnetic radiation		
Dependence	1.3	—
Emitting	1.3	—
Sensitivity	1.3	—
Electromagnetically operated counter	12.2	M
Electron tube	7.1	V
Applications	7.3	V
Heater	7.1.5	—
Notes	7.2	—
Terminals	5.1.2	E
Electronic divider	17.5	A
Electronic flash tube	11.1.6	DS
Electronic function generator	17.6	A
Electronic multiplier	17.4	A
Element		
Circuit (General)	16.1.1	—
Film (arrestor)	9.3.7	E
Fuse	9.1	F
Fusible	9.1	F
Hall	8.9	E
Thermal	2.14	—
Emitter	8.2.4	—
Emitting electrode	7.1.1	—
Cold cathode	7.1.1.3	—
Directly heated cathode	7.1.1.1	—
Indirectly heated cathode	7.1.1.2	—
Ionically heated cathode	7.1.1.6	—
Photocathode	7.1.1.4	—
Pool cathode	7.1.1.5	—
Enclosure	1.10	—
Envelope	1.10	—
Connections	5.1.2	E
Terminals	5.1.2.2	E
Epitaxial transistor		
PNP-type	8.6.1	Q
NPN-type	8.6.2	Q
Equalizer	16.1.1.2	EQ
Equivalent chassis connection	3.9.2	—

Name	Item Number	Class Letter
Erasing head	2.9.4	PU
Esaki diode	8.5.7.1	D,CR
Evacuated switch	4.25.3	S
Exchange equipment	20.3	—
Excitor electrode	7.1.2.4	—
Expansion amplifier	16.2.1	AR
Explosive squib	2.12.1	SQ
External shield, X-ray	7.1.6.2	E
Extinguisher, fire (actuating head)	16.12	E
Extrinsic adjustability	1.1	—
Facsimile (telegraph)		
Qualifying symbol	20.5.6.6	—
Receiver	20.5.7.6	—
Facsimile set	16.1.1.2	A
Fast operate relay	4.30	K
Fast release relay	4.30	K
Fault signal code	19.1.3	—
Feed-through capacitor	2.2.12	C
Feedback amplifier	16.2.8	AR
Female nonpolarized connector	5.4.4	J,P
Female polarized connector	5.4.5	J,P
Ferrite bead ring	15.18	E
Field		
Commutating	13.2.1	L
Compensating	13.2.1	L
Generator or motor	13.2	L
Permanent magnet	13.2.4	E
Separately excited	13.2.3	L
Series	13.2.2	L
Shunt	13.2.3	L
Field-effect transistor		
N-type	8.6.10.1	Q
P-type	8.6.11.1	Q
Field polarization amplitude modulator	15.8.6	A,U
Field polarization rotator	15.8.5	A,U
Field winding	13.2	L
Filament, electron tube	7.1.5	—
Film element, arrestor	9.3.7	E
Filter	16.1.1.2	FL
Band elimination	16.1.1.2	FL
Bandpass	16.1.1.2	FL
Frequency	15.16.2	FL
High pass	16.1.1.2	FL
Low pass	16.1.1.2	FL
Mode	15.16.1	FL
Fire detector, continuous loop	2.16	E
Fire extinguisher (actuating head)	16.12	E
Five conductor cable	3.1.8.6	W
Fixed capacitor	2.2.1	C
Fixed contact	4.2.1	E
Fixed direction circulator	15.8.4	HY
Flag indicator, coil operated	6.2.9	L
Flanges, waveguide	5.7	J,P
Flash tube, electronic	11.1.6	DS
Flasher (circuit interrupter)	4.22	S
Flexible waveguide	3.6.4	W
Flow	1.7	—
Flow-actuated switch	4.17	S
Fluorescent lamp	11.1.2	DS
Foot operated switch	4.23	S
Forward-wave traveling-wave tube	15.14.1-5	V
Four layer diode	8.5.8	D,CR
Four-position switch	4.3.8.3	S
Four-wire two-way repeater	16.4.4	AR

Name	Item Number	Class Letter
Frame connection	3.9.2	—
Frequency converter, induction	13.5.2	G
Frequency filter	15.16.2	Z
Frequency meter	12.1	M
Full-wave rectifier, bridge	16.3.3	D,CR
Function potentiometer	17.9	R
Functional flow path	19.1.1	—
Functional symbols		
Amplifier circuit	19.2.1	—
Composite circuit	19.2.8	—
Digital logic elements	19.2.7	—
Linear element	19.2.3	—
Relay contacts	19.2.4	—
Relay or operating coil	19.2.5	—
Signal generator	19.2.2	—
Switch	19.2.6	—
Switching	4.1	—
Fuse	9.1	F
Fusible element	9.1	F
Fusible link	2.1.2.3	SQ
Future		
Equipment	A4.10	—
3.4	—	—
Path	3.4	W
Galvanometer	12.1	M
Gap	9.3	E
Horn	9.3.4	E
Protective	9.3.5	E
Sphere	9.3.6	E
Gas (recognition symbol)	1.4.1	—
Gas-filled tube envelope	1.10.3	—
Gas-filled waveguide	3.6.2.3	W
Gas pressure (relay protective function)	9.5.12.19	—
Gaseous liquid (recognition symbol)	1.4.4	—
Gate (control electrode)	8.2.9	—
Geiger-Muller counter tube	7.5	V
Generalized ac source	2.7	—
Generalized integrator	17.7	A
Generating station	21.1	—
Generator (rotating machinery)		
Acyclic	13.4.19	G
Alternating current	13.1.2.2	G
13.5-6	G	
Amplidyne	13.4.20.23	G
Compound (dc)	13.4.9-10	G
Compound (dc-3 wire)	13.4.13-14	G
Direct current	13.1.2.1	G
13.4	G	
Double current	13.4.18	G
Field	13.2	L
Hand	13.1.6	G
Magnetolectric	13.5.10	G
Regulating	13.4.20-23	G
Synchronous	13.1.2.3	G
13.6.1	G	
Winding connection symbols	13.3	—
Generator, electronic function	17.6	A
Gland, cable	3.10	E
Glow lamp	11.1.3	DS
Goubau line	3.6.7	W
Governor	4.27	S
Grid electrode	7.1.2.1	—
Grid-type annunciator	11.2.2	DS
Ground	3.9.1	—
Low-noise	3.9.1.1	—

Name	Item Number	Class Letter
Noiseless	3.9.1.1	—
Protective	3.9.1.2	—
Relay, protective function	9.5.10	—
Safety	3.9.1.2	—
Ground detector	12.1	—
Grouping of leads	3.1.10	—
Guided path	3.1.1	W
Gyrator	15.8.3	Z
Gyro	16.9	A
Gyrocompass	16.9	A
Gyroscope	16.9	A
H-plane coupling	15.2.1	CP
Half-wave antenna	2.3	E
Half-wave rectifier (diode)	8.5.1	D,CR
Hall element	8.9	E
Hall generator	8.9	E
Hand generator	13.1.5	G
Handset	10.3	HS
Head	2.9	PU
Erasing	2.9.4	PU
Playback	2.9.3	PU
Recorder	2.9.2	PU
Reproducer	2.9.3	PU
Stereo	2.9.6	PU
Headset		
Double	10.4.2	HT
Single	10.4.3	HT
Hearing aid receiver	10.4	HT
Heater, electron tube	7.1.5	—
Heating lamp	11.1.1	HR
Heating resistor	2.1.8	HR
Hermaphroditic connection	3.1.6.5	J,P
High-pass filter	16.1.1.2	FL
Hook switch	4.25.1	S
Horn	10.1.3	LS
Horn gap	9.3.4	E
Howler	10.1.3.2	LS
Hybrid	15.4	HY
Circular	15.4.4	HY
Junction	15.4.2	HY
Hydroelectric generating station	21.2	—
Hydrophone	10.1.3	MK
Hysteresis motor	13.5.7	B
Ignitor electrode	7.1.2.3	—
Ignitor plug	2.17	E
Ignitor squib	2.12.2	SQ
Illuminating lamp	11.1.4	DS
Incandescent lamp	11.1.4	DS
Indicating, pilot, signaling or switchboard light	11.2.7	DS
Indicating meter	12.1	M
Indicator, coil operated flag	6.2.9	L
Indirectly heated cathode	7.1.1.2	—
Induction generator	13.5.1	G
Induction motor	13.5.1	B
Induction voltage regulator	6.4.12-14	VR
Inductive reactance	15.1.2.2	Z
Inductive susceptance	15.1.2.3	Z
Inductive termination	6.2.7	AT
Inductor	6.2	L
Saturable-core	6.3	L
Shunt	6.2.6	L
Tapped	6.2.6	L
Inertia switch	4.31	S

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Inherent variability	1.1.2	—	Light		
Linear	1.1.2.1	—	Emitting diode	8.5.4.2	DS
Nonlinear	1.1.2.2	—	Illuminating	11.1.4	DS
Instrument, meter	12.1	M	Indicating or pilot	11.2.7	DS
Instrument shunt	2.1.9	R	Jeweled signal	11.2.8	DS
Insulated gate	8.2.8	—	Sensitive diode	8.5.4.1	D,CR
Integral heater, thermocouple	2.13.2	TC	Signal	11.2.7	DS
Integrating meter	12.1	M	Source, general	11.1.1	DS
Integrator (amplifier)	17.3	A	Switchboard	11.2.7	DS
Integrator, generalized	17.7	A	Light dependent device	1.3	—
Intentional direct current			Lightning arrester	9.3	E
isolation	3.5	—	Limit switch	4.14	S
Interlock			Spring return	4.14.5	S
Mechanical	14.1	—	Limiter, current	9.2	F
Safety	4.15	S	Limiting amplifier	16.2.1	AR
Internal shield, tube	7.1.6.1	—	Line		
Interruptor, vibrator	4.28	G	Distribution	3.2	—
Intrinsic region	8.2.7	—	Loaded	3.2.5	W
Intrinsic variability	1.1.2	—	Overhead	3.2.4	W
Inverter (rotating machine)	13.7	MG	Radio	3.2.6	W
Ionically heated cathode	7.1.1.6	—	Submarine	3.2.3	W
Ionization chamber	7.5	V	Telephone	3.2.1.1	W
Ionizing radiation			Transmission	3.2	W
Dependence, sensitivity	1.3.2	—	Underground	3.2.2	W
Emissivity	1.3.3	—	Underwater	3.2.3	W
Isolation, intentional dc	3.5	—	Line stretcher	15.19	W
Isolator (nonreciprocal)	15.8.1	AT	Linear adjustability	1.1.1.3	—
Isolator, photon-coupled	8.10	A,U	Linear coupler	6.5	T
			Linear variability	1.1.2.1	—
			Link sensing	2.12.3	SQ
Jack	5.3.3	J	Linkage, mechanical	14.1	—
Coaxial	5.6	J	Liquid (recognition symbol)	1.4.2	—
Connector	5.3	J	Liquid level switch	4.18	S
Contact	4.2.1.1	E	Load-ratio control		
Jeweled signal light	11.2.8	DS	Autotransformer	6.4.10.2	T
Joint, rotary	15.7	E	Transformer	6.4.11	T
Junction, hybrid	15.4.2	HY	Loaded line	3.2.5	W
Junction of paths or			Local battery telephone set	20.6.2	A
conductors	3.1.6	—	Locking switch	4.10	S
Junction transistor	8.6.1	Q	Loop antenna	2.3.3	E
			Loop coupling		
Key, telegraph	4.26	S	Electron tube	7.1.7.1	E
Key contact	4.2.1.1	E	Path	15.3	CP
Key operated lock switch	4.25.5	S	Space	15.2.2	CP
Key switch	4.12	S	Loudspeaker	10.1.3	LS
Keyboard (telegraph)	20.5.6.5	—	Loudspeaker microphone	10.1.3.3	LS
Keyboard perforator	20.5.7.7	—	Loudspeaker-type telephone		
Kinescope	7.3.6	V	set	20.6.9	A
Klystron	15.12	V	Low-noise ground	3.9.1.1	—
Knife switch	4.6.3	S	Low-pass filter	16.1.1.2	FL
			Low-voltage power network	16.5.2	Z
Lamp	11.1	—	Machine		
Ballast	11.1.5	RT	AC and dc composite	13.7	MG
Cold-cathode	11.1.3	DS	Alternating current	13.5-6	B,G
Communication switchboard	11.2.6	DS	Direct current	13.4	B,G
Fluorescent	11.1.2	DS	Rotating	13.1	—
Glow	11.1.3	DS	Magic T	15.4.2	HY
Incandescent	11.1.4	DS	Magnet, permanent	2.8	E
Indicating	11.2.7	DS	Magnetic		
Neon	11.1.3	DS	Amplifier	16.2	AR
Solid state	11.1.1	DS	Blowout coil	4.4	L
8.5.4.2			Core	6.1.2	E
Switchboard	11.2.7	DS	Core transformer	6.4.2	T
Latching relay	4.30	K	Field dependent device	1.2.2	—
Lead-screw limit switch	4.14.3	S	Head	2.9	PU
Letter combinations, terminal	5.1.2	—	Memory core	6.1.4	E
Lever-switch	4.12	S	Shielded windings	6.4.2.3	—

Name	Item Number	Class Letter
Magnetic-latching relay	4.30	K
Magnetically polarized relay	4.30	K
Magnetoelectric generator	13.5.10	G
Magnetoresistor	2.1.7	R
Magnetron	15.11	V
Major functional flow path	19.1.1.1	—
Make contact	4.3.2	S
Make switch		
Locking	4.10.1	S
Nonlocking	4.9.1	S
Pushbutton	4.7.1	S
Make-before-break contact	4.3.4	S
Make-before-break switch	4.10.5	S
Male nonpolarized connector	5.4.3	J,P
Manual Control	14.4	—
Manual switchboard	20.3.3	—
Manually restored drop	11.2.4	DS
Marconi antenna	2.3	E
Marginal relay	4.30	K
Master switch	4.13.9	S
Mated waveguide flanges	5.7.1-2	J,P
Mating connectors	5.3.4	J,P
Measuring transducer	2.11	A,MT
Mechanical		
Connection	14.1	—
Interlock	14.1	—
Linkage	14.1	—
Mercury pool tube	7.3.7	V
Mercury switch	4.32	S
Mesa transistor	8.6.1	Q
Message register	12.2	M
Metallic rectifier	8.5.1	D,CR
Meter	12.1	M
Metering device, outdoor	6.4.21	T
Microammeter	12.1	M
Microphone	10.2	MK
Microphone-loudspeaker	10.1.3.3	LS
Milliammeter	12.1	M
Minor functional flow path	19.1.1.2	—
Mobile radio station	20.1.3	—
Mode filter	15.16.1	FL
Mode suppressor	15.6	FL
Mode transducer	15.5	MT
Modifiers (see qualifiers)		
Modulator, field polarization, amplitude	15.8.6	A,U
Modulator, diode-type ring	16.8	D,CR
Moist gas (recognition symbol)	1.4.4.2	—
Momentary contact	4.2.1.3	E
Momentary switch	4.7	S
Monitoring amplifier	16.2.1	AR
Motion, mechanical	14.2	—
Motional pickup transducer	2.11	A,MT
Motor		
Alternating current	13.1.3.2	B
Compound, dc	13.4.9.10	B
Converter	13.7.5	MG
Direct current	13.1.3.1	B
Field	13.2	L
Induction	13.5	B
Multispeed	13.1.4	B
Reluctance	13.5.8	B
Series ac	13.5.3	B
Split-phase	13.5.1	B
Squirrel-cage	13.5.1	B
Synchronous	13.1.3.3	B
DC field	13.6.1	B
Winding symbols	13.3	—

Name	Item Number	Class Letter
Movable short	3.8.3	AT
Moving contact	4.2.2	E
Multiplier, electronic	17.4	A
Multicell battery	2.5.3	BT
Multigap arrester	9.3.8	E
Multiple monolithic transistor	8.6.2.1	Q
Multiposition switch	4.13	S
Multispeed motor	13.1.4	B
Multistub tuner	15.1.6	Z
Multiway switch	4.3.8	S
Multiwinding coil	4.5.2	K
Mushroom head switch	4.25.4	S
N-emitter		
Plurality of	8.2.4.2.1	—
Single	8.2.4.2	—
Negative phase-sequence overcurrent (relay protective function)	9.5.12.18	—
Neon lamp	11.1.3	DS
Network	16.5	Z
Low voltage power	16.5.2	Z
Phase changing	16.6	Z
Protector	9.4.3	CB
N/P region	8.2.2.2	—
No bias relay	4.30	K
Noise meter	12.1	M
Noiseless clean earth	3.9.1.1	—
Nonionizing electromagnetic radiation		
Dependence or emissivity	1.3.1	—
Nonlinear		
Adjustability	1.1.1.4	—
Resistor	2.1.5	R
Variability		
Inherent	1.1.2.2	—
Preset	1.1.1.2	—
Nonlocking switch	4.9	S
Nonpolarized connectors	5.4.3-4	J,P
Nonreactive relay	4.30	K
Nonreciprocal devices	15.8	—
Directional phase shifter	15.8.2	Z
Nonshorting selector switch	4.13.2	S
Normaled through connector	5.3.6	J,P
NPIN with ohmic connection	8.6.5	Q
NPIN with ohmic connection	8.6.7	Q
NPN transistor	8.6.2	Q
with multiple emitters	8.6.2.1	Q
NPN transverse biased	8.6.3	Q
PNPN switch, triode	8.6.13.1	Q
Numerous conductors	3.1.2.3	W
Ohmic drop exciter	13.5.14:15	—
Ohmmeter	12.1	M
Oil pressure meter	12.1	M
One-time thermal-overload device	9.1	F
One-way repeater	16.4.1	AR
One-way simplex telegraph repeater	20.4.1	—
Open circuit	3.8.1	AT
Operating coil	4.5	L
Operating quantity (relays)	9.5.9	—
Operational amplifier	17.1	AR
Operator's set	10.3	HS
Optical shielding	1.11.2	E
Oscillator	2.7	G

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Oscillograph	12.1	M	Phototransistor (2-lead)	8.5.10	D,CR
Oscilloscope	12.1	M	Phototransistor (3-lead)	8.6.16	Q
Out-of-step (protective relay function)	9.5.12.20	—	Phototube	7.3.5	V
Outdoor metering device	6.4.21	T	Photovoltaic transducer	8.7.3	BT
Output amplifier	16.2.1	AR	Physical state recognition symbol	1.4	—
Output control, variable	2.4.4	AT	Pickup	2.9	PU
Overcurrent (protective relay function)	9.5.12.1	—	Picture tube	7.3.6	V
Overfrequency (protective relay function)	9.5.12.10	—	Piezoelectric crystal unit	2.10	Y
Overhead line	3.2.4	W	Pilot light	11.2.7	DS
Overtemperature (protective relay function)	9.5.12.11	—	Pilot wire (relay protective function)		
Overvoltage absorber	8.5.6	D,VR	Differential current (relay)	9.5.12.14	K
P-emitter			Directional comparison (relay)	9.5.12.15	K
Plurality of	8.2.4.1.1	—	Relay	9.5.7	K
Single	8.2.4.1—	—	PIN-type diode	8.5.12	D,CR
P/N region	8.2.2.1	—	Plain waveguide flanges	5.7.3	J,P
Pad	2.4.1	AT	Planar transistor		
Page printing (telegraph)			PNP-type	8.6.1	Q
Qualifying symbol	20.5.6.4	—	NPN-type	8.6.2	Q
Receiver	20.5.7.4	—	Playback head	2.9.3	PU
Pair	3.1.7.1	W	Plug	5.3	P
Parametric amplifier	16.2	AR	Coaxial	5.6	P
Parametric diode	8.5.2	D,CR	Connector	5.3	P
Passive relay station	20.1.7	—	Female	5.3.1	P
Passive space station	20.2.3	—	Ignitor	2.17	E
Path	3.1	W	Male	5.3.2	P
Air or space	3.1.3	—	Switchboard	5.3.5	P
Conductive	3.1.2	W	Pneumatic (recognition symbol)	1.4.1	—
Crossing of	3.1.6	—	P/N region	8.2.2.1	—
Dielectric	3.1.4	W	PNIN with ohmic connection	8.6.6	Q
Junction of paths	3.1.5	—	PNIP with ohmic connection	8.6.4	Q
Transmission	3.1	W	PNP transistor	8.6.1	Q
Pentode	7.3.2	V	With case connected	8.6.1.1	Q
Perforated tape (telegraph)	20.5.6.2	—	PNPN switch		
Permanent magnet	2.8	E	Diode	8.5.8	D,CR
Phase balance (relay protective function)	9.5.12.12	K	Triode	8.6.12.1	Q
Phase changing network	16.6	Z	Point contact transistor	8.6.1	Q
Phase sequence quantities	9.5.11	—	Polarity markings	1.6.1.2	—
Phase sequence (relay protective function)	9.5.12.13	K	Instantaneous (windings)	1.6.3	—
Phase shifter	16.6	Z	Polarized capacitor	2.2.2	C
Capacitor	2.2.7	C	Polarized connector	5.4.5	J,P,X
Differential	16.6.4	Z	Polarizing marking, instantaneous	1.6.3	—
Nonreciprocal	15.8.2	Z	Polyphase transformer	6.4.16	T
Rotating machines	13.5.17-18	Z	Pool cathode	7.1.1.5	—
VHF, UHF, SHF	15.17	Z	Pool cathode rectifier	7.3.7.5	V
Phase shifting network	16.6	Z	Portable radio station	20.1.2	—
Phasemeter	12.1	M	Position indicator	12.1	M
Photocathode	7.1.1.4	—		16.10	M
Photocell, barrier	8.7.3	BT	Position transmitter	16.11	—
Photoconductive transducer			Positional servomechanism	17.8	A
Asymmetrical	8.5.4	D,CR	Positive phase sequence undervoltage (protective relay function)	9.5.12.17	—
Symmetrical	8.7.1	D,CR	Potential device, capacitor coupling	2.2.15-17	A,U
Photodiode	2.1.13	R	Potential transformer	6.4.20	T
Emissive type	8.5.4	—	Polarity marking	1.6.3.2	—
Sensitive type	8.5.4.2	DS	Potentiometer	2.1.3	R
Photo-duo-diode	8.5.4.1	D,CR	Function	17.9	R
Photoemissive diode with phototransistor (Isolator)	8.5.4.3	D,CR	Potentiometer contact, adjustable	4.2.2.1	E
Photon-coupled isolator	8.10.4	A,U	Power		
Photosensitive cell	8.10	A,U	Amplifier	16.2.1	AR
	8.7	—	Connector	5.4	J,P
			Directional relay	9.5.12.5	K
			Factor meter	12.1	M
			Flow	1.7	—
			Rectifier	16.3	PS

Name	Item Number	Class Letter
Supply	16.1.1.2	PS
DC	2.5.1	BT
Supply connectors	5.4	J,P
Preamp	16.2.1	AR
Preamplifier stage	16.2.1	AR
Preset adjustability	1.1.1.2	—
Continuous	1.1.4.1	—
In steps	1.1.4.2	—
Pressure operated switch	4.19	S
	4.33	S
Pressure tight bulkhead		
cable gland	3.10	E
Primary detector	2.11	MT
Prime movers (generating stations)	21.4	—
Printed wiring board chassis connection	3.9.2	—
Printing reperforator (telegraph)	20.5.7.3	—
Probe, test	5.3.2	E
Probe coupling	15.2.5	CP
Program amplifier	16.2.1	AR
Proportional counter tube	7.5	V
Protective functions, relay	9.5.1	—
Protective gap	9.3.5	E
Protective ground	3.9.1.2	—
Protector		
Network	9.4.3	CB
Telephone	9.3.2	E
Pushbutton switch	4.7.8	S
Pushbutton telephone set	20.6.5	A
Quad conductors	3.1.7.3	W
Quartz crystal unit	2.10	Y
Radiation indicators	1.3	—
Radio beacon	20.1.5	—
Radio frequency cable, coaxial	3.1.9	W
Radio link	3.2.6	W
Radio station	20.1	—
Reactance		
Capacitive	15.1.2.1	Z
Diode	8.5.2	D,CR
Inductive	15.1.2.2	Z
Infinite, L-C circuit	15.1.2.5	Z
Zero, L-C circuit	15.1.2.4	Z
Reactive factor meter	12.1	M
Reactor	6.2	L
Reading head	2.9.3	PU
Receiver		
Hearing aid	10.4	HT
Synchro	13.8	B
Telegraph	20.5.3	—
Telephone	10.4	HT
Receptacle	5.3.3	J,P
Recorder set, sound	16.1.1.2	A
Recording		
Demand meter	12.1	M
Head	2.9.2	PU
Meter	12.1	M
Pickup	2.9.2	PU
Unit	16.1.1.2	A
Rectangular waveguide	3.6.2	W
Rectifier		
Bridge-type	16.3	—
Controlled	16.3.2	PS
Semiconductor (diode-type)	8.5.8.9	D,CR
Semiconductor (triode-type)	8.6.12, 13,15	—

Name	Item Number	Class Letter
Diode (semiconductor type)	8.5.1	D,CR
Electron tube	7.1	V
Metallic	8.5.1	D,CR
Polarity marking	16.3.4	—
Semiconductor	8.5.1	D,CR
Tube		
Gas filled	7.3.4.1	V
Pool type	7.3.7.3-5	V
Rectifying junction	8.2.2	—
Reed, vibrator	4.2.2.5	MP
Regenerative-type telegraph		
repeater	20.4.5.4	—
Register, message	12.2	M
Regulating generator	13.4.20	G
Regulating machine	13.5.16	G
Regulator		
Bidirectional diode	8.5.6.2	D,VR
Current (diode)	8.5.11	D,CR
Induction voltage	6.4.12-14	T
Load ratio control transformer	6.4.11	T
Speed	4.27	S
Step voltage	6.4.10	VR
	6.4.10.1	T
	6.4.12-14	VR
Unidirectional diode voltage	8.5.6.1	D,VR
Relay	4.30	K
Coil	4.5	L
Basic	4.30.1	—
Contact	4.2.1.1	E
Demand totalizing meter	12.1	M
Functions (protective)	9.5.1	—
Operating coil	4.5	L
Operating quantities	9.5.9	—
Protective functions	9.5.1	—
Shunt	2.1.9	R
Thermal	4.30.5	K
Reluctance motor	13.5.8	B
Remanent relay	4.30	K
Repeater	16.4	AR
Repeating coil (see transformer)		
Reproducer	2.9	PU
Sound	2.9.3	PU
Reproducing unit	16.1.1.2	A
Repulsion motor	13.5.1	B
Repulsion-start motor	13.5.6	B
Resistance (discontinuity)	15.1.2.3	Z
Resistance, lamp	11.1.5	RT
Resistive termination	2.2.11	AT
Resistor	2.1	R
Adjustable	2.1.3	R
Heating	2.1.8	HR
Nonlinear	2.1.5	R
Shunt	2.1.10	R
Tapped	2.1.2	R
Thermal (thermistor)	2.1.12	RT
Voltage sensitive	2.1.6	RV
Resolver	13.8	B
Resonator		
Cavity	15.9	Z
Tube (cavity type) elements	15.10	—
Return circuit	3.9	—
Reversible direction circulator	15.8.4.1	HY
RF amplifier	16.2.1	AR
RF coupler, rotary	15.7	E
Rheostat	2.1.4	R
Ridged waveguide	3.6.6	W
Ringer, telephone	10.1.1	LS
Ringing relay	4.30	K

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Rotary			Single conductor	3.1.8.1	W
Amplifier	13.4.20-23	G	Transformer	6.4.2.2	T
Coupler	15.7	E	Two conductor cable	3.1.8.4	W
Joint	15.7	E	Shifter, phase	16.6	Z
Phase converter	13.5.1	B	Nonreciprocal	15.8.2	Z
Switch	4.14.4	S	Rotating machine	13.5.17-18	Z
Rotary converter, dc to dc	13.4.24	MG	VHF, UHF, SHF	15.17	Z
Rotating			Shockley diode	8.5.8	CR,D
Amplifier	13.4.20-23	G	Short circuit	3.8.2	E
Armature	13.1.5	E	Shorting selector switch	4.13.3	S
Electrical contact ring (slip ring)	4.2.2.7	SR	Shunt		
Machine	13.1	B,G	Capacitor	2.2.9	C
Rotation	14.2.3	—	Drive vibrator	4.28.1	G
Rotation speed indicator	14.2.6	—	Element, discontinuity	15.1.3	Z
Rotator, field polarization	15.8.1	A,U	Field	13.2.3	L
Safety gap	9.3	E	Conductor	6.2.6	L
Safety ground	3.9.1.2	—	Instrument relay	2.1.9	R
Safety interlock	4.15	S	Resistor	2.1.10	R
Circuit closing	4.15.2	S	Signal code	19.1.2	—
Circuit opening	4.15.1	S	Signal flow	1.7	—
Sandwich line	3.7.2	W	Signal light	11.2.7	DS
Sandwich wound relay	4.30	K	Signaling device		
Saturable-core inductor	6.3	L	Audible	10.1	LS
Saturable-core reactor	6.3	L	Visual	11.2	DS
Scott connection	1.9.10	—	Simultaneous printing/ perforating (telegraph)	20.5.6.3	—
SCR (see semiconductor controlled rectifier)			Single-current telegraph repeater	20.4.4.2	—
Sector switch	4.6.7	S	Single headset	10.4.3	HT
Segmental contact switch	4.13.4	S	Single phase transformer	6.4.15	T
Selector switch	4.13	S	Single-throw switch	4.6.1	S
Self-interrupting switch	4.22	S	Siren	10.1.3	LS
Semiconductor controlled rectifier (SCR)	8.6.2,13	Q	Six-phase symbols	1.9.11,14	—
Semiconductor controlled switch	8.6.14	Q	Sleeve	4.2.1.3	—
Semiconductor device	8.1	—	Slide screw tuner	15.1.4	Z
Diode	8.5	D,CR,VR	Slide switch	4.13.8	S
Element symbols	8.2	—	Sliding contact	4.2.2.1	E
Hall element	8.9	E	Slip ring	4.2.2.7	SR
Hall generator	8.9	E	Slow operate and release relay	4.30	K
Photosensitive cell	8.7	—	Slow operate relay	4.30	K
Rules	8.4	—	Slow release relay	4.30	K
Solid-state thyatron	8.11	Q	Slow-wave structure	2.6.3	DL
Terminals	5.1.2	E	Snap-off diode	8.5.9	D,CR
Tetrode	8.6.14	Q	Solar cell	8.7.3	BT
Thermocouple	8.8	TC	Solenoid	4.5	L
Three-terminal devices	8.6	E	Solid dielectric waveguide	3.6.2.2	W
Two terminal devices	8.5	—	Solid (recognition symbol)	1.4.3	—
Sensing link	2.12.3	SQ	Solid-state thyatron	8.11	Q
Sensor	2.11	MT	Solion	7.4	V
Temperature	2.16	E	Sound projector, underwater	10.1.3	LS
Separate drive vibrator	4.28.2	G	Sound recorder head	2.9.2	PU
Separately excited field	13.2.3	L	Sound reproducer head	2.9.3	PU
Series element (discontinuity)	15.1.1	Z	Sound-powered telephone set	20.6.11	A
Series field	13.2.2	L	Sounder, telegraph	10.1.4	LS
Servomechanism, positional	17.8	A	Source, generalized ac	2.7	—
Set			Space path	3.1.3	—
Facsimile	16.1.1.2	A,U	Space station	20.2	—
Operator's	10.3	HS	Spark gap	9.3	E
Shaded-pole motor	13.5.5	B	Speaker	10.1.3	LS
Shaft operated switch	4.24	S	Special cable indicator	1.13	—
Shield, shielding	1.11	—	Special connector indicator	1.13	—
Electrical	1.11.1	E	Special features		
Electron tube	7.1.6	E	Adjustability	1.1.3	—
Magnetic	1.11.1	E	Preset	1.1.4	—
Optical	1.11.2	E	Special-property		
Shielded			Device symbols	8.3	—
Five conductor cable	3.1.8.2	W	Indicators	1.2	—
			Speed operated switch	4.24	S
			Speed regulator	4.27	S

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Sphere gap	9.3.6	E	Semiconductor controlled	8.6.14	Q
Splice	3.1.6.4	E	Safety, interlock	4.15	S
Split envelope tube	1.10.2	—	Selector	4.13	S
Split-phase motor or generator	13.5.1	B,G	Sector	4.13	S
Split-reed vibrator	4.2.2.6	MP	Sector switch	4.6.7	S
Split-stator capacitor	2.2.8	C	Self-interrupting switch	4.22	S
Spring return switch	4.7	S	Telegraph key	4.26	S
Squib	2.12	SQ	Telephone	4.25.2	S
Explosive	2.12.1	SQ	Temperature-actuated	4.20	S
Igniter	2.12.2	SQ	Thermal cutout (flasher)	4.22	S
Squirrel-cage machine	13.5.1	B,G	Thermostat	4.21	S
Stabistor	8.5.1	CR	Time-delay	4.16	S
Standard volume indicator	12.1	M	Two-circuit	4.7.3	S
Star connection	1.9.7	—		4.8	S
Station, telephone	16.1.1.2	A		4.9.3	S
Steam (recognition symbol)	1.4.4.2	—	Vibrator	4.28	G
Step-recovery diode	8.5.13	D,CR	Switch, inertia	4.31	S
Step-voltage regulator	6.4.10.1	T	Switch contact	4.2	E
Stereo head	2.9.6	PU	Switchboard		
Storage diode	8.5.5	D,CR	Jack	5.3.5.1	J
Stretcher, line	15.19	W	Lamp	11.2.6	DS
Strip, bimetallic	2.14	—	Light	11.2.7	DS
Strip-type transmission path	3.7	W	Manual	20.3.3	—
Stripline			Switching, automatic	20.3.2	—
Balanced	3.7.2	W	Switching function	4.1	—
Unbalanced	3.7.1	W	Symmetrical varistor	2.1.6	RV
Structure, slow-wave	2.6.3	DL	Symmetrical waveguide		
Submarine line	3.2.3	W	connector	5.7.1	J,P
Substation	21.5	—	Synchro	13.8	B
Subsynchronous motor	13.5.9	B	Synchronous		
Summing amplifier	17.2	AR	Condenser	13.6.1-4	G
Supply, power	16.1.1.2	PS	Converter	13.7.1-4	MG
Suppression, mode	15.6	Z	Frequency changer	13.6.5-6	MG
Surface barrier transistor			Generator	13.6.1-4	G
NPN-type	8.6.2	Q	Induction motor	13.5.2	B
PNP-type	8.6.1	Q	Motor	13.6.1-4	B
Surge arrester	9.3	E	(Induction)	13.5.2	B
Susceptance, capacitive	15.1.2.1	Z	Synchroscope	12.1	M
Inductive	15.1.2.3	Z			
Infinite	15.1.2.4	Z	T or Y adapter	5.6.5	CP
Zero	15.1.2.5	Z	Tape printing (telegraph equipment)		
Switch	4.6	S	Qualifying symbols	20.5.6.1	—
Aneroid	4.33	S	Receiver	20.5.7.1	—
Breaker	9.4	CB	Tapped		
Centrifugal	4.24	S	Delay function	2.6.2	DL
Combination locking and nonlocking	4.11	S	Heater	7.2.3	—
Contact	4.2.12	E	Inductor	6.2.3	L
Contactor	4.29	S	Resistor	2.1.2	R
Flow-actuated	4.17	S	Transformer	6.4.7	T
Foot-operated	4.23	S	Telegraph		
General	4.6	S	Equipment	20.5	—
Governor	4.27	S	Key	4.26	S
Hook	4.25.1	S	Repeater	20.4	—
Horn gap	4.6.6	S	Sounder	10.1.4	LS
Interlock, safety	4.15	S	Telemeter	12.1	M
Key	4.12	S	Telephone		
Knife	4.6.3	S	Bell	10.1.1	LS
Lever	4.12	S	Dial	16.1.1.2	S
Limit	4.14	S	Dial switch	4.25.2	S
Liquid-level-actuated	4.18	S	Handset	10.3	HS
Locking	4.10	S	Headset	10.4	HT
Mercury	4.32	S	Line equalizer	16.1.1.2	EQ
Multiposition	4.13	S	Operator's set	10.3	HS
Multiway	4.3.8	S	Protector block	9.3.2	E
Nonlocking	4.9	S	Receiver	10.4	HT
Pressure-actuated	4.19	S	Ringer	10.1.1	LS
	4.33	—	Set	20.6	A
Pushbutton	4.7	S			

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Station	16.1.1.2	A	Traic, gated switch	8.6.15	Q
Transmitter	10.2	MK	Triode type		
Teleprinter	16.1.1.2	A	Bidirectional	8.6.15	Q
Teletypewriter	16.1.1.2	A	Reverse-blocking		
Temperature			N-type gate	8.6.12	Q
Actuated switch	4.20	S	P-type gate	8.6.13	Q
Dependent device	1.2.1	—	Time closing contact	4.3.5	S
Dependent diode	8.5.3	D,CR	Time-delay switches	4.16	S
Measuring thermocouple	2.13.1	TC	Time-opening contact	4.3.6	S
Semiconductor	8.8.1	TC	Time-sequential closing contact	4.3.7	S
Meter	12.1	M	Toggle-switch		
Temperature sensor	2.16	E	Locking	4.10	S
Sensing element	2.1.12	RT	Nonlocking	4.9	S
Tenpoint selector switch	4.13.6	S	Torque (synchro)		
Terminal board	5.1.1.1	TB	Differential receiver	13.8	B
Terminal discontinuity	15.1.1.1	Z	Differential transmitter	13.8	B
Terminal			Receiver	13.8	B
Circuit	5.1.1	E	Transmitter	13.8	B
Electron tube, semiconductor			Torque amplifier	16.2.1	AR
devices, etc.	5.1.2	—	Total time meter	12.1	M
Base pin	5.1.2.1	—	TR tube	15.13	V
Connected to envelope	5.1.2.5	—	Track switch		
Envelope	5.1.2.2	—	Closing	4.14.1	S
Keyed	5.1.2.5	—	Opening	4.14.2	S
Reference point	5.1.2.4	—	Transducer		
Terminating element	3.8	AT	Measuring	2.11	A,MT
Termination	3.8	AT	Mode	15.5	MT
Cable	5.2	E	Motional pickup	2.11	A,MT
Capacitive	2.2.10	AT	Photoconductive		
Inductive	6.2.7	AT	Asymmetrical	8.5.4.1	D,CR
Resistive	2.1.11	AT	Symmetrical	2.1.13	R
Short circuit	3.8.2	E	Photovoltaic	8.7.3	BT
Test			Thermomechanical	2.14	HR
Block	5.5	TB	Transductor	6.3	L
Clip	5.3.1	E	Transfer (switching function)	4.1.3	S
Point	1.5	—	Transfer contact	4.3.3	S
Probe	5.3.2	E	Transformer	6.4	T
Thermal			Adjustable	6.4.9	T
Converter	12.1	M	Inductance	6.4.4-6	T
Cutout	4.22	S	Auto	6.4.8-10	T
Element	2.14	HR	Bank, 3 phase	6.4.15.1	T
Relay	4.30.5	K	Connection symbols	1.9	—
Resistor	2.1.12	RT	Current	6.4.18	T
Thermistor	2.1.12	RT	Load-ratio control	6.4.10.2	T
Thermoelectric generating				6.4.11	T
station	21.3	—	Polyphase	6.4.16	T
Thermocouple	2.13	TC	Potential	6.4.20	T
Insulated heater	2.13.2.2	TC	Saturating	6.4.3	T
Internally connected heater	2.13.2.1	TC	Single-phase	6.4.15	T
Thermopile	2.13.3	TC	Synchro control	13.8.2	B
Thermostat	4.21	S	Three winding	6.4.17	T
Three conductors	3.1.2.2	W	Winding with adjustable		
Three-phase symbols	1.9.3-10	—	inductance	6.4.4-5	T
Three-pole knife switch	4.6.4	S	Transistor	8.1	—
Three-position switch	4.3.8.2	S	Darlington	8.6.17	Q
Three-position transfer switch	4.10.4	S	Transition region	8.2.6	—
Three-wire phase shifter	16.6.2	Z	Translation (motion)	14.2	—
Thyratron	7.3.9	V	Transmission line	3.2	W
Solid-state	8.11	Q	Transmission path	3.1	W
Thyristor			Transmitter		
Diode type, bidirectional	8.5.9	D,CR	Position	16.11	—
Diode type, reverse-blocking	8.5.8	D,CR	Synchro	13.8.2	B
Semiconductor controlled			Telegraph	20.5.2	—
rectifier			Telephone	10.2	MK
N-type gate	8.6.12	Q	Traveling-wave		
P-type gate	8.6.13	Q	Structure, slow	2.6.3	DL
Semiconductor controlled			Tubes	15.14	V
switch	8.6.14	Q	Triac	8.6.15	Q
Tetrode type, reverse-blocking	8.6.14	Q	Triax (cable)	3.1.9.4	W

Name	Item Number	Class Letter	Name	Item Number	Class Letter
Trigger diac	8.5.6.3	D,CR	Variability	1.1	—
Trimmer capacitor	2.2.4	C	Adjustability		
Triode	7.3.1	V	Continuous	1.1.3.1	—
Triple-twisted conductors	3.1.7.2	W	Steps	1.1.3.2	—
Tube			General	1.1.1.1	—
Ballast	11.1.5	RT	Inherent (intrinsic)	1.1.2	—
Electron (see electron tube)	7.1	V	Linear	1.1.1.3	—
Tunable resonator	15.9.3	Z	Inherent	1.1.2.1	—
Tuned cavity	15.9	Z	Nonlinear	1.1.1.4	—
Tuner			Inherent	1.1.2.2	—
E-H	15.1.5	Z	Preset	1.1.1.2	—
Slide screw	15.1.4	Z	Continuous	1.1.4.1	—
Tunnel diode	8.5.7.1	D,CR	Steps	1.1.4.2	—
Tunneling (special-property indicator)	8.3.2	—	Variable		
Twinax (cable)	3.1.9.3	W	Attenuator	2.4.4	AT
Twin-triode electron tube	7.3.3	V	Capacitor	2.2.1	C
Twisted pair conductor	3.1.7.1	W	Delay element	2.6.3	DL
Twisted waveguide	3.6.5	W	Inductance	6.2.4	L
Two-circuit switch			Resistor	2.1.4	R
Maintained	4.8	S	Varicap	8.5.2	D,CR
Mementary	4.7.3	S	Varistor		
Nonlocking	4.9.3	S	Asymmetrical	8.5.1	D,CR
Two-conductor cable	3.1.8.5	W	Symmetrical	2.1.6	RV
Two conductors (path)	3.1.2.1	W	Varmeter	12.1	M
Two-phase			Velocity, angular	14.2.6	—
Connection	1.9.1.2	—	Velocity modulated tube	15.12	V
Winding (rotating machine)	13.3.2	—	Vibrator	4.28	G
Two-pole double-throw switch	4.6.2.1	S	Interruptor	4.28	G
Two-pole field-discharge switch	4.6.5	S	Reed	4.2.2.5	MP
Two-position switch	4.3.8.1	S	Split-reed	4.2.2.6	MP
Two-position transfer switch	4.10.3	S	Visual-signaling device	11.2	DS
Two-way			Volt-ammeter	12.1	M
Repeater	16.4.2	AR	Voltage reference diode	8.5.6.1	VR
Bypassed	16.4.3	AR	Voltage regulator		
Simplex	20.5.4	—	Auto transformer	6.4.10	T
Telegraph repeater	20.4.2	—	Bidirectional diode	8.5.6.2	D,VR
			Control transformer	6.4.11	T
Unbalanced			Diode	8.5.6	D,VR
Attenuator	2.4.3	AT	Induction	8.4.12	VR
Fixed	2.4.3	AT	3-phase induction	6.4.14	VR
Variable	2.4.6	AT	Triplex induction	6.4.13	VR
Stripline	3.7.1	W	Tube	7.3.4.1	V
Under (protective relay function)	9.5.3	—	Voltage sensitive resistor	2.1.6	RV
Underground cable	3.2.2	W	Voltmeter	12.1	M
Underground line	3.2.2	W	Volume indicator	12.1	M
Undervoltage (protective relay function)	9.5.12.4	—			
Underwater line	3.2.3	W	Wafer switch	4.13.7	S
Underwater sound projector	10.1.3	LS	Watthour meter	12.1	M
Unidirectional attenuator	2.4.4	AT	Wattmeter	12.1	M
Unidirectional negative-resistance breakdown diode	8.5.6.3	D,CR	Waveguide	3.6	W
Unijunction transistor			Circular	3.6.1	W
N-type	8.6.8	Q	Coaxial	3.6.3	W
P-type	8.6.9	Q	Connector	5.7	J,P
Unit			Coupler, directional	15.3	DC
Piezoelectric crystal	2.10	Y	Coupling	15.2	CP
Recording	16.1.1.2	A	Directric-filled metallic	3.6.2.1	W
Reproducing	16.1.1.2	A	Flexible	3.6.4	W
			Gas filled	3.6.2.3	W
Vacuum-operated switch	4.19	S	Mode transducer	15.5	MT
Vacuum tube	7.1	V	Mode suppressor	15.6	Z
Valve element arrester	9.3.7	E	Rectangular	3.6.2	W
Varactor	8.5.2	D,CR	Resonator	15.9.2	Z
Varhour meter	12.1	M	Ridged	3.6.6	W
			Rotary coupler	15.7	E
			Rotary joint	15.7	E
			Sandwich line	3.7.2	W
			Solid-dielectric	3.6.2.2	W

Waveguide flange
Zig-zag connection symbol


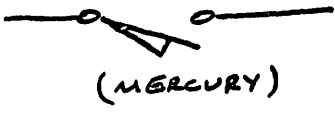

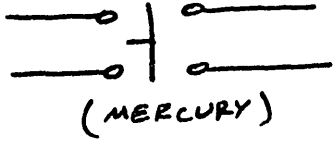

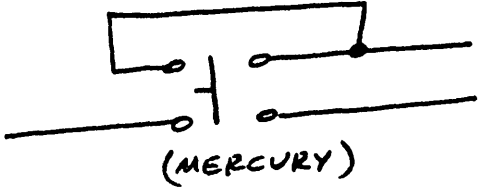
Index

Waveguide flange
Zig-zag connection symbol

<i>Name</i>	<i>Item Number</i>	<i>Class Letter</i>
Stripline	3.7.1	W
Termination	3.8	AT
Twisted	3.6.5	W
Waveguide flange	5.7	J,P
Choke	5.7.4	J
Mated	5.7.1-2	J,P
Plain	5.7.3	P
Winding	6.2	L
Connection symbol	1.9	—
Field	13.2	L
Operating coil	4.5	L
Symbols (rotating machine)	13.3	—
Transformer	6.4.1	T
Wiring	3.1	W
Alternate	3.3	—
Wound rotor motor	13.5.2	B
Writing head	2.9.2	PU
Wye		
Grounded (rotating machine)	13.3.4	—
Ungrounded (rotating machine)	13.3.3	—
Wye connection	1.9.7	—
X-ray tube	7.3.8	V
Y adapter	5.4.5	CP
Zener diode	8.5.6.1	D,VR
Zig-zag connection symbol		
3-phase	1.9.9	—
6-phase, double	1.9.14	—

Name *Item
Number* *Class
Letter*

SYMBOLS FOR MERCURY SWITCHES

<u>SWITCH TYPE</u>	<u>SYMBOL</u>	<u>REFERENCE DESIGNATION CLASS LETTER</u>
 SPST	 (MERCURY)	S
 TWO-CIRCUIT	 (MERCURY)	S
 SPDT	 (MERCURY)	S

TO CLARIFY THE DIAGRAM, THE WORD "MERCURY" MAY BE PRINTED ADJACENT TO THE SYMBOL, AS SHOWN, OR MAY BE EXPLAINED IN THE PARTS LIST (OR BOTH).

SOURCE: MICRO SWITCH CATALOG 50, ISSUE K
 (1974)
 SECTION E