NEMA Standards Publication ICS 19-2002

Industrial Control and Systems:
Diagrams, Device Designations, and Symbols

Published by

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

www.nema.org

© Copyright 2002 by the National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, expressed or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfil any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety–related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

--`,,`-`-`,,`,,`,`,,`---

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

CONTENTS

Foreword ii
1 GENERAL INFORMATION 1
1.1 Scope 1
1.2 Definitions 1
2 DIAGRAM AND DRAWING IDENTIFICATION 2
2.1 General 2
2.2 Types of Diagrams or Drawings 2
2.3 Forms of Diagrams or Drawings 3
2.4 Other Drawings 3
3 WIRELESS CONNECTION DIAGRAMS 3
3.1 Symbols 3
3.2 Physical Arrangement 3
3.3 Device Designations 3
3.4 Terminal Markings 3
3.5 Control-Circuit Connections 3
3.6 Power-Circuit Connections 4
4 DESIGNATIONS 4
4.1 Device 4
4.2 Coil and Contact 4
5 GRAPHIC SYMBOLS 4
5.1 Definition and Use 4
5.2 Symbol Principles 4
5.3 Uniformly Shaped Symbols 5
5.4 Organization of Symbols 5
6 TERMINAL MARKINGS 5
7 SOLID-STATE ELEMENTS OR DEVICES 6
TABLES
1 Device Designations 7
2 Coil and Contact Designations 8
FIGURES
1 Example Wireless Diagram 9
2 Uniformly Shaped Symbols 11
3 Graphic Symbols 12

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Foreword

This Standards Publication was prepared by a technical committee of the NEMA Industrial Automation Control Products and Systems Section. It was approved in accordance with the bylaws of NEMA and supersedes the indicated NEMA Standards Publication. This Standards Publication contains the information that was previously located in Clause 9 of ICS 1-1993, *General Requirements*, and is now being published separately as an informational guide.

To continue to serve the best interests of users of Industrial Control and Systems equipment, the Industrial Automation Control Products and Systems Section is actively cooperating with other standardization organizations in the development of simple and more universal metrology practices. In this publication, the U.S. customary units are gradually being supplemented by those of the modernized metric system known as the International Systems of Units (SI). This transition involves no changes in standard dimensions, tolerances, or performance specifications.

NEMA Standards Publications are subject to periodic review. They are revised frequently to reflect user input and to meet changing conditions and technical progress. Proposed revisions to this Standards Publication should be submitted to:

Vice President, Engineering Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

This standards publication was developed by the Industrial Automation Control Products and Systems Section. Section Approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Section was composed of the following members:

ABB Control, Inc.—Wichita Falls, TX
Alstom Power Conversion—Pittsburgh, PA
Automatic Switch Company—Florham Park, NJ
Balluff, Inc.—Florence, KY
Carlo Gavazzi, Inc.—Buffalo Grove, IL
CMC Torque Converters—Billerica, MA
Control Concepts Corp—Beaver, PA
Cooper Bussman—St. Louis, MO
Cummins, Inc.—Minneapolis, MN
Cyberex LLC—Richmond, VA
Eaton Corporation—Milwaukee, WI
Electro Switch Corporation—Weymouth, MA
Emerson Process Management—Austin, TX
Entrelec, Inc.—Irving, TX
GE Industrial Systems—Plainville, CT
Hubbell Incorporated—Madison, OH
Joslyn Clark Controls, Inc.—Lancaster, SC
Lexington Switch & Controls—Madison, OH
Lincoln Electric—Cleveland, OH
Master Controls Systems, Inc.—Lake Bluff, IL
Metron, Inc.—Denver, CO
Mitsubishi Electric Automation, Inc.—Vernon Hills, IL
Moeller Electric Corporation—Franklin, MA

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Omron Electronics LLC—Schaumburg, IL
Peerless-Winsmith, Inc.—Warren, OH
Pepperl & Fuchs, Inc.—Twinsburg, OH
Phoenix Contact, Inc.—Harrisburg, PA
Pittman, Division of Penn Engineering and Mfg. Corp.—Harleysvile, PA
Post Glover Resistors, Inc.—Erlanger, KY
R. Stahl, Inc.—Woburn, MA
Reliance Controls Corp.—Racine, WI
Robert Bosch Corp.—Avon, CT
Rockwell Automation—Milwaukee, WI
Russelectric, Inc.—Hinngham, MA
Schneider Automation, Inc.—North Andover, MA
SEW-Eurodrive, Inc.—Lyman, SC
Siemens Corporate Research—Princeton, NJ
Siemens Energy & Automation, Inc.—Duluth, GA
Square D Company—Raleigh, NC
Texas Instruments, Inc.—Attleboro, MA
Torna Tech, Inc.—St. Laurent, QC, Canada
Toshiba International Corporation—Houston, TX
Total Control Products, Inc.—Addison, TX
Tyco Electronics/AMP—Harrisburg, PA
WAGO Corp.—Germantown, WI
Weidermuller, Inc.—Richmond, VA
Yaskawa Electric America, Inc.—Waukegan, IL

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

< This page is intentionally left blank. >

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Guide For Diagrams, Devices Designations, and Symbols for Industrial Controls and Systems

1 GENERAL INFORMATION

1.1 Scope

The scope of this document is to provide guidelines for representation of devices on diagrams and drawings in a standardized manner.

1.2 Definitions

block diagram: A diagram made up of a group of interconnected blocks, each of which represents a device or subsystem.

connection diagram: See wiring diagram.

construction diagram: A diagram that shows the physical arrangement of parts, such as wiring, buses, resistor units, etc.

Example: A diagram showing the arrangement of grids and terminals in a grid-type resistor.

control sequence diagram: A portrayal of the contact positions or connections that are made for each successive step of the control action.

control system diagram: A conceptual diagram of the functional interrelationship of subsystems, usually in block form that does not include the process equipment or details of circuits and device elements.

controller diagram: A diagram that shows the electrical connections between the parts comprising the controller and that shows electrical connections.

dimension drawing; outline drawing: A drawing (base plan, floor plan, etc) which shows the physical space and mounting requirements of a piece of equipment.

It shall be permitted to also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

graphic symbol: Symbols 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 device designations.

interconnection diagram: A diagram that shows only the external connections between controllers and associated machinery and equipment.

one-line diagram; single-line diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electrical circuit or circuits and the component devices or parts used therein. Physical relationships are usually disregarded.

process diagram; flow diagram: A conceptual diagram of the functional interrelationship of subsystems in block or pictorial form that shows process equipment such as machinery for proper understanding.

schematic diagram; elementary diagram: A diagram that shows all circuits and device elements of an equipment and its associated apparatus or any clearly defined functional portion thereof.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Such diagram emphasizes the device elements of a circuit and their functions as distinguished from the physical arrangement of the contactors, devices or elements of a circuit system.

Circuits that function in a definite sequence are arranged to indicate that sequence.

single-line diagram: See one-line diagram.

wiring diagram; connection diagram: A diagram that locates and identifies electrical devices, terminals, and interconnecting wiring in an assembly.

A wiring diagram may be:

In a form showing interconnecting wiring by lines or indicating interconnecting wiring only by terminal designations (wireless diagram), or a panel layout diagram showing the physical location of devices plus:

a) The elementary wiring diagram, or
b) A wiring table, or
c) A computer wiring chart, or
d) A machine command tape or cards

The term does not include mechanical drawings, commonly referred to as wiring templates, wiring assemblies, cable assemblies, etc.

wireless connection diagram: A diagram that shows the general physical arrangement of devices in a control equipment and connections between these devices, terminals, and terminal boards for outgoing connections to external apparatus.

Connections are shown in tabular form and not by lines. An elementary (or schematic) diagram may be included in the connection diagram.

2 DIAGRAM AND DRAWING IDENTIFICATION

2.1 General

Diagrams and drawings shall be identified by one of the titles shown in Types of Diagrams or Drawings or by a combination of titles from Types of Diagrams or Drawings and titles from Forms of Diagrams or Drawings, where applicable, but not solely by the titles given in Forms of Diagrams or Drawings.

2.2 Types of Diagrams or Drawings

Diagrams or drawings shall be permitted to be one of the following types:

a) Wiring or connection diagram
b) Construction diagram
c) Control sequence diagram
d) Control system diagram
e) Controller diagram
f) Dimension or outline drawing
g) Illustrative diagram
h) Interconnection diagram
i) Logic diagram

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

j) Process or flow diagram

k) Schematic or elementary diagram

l) Wireless connection

2.3 Forms of Diagrams or Drawings

Diagrams or drawings shall be permitted to take one or a combination of the following forms:

a) Block diagram

b) Logic diagram

c) One-line or single line diagram

2.4 Other Drawings

There may be additional drawings, such as conduit layout drawings, foundation drawings, etc.

3 WIRELESS CONNECTION DIAGRAMS

3.1 Symbols

Symbols for the devices shown in wireless connection diagrams shall be in accordance with Graphic Symbols found thereafter. Detailed device symbols shall be made up to represent the physical arrangement of the main component parts and of the terminals to which connections are made.

3.2 Physical Arrangement

The physical arrangement of devices in a wireless connection diagram shall correspond to the physical arrangement of the equipment. Physical groupings comprising control panel sections, auxiliary panels, sub-panels, overhead racks, resistor compartments, and the like shall be so indicated and marked. See Figure 1 for an example of a wireless connection diagram.

3.3 Device Designations

Each device in an equipment to which a connection is made shall be assigned a device designation which shall be in accordance with the requirements found in the Designations section. These designations shall be distinct and there shall be no duplication of designations for the devices in any connection diagram. All designations shall correspond to those used in the elementary diagram.

3.4 Terminal Markings

Each terminal of a device to which a connection is to be made shall be assigned a distinct terminal marking. This marking shall correspond to the one used in the elementary diagram for designating the same circuit.

3.5 Control-Circuit Connections

Control-circuit connections shall be listed in the form of a wire table that shall consist of a single continuous column. This table shall list the circuit (terminal) numbers in numerical or alphabetical order, or both. Opposite each circuit (terminal) number shall be listed the designations of the devices to which the circuit will be connected. Short connections between terminals of the same device or between points on a terminal board are sometimes drawn as lines.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

3.6 Power-Circuit Connections

Power-circuit connections shall be drawn completely by lines or shall be included in a wire table.

4 DESIGNATIONS

4.1 Device

Device designations are intended for use on diagrams in connection with graphic symbols to indicate the function of the particular device. Device designations are based on the assignment of a letter or letters to each of the fundamental functions performed by the component devices of a complete control equipment. Suitable prefix numbers or letters, or both, and suffix letters may be added to the basic device designations to discriminate between devices performing similar functions.

Where two or more basic device designations are combined, the function designation is normally given first. For example, the first control relay initiating a jog function is designated ”1JCR.”

Device designations are given in alphabetical order in Table 1. Where alternate designations are shown, care shall be taken not to use the same designation for different kinds of devices on the same drawing.

Prefix numbers are used with device designations to distinguish two or more devices having the same function. These numbers are assigned in an orderly fashion in agreement with the order of the relaying or switching or functional sequence, where possible.

4.2 Coil and Contact

Table 2 shows the designation used to identify the functions of coils and contacts on complex devices. They are not a part of the device designation. Where used in connection with a device designation, the two designations shall be separated by hyphen, parenthesis, or suitable means.

5 GRAPHIC SYMBOLS

5.1 Definition and Use

Graphic symbols are a shorthand means of showing graphically the functioning or interconnections of a circuit. They are used on schematic, one-line, or wiring diagrams. Graphic symbols are correlated with parts lists, descriptions, or instructions by means of device designation. See Table 1.

5.2 Symbol Principles

The graphic symbols given in Figure 3 are in general use on industrial control diagrams. Symbols not readily recognizable have been excluded. Other symbols may be used on industrial control diagrams provided a suitable explanation is given to their meaning.

The orientation of a symbol on a drawing, including a mirror image presentation, does not alter the meaning of the symbol.

The width of a line does not affect the meaning of the symbol. A wider line may be used for emphasis or for power wiring in contrast to control wiring.

The symbols shown in Figure 3 are in their correct relative size; they were prepared on a 2.54 mm (0.10 inch) grid basis. A symbol may be drawn to any proportional size that suits a particular drawing, depending on the reduction or enlargement anticipated.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Where polarity marks are used, the sign + is positive and the sign – is negative.

The arrowhead or triangle of a symbol may be closed or open unless noted.

The symbol for a terminal may be added to each point of attachment of conductors to any one of the symbols, but such added terminal symbols shall not be considered to be part of the individual graphic symbol itself. The use of terminal symbols on all diagrams is optional.

DO NOT SHOW TERMINALS ON ELEMENTARY DIAGRAMS UNLESS THOSE TERMINALS ARE ACCESSIBLE TO THE CUSTOMER.

On a schematic diagram, parts of a symbol for a device, such as a relay, contactor, or transformer, may be separated. Each of the parts of the device then must carry the same designation.

In general, the angle at which a connecting line is brought to a symbol has no particular significance unless otherwise noted.

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

– – – – – – – – – – – – – – – –

An enclosure of a device or panel outline may be shown on a wiring or interconnection diagram as a solid line or a series of long dashes. A pictorial representation may be used as an alternate for any of the wiring and interconnection diagram symbols shown in this standard.

5.3 Uniformly Shaped Symbols

Rather than create new distinctively shaped symbols for new devices, a uniformly shaped symbol shall be used. The uniformly shaped symbol shall also be permitted to be used as an alternate for any distinctively shaped symbol shown in this standard. The uniformly shaped symbol is a rectangle, properly labeled at the top to designate the type of device it represents and at the bottom to identify the device in a particular circuit. Terminal identification shall be immediately outside the rectangle. Examples to illustrate the use of uniformly shaped symbols are shown in Figure 2.

5.4 Organization of Symbols

The symbols shown in Figure 3 are given in alphabetical order and are in general agreement with American National Standards.

The wiring diagram symbols for any device will consist of the basic NEMA Standard symbols arranged to represent the particular device and will vary with the manufacturer.

Where more than one symbol is shown, the first one shown is to be preferred. The symbols, arranged in two columns from left to right, are:

a) For use on schematic or elementary diagrams

b) For use on wiring or interconnecting diagrams

6 TERMINAL MARKINGS

Terminal markings used on connection diagrams for designating connections shall conform to those shown in the applicable standards of ICS2.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

7 SOLID-STATE ELEMENTS OR DEVICES

A diamond surrounding a symbol indicates a solid-state device which has the same function as the electromechanical device represented by the symbol without the diamond. These symbols are intended primarily for use on control-circuit diagrams along with electromechanical devices. It is recommended that when the diamond is used for this purpose, an explanation of its meaning be stated on the diagram. A uniformly shaped symbol with a description or a complete circuit of the device may be used where preferred.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 1
DEVICE DESIGNATIONS

Device or Function	Designation
Accelerating	A
Ammeter	AM
Braking	B
Capacitor, Capacitance	C or CAP
Circuit breaker	CB
Control relay	CR
Current transformer	CT
Demand meter	DM
Diode	D
Disconnect switch	DS or DISC
Dynamic braking	DB
Field accelerating	FA
Field contactor	FC
Field decelerating	FD
Field-loss	FL
Forward	F or FWD
Frequency meter	FM
Fuse	FU
Ground protective	GP
Hoist	H
Jog	J
Limit switch	LS
Lower	L
Main contactor	M
Master control relay	MCR
Master switch	MS
Overcurrent	OC
Overload	OL
Overvoltage	OV
Plugging or potentiometer	P
Power factor meter	PFM
Pressure switch	PS
Pushbutton	PB
Reactor, reactance	X
Rectifier	REC
Resistor, resistance	R or RES
Reverse	REV
Rheostat	RH
Selector switch	SS
Silicon controlled rectifier	SCR
Solenoid valve	SV
Squirrel cage	SC
Starting contactor	S
Supressor	SU
Tachometer generator	TACH
Terminal block or board	TB
Time-delay relay	TR
Transformater	T
Transistor	Q
Undervoltage	UV
Voltmeter	VM
Watthour meter	WHM
Wattmeter	WM

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 2
COIL AND CONTACT DESIGNATIONS

Function	Designation
Closing coil	CC
Holding coil	HC
Latch coil	LC
Time-delay closing contacts	TC or TDC
Time-delay opening contacts	TO or TDO
Trip coil	TC
Unlatch coil	ULC

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

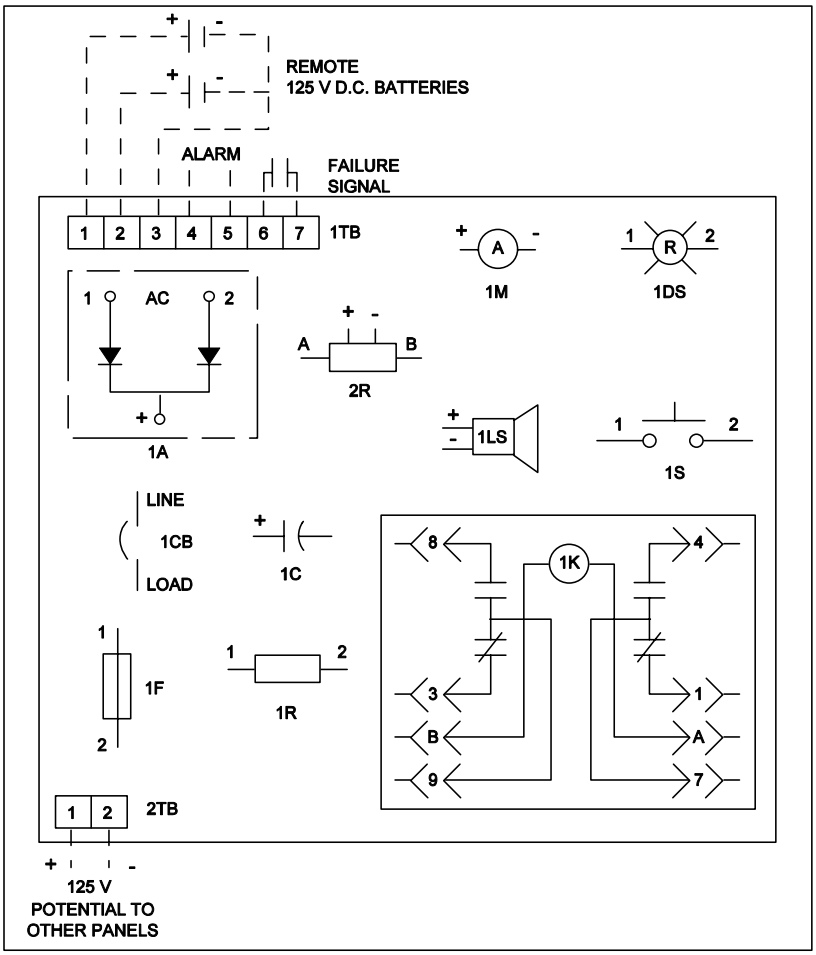


Figure 1
EXAMPLE WIRELESS DIAGRAM

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Wire Run List		
Wire Number	**Connect to**	
1	1TB-1	1A-AC1
2	1TB-2	1A-AC2
3	1TB-3	2TB-2, C1-(⁻), 1K-B, 1LS-(⁻), 1DS-2
4		1A-(+), ICB-Line
5		ICB-Load, 1F-1
6		1F-2, 2R-A, 1C-(+)
7	1TB-4	2R-B, 2TB-1
8		2R-(+), 1M-(+)
9		2R-(⁻), 1M-(⁻)
10	1TB-5	1K-9, 1S-1
11		1K-3, 1R-1
12		1R-2, 1LS-(+)
13		1K-A, 1K-6, 1S-2, 1DS-1
14	1TB-6	1K-4
15	1TB-7	1K-7

Figure 1
EXAMPLE WIRELESS DIAGRAM (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

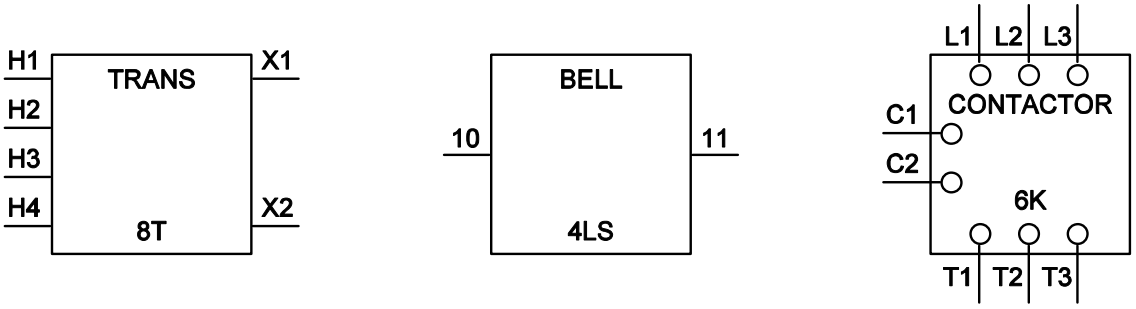


Figure 2
UNIFORMLY SHAPED SYMBOLS

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

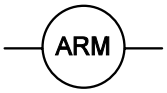
ADJUSTABILITY

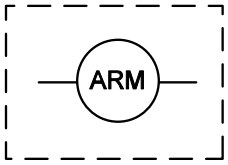
General



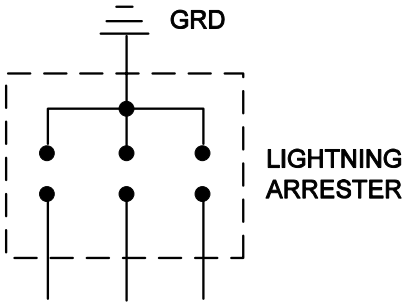
none

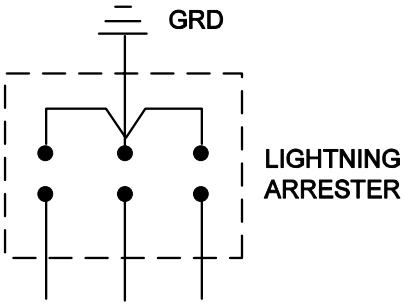
ARMATURE WITH COMMUTATOR AND BRUSHES



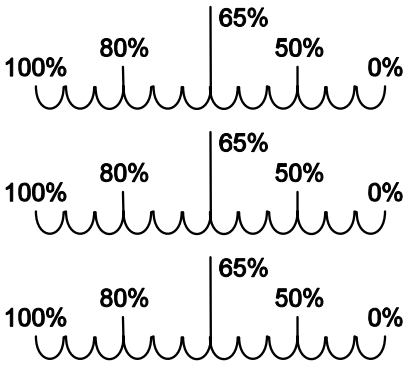


ARRESTER, LIGHTNING





AUTOTRANSFORMER



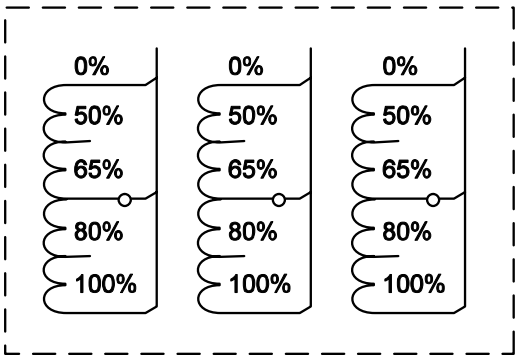


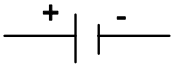
Figure 3
GRAPHIC SYMBOLS

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

BATTERY

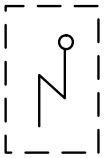
The long line is always positive, but polarity may be indicated in addition.



none

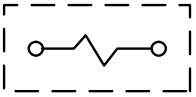
BLOWOUT COIL



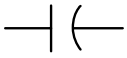


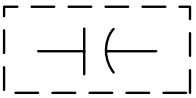
BRAKE COIL





CAPACITOR





CAPACITOR, POLARIZED

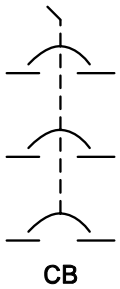
Show polarity of leads, + and/or -.
+ on straight side, - on curved side.

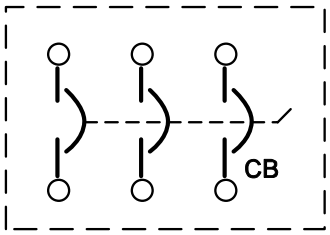
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

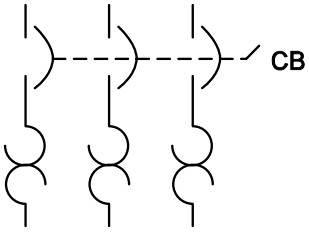
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

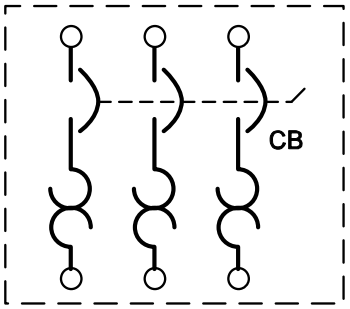
CIRCUIT BREAKER, 3-POLE, NONAUTOMATIC



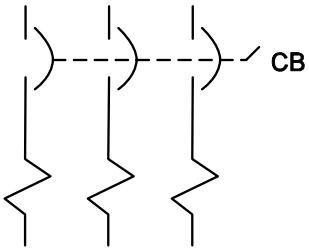


CIRCUIT BREAKER, 3-POLE,
WITH THERMAL TRIP UNITS





CIRCUIT BREAKER, 3-POLE,
WITH ONLY MAGNETIC TRIP UNITS



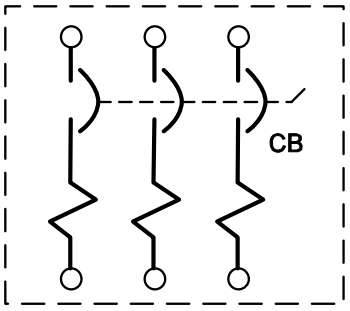
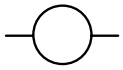


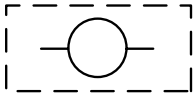
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

COIL, OPERATING





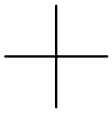
CONDUCTOR, OR CONDUCTIVE PATH

CONTROL

POWER

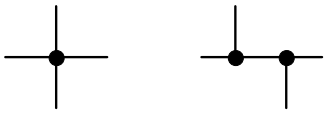
The distinction between power and control wiring is made by using heavy or light lines.

CONDUCTOR, CROSSING OF PATHS OR CONDUCTORS NOT CONNECTED



(NOT APPLICABLE)

CONDUCTOR, JUNCTIONS OF CONNECTED PATHS, CONDUCTORS OR WIRES

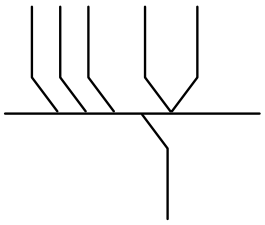


(NOT APPLICABLE)

CONDUCTOR, MULTICONDUCTOR CABLE

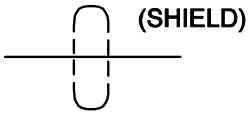
The bend of the line indicates the direction the conductor continues within the cable.

(NOT APPLICABLE)



CONDUCTOR, SHIELDED

Shield may be grounded.
Show polarity of leads, + and/or -.



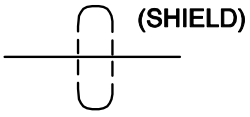


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

CONNECTION, MECHANICAL

CONNECTION, MECHANICAL WITH INTERLOCK





CONNECTOR, DISCONNECTING DEVICE

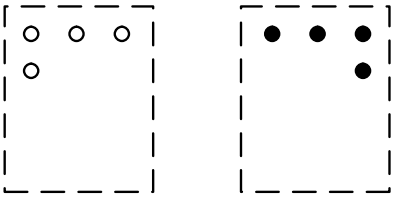
The connector symbol is not an arrowhead. It is larger and the lines are drawn at a 90 degree angle.

CONNECTOR, FEMALE



CONNECTOR, MALE

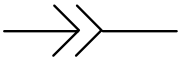




FEMALE (SOCKET) MALE (PLUG)

Number and arrangement of pins should agree with actual type of connector used.

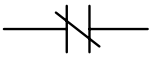
CONNECTOR, SEPARABLE OR JACKS ENGAGED



CONTACT, BASIC ASSEMBLIES

Show a contact 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 any nature, and a 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. Where it is desirable to show contacts in the energized condition or where confusion may result, add a note.

CONTACT, NORMALLY CLOSED



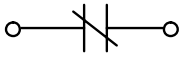


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

CONTACT, BASIC ASSEMBLIES (continued)

CONTACT, NORMALLY OPEN



CONTACT, TRANSFER



CONTACT, TIME DELAY

The point of the arrow indicates the direction of the switch operation in which contact action is delayed. (Time-delay closing contacts and Time-delay opening contacts.)

NORMALLY OPEN WITH TIME DELAY CLOSING (T.C.)



NORMALLY OPEN WITH TIME DELAY OPENING (T.O.)



NORMALLY CLOSED WITH TIME DELAY OPENING (T.O.)



NORMALLY CLOSED WITH TIME DELAY CLOSING (T.C.)



CONTACT, TIME SEQUENTIAL CLOSING



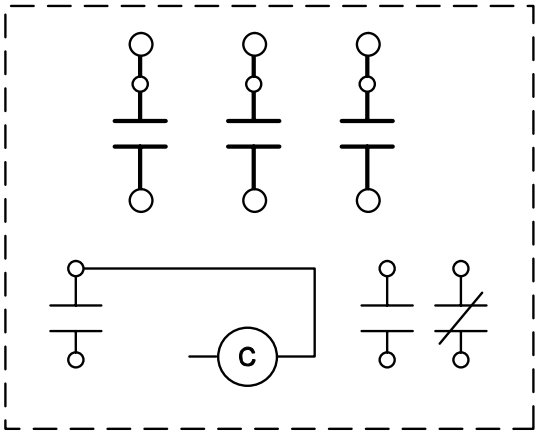
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

CONTACTOR, WITH AUXILIARY CONTACTS

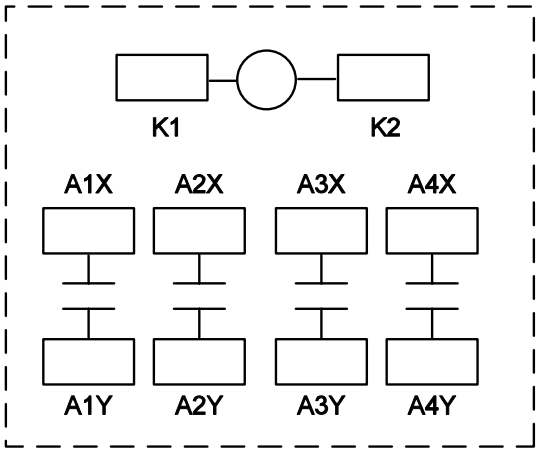
Symbols of contacts and coils shown separately on elementary diagram.



*EXAMPLE

CONTROL RELAY

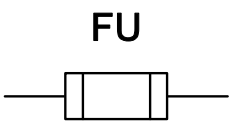
Symbols of contacts and coils shown separately on elementary diagram.



*EXAMPLE

*Example only: symbol varies with device type.

FUSE



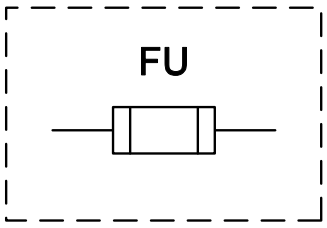


Figure 3
GRAPHIC SYMBOLS (continued)

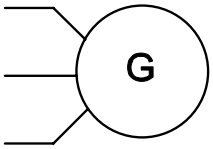
--`,,`-`-`,,`,,`,`,,`---

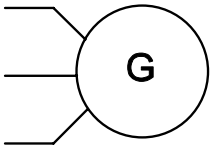
© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

GENERATOR, THREE-PHASE

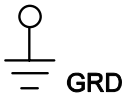




GROUND, CHASSIS OR FRAME

A chassis, bus, or frame connection which is intended to be at earth potential.





A chassis, bus, or frame connection which is may be a substantial potential with respect to the earth or structure in which it is mounted.





Figure 3
GRAPHIC SYMBOLS (continued)

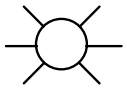
© Copyright 2002 by the National Electrical Manufacturers Association.

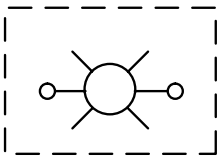
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

LIGHT, INDICATING

(Pilot or Signaling) To indicate characteristic, Insert the specified letter(s) inside the symbol.

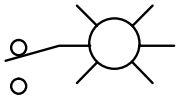
A - Amber
B - Blue
C - Clear
G - Green
NE - Neon
R - Red
W - White
Y - Yellow

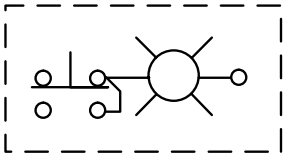




*EXAMPLE

LIGHT, INDICATING, PUSH TO TEST





*EXAMPLE

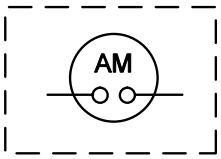
METER (INSTRUMENT)

To indicate the function of the meter or instrument place the specified letter(s) within the symbol.

M - Ammeter
AH - Ampere-Hour
mA - Milliammeter
µA - Microammeter
PF - Power Factor
V - Voltmeter
VA - Volt-Ammeter
VAS - Varmeter
VARH - Varhour meter
W - Wattmeter
WH - Watthour meter



For other functions, use adequate description



*EXAMPLE

Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

MOTION, MECHANICAL

TRANSLATION, ONE DIRECTION



TRANSLATION, BOTH DIRECTIONS



ROTATION, ONE DIRECTION



ROTATION, BOTH DIRECTION



MOTOR, THREE-PHASE, INDUCTION



OVERLOAD RELAY

OVERLOAD RELAY, MAGNETIC

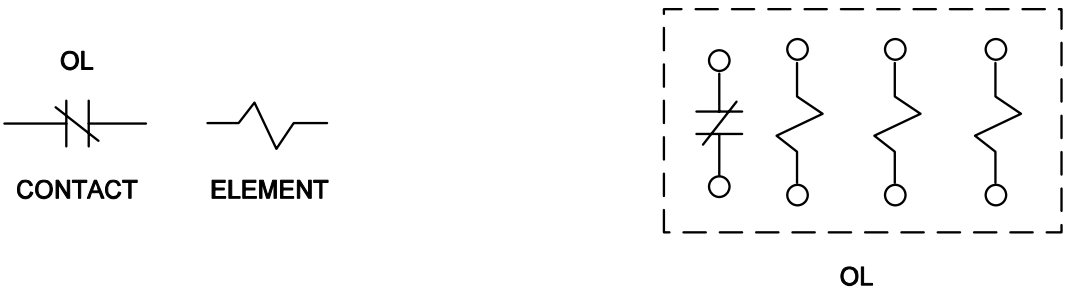


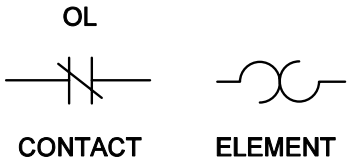
Figure 3
GRAPHIC SYMBOLS (continued)

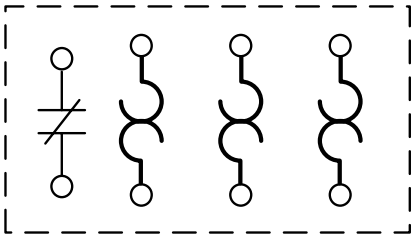
© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

OVERLOAD RELAY (continued)

OVERLOAD RELAY, THERMAL





*EXAMPLE

REACTOR (CORE NOT SPECIFIED)
Polarity may be added to direct current winding.



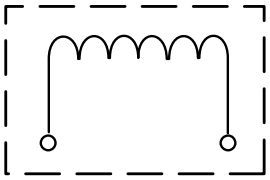


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

REACTOR (MAGNETIC SPECIFIED)

Polarity may be added to direct current winding.



RECTIFIER, GENERAL

Triangle points in direction of forward current as indicated by a dc ammeter. Electron flow is in the opposite direction.

RECTIFIER (SEMICONDUCTOR DIODE)



RECTIFIER, FULL WAVE BRIDGE TYPE

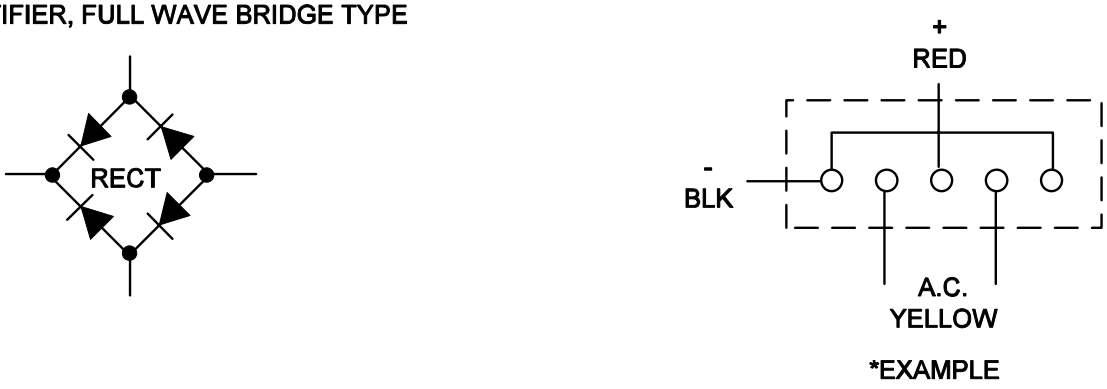


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

RECTIFIER, SILICON CONTROLLED (THYRISTOR)



RESISTOR, FIXED



RESISTOR, ADJUSTABLE (RHEOSTAT)

On elementary diagrams, use arrows or descriptive terms to show change in function.

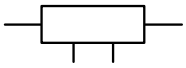


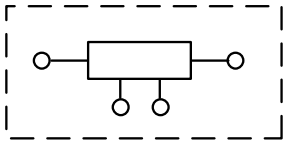
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

RESISTOR, TAPPED





SHIELD, SHIELDING

Used for electrical or magnetic shielding. See "Conductor, Shielded Single or Multiconductor."





SHUNT, INSTRUMENT

Terminals in the rectangle are for the connection of the instrument.

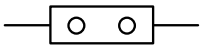


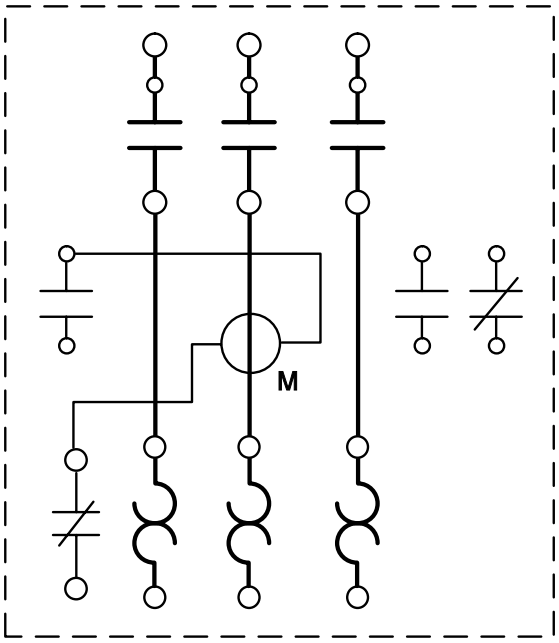


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

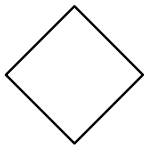
STARTER, WITH AUXILIARY CONTACTS (EXAMPLE)



*EXAMPLE

SOLID-STATE ELEMENTS OR DEVICES

Any circuit symbol enclosed in a diamond denotes a solid-state element or device.



Examples *

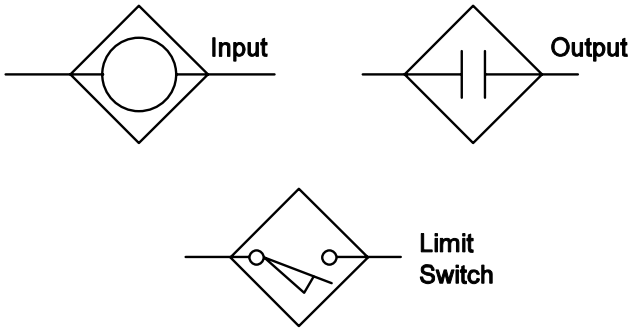


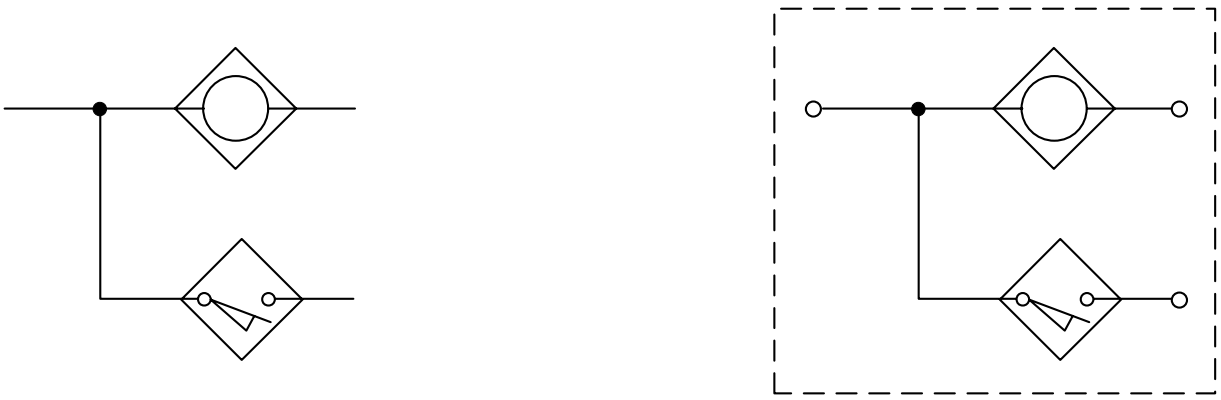
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

SOLID-STATE ELEMENTS OR DEVICES (continued)

When the input(s) and output(s) of solid-state devices are not isolated, enclose complete device in a box. Show connection between input and output.



SWITCH

See also "Contact - Basic assemblies."

SWITCH, DOUBLE THROW



Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

FOOT SWITCH

OPENED BY FOOT PRESSURE



CLOSED BY FOOT PRESSURE



LIMIT SWITCH (POSITION SWITCH)

NORMALLY OPEN



NORMALLY OPEN, HELD CLOSED



NORMALLY CLOSED



NORMALLY CLOSED, HELD OPEN



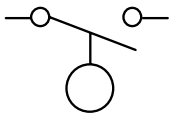
Figure 3
GRAPHIC SYMBOLS (continued)

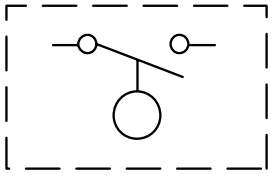
© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

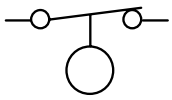
FLOAT SWITCH

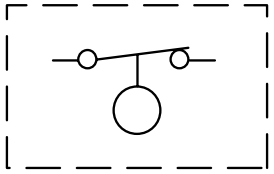
CLOSING ON RISING LEVEL





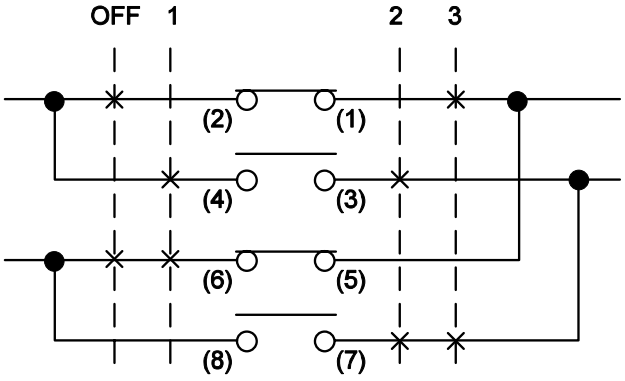
OPENING ON RISING LEVEL

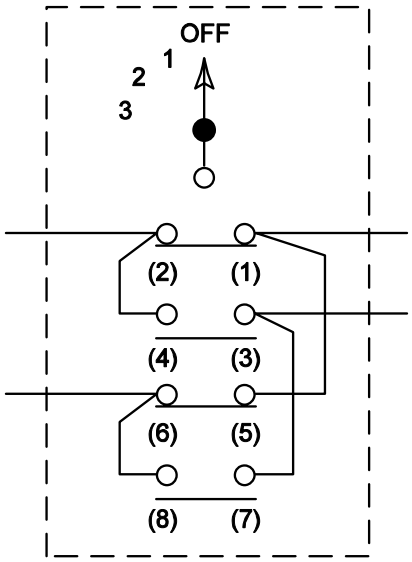




MASTER SWITCH

FOUR POSITIONS
OFF, 1, 2, AND 3





× INDICATES CONTACT CLOSED IN POSITION

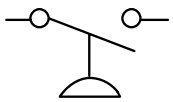
Figure 3
GRAPHIC SYMBOLS (continued)

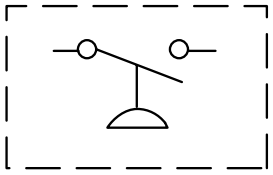
© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

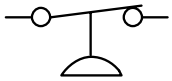
PRESSURE SWITCH

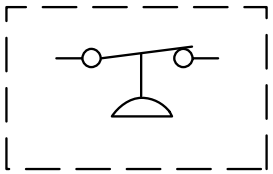
CLOSED BY RISING PRESSURE





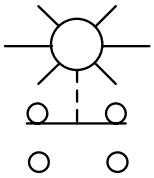
OPENED BY RISING PRESSURE

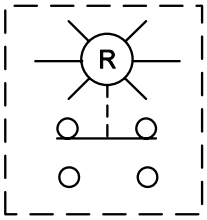




PUSHBUTTON SWITCHES

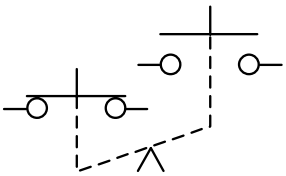
ILLUMINATED

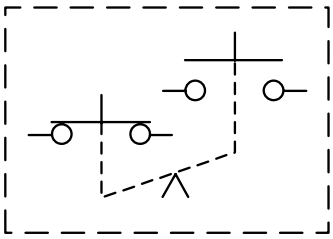




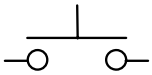
*EXAMPLE

MAINTAINED, TWO CIRCUIT
(Latched or not spring return)





MOMENTARY OR SPRING RETURN,
NORMALLY OPEN CIRCUIT CLOSING-MAKE



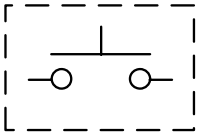
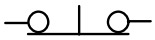


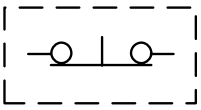
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

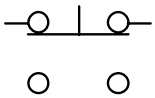
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

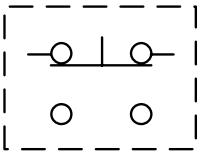
MOMENTARY OR SPRING RETURN,
NORMALLY OPEN AND NORMALLY CLOSED



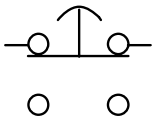


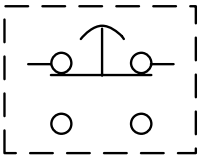
MOMENTARY OR SPRING RETURN,
NORMALLY OPEN AND NORMALLY CLOSED,
DOUBLE CIRCUIT



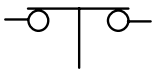


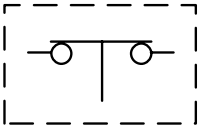
MUSHROOM HEAD
Applied to two circuit pushbutton.





WOBBLE STICK

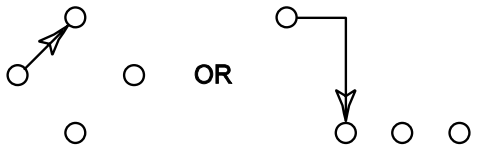




*EXAMPLE ONLY

SELECTOR SWITCHES

NONSHORTING (NONBRIDGING) DURING CONTACT TRANSFER



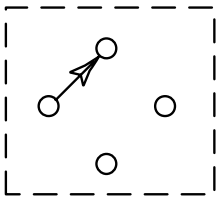
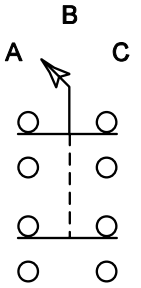


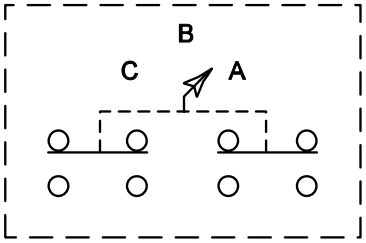
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

WITH PUSHBUTTON TYPE CONTACT MECHANISM

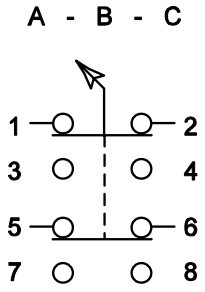




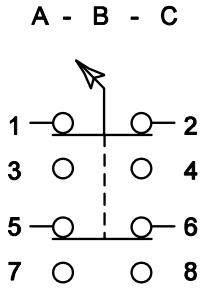
*EXAMPLE

SELECTOR PUSHBUTTON
(Can be pushed or pulled into two or more positions and rotated into two or more positions.)

Show a table of contact operation on the diagram. Point the arrow to the position designator which identifies the position in which the contacts are shown when the button is in the normal mode.



CONTACTS	SELECTOR POSITION								
	A			B			C		
	BUTTON			BUTTON			BUTTON		
	IN	NORMAL	OUT	IN	NORMAL	OUT	IN	NORMAL	OUT
1 - 2		X		X	X		X		
3 - 4	X					X		X	X
5 - 6	X	X	X		X				
7 - 8							X	X	X
X - INDICATES CONTACT CLOSED									



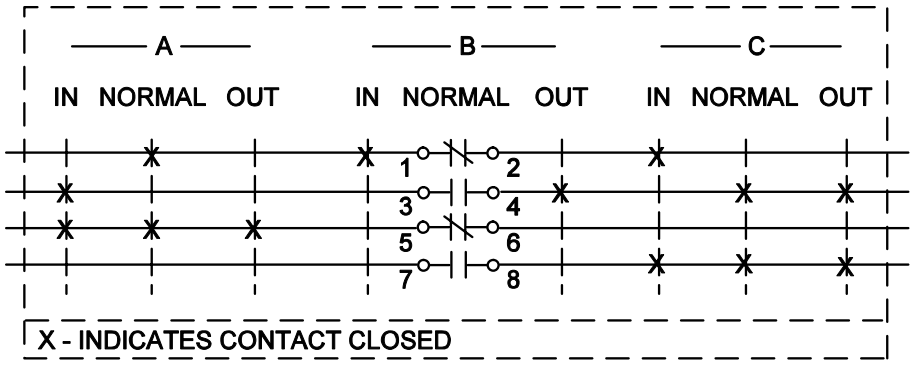


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

SWITCH, SINGLE THROW



SPEED SWITCH
(Operated by shaft rotation) (F = Forward, R = Reverse)

ANTI-PLUGGING SWITCH
(Prevents plugging of drive)



Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

PLUGGING SWITCH
(Remove plug-stop action after drive has practically come to rest.)



PRESET SPEED SWITCH
(Operates at a preset speed.)



TEMPERATURE SWITCH

CLOSED BY RISING TEMPERATURE



OPENED BY RISING TEMPERATURE

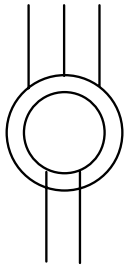


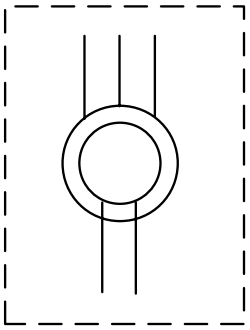
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

SYNCHRONOUS MOTOR, OR AC GENERATOR
Omit the field for synchronous induction, reluctance or hyteresis motor.





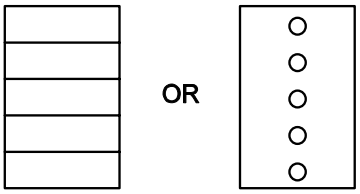
TERMINAL
(Show only where accessible as a field wiring terminal.)



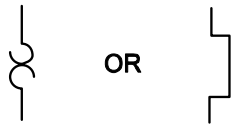


TERMINAL BOARD

NONE



THERMAL ELEMENT ACTUATING DEVICE



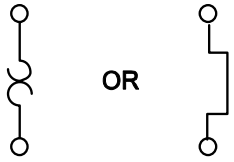
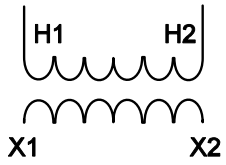


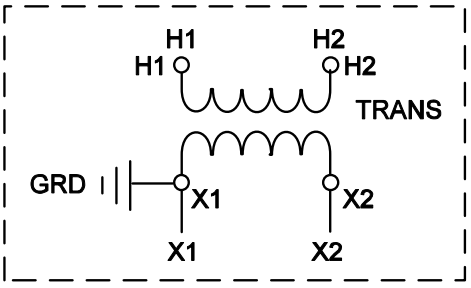
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

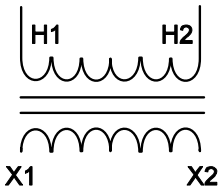
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

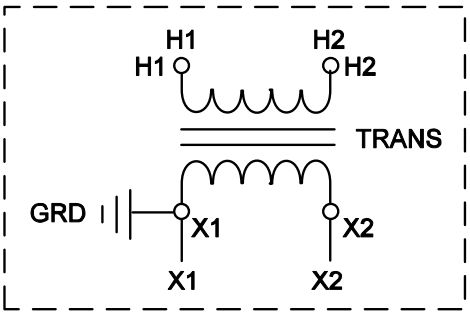
TRANSFORMER, GENERAL (CORE NOT SPECIFIED)
(See Autotransformer) On elementary diagram, windings
of the same transformer may be shown at different locations.



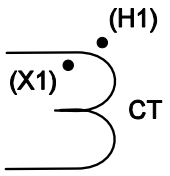


TRANSFORMER (MAGNETIC CORE)





TRANSFORMER, CURRENT
With polarity mark (●) when required. Instanteous direction of current
into one polarity mark corresponds to current out of the other polarity mark.



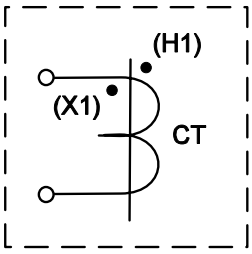
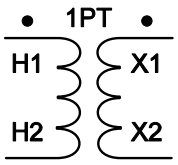


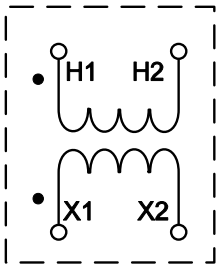
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

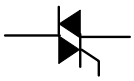
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

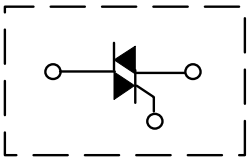
TRANSFORMER, POTENTIAL
With polarity mark (●) when required. Instanteous direction of current into one polarity mark corresponds to current out of the other polarity mark. In lieu of polarity marking shown use terminal identification, in with 2.10 of the NEMA Standards Publication for Specialty Transformers, Standards Publication No. ST 1.





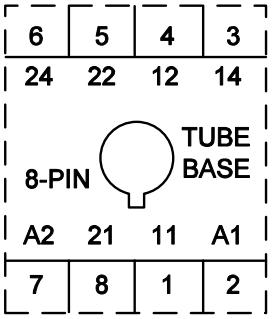
TRIAC
(Bidirectional Triode Thyristor)





SOCKET

NONE



*EXAMPLE

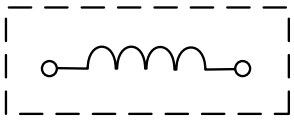
Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

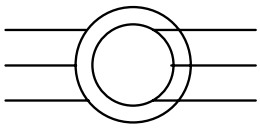
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

WINDING





WOUND ROTOR INDUCTION MOTOR OR INDUCTION FREQUENCY CONVERTER



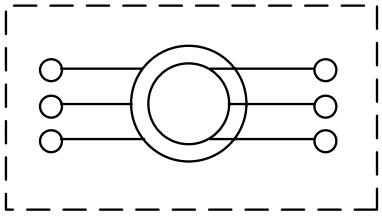


Figure 3
GRAPHIC SYMBOLS (continued)

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale