IEEE Standard
American National Standard
Canadian Standard

Graphic Symbols for Electrical and Electronics Diagrams
(Including Reference Designation Letters)

Sponsor
IEEE Standards Coordinating Committee 11, Graphic Symbols

Secretariat for American National Standards Committee Y32

American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers

Approved September 4, 1975
Reaffirmed October 20, 1988
Reaffirmed December 2, 1993

IEEE Standards Board
Approved October 31, 1975
Reaffirmed January 16, 1989

American National Standards Institute
Approved October 9, 1975

Canadian Standards Association
Approved Adopted for Mandatory Use October 31, 1975

Department of Defense, United States of America
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: Military Coordinating Activity:
Army - EL
Navy - SH
Air Force - 16

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

User Activities: Project Number: DRPR-0176
Army - ME
Navy - EC, MC

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

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.

Graphic Symbols for Electrical and Electronics Diagrams

REXDALE, October 9, 1975

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

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

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

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

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

IEEE Standards Board

Approved September 4, 1975

Joseph L. Koepfinger, Chair
Warren H. Cook, Vice Chair
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

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. However, individual symbols contained in this standard may be utilized without further permission of the IEEE. Any statement that the symbols used are in conformance with this standard shall be on the user’s own responsibility.
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])


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, Chair**

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

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

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

**George Platt, Vice Chair, Mechanical**

**Alvin Lai, Secretary**

<table>
<thead>
<tr>
<th>Organization Represented</th>
<th>Name of Representative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustical Society of America</td>
<td>Laurence Batchelder</td>
</tr>
<tr>
<td></td>
<td>Harry F. Olson</td>
</tr>
<tr>
<td>American Chemical Society</td>
<td>Robert F. Schuerer</td>
</tr>
<tr>
<td>American Gear Manufacturers Association</td>
<td>James R. Couper</td>
</tr>
<tr>
<td>American Institute of Chemical Engineers</td>
<td>Francis Saint</td>
</tr>
<tr>
<td>American Institute for Design and Drafting</td>
<td>Irving Goldstein</td>
</tr>
<tr>
<td>American Institute of Industrial Engineers</td>
<td>(Vacant)</td>
</tr>
<tr>
<td>American Institute of Mining, Metallurgical and Petroleum Engineers</td>
<td>(Vacant)</td>
</tr>
<tr>
<td>American Society of Agriculture Engineers</td>
<td>James A. Basselman</td>
</tr>
<tr>
<td>American Society of Civil Engineers</td>
<td>(Vacant)</td>
</tr>
<tr>
<td>American Society for Engineering Education</td>
<td>I. L. Hill</td>
</tr>
<tr>
<td>American Society of Heating, Refrigerating and Air Conditioning Engineers</td>
<td>N. LaCourte</td>
</tr>
<tr>
<td>American Society of Mechanical Engineers</td>
<td>James C. Church</td>
</tr>
<tr>
<td></td>
<td>R. W. Cockrell</td>
</tr>
<tr>
<td></td>
<td>R. R. Machell, Jr.</td>
</tr>
<tr>
<td></td>
<td>O. J. Maha</td>
</tr>
<tr>
<td></td>
<td>H. E. Walchli</td>
</tr>
<tr>
<td>American Society of Sanitary Engineering</td>
<td>A. P. Arndt</td>
</tr>
<tr>
<td>American Welding Society</td>
<td>Frank Speight (Alt)</td>
</tr>
<tr>
<td>Association of American Railroads</td>
<td>M. F. McCircle</td>
</tr>
<tr>
<td>Association for Computing Machinery</td>
<td>Patrick G. Skelly</td>
</tr>
<tr>
<td>Canadian Standards Association</td>
<td>Arthur C. Gannet (Alt)</td>
</tr>
<tr>
<td>Illuminating Engineering Society</td>
<td>John E. Kaufman (Alt)</td>
</tr>
<tr>
<td>Individual Member</td>
<td>Charles A. Fricke</td>
</tr>
<tr>
<td>Institute of Electrical and Electronics Engineers</td>
<td>G. A. Knapp</td>
</tr>
<tr>
<td></td>
<td>Sidney V. Soanes</td>
</tr>
<tr>
<td></td>
<td>Steven A. Wassermann</td>
</tr>
<tr>
<td>Instrument Society of America</td>
<td>George Platt</td>
</tr>
<tr>
<td>Mechanical Contractors Association of America</td>
<td>J. R. Mance</td>
</tr>
<tr>
<td>National Association of Plumbing, Heating, Cooling Contractors</td>
<td>R. E. White</td>
</tr>
<tr>
<td>National Electrical Contractors Association</td>
<td>William H. Paules</td>
</tr>
<tr>
<td>National Electrical Manufacturers Association</td>
<td>Walter F. Huette</td>
</tr>
<tr>
<td></td>
<td>F. V. Kupchak</td>
</tr>
<tr>
<td></td>
<td>R. F. Franciose (Alt)</td>
</tr>
<tr>
<td></td>
<td>Roland Russo (Alt)</td>
</tr>
<tr>
<td></td>
<td>Mrs. R. L. Mancini (Alt)</td>
</tr>
</tbody>
</table>
The Task Group on Graphic Symbols, Y32.2, which revised and processed this standard, had the following personnel:

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

<table>
<thead>
<tr>
<th>Member</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. J. Balke</td>
<td>W. Grasson</td>
</tr>
<tr>
<td>L. Batchelder</td>
<td>C. J. Hart</td>
</tr>
<tr>
<td>L. E. Barrow</td>
<td>A. Hendry, <em>Canadian Liaison</em></td>
</tr>
<tr>
<td>V. W. Bennett</td>
<td>G. A. Knapp</td>
</tr>
<tr>
<td>H. L. Cook</td>
<td>R. Legg*</td>
</tr>
<tr>
<td>D. Drusdow</td>
<td>L. A. Meadows‡</td>
</tr>
<tr>
<td>S. K. Ghandi</td>
<td>C. R. Muller*</td>
</tr>
<tr>
<td>C. A. Nazian</td>
<td>R. V. Rice</td>
</tr>
<tr>
<td>E. F. V. Robinson‡, <em>Canadian Liaison</em></td>
<td>J. W. Siefert</td>
</tr>
<tr>
<td>J. W. Siefert</td>
<td>S. A. Wassermann</td>
</tr>
<tr>
<td>S. V. Soanes</td>
<td>R. M. Stern*</td>
</tr>
<tr>
<td>J. C. White</td>
<td>J. Zeno</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Member</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. B. Augus, Jr</td>
<td>G. A. Knapp</td>
</tr>
<tr>
<td>F. K. Becker</td>
<td>L. A. Meadows‡</td>
</tr>
<tr>
<td>J. C. Brown</td>
<td>R. V. Rice</td>
</tr>
<tr>
<td>J. M. Carroll</td>
<td>G. Shapiro</td>
</tr>
<tr>
<td>H. L. Cook</td>
<td>J. W. Siefert</td>
</tr>
<tr>
<td>E. T. B. Gross</td>
<td>S. V. Soanes</td>
</tr>
<tr>
<td>R. M. Stern</td>
<td>L. H. Warren</td>
</tr>
<tr>
<td>S. A. Wassermann</td>
<td>J. C. White</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Member</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. W. Bennett</td>
<td>R. Legg</td>
</tr>
<tr>
<td>I. M. Berger (<em>SCC 11.1</em>)</td>
<td>J. Lusti (<em>SCC 11.6</em>)</td>
</tr>
<tr>
<td>T. L. Bisbee</td>
<td>L. A. Meadows‡</td>
</tr>
<tr>
<td>V. Condello</td>
<td>C. R. Muller</td>
</tr>
<tr>
<td>H. L. Cook</td>
<td>G. Panula (<em>SCC 11.6</em>)</td>
</tr>
<tr>
<td>D. Drusdow</td>
<td>R. V. Rice (<em>SCC 11.1</em>)</td>
</tr>
<tr>
<td>A. C. Gannett</td>
<td>A. I. Rubin (<em>SCC 11.1</em>)</td>
</tr>
<tr>
<td>G. A. Knapp</td>
<td>F. A. Saint</td>
</tr>
<tr>
<td>E. J. Lombardi (<em>SCC 11.6</em>)</td>
<td>G. Shapiro</td>
</tr>
<tr>
<td>J. W. Siefert (<em>SCC 11.1</em>)</td>
<td>H. Seaman</td>
</tr>
<tr>
<td>P. G. Skelly (<em>SCC 11.6</em>)</td>
<td>S. V. Soanes (<em>SCC 11.1</em>)</td>
</tr>
<tr>
<td>R. M. Stern</td>
<td>S. A. Wasserman</td>
</tr>
<tr>
<td>S. A. Wasserman</td>
<td>R. Rondinelli (<em>Alt</em>)</td>
</tr>
<tr>
<td>W. W. Varnedoe (<em>SCC 11.6</em>)</td>
<td>J. Zeno (<em>SCC 11.1</em>)</td>
</tr>
</tbody>
</table>

* Member of Y32.2 Editorial Committee.  
‡ Retired.
<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>A1 Scope</td>
<td>1</td>
</tr>
<tr>
<td>A2 Arrangement</td>
<td>2</td>
</tr>
<tr>
<td>A3 Application</td>
<td>2</td>
</tr>
<tr>
<td>A4 Drafting Practices Applicable to Graphic Symbols</td>
<td>3</td>
</tr>
<tr>
<td>Section 1 Qualifying Symbols</td>
<td>5</td>
</tr>
<tr>
<td>1.1 Adjustability</td>
<td>5</td>
</tr>
<tr>
<td>1.2 Special-Property Indicators</td>
<td>7</td>
</tr>
<tr>
<td>1.3 Radiation Indicators (electromagnetic and particulate)</td>
<td>8</td>
</tr>
<tr>
<td>1.4 Physical State Recognition Symbols</td>
<td>9</td>
</tr>
<tr>
<td>1.5 Test-Point Recognition Symbol</td>
<td>10</td>
</tr>
<tr>
<td>1.6 Polarity Markings</td>
<td>10</td>
</tr>
<tr>
<td>1.7 Direction of Flow of Power, Signal, or Information</td>
<td>12</td>
</tr>
<tr>
<td>1.8 Kind of Current (General)</td>
<td>13</td>
</tr>
<tr>
<td>1.9 Connection Symbol</td>
<td>14</td>
</tr>
<tr>
<td>1.10 Envelope</td>
<td>17</td>
</tr>
<tr>
<td>1.11 Shield</td>
<td>18</td>
</tr>
<tr>
<td>1.12 Special Connector or Cable Indicator</td>
<td>19</td>
</tr>
<tr>
<td>1.13 Electret (shown with electrodes)</td>
<td>19</td>
</tr>
<tr>
<td>Section 2 Graphic Symbols for Fundamental Items (not included in other sections)</td>
<td>19</td>
</tr>
<tr>
<td>2.1 Resistor</td>
<td>19</td>
</tr>
<tr>
<td>2.2 Capacitor</td>
<td>24</td>
</tr>
<tr>
<td>2.3 Antenna</td>
<td>28</td>
</tr>
<tr>
<td>2.4 Attenuator</td>
<td>32</td>
</tr>
<tr>
<td>2.5 Battery</td>
<td>33</td>
</tr>
<tr>
<td>2.6 Delay Function</td>
<td>34</td>
</tr>
<tr>
<td>2.7 Oscillator</td>
<td>35</td>
</tr>
<tr>
<td>2.8 Permanent Magnet</td>
<td>35</td>
</tr>
<tr>
<td>2.9 Pickup</td>
<td>35</td>
</tr>
<tr>
<td>2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz)</td>
<td>36</td>
</tr>
<tr>
<td>2.11 Transducer</td>
<td>36</td>
</tr>
<tr>
<td>2.12 Squib, Electric</td>
<td>37</td>
</tr>
<tr>
<td>2.13 Thermocouple (dissimilar-metals device)</td>
<td>37</td>
</tr>
<tr>
<td>2.14 Thermal Element</td>
<td>38</td>
</tr>
<tr>
<td>2.15 Spark Gap</td>
<td>38</td>
</tr>
<tr>
<td>2.16 Igniter Gap</td>
<td>38</td>
</tr>
<tr>
<td>CLAUSE</td>
<td>PAGE</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2.16 Continuous Loop Fire Detector (temperature sensor)</td>
<td>38</td>
</tr>
<tr>
<td>2.17 Ignitor Plug</td>
<td>38</td>
</tr>
<tr>
<td>Section 3 Graphic Symbols for Transmission Path</td>
<td>39</td>
</tr>
<tr>
<td>3.1 Transmission Path</td>
<td></td>
</tr>
<tr>
<td>Conductor</td>
<td></td>
</tr>
<tr>
<td>Cable</td>
<td></td>
</tr>
<tr>
<td>Wiring</td>
<td>39</td>
</tr>
<tr>
<td>3.2 Distribution Lines</td>
<td></td>
</tr>
<tr>
<td>Transmission Lines</td>
<td>45</td>
</tr>
<tr>
<td>3.3 Alternative or Conditional Wiring</td>
<td>47</td>
</tr>
<tr>
<td>3.4 Associated or Future</td>
<td>47</td>
</tr>
<tr>
<td>3.5 Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications</td>
<td>48</td>
</tr>
<tr>
<td>3.6 Waveguide</td>
<td>48</td>
</tr>
<tr>
<td>3.7 Strip-Type Transmission Line</td>
<td>49</td>
</tr>
<tr>
<td>3.8 Termination</td>
<td>49</td>
</tr>
<tr>
<td>3.9 Circuit Return</td>
<td>50</td>
</tr>
<tr>
<td>3.10 Pressure Tight Bulkhead Cable Gland</td>
<td>51</td>
</tr>
<tr>
<td>Cable Sealing End</td>
<td></td>
</tr>
<tr>
<td>Section 4 Graphic Symbols for Contacts, Switches, Contactors, and Relays</td>
<td>52</td>
</tr>
<tr>
<td>4.1 Switching Function</td>
<td>52</td>
</tr>
<tr>
<td>4.2 Electrical Contact</td>
<td>52</td>
</tr>
<tr>
<td>4.3 Basic Contact Assemblies</td>
<td>54</td>
</tr>
<tr>
<td>4.4 Magnetic Blowout Coil</td>
<td>57</td>
</tr>
<tr>
<td>4.5 Operating Coil</td>
<td></td>
</tr>
<tr>
<td>Relay Coil</td>
<td>57</td>
</tr>
<tr>
<td>4.6 Switch</td>
<td>58</td>
</tr>
<tr>
<td>4.7 Pushbutton, Momentary or Spring-Return</td>
<td>59</td>
</tr>
<tr>
<td>4.8 Two-circuit, Maintained or Not Spring-Return</td>
<td>60</td>
</tr>
<tr>
<td>4.9 Nonlocking Switch, Momentary or Spring-Return</td>
<td>60</td>
</tr>
<tr>
<td>4.10 Locking Switch</td>
<td>61</td>
</tr>
<tr>
<td>4.11 Combination Locking and Nonlocking Switch</td>
<td>62</td>
</tr>
<tr>
<td>4.12 Key-Type Switch</td>
<td>62</td>
</tr>
<tr>
<td>Lever Switch</td>
<td></td>
</tr>
<tr>
<td>4.13 Selector or Multiposition Switch</td>
<td>63</td>
</tr>
<tr>
<td>4.14 Limit Switch</td>
<td></td>
</tr>
<tr>
<td>Sensitive Switch</td>
<td>66</td>
</tr>
<tr>
<td>4.15 Safety Interlock</td>
<td>67</td>
</tr>
<tr>
<td>4.16 Switches with Time-Delay Feature</td>
<td>68</td>
</tr>
<tr>
<td>4.17 Flow-Actuated Switch</td>
<td>69</td>
</tr>
<tr>
<td>4.18 Liquid-Level-Actuated Switch</td>
<td>69</td>
</tr>
<tr>
<td>4.19 Pressure- or Vacuum-Actuated Switch</td>
<td>69</td>
</tr>
<tr>
<td>4.20 Temperature-Actuated Switch</td>
<td>70</td>
</tr>
<tr>
<td>4.21 Thermostat</td>
<td>70</td>
</tr>
<tr>
<td>4.22 Flasher</td>
<td></td>
</tr>
<tr>
<td>Self-Interrupting Switch</td>
<td>71</td>
</tr>
<tr>
<td>4.23 Foot-Operated Switch</td>
<td>72</td>
</tr>
<tr>
<td>Foot Switch</td>
<td></td>
</tr>
<tr>
<td>Clause</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>4.24 Switch Operated by Shaft Rotation and Responsive to Speed or Direction</td>
<td>72</td>
</tr>
<tr>
<td>4.25 Switches with Specific Features</td>
<td>73</td>
</tr>
<tr>
<td>4.26 Telegraph Key</td>
<td>73</td>
</tr>
<tr>
<td>4.27 Governor (Contact-making)</td>
<td>74</td>
</tr>
<tr>
<td>Speed Regulator</td>
<td>74</td>
</tr>
<tr>
<td>4.28 Vibrator, Interrupter</td>
<td>74</td>
</tr>
<tr>
<td>4.29 Contactor</td>
<td>74</td>
</tr>
<tr>
<td>4.30 Relay</td>
<td>76</td>
</tr>
<tr>
<td>4.31 Inertia Switch (operated by sudden deceleration)</td>
<td>78</td>
</tr>
<tr>
<td>4.32 Mercury Switch</td>
<td>78</td>
</tr>
<tr>
<td>4.33 Aneroid Capsule (air pressure) Operated Switch</td>
<td>79</td>
</tr>
<tr>
<td><strong>Section 5 Graphic Symbols for Terminals and Connectors</strong></td>
<td>79</td>
</tr>
<tr>
<td>5.1 Terminals</td>
<td>79</td>
</tr>
<tr>
<td>5.2 Cable Termination</td>
<td>81</td>
</tr>
<tr>
<td>5.3 Connector</td>
<td>81</td>
</tr>
<tr>
<td>Disconnecting Device</td>
<td></td>
</tr>
<tr>
<td>Jack</td>
<td>81</td>
</tr>
<tr>
<td>Plug</td>
<td>81</td>
</tr>
<tr>
<td>5.4 Connectors of the Type Commonly Used for Power-Supply Purposes</td>
<td>84</td>
</tr>
<tr>
<td>5.5 Test Block</td>
<td>86</td>
</tr>
<tr>
<td>5.6 Coaxial Connector</td>
<td>86</td>
</tr>
<tr>
<td>Coaxial Junction</td>
<td>86</td>
</tr>
<tr>
<td>5.7 Waveguide Flanges</td>
<td>87</td>
</tr>
<tr>
<td>Waveguide Junction</td>
<td>87</td>
</tr>
<tr>
<td><strong>Section 6 Graphic Symbols for Transformers, Inductors, and Windings</strong></td>
<td>88</td>
</tr>
<tr>
<td>6.1 Core</td>
<td>88</td>
</tr>
<tr>
<td>6.2 Inductor</td>
<td>89</td>
</tr>
<tr>
<td>Winding (machine or transformer)</td>
<td></td>
</tr>
<tr>
<td>Reactor Radio-Frequency Coil</td>
<td>89</td>
</tr>
<tr>
<td>Telephone Retardation Coil</td>
<td>89</td>
</tr>
<tr>
<td>6.3 Transductor</td>
<td>90</td>
</tr>
<tr>
<td>Saturable-Core Inductor</td>
<td></td>
</tr>
<tr>
<td>Saturable-Core Reactor</td>
<td>90</td>
</tr>
<tr>
<td>6.4 Transformer</td>
<td>92</td>
</tr>
<tr>
<td>Telephone Induction Coil</td>
<td>92</td>
</tr>
<tr>
<td>Telephone Repeating Coil</td>
<td>92</td>
</tr>
<tr>
<td>6.5 Linear Coupler</td>
<td>100</td>
</tr>
<tr>
<td><strong>Section 7 Graphic Symbols for Electron Tubes and Related Devices</strong></td>
<td>100</td>
</tr>
<tr>
<td>7.1 Electron Tube</td>
<td>100</td>
</tr>
<tr>
<td>7.2 General Notes</td>
<td>104</td>
</tr>
<tr>
<td>7.3 Typical Applications</td>
<td>105</td>
</tr>
<tr>
<td>7.4 Solion</td>
<td>109</td>
</tr>
<tr>
<td>Ion-Diffusion Device</td>
<td>109</td>
</tr>
<tr>
<td>7.5 Coulomb Accumulator</td>
<td>110</td>
</tr>
<tr>
<td>Electrochemical Step-Function Device</td>
<td>110</td>
</tr>
<tr>
<td>CLAUSE</td>
<td>PAGE</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>7.6 Conductivity Cell</td>
<td>110</td>
</tr>
<tr>
<td>7.7 Nuclear-Radiation Detector (gas-filled)</td>
<td>110</td>
</tr>
<tr>
<td>Ionization Chamber</td>
<td></td>
</tr>
<tr>
<td>Proportional Counter Tube</td>
<td></td>
</tr>
<tr>
<td>Geiger-Müller Counter Tube</td>
<td></td>
</tr>
<tr>
<td>Section 8 Graphic Symbols for Semiconductor Devices</td>
<td>111</td>
</tr>
<tr>
<td>8.1 Semiconductor Device</td>
<td>111</td>
</tr>
<tr>
<td>Transistor</td>
<td></td>
</tr>
<tr>
<td>Diode</td>
<td></td>
</tr>
<tr>
<td>8.2 Element Symbols</td>
<td>111</td>
</tr>
<tr>
<td>8.3 Special-Property Indicators</td>
<td>116</td>
</tr>
<tr>
<td>8.4 Rules for Drawing Style 1 Symbols</td>
<td>117</td>
</tr>
<tr>
<td>8.5 Typical Applications, Two-Terminal Devices</td>
<td>118</td>
</tr>
<tr>
<td>8.6 Typical Applications, Three- (or more) Terminal Devices</td>
<td>123</td>
</tr>
<tr>
<td>8.7 Photosensitive Cell</td>
<td>129</td>
</tr>
<tr>
<td>8.8 Semiconductor Thermocouple</td>
<td>130</td>
</tr>
<tr>
<td>8.9 Hall Element</td>
<td>130</td>
</tr>
<tr>
<td>Hall Generator</td>
<td></td>
</tr>
<tr>
<td>8.10 Photon-Coupled Isolator</td>
<td>130</td>
</tr>
<tr>
<td>8.11 Solid-State Thyatron (replacement type)</td>
<td>131</td>
</tr>
<tr>
<td>Section 9 Graphic Symbols for Circuit Protectors</td>
<td>132</td>
</tr>
<tr>
<td>9.1 Fuse (one-time thermal current-overload device)</td>
<td>132</td>
</tr>
<tr>
<td>9.2 Current Limiter (for power cable)</td>
<td>133</td>
</tr>
<tr>
<td>9.3 Lightning Arrester</td>
<td>134</td>
</tr>
<tr>
<td>Arrester (electric surge, etc)</td>
<td></td>
</tr>
<tr>
<td>Gap</td>
<td></td>
</tr>
<tr>
<td>9.4 Circuit Breaker</td>
<td>135</td>
</tr>
<tr>
<td>9.5 Protective Relay</td>
<td>136</td>
</tr>
<tr>
<td>Section 10 Graphic Symbols for Acoustic Devices</td>
<td>140</td>
</tr>
<tr>
<td>10.1 Audible-Signaling Device</td>
<td>140</td>
</tr>
<tr>
<td>10.2 Microphone</td>
<td>142</td>
</tr>
<tr>
<td>Telephone Transmitter</td>
<td></td>
</tr>
<tr>
<td>10.3 Handset</td>
<td>142</td>
</tr>
<tr>
<td>Operator’s Set</td>
<td></td>
</tr>
<tr>
<td>10.4 Telephone Receiver</td>
<td>143</td>
</tr>
<tr>
<td>Earphone</td>
<td></td>
</tr>
<tr>
<td>Hearing-Aid Receiver</td>
<td></td>
</tr>
<tr>
<td>Section 11 Graphic Symbols for Lamps and Visual-Signaling Devices</td>
<td>144</td>
</tr>
<tr>
<td>11.1 Lamp</td>
<td>144</td>
</tr>
<tr>
<td>11.2 Visual-Signaling Device</td>
<td>146</td>
</tr>
<tr>
<td>Section 12 Graphic Symbols for Readout Devices</td>
<td>148</td>
</tr>
<tr>
<td>12.1 Meter</td>
<td>148</td>
</tr>
<tr>
<td>Clause</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>12.2 Electromagnetically Operated Counter</td>
<td>149</td>
</tr>
<tr>
<td>Section 13 Graphic Symbols for Rotating Machinery</td>
<td>150</td>
</tr>
<tr>
<td>13.1 Rotating Machine</td>
<td>150</td>
</tr>
<tr>
<td>13.2 Field, Generator or Motor</td>
<td>151</td>
</tr>
<tr>
<td>13.3 Winding Connection Symbols</td>
<td>152</td>
</tr>
<tr>
<td>13.4 Applications: Direct-Current Machines</td>
<td>153</td>
</tr>
<tr>
<td>13.5 Applications: Alternating-Current Machines</td>
<td>158</td>
</tr>
<tr>
<td>13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation</td>
<td>161</td>
</tr>
<tr>
<td>13.7 Applications: Alternating- and Direct-Current Composite</td>
<td>162</td>
</tr>
<tr>
<td>13.8 Synchro</td>
<td>163</td>
</tr>
<tr>
<td>Section 14 Graphic Symbols for Mechanical Functions</td>
<td>164</td>
</tr>
<tr>
<td>14.1 Mechanical Connection</td>
<td>164</td>
</tr>
<tr>
<td>14.2 Mechanical Motion</td>
<td>165</td>
</tr>
<tr>
<td>14.3 Clutch</td>
<td>166</td>
</tr>
<tr>
<td>14.4 Manual Control</td>
<td>167</td>
</tr>
<tr>
<td>Section 15 Graphic Symbols Commonly Used in Connection with VHF, UHF, SHF Circuits</td>
<td>168</td>
</tr>
<tr>
<td>15.1 Discontinuity (Introducing intentional wave reflection)</td>
<td>168</td>
</tr>
<tr>
<td>15.2 Coupling</td>
<td>170</td>
</tr>
<tr>
<td>15.3 Directional Coupler</td>
<td>172</td>
</tr>
<tr>
<td>15.4 Hybrid</td>
<td>173</td>
</tr>
<tr>
<td>15.5 Mode Transducer</td>
<td>174</td>
</tr>
<tr>
<td>15.6 Mode Suppressor</td>
<td>175</td>
</tr>
<tr>
<td>15.7 Rotary Joint (radio-frequency rotary coupler)</td>
<td>175</td>
</tr>
<tr>
<td>15.8 Nonreciprocal Devices</td>
<td>176</td>
</tr>
<tr>
<td>15.9 Resonator</td>
<td>177</td>
</tr>
<tr>
<td>15.10 Resonator (cavity-type) Tube</td>
<td>178</td>
</tr>
<tr>
<td>15.11 Magnetron</td>
<td>178</td>
</tr>
<tr>
<td>15.12 Velocity-Modulation (velocity-variation) Tube</td>
<td>179</td>
</tr>
<tr>
<td>15.13 Transmit-Receive (TR) Tube</td>
<td>179</td>
</tr>
<tr>
<td>15.14 Traveling-Wave-Tube</td>
<td>180</td>
</tr>
<tr>
<td>15.15 Balun</td>
<td>182</td>
</tr>
<tr>
<td>15.16 Filter</td>
<td>182</td>
</tr>
<tr>
<td>15.17 Phase Shifter (matched)</td>
<td>182</td>
</tr>
<tr>
<td>15.18 Ferrite Bead Ring</td>
<td>183</td>
</tr>
<tr>
<td>15.19 Line Stretcher (with female connectors shown)</td>
<td>183</td>
</tr>
</tbody>
</table>
### Section 16 Graphic Symbols for Composite Assemblies

<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1 Circuit Assembly</td>
<td>184</td>
</tr>
<tr>
<td>Circuit Subassembly</td>
<td></td>
</tr>
<tr>
<td>Circuit Element</td>
<td>184</td>
</tr>
<tr>
<td>16.2 Amplifier</td>
<td>185</td>
</tr>
<tr>
<td>16.3 Rectifier</td>
<td>187</td>
</tr>
<tr>
<td>16.4 Repeater (includes Telephone Repeater)</td>
<td>187</td>
</tr>
<tr>
<td>16.5 Network</td>
<td></td>
</tr>
<tr>
<td>Artificial Line (other than delay line)</td>
<td>188</td>
</tr>
<tr>
<td>16.6 Phase Shifter</td>
<td>188</td>
</tr>
<tr>
<td>Phase-Changing Network</td>
<td></td>
</tr>
<tr>
<td>16.7 Chopper</td>
<td>189</td>
</tr>
<tr>
<td>16.8 Diode-Type Ring Demodulator</td>
<td>190</td>
</tr>
<tr>
<td>Diode-Type Ring Modulator</td>
<td></td>
</tr>
<tr>
<td>16.9 Gyro</td>
<td>190</td>
</tr>
<tr>
<td>Gyroscope</td>
<td></td>
</tr>
<tr>
<td>Gyrocompass</td>
<td>190</td>
</tr>
<tr>
<td>16.10 Position Indicator</td>
<td>190</td>
</tr>
<tr>
<td>16.11 Position Transmitter</td>
<td>191</td>
</tr>
<tr>
<td>16.12 Fire Extinguisher Actuator Heads</td>
<td>191</td>
</tr>
</tbody>
</table>

### Section 17 Graphic Symbols for Analog and Digital Logic Functions

<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.1 Operational Amplifier</td>
<td>192</td>
</tr>
<tr>
<td>17.2 Summing Amplifier</td>
<td>192</td>
</tr>
<tr>
<td>17.3 Integrator (Amplifier)</td>
<td>192</td>
</tr>
<tr>
<td>17.4 Electronic Multiplier</td>
<td>193</td>
</tr>
<tr>
<td>17.5 Electronic Divider</td>
<td>193</td>
</tr>
<tr>
<td>17.6 Electronic Function Generator</td>
<td>193</td>
</tr>
<tr>
<td>17.7 Generalized Integrator</td>
<td>193</td>
</tr>
<tr>
<td>17.8 Positional Servomechanism</td>
<td>193</td>
</tr>
<tr>
<td>17.9 Function Potentiometer</td>
<td>193</td>
</tr>
</tbody>
</table>

### Section 18 Graphic Symbols for Digital Logic Functions

<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1 Digital Logic Functions</td>
<td>194</td>
</tr>
</tbody>
</table>

### Section 19 Graphic Symbols for Special-Purpose Maintenance Diagrams

<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.0 Introduction</td>
<td>194</td>
</tr>
<tr>
<td>19.1 Data-Flow Code Signals</td>
<td>195</td>
</tr>
<tr>
<td>19.2 Functional Circuits</td>
<td>197</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Clause</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1 Radio Station</td>
<td>198</td>
</tr>
<tr>
<td>20.2 Space Station</td>
<td>200</td>
</tr>
<tr>
<td>20.3 Exchange Equipment</td>
<td>201</td>
</tr>
<tr>
<td>20.4 Telegraph Repeater</td>
<td>201</td>
</tr>
<tr>
<td>20.5 Telegraph Equipment</td>
<td>203</td>
</tr>
<tr>
<td>20.6 Telephone Set</td>
<td>206</td>
</tr>
<tr>
<td>CLAUSE</td>
<td>PAGE</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>Section 21 Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts</td>
<td>208</td>
</tr>
<tr>
<td>21.1 Generating Station</td>
<td>208</td>
</tr>
<tr>
<td>21.2 Hydroelectric Generating Station</td>
<td>208</td>
</tr>
<tr>
<td>21.3 Thermoelectric Generating Station</td>
<td>209</td>
</tr>
<tr>
<td>21.4 Prime Mover (qualifying symbols)</td>
<td>210</td>
</tr>
<tr>
<td>21.5 Substation</td>
<td>210</td>
</tr>
<tr>
<td>Section 22 Class Designation Letters</td>
<td>211</td>
</tr>
<tr>
<td>22.1 Class Designation Letter</td>
<td>211</td>
</tr>
<tr>
<td>22.2 Special Considerations for Class Designation Letter Assignment</td>
<td>211</td>
</tr>
<tr>
<td>22.3 Item Names</td>
<td>212</td>
</tr>
<tr>
<td>22.4 Class Designation Letters: Alphabetical List</td>
<td>212</td>
</tr>
<tr>
<td>22.5 Item Names: Alphabetical List</td>
<td>220</td>
</tr>
<tr>
<td>22.6 Item Designations, IEC 113-2</td>
<td>220</td>
</tr>
<tr>
<td>Section 23 Referenced Standards and Canadian Standard Z99 Modifications</td>
<td>220</td>
</tr>
<tr>
<td>23.1 Referenced Standards</td>
<td>220</td>
</tr>
<tr>
<td>100 Canadian Standard Z99 Modifications to American National Standard Y32.2-1975 (IEEE Std 315-1975)</td>
<td>221</td>
</tr>
<tr>
<td>Annex A (Informative) Cross Reference List of Changed Item Numbers</td>
<td>222</td>
</tr>
<tr>
<td>Annex C (Informative) Revised or Deleted Symbols</td>
<td>225</td>
</tr>
<tr>
<td>Annex D (Informative) Revised or Deleted Symbols</td>
<td>226</td>
</tr>
<tr>
<td>Annex E (Informative) Revised or Deleted Symbols</td>
<td>236</td>
</tr>
<tr>
<td>Annex F (Informative) Cross-Reference List of Class Designation Letters</td>
<td>241</td>
</tr>
</tbody>
</table>
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-C current Path in Coaxial or Waveguide Applications
8. Semiconductor Devices
8.1 Semiconductor Device
   Transistor
   Diode
8.2 Element Symbols
8.3 Special Property Indicators
8.4 Rules for Drawing Style 1 Symbols
8.5 Typical Applications: Two-Terminal Devices
8.6 Typical Applications: Three- (or More) Terminal Devices
8.7 Photosensitive Cell
8.8 Semiconductor Thermocouple

8.9 Hall Element
   Hall Generator
8.10 Photon-coupled isolator
8.11 Solid-state-thyratron

9. Circuit Protectors
9.1 Fuse
9.2 Current Arrester
9.3 Lightning Arrester
   Arrester Gap

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

13. Rotating Machinery
13.1 Rotating Machine
13.2 Field, Generator or Motor
13.3 Winding Connection 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
21.2 Hydroelectric generating station

21.3 Thermoelectric generating station

21.4 Prime mover

21.5 Substation

22. Class Designation Letters

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

Graphic Symbols for Electrical and Electronics Diagrams
(Including Reference Designation Letters)

Introduction

A1. Scope

A1.1 Purpose

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

A1.2 Definition and Use

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

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

---

1For example, when a lamp is employed as a nonlinear resistor, the nonlinear resistor symbol is used. For reference designation information, see Section 22 of this standard.
be in accordance with American National Standard Reference Designations for Electrical and Electronics Parts and Equipment, Y32.16-1975 (IEEE Std 200-1975).

A2. Arrangement

A2.1 Indexing, Grouping, and Standard Item Names

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

A2.2 Significance of Columnar Placement of Symbols

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

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

A2.3 IEC Identification

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

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

A4.6 Arrowheads

The arrowhead of a symbol may be closed → or open → unless otherwise noted in this standard.

A4.7 Terminal Symbols

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

A4.8 Correlation of Symbol Parts

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

A4.9 Angle of Connecting Lines

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

A4.10 Future or Associated Paths and Equipment

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

A4.11 Envelope or Enclosure

A4.11.1

The envelope or enclosure symbol shall be used:

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

2The symbols shown in this edition of the standard are larger in size than those shown in the 1967 edition. All of the symbols have been prepared so that the connection points are located at intersections of a modular (incremental) grid.
b) If the device envelope is electrically connected to one of the device elements and this is an essential (not merely incidental) functional property of the device.

A4.11.2

The envelope or enclosure symbol should be used:

a) To emphasize that certain symbols having nonconnected lines are a single assembly (for example, see symbol 8.6.10.5).

b) If it is desired to distinguish a class of devices, such as transistors or semiconductor controlled rectifiers, from other devices (but this should be consistent for all devices of the same class on any one diagram).

c) To associate the parts of symbols having adjacent characteristic qualifiers (for example: $t^o$, $\tau$, $\omega$, $\times$).

A4.11.3

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

A4.12 Addition of Supplementary Data

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

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

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

1. Qualifying Symbols

1.1 Adjustability

Variability

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

NOTES:

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

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

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

1.1.1 Adjustability (extrinsic adjustability)

1.1.1.1 General

1.1.1.2 Preset, general

1.1.1.3 Linear (shown applied to 1.1.1.1)

1.1.1.4 Nonlinear (shown applied to 1.1.1.1)

1.1.2 Inherent variability (intrinsic variability)

1.1.2.1 Linear

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

1.1.3.1 Continuous

1.1.3.2 In steps

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

1.1.4.1 Continuous

1.1.4.2 In steps

1.2 Special-Property Indicators

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

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

1.2.1 Temperature dependence

1.2.2 Magnetic-field dependence

1.2.3 Storage (Greek letter tau)
1.2.4 Saturable properties (general)

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

1.2.5 Delay

1.3 Radiation Indicators (electromagnetic and particulate)

Use only if essential to indicate special property.

NOTES:

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

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

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

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

1.3.2 Radiation, ionizing

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

- Alpha particle $\alpha$
- Beta particle $\beta$
- Gamma ray $\gamma$
- Deuteron $d$
- Proton $p$
- Neutron $n$
- Pion $\pi$
- K-meson $\tau$
- Muon $K$
- X-ray $X$
1.4 Physical State Recognition Symbols

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

1.4.1 Gas (air); pneumatic

1.4.2 Liquid

1.4.3 Solid

1.4.4 Showing two or more states

Use only if essential to indicate special condition.

NOTES:

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

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

1.4.4.1 Application: Gaseous liquid

1.4.4.2 Application: Steam (or moist gas)
1.4.5 Electret material

1.5 Test-Point Recognition Symbol

Used if necessary to emphasize test points.

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

1.5.1 General

1.5.2 Application: test-point recognition for a test jack

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

1.5.4 Application: test-point recognition for a circuit terminal

1.6 Polarity Markings

1.6.1 Positive
1.6.2 Negative

1.6.3 Instantaneous polarity markings

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

NOTES:

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

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

1.6.3.1 Application: instantaneous polarity markings with current transformer shown

1.6.3.2 Application: instantaneous polarity markings with potential transformer shown
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.

![Diagram of one-way flow](image)

See Note 1.7.1A

1.7.2 Either way (but not simultaneously)

![Diagram of either way flow](image)

See Note 1.7.1A

1.7.3 Both ways, simultaneously

![Diagram of both ways flow](image)

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.”

![Diagram of application flow](image)

See Note 1.7.4A
1.7.5 Application: one-way circuit element, general

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

See Note 1.7.5A

1.8 Kind of Current (General)

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

1.8.1 Direct current

To be used in cases when other symbol is not suitable

1.8.2 Alternating current

1.8.3 Alternating current, frequency ranges

Use only if necessary to distinguish among different frequency bands.

NOTES:

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

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

1.8.3.1 Power frequencies

See Notes 1.8.3.A and B
1.8.3.2 Audio frequencies

\[ \text{IEC} \quad \sim \text{f} \]

or

\[ \text{IEC} \quad \sim \text{f} \]

See Notes 1.8.3A and B

1.8.3.3 Superaudio, carrier, and radio frequencies

\[ \text{IEC} \quad \sim \text{f} \]

or

\[ \text{IEC} \quad \sim \text{f} \]

See Notes 1.8.3A and B

1.8.4 Direct or alternating current (universal)

\[ \text{IEC} \quad \sim \text{f} \]

1.8.5 Undulating or rectified current

\[ \text{IEC} \quad \sim \text{f} \]

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

\[ \text{IEC} \quad \sim \]

1.9.1.1 2-phase 3-wire, grounded

\[ \text{IEC} \quad \frac{1}{2} \]

1.9.2 2-phase 4-wire

\[ \frac{1}{2} \]

or

\[ \frac{1}{2} \]
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

\[ \triangle \]

1.9.7 3-phase, wye or star, ungrounded

\[ \star \]

1.9.7.1 3-phase, wye, grounded neutral

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

\[ \star \]

1.9.8 3-phase 4-wire, ungrounded

\[ \star \]

1.9.9 3-phase, zigzag, ungrounded

\[ \star \]

1.9.9.1 3-phase, zigzag, grounded

\[ \star \]

1.9.10 3-phase, Scott or T

\[ \star \]

1.9.11 6-phase, double-delta

\[ \star \]
1.9.12 6-phase, hexagonal (or chordal)

1.9.13 6-phase, star (or diametrical)

1.9.13.1 6-phase, star, with grounded neutral

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

1.10 Envelope
Enclosure

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

See paragraph A4.11.1 of the Introduction.

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

1.10.1 General
1.10.2 Split envelope
If necessary, envelope may be split.

![Split envelope symbol](image)

1.10.3 Application: gas-filled envelope
The gas-recognition symbol (dot) may be located as convenient. See symbol 1.4.1

![Gas-filled symbol](image)

1.10.4 Application: liquid-filled envelope
The liquid-recognition symbol may be located as convenient. See symbol 1.4.2

![Liquid-filled symbol](image)

1.11 Shield
Shielding
Normally used for electric or magnetic shielding.

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

When used for other shielding, a note should so indicate. For typical applications see
CAPACITOR (symbol 2.2.3)

TRANSMISSION PATH (symbols 3.1.8.1, 3.1.8.2, and 3.1.8.3)

TRANSFORMER (symbols 6.4.2.2 and 6.4.2.3)

1.11.1 General
These are long dashes.
1.11.2 Optical

1.12 Special Connector or Cable Indicator

NOTES:

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

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

1.13 Electret (shown with electrodes)

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

Cross References

See also Section 19.

NOTES:

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

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

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

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

2.1 Resistor

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

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

2.1.2 Tapped resistor

2.1.3 Application: with adjustable contact. See also symbol 14.2.5

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

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

2.1.6 Symmetrical varistor (intrinsic); voltage-sensitive resistor \( \hat{\mathcal{F}} \) (silicon carbide, etc)

2.1.7 Magnetoresistor (intrinsic) (linear type shown)

2.1.8 Heating resistor

2.1.9 Instrument or relay shunt

Connect instrument or relay to terminals in the rectangle
2.1.10 Shunt resistor

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    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

\[ \text{See Note 2.1.12A} \]

2.1.12.1.2 Nonlinear

\[ \text{See Note 2.1.12A} \]

2.1.12.1.3 Positive temperature coefficient

\[ \text{See Note 2.1.12A} \]

2.1.12.1.4 Negative temperature coefficient

\[ \text{See Note 2.1.12A} \]

2.1.12.2 With independent integral heater

\[ \text{See Note 2.1.12A} \]

2.1.12.2.1 Nonlinear

\[ \text{See Note 2.1.12A} \]

2.1.13 Symmetrical photoconductive transducer (resistive)

\[ \text{See Note 2.1.12A} \]
2.2 Capacitor

NOTES:

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

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

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

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

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

2.2.1 General

   Style 1 —— IEC

   OR

   Style 2 —— IEC

2.2.1.1 With identified electrode

NOTES:

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

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

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

See General Symbols 2.2.1 and Note 2.2B

   Style 1 —— IEC

   OR

   Style 2 —— IEC

   See Note 2.2.1.1B
2.2.2 Polarized capacitor

See General Symbols 2.2.1 and Note 2.2B

![Polarized capacitor symbol]

**Style 1**

**Style 2**

2.2.3 Shielded capacitor

See General Symbols 2.2.1 and Note 2.2B

![Shielded capacitor symbol]

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

![Adjustable or variable capacitor symbol]

**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

![Adjustable or variable capacitor symbol with moving element]

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

See General Symbols 2.2.1 and Note 2.2B

![Adjustable or variable capacitor with mechanical linkage]

IEC
2.2.6 Continuously adjustable or variable differential capacitor

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

![Image of continuously adjustable or variable differential capacitor]

2.2.7 Phase-shifter capacitor

See General Symbols 2.2.1 and Note 2.2B

![Image of phase-shifter capacitor]

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

![Image of split-stator capacitor]

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

![Image of feed-through capacitor]

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

![Image of feed-through capacitor application]
2.2.10 Capacitive termination

Commonly used on coaxial and wave-guide diagrams.

2.2.10.1 Application: series capacitor and path open

See General Symbols 2.2.1 and Note 2.2B

2.2.10.2 Application: series capacitor and path short-circuited

See General Symbols 2.2.1 and Note 2.2B

2.2.11 Shunt capacitor

2.2.12 Coupling capacitor (for power-line carrier)

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

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

2.2.13 Capacitor bushing for circuit breaker or transformer
2.2.14 Application: capacitor-bushing potential device

![Symbol](image1.png)

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.

![Symbol](image2.png)

*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)

![Symbol](image3.png)

†See Note 2.2.15

2.3 Antenna

2.3.1 General

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

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

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

The stem of the symbol may represent any type of balanced or unbalanced feeder, including a single conductor.
2.3.1.1 Application: turnstile antenna

2.3.2 Dipole

2.3.3 Loop

2.3.4 Antenna counterpoise

2.3.5 Qualifying symbols to indicate polarization

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

2.3.5.1 Plane polarization
2.3.5.2 Application: antenna with horizontal polarization

![Horizontal Polarization Symbol]

2.3.5.3 Application: antenna with vertical polarization

![Vertical Polarization Symbol]

2.3.5.4 Circular polarization

![Circular Polarization Symbol]

2.3.5.5 Application: antenna with circular polarization

![Circular Polarization Symbol]

2.3.6 Qualifying symbols to indicate direction of radiation

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

NOTES:

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

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

2.3.6.1 Fixed in azimuth

![Fixed in Azimuth Symbol]

2.3.6.2 Adjustable in azimuth

![Adjustable in Azimuth Symbol]
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

![Antenna with adjustable directivity in elevation diagram](image)

2.3.7.5 Direction finding, radio goniometer, or radio beacon antenna

![Direction finding antenna diagram](image)

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

![Fixed azimuth antenna diagram](image)

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

![Radar antenna diagram](image)

See Note 2.3.6B

2.4 Attenuator

2.4.1 Fixed attenuator pad (general)

![Fixed attenuator diagram](image)

2.4.2 Balanced, general

![Balanced attenuator diagram](image)
2.4.3 Unbalanced, general

2.4.4 Variable attenuator (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
Slow-Wave Structure

2.6.1 Delay element, general

NOTES:

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

2.6.1B — The two vertical lines indicate input side.

2.6.2 Tapped delay element

*See Note 2.6.1A and general symbols 2.6.1
2.6.3 Variable delay element

2.6.4 Slow-wave structure

2.7 Oscillator
Generalized Alternating-Current Source

2.8 Permanent Magnet

2.9 Pickup
Head

2.9.1 General

2.9.2 Writing; recording; head, sound-recorder

The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
2.9.3 Reading; playback; head, sound-reproducer

2.9.4 Erasing; magnetic eraser

2.9.5 Application: writing, reading, and erasing

2.9.6 Stereo

2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz)

2.11 Transducer

Accelerometer

Motional Pickup Transducer

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

---

4The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
2.12 Squib, Electric

2.12.1 Explosive

2.12.2 Igniter

2.12.3 Sensing link; fusible link, ambient-temperature operated

Avoid conflict with symbol 3.6.4 if used on the same diagram

2.13 Thermocouple (dissimilar-metals device)

2.13.1 Temperature-measuring

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

2.13.2.2 With integral insulated heater

See paragraph A4.11 of the introduction
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)

NOTES:

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

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

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

3.1 Transmission Path
Conductor
Cable
Wiring

3.1.1 Guided path, general

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

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

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

See also item 3.2.1

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

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.

3.1.5 Crossing of paths or conductors not connected

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

3.1.6 Junction of paths or conductors

3.1.6.1 Junction (if desired)

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

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

3.1.6.5 Conductor junction (such as hermaphroditic connectors)

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:

\[
P \quad = \quad \text{Pair} \\
T \quad = \quad \text{Triple}
\]
3.1.7.3 Quad

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

3.1.8 Assembled conductors; cable

Commonly used in communication diagrams.

3.1.8.1 Shielded single conductor

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

![Diagram of shielded 5-conductor cable]

3.1.8.4 Application: shielded 2-conductor cable with shield grounded

![Diagram of shielded 2-conductor cable]

3.1.8.5 2-conductor cable

![Diagram of 2-conductor cable]

3.1.8.6 Application: 5-conductor cable

![Diagram of 5-conductor cable]

3.1.9 5 Coaxial cable, recognition symbol; coaxial transmission path; radio-frequency cable  \[\square\] (coaxial)

NOTES:

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

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

3.1.9.1 5 General

![Diagram of coaxial symbol]

See Note 3.1.9A

---

5The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
3.1.9.2 Application: coaxial structure not maintained on the right

\[
\text{See Note 3.1.9B}
\]

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

\[
\text{See Note 3.1.9A}
\]

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

\[
\text{See Note 3.1.9A}
\]

3.1.10 Grouping of leads

3.1.10.1 General

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

\[
\text{See Note 3.1.9A}
\]

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

The lower symbol consists of long dashes.

---

\[^{6}\text{The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.}\]
### 3.1.11 Interrupted path

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

**NOTES:**

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

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

*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 \textit{IEC}
- **S** sound (television) \textit{IEC}
- **T** telegraphy transmission of data \textit{IEC}
- **V** video (television) \textit{IEC}
3.2.1.1 Application: telephone line

IEC  F

3.2.2 Cable underground; underground line

IEC  OR  OR  OR

These are long dashes.
Avoid conflict with symbol 3.2.6 if used on the same diagram.

3.2.3 Submarine line; underwater line

IEC

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

IEC

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

IEC

3.2.6 Radio link
Use only if essential to distinguish radio links or any radio portion of a circuit.
Avoid conflict with symbol 3.2.2 if used on the same diagram.
These are long dashes.
3.2.6.1 Application: radio link (with antenna shown)

![Diagram of radio link (with antenna shown)]

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

![Diagram of radio link carrying television 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.

![Diagram of alternative or conditional wiring] See Note 3.3A

3.3.1 Application: 3 alternative paths

![Diagram of three 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

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).

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.

Cross References

NOTES:

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

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

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

4.1 Switching Function

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

4.1.1 Conducting, closed contact (break)

4.1.2 Nonconducting, open contact (make)

4.1.3 Application: transfer

4.2 Electrical Contact

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

See also 4.9 and 4.11
4.2.1.3 7 Sleeve

4.2.2 Moving Contact

4.2.2.1 Adjustable or sliding contact for resistor, inductor, etc

4.2.2.2 Locking

4.2.2.3 Nonlocking

4.2.2.4 Segment; bridging contact
See also items 4.13.3 and 4.13.4

4.2.2.5 Vibrator reed

4.2.2.6 Vibrator split reed

4.2.2.7 Rotating contact (slip ring) and brush

---

7 The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
4.3 Basic Contact Assemblies

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

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

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

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

In the parallel-line contact symbols shown below, the length of the parallel lines shall be approximately $1\frac{1}{4}$ times the width of the gap (except for symbol 4.3.7).

4.3.1 Closed contact (break)

4.3.2 Open contact (make)
4.3.3 Transfer

4.3.4 Make-before-break

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

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

```
  +------------------+
  |                  |
  +--------+--------+  |
  |               |    OR
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
```

4.3.8 Multiway transfer switch

4.3.8.1 Two-position switch (90° step)

```
  +------------------+
  |                  |
  +--------+--------+  |
  |               |    IEC
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
```

4.3.8.2 Three-position switch (120° step)

```
  +------------------+
  |                  |
  +--------+--------+  |
  |               |    IEC
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
```

4.3.8.3 Four-position switch (45° step)

```
  +------------------+
  |                  |
  +--------+--------+  |
  |               |    IEC
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
  |          |    |  |
  +----+----+----+  |
```
4.4 Magnetic Blowout Coil

4.5 Operating Coil
Relay Coil

See also INDUCTOR; WINDING; etc (item 6.2)

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

4.5.1 Semicircular dot indicates inner end of winding

4.5.2 Application: multiwinding coil (2 windings shown)

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

---

The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.
4.5.3 Electromagnetic actuator (solenoid), with mechanical linkage shown

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

4.6 Switch

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

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

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

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

4.6.1 Single-throw, general

4.6.2 Double-throw, general

4.6.2.1 Application: 2-pole double-throw switch with terminals shown
4.6.3 Knife switch \( \square \), 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 \( \square \)

4.7 Pushbutton \( \square \), 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.
4.13.2 Break-before-make, nonshorting (nonbridging) during contact transfer

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

4.13.4 Segmental contact

4.13.5 22-point selector switch

4.13.6 10-point selector switch with fixed segment

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

Viewed from end opposite control knob or actuator unless otherwise indicated. For more than one section, the first section is the one nearest control knob or actuator. When contacts are on both sides, front contacts are nearest control knob.
4.13.8 Slide switch, typical ladder-type interlock

In the example, one slide is shown operated.

Slides are shown in released position unless otherwise noted.

4.13.9 Master or control switch

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

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

A table of contact operation must be shown on the diagram. A typical table is shown below. Tabulate special features in note.
4.13.11 Drum switch, sliding-contact type, typical example

4.14 Limit Switch
Sensitive Switch

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

4.14.5 Limit switch, directly actuated, spring returned

4.14.5.1 Normally open

4.14.5.2 Normally open—held closed

4.14.5.3 Normally closed

4.14.5.4 Normally closed—held open

4.15 Safety Interlock

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

4.15.1 If specific type identification is required: circuit opening

4.15.2 If specific type identification is required: circuit closing
4.16 Switches with Time-Delay Feature

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

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

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

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

4.16.4 Closed switch with time-delay closing (TDC) feature
4.17 Flow-Actuated Switch

4.17.1 Closes on increase in flow.

4.17.2 Opens on increase in flow

4.18 Liquid-Level-Actuated Switch

4.18.1 Closes on rising level

4.18.2 Opens on rising level

4.19 Pressure- or Vacuum-Actuated Switch

4.19.1 Closes on rising pressure

4.19.2 Opens on rising pressure
4.20 Temperature-Actuated Switch

4.20.1 Closes on rising temperature

4.20.2 Opens on rising temperature

4.21 Thermostat

NOTES:

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

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

4.21.1 Closes on rising temperature

\[ t^\circ \]

See Note 4.21A

4.21.1.1 With contact-motion direction clarified

\[ \rightarrow t^\circ \]

See Note 4.21B

4.21.2 Opens on rising temperature

\[ t^\circ \]

See Note 4.21A
4.21.3 Transfers on rising temperature

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

4.21.5 Application: multifunction, typical

4.21.6 With integral heater and transfer contacts

Use only if essential to indicate integral heater details.

4.21.7 Application: with operating temperatures indicated

4.22 Flasher
Self-Interrupting Switch
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)

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

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

4.29.4 Electrically operated 1-pole contactor with shunt blowout coil

* See Note 4.5A
4.30 Relay

See OPERATING COIL; RELAY COIL (item 4.5)

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

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

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

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

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

R
4.30.2 Application: relay with transfer contacts

![Relay Diagram]

* See Note 4.5A

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

![Relay Diagram]

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

![Relay Diagram]

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)

![Diagram of a relay with acceleration cutoff]

4.33 Aneroid Capsule (air pressure) Operated Switch

![Diagram of an aneroid capsule 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.

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

5. Graphic Symbols for Terminals and Connectors

5.1 Terminals

5.1.1 Circuit terminal

![Diagram of a circuit terminal]

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.

**NOTES:**

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

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

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

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

See Note 5.1.2A

#### 5.1.2.2 Envelope terminals

See Note 5.1.2A

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

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

See Note 5.1.2A

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

5.1.2.5 Terminals connected to metallic envelope or enclosure

5.2 Cable Termination

Line shown on left of symbol indicates cable.

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.

---

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 (→ ).

---

5.3.3.2 Plug (usually movable)

---

5.3.4 Separable connectors (engaged)

---

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

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

9 The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
5.3.6.1 Jacks with circuit normalled through one way

5.3.6.2 Jacks with circuit normalled through both ways

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

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


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

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.

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

6.1 Core

6.1.1 General or air core

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

NO SYMBOL

6.1.2 Magnetic core of inductor or transformer

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

6.1.3 Core of magnet

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

6.1.4 Magnetic-memory core

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

See also item 15.18.

6.1.4.1 Single-aperture type with windings shown

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

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

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

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

6.2.1 General

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

IEC

6.2.2 Magnetic-core inductor

Telephone loading coil

If necessary to show a magnetic core.

IEC

6.2.3 Tapped

IEC

6.2.4 Adjustable inductor

IEC

6.2.5 Adjustable or continuously adjustable inductor

IEC

6.2.6 Shunt inductor

IEC

6.2.7 Inductive termination

Commonly used in coaxial and waveguide diagrams.
6.2.7.1 Application: series inductor and path open

6.2.7.2 Application: series inductor and path short-circuited

6.2.8 Carrier line trap (carrier elimination filter)

6.2.8.1 General

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

2f Two frequency
WB Wide band
NB Narrow band

6.2.9 Coil operated flag indicator

6.3 Transductor
Saturable-Core Inductor
Saturable-Core Reactor

NOTES:

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

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

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

6.3.1 Transductor element, assembled

When windings are separated on a drawing, suitable indication shall be provided to show that they are on the same core.
6.3.2 Application: single-phase series transductor with winding-polarity and kind-of-current markings shown

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

See Notes 6.3B and C

6.3.3 Application: single-phase parallel transductor 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 transductor with two control circuits and kind-of-current markings shown

See Note 6.3B

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

See Note 6.3B
6.4 Transformer
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

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

6.4.9 Adjustable

6.4.10 Step-voltage regulator or load-ratio control autotransformer
6.4.10.1 Step-voltage regulator

6.4.10.2 Load-ratio control auto-transformer

6.4.11 Load-ratio control transformer with taps

6.4.12 1-phase induction voltage regulator(s)

Number of regulators may be written adjacent to the symbol.
6.4.13 Triplex induction voltage regulator

6.4.14 3-phase induction voltage regulator

6.4.15 1-phase, 2-winding transformer
6.4.15.1 Application: 3-phase bank of 1-phase, 2-winding transformers with wye-delta connections

6.4.15.2 Three phase transformer with 4 taps with wye-wye connections
**6.4.16** Polyphase transformer

![Polyphase transformer diagram]

**6.4.17** 1-phase, 3-winding transformer

![1-phase, 3-winding transformer diagram]
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

10 The broken line — — — indicates where line connection to a symbol is made and is not part of the symbol.
6.5 Linear Coupler

Cross References

NOTES:

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

7. Graphic Symbols for Electron Tubes and Related Devices

7.1 Electron Tube

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.

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.

The broken line -—- indicates where line connection to a symbol is made and is not part of the symbol.
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 7.1.1A

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

7.1.5 Heater

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 12 Ion-diffusion barrier, shown with envelope

Commonly used with liquid-filled tubes.

---

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

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

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

7.2.3 A diagram for a tube having more than one heater or filament shall show only one heater or filament symbol 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

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

Anode symbols are located as convenient.
7.3.7.5 Pool-type cathode power rectifier

7.3.8 X-ray tube

7.3.8.1 With filamentary cathode and focusing grid (cup)

The anode may be cooled by fluid or radiation.

7.3.8.2 With control grid, filamentary cathode, and focusing cup

7.3.8.3 With grounded electrostatic shield

7.3.8.4 Double focus with rotating anode

See item 7.2.9

7.3.8.5 With multiple accelerating electrode electrostatically and electromagnetically focused

See item 7.2.9
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.

<table>
<thead>
<tr>
<th>I</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Shield</td>
</tr>
<tr>
<td>R</td>
<td>Readout</td>
</tr>
<tr>
<td>C</td>
<td>Common</td>
</tr>
</tbody>
</table>

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.

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

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

Magnetron (item 15.11)

Resonator (cavity-type) Tube (item 15.10)

NOTES:

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

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

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

8. Graphic Symbols for Semiconductor Devices

8.1 Semiconductor Device

Transistor

Diode

See paragraph A4.11 of the Introduction

NOTES:

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

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

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

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

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

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

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

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

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

8.2 Element Symbols

8.2.1 Semiconductor region with one ohmic connection

As shown, the horizontal line is the semiconductor region and the vertical line is an ohmic connection.
The line representing the ohmic connection shall not be drawn at the very end of the line representing the semiconductor region.

**8.2.1.1** Semiconductor region with a plurality of ohmic connections

Examples show 2 ohmic connections.

**8.2.2** Rectifying junction or junction which influences a depletion layer

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

See item 8.6

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

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

**8.2.2.1** P region N region

**8.2.2.2** N region on P region
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 N on 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

\[ \text{Diagram of insulated gate} \]

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.

\[ \text{Diagram of multiple gates} \]

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

\[ \text{Diagram of gate with external connection} \]

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.

\[ \text{Diagram of gate with turn-off feature} \]
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.

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.

8.3.2 Tunneling

8.3.3 Backward

8.3.4 Capacitive
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.

<table>
<thead>
<tr>
<th>Name of Terminal</th>
<th>Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode</td>
<td>A</td>
</tr>
<tr>
<td>Base</td>
<td>B</td>
</tr>
<tr>
<td>Collector</td>
<td>C</td>
</tr>
<tr>
<td>Drain</td>
<td>D</td>
</tr>
<tr>
<td>Emitter</td>
<td>E</td>
</tr>
<tr>
<td>Gate</td>
<td>G</td>
</tr>
<tr>
<td>Cathode</td>
<td>K</td>
</tr>
<tr>
<td>Source</td>
<td>S</td>
</tr>
<tr>
<td>Main terminal*</td>
<td>T</td>
</tr>
<tr>
<td>Substrate (bulk)</td>
<td>U</td>
</tr>
</tbody>
</table>

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

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

Construction of symbol by successively using symbols 8.2.4.1, 8.2.5, and 8.2.1.
8.4.2 PNNIP device (example of a complex device with multiple emitters and bases)

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

8.5 Typical Applications, Two-Terminal Devices

See paragraph A4.11 of the Introduction

See Note 8.4A

8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier

8.5.2 Capacitive diode (varactor)

8.5.3 Temperature-dependent diode

8.5.4 Photodiode

See item 1.3
8.5.4.1 Photosensitive type

8.5.4.2 Photoemissive type

See also item 11.1.1

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

8.5.4.3.1 NPN-type

8.5.4.3.2 PNP-type

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

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

8.5.6 Breakdown diode; overvoltage absorber

See also item 9.3

8.5.6.1 Unidirectional diode; voltage regulator

Style 1

OR

Style 2

8.5.6.2 Bidirectional diode

Style 1

Style 2

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.

8.5.7.2 Backward diode; tunnel rectifier

For this application, Note 8.2.2A does not apply.
8.5.8 Thyristor, reverse-blocking diode-type

8.5.8.1 General

8.5.8.2 Light-activated type

8.5.9 Thyristor, bidirectional diode type; bi-switch

See also symbol 8.6.15

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

See also symbol 8.6.16, for 3-terminal device
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 NPIP 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

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)

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

8.6.12.2 Gate turn-off type

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

8.6.13.2 Gate turn-off type
8.6.14 Thyristor, reverse-blocking tetrode-type; semiconductor controlled switch

![Symbol 8.6.14](image)

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

See also symbol 8.5.9

![Symbol 8.6.15](image)

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

![Symbol 8.6.16](image)

8.6.17 Darlington transistor (NPN-type)

![Symbol 8.6.17](image)

8.7 Photosensitive Cell

See paragraph A4.11 of the Introduction

8.7.1 Asymmetrical photoconductive transducer

USE SYMBOL 8.5.4.1

8.7.2 Symmetrical photoconductive transducer (resistive)

USE SYMBOL 2.1.13
8.7.3 Photovoltaic transducer; barrier photocell; blocking-layer cell; solar cell

8.8 Semiconductor Thermocouple

8.8.1 Temperature-measuring

See paragraph A4.11 of the Introduction

8.8.2 Current-measuring

8.9 Hall Element

Hall Generator

See paragraph A4.11 of the Introduction

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

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

See Note 8.9A

8.10 Photon-Coupled Isolator

See also symbol 15.8.1

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

See Note 8.10A

8.10.2 Complete isolator (single-package type)

See Note 8.2.9A

8.10.3 Application: Incandescent lamp and symmetrical photoconductive transducer

8.10.4 Application: Photoemissive diode and phototransistor

8.11 Solid-State 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.

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

9. Graphic Symbols for Circuit Protectors

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

9.1.1 General

9.1.1.1 Fuse, supply side indicated by a thick line

9.1.2 Fuse with alarm contact

NOTE — 9.1.2A: When fuse blows, alarm bus A is connected to power supply bus S. The letters S (supply), L (load), and A (alarm circuit) are for explanation only, and are not part of the symbol.
9.1.3 Isolating fuse-switch; high-voltage primary fuse cutout, dry

9.1.4 High-voltage primary fuse cutout, oil

9.1.5 Isolating fuse-switch for on-load switching

9.1.6 Temperature-sensitive fuse (ambient-temperature operated)

USE SYMBOL 2.12.3

9.2 Current Limiter (for power cable)

The arrowheads in this case are filled.

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

See Note 9.2A

Avoid conflict with symbol 1.7.3 if used on the same diagram.
9.3 Lightning Arrester
Arrester (electric surge, etc)
Gap

See also symbol 8.5.6

9.3.1 General

9.3.2 Carbon block; telephone protector block
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

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.
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.

\[ C \quad \text{Current}^{13} \]

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

|> V <|

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

\[ \text{PW} \]

9.5.12.16 Carrier pilot

\[ \text{cc} \]

9.5.12.17 Positive phase-sequence undervoltage

\[ \text{V} \]

9.5.12.18 Negative phase-sequence overcurrent

\[ \text{C} \]

9.5.12.19 Gas-pressure (Buchholz)

\[ \text{GP} \]

9.5.12.20 Out-of-step

\[ \text{S} \]

### Cross References

**NOTES:**

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

### 10. Graphic Symbols for Acoustic Devices

#### 10.1 Audible-Signaling Device

10.1.1 Bell, electrical \( \mathfrak{B} \); telephone ringer \( \mathfrak{R} \)

**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.
10.1.1.1 Single-stroke

10.1.2 Buzzer

10.1.3 Loudspeaker
   Horn, Electrical
   Siren
   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
* HW Howler
* LS Loudspeaker
* SN Siren
‡ 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
10.1.3.3 Loudspeaker-microphone; underwater sound transducer, two-way

10.1.4 Telegraph sounder

10.2 Microphone

Telephone Transmitter

10.2.1 General

10.3 Handset

Operator's Set

10.3.1 General

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

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

11. Graphic Symbols for Lamps and Visual-Signaling Devices

11.1 Lamp

See also item 8.5.4.2

11.1.1 Lamp, general; high source, general

See also item 11.2.7

NOTES:

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

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

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

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

11.2.7.1 Application: green signal light

11.2.8 Jeweled signal light

Cross References

NOTES:

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

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

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

12.1 Meter

**Instrument**

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

*A* See Note 12.1A

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Ammeter</td>
</tr>
<tr>
<td>AH</td>
<td>Ampere-hour meter</td>
</tr>
<tr>
<td>C</td>
<td>Coulombmeter</td>
</tr>
<tr>
<td>CMA</td>
<td>Contact-making (or breaking) ammeter</td>
</tr>
<tr>
<td>CMC</td>
<td>Contact-making (or breaking) clock</td>
</tr>
<tr>
<td>CMV</td>
<td>Contact-making (or breaking) voltmeter</td>
</tr>
<tr>
<td>CRO</td>
<td>Oscilloscope, Cathode-ray oscillograph</td>
</tr>
<tr>
<td>DB</td>
<td>DB (decibel) meter</td>
</tr>
<tr>
<td>DBM</td>
<td>DBM (decibels referred to 1 milliwatt) meter</td>
</tr>
<tr>
<td>DM</td>
<td>Demand meter</td>
</tr>
<tr>
<td>DTR</td>
<td>Demand-totalizing relay</td>
</tr>
<tr>
<td>F</td>
<td>Frequency meter</td>
</tr>
<tr>
<td>GD</td>
<td>Ground detector</td>
</tr>
<tr>
<td>I</td>
<td>Indicating meter</td>
</tr>
<tr>
<td>INT</td>
<td>Integrating meter</td>
</tr>
<tr>
<td>µA or UA</td>
<td>Microammeter</td>
</tr>
<tr>
<td>MA</td>
<td>Milliammeter</td>
</tr>
<tr>
<td>NM</td>
<td>Noise meter</td>
</tr>
<tr>
<td>OHM</td>
<td>Ohmmeter</td>
</tr>
<tr>
<td>OP</td>
<td>Oil pressure meter</td>
</tr>
<tr>
<td>OSCG</td>
<td>Oscillograph, string</td>
</tr>
<tr>
<td>PF</td>
<td>Power factor meter</td>
</tr>
<tr>
<td>PH</td>
<td>Phasemeter</td>
</tr>
<tr>
<td>PI</td>
<td>Position indicator</td>
</tr>
<tr>
<td>RD</td>
<td>Recording demand meter</td>
</tr>
<tr>
<td>REC</td>
<td>Recording meter</td>
</tr>
<tr>
<td>RF</td>
<td>Reactive factor meter</td>
</tr>
<tr>
<td>SY</td>
<td>Synchroscope</td>
</tr>
<tr>
<td>t°</td>
<td>Temperature meter</td>
</tr>
<tr>
<td>THC</td>
<td>Thermal converter</td>
</tr>
<tr>
<td>TLM</td>
<td>Telemeter</td>
</tr>
<tr>
<td>TT</td>
<td>Total time meter</td>
</tr>
<tr>
<td>V</td>
<td>Voltmeter</td>
</tr>
<tr>
<td>VA</td>
<td>Volt-ammeter</td>
</tr>
</tbody>
</table>
VAR Varometer
VARH Varhour meter
VI Volume indicator
VU Standard volume indicator
W Wattmeter
WH Watthour meter

12.1.1 Galvanometer

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

13.1 Rotating Machine

13.1.1 Basic

13.1.2 Generator (general)

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

13.1.2.1 Generator, direct-current

13.1.2.2 Generator, alternating-current

13.1.2.3 Generator, synchronous

13.1.3 Motor (general)
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

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

The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
13.2.3 Shunt, or separately excited

13.2.4 Permanent magnet

USE SYMBOL 2.8

13.3 Winding Connection Symbols

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

13.3.1 1-phase

13.3.2 2-phase

13.3.3 3-phase wye (ungrounded)

13.3.4 3-phase wye (ungrounded)

13.3.5 3-phase delta

13.3.6 6-phase diametrical
13.3.7 6-phase double-delta

13.4 Applications: Direct-Current Machines

13.4.1 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

---

15 The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
13.4.5 16 Direct-current series motor or 2-wire generator; with commutating or compensating field winding, or both

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

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

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

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

---

16The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
13.4.10 17 Direct-current compound motor or 2-wire generator or stabilized shunt motor; with commutating or compensating field winding, or both

13.4.11 17 Direct-current 3-wire shunt generator

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

13.4.13 17 Direct-current 3-wire compound generator

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

17 The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.
13.4.15 18 Direct-current balancer, shunt wound

13.4.16 18 Direct-current balancer, compound wound

13.4.17 18 Dynamotor

13.4.18 18 Double-current generator

13.4.19 18 Acyclic generator, separately excited

---

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

---

*The broken line — — indicates where line connection to a symbol is made and is not part of the symbol.*
13.5 Applications: Alternating-Current Machines

13.5.1 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

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

The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.
13.5.7 21 1-phase hysteresis motor

13.5.8 21 Reluctance motor

13.5.9 21 1-phase subsynchronous reluctance motor

13.5.10 21 Magnetoelectric generator, 1-phase; telephone magneto

13.5.11 21 Shunt-characteristic brush-shifting motor

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

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

21 The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
13.5.14 Ohmic-drop exciter with 3- or 6-phase input

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

13.5.16 3-phase regulating machine

13.5.17 Phase shifter with 1-phase output

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

13.5.18 Phase shifter with 3-phase output

See PHASE SHIFTER (item 16.6) and TRANSFORMER (item 6.4)
13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation

13.6.1 22 Synchronous motor, generator, or condenser

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

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

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

13.6.5 22 Synchronous-synchronous frequency changer

---

22 The broken line —— indicates where line connection to a symbol is made and is not part of the symbol.
13.6.6 23 Synchronous-induction frequency changer

13.7 Applications: Alternating- and Direct-Current Composite

13.7.1 23 Synchronous or regulating-pole converter

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

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

23 The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
13.7.4 Synchronous converter, compound-wound with commutating or compensating field windings, or both

13.7.5 Motor converter

13.8 Synchro

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

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

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

13.8.1 General

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

---

24 The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.
13.8.2 Synchro, control transformer; synchro, receiver  

13.8.3 Synchro, differential receiver; synchro, differential transmitter

13.8.4 Synchro, resolver

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

Cross References

14. Graphic Symbols for Mechanical Functions

14.1 Mechanical Connection
Mechanical Interlock

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

14.1.1 Mechanical connection

The top symbol consists of short dashes.

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

These are short dashes.

14.1.3 Mechanical interlock, other

INDICATE BY A NOTE

14.2 Mechanical Motion

14.2.1 Translation, one direction

14.2.2 Translation, both directions

14.2.3 Rotation, one direction

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.

14.2.4 Rotation, both directions

14.2.4.1 Alternating or reciprocating

For application see symbol 2.3.7.7
**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.

![Circuit symbol for rotation designation](image)

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

See symbol 4.24.4 for application

![Circuit symbol for rotational speed or angular velocity dependence](image)

**14.3 Clutch**

**Brake**

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

![Circuit symbol for clutch disengaged](image)

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

![Circuit symbol for clutch engaged](image)
14.3.3 Brake applied when operating means (not shown) is energized

![Brake applied diagram]

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

![Brake released diagram]

14.4 Manual Control

14.4.1 General

![General control diagram]

14.4.2 Operated by pushing

![Pushing control diagram]

14.4.3 Operated by pushing and pulling (push-pull)

![Push-pull control diagram]

Cross References

NOTES:

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

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

3 — For centered figures with symbols appearing side by side, the symbol on the left-hand side should be considered to be for a single line (one-line) diagram and the symbol on the right-hand side for a complete diagram, i.e., 1.5.1.
15. Graphic Symbols Commonly Used in Connection with VHF, UHF, SHF Circuits

15.1 Discontinuity (Introducing intentional wave reflection)

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

Commonly used for coaxial and waveguide transmission.

15.1.1 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

\[\text{IEC} \quad \triangle \]

\[\text{IEC} \quad \triangle \]

\[\text{IEC} \quad \triangle \]

\[\text{IEC} \quad \triangle \]

---

\[\text{IEC} \quad \triangle \]

---

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

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

![Conductance Symbol]

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

![Inductance-Capacitance Circuit]

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

![Inductance-Capacitance Circuit]

15.1.4 Slide-screw tuner

![Slide-Screw Tuner]

15.1.5 E-H tuner

![E-H Tuner]

15.1.6 Multistub tuner with 3 stubs

![Multistub Tuner]

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.

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

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
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

![Loop Coupling Diagram]

15.3.4 Application: probe coupling, 30-decibel transmission loss

![Probe Coupling Diagram]

15.3.5 Application: resistance coupling, 30-decibel transmission loss

![Resistance Coupling Diagram]

15.3.6 Application: directional coupler showing coupling loss and directivity

First value is coupling loss; second value is directivity.

![Directional Coupler Diagram]

15.4 Hybrid
Directionally Selective Transmission Devices

15.4.1 Hybrid (general)

![Hybrid General Diagram]

15.4.2 Hybrid, junction (magic T)

Commonly used in coaxial and waveguide transmission

![Hybrid Junction Diagram]
15.4.3 Application: rectangular waveguide and coaxial coupling

![Diagram of 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.

![Diagram of hybrid, circular (basic)]

* See Note 15.4.4A

15.4.4.1 Application: 4-arm circular hybrid

![Diagram of 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

![Diagram of rectangular waveguide circular hybrid]

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)

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.

15.7.1.1 Application: coaxial type in rectangular waveguide system
15.7.1.2 Application: circular waveguide type in rectangular waveguide system

![Symbol]

15.8 Nonreciprocal Devices

15.8.1 Isolator

See also symbol 8.10

![Symbol]

15.8.2 Nonreciprocal directional phase shifter

![Symbols]

15.8.3 Gyrator

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

![Symbol]

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.

![Symbol]

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

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

![Backward-wave traveling-wave-tube oscillator diagram]

15.15 Balun

15.15.1 General

![Balun symbol]

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

![Balun application diagram]

15.16 Filter

15.16.1 Mode filter

![Mode filter symbol]

15.16.2 Frequency filter (bandpass)

See also symbol 16.1.1.2

![Frequency filter symbol]

15.17 Phase Shifter (matched)

See also symbols 15.8.2 and 16.6

---

26The broken line - — - indicates where line connection to a symbol is made and is not part of the symbol.
15.18 Ferrite Bead Ring

See also symbol 6.1.4

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

15.18.1 General

15.18.2 Application: with equivalent circuit (LC network) shown

15.19 Line Stretcher (with female connectors shown)

Cross References

- Bifilar Slow-Wave Structure (item 2.6.4)
- Capacitive Termination (item 2.2.10)
- Coaxial Cable, Recognition Symbol (item 3.1.9)
- Inductive Termination (item 6.2.7)
- Intentional Isolation of DC Path in Coaxial or Waveguide Applications (item 3.5)
- Permanent Magnet (item 2.8)
- Resistive Termination (item 2.1.11)
- Shunt Capacitor (item 2.2.11)
- Shunt Inductor (item 6.2.6)
- Shunt Resistor (item 2.1.10)
- Strip-Type Transmission Line (item 3.7)
- Termination (item 3.8)
- Waveguide (item 3.6)
Waveguide Flanges (item 5.7)

NOTES:

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

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

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

16. Graphic Symbols for Composite Assemblies

16.1 Circuit Assembly

Circuit Subassembly

Circuit Element

NOTES:

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

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

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

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

16.1.1 General

   * See Note 16.1A

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

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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLK</td>
<td>Clock</td>
</tr>
<tr>
<td>EQ</td>
<td>Equalizer</td>
</tr>
<tr>
<td>FAX</td>
<td>Facsimile set</td>
</tr>
<tr>
<td>FL</td>
<td>Filter</td>
</tr>
<tr>
<td>FL-BE</td>
<td>Filter, band-elimination</td>
</tr>
<tr>
<td>FL-BP</td>
<td>Filter, bandpass</td>
</tr>
<tr>
<td>FL-HP</td>
<td>Filter, high-pass</td>
</tr>
<tr>
<td>FL-LP</td>
<td>Filter, low-pass</td>
</tr>
<tr>
<td>IND</td>
<td>Indicator</td>
</tr>
<tr>
<td>PS</td>
<td>Power supply</td>
</tr>
<tr>
<td>RG</td>
<td>Recording unit</td>
</tr>
</tbody>
</table>
RU Reproducing unit
ST-INV Static inverter
DIAL Telephone dial
TEL Telephone station
TPR Teleprinter .jackson
TTY Teletypewriter .jackson

16.2 Amplifier

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

16.2.1 General

The triangle is pointed in the direction of transmission.

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

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

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

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

See Note 16.2.1A

16.2.2 Magnetic amplifier
16.2.3 Application: amplifier with two inputs

See Note 16.2.1A

16.2.4 Application: amplifier with two outputs

See Note 16.2.1A

16.2.5 Application: amplifier with adjustable gain

See Note 16.2.1A

16.2.6 Application: amplifier with associated attenuator

See Note 16.2.1A

16.2.7 Application: amplifier with associated power supply

See Note 16.2.1A

16.2.8 Application: amplifier with external feedback path

See Note 16.2.1A
16.3 Rectifier

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

16.3.1 General

NOTES:

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

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

See Notes 16.3.1A and B

16.3.2 Controlled

See Notes 16.3.1A and B

16.3.3 Bridge-type rectifier

See item 8.5.1

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

For connection or wiring diagram

16.4 Repeater (includes Telephone Repeater □)

16.4.1 1-way repeater

Triangle points in the direction of transmission.
16.4.2 2-wire, 2-way repeater

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

16.4.4 4-wire, 2-way repeater

16.5 Network
Artificial Line (other than delay line)

16.5.1 General

16.5.2 Network, low-voltage power

16.6 Phase Shifter
Phase-Changing Network

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

See also symbol 15.17
16.6.1 General

16.6.2 3-wire or 3-phase

16.6.3 Application: adjustable

16.6.4 Differential phase shifter

Phase shift $\phi$ in direction of arrowhead; magnitudes shall be indicated.

16.6.5 Application: adjustable

16.7 Chopper

NOTES:

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

16.7B — When diagram is other than single line, show connections as required for a specific device.
16.8 Diode-Type Ring Demodulator
Diode-Type Ring Modulator

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

17.1 Operational Amplifier

17.2 Summing Amplifier

(4 inputs and 1 output shown)

17.3 Integrator (Amplifier)

(4 inputs and 1 output shown)

NOTES:

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

17.3B — The letters IC mean Initial Conditions.

* See Note 17.3A
17.4 Electronic Multiplier

17.4.1 Two dependent multipliers

17.5 Electronic Divider

17.6 Electronic Function Generator

17.7 Generalized Integrator

17.8 Positional Servomechanism

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

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

Cross References

18. Graphic Symbols for Digital Logic Functions

18.1 Digital Logic Functions

(See cross references)

Cross References

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


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

NOTES:

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

19. Graphic Symbols for Special-Purpose Maintenance Diagrams

19.0 Introduction

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

See paragraph A4.5 of the Introduction

---

27 The symbols shown in this section have comparable meanings or applications when used for drawings in mechanical, medical, or other disciplines or fields.
19.1 Data-Flow Code Signals

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

19.1.1 Functional flow path

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

19.1.1.1 Major (most significant)

19.1.1.2 Minor (least significant)

19.1.2 Signal code

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

19.1.2.1 Normal

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

19.1.2.1.1 Application: emergency mode

19.1.2.1.2 Application: automatic mode

19.1.2.2 Secondary flow; power distribution
19.1.2.3 Reference signal voltage; reference frequency

19.1.2.4 Signal to energize relay

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

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

19.1.2.6 Gating; synchronizing signal; low-level modulating signal

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

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

19.1.2.8 Feedback

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

19.1.3 Fault-signal code

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

19.1.3.1 Application: fault-isolation signal to relay
19.2 Functional Circuits

See Note 19.1A

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

NOTES:

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

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

*See Note 19.2.1B

19.2.2 Signal generator; signal processor

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

*See Note 19.2.1B

19.2.3 Linear element; linear network

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

*See Note 19.2.1B

19.2.4 Relay contacts

*See Note 19.2.1B
19.2.5 Relay coil or operating coil

![Diagram of a relay coil or operating coil]

*See Note 19.2.1B

19.2.6 Switch

![Diagram of a 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)

![Diagram of a composite circuit]

*See Note 19.2.1B

Cross References

NOTES:

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

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

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

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

20.1 Radio Station

Other antenna symbols may be used to indicate specific types.

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

* 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

![Diagram of 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

![Diagram of polar direct-current/alternating-current for one-way simplex operation]

20.4.5.4 Regenerative type for one-way simplex operation

![Diagram of regenerative type for one-way simplex operation]

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.

![Diagram of general telegraph equipment]

20.5.2 Transmitter

![Diagram of transmitter]

20.5.3 Receiver

![Diagram of receiver]
**20.5.4** Two-way simplex

![Two-way simplex symbol]

**20.5.5** Duplex

![Duplex symbol]

**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

![Tape printing symbol]

**20.5.6.2** Tape perforating; perforated tape

![Tape perforating symbol]

**20.5.6.3** Simultaneous printing on and perforating of one tape

![Simultaneous printing symbol]

**20.5.6.4** Page printing

![Page printing symbol]

**20.5.6.5** Keyboard

![Keyboard symbol]

**20.5.6.6** Facsimile

![Facsimile symbol]
20.5.7 Applications:

20.5.7.1 Tape-printing receiver

20.5.7.2 Tape-printing receiver with keyboard transmitter

20.5.7.3 Printing reperforator

20.5.7.4 Page-printing receiver

20.5.7.5 Page-printing receiver with keyboard transmitter

20.5.7.6 Facsimile receiver

20.5.7.7 Keyboard perforator
20.5.7.8 Automatic transmitter using perforated tape

![Automatic transmitter using perforated tape](image)

20.5.7.9 Separate reperforator and automatic transmitter with continuous tape feed

![Separate reperforator and automatic transmitter with continuous tape feed](image)

20.6 Telephone Set

20.6.1 General

![General](image)

20.6.2 Local-battery

![Local-battery](image)

20.6.3 Common-battery

![Common-battery](image)

20.6.4 Dial-type

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

![Dial-type](image)

20.6.5 Pushbutton dialing

![Pushbutton dialing](image)
20.6.6 With two or more extension lines

20.6.7 With coin box

20.6.8 With ringing generator

20.6.9 Loudspeaker-type

20.6.10 Amplifier-type

20.6.11 Sound-powered

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

NOTES:

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

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

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

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

21.1 Generating Station

NOTES:

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

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

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

21.1.1 General

See note 21.1A

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

21.3.4 Nuclear energy fueled
21.3.5 Geothermic

21.4 Prime Mover (qualifying symbols)

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

See Note 21.1A

21.4.1 Gas turbine

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

21.4.2 Reciprocating engine

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

21.5 Substation

See Note 21.1A

21.5.1 General

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

Use if essential to show type of equipment.

Cross References

NOTES:

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

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

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

22. Class Designation Letters

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

22.1 Class Designation Letter

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

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

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

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

22.2 Special Considerations for Class Designation Letter Assignment

22.2.1 Actual versus intended function

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

---

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


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

22.2.2 Assembly versus subassembly

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

22.2.3 Subassembly versus individual part

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

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

22.2.4 Specific versus general

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

22.2.5 Inseparable subassemblies

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

22.3 Item Names

In the alphabetically arranged class letter list of paragraph 22.4, item names approved in the Federal Item Identification Guide, Cataloging Handbook H6-1, as of the date of this edition (though additional modifiers may be necessary), are indicated by the symbol . 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<sup>†</sup> | electronic divider |
| (see also U and 22.2.4) | electronic function generator (other than rotating) |
|                     | electronic multiplier |
|                     | facsimile set |
|                     | field-polarization amplitude modulator |
|                     | field-polarization rotator |
|                     | general circuit element |
|                     | gyroscope |
|                     | integrator |
|                     | positional servomechanism |
|                     | sensor (transducer to electric power) |
|                     | separable assembly<sup>‡</sup> |
|                     | separable subassembly |
|                     | telephone set |
|                     | telephone station |
|                     | teleprinter |
|                     | teletypewriter |

| AR | amplifier (other than rotating) |
|    | repeater |

| AT | bolometer |
|    | capacitive termination |
|    | fixed attenuator |
|    | inductive termination |
|    | isolator (nonreciprocal device) |
|    | pad |
|    | resistive termination |

| B | blower |
|   | motor |
|   | synchro |

| BT | barrier photocell |
|    | battery |
|    | battery cell |
|    | blocking layer cell |
|    | photovoltaic transducer |
|    | solar cell |

| C | capacitor bushing |
|   | capacitor |

| CB | circuit breaker |
|    | network protector |

| CP | connector adapter |
|    | coupling (aperture, loop, or probe) |
|    | junction (coaxial or waveguide) |
D or CR  asymmetrical varistor
crystal diode
current regulator (semiconductor
device)
diode (semiconductor type)
diode rectifier (semiconductor type)
diode-type ring demodulator
diode-type ring modulator
metallic rectifier
photodiode (photosensitive type)
stabilisor
thyristor (semiconductor diode
type)
varactor

D or VR  breakdown diode (voltage
regulator)
overvoltage absorber

DC  directional coupler

DL  delay function
delay line
slow-wave structure

DS  alphanumeric display device
annunciator
electrically restored drop
genral light source
indicator (excluding meter or
thermometer)
lamp (excluding heating lamp)
light-emitting solid-state device
manually restored drop
photodiode (photoemissive type)
signal light
visual alarm
visual indicator
visual signaling device
E* aluminum cell
antenna
armature
binding post
 cable termination
 carbon block
circuit terminal
conductivity cell
electrical contact
electrical contact brush
electrical shield
electrolytic cell
ferrite bead rings
film element
gap (horn, protective, or sphere)
Hall element
ignitor gap
insulator
lightning arrester
magnetic core
miscellaneous electrical part
optical shield
permanent magnet
rotary joint (microwave)
short circuit (termination)
spark gap
splice
telephone protector
telephone protector block
terminal (individual)
valve element
vibrating reed

EQ equalizer
equalizing network

F current limiter (for power cable)
fuse
fuse cutout

FL filter

G electronic chopper
generator
ignition magneto
interrupter vibrator
oscillator
rotating amplifier (regulating
generator)
telephone magneto

H* hardware (common fasteners, etc)

HP* hydraulic part

HR heater
heating lamp
heating resistor
infrared lamp
thermomechanical transducer

HS handset
operator’s set
HT  earphone  
  electrical headset  
  receiver (excluding radio receiver)  
  telephone receiver

HY  circulator  
  directionally selective transmission device  
  hybrid circuit network  
  hybrid coil (telephone usage)  
  hybrid junction (magic T)

J  disconnecting device (receptacle connector)  
  electrical receptacle connector  
  jack  
  receptacle (connector, stationary portion)  
  waveguide flange (choke)

K  contactor (magnetically operated)  
  relay

L  coil (all not classified as transformers)  
  electrical solenoid  
  field winding  
  generator field  
  inductor  
  lamp ballast  
  motor field  
  reactor  
  winding

LS  audible alarm  
  audible signaling device  
  buzzer  
  electric bell  
  electric horn  
  loudspeaker  
  loudspeaker-microphone  
  siren  
  telephone ringer  
  telephone sounder  
  underwater sound transducer

M  clock  
  coulomb accumulator  
  elapsed time recorder  
  electric timer  
  electrical counter  
  electrochemical step-function device  
  instrument  
  message register  
  meter  
  meter-type level pressure gage  
  oscillograph  
  oscilloscope  
  position indicator  
  thermometer
MG converter (rotating machine)
dynamotor
inverter (motor-generator)
motor-generator

MK hydrophone
microphone
telephone transmitter

MP** brake
clutch
mechanical interlock
mechanical part
miscellaneous mechanical part
(bearing, coupling, gear, shaft)

MT accelerometer
measuring transducer
mode transducer
motional pickup transducer
primary detector

N** equipment subdivision

P disconnecting device (plug connector)
electrical plug connector
plug (connector, movable portion)
waveguide flange (plain)

PS power supply
rectifier (complete power-supply assembly)

PU head (with various modifiers)
sound reproducer

Q semiconductor controlled rectifier
semiconductor controlled switch
phototransistor (3 terminal)
thyatron (semiconductor device)
thyatron (semiconductor triode type)
transistor

R function potentiometer
instrument shunt
magnetoresistor
potentiometer
relay shunt
resistor
rheostat

RE radio receiver

RT ballast lamp
ballast tube
current-regulating resistor
resistance lamp
temperature-sensing element
thermal resistor
thermistor

RV symmetrical varistor
voltage-sensitive resistor
S  contactor (manually, mechanically,  
or thermally operated)  
disconnecting device (switch)  
electrical safety interlock  
flasher (circuit interrupter)  
governor (electrical contact  
type)  
speed regulator (electrical contact  
type)  
switch  
telegraph key  
phone dial  
thermal cutout (circuit interrupter)  
(at not visual)  
thermostat  

SQ  electric squib  
explosive squib  
fusible link  
igniter squib  
sensing link  

SR  electrical contact ring  
rotating contact  
slip ring  

T  autotransformer  
coaxial taper  
linear coupler  
telephone induction coil  
telephone repeating coil  
transformer  
waveguide taper  

TB  connecting strip  
terminal board  
terminal strip  
test block  

TC  semiconductor thermocouple  
thermocouple  
thermopile  

TP††  test point  

TR  radio transmitter  

U*†  inseparable assembly  
(integrated-circuit package)  
microcircuit  
micromodule  
photon-coupled isolator  

V  electron tube  
Geiger-Muller counter tube  
ionization chamber  
klystron  
magnetron  
phototube  
proportional counter tube  
resonator tube (cavity type)  
solion  
thyratron (electron tube)  
traveling-wave tube  
voltage regulator (electron tube)
| VR | induction voltage regulator 
(see also D) voltage regulator (excluding electron tube) |
|----|--------------------------------------------------|
| W  | bus bar  
 cable  
 cable assembly (with connectors)  
 coaxial cable  
 conductor  
 distribution line  
 distribution path  
 Goubau line  
 strip-type transmission line  
 transmission line  
 transmission path  
 waveguide  
 wire |
| WT†‡ | wiring tiepoint |
| X  | fuseholder  
 lampholder  
 socket |
| Y  | magnetostriction oscillator  
 piezoelectric crystal unit  
 quartz crystal unit  
 tuning-fork resonator |
| 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  
 resonator (tuned cavity)  
 slide-screw tuner |

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

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

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

** Not a class letter, but used to identify a subdivision of an equipment in the Location Numbering Method.
22.5 Item Names: Alphabetical List

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

22.6 Item Designations, IEC 113-2

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

23. Referenced Standards and Canadian Standard Z99 Modifications

23.1 Referenced Standards

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


29 For Military Applications:

(1) Refer to the latest edition adopted for mandatory use by the Department of Defense.
(2) Refer to the following military standards (latest edition at time of invitation to bid) in lieu of the American National Standards:
(3) The following documents are listed for purposes of information only:
   MIL-STD-100 Engineering Drawing Practices.
   MIL-M-24100 Manuals, Technicals: Functionally Oriented Maintenance Manual (FOMM)
   Federal Cataloging Handbook H6-1, Section A.

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

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

These items are illustrated below:

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

Cross References

Annex A

Cross Reference List of Changed Item Numbers

(Informative)

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

<table>
<thead>
<tr>
<th>ANSI Y32.2-1970</th>
<th>ANSI Y32.2-1975</th>
<th>ANSI Y32.2-1970</th>
<th>ANSI Y32.2-1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.1.1</td>
<td>1.3.1</td>
<td>2.2.14</td>
<td>2.2.13</td>
</tr>
<tr>
<td>1.3.1.2</td>
<td>1.3.1</td>
<td>2.2.15</td>
<td>2.2.14</td>
</tr>
<tr>
<td>1.3.2.1</td>
<td>1.3.2</td>
<td>2.2.16</td>
<td>2.2.15</td>
</tr>
<tr>
<td>1.3.2.2</td>
<td>1.3.2</td>
<td>2.2.17</td>
<td>2.2.16</td>
</tr>
<tr>
<td>1.3.3</td>
<td>1.3.2</td>
<td>2.3.6.8</td>
<td>14.2.4.1</td>
</tr>
<tr>
<td>1.3.3.1</td>
<td>1.3.2</td>
<td>2.6.1 (top)</td>
<td>2.6.4</td>
</tr>
<tr>
<td>1.3.3.2</td>
<td>1.3.2</td>
<td>2.6.3</td>
<td>2.6.4</td>
</tr>
<tr>
<td>2.2.9</td>
<td>2.2.11</td>
<td>4.2.1.1 (bottom)</td>
<td>4.2.1.2</td>
</tr>
<tr>
<td>2.2.11</td>
<td>2.2.12</td>
<td>4.2.1.2</td>
<td>4.2.1.1</td>
</tr>
<tr>
<td>2.2.12</td>
<td>2.2.9</td>
<td>4.2.1.3</td>
<td>4.2.1.2</td>
</tr>
<tr>
<td>2.2.13</td>
<td>2.2.9.1</td>
<td>4.2.1.4</td>
<td>4.2.1.3</td>
</tr>
</tbody>
</table>
Annex B

Reference Data

International Electrotechnical Commission (IEC)

Publication 117: Recommended Graphical Symbols
(Informative)

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

<table>
<thead>
<tr>
<th>Publication 117</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>General Index (1973)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Generating stations and substations, lines for transmission and distribution (1963) Amendment 1 (August 1973)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Semiconductor devices, capacitors (Second edition, 1971)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Architectural diagrams (1967)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td>Date</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>10</td>
<td>Aerials (antennas) and radio stations (1968)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplement A (Nov 1969)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Microwave technology (1968)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>First supplement (1971)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Frequency spectrum diagrams (1968)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Block symbols for transmission and miscellaneous applications (1969)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Telecommunication lines and accessories (1971)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplement A (May 1974)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Binary logic elements (1972)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Ferrite Cores and magnetic storage matrices (1972)</td>
<td></td>
</tr>
</tbody>
</table>
### Annex C
### Revised or Deleted Symbols
*(Informative)*

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

### Revised or Deleted Symbols

*(Informative)*

<table>
<thead>
<tr>
<th>Symbols Formerly in USAS Y32.2-1967</th>
<th>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modified</strong></td>
<td></td>
</tr>
<tr>
<td>1.7.2 Both ways</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>See item 1.7.2</td>
</tr>
<tr>
<td><strong>Expanded</strong></td>
<td></td>
</tr>
<tr>
<td>2.1.12 Thermistor</td>
<td></td>
</tr>
<tr>
<td>Thermal resistor</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>2.1.12.1 General</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>See item 2.1.12</td>
</tr>
<tr>
<td>2.1.12.2 With independent integral heater</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>2.8 Permanent Magnet</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>See item 2.8</td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>3.1.9 Coaxial cable, recognition symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Coaxial transmission path</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Radio-frequency cable</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
<td>3.1.9A: If necessary for clarity, an outer-conductor connection to the symbol shall be made where the broken line - - - is shown.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>See Note 3.1.9A</td>
</tr>
</tbody>
</table>
### Symbols Formerly in USAS Y32.2-1967

<table>
<thead>
<tr>
<th>Revised and Expanded</th>
<th>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.21 Thermostat</strong></td>
<td>See items 4.21 through 4.21.7</td>
</tr>
<tr>
<td>Ambient-temperature-operated device. Operates on rising temperature.</td>
<td></td>
</tr>
<tr>
<td><strong>4.21.1 With break contact</strong></td>
<td>See also item 4.20.2</td>
</tr>
<tr>
<td>![Thermostat with break contact]</td>
<td></td>
</tr>
<tr>
<td><strong>4.21.2 With make contact</strong></td>
<td>See also item 4.20.2</td>
</tr>
<tr>
<td>![Thermostat with make contact]</td>
<td></td>
</tr>
<tr>
<td><strong>4.21.3 With integral heater and transfer contacts</strong></td>
<td>See items 4.21 through 4.21.7</td>
</tr>
<tr>
<td>![Thermostat with heater and transfer contacts]</td>
<td></td>
</tr>
<tr>
<td><strong>Deleted</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4.30 Relay</strong></td>
<td>See item 4.30</td>
</tr>
<tr>
<td>![Relay symbols]</td>
<td></td>
</tr>
<tr>
<td><strong>Revised and Expanded</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4.30.5 Thermal relay</strong></td>
<td>See items 4.30.5 through 4.30.6</td>
</tr>
<tr>
<td>![Thermal relay symbols]</td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td><strong>5.6.2 Coaxial with the outside conductor shown carried through</strong></td>
<td>See item 5.6.2</td>
</tr>
<tr>
<td>![Coaxial with conductor carried through]</td>
<td></td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>5.6.3 Application: Coaxial with outside conductor shown carried through; with outside conductor terminated on chassis</td>
<td>See item 5.6.3</td>
</tr>
<tr>
<td><img src="image1" alt="Coaxial Symbol" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>5.6.4 Application: Coaxial with center conductor shown carried through; outside conductor not carried through</td>
<td>See item 5.6.4</td>
</tr>
<tr>
<td><img src="image2" alt="Coaxial Symbol" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>5.7.1 Mated (general)</td>
<td>See item 5.7.1</td>
</tr>
<tr>
<td><img src="image3" alt="Mated Symbol" /></td>
<td></td>
</tr>
<tr>
<td><strong>Deleted</strong></td>
<td></td>
</tr>
<tr>
<td>5.7.4 Application: mated choke flanges in rectangular waveguide line</td>
<td>See item 5.7.4</td>
</tr>
<tr>
<td><img src="image4" alt="Mated Choke Flanges" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>5.7.5 Application: rectangular waveguide with mated plain and choke flanges with direct-current isolation (insulation) between sections of waveguide.</td>
<td>See item 5.7.5</td>
</tr>
<tr>
<td><img src="image5" alt="Rectangular Waveguide" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>7.3.6 Cathode-ray tube</td>
<td>See items 7.3.6 through 7.3.6.2.2</td>
</tr>
<tr>
<td>7.3.6.1 With electric-field deflection</td>
<td></td>
</tr>
<tr>
<td><img src="image6" alt="Cathode-ray Tube Electric" /></td>
<td></td>
</tr>
<tr>
<td>7.3.6.2 For magnetic deflection</td>
<td></td>
</tr>
<tr>
<td><img src="image7" alt="Cathode-ray Tube Magnetic" /></td>
<td></td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Revised</td>
<td>8.6.15 Thyristor, bidirectional triodetype; triac; gated switch</td>
</tr>
<tr>
<td></td>
<td>See item 8.6.15</td>
</tr>
<tr>
<td>Revised and Expanded</td>
<td>9.1.2 High-voltage primary fuse cut-out, dry</td>
</tr>
<tr>
<td></td>
<td>See item 9.1.3</td>
</tr>
<tr>
<td>Revised and Expanded</td>
<td>9.1.4 With alarm contact</td>
</tr>
<tr>
<td></td>
<td>When fuse blows, alarm bus A is connected to power bus B. Letters</td>
</tr>
<tr>
<td></td>
<td>are for explanation and are not part of the symbol.</td>
</tr>
<tr>
<td>Revised</td>
<td>10.4.1 General</td>
</tr>
<tr>
<td></td>
<td>See item 10.4.1</td>
</tr>
<tr>
<td>Revised</td>
<td>15.2.4 Coupling by loop from coaxial to circular waveguide with</td>
</tr>
<tr>
<td></td>
<td>direct-current grounds connected</td>
</tr>
<tr>
<td></td>
<td>See item 15.2.4</td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>15.2.7 Coupling by probe from coaxial to rectangular waveguide with direct-current grounds connected</td>
<td>See item 15.2.7</td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>15.3.2 Application: E-plane aperture coupling, 30-decibel transmission loss</td>
<td>See items 15.3.2 through 15.3.6</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>15.3.3 Application: loop coupling, 30-decibel transmission loss</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>15.3.4 Application: probe coupling, 30-decibel transmission loss</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>15.3.5 Application: resistance coupling, 30-decibel transmission loss</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>See item 15.4.4</td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Deleted</td>
<td></td>
</tr>
<tr>
<td>15.4.5.1 Application: circulator, reversible direction</td>
<td>See item 15.8.4.1</td>
</tr>
<tr>
<td>The polarity symbol (item 1.6) must be used with electromagnet symbol to indicate proper direction flow.</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>15.5.3 Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected.</td>
<td>See item 15.5.3</td>
</tr>
<tr>
<td><img src="image2.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>15.7.1.1 Application: coaxial type in rectangular waveguide system</td>
<td>See item 15.7.1.1</td>
</tr>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Deleted</td>
<td></td>
</tr>
<tr>
<td>15.8.3 Unidirectional (isolator) Power flowing in direction of arrow is not intentionally attenuated.</td>
<td>See item 15.8.1</td>
</tr>
<tr>
<td><img src="image4.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>See item 15.9.2</td>
</tr>
<tr>
<td><img src="image5.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>15.9.3 Application: tunable resonator having adjustable Q coupled by a probe to a coaxial system</td>
<td>See item 15.9.3</td>
</tr>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>15.11.1 Resonant type with coaxial output</td>
<td>See item 15.11.1</td>
</tr>
<tr>
<td><img src="image2.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>See item 15.12.2</td>
</tr>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>See item 15.14.1</td>
</tr>
<tr>
<td><img src="image4.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>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</td>
<td>See item 15.14.2</td>
</tr>
<tr>
<td>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</td>
<td>See item 15.14.3</td>
</tr>
<tr>
<td>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</td>
<td>See item 15.14.4</td>
</tr>
<tr>
<td>Symbols Formerly in USAS Y32.2-1967</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td><strong>See item 15.14.6</strong></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td><img src="image2.png" alt="Diagram 2" /></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td><strong>See item 15.14.7</strong></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td><img src="image3.png" alt="Diagram 3" /></td>
<td><img src="image4.png" alt="Diagram 4" /></td>
</tr>
<tr>
<td><strong>Revised</strong></td>
<td><strong>See item 15.14.8</strong></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td><img src="image5.png" alt="Diagram 5" /></td>
<td><img src="image6.png" alt="Diagram 6" /></td>
</tr>
</tbody>
</table>
Deleted

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>Amplifier</td>
</tr>
<tr>
<td>AT</td>
<td>Attenuator</td>
</tr>
<tr>
<td>C</td>
<td>Capacitor</td>
</tr>
<tr>
<td>CB</td>
<td>Circuit breaker</td>
</tr>
<tr>
<td>HS</td>
<td>Handset</td>
</tr>
<tr>
<td>I</td>
<td>Indicating or switchboard lamp</td>
</tr>
<tr>
<td>L</td>
<td>Inductor</td>
</tr>
<tr>
<td>J</td>
<td>Jack</td>
</tr>
<tr>
<td>LS</td>
<td>Loudspeaker</td>
</tr>
<tr>
<td>MIC</td>
<td>Microphone</td>
</tr>
<tr>
<td>OSC</td>
<td>Oscillator</td>
</tr>
<tr>
<td>PAD</td>
<td>Pad</td>
</tr>
<tr>
<td>P</td>
<td>Plug</td>
</tr>
<tr>
<td>HT</td>
<td>Receiver, headset</td>
</tr>
<tr>
<td>K</td>
<td>Relay</td>
</tr>
<tr>
<td>R</td>
<td>Resistor</td>
</tr>
<tr>
<td>S</td>
<td>Switch or key switch</td>
</tr>
<tr>
<td>T</td>
<td>Transformer</td>
</tr>
<tr>
<td>WR</td>
<td>Wall receptacle</td>
</tr>
</tbody>
</table>

See item 16.1.1

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

Revised or Deleted Symbols

(Informative)

<table>
<thead>
<tr>
<th>Symbols Formerly in USA Standard Y32.2-1962 &amp; Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)</th>
<th>Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deleted 11.3.1 On a connection or wiring diagram, a 3-pole single-throw circuit breaker (with terminals shown) may be drawn as shown below</td>
<td>See ANSI Y14.15-1966</td>
</tr>
<tr>
<td>See Note 11.3A FOR CONNECTION OR WIRING DIAGRAM</td>
<td></td>
</tr>
<tr>
<td>Corrected 34.11.10.2 Double-cavity klystron, integral cavity, permanent external-ganged tuning, loop coupled (coupling loop may be shown inside if desired) See item 34.8.1</td>
<td>See item 15.12.2</td>
</tr>
<tr>
<td></td>
<td>See item 6.3</td>
</tr>
<tr>
<td>Revised and Expanded 42.7 Saturable-core inductor (reactor) Polarity marks may be added to direct-current winding. Explanatory words and arrow are not part of the symbols shown.</td>
<td></td>
</tr>
<tr>
<td>Revised 48 Meter Instrument T Temperature meter</td>
<td>See item 12.1</td>
</tr>
<tr>
<td>Symbols Formerly in USA Standard Y32.2-1962 &amp; Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)</td>
<td>Recommended Symbols in ANSI Y32.2-1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Corrected 53.3 Application: transducer from rectangular waveguide to coaxial with mode suppression and direct-current grounds connected</td>
<td>See item 15.5.3</td>
</tr>
<tr>
<td>Corrected 58.8.2 Coaxial cable, recognition symmetry-Coaxial transmission path Cable, radio frequency $\mathcal{F}$, (Coaxial) See item 58.1.</td>
<td>See item 3.1.9</td>
</tr>
<tr>
<td>Corrected 58.8.4 Shielded 2-conductor cable with shield grounded</td>
<td>See item 3.1.8.4</td>
</tr>
<tr>
<td>Corrected 71.2.1 Resonator with mode suppression coupled by an E-plane aperture to a guided transmission path and by a loop to a coaxial path.</td>
<td>See item 15.9.2</td>
</tr>
<tr>
<td>Revised 76.12.7 Wafer, 3-pole 3-circuit with 2 nonshorting and 1 shorting moving contacts Viewed from end opposite control knob or actuator unless otherwise indicated. For more than one section, section No. 1 is nearest control knob. When contacts are on both sides, front contacts are nearest control knob.</td>
<td>See item 4.13.7</td>
</tr>
<tr>
<td>Symbols Formerly in USA Standard Y32.2-1962 &amp; Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)</td>
<td>Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Deleted</td>
<td></td>
</tr>
<tr>
<td><strong>81.5 Applications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>NOTES:</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>81.5C — If pins are omitted in an otherwise standard terminal arrangement, do not respace the remaining pins.</td>
<td></td>
</tr>
<tr>
<td>81.5D — A terminal at the center of the terminal arrangement shall be identified as the CENTER terminal lead or pin.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>81.5.1</strong> Two-terminal device with one flexible lead and one rigid terminal connected to a metallic envelope (typical semiconductor diode shown).</td>
<td>See ANSI Y14.15-1966</td>
</tr>
<tr>
<td><strong>81.5.2</strong> Two-terminal device with rigid terminals and reference point located at one of the terminals (typical semiconductor diode shown).</td>
<td></td>
</tr>
<tr>
<td><strong>81.5.3</strong> Three-terminal device with circular arrangement of pin terminals with base orientation determined by gap in pin spacing (typical transistor shown).</td>
<td></td>
</tr>
<tr>
<td>Symbols Formerly in USA Standard Y32.2-1962 &amp; Supplement Y32.2A-1964 or MIL-STD-15-1A (including original item numbers)</td>
<td>Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Deleted (continued)</td>
<td></td>
</tr>
</tbody>
</table>

#### 81.5.4
Three-terminal device with rigid terminals, one connected to the metallic enclosure, and index pin (typical transistor shown).

![Three-terminal device](image1)

#### 81.5.5
Four-terminal device with in-line pin terminals, one connected to metallic envelope, and reference point (typical transistor shown).

![Four-terminal device](image2)

#### 81.5.6
Five-terminal device with in-line terminal leads, one connected to metallic enclosure and reference point (typical relay shown).

![Five-terminal device](image3)

#### 81.5.7
Device with 8-terminal keyed (such as octal) base, rigid envelope terminal, and magnetic envelope connected to base terminal (typical triode-heptode shown).

![Device with 8-terminal](image4)
<table>
<thead>
<tr>
<th>Deleted (continued)</th>
<th>Recommended Symbols in ANSI Y32.2 - 1975, if Not Otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>81.5.8</strong> 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).</td>
<td></td>
</tr>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td><strong>81.5.9</strong> Device with 9-terminal (such as noval) base utilizing gap in pin spacing to establish base orientation (typical twin triode shown).</td>
<td></td>
</tr>
<tr>
<td><img src="image2" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Revised <strong>84 Thermistor Resistor, Thermal</strong></td>
<td>See items 1.2.1 and 2.1.12</td>
</tr>
<tr>
<td>“T” indicates that the primary characteristic of the element within the circle is a function of temperature.</td>
<td></td>
</tr>
<tr>
<td>Revised <strong>84.1 General</strong></td>
<td>See item 2.1.12.1</td>
</tr>
<tr>
<td><img src="image3" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Revised <strong>85.2.1 Temperature-measuring semiconductor thermocouple</strong></td>
<td>See item 8.8.1</td>
</tr>
<tr>
<td><img src="image4" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Corrected <strong>86.1.1 Application: transformer with direct-current connections and mode suppression between two rectangular waveguides</strong></td>
<td>See item 6.4.1.1</td>
</tr>
<tr>
<td><img src="image5" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>
Annex F

Cross-Reference List of Class Designation Letters

(Informative)

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

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

<table>
<thead>
<tr>
<th>IEC Publication 113-2 Terminology</th>
<th>Letter Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustical indicator H</td>
<td>LS</td>
</tr>
<tr>
<td>Adjustable resistor R R</td>
<td></td>
</tr>
<tr>
<td>Aerial W E</td>
<td></td>
</tr>
<tr>
<td>Amplifier A AR</td>
<td></td>
</tr>
<tr>
<td>Amplifier (with tubes) A AR</td>
<td></td>
</tr>
<tr>
<td>Arrester F E</td>
<td></td>
</tr>
<tr>
<td>Assemblies A A,U</td>
<td></td>
</tr>
<tr>
<td>Auxiliary switch S S</td>
<td></td>
</tr>
<tr>
<td>Battery G BT</td>
<td></td>
</tr>
<tr>
<td>Bistable element D U,A</td>
<td></td>
</tr>
<tr>
<td>Brake Y MP</td>
<td></td>
</tr>
<tr>
<td>Busbar W W</td>
<td></td>
</tr>
<tr>
<td>Cable W W</td>
<td></td>
</tr>
<tr>
<td>Cable balancing network Z Z</td>
<td></td>
</tr>
<tr>
<td>Capacitor C C</td>
<td></td>
</tr>
<tr>
<td>Changer U A,B,G,MT</td>
<td></td>
</tr>
<tr>
<td>Circuit breaker Q CB</td>
<td></td>
</tr>
<tr>
<td>Clutch Y MP</td>
<td></td>
</tr>
<tr>
<td>Coder U U,A</td>
<td></td>
</tr>
<tr>
<td>Comander Z A</td>
<td></td>
</tr>
<tr>
<td>Connecting stage S S</td>
<td></td>
</tr>
<tr>
<td>Contactors K K</td>
<td></td>
</tr>
<tr>
<td>Control switch S S</td>
<td></td>
</tr>
<tr>
<td>Converter U A,U, MG</td>
<td></td>
</tr>
<tr>
<td>Core, storage D E</td>
<td></td>
</tr>
<tr>
<td>IEC Publication 113-2 Terminology</td>
<td>Letter Code</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td># Crystal filter</td>
<td>Z FL</td>
</tr>
<tr>
<td>@ Crystal transducer</td>
<td>B Y</td>
</tr>
<tr>
<td>* Current transformer</td>
<td>T T</td>
</tr>
<tr>
<td># Delay device</td>
<td>D DL</td>
</tr>
<tr>
<td># Delay line</td>
<td>D DL</td>
</tr>
<tr>
<td># Demodulator</td>
<td>U A</td>
</tr>
<tr>
<td>* Dial contact</td>
<td>S S</td>
</tr>
<tr>
<td>@ Diode</td>
<td>V D</td>
</tr>
<tr>
<td>@ Dipole</td>
<td>W E</td>
</tr>
<tr>
<td>@ Disconnecting plug</td>
<td>X P</td>
</tr>
<tr>
<td>* Disconnecting socket</td>
<td>X X</td>
</tr>
<tr>
<td># Discriminator</td>
<td>U A</td>
</tr>
<tr>
<td># Disk recorder</td>
<td>D A</td>
</tr>
<tr>
<td># Dynamotor</td>
<td>B MG</td>
</tr>
<tr>
<td># Electrically operated mechanical device</td>
<td>Y MT</td>
</tr>
<tr>
<td>* Electronic tube</td>
<td>V V</td>
</tr>
<tr>
<td># Equalizer</td>
<td>Z EQ</td>
</tr>
<tr>
<td># Filter</td>
<td>Z FL</td>
</tr>
<tr>
<td># Frequency changer</td>
<td>U A,B,G</td>
</tr>
<tr>
<td>* Fuse</td>
<td>F F</td>
</tr>
<tr>
<td>* Gas discharge tube</td>
<td>V V</td>
</tr>
<tr>
<td>* Generator</td>
<td>G G</td>
</tr>
<tr>
<td># Heating device</td>
<td>E HR</td>
</tr>
<tr>
<td>* Hybrid</td>
<td>Z Z</td>
</tr>
<tr>
<td># Indicating device</td>
<td>P DS</td>
</tr>
<tr>
<td>* Induction coil</td>
<td>L L</td>
</tr>
<tr>
<td>* Inductors</td>
<td>L L</td>
</tr>
<tr>
<td># Integrating measuring device</td>
<td>P M,MT,Z</td>
</tr>
<tr>
<td># Inverter</td>
<td>U A,U,PS,MG</td>
</tr>
<tr>
<td># Isolator</td>
<td>Q AT</td>
</tr>
<tr>
<td>* Jumper wire</td>
<td>W W</td>
</tr>
<tr>
<td># Laser</td>
<td>A MT,A</td>
</tr>
<tr>
<td># Lighting device</td>
<td>E DS</td>
</tr>
<tr>
<td>* Limit switch</td>
<td>S S</td>
</tr>
</tbody>
</table>
### IEC Publication 113-2

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Letter Code</th>
</tr>
</thead>
<tbody>
<tr>
<td># Limitter</td>
<td>Z MT,RE</td>
</tr>
<tr>
<td>@ Line trap</td>
<td>L FL,MP,V</td>
</tr>
<tr>
<td># Loudspeaker</td>
<td>B LS</td>
</tr>
<tr>
<td># Magnetic amplifier</td>
<td>A AR</td>
</tr>
<tr>
<td># Magnetic tape recorder</td>
<td>D A</td>
</tr>
<tr>
<td>* Maser</td>
<td>A A</td>
</tr>
<tr>
<td>@ Measuring equipment</td>
<td>P M</td>
</tr>
<tr>
<td># Microphone</td>
<td>B MK</td>
</tr>
<tr>
<td>* Miscellaneous</td>
<td>E E</td>
</tr>
<tr>
<td># Modulator</td>
<td>U A</td>
</tr>
<tr>
<td># Monostable element</td>
<td>D A,U</td>
</tr>
<tr>
<td>@ Motor</td>
<td>M B</td>
</tr>
<tr>
<td># Optical indicator</td>
<td>H DS</td>
</tr>
<tr>
<td>@ Oscillator</td>
<td>G Y,G</td>
</tr>
<tr>
<td>* Overvoltage discharge device</td>
<td>F F,E</td>
</tr>
<tr>
<td>@ Parabolic aerial</td>
<td>W E</td>
</tr>
<tr>
<td>@ Photoelectric cell</td>
<td>B V</td>
</tr>
<tr>
<td># Pickup</td>
<td>B PU</td>
</tr>
<tr>
<td>@ Plug</td>
<td>X P</td>
</tr>
<tr>
<td># Pneumatic value</td>
<td>Y MP</td>
</tr>
<tr>
<td>* Potentiometer</td>
<td>R R</td>
</tr>
<tr>
<td>@ Power switchgear</td>
<td>Q CB,S</td>
</tr>
<tr>
<td>* Protective device</td>
<td>F F</td>
</tr>
<tr>
<td>* Pushbutton</td>
<td>S S</td>
</tr>
<tr>
<td>@ Quartz-oscillator</td>
<td>G Y</td>
</tr>
<tr>
<td># Recording device</td>
<td>P A,M</td>
</tr>
<tr>
<td># Register</td>
<td>D A,U,M</td>
</tr>
<tr>
<td>* Relay</td>
<td>K K</td>
</tr>
<tr>
<td>* Resistor</td>
<td>R R</td>
</tr>
<tr>
<td>* Resolver</td>
<td>B B</td>
</tr>
<tr>
<td>* Rheostat</td>
<td>R R</td>
</tr>
<tr>
<td>* Rotating frequency generator</td>
<td>G G,MG</td>
</tr>
<tr>
<td>* Rotating generator</td>
<td>G G</td>
</tr>
<tr>
<td>* Selector</td>
<td>S S</td>
</tr>
<tr>
<td>IEC Publication 113-2 Terminology</td>
<td>Letter Code</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>* Selector switch</td>
<td>S S</td>
</tr>
<tr>
<td>#, @ Semiconductor</td>
<td>V D.CR.Q</td>
</tr>
<tr>
<td>* Shunt (resistor)</td>
<td>R R</td>
</tr>
<tr>
<td># Signal generator</td>
<td>P A</td>
</tr>
<tr>
<td># Signaling device</td>
<td>H DS</td>
</tr>
<tr>
<td>* Socket</td>
<td>X X</td>
</tr>
<tr>
<td># Soldering terminal strip</td>
<td>X E,TB</td>
</tr>
<tr>
<td># Static frequency changer</td>
<td>U A</td>
</tr>
<tr>
<td># Storage device</td>
<td>D A,U</td>
</tr>
<tr>
<td>* Subassembly</td>
<td>A A</td>
</tr>
<tr>
<td># Supply</td>
<td>G A,PS</td>
</tr>
<tr>
<td># Supply device</td>
<td>G A,PS</td>
</tr>
<tr>
<td>* Sychro</td>
<td>B B</td>
</tr>
<tr>
<td># Telegraph translator</td>
<td>U A</td>
</tr>
<tr>
<td>@ Terminal</td>
<td>X E</td>
</tr>
<tr>
<td># Terminal board</td>
<td>X TB</td>
</tr>
<tr>
<td># Termination</td>
<td>Z AT</td>
</tr>
<tr>
<td># Test jack</td>
<td>X E,J</td>
</tr>
<tr>
<td># Testing equipment</td>
<td>P A</td>
</tr>
<tr>
<td># Thermistor</td>
<td>R RT</td>
</tr>
<tr>
<td># Thermo cell</td>
<td>B A,TC</td>
</tr>
<tr>
<td># Thermoelectric sensor</td>
<td>B A</td>
</tr>
<tr>
<td># Thyristor</td>
<td>V Q</td>
</tr>
<tr>
<td># Transducer (nonelectrical quantity to electrical quantity)</td>
<td>B A,BT</td>
</tr>
<tr>
<td>* Transformer</td>
<td>T T</td>
</tr>
<tr>
<td>* Transmission path</td>
<td>W W</td>
</tr>
<tr>
<td>@ Transistor</td>
<td>V Q</td>
</tr>
<tr>
<td>* Tube (electron)</td>
<td>V V</td>
</tr>
<tr>
<td>* Voltage transformer (potential)</td>
<td>T T</td>
</tr>
<tr>
<td>* Waveguide</td>
<td>W W</td>
</tr>
<tr>
<td># Waveguide directional coupler</td>
<td>W DC</td>
</tr>
</tbody>
</table>
IEEE Standard
American National Standard

Supplement to
Graphic Symbols for Electrical and Electronics Diagrams

Sponsor

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

Approved September 19, 1985
Reaffirmed December 2, 1993

IEEE Standards Board

Approved November 15, 1985

American National Standards Institute

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. However, individual symbols contained in this standard may be utilized without further permission of the IEEE. Any statement that the symbols used are in conformance with this standard shall be on the user’s own responsibility.
IEEE Standards documents are developed within the Technical Committees of the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE which have expressed an interest in participating in the development of the standard.

Use of an IEEE Standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least once every five years for revision or reaffirmation. When a document is more than five years old, and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason IEEE and the members of its technical committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretation should be addressed to:

Secretary, IEEE Standards Board
345 East 47th Street
New York, NY 10017
USA

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.
Foreword

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

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

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

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

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

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

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

Robert B. Angus, Jr.  Conrad R. Muller  S. V. Soanes
J. C. Brown  John B. Peatman  Roger M. Stern
John M. Carroll  J. William Siefert  Leter H. Warren
Gordon A. Knapp  Thomas R. Smith  Steven A. Wasserman
When the IEEE Standards Board approved this standard on September 19, 1985, it had the following membership:

**John E. May, Chair**

**John P. Riganati, Vice Chair**

**Sava I. Sherr, Secretary**

<table>
<thead>
<tr>
<th></th>
<th>Jay Forster</th>
<th>Lawrence V. McCall</th>
</tr>
</thead>
<tbody>
<tr>
<td>James H. Beall</td>
<td>Fletcher H. Buckley</td>
<td>Daniel L. Goldberg</td>
</tr>
<tr>
<td>Rene Castenschiold</td>
<td>Edward Chelotti</td>
<td>Kenneth D. Hendrix</td>
</tr>
<tr>
<td>Edward J. Cohen</td>
<td>Edward J. Cohen</td>
<td>Irvin N. Howell</td>
</tr>
<tr>
<td>Paul G. Cummings</td>
<td>Donald T. Michael*</td>
<td>Kenneth D. Hendrix</td>
</tr>
<tr>
<td>Donald C. Fleckenstein</td>
<td>Joseph L. Koepfinger*</td>
<td>Frank L. Rose</td>
</tr>
<tr>
<td></td>
<td>R. F. Lawrence</td>
<td>Clifford O. Swanson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J. Richard Weger</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W. B. Wilkens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charles J. Wylie</td>
</tr>
</tbody>
</table>

*Member emeritus
<table>
<thead>
<tr>
<th>CLAUSE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA1 Purpose</td>
<td>254</td>
</tr>
<tr>
<td>AA2 Scope</td>
<td>254</td>
</tr>
<tr>
<td>AA3 Organization</td>
<td>254</td>
</tr>
<tr>
<td>AA4 References</td>
<td>254</td>
</tr>
</tbody>
</table>

**Section 1 Qualifying Symbols**

1.1 Adjustability
   - Variability ................................................................. 256
1.2 Special-Property Indicators ................................................................. 256
1.3 Radiation Indicators (electromagnetic and particulate) ......................... 257
1.4 Physical State Recognition Symbols ................................................. 258
1.7 Direction of Flow of Power, Signal, or Information ...................... 258
1.8 Kind of Current ........................................................................ 260
1.10 Envelope
   - Enclosure ............................................................................. 261
1.14 Operational Dependence On a Characteristic Quantity ............ 261
1.15 Signal Identifiers ................................................................... 262
1.16 Signal Waveforms .................................................................. 262
1.17 Control by Nonelectrical Quantities ........................................ 263

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

2.1 Resistor ................................................................................. 264
2.2 Capacitor .................................................................................. 264
2.3 Antenna ...................................................................................... 265
2.4 Attenuator ................................................................................ 267
2.6 Delay Function
   - Delay Line
   - Slow-Wave Structure ............................................................. 268
2.9 Pickup
   - Head ............................................................................................ 270
2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz ) ......................... 270
2.17 Ignitor Plug ............................................................................ 271
2.18 Signal Waveforms .................................................................. 271
2.19 Faults ...................................................................................... 272

**Section 3 Graphic Symbols for Transmission Path**

3.1 Transmission Path
   - Conductor
   - Cable
   - Wiring ...................................................................................... 272
3.2 Distribution Lines
   - Transmission Lines .................................................................. 274
3.6 Waveguide ................................................................................ 277
3.10 Pressure Tight Bulkhead Cable Gland
   - Cable Sealing End ................................................................... 278
<table>
<thead>
<tr>
<th>Clause</th>
<th>Section 4 Graphic Symbols for Contacts, Switches, Contactors, and Relays</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Switching Function ................................................................. 278</td>
</tr>
<tr>
<td>4.3</td>
<td>Basic Contact Assemblies ............................................................ 279</td>
</tr>
<tr>
<td>4.6</td>
<td>Switch ................................................................................................. 284</td>
</tr>
<tr>
<td>4.14</td>
<td>Limit Switch</td>
</tr>
<tr>
<td>Sensitive Switch ................................................................. 286</td>
<td></td>
</tr>
<tr>
<td>4.21</td>
<td>Thermostat ......................................................................................... 286</td>
</tr>
<tr>
<td>4.22</td>
<td>Flasher</td>
</tr>
<tr>
<td>Self-Interrupting Switch ............................................................. 287</td>
<td></td>
</tr>
<tr>
<td>4.29</td>
<td>Contactor ............................................................................................. 287</td>
</tr>
<tr>
<td>4.34</td>
<td>Multipole and Multiposition Switches .................................................. 288</td>
</tr>
<tr>
<td>4.35</td>
<td>Switchgear and Controlgear ............................................................... 295</td>
</tr>
<tr>
<td>4.36</td>
<td>Block Symbols for Motor Starters ...................................................... 296</td>
</tr>
<tr>
<td>4.37</td>
<td>Operating Devices for Electromechanical (all or nothing)</td>
</tr>
<tr>
<td>Relays ................................................................................................. 298</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clause</th>
<th>Section 5 Graphic Symbols for Terminals and Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>Connector</td>
</tr>
<tr>
<td>Disconnecting Device</td>
<td></td>
</tr>
<tr>
<td>Plug ................................................................. 301</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>Coaxial Connector</td>
</tr>
<tr>
<td>Coaxial Junction .......................................................... 304</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clause</th>
<th>Section 6 Graphic Symbols for Transformers, Inductors, and Windings</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Core ................................................................................................. 304</td>
</tr>
<tr>
<td>6.2</td>
<td>Inductor</td>
</tr>
<tr>
<td>Winding (machine or transformer)</td>
<td></td>
</tr>
<tr>
<td>Reactor</td>
<td></td>
</tr>
<tr>
<td>Radio-Frequency Coil</td>
<td></td>
</tr>
<tr>
<td>Telephone Retardation Coil .......................................................... 305</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Transformer</td>
</tr>
<tr>
<td>Telephone Induction Coil</td>
<td></td>
</tr>
<tr>
<td>Telephone Repeating Coil .......................................................... 306</td>
<td></td>
</tr>
<tr>
<td>6.6</td>
<td>Ferrite Cores—Symbol Elements ...................................................... 317</td>
</tr>
<tr>
<td>6.7</td>
<td>Ferrite Cores .................................................................................. 318</td>
</tr>
<tr>
<td>6.8</td>
<td>Magnetic Storage Matrices (Topographical Representation) ................. 319</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clause</th>
<th>Section 7 Graphic Symbols for Electron Tubes and Related Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Electron Tube .................................................................................. 319</td>
</tr>
<tr>
<td>7.3</td>
<td>Typical Applications ........................................................................ 324</td>
</tr>
<tr>
<td>7.4</td>
<td>Solion</td>
</tr>
<tr>
<td>Ion-Diffusion Device ................................................................. 325</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Coulomb Accumulator</td>
</tr>
<tr>
<td>Electrochemical Step-Function Device ............................................. 326</td>
<td></td>
</tr>
<tr>
<td>CLAUSE</td>
<td>PAGE</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>7.7 Nuclear-Radiation Detector</td>
<td>327</td>
</tr>
<tr>
<td>Ionization Chamber</td>
<td></td>
</tr>
<tr>
<td>Proportional Counter Tube</td>
<td></td>
</tr>
<tr>
<td>Geiger-Müller Counter Tube</td>
<td></td>
</tr>
<tr>
<td>8.2 Section 8 Graphic Symbols for Semiconductor Devices</td>
<td>328</td>
</tr>
<tr>
<td>8.3 Special-Property Indicators</td>
<td>331</td>
</tr>
<tr>
<td>8.5 Typical Applications, Two-Terminal Devices</td>
<td>332</td>
</tr>
<tr>
<td>8.6 Typical Applications, Three- (or more) Terminal Devices</td>
<td>337</td>
</tr>
<tr>
<td>8.10 Photon-Coupled Isolator</td>
<td>344</td>
</tr>
<tr>
<td>8.12 Ionizing Radiation Detectors</td>
<td>345</td>
</tr>
<tr>
<td>9.1 Section 9 Graphic Symbols for Circuit Protectors</td>
<td>346</td>
</tr>
<tr>
<td>9.3 Lightning Arrester</td>
<td>347</td>
</tr>
<tr>
<td>9.4 Circuit Breaker</td>
<td>348</td>
</tr>
<tr>
<td>9.6 Protective Relays—Block Symbols and Qualifying Symbol</td>
<td>350</td>
</tr>
<tr>
<td>9.7 Examples of Protective Relays</td>
<td>352</td>
</tr>
<tr>
<td>9.8 Other Relays Devices</td>
<td>354</td>
</tr>
<tr>
<td>10.1 Section 10 Graphic Symbols for Acoustic Devices</td>
<td>355</td>
</tr>
<tr>
<td>11.1 Section 11 Graphic Symbols for Lamps and Visual-Signaling Devices</td>
<td>356</td>
</tr>
<tr>
<td>11.3 Electromechanical Signal</td>
<td>357</td>
</tr>
<tr>
<td>12.1 Section 12 Graphic Symbols for Readout Devices</td>
<td>357</td>
</tr>
<tr>
<td>12.2 Electromagnetically Operated Counter</td>
<td>358</td>
</tr>
<tr>
<td>12.3 Indicating, Recording, and Integrating Instruments, General Symbols</td>
<td>358</td>
</tr>
<tr>
<td>12.4 Examples of Indicating Instruments</td>
<td>360</td>
</tr>
<tr>
<td>12.5 Examples of Recording Instruments</td>
<td>362</td>
</tr>
<tr>
<td>12.6 Examples of Integrating Instruments</td>
<td>362</td>
</tr>
<tr>
<td>12.7 Counting Devices</td>
<td>365</td>
</tr>
<tr>
<td>12.8 Telemetering Devices</td>
<td>366</td>
</tr>
<tr>
<td>12.9 Electric Clocks</td>
<td>366</td>
</tr>
<tr>
<td>13.1 Section 13 Graphic Symbols for Rotating Machinery</td>
<td>367</td>
</tr>
<tr>
<td>13.5 Applications: Alternating-Current Machines</td>
<td>367</td>
</tr>
<tr>
<td>13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation</td>
<td>368</td>
</tr>
</tbody>
</table>
Section 14 Graphic Symbols for Mechanical Functions

14.2 Mechanical Motion ........................................................................................................ 368
14.3 Clutch
   Brake................................................................................................................................... 370
14.4 Manual Control ............................................................................................................... 371
14.5 Detents, Latching, and Blocking.................................................................................... 374

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

15.2 Coupling...................................................................................................................... 375
15.4 Hybrid
   Directionally Selective Transmission Devices................................................................. 375
15.5 Mode Transducer.......................................................................................................... 376
15.6 Mode Suppressor.......................................................................................................... 376
15.7 Rotary Joint (radio-frequency rotary coupler) .............................................................. 376
15.8 Nonreciprocal Devices................................................................................................. 376
15.9 Resonator
   Tuned Cavity ................................................................................................................... 377
15.10 Resonator (cavity-type) Tube ..................................................................................... 378
15.11 Magnetron..................................................................................................................... 379
15.12 Velocity-Modulation (velocity-variation) Tube .......................................................... 380
15.13 Transmit–Receive (TR) Tube ....................................................................................... 382
15.14 Traveling-Wave Tube ................................................................................................. 382
15.16 Filter ............................................................................................................................ 386
15.20 Multiport Devices......................................................................................................... 386
15.21 Lasers and Masers....................................................................................................... 387

Section 16 Graphic Symbols for Composite Assemblies

16.1 Circuit Assembly
   Circuit Subassembly
   Circuit Element............................................................................................................... 389
16.2 Amplifier ....................................................................................................................... 390
16.9 Gyro
   Gyroscope
   Gyrocompass.................................................................................................................... 390
16.13 Changer, General Symbol—Converter General Symbol ............................................. 391
16.14 Galvanic Seperator..................................................................................................... 392
16.15 Heat Source, General Symbol..................................................................................... 392
16.16 Generator, General Symbol....................................................................................... 392
16.17 Sensors and Detectors................................................................................................ 394
16.18 Applications of Sensors ........................................................................................... 394

Section 17 Graphic Symbols for Analog and Digital Logic Functions

17.10 Analog Elements for Computations and Control......................................................... 395

Section 18 Graphic Symbols for Digital Logical Functions

No changes
Section 19 Graphic Symbols for Special-Purpose Maintenance Diagrams

No changes

Section 20 Graphic Symbols Commonly Used on System Diagrams, Maps, and Charts (Communications Equipment)

20.3 Exchange Equipment (Relocation of 20.3.2 and 20.3.3) ............................................................... 404

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

21.1 Generating Station ........................................................................................................................ 404
21.2 Hydroelectric Generating Station ................................................................................................... 405
21.3 Thermoelectric Generating Station ............................................................................................... 406
21.4 Prime Mover (qualifying symbols) ............................................................................................... 407
21.5 Substation ..................................................................................................................................... 408
21.6 Wind Generating Station .............................................................................................................. 408
21.7 Plasma Generating Station .......................................................................................................... 409

Section 22 Class Designation Letters

No changes

Section 23 Referenced Standards

See AA4

Section 24 Telecommunications Switching and Peripheral Equipment

24.1 Switching Systems ....................................................................................................................... 409
24.2 Block Symbols for Switching Equipment .................................................................................... 413
24.3 Qualifying Symbols for Transducers, Recorders, and Reproducers ........................................... 413
24.4 Recorders and Reproducers ....................................................................................................... 414

Section 25 Telecommunications Transmission

25.1 Amplified Circuits ....................................................................................................................... 415
25.2 Qualifying Symbols for Pulse Modulation ................................................................................. 416
25.3 Signal Generator, Waveform Generator ..................................................................................... 417
25.4 Changers, Converter, General Symbol ....................................................................................... 418
25.5 Filters ......................................................................................................................................... 418
25.6 Networks .................................................................................................................................... 419
25.7 Electronic Chopping Device ....................................................................................................... 422
25.8 Threshold Devices ....................................................................................................................... 422
25.9 Terminating Sets ......................................................................................................................... 424
25.10 Modulator, Demodulator, Discriminator .................................................................................. 425
25.11 Concentrators, Multiplexers ...................................................................................................... 426
25.12 Frequency Spectrum Diagram Symbol Elements ....................................................................... 427
25.13 Examples of Frequency Spectrum Diagrams .......................................................................... 430
25.14 Fiber Optic Devices .................................................................................................................. 432
American National Standard
IEEE Standard

Supplement to
Graphic Symbols for Electrical and
Electronics Diagrams

AA1. Purpose

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

AA2. Scope

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

3) Street maps and building system layouts for cable TV application. See ANSI/IEEE Std 623-1976 [8] and IEC
Publication 617 (1983) [22], Part 11, ch III.

AA3. Organization

This supplement places the IEC Publication 617 new material in a practical sequence with related material in ANSI/
IEEE Std 315-1975 [7]. Except where the nature of the revisions dictate otherwise (for reasons of clarity) existing

AA4. References

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


Used in Architecture and Building Construction.


---

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


1. Qualifying Symbols

1.1.1.2 Preset, general

Add:

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

1.1.1.2.1 Application: preset adjustment permitted only at zero current.

After 1.1.4.2

Add:

1.1.5 Automatic (inherent) control

The controlled quantity may be indicated adjacent to the symbol.

1.1.5.1 Application: Amplifier with automatic gain control

1.2.1 Temperature dependence

Add:

OR

θ
After 1.2.5

Add:

1.2.6 Thermal effect

1.2.7 Electromagnetic effect

1.2.8 Magnetostrictive effect

After 1.3.1

Add:

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

Revise the NOTE to read as follows:

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

- Alpha particle \( \alpha \)
- Beta particle \( \beta \)
- Gamma ray \( \gamma \)
- Deutron \( d \)
- Proton \( p \)
- Neutron \( n \)
- Pion \( \pi \)
- K-meson \( K \)
- Muon \( \mu \)
- X ray \( X \)

Add:

IEC Designations

\( \alpha \) = alpha particle
\[ \beta = \text{beta particle} \]
\[ \gamma = \text{gamma ray} \]
\[ \delta = \text{deuteron} \]
\[ \rho = \text{proton} \]
\[ \eta = \text{neutron} \]
\[ \pi = \text{pion} \]
\[ \kappa = \text{K meson} \]
\[ \mu = \text{muon} \]
\[ X = \text{X ray} \]

1.4.3 Solid

Add:

\[ \square \]

Add:

1.4.6 Material, semiconducting

1.4.7 Material, insulating

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.
1.7.2 Either way (but not simultaneously)

Add:

OR

See NOTE 1.7.1A

1.7.3 Both ways, simultaneously

Add:

OR

See NOTE 1.7.1A

Avoid conflict with symbol 9.2 if used on the same diagram

After 1.7.5

Add:

1.7.6 Transmission

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

See NOTE 1.7.6A

1.7.8 Energy flow from the busbars

1.7.9 Energy flow towards the busbars

1.7.10 Bidirectional energy flow

1.8.1

Add:

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

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

2M may be replaced by 2 + M

1.8.2 Alternating current

Add:

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

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

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

1.8.2.1 Application: Alternating current of 60 Hz
1.8.2.2 Application: Alternating current frequency range 100 kHz to 600 kHz

\[ f \approx 100 \ldots 600 \text{ kHz} \]

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

3N may be replaced by 3 + N

\[ 3N \approx 60 \text{ Hz} \quad 480/277 \text{ V} \]

1.8.2.4 Neutral

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

\[ \text{IEC} \quad N \]

1.8.2.5 Midwire

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

\[ \text{IEC} \quad M \]

After 1.10.4

Add:

1.10.5 Conductive coating on internal surface of envelope

\[ \text{IEC} \]

Add:

1.14 Operational Dependence On a Characteristic Quantity

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

\[ \text{IEC} \quad > \]

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

\[ \text{IEC} \quad < \]
1.14.3 Operating when the characteristic quantity is either higher than a given high setting or lower than a given low setting

\[ \text{IBC} \uparrow \]

1.14.4 Operating when value of the characteristic quantity becomes zero

\[ \text{IBC} = 0 \]

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

\[ \text{IBC} \approx 0 \]

1.15 Signal Identifiers

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

1.15.1 Identifier of analog signals

\[ \text{IBC} \cap \]

1.15.2 Identifier of digital signals

\[ \text{IBC} \# \]

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

1.16 Signal Waveforms

Each symbol represents an idealized shape of the waveform.

1.16.1 Positive-going pulse

\[ \text{IBC} \uparrow \]

1.16.2 Negative-going pulse

\[ \text{IBC} \downarrow \]

1.16.3 Pulse of alternating current

\[ \text{IBC} \downarrow \uparrow \]
1.16.4 Positive-going step function

1.16.5 Negative-going step function

1.16.6 Sawtooth

1.17 Control by Nonelectrical Quantities

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

1.17.1 Control by fluid level

1.17.2 Control by number of events
Control by a counter

1.17.3 Control by flow

1.17.3.1 Application: Control by gas flow

1.17.4 Control by relative humidity
After 2.1.4

Add:

2.1.4.1 Application: preset adjustable resistor

2.1.7 Magnetoresistor (intrinsic) (linear type shown)

Add:

After 2.1.9

Add:

2.1.9.1 Shunt
Resistor with separate current and voltage terminals

2.1.13 Symmetrical photoconductive transducer (resistive)

Add:

After 2.2.2

Add:

2.2.2.1 Temperature dependent polarized capacitor, where deliberate use is made of the temperature coefficient, for example, ceramic capacitor.
NOTE — 2.2.2.1A: $\theta$ may be replaced by $r^\circ$.

\[ \text{IEC} \quad \theta \]

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

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

\[ \text{IEC} \quad \pm U \]

After **2.2.4**

Add:

**2.2.4A** Capacitor with preset adjustment

\[ \text{IEC} \quad \pm U \]

### 2.2.4.1 With moving element indicated

Revise NOTE 2.2.4.1A to read as follows:

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

See General Symbols 2.2.1 and NOTE 2.2B

![Style 1 OR Style 2]

After **2.3.2**

Add:

**2.3.2.1** Folded dipole

![IEC Diagram]
2.3.2.2 Folded dipole, shown with three directors and one reflector

After 2.3.3

Add:

2.3.3.1 Slot antenna, shown with rectangular waveguide feeder

2.3.3.2 Horn antenna
Horn feed

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

2.3.3.4 Paraboloidal antenna, shown with rectangular waveguide feeder

2.3.3.5 Horn-reflector antenna, shown with circular waveguide feeder
2.3.3.6 Rhombic antenna, shown terminated by a resistor

![Rhombic antenna diagram]

2.3.3.7 Magnetic rod antenna, for example ferrite.

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

![Magnetic rod antenna diagram]

2.4 Attenuator

2.4.1 Fixed attenuator [pad (general)]

![Fixed attenuator diagram]

Add:

![Addition symbol for fixed attenuator]

2.4.4 Variable attenuator [variable symbol (general)]

![Variable attenuator diagram]

Add:

![Addition symbol for variable attenuator]
After 2.6.1

Add:

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

2.6.1.2 Coaxial delay line

2.6.1.3 Mercury delay line with piezoelectric transducers

2.6.1.4 Delay line comprising an artificial line

2.6.4 Slow-wave structure

*See NOTE 2.6.1A

Add:

2.6.4.1 Open slow-wave structure (arrow indicates direction of energy flow)
2.6.4.2 Single electrode for electrostatic focusing along open slow-wave structure

![Single electrode diagram]

2.6.4.3 Closed slow-wave structure, shown with envelope

![Closed slow-wave structure diagram]

2.6.5 Delay Line Circuits

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

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

![Magnetostrictive delay line diagram]

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

Intermediate output with 50 µs delay

Final output with 100 µs delay
2.6.5.3 Coaxial delay line

![Coaxial delay line diagram]

2.6.5.4 Solid material delay line with piezoelectric transducers

![Solid material delay line diagram]

2.9.64 Stereo

![Stereo diagram]

Add:

2.9.6.1 Stylus-operated stereo-phonic head

![Stylus-operated stereo-phonic head diagram]

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

![Light sensitive reproducing head diagram]

2.10 Piezoelectric Crystal Unit (including Crystal Unit, Quartz)

![Piezoelectric crystal unit diagram]

Add:

2.10.1 Piezoelectric crystal with three electrodes

![Piezoelectric crystal with three electrodes diagram]
2.10.2 Piezoelectric crystal with two pairs of electrodes

Add:

2.17.1 Ignition unit, high energy

Add:

2.18 Ideal Circuit Elements

2.18.1 Ideal current source

2.18.2 Ideal voltage source

2.18.3 Ideal gyrator
2.19 Faults

2.19.1 Fault (indication of assumed fault location)

2.19.2 Flashover
  Breakthrough

After 3.1.2.3

Add:

3.1.2.4 Flexible conductor

3.1.6 Junction of paths or conductors

After 3.1.6.3

Add:

3.1.6.3A Connection common to a group of similar items

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

3.1.6.3A.1 EXAMPLE: Multiple uniselector banks show for 10 banks
After 3.1.6.5

Add:

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

![Diagram](image1)

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

![Diagram](image2)

3.1.7.2 Twisted (shown with two twisted conductors)

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

\[
\begin{align*}
P & = \text{Pair} \\
T & = \text{Triple}
\end{align*}
\]

![Diagram](image3)

Add:

![Diagram](image4)

*See NOTE 3.1.7.2A*
**After 3.1.8.6**

*Add:*

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

The interchanged conductors may be indicated.


3.1.8.7.1 *EXAMPLE:* Change of phase sequence

**After 3.2.6.2**

*Add:*

**3.2.7** Duct or pipe

![Duct or pipe diagram]

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

**3.2.7.1 ** *EXAMPLE:* Line of six-way duct

![Line of six-way duct diagram]

**3.2.8** Line with manhole, giving access to jointing chamber

![Line with manhole diagram]
3.2.9 Straight-through joint box, shown with three conductors:

Multiline representation

![Multiline representation](image)

3.2.9.1 Single-line representation

![Single-line representation](image)

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

Multiline representation

![Multiline representation](image)

3.2.10.1 Single-line representation

![Single-line representation](image)

3.2.11 Line with buried jointing point

![Line with buried jointing point](image)

3.2.12 Line with gas or oil block

![Line with gas or oil block](image)

3.2.13 Line with gas or oil stop valve

![Line with gas or oil stop valve](image)
3.2.14 Line with gas or oil block bypass

3.2.15 Power feeding

3.2.15.1 Power feeding (ac) on telecommunication lines

3.2.15.2 Power feeding (dc) on telecommunication lines

3.2.16 Anticreepage device

Anticreepage device for cable

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

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

3.2.17 Overground, weatherproof enclosure, general symbol

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

3.2.17.1 EXAMPLE: Amplifying point in a weatherproof enclosure
3.2.18 Crossconnection point

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

3.2.19 Line concentrator

Automatic line connector

3.2.19.1 EXAMPLE: Line concentrator on a pole

3.2.20 Protective anode

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

3.2.20.1 EXAMPLE: Magnesium protective anode

After 3.6.7

Add:

3.6.8 Optical fiber
After 3.10

Add:

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

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

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

4.1 Switching Function

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

Add:

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

4.1A.1 Contactor functions

4.1A.2 Circuit-breaker function

4.1A.3 Disconnector (isolator) function

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

4.1A.5 Automatic release function
4.1A.6 Position switch function
Limit switch function

NOTES:

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

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

4.1A.7 Spring return function

NOTES:

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

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

4.1A.8 Nonspring return (stay put) function

NOTES:

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

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

4.3 Basic Contact Assemblies

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

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

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

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

A small circle, open or filled in, representing the hinge-point may be added to most of the symbols for contacts, switches, and controlgear. See for example 4.3A.1.1.

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

4.3A Contacts with two or three positions

4.3A.1 Make contact

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

4.3A.1.1 Make contact

4.3A.1.1.1

4.3A.1.2 Break contact

4.3A.1.3 Change-over break before make contact
4.3A.1.4 Two-way contact with center-off position

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

4.3A.1.5.1

4.3A.1.6 Contact with two makes

4.3A.1.7 Contact with two breaks

4.3A.2 Passing contacts with two positions

4.3A.2.1 Passing make contact closing momentarily when its operating device is actuated.
4.3A.2.2 Passing make contact closing momentarily when its operating device is released

![Diagram of 4.3A.2.2]

4.3A.2.3 Passing make contact closing momentarily when its operating device is actuated or released

![Diagram of 4.3A.2.3]

4.3A.3 Early and late operating contacts

4.3A.3.1 Make contact (of a multiple contact assembly) which is early to close relative to the other contacts of the assembly

![Diagram of 4.3A.3.1]

4.3A.3.2 Make contact (of a multiple contact assembly) which is late to close relative to the other contacts of the assembly

![Diagram of 4.3A.3.2]

4.3A.3.3 Break contact (of a multiple contact assembly) which is late to open relative to the other contacts of the assembly

![Diagram of 4.3A.3.3]

4.3A.3.4 Break contact (of a multiple contact assembly) which is early to open relative to the other contacts of the assembly

![Diagram of 4.3A.3.4]
4.3A.4 Examples of contacts with intentional delay

4.3A.4.1 Make contact delayed when closing (operating device actuated)

4.3A.4.2

4.3A.4.3 Break contact delayed when reclosing (operating device released)

4.3A.4.4

4.3A.4.5 Make contact delayed when closing and opening

4.3A.4.6 Contact assembly with one make contact not delayed, one make contact delayed when reopening and one break contact delayed when opening
4.3A.5 Examples of spring return and nonspring return (stay put) contacts

4.3A.5.1 Make contact with spring return

4.3A.5.2 Make contact without spring return (stay put)

4.3A.5.3 Break contact with spring return

4.3A.5.4 Two-way contact with center-off position with spring return from the left-hand position but not from the right-hand one (stay put)

Add:


4.3.1 Closed contact (break)

No change in existing symbols but IEC approval will be withdrawn in the future.

4.3.8.3

Add:

4.6.3

Indication of operating method

Former 4.6.3 is now 4.6.3.5
Devices with *push or pull* operation normally have spring return. It is therefore not necessary to show the automatic return symbol (14.5.1). On the other hand, a detent symbol (14.5.2) should be shown in the exceptional cases where locking exists.

Devices operated by turning do not usually have automatic return. It is therefore not necessary for the detent symbol (14.5.2) to be shown. On the other hand, the automatic return symbol (14.5.1) should be shown in those cases where an automatic return exists.

4.6.3.1 Manually operated switch; general symbol

4.6.3.2 Push-button switch (nonlocking)

4.6.3.3 Pull-switch (nonlocking)

4.6.3.4 Turn-switch (locking)

4.6.3.5 Knife switch, general
4.14.5.3 Normally closed

Add:

$\text{OR}$

After 4.14.5.4

Add:

4.14.5.5 Position or limit switch mechanically operated in both directions with two separate circuits

4.21.1 Closes on rising temperature

Add:

See NOTE 4.21A

4.21.2 Opens on rising temperature

Add:

See NOTE 4.21A
4.22 Flasher
Self-Interrupting Switch

Add:

4.22.1 Self-operating thermal switch, break contact

NOTE — 4.22.1A: It is important to distinguish between a contact as shown and a contact of a thermal relay, which in detached representation may be shown as follows:

4.22.2 Gas discharge tube with thermal element
Starter for fluorescent lamp

Revise 4.29.1 to read as follows:

4.29.1 Manually operated 3-pole contactor
After 4.33

Add:

4.34 Multipole and Multi-position Switches (IEC Publication 617-7 (1983) [18]

4.34.1 Key operated lever or turn switches (compare with 4.12 items)

4.34.1.1 Three position lever-operated switch, locking in the upper position and with spring return from the lower position to the middle one, shown with terminals

4.34.1.2 Button-operated switch in which one set of contacts is operated by pushing the button (nonlocking) and another set by turning it (locking), shown with terminals

The bracket indicates that there is only one actuator
4.34.1.3 Button-operated switch in which the same set of contacts may be operated in two different ways; either by turning (with locking) or pushing (with spring return), shown with terminals

4.34.2 Multiposition Switches

4.34.2.1 Single-pole n-position switch, shown for \( n = 6 \)

4.34.2.2 Single-pole n-position switch, alternative for use when \( n \) is small, shown for \( n = 4 \)

4.34.2.3 Example with position diagram

NOTE — 4.34.2.3A: It is sometimes convenient to indicate the purpose of each switch position by adding text to the position diagram. It is also possible to indicate limitations of movement of the operating device as in the examples which follow:
The operating device (for example handwheel) can be turned only from positions 1 to 4 and back.

The operating device can be turned in the clockwise direction only.

The operating device can be turned in the clockwise direction without limitation and may be turned in the counter-clockwise direction only between positions 3 and 1.

4.34.2.4 Four-position switch, manually operated, having four independent circuits

4.34.2.5 Single-pole, four-position switch in which position 2 cannot be connected
4.34.2.6 Single-pole, six-position switch with a wiper that bridges only while passing from one position to the next

4.34.2.7 Single-pole multiposition switch with a wiper that bridges three consecutive terminals in each switch position

4.34.2.8 Single-pole multiposition switch with a wiper that bridges four terminals but omits one intermediate terminal in each switch position

4.34.2.9 Single-pole multiposition switch for cumulative parallel switching

4.34.2.10 One pole of a six-position multipole switch

The pole shown makes earlier than the other poles when the wiper moves from position 2 to 3 and breaks later than the other poles when the wiper moves from position 5 to 6. When the wiper moves in the opposite direction the early make becomes a later break and vice versa.
4.34.3 Block Symbols for Complex Switches

There are many ways in which complex switching functions can be achieved mechanically, for example by rotary wafer switches, slide switches, drum controllers, cam-operated contact assemblies, etc. There are also many ways in which the switching functions may be symbolized on circuit diagrams. Study has shown that there is no unique system of symbolization which is superior in every application. The system employed should be chosen with due regard to the purpose of the diagram and the degree of complexity of the switching device it is desired to symbolize. This section therefore presents one possible method of symbolizing complex switches. To facilitate understanding each example includes a constructional drawing of the device symbolized. The method shown here uses a general symbol for a complex switch which must be supplemented by a table of connections. Two examples are shown.

4.34.3.1 Complex switch, general symbol

4.34.3.2 EXAMPLE: 18-position rotary wafer switch with six terminals, here designated A to F, constructed as shown in the bottom diagram (switch shown in position 1)
Table of connections

4.34.3.3 EXAMPLE: Six-position rotary drum switch with five terminals, constructed as shown in the bottom diagram
The symbols + - and O indicate the terminals that are connected together at any position (rest-position or intermediate position) of the switch, that is, terminals having the same indicating symbol for example, + are interconnected.

**NOTE — 4.34.3.3A:** Where additional symbols are required, the characters available on a typewriter should be used, for example, x, =.

<table>
<thead>
<tr>
<th>Position</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
4.35 Switchgear and Controlgear

4.35.1 Switch (mechanical)

4.35.2 Contactor (contact open in the unoperated position)

4.35.3 Contactor with automatic release

4.35.4 Contactor (contact closed in the unoperated position)

4.35.5 Circuit breaker
4.35.6 Disconnector (isolator)

4.35.7 Two-way disconnector (isolator) with center-off position

4.35.8 Switch-disconnector (on-load isolating switch)

4.35.9 Switch-disconnector with automatic release

4.35.10 Disconnector (isolator) with blocking device, manually operated

4.36 Block Symbols for Motor Starters

4.36.1 Motor starter, general symbol

NOTE — 4.36.1A: Qualifying symbols may be shown inside the general symbol to indicate particular types of starters. See symbols 4.36.5, 4.36.7, and 4.36.8.
4.36.2 Starter operated in steps

NOTE — 4.36.2A: The number of steps may be indicated.

4.36.3 Starter-regulator

4.36.4 Starter with automatic release

4.36.5 Direct on line contactor starter for reversing motor

Full voltage contactor starter for reversing motor

4.36.6 Star-delta starter

4.36.7 Autotransformer starter
4.36.8 Starter-regulator with thyristors

4.37 Operating Devices for Electromechanical (all or nothing) Relays

4.37.1 Operating device, general symbol

4.37.2

NOTE — 4.37.2A: Operating devices with several windings may be indicated by inclusion of the appropriate number of inclined strokes or by repeating symbol 4.37.1 or 4.37.2.

4.37.3 EXAMPLES: Operating device with two separate windings assembled representation

4.37.4
4.37.5 Operating device with two separate windings, detached representation

4.37.6

4.37.7 Relay coil of a slow-releasing relay

4.37.8 Relay coil of a slow-operating relay

4.37.9 Relay coil of a slow-operating and slow-releasing relay

4.37.10 Relay coil of a high-speed relay (fast operating and fast releasing)
4.37.11 Relay coil of a relay unaffected by alternating current

4.37.12 Relay coil of an alternating current relay

4.37.13 Relay coil of a mechanically resonant relay

4.37.14 Relay coil of a mechanically latched relay

4.37.15 Relay coil of a polarized relay

NOTE — 4.37.15A: Dots may be used to indicate the relationship between the direction of the current through the winding of a polarized relay and the movement of the contact arm.

When the winding terminal identified by the polarity dot is positive with respect to the other winding terminals, the contact arm moves or tends to move towards the position marked with the dot.

4.37.16 EXAMPLES: Polarized relay, self restoring, operating for only one direction of current in the winding
4.37.17 Polarized relay with neutral position, self restoring, operating for either direction of current in the winding

4.37.18 Polarized relay with two stable positions

4.37.19 Relay coil of a remanent relay

5. Graphic Symbols for Terminals and Connectors

5.3 Connector
Disconnecting Device

Jack □
Plug □

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

5.3.1 Female contact

Add:

OR

Copyright © 1975 IEEE All Rights Reserved
5.3.2 Male contact

\[
\text{Add:}
\]

Revise 5.3.4.1 to read as follows:

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

\[
\text{Add:}
\]

5.3.5.1 2-conductor (jack)

\[
\text{Add:}
\]

5.3.5.2 2-conductor (plug)
5.3.5.3 35 3-conductor (jack) with 2 break contacts (normals) and 1 auxiliary make contact

Add:

5.3.5.4 3-conductor (plug)

Add:

5.3.5.5 Break or isolating jack, telephone type

After 5.3.6.4

Add:

5.3.7 Adapter

5.7.3.1 Plug and socket-type connector, for example U-link: male-male

5.3.7.2 Male-female

35 The broken line - - - indicates where line connection to a symbol is made and is not part of the symbol.
5.3.7.3 Male-male with socket access

5.3.8 Butt-connector

5.3.9 Connecting link, closed

5.3.9.1

5.3.9.2 Connecting link, open

After 5.6.1

Add:

5.6.1A Coaxial plug and socket

NOTE — 5.6.1A: If the coaxial plug or socket is connected to a coaxial pair, the tangential line(s) should be appropriately extended.

6. Graphic Symbols for Transformers, Inductors, and Windings

6.1.2 Magnetic core of inductor or transformer

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

Add:

OR
Revise 6.2.1 to read as follows:

6.2.1 General

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

See NOTE 6.2.1A

Add:

6.2.1A Choke Reactor

See NOTE 6.4.1A

6.2.2 Magnetic-core inductor
Telephone loading coil
If necessary to show a magnetic core.

Add:

6.2.2.1 Inductor with gap in magnetic core

Add:

6.2.4.1 Inductor with moving contact, variable in steps
After 6.2.5
Add:

6.2.5A Variometer

6.2.9
See new 11.3.3
After 6.2.9
Add:

6.2.10 Coaxial choke with magnetic core

6.2.11 Ferrite bead, shown on a conductor

Revise NOTE 6.4.1A to read as follows:

NOTE — 6.4.1A: This symbol is the preferred single-line symbol in IEC Publication 617-6 (1983) [17]. It should be used on schematics for equipments having international usage, especially when the equipment will be marked using this symbol (in accordance with IEC Publication 417 (1973) [10].

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

6.4.2.3A Single-phase transformer with two windings and screen.

Revise 6.4.4 to read as follows:

6.4.4 One winding with adjustable inductance

NOTE — 6.4.4A: The former right-hand $\emptyset$ symbol has been deleted. It is no longer recommended for use on complete diagrams.

6.4.6 Adjustable mutual inductor; constant-current transformer
6.4.7 With taps, 1-phase

Add:

6.4.7A Transformer with center tapping on one winding

Revise 6.4.8 to read as follows:

6.4.8 Autotransformer, 1-phase

OR

See NOTE 6.4.4A

See NOTE 6.4.1A

Add:
**6.4.8A** Autotransformer, three-phase, star connection

Revise **6.4.9** to read as follows:

**6.4.9** Adjustable

OR

See NOTE 6.4.1A

Revise **6.4.12** to read as follows:

**6.4.12** 1-phase induction voltage regulator(s)

Number of regulators may be written adjacent to the symbol.
Revise 6.4.14 to read as follows:

6.4.14 3-phase induction voltage regulator
Revise 6.4.15 to read as follows:

6.4.15 1-phase, 2-winding transformer

OR

See NOTE 6.4.1A

Revise 6.4.15.1 to read as follows:

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

OR

See NOTE 6.4.1A

The alternate symbol has been corrected to conform to IEC Publication 617-6 (1983) [17]. Shown outside the symbol is Y. Reason: Three separate transformers.
Revise 6.4.15.2 to read as follows:

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

See NOTE 6.4.1A

6.4.16 Polyphase transformer

Add:
6.4.16A.1 Three-phase transformer, connection star-delta

6.4.16A.2

See 6.4.15.2

6.4.16A.3 Three-phase transformer with on-load tap changer, connection star-delta

6.4.16A.4 Three-phase transformer, connection star-zigzag
6.4.16A.5 Three-phase transformer, connection star-star-delta

![Diagram of three-phase transformer]

Revise 6.4.17 to read as follows:

6.4.17 1-phase, 3-winding transformer

![Diagrams of 1-phase, 3-winding transformer]

See NOTE 6.4.1A

6.4.18 Current transformer(s)

Avoid conflict with symbol 3.2.5 if used on the same diagram.
6.4.18.1 Current transformer with two cores and two secondary windings

The terminal symbols shown at each end of the primary circuit indicate that only a single device is represented.

NOTE — 6.4.18.1A: In the right-hand symbol core symbols may be omitted.

6.4.18.2 Current transformer with two secondary windings on one core.

NOTE — 6.4.18.2A: In the right-hand symbol the core symbol shall be drawn.
6.4.18.3 Current transformer with one secondary winding with three tappings

6.4.18.4 Current transformer where the primary conductor forms five winding turns

6.4.18.5 Pulse or current transformer with one permanent winding and three threaded windings

6.4.18.6 Pulse or current transformer with two permanent windings on the same core and with nine threaded windings
6.4.20 Potential transformer(s)

Add:

After 6.5

Add:

6.6 Ferrite Cores—Symbol Elements (IEC Publication 617-4 (1983) [15])

6.6.1 Ferrite core

6.6.2 Flux/current direction indicator

This symbol indicates that a horizontal line drawn at a right angle through a core symbol represents a core winding, and it also gives the relative directions of current and flux.

NOTE — 6.6.2A: This symbol is not applicable for topographical representation.
6.6.3 Ferrite core with one winding

The oblique line may be regarded as a reflector that relates the directions of current and flux as shown below.

For drawing convenience, lines representing conductors are often shown crossing core symbols even though there is no winding on the magnetic circuit. Except in topographical representation the use of the oblique stroke is mandatory in all cases where a line through the core symbol represents a winding.

EXAMPLE:

6.7 Ferrite Cores (IEC Publication 617-4 (1983) [15])

6.7.1 Ferrite core with five windings

NOTE — 6.7.1A: Information on the direction of current, its relative amplitude and the logic conditions imposed by the state of the magnetic remanence may be added.
6.7.2 Ferrite core with one winding of m turns

\[ N = m \]

6.8 Magnetic Storage Matrices (Topographical Representation)

6.8.1 Ferrite core matrix with \( x \) and \( y \) windings and a readout winding. The symbol of a ferrite core, 6.6.1, is shown at 45° to the horizontal.

6.8.2 Matrix arrangement comprising thin sheet magnetic stores, located between thin sheet wiring layers.

7. Graphic Symbols for Electron Tubes and Related Devices

7.1.1.1 Directly heated (filamentary) cathode

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

Add:

After 7.1.1.6

Add:

7.1.1.7 Photoemissive electrode

Add:

7.1.2.1 Grid

Beam-confining or beam-forming electrodes

Add:

7.1.2.1.1 Grid with secondary emission
Revise 7.1.2.2 to read as follows:

7.1.2.2 Deflecting electrodes (used in pairs)

7.1.2.2A Radial deflecting electrodes, one pair of electrodes shown

After 7.1.2.4

Add:

7.1.2.5 Ion diffusion barrier

7.1.2.6 Intensity modulating electrode

NOTE — 7.1.2.6A: Symbol 7.1.2.1 may be used if no confusion will arise:

7.1.2.7 Focusing electrode with aperture

Beam-forming plate

See NOTE 7.1.2.6A

7.1.2.8 Beam-splitting electrode internally connected to the final focusing electrode of the electron gun

7.1.2.9 Cylindrical focusing electrode

Drift space electrode

Electronic lens element
7.1.2.10 Cylindrical focusing electrode with grid

7.1.2.11 Multiaperture electrode

7.1.2.12 Quantizing electrode

Sampling electrode

7.1.5 Heater

After 7.1.8

Add:

7.1.9 Storage electrodes

7.1.9.1 Storage electrode
7.1.9.2 Photoemissive storage electrode

7.1.9.3 Storage electrode with secondary emission in the direction of the arrow

7.1.9.4 Photoconductive storage electrode

7.1.10 Symbol elements for microwave tubes

7.1.10.1 Electron gun assembly, shown with envelope

7.1.10.2 Reflector
Repelling electrode (used in velocity modulated tubes)

7.1.10.3 Nonemitting sole for open slow-wave structure

7.1.10.4 Nonemitting sole for closed slow-wave structure
7.1.10.5 Emitting sole (arrow indicates direction of electron flow)

Add:

7.3.6.1 With electric-field (electrostatic) deflection

Add:

7.3.6.1.1 Double-beam cathode-ray tube, split-beam type with:
- Electrostatic deflection
- Indirectly heated cathode

Add:

7.3.6.2.3 Cathode-ray tube with electromagnetic deviation, with:
- Permanent magnet focusing and ion trap
- Intensity modulating electrode
- Indirectly heated cathode

For example, television picture tube
7.4 Solion
Ion-Diffusion Device

7.4.1 Diode solion

Add:

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
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.
Revise 7.7.1 to read as follows:

7.7.1 General

![Diagram]

See NOTE 7.7A

Revise 7.7.2 to read as follows:

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

![Diagram]

See NOTE 7.7A

After 7.7.2

Add:

7.7.3 Ionizing radiation detectors

7.7.3.1 Ionization chamber

![Diagram]

7.7.3.2 Ionization chamber with grid

![Diagram]
7.7.3.3 Ionization chamber with guard ring

![Ionization chamber with guard ring diagram]

7.7.3.4 Ionization chamber, compensated type

![Ionization chamber, compensated type diagram]

7.7.3.5 Faraday cup

![Faraday cup diagram]

7.7.3.6 Counter tube

![Counter tube diagram]

7.7.3.7 Counter tube with guard ring

![Counter tube with guard ring diagram]

8. Graphic Symbols for Semiconductor Devices

Revise 8.2.2 to read as follows:

8.2.2 Rectifying junction or junction which influences a depletion layer

Arrowheads (→) shall be half the length of the arrow away from the semiconductor base region.
See item 8.6

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

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

Add:

8.2.2A Rectifying junction

Revise:

8.2.2.1 P region on N region

Add:

Revise:

8.2.2.2 N region on P region

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

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

Add:

8.2.3A Indication of the conductivity type of the channel for insulated gate field effect transistors (IGFET)

8.2.3A.1 N-type channel on P-type substrate, shown for a depletion type IGFET

8.2.3A.2 P-type channel on an N-type substrate, shown for an enhancement type IGFET

8.2.4.1 P emitter on N region

Add:

8.2.4.1.1 Plurality of P emitters on N region

Add:
**8.2.4.2 N emitter on P region**

\[
\text{Add:}
\]

**8.2.4.2.1 Plurality of N emitters on P region**

\[
\text{Add:}
\]

**CORRECTION:** *Symbol was omitted in some printings.*

**8.2.9.2 Gate (no external connection)**

For application, see symbol 8.5.9

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

\[\text{Style 3} \quad \text{See NOTE 8.2.9A}\]

**8.3.1 Breakdown**

Do not rotate or show in mirror-image form.

\[\text{Style 1} \quad \text{IEC} \quad \text{J}\]
Add:

**8.3.1A** Bidirectional breakdown effect

![Diagram for bidirectional breakdown effect]

8.3.3 Backward

![Diagram for backward symbol]

Add:

After **8.3.4**

Add:

**8.3.5** Schottky effect

![Diagram for Schottky effect]

8.5.1 Semiconductor diode; semiconductor rectifier diode; metallic rectifier

![Diagram for semiconductor diode]
8.5.2 Capacitive diode (varactor)

Add:

8.5.3 Temperature-dependent diode

Add:

8.5.4.1 Photosensitive type

Add:

8.5.4.2 Photoemissive type

See also item 11.1.1
Add:

8.5.6.1 Unidirectional diode; voltage regulator

Style 1

*Style 2

Add:

*Note conflict with 8.3.1A

8.5.6.2 Bidirectional diode

Style 1

Style 2

Add:

8.5.7 Tunnel and backward diodes

8.5.7.1 Tunnel diode

For this application, NOTE 8.2.2A does not apply.
8.5.7.2 Backward diode; tunnel rectifier

For this application, NOTE 8.2.2A does not apply.
8.5.8 Thyristor, reverse-blocking diode-type

8.5.8.1 General

After 8.5.8.2

Add:

8.5.8.3 Reverse conducting diode thyristor

8.5.9 Thyristor, bidirectional diode type; bi-switch

See also symbol 8.6.15

Add:

8.5.11 Current regulator

*Note conflict with 8.3.3
8.6 Typical Applications, Three- (or more) Terminal Devices

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


Add:

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

See NOTE 8.6.1A

Add:

8.6.2A NPN transistor with collector connected to the envelope

After 8.6.2.1

Add:

8.6.2.2 NPN avalanche transistor
**8.6.3** NPN transistor with transverse-biased base

See NOTE 8.6.1A

**8.6.4** PNIP transistor with ohmic connection to the intrinsic region

See NOTE 8.6.1A

**8.6.6** PNIN transistor with ohmic connection to the intrinsic region

See NOTE 8.6.1A

**8.6.8** Unijunction transistor with N-type base

See NOTE 8.6.1A
8.6.9 Unijunction transistor with P-type base

See NOTE 8.6.1A

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

8.6.10.1 N-channel junction gate

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

See NOTE 8.6.1A

NOTE 8.6.10.1A: The gate and source connections shall be drawn in line.
8.6.10.2 N-channel insulated-gate, depletion-type, single-gate, passive-bulk (substrate), three-terminal device

Add:

8.6.10.2A IGFET enhancement-type, single-gate, N-type channel without substrate connection

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

Add:

8.6.10.3A IGFET enhancement-type, single-gate, N-type channel with substrate internally connected to source

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

\[ \text{Add:} \]

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

8.6.11.1 P-channel junction gate

See NOTE 8.6.1A

\[ \text{Add:} \]

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

\[ \text{Add:} \]

8.6.11.2A Insulated-gate field-effect transistor (abridged IGFET) enhancement type, single gate. P-type channel without substrate connection

NOTE — 8.6.11.2A: For an example with multiple gates, see symbol 8.6.10.4.1.
8.6.11.5 P-channel insulated-gate, enhancement-type, single-gate, active-bulk (substrate) externally terminated, four-terminal device

8.6.12.1 General

8.6.12.2 Gate turn-off type
8.6.13.1 General

8.6.13.2 Gate turn-off type

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

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

See also symbol 8.5.9
8.6.16 Phototransistor (PNP-type)

See also symbol 8.5.10, for 2-terminal device

After 8.10.4

Add:

8.10.5 Optical coupling device
Opto isolator

Shown with light emitting diode and phototransistor

8.10.6 Magnetic coupling device
Magnetic isolator
After 8.11.2

Add:

8.12 Ionizing Radiation Detectors

8.12.1 Detector, semiconductor type

8.12.2 Scintillator detector

8.12.3 Cerenkov detector

8.12.4 Thermoluminescence detector
9. Graphic Symbols for Circuit Protectors

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

9.1.1 General

Add:

9.1.1A Fuse with mechanical linkage (striker fuse)

Revise:

9.1.2 Fuse with alarm contact

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

9.1.2.1 Fuse with alarm contact, three terminals

\[ 
\text{F} \quad \text{F} 
\]

9.1.2.2 Fuse with separate alarm circuit

\[ 
\text{F} \quad \text{F} 
\]

Add:

9.1.3.1 Fuse-switch

\[ 
\text{F} \quad \text{F} 
\]

9.3 Lightning Arrester \[ \text{F} \]
Arrester (electric surge, etc)
Gap

See also symbol 8.5.6

9.3.1 General

\[ 
\rightarrow \quad \text{OR} 
\]

Add:

\[ 
\text{OR} 
\]

\[ 
\text{F} \quad \text{F} 
\]
9.3.1.1 Double spark-gap

After 9.3.9

Add:

9.3.10 Surge arrester
   (Lightning arrester)

9.3.11 Protective gas discharge tube

9.3.12 Symmetric protective gas discharge tube

Revise 9.4 to read as follows:

9.4 Circuit Breaker

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

9.4.1 General
9.4.2 Air circuit breaker, if distinction is needed; for alternating-current circuit breakers rated at 1500 volts or less and for all direct-current circuit breakers.

```
\)[
```

9.4.3 Network protector

```
\)[
```

9.4.4 Circuit breaker, other than covered by symbol 9.4.1

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

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

```
\)
```

See NOTE 9.4.4A

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

```

OR
```

```

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

9.4.7 Application: 3-pole circuit breaker, drawout type

After 9.5.12.20

Add:

9.6 Protective Relays (IEC Publication 617-7 (1983 [18]) Block Symbol and Qualifying Symbol

9.6.1 Measuring relay or related device

The asterisk must be replaced by one or more letters or qualifying symbols indicating the parameters of the device, in the following order; characteristic quantity and its mode of variation; direction of energy flow; setting range, resetting ratio; delayed action; value of time delay


Symbols 9.6.2, 9.6.4, and 9.6.7 show how letter and qualifying symbols may be combined.

NOTES:

9.6.1B — A figure giving the number of similar measuring elements may be included in the symbol as shown in example 9.7.5.

9.6.1C — The symbol may be used as a functional symbol representing the whole of the device, or as a symbol representing only the actuating element of the device.

9.6.2 Voltage failure to frame (frame potential in case of fault)

NOTE — 9.6.2A: U may be replaced by V.
9.6.3 Residual voltage

The NOTE with symbol 9.6.2 is applicable

\[ U_{rsd} \]

9.6.4 Reverse current

\[ I \]

9.6.5 Differential current

\[ I_d \]

9.6.6 Percentage differential current

\[ \frac{I_d}{I} \]

9.6.7 Earth fault current

\[ I \]

9.6.8 Current in the neutral conductor

\[ I_N \]

9.6.9 Current between neutrals of two polyphase systems

\[ I_{N-N} \]

9.6.10 Power at phase angle \( \alpha \)

\[ P_{\alpha} \]

9.6.11 Inverse time-lag characteristic
9.7 Examples of Protective Relays (IEC Publication 617-7 (1983) [18])

9.7.1 No voltage relay

9.7.2 Reverse current relay

9.7.3 Underpower relay

9.7.4 Delayed overcurrent relay

9.7.5 Overcurrent relay with two current elements and a setting range from 5 A to 10 A

9.7.6 Maximum reactive power relay:

- Energy-flow towards the busbars
- Operating value 1 Mvar
- Time-lag adjustable from 5 s to 10 s
9.7.7 Undervoltage relay:
- Setting range from 50 V to 80 V
- Resetting ratio 130%

9.7.8 Current relay operating above 5 A and below 3 A

9.7.9 Under-impedance relay

9.7.10 Relay detecting interturn short-circuits

9.7.11 Divided-conductor detection relay
9.7.12 Phase-failure detection relay in a three-phase system

9.7.13 Locked-rotor detection relay operating by current sensing

9.7.14 Overcurrent relay with two outputs, one active at current above five times the setting value, the other with inverse time-lag characteristic

9.8 Other Relay Devices

9.8.1 Buchholz protective device (gas relay)

9.8.2 Auto-reclose device
10. Graphic Symbols for Acoustic Devices

10.1.2 Buzzer

Add:

Revise:

10.1.3.3 Loudspeaker-microphone
Underwater sound transducer, two-way

After 10.1.4

Add:

10.1.5 Hydrophone (supersonic transmitter-receiver)

10.1.6 Horn

10.1.7 Siren
10.1.8 Whistle, electrically operated

11. Graphic Symbols for Lamps and Visual-Signaling Devices

After NOTE 11.1.1C

Add:

11.1.1A Lamp (IEC Publication 617-8 (1983) [19])

11.1.1A.1 Lamp, general symbol

Signal lamp, general symbol

If it is desired to indicate the color, a notation according to the following code is placed adjacent to the symbol:

RD = red
YE = yellow
GN = green
BU = blue
WH = white

If it is desired to indicate the type of lamp, a notation according to the following code is placed adjacent to the symbol:

Nc = neon
Xe = xenon
Na = sodium vapor
Hg = mercury
I = iodine
IN = incandescent
EL = electroluminescent
ARC = arc
FL = fluorescent
IR = infrared
UV = ultraviolet
LED = light-emitting diode
11.1.1A.2 Signal lamp, flashing type

After 11.2.8

Add:

11.3 Electromechanical Signal

11.3.1 Indicator, electromechanical
Annunciator, element

11.3.2 Electromechanical position indicator with one de-energized (shown) and two operated positions

11.3.3 Coil operated flag indicator

(Relocated from 6.2.9)

12. Graphic Symbols for Readout Devices

12.1 Meter
Instrument

Add:

Note that IEC Publication 617-8 (1983) [19]

— Distinguishes symbolwise between indicating, recording, and integrating instruments (see 12.3)
— Carefully follows the lettering style (uppercase, lowercase) specified for the SI system of measurement (see 12.4 through 12.6)

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

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

12.2 Electromagnetically Operated Counter
Message Register
See also 12.7

12.2.1 General

12.2.2 With make contact

Add:

12.3 Indicating, Recording and Integrating Instruments, General Symbols (IEC Publication 617-8 (1983) [19]

NOTE — 12.3A: The asterisk within the symbols of this section shall be replaced with one of the following:

- The letter symbol for the unit of the quantity measured, or a multiple or sub-multiple thereof (see examples 12.4.1 and 12.4.7)
- The letter symbol for the quantity measured (see examples 12.4.5 and 12.4.6)
- A chemical formula (see example 12.4.13)
- A graphic symbol (see example 12.4.8)

The symbol or formula used should be related to the information displayed by the instrument regardless of the means used to obtain the information.

NOTE — 12.3B: Letter symbols for units and for quantities shall be selected from one of the parts of IEC Publication 27 [9], ANSI/IEEE Std 260-1978 [5], and ANSI/IEEE Std 280-1985 [6].
Provided IEC Publication 27 [9], ANSI/IEEE Std 260-1978 [5], ANSI/IEEE Std 280-1985 [6], or the letter symbols for chemical elements, do not apply, other letter symbols may be used, if they are explained on the diagram or in referenced documents.

NOTE — 12.3C: If the letter symbol for the unit of the quantity measured is used, it may be necessary to show the letter symbol for the quantity as supplementary information. It should be placed below the unit letter symbol (see example 12.4.2).

Supplementary information concerning the quantity measured, and any necessary qualifying symbol may be shown below the quantity letter symbol.

NOTE — 12.3D: If more than one quantity is indicated or recorded by an instrument, the appropriate symbol outlines shall be placed attached in line, horizontally or vertically (see examples 12.5.2 and 12.6.14).

12.3.1 Indicating instrument

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

12.3.2 Recording instrument

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

12.3.3 Integrating instrument

Energy meter

The asterisk shall be replaced in accordance with the rules given in NOTE 12.3A

NOTES:

12.3.3A — The symbol may also be used for a remote instrument which repeats a reading transmitted from an integrating meter. For example, see symbol 12.6.11.

12.3.3B — The outline may be combined with that for a recording instrument to represent a combined instrument. For example, see symbol 12.6.14.

12.3.3C — Symbols from 1.7 may be used to specify the direction of energy flow. For examples, see symbols 12.6.4 to 12.6.7.

12.3.3D — The number of rectangles at the top of the symbol indicates the number of different summations by a multirate meter. For example, see symbol 12.4.8.
12.4 Examples of Indicating Instruments (IEC Publication 617-8 (1983) [19])

12.4.1 Voltmeter

12.4.2 Reactive current ammeter

12.4.3 Maximum demand indicator actuated by an integrating meter

12.4.4 Varmeter

12.4.5 Power-factor meter

12.4.6 Phase meter

12.4.7 Frequency meter
12.4.8 Synchronoscope

12.4.9 Wavemeter

12.4.10 Oscilloscope

12.4.11 Differential voltmeter

12.4.12 Galvanometer

12.4.13 Salinity meter

12.4.14 Thermometer
   Pyrometer

NOTE — 12.4.14A: $\theta$ may be replaced by $\tau$.
12.4.15 Tachometer

12.5 Examples of Recording Instruments (IEC Publication 617-8 (1983) [19])

12.5.1 Recording wattmeter

12.5.2 Combined recording wattmeter and varmeter

12.5.3 Oscillograph

12.6 Examples of Integrating Instruments (IEC Publication 617-8 (1983) [19])

12.6.1 Hour meter

12.6.2 Ampere-hour meter
12.6.3 Watthour meter

12.6.4 Watthour meter, measuring energy transmitted in one direction only

12.6.5 Watthour meter, measuring the energy flow from the busbars

12.6.6 Watthour meter, measuring the energy flow towards the busbars

12.6.7 Import-export watthour meter

12.6.8 Multirate watthour meter, two-rate shown
12.6.9 Excess watthour meter

12.6.10 Watthour meter with transmitter

12.6.11 Remote meter (repeater) actuated by a watthour meter

12.6.12 Remote meter (repeater) with printing device, actuated by a watthour meter

12.6.13 Watthour meter with maximum demand indicator

12.6.14 Watthour meter with maximum demand recorder
12.6.15 Varhour meter

12.7 Counting Devices (IEC Publication 617-8 (1983) [19])

12.7.1 Counting function of a number of events, qualifying symbol

12.7.2 Pulse meter (electrically-operated counting device)

12.7.3 Pulse meter manually preset to \( n \) (reset if \( n \cdot 0 \))

12.7.4 Pulse meter electrically reset to 0

12.7.5 Pulse meter with multiple contacts

Respective contacts close once at every unit \( (10^0) \), ten \( (10^1) \), hundred \( (10^2) \), thousand \( (10^3) \) events registered by the counter
12.7.6 Counting device, cam driven and closing a contact for each \( n \) events

12.8 Telemetering Devices

12.8.1 Signal translator, general symbol

12.8.2 Telemetering transmitter

12.8.3 Telemetering receiver

12.9 Electric Clocks

12.9.1 Clock, general symbol
Secondary clock

12.9.2 Master clock
12.9.3 Clock with switch

![Clock with switch diagram]

13. Graphic Symbols for Rotating Machinery

Add:

13.1.5A Brush (on slip-ring or commutator)

NOTE — 13.1.5A: Brushes are shown only if necessary.

![Brush diagram]

Add:

13.1.7 Linear motor, general symbol

![Linear motor diagram]

13.1.8 Stepping motor, general symbol

![Stepping motor diagram]

Add:

13.5.1.1 Induction motor, three-phase, squirrel cage

![Induction motor diagram]
13.5.1.2 Induction motor, single-phase, squirrel cage, leads of split phase brought out

13.5.1.3 Induction motor, three-phase, star-connected, with automatic starter in the rotor

13.5.1.4 Linear induction motor, three-phase, movement limited to one direction

Add:

13.6.1.1 Synchronous generator, three-phase, permanent magnet

14. Graphic Symbols for Mechanical Functions

14.2 Mechanical Motion

14.2.1 Translation, one direction

Add:

14.2.1A Rectilinear force or motion in the direction of the arrow
14.2.2 Translation, both directions

Add:

14.2.2A Bidirectional rectilinear forces or motion

EXAMPLE: Frequency is increased when wiper 3 is moved towards terminal 2

After 14.2.4

Add:

14.2.4A Bidirectional rotation, limited in both directions

14.2.4.1 Alternating or reciprocating

For application see symbol 2.3.7.7

Add:

After 14.2.6

Add:

14.2.7 Delayed action

14.2.7.1 Delayed action

NOTE — 14.2.7.1A: Delayed action in the direction of movement from the arc towards its center
14.2.7.2

Revise 14.3.3 to read as follows:

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

Revise 14.3.4 to read as follows:

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

Add:

14.3.5 Brake (IEC Publication 617 (1983) [13])

14.3.5.1 EXAMPLE: Electric motor with brake applied.

14.3.5.2 EXAMPLE: Electric motor with brake released.

14.3.6 Gearing
After 14.4.2

Add:

14.4.2A Operating by pulling.

Add:

14.4.4 Manually operated control with restricted access

14.4.5 Operated by turning

14.4.6 Operated by proximity effect

14.4.7 Operated by touching

14.4.8 Emergency switch (mushroom-head safety feature)

14.4.9 Operated by handwheel

14.4.10 Operated by pedal
14.4.11 Operated by lever

14.4.12 Operated by removable handle

14.4.13 Operated by key

14.4.14 Operated by crank

14.4.15 Operated by roller

14.4.16 Operated by cam

NOTE — 14.4.16A: If desired, a more detailed drawing of the cam may be shown. This applies also to a profile plate.

14.4.16.1 EXAMPLE: Cam profile

14.4.16.2 Profile plate
Cam profile (developed representation)

14.4.16.3 Operated by cam and roller
14.4.17 Operated by stored mechanical energy

NOTE — 14.4.17A: Information showing the form of stored energy may be added in the square.

14.4.18 Operated by pneumatic or hydraulic control, single acting

14.4.19 Operated by pneumatic or hydraulic control, double acting

14.4.20 Operated by electromagnetic actuator

14.4.21 Operated by electromagnetic overcurrent protection

14.4.22 Operated by thermal actuator, for example thermal relay, thermal overcurrent protection

14.4.23 Operated by electric motor

14.4.24 Operated by electric clock
14.5 Detents, Latching, and Blocking

14.5.1 Automatic return

NOTE — 14.5.1A: The triangle is pointed in the return direction.

14.5.2 Detent
Nonautomatic return
Device for maintaining a given position

14.5.3 Detent, disengaged

14.5.4 Detent, engaged

14.5.5 Mechanical interlock between two devices

14.5.6 Latching device, disengaged

14.5.7 Latching device, engaged

14.5.8 Blocking device
14.5.9 Blocking device engaged, movement to the left is blocked

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

15.2 Coupling

Commonly used in coaxial and waveguide diagrams.

Add:

15.2A Coupler (or feed) type unspecified, general symbol

15.2A.1 EXAMPLE: Coupler to a cavity resonator

15.2A.2 EXAMPLE: Coupler to a rectangular waveguide

After 15.2.7

Add:

15.2.8 Slow-wave coupler

15.2.9 Helical coupler
After 15.4.4.2

Add:

15.4.4.3 Quadrature hybrid junction

After 15.5.3

Add:

15.5.4 Taper transition from circular rectangular waveguide

15.6 Mode Suppressor

Commonly used in coaxial and waveguide transmission

15.6.1 General

The asterisk shall be replaced by the indication of the mode suppressed

15.7 Rotary Joint (radio-frequency rotary coupler)

Add:

15.7A Rotatable, with symmetrical connectors

15.8.4.1 Reversible direction

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

Commonly used for coaxial and waveguide transmission.

Add:

15.9.1.1 Cavity resonator forming an integral part of tube

15.9.1.2 Cavity resonator, partly or wholly external to tube
After 15.9.4

Add:

15.9.5 Tetrapole

15.9.5.1 Tetrapole with loop coupler

After 5.10.3

Add:

15.10.4 Permanent magnet producing a transverse field (in a crossed field or magnetron type tube)

15.10.5 Electromagnet producing a transverse field (in a crossed field or magnetron type tube)
15.11 Magnetron

15.11.1 Resonant type with coaxial output

Add:

15.11.1A Magnetron oscillator tube with:

- Indirectly heated cathode
- Closed slow-wave structure with dc connection by way of a waveguide
- Permanent field magnet
- Window-coupler to rectangular waveguide

15.11.1A.1

Simplified form

After 15.11.3

Add:

15.11.4 Backward (traveling) wave oscillator tube (voltage tunable magnetron) with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Closed slow-wave structure with dc connection by way of waveguide
- Nonemitting sole
- Permanent field magnet
- Window-coupler to rectangular waveguide
After 15.12.1

Add:

15.12.1A Reflex klystron with:

- Indirectly heated cathode
- Beam-forming plate
- Grid
- Tunable integral cavity resonator
- Reflector
- Loop coupler to coaxial output

15.12.1A.1
After 15.12.2

Add:

15.12.3 Klystron with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- External tunable input cavity resonator
- Drift space electrode
- External tunable output cavity resonator with dc connection
- Collector
- Focusing coil
- Input loop coupler to coaxial waveguide
- Output window coupler to rectangular waveguide

15.12.3.1

Simplified form
After 15.13

Add:

15.13.1 T-R tube

After 15.14.8

Add:

15.14.9 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Collector
- Focusing coil
- Probe-couplers to rectangular waveguides each with sliding short

For a simplified form see symbol 15.14.11.1.

15.14.10 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Collector
- Permanent focusing-magnet
- Slow-wave couplers to rectangular waveguides
For a simplified form see symbol 15.14.11.1.

15.14.11 O-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
- Intensity modulation electrode
- Beam-forming plate
- Slow-wave structure with dc connection
- Electrostatic focusing electrode
- Collector
- Slow-wave couplers to rectangular waveguides

For a simplified form see symbol 15.14.11.1.


15.14.12 M-type forward traveling wave amplifier tube with:

- Indirectly heated cathode
— Intensity modulating electrode
— Beam-forming plate
— Preheated nonemitting sole
— Slow-wave structure with dc connection
— Collector
— Permanent transverse field magnet
— Window couplers to rectangular waveguides

15.14.12.1

15.14.13 M-type backward (traveling) wave amplifier tube with:

— Filament-heated emitting sole
— Slow-wave structure with dc connection
— Permanent transverse field magnet
— Window-couplers to rectangular waveguides
15.14.13.1

15.14.14 M-type backward (traveling) wave oscillator tube with:

- Indirectly heated cathode
- Intensity modulating electrode
- Beam-forming plate
- Nonemitting sole
- Slow-wave structure with dc connection by way of waveguide
- Collector
- Permanent transverse field magnet
- Window-coupler to rectangular waveguide
15.16 Filter

15.16.1 Mode filter

\[
\text{Add:}
\]

The asterisk shall be replaced by the indication of the mode suppressed.

After 15.16.2

\[
\text{Add:}
\]

15.16.3 Bandpass filter switched by gas discharge

After 15.19

\[
\text{Add:}
\]

15.20 Multiport Devices

15.20.1 Three-port junction

NOTE — 14.20.1A: The type of coupling, power division proportions, reflection coefficients, etc, may be indicated as shown below. The angles between the ports may be drawn as convenient.

15.20.1.1 EXAMPLE: Series T, \( E \)-plane T
15.20.1.2 EXAMPLE: Shunt T, $H$-plane T

![Diagram of Shunt T, H-plane T]

15.20.1.3 EXAMPLE: Power divider:

Power divided into ratio 6:4

![Diagram of Power Divider]

15.20.2 Four-port junction

![Diagram of Four-port Junction]

15.20.2.1

NOTE — 15.20.2.1A: The convention is that the power entering at one port is conveyed only to the two directly connected ports and thence away from the device.

![Diagram of Four-port Junction Form 2]

15.21 Lasers and Masers

15.21.1 Maser, general symbol

NOTES:

15.21.1A — The symbol represents the transition from one energy level to a lower one. It is drawn preferably in the lower left-hand quarter of the square.

15.21.1B — Pumping by light may be shown by placing symbol 1.3.1 ( ) above

a) An appropriate symbol chosen from 1.4, or
b) The chemical symbol for the material

For example of application, see symbol 15.21.2.2
15.21.1.1 EXAMPLE: Maser used as an amplifier

15.21.2 Laser (optical maser), general symbol

The NOTES with symbol 15.21.1 apply.

15.21.2.1 EXAMPLES: Laser used as a generator

15.21.2.2 Ruby laser generator
15.21.2.3 Ruby laser generator, shown with xenon lamp as pumping source

16. Graphic Symbol for Composite Assemblies

After 16.1.1

Add:

16.1.1A Item
Equipment
Functional unit

NOTE — 16.1.1A: Suitable symbols or legends shall be inserted in or added to the symbol outline to indicate the item, equipment, or function.

Revise 16.1.1.1 to read as follows:

16.1.1.1 Accepted abbreviations from ANSI Y1.1-1972 (R 1984) [1] may be used in the rectangle.
After 16.2.8

Add:

16.2.9 Negative impedance both-way amplifier

16.2.10 Amplifier with bypass used for signaling or power feeding, or both

16.2.11 Amplifier with external direct-current control

NOTE — 16.2.11A: The controlled quantity may be indicated beside the arrowhead.

Revise 16.9 to read as follows:

16.9 Gyro
Gyroscope
Gyrocompass

Add:

16.9.1 Gyro
Add:

16.13 Changer, General Symbol Converter, General Symbol

If the direction of change is not obvious, it may be indicated by an arrowhead on the outline of the symbol.

A symbol or legend indicating the input or output quantity, waveform, etc may be inserted in each half of the general symbol to show the nature of the change.


The diagonal line from this symbol is used in the form of a solidus to show a converting function.

16.13.1 DC converter

16.13.2 Rectifier

16.13.3 Rectifier in full wave (bridge) connection

16.13.4 Inverter

16.13.5 Rectifier/inverter
16.14 Galvanic Separator

![Diagram of galvanic separator]

NOTE — 16.14A: If necessary, indication of the way of separation may be given below the qualifying symbol.

For example:

![Diagram of galvanic separation by opto-coupler]

Galvanic separation by opto-coupler

16.15 Heat Source, General Symbol

16.15.1 Radioisotope heat source

16.15.2 Combustion heat source

16.16 Generator, General Symbol

NOTE — 16.16A: For a rotating generator, use symbol

See 13.1
16.16.1 Thermoelectric generator, with combustion heat source

16.16.2 Thermoelectric generator with nonionizing radiation heat source

16.16.3 Thermoelectric generator with radioisotope heat source

16.16.4 Thermionic diode generator with nonionizing radiation heat source

16.16.5 Thermionic diode generator with radioisotope heat source
16.16.6 Photovoltaic generator

![Photovoltaic generator diagram]

16.17 Sensors and Detectors

16.17.1 Proximity sensor

![Proximity sensor diagram]

16.17.2 Proximity sensing device, block symbol

NOTE — 16.17.2A: The method of operating may be indicated.

![Proximity sensing device diagram]

16.17.2.1 EXAMPLE: Capacitive proximity detector operating on the approach of solid material

![Capacitive proximity detector diagram]

16.17.3 Touch sensor

![Touch sensor diagram]

16.18 Applications of Sensors

16.18.1 Touch sensitive switch, make contact

![Touch sensitive switch diagram]
16.18.2 Proximity switch, make contact

![Proximity switch, make contact diagram]

16.18.3 Proximity switch, operated on the approach of a magnet, make contact

![Proximity switch, operated on the approach of a magnet, make contact diagram]

16.18.4 Proximity switch, operated on the approach of iron, break contact

![Proximity switch, operated on the approach of iron, break contact diagram]

17. Graphic Symbols for Analog and Digital Logic Functions

NOTE — 17A: The existing Section 17, symbols 17.1 through 17.9 (inclusive) filled a need for programming operations using general purpose computers equipped with removable programming (patch) panels. IEC Publication 617-13 (1978) [24] provides a more sophisticated system.

17.10 Analog Elements (IEC Publication 617-13 (1978) [24]) for Computation and Control

17.10.1 General Rules

1) In many figures lowercase letters appear that are not part of the symbols and are added only for the purpose of identification of inputs and outputs as referenced in the description.

2) The symbols for sign indication are + and -. They are placed inside the outline of the symbol adjacent to each relevant input and output.

3) Weighting factors applied to the input signals are each indicated by a sign indicator in combination with a numerical value placed inside the outline of the symbol adjacent to the relevant input. In this standard $w_1, w_2, \ldots, w_n$ which are understood to include the proper sign, will be used to denote the values of the weighting factors. When the weighting factor is +1 or -1, the number 1 may be omitted.

4) The symbol $f$ is used to denote the function of an analog element. $f$ may be replaced by a symbol or a graph denoting the actual function.

5) EXAMPLE:
Element in which:

\[ u = -f(2x, -y, z) \]

### 17.10.2 Qualifying symbols for signal identification

*See 1.15*

### 17.10.3 Qualifying symbols for amplifiers

1) When an element performs a specific function in addition to amplification, \( f \) may be replaced by the appropriate qualifying symbol (see symbols 17.10.3.1 to 17.10.3.4) or may be omitted if no confusion can arise.

2) In particular cases, for example integrating amplifiers, special purpose inputs may be defined using symbols 17.10.3.5 to 17.10.3.11. If these symbols are not sufficient, controlling inputs should be labelled \( C_1, C_2 \ldots \) etc, and the effects of these should be defined in an associated table.

#### 17.10.3.1 Summing

\[ \sum \]

#### 17.10.3.2 Integrating

\[ \int \]

#### 17.10.3.3 Differentiating

\[ \frac{d}{dt} \]

#### 17.10.3.4 Logarithmic

\[ \log \]

#### 17.10.3.5 Frequency compensation

\[ F \]

#### 17.10.3.6 Initial condition, analog value of integration

\[ I \]
17.10.3.7 Control: the defined 1-state allows integration

\[ C \]

17.10.3.8 Hold: the defined 1-state holds last value

\[ H \]

17.10.3.9 Reset: the defined 1-state resets the output condition to zero

\[ R \]

17.10.3.10 Set: the defined 1-state sets to initial condition

\[ S \]

17.10.3.11 Supply voltage (to be used if special requirements exist). Any necessary identification of the supply (numeric) or polarity (+ or -) follows the letter \( U \)

\[ U \]

17.10.4 Amplifiers

17.10.4.1 Amplifier for analog computation. General symbol.

\[ \]

\[ \]

\[ w_1 \ldots w_n \] represent the signed values of the weighting factors.

\[ m_1 \ldots m_k \] represent the signed values of the amplification factors.

\[ u_i = m \cdot m_1 \cdot f(w_1 \cdot a_1, w_2 \cdot a_2, \ldots, w_n \cdot a_n) \]

where:

\[ i = 1, 2, \ldots, k \]
The sign of the amplification factor is to be maintained at each of the outputs, except for those being digital in nature.

When there is only one amplification factor for the whole element, or there is a common factor resulting from weighting factors and amplification factors, the \( m \) in the qualifying symbol may be replaced by the absolute value.

When \( m = 1 \), the number 1 may be omitted. Signs should always be maintained at analog outputs.

The use of the sign \( \infty \) as an amplification factor is recommended where the nominal open loop gain is very high and the knowledge of its exact value is not of particular concern.

**EXAMPLES:**

17.10.4.2 High gain differential amplifier (operational amplifier)

17.10.4.3 High gain amplifier with a nominal amplification of 10 000 and two complementary outputs

17.10.4.4 Inverting amplifier with an amplification of 1

17.10.4.5 Amplifier with two outputs, the upper, noninverting, has an amplification of 2, the lower, inverting output, has an amplification of 3
17.10.4.6

Integrating amplifier (integrator)

\[ u = -10 \left( 0.1a + 0.1b + 0.2c + 0.5d + 1.0e \right) = -(a + b + 2c + 5d + 10e) \]

17.10.4.7 Integrating amplifier (integrator)

If \( f = 1 \), \( g = 0 \), and \( h = 0 \), then

\[ u = -80 \left[ v(t = 0) + \int_0^t (2a + 3b) \, dt \right] \]

NOTE — The symbols for signal identification (\( \cap \) and \( # \)) may be omitted if no ambiguity arises.

17.10.4.8 Differentiating amplifier (differentiator)

\[ u = 5 \frac{d}{dt} (a - 4b) \]
17.10.4.9 Logarithmic amplifier

\[ u = -\log (-a + 2b) \]

17.10.5 Function generators

17.10.5.1 Function generator, general symbol

\[ f(x_1 \ldots x_n) \]

\( x_1 \ldots x_n \) represent the arguments of the function and may each be replaced by an appropriate indication, provided that no ambiguity can arise. All weighting factors are assigned the value +1 and are therefore omitted.

\( f(x_1 \ldots x_n) \) shall be replaced by an appropriate indication of, or reference to, the function (see for example, IEC Publication 27-1 (1971) [9]).

NOTE — 17.10.5.1A: the graphic “/” shall not be used for the indication of the division because of ambiguity with the symbols for the level converter and the code converter.

EXAMPLES:

17.10.5.2 Multiplier with weighting factor of -2

\[ u = -2ab \]
17.10.5.3 Divider

\[
\frac{x}{y} = u
\]

17.10.5.4 Multiplier-divider

\[
\frac{x y}{z} = u
\]

17.10.5.5 Cotangent function

\[
\cot x = u
\]

17.10.5.6 Exponential function

\[
3 \times y = u
\]
17.10.6 Coordinate converters

17.10.6.1 Coordinate converter, polar to rectangular

\[ u_1 = r \cdot \cos \theta \]
\[ u_2 = r \cdot \sin \theta \]

17.10.6.2 Coordinate converter, rectangular to polar

\[ u_1 = \sqrt{a^2 + b^2} \]
\[ u_2 = \arctan \frac{b}{a} \]

17.10.7 Signal convertors

1) The indication of the specific relation between inputs and outputs may be shown inside the outline.
2) If the digital information is serial, the most significant bit is presented first unless otherwise indicated.

17.10.7.1 Digital to analog converter. General symbol.

17.10.7.2 Analog to digital converter. General symbol.
17.10.7.3 Analog to digital converter that converts the input range 4 mA-20 mA into a 4-bit weighted binary code.

17.10.8 Electronic switches

NOTE — Electronic switches are being considered in connection with binary logic elements. The results of this work may be published as a supplement to IEC Publication 617-12 (1983) [23]. See ANSI/IEEE Std 91-1984 [4].

17.10.8.1 Bidirectional switch (make), general symbol

The analog signal can pass in either direction between \( c \) and \( d \) as long as the digital input \( e \) stands at its defined 1-state.

NOTE — 17.10.8.1A: An arrow may be added to indicate an unidirectional switch (make).

17.10.8.2 EXAMPLE: The analog signal can pass only in the direction indicated by the arrow as long as the digital input \( e \) stands at its defined 1-state.

17.10.8.3 Bidirectional switch (break), general symbol

The analog signal can pass in either direction between \( c \) and \( d \) as long as the digital input \( e \) stands at its defined 0-state.

NOTE — 17.10.8.3A: An arrow may be added to indicate an unidirectional switch (break).

17.10.8.4 EXAMPLE: The analog signal can pass only in the direction indicated by the arrow as long as the digital input \( e \) stands at its defined 0-state.
17.10.8.5 Bidirectional transfer switch operated by the AND function of two digital inputs.

17.10.8.6 Two independent bidirectional switches (one make and one break), both operated by the same binary input.

17.10.9 Coefficient scaler

NOTE — 17.10.9A: The value of the coefficient may be shown adjacent to and outside the outline of the symbol.

20. Communications Equipment

Relocate:

20.3.2 Relocate to 24.2.1

20.3.3 Relocate to 24.2.2

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

21.1 Generating Station

NOTES:

21.1A — Symbols for “planned” applications appear to the left; symbols for “in service” applications appear to the right.
21.1B — The preferred symbol is the square, but if necessary, a rectangle may be used.

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

21.1.1 General

See NOTE 21.1A

Add:

21.1.2 Combined electric and heat generating station

Revise to read as follows:

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

21.3.4 Nuclear-energy fueled
21.3.5 Geothermic

Add:

21.3.6 Solar generating station

Revise to read as follows:

21.4 Prime Mover (qualifying symbols)

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

See NOTE 21.1A

21.4.1 Gas turbine

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

21.4.2 Reciprocating engine
21.4.2.1 Application: shown for oil- or gas-fueled generation station

![Diagram of oil- or gas-fueled generation station]

21.5 Substation

See NOTE 21.1A

21.5.1 General

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

![Diagram of general substation]

21.5.2 Rectifier substation

Use if essential to show type of equipment.

![Diagram of rectifier substation]

Add:

21.5.3 Converting substation, dc to ac shown

![Diagram of converting substation]

21.6 Wind Generating Station

![Diagram of wind generating station]
21.7 Plasma Generating Station MHD (magneto-hydrodynamic)

24. Telecommunications Switching and Peripheral Equipment

24.1 Switching Systems

The symbols in this section may be used to represent switching systems without regard to the type of equipment used as shown in the examples of trunking diagrams in the Appendix to this section.

The following terms are used in this section with the meaning as given below.

Connecting stage:

An arrangement of inlets and outlets so that only one switching point is used to connect one inlet to an outlet. A number of connections may exist at any time in one connecting stage.

Marking stage:

In a common-control system, that sequence of connecting stages that is controlled by one marking process. A marking stage may consist of one or more connecting stages.

Switching stage:

A sequence of connecting stages that jointly perform a specified switching function, for example preselection or route selection.

Highway-group:

The maximum number of circuits that have access to one highway.

24.1.1 Connecting stage

24.1.1.1

Connecting stage, shown with inlets and outlets, general symbol
Circuits on one side can be connected individually to circuits on the other side

![Diagram](image1)

**24.1.1.2** Connecting stage with \( x \) inlets and \( y \) outlets

![Diagram](image2)

**24.1.1.3** Connecting stage composed of \( z \) grading groups, each consisting of \( x \) inlets and \( y \) outlets

![Diagram](image3)

**24.1.1.4** Connecting stage with one group of inlets and two groups of outlets

NOTE — 24.1.1.4A: The number of inlets or outlets in each group may be indicated by a figure on the relevant line.

![Diagram](image4)

**24.1.1.5** Connecting stage interconnecting one group of bothway trunks with two groups of unidirectional trunks of opposite sense

![Diagram](image5)

**24.1.2** Marking stage

**24.1.2.1** Marking stage consisting of only one connecting stage

NOTE — 24.1.2.1A: The qualifying symbol indicating a marking stage is a dot. It should be added to the inlets of the first connecting stage and to the outlets of the last connecting stage of that marking stage.
24.1.2.2 EXAMPLES: Marking stage consisting of three connecting stages

24.1.2.3 Mixed marking stage consisting of one, two, and three connecting stages

24.1.3 Switching stage

24.1.3.1 Switching stage consisting of one connecting stage

NOTE — 24.1.3.1A: The qualifying symbol indicating a switching stage is an arc. It should be added to the inlets of the first connecting stage and to the outlets of the last connecting stage of that switching stage.

24.1.3.2 EXAMPLES: Switching stage consisting of three connecting stages

24.1.3.3 Mixed switching stage consisting of one, two, and three connecting stages

24.1.4 Examples of trunking diagrams

24.1.4.1 Trunking diagram for a switching system that consists of two marking stages, ABC or ABCD and E, EF or EFG, interconnected by other equipment represented by the squares. Calls are routed as follows:

1) Incoming calls by way of DCBA
2) Calls between subscribers connected to the same exchange by way of ABC, EF, and CBA
3) Outgoing calls by way of ABC and either E, EF, or EFG
24.1.4.2 Trunking diagram of a switching system showing three switching stages

1) Preselection stage A
2) Route selection stage B or BC
3) Final selection stage D

Other equipment not concerned with switching
24.2 Block Symbols for Switching Equipment

24.2.1 Automatic switching*

![Automatic switching symbol]

*Relocated from 20.3.2

24.2.2 Manual switchboard*

![Manual switchboard symbol]

*Relocated from 20.3.3

24.3 Qualifying Symbols for Transducers, Recorders, and Reproducers

24.3.1 Magnetic type

![Magnetic type symbol]

24.3.2 Moving coil or ribbon type

![Moving coil or ribbon type symbol]

24.3.3 Moving iron type

![Moving iron type symbol]

24.3.4 Stereo type

![Stereo type symbol]

24.3.5 Disc type

![Disc type symbol]
24.3.6 Tape or film type

24.3.7 Drum type

24.3.8 Recording or reproducing (the arrow points in the direction of energy transfer)

24.3.9 Recording and reproducing

24.3.10 Erasing

24.4 Recorders and Reproducers

24.4.1 Recorder or reproducer, or both, general symbol

NOTE — 24.4.1A: The qualifying symbol depicting a transducer head may be replaced by other qualifying symbols.

24.4.1.1 EXAMPLE: Recorder and reproducer, magnetic drum type
24.4.2 Reproducer with a stylus operated head

24.4.3 Recorder, film-type, with a head producing modulated light

24.4.4 Reproducer, disc-type, with a light-operated head

25. Telecommunications Transmission

25.1 Amplified Circuits

25.1.1 Two-wire line with unidirectional amplification

25.1.2 Two-wire line with both-way amplification
25.1.3 Four-wire circuit with both-way amplification

\[\text{Diagram of four-wire circuit with both-way amplification}\]

25.1.4 Four-wire type circuit with frequency separation

\[\text{Diagram of four-wire type circuit with frequency separation}\]

25.1.5 Four-wire circuit with both-way terminal amplification with echo suppression

\[\text{Diagram of four-wire circuit with both-way terminal amplification with echo suppression}\]

25.2 Qualifying Symbols for Pulse Modulation

25.2.1 Pulse-position or pulse-phase modulation

\[\text{Diagram of pulse-position or pulse-phase modulation}\]

25.2.2 Pulse-frequency modulation

\[\text{Diagram of pulse-frequency modulation}\]
25.2.3 Pulse-amplitude modulation

25.2.4 Pulse-interval modulation

25.2.5 Pulse-duration modulation

25.2.6 Pulse-code modulation

NOTE — 25.2.6A: The * must be replaced by details of the code.

25.2.6.1 EXAMPLE: 3-out-of-7 code

25.3 Signal Generator Waveform Generator

25.3.1 Sine-wave generator, 500 Hz
25.3.2 Sawtooth generator, 500 Hz

\[ \text{Sawtooth generator, 500 Hz} \]

25.3.3 Pulse generator

\[ \text{Pulse generator} \]

25.3.4 Variable frequency sine-wave generator

\[ \text{Variable frequency sine-wave generator} \]

25.3.5 Noise generator

\[ k = \text{Boltzmann's constant} \]
\[ T = \text{absolute temperature} \]

\[ \text{Noise generator} \]

25.4 Changers

Converter, General Symbol

\[ \text{Converter, General Symbol} \]

25.4.1 Frequency changer, changing from \( f_1 \) to \( f_2 \)

\[ \text{Frequency changer, changing from } f_1 \text{ to } f_2 \]
25.4.2 Frequency multiplier

25.4.3 Frequency divider

25.4.4 Pulse inverter

25.4.5 Code converter, five-unit binary code to seven-unit binary code

25.4.6 Changer giving clock-time indication in five-unit binary code

25.4.7 Pulse regenerator

25.5 Filters

25.5.1 Filter, general symbol
25.5.2 High-pass filter

25.5.3 Low-pass filter

25.5.4 Band-pass filter

25.5.5 Band-stop filter

25.6 Networks

25.6.1 Device for pre-emphasis of higher frequencies

25.6.2 Device for de-emphasis of higher frequencies

25.6.3 Compressor
25.6.4 Expander

25.6.5 Artificial line

25.6.6 Phase-changing network

NOTE — $\phi$ may be replaced by $B$ if no confusion arises

*Coordinate with symbol 15.17

25.6.7 Distortion corrector, general symbol

25.6.8 Amplitude/frequency distortion corrector, for example, equalizer

25.6.9 Phase/frequency distortion corrector

NOTE — 25.6.9A: If it is desirable to indicate that the equalization refers to the time derivative of $\phi$, $\phi$ may be replaced by $\Phi$. 
25.6.10 Delay/frequency distortion corrector

![Delay/frequency distortion corrector diagram]

25.6.11 Nondistorting amplitude controller

![Nondistorting amplitude controller diagram]

25.6.12 Mixing network

![Mixing network diagram]

25.7 Electronic Chopping Device

![Electronic Chopping Device diagram]

25.8 Threshold Devices

There are two ways of showing details of the operation carried out by a threshold device. The first is the use of the symbol 25.8.1 supplemented by appropriate waveform symbols on the input and output lines. The second is the use of a specific symbol consisting of a rectangle containing a figure derived from the input/output characteristic in the following manner:

The axes are deleted, but the origin is indicated by a short vertical stroke representing the y-axis.

EXAMPLE:

![Threshold device example]

The origin may be located in the rectangle in such a position that the characteristic makes the maximum use of the available space.
EXAMPLE:

![Threshold device, type unspecified (for example clipper)](image1)

**25.8.1** Threshold device, type unspecified (for example clipper)

![Device having a linear input/output characteristic for all signals that exceed a given threshold value and which has no output for input signals having an instantaneous amplitude between zero and that threshold](image2)

**25.8.2** Device having a linear input/output characteristic for all signals that exceed a given threshold value and which has no output for input signals having an instantaneous amplitude between zero and that threshold

![Device having a linear input/output characteristic for all signals that exceed a preset threshold value and that has no output for input signals having an instantaneous amplitude between zero and that threshold](image3)

**25.8.3** Device having a linear input/output characteristic for all signals that exceed a preset threshold value and that has no output for input signals having an instantaneous amplitude between zero and that threshold

![Positive peak clipper](image4)

**25.8.4** Positive peak clipper

![Negative peak clipper](image5)

**25.8.5** Negative peak clipper
25.9 Terminating Sets

25.9.1 Terminating set

25.9.2 Balancing network

25.9.3 Terminating set with balancing network

25.9.4 Hybrid transformer

25.9.5 Asymmetric (skew) hybrid transformer, shown with balancing network
25.9.6 Equipment for connecting a four-wire circuit to either a two-wire circuit or a four-wire circuit depending upon the reception of a control signal

![Diagram of equipment for connecting a four-wire circuit to either a two-wire circuit or a four-wire circuit depending upon the reception of a control signal.]

25.10 Modulator
Demodulator
Discriminator

25.10.1 General symbol

![Diagram of general symbol for modulator, demodulator, and discriminator.]

NOTE — 25.10.1A: This symbol is used as follows: (Letters and input and output lines have been added in the figure for the purpose of explanation.)

![Diagram showing input and output connections for the general symbol.]

a and b represent the modulating or modulated signal input and the modulated or demodulated signal output

c represents the input of the carrier-wave if required

Qualifying symbols may be placed inside or outside the symbol as shown below

25.10.1.1 Modulator, double side-band output

![Diagram of modulator, double side-band output.]

25.10.1.2 Pulse code modulator (seven-unit binary code output)

![Diagram of pulse code modulator (seven-unit binary code output).]
25.10.2 Demodulator, single side-band with suppressed carrier to audio

![Demodulator Symbol]

25.11 Concentrators Multiplexers

25.11.1 Concentrating switching function from left to right, qualifying symbol

![Concentrator Symbol]

25.11.2 Expanding switching function from left to right, qualifying symbol

![Multiplexer Symbol]

25.11.3 *EXAMPLES:* Concentrator with m input circuits and n output circuits

![Concentrator Example]

25.11.4 Multiplexing function, qualifying symbol

![Multiplexing Symbol]

25.11.5 Demultiplexing function, qualifying symbol

NOTE — 25.11.5A: If confusion can arise, DX may be replaced by DMUX.
25.11.6 Multiplexing and demultiplexing function, qualifying symbol

![Multiplexing and demultiplexing symbol](image)

25.11.7 Multiplexer with analog/digital conversion

![Multiplexer symbol](image)

25.11.8 Multiplexer/demultiplexer with analog/digital conversion

![Multiplexer/demultiplexer symbol](image)

25.12 Frequency Spectrum Diagram Symbol Elements

A frequency spectrum is represented on a diagram by means of symbols on a horizontal frequency axis. The symbols show the functions of the various frequencies and frequency bands used in the transmission system as well as their relative positions in the spectrum.

25.12.1 Carrier frequency

NOTES:

25.12.1A — When this symbol is used to represent a carrier that is modulated in frequency or phase the $f$ or $\varphi$ is added. See, for example, symbol 25.13.2.

25.12.1B — The arrowhead on the vertical line representing the carrier (and the arrowhead on the frequency axis) may be omitted if no confusion will result.

![Carrier frequency symbol](image)

25.12.1.1 Suppressed-carrier frequency

![Suppressed-carrier frequency symbol](image)
25.12.1.2 Reduced-carrier frequency

25.12.2 Pilot frequency

NOTE — 25.12.2A: For FDM transmission systems the order of the group to which the pilot refers, that is, group, supergroup, mastergroup, or supermastergroup may be indicated by adding the respective number 1, 2, 3, or 4 of oblique strokes.

EXAMPLE: Supergroup pilot frequency

25.12.2.1

25.12.2.2 Suppressed pilot frequency

25.12.3 Additional measuring frequency

25.12.3.1 Additional measuring frequency, transmitted or measured on request
25.12.4 Signaling frequency

![Signaling frequency diagram]

25.12.5 Frequency band

NOTES:

25.12.5A — If it is desired to show whether a particular band of frequencies is erect or inverted, symbol 25.12.6 or 25.12.7 should be used.

25.12.5B — The order of a band of frequencies forming part of a transmission system may be indicated by adding oblique strokes according to NOTE 25.12.2A of symbol 25.12.2.

![Frequency band diagram]

24.12.5.1 EXAMPLE: Mastergroup

NOTE — 25.12.5.1A: The division of a band into channels, groups, etc, may be shown by adding vertical lines.

![Mastergroup diagram]

25.12.5.2 EXAMPLE: Band of frequencies from $f_1$ to $f_2$ divided into five channels, groups, etc.

![Band of frequencies diagram]

25.12.6 Erect band of frequencies

NOTES:

25.12.6A — There is no indication of how much of the bandwidth shown by the symbol is actually used.

25.12.6B — This symbol may be used to represent a single channel, group, etc, or a number of channels, groups, etc, providing they are all erect.

![Erect band diagram]
25.12.6.1 *EXAMPLE:* Band of frequencies consisting of a group of 12 erect channels

![](image1)

25.12.6.2

![](image2)

25.12.7 Inverted band of frequencies

NOTE — 25.12.6A and 25.12.6B apply.

![](image3)

25.12.8 Band of mixed channels, groups, etc, some erect, remainder inverted

![](image4)

25.13 Examples of Frequency Spectrum Diagrams

25.13.1 Amplitude-modulated carrier with both sidebands

![](image5)

25.13.2 Phase modulated carrier with both sidebands

NOTE — 25.13.2A: For frequency modulation, replace $\varphi$ with $f$.

![](image6)
25.13.3 Amplitude-modulated carrier with both sidebands, lower modulating frequencies not being transmitted

![Diagram](image1)

25.13.4 Amplitude-modulated carrier with both sidebands, modulating frequencies down to zero being transmitted

![Diagram](image2)

25.13.5 Single-sideband suppressed carrier

![Diagram](image3)

25.13.6 Reduced-carrier with single, lower, erect sideband

![Diagram](image4)

25.13.7 Suppressed-carrier with single-sideband scrambled for secrecy

![Diagram](image5)

25.13.8 Amplitude-modulated carrier with upper sideband and lower vestigial sideband, modulating frequencies down to zero being transmitted

![Diagram](image6)
25.13.9 Band of five channels, groups, etc, four of which are inverted and one erect

25.13.10 4 MHz transmission system showing supergroups and pilot frequencies

25.14 Fiber Optic Devices

25.14.1 Guided light transmitter

25.14.2 Guided light receiver
Acceptance Notice

This non-Government standard was adopted on 24 December, 1986, and is approved for use by the DoD. The indicated industry group has furnished the clearance required by existing regulations. Copies of the document are stocked by DoD Single Stock Point, Naval Publications and Forms Center, Philadelphia, PA 19120, for issue to DoD activities only. Contractors and industry groups must obtain copies directly from the Institute of Electrical and Electronics Engineers, Inc, 345 East 47th Street, New York, NY 10017.

Title of Document: IEEE Standard
Supplement to Graphic Symbols for Electrical and Electronics Diagrams
Date of Specific Issue Adopted: 12 September, 1986
Releasing Industry Group: The Institute of Electrical and Electronics Engineers, Inc
Custodians:
Army — AR
Navy — SH
Air Force — 16
Military Coordinating Activity:
Army — AR
Project DRPR-0285
Review Activities:
Army — AV, ER, CR
Navy — AS, OS, YD
User Activities:
Army — ME, MI
Navy — EC, MC

NOTICE: When reaffirmation, amendment, revision, or cancellation of this standard is proposed, the industry group responsible for this standard shall inform the military coordinating activity of the requested change and request participation.