Proposed Recommended Practice for the Preparation and Use of Symbols

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Foreword

In the IEEE, as in engineering and the sciences in general, graphic and alphabetic symbols and designations are an important factor in effective communication. The rapid technological expansion in the electrical and electronics fields results in proposals for new symbols and designations being generated in many areas. In order to eliminate confusion, it is necessary to establish and use a coordinated set of symbols and designations, thus providing a common language that is formed according to carefully established principles.

As a result of discussions in the Symbols Committee and later in the Standards Committee, this Recommended Practice for the Preparation and Use of Symbols was developed. The purpose of the recommendations is to provide guidance to the Technical Committees and others within the IEEE who may be engaged either in developing Standards Publications or in preparing publications. It is believed that by following the guidelines laid down herein, it will be possible for such committees and individuals to develop Standards Publications which employ fully coordinated and universally understood symbology.

In addition, there is much information in this Recommended Practice that can be of considerable aid to persons and organizations who are users of symbols. The Standards Coordinating Committee for Letter and Graphic Symbols feels that the availability of this document to such users will provide answers to many questions and solutions to many problems frequently encountered in the application of symbology. Questions to which the answers cannot be found in this Recommended Practice may be directed to

IEEE Standards Coordinating Committee for Letter and Graphic Symbols
Institute of Electrical and Electronics Engineers
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New York, N.Y. 10017

This Recommended Practice was prepared primarily by R. T. Haviland during the period 1962 through 1964 in frequent consultation with, and with invaluable aid from, the Standards Coordinating Committee for Letter and Graphic Symbols (formerly the Symbols Committee), whose membership included the following:

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Proposed Recommended Practice for the Preparation and Use of Symbols

I INTRODUCTION

The IEEE Standards Coordinating Committee for Letter and Graphic Symbols recognizes the need for guidelines to be used in developing and applying those symbols that are employed in the electrical and electronics fields. These include: abbreviations, functional designations, graphic symbols, letter combinations, mathematical symbols, reference designations, symbols for quantities, and symbols for units. Such guidelines are useful not only to members of the Standards Coordinating Committee, but are especially helpful to any other committee engaged in developing Standards Publications in the areas mentioned. Accordingly, these guidelines have been formulated and are given in detail herein.

There is considerable confusion as to what is meant by the terms “abbreviation”, “designation”, and “symbol”. The first step, then, is to define the terms involved. This has been done and, for additional guidance, examples have been included to show how such terms are used.

Applicable reference Standards Publications are listed at the end of each section. The basic Standards Publication number is given for each document; it is assumed that the user will obtain the latest issue and amendment in each case.

Committees, Subcommittees, and Task Forces of the IEEE and its Groups that find it necessary to engage in the development of symbols are required to advise the IEEE Standards Coordinating Committee for Letter and Graphic Symbols of the intended action before beginning work. Other bodies (outside of IEEE) are urged to do so. The Standards Coordinating Committee for Letter and Graphic Symbols is continuously reviewing and coordinating in the above-mentioned areas. This committee also is constantly engaged in developing new symbols to take care of advances in the state of the electrical and electronics arts. A considerable background in symbology has been built up by this committee over the years, and its aid and counsel are available to any individual or group.

II DEFINITIONS

Abbreviation—A shortened form of a word or expression. (For special-purpose abbreviations, *see also:* “Functional Designation”, “Letter Combination”, “Mathematical Symbol”, “Reference Designation”, “Symbol for a Quantity”, “Symbol for a Unit”.)

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Functional Designation—Letters, numbers, words, or combinations thereof, used to indicate the function of an item or a circuit, or of the position or state of a control or adjustment. (*Compare with:* "Letter Combination", "Reference Designation", "Symbol for a Quantity".)

Graphic Symbol—A geometric representation used to depict graphically the generic function of an item as it normally is used in a circuit.

Letter Combination—One or more letters which form a part of the graphic symbol for an item and denote its distinguishing characteristic. (*Compare with:* "Functional Designation", "Reference Designation", "Symbol for a Quantity".)

Mathematical Symbol—A graphic sign, a letter or letters (which may have letters or numbers, or both, as subscripts or superscripts, or both), used to denote the performance of a specific mathematical operation, or the result of such operation, or to indicate a mathematical relationship. (*Compare with:* "Symbol for a Quantity", "Symbol for a Unit".)

Reference Designation—Numbers, or letters and numbers, used to identify and locate units, portions thereof, and basic parts of a specific set. (*Compare with:* "Functional Designation" and "Symbol for a Quantity".)

Symbol for a Quantity (Quantity Symbol)—A letter (which may have letters or numbers, or both, as subscripts or superscripts, or both), used to represent a physical quantity or a relationship between quantities. (*Compare with:* "Abbreviation", "Functional Designation", "Mathematical Symbol", "Reference Designation", and "Symbol for a Unit".)

Symbol for a Unit (Unit Symbol)—A letter, a character, or combinations thereof, that may be used in place of the name of the unit. With few exceptions, the letter is taken from the name of the unit. (*Compare with:* "Abbreviation", "Mathematical Symbol", "Symbol for a Quantity".)

III ABBREVIATIONS

1 Definition: Abbreviation

A shortened form of a word or expression. (For special-purpose abbreviations, *see also:* "Functional Designations", "Letter Combinations", "Mathematical Symbols", "Reference Designations", "Symbols for Quantities", and "Symbols for Units".)

2 Application

Abbreviations are used on diagrams, drawings, parts lists, etc., as well as in text and tabular matter, and on nameplates, panels, etc.

3 General Rules

a) Development of a new abbreviation shall be considered only if there is a genuine need for it, and only after a thorough search of widely recognized Standards Publications indicates that there is no existing abbreviation that will meet the requirements.
b) When a search of the applicable Standards Publications does not reveal the desired abbreviation, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) *Abbreviation Patterns*—Examination of existing Standards Publications will reveal that most abbreviations fall into one of the following patterns:
    1) Initial letter of a one-word term:

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n negative
p positive

2) Initial letters of a multiword term:
ac alternating current
vhf very high frequency

3) Initial letters of the elements of a compound term:
ccw counterclockwise
uv ultraviolet

4) First portion of a term:
approx approximate
discr discriminator

5) First portions of the words of a multiword term:
modem modulator-demodulator
magamp magnetic amplifier

6) Omission of most vowels and (sometimes) consonants:
rcvr receiver
swbd switchboard

d) *Distinctiveness*—Wherever possible, the abbreviation for a term should be distinctive, brief, mnemonic, quickly recognizable, and unambiguous. For example, "rep" could mean repeater, repeller, repair, or repetition, among other terms; but the use of rptr, rplr, rpr, and rptn, respectively, for their abbreviations, eliminates any confusion and, at the same time, makes for faster phonetic recognition by the reader. Note also "tel" for telephone or telegraph; and "elec" for electrical or electronic.

e) *Recommended Usage*—
1) Abbreviations should not be used if they could possibly be misinterpreted or result in a lack of comprehension by the reader. If there is doubt that the reader will understand the meaning of an abbreviation, it is recommended that, in text, the abbreviation be followed by the term spelled out in parentheses the first time it appears. In tabular matter and on drawings, a note, footnote, key, or legend should be included, as appropriate. WHEN IN DOUBT, SPELL IT OUT!
2) In text, the use of abbreviations should be held to a minimum, except where a term is repeated frequently, or its abbreviation and meaning are widely understood.
3) Technical data prepared for distribution within a single organization may make substantial use of abbreviations because the technical data comprehension of the user is known. In most documents, however, the use of abbreviations should be limited in the introductory section that is intended primarily for nontechnical management and supervisory personnel, even though abbreviations may be employed freely elsewhere.

f) *Taste*—Good taste and judgment must be observed in the development of new abbreviations. Carefully avoid any abbreviation which spells an English word that could be construed as profane, indecent, or obscene.

g) *Short Words*—In general, avoid abbreviating short words, except those established by longstanding practice.

h) *Word Combinations*—Single abbreviations may be combined, when necessary, to form an abbreviation for a word combination, according to patterns established by the forms given. Abbreviations given for word combinations, however, shall not be separated for use singly: e.g., use AGC for automatic gain control, but do not separate and use A for automatic, G for gain, or C for control.

i) *Capitalization*—
1) Abbreviations used as functional designations, letter combinations, or reference designations are intended primarily for use on diagrams, nameplates and the like. As such, they normally are printed in capital letters.
2) Abbreviations used as quantity symbols or unit symbols may consist of upper-case or lower-case letters, or a mixture of both. The appropriate rules should be followed closely as a change of case often denotes a change of meaning.
3) General abbreviations, not included in the above classifications, usually may be written in either upper- or lower-case letters, according to the style preference of the user. The following ground rules, however, are recommended.
a) As a general rule, lower-case letters are recommended for abbreviations in text and tables, except:
— where the use of capital letters has been established by longstanding practice (**e.g., AQL, NRZ**);

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— for names of widely used major electronic systems **(e.g., IFF, GCA)**;
— where capitalization agrees with the parent words **(e.g., AWG)**.

b) Capital letters generally are used on drawings, nameplates, and in titles, table headings, and similar places, provided no confusion is likely. When drawings are to be microfilmed, special consideration should be given to the question of legibility, particularly where lower-case letters are used.

4) Where an abbreviation appears on a panel, nameplate, or illustration, the direct specific reference in text to that feature of the panel, nameplate, or illustration must appear in identical form with regard to spelling and capitalization.

j) *Punctuation*—Punctuation marks shall not be part of abbreviations of technical terms, except that a period shall be placed at the end of any abbreviation that spells an English word if the omission of such period would result in ambiguity or confusion.

k) *Spacing*—Spaces between letters are used only for clarity, especially in abbreviations for word combinations or phrases. Example: ref des for reference designation.

l) *Tense and Number*—The same abbreviation should be used for all tenses (discharge—disch, discharged—disch), the singular or plural, and the noun or modifying forms of a term.

4 Examples

See 3c.

5 Reference Standards

a) *Industry.*

ASA Z32.13	American Standard Abbreviations for Use on Drawings.
ASA Z10.1	American Standard Abbreviations for Scientific and Engineering Terms.
IEEE No. 198	Abbreviations of Radio-Electronic Terms. (Same as 51 IRE 21.S1. Abbreviations for Units portion superseded by IEEE No. 260.)

b) *Military.*

MIL-STD-12	Abbreviations for Use on Drawings and in Technical Type Publications.

IV FUNCTIONAL DESIGNATIONS

1 Definition: Functional Designation

Letters, numbers, words, or combinations thereof, used to indicate the function of an item or a circuit, or of the position or state of a control or adjustment. (*See also:* “Letter Combinations”, “Reference Designations”, and “Symbols for Quantities”.)

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2 Application

Functional designations are commonly used on panels of equipment and in documentation to identify and locate items by the function they perform. Functional designations are used by some segments of the communications, industrial control, and switchgear industries in lieu of, or in addition to, reference designations.

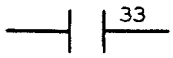
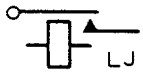
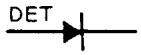
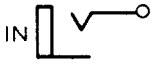
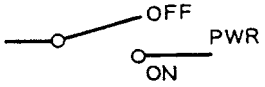
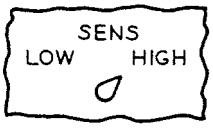
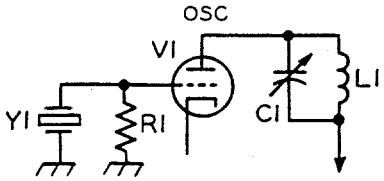
3 General Rules

a) Development of a new functional designation shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing functional designation that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired functional designation, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) A functional designation shall consist of numerals or upper-case letters, or both.
d) When used on a drawing or illustration, the size of a functional designation shall permit reduction where necessary without loss of legibility. When such designations are marked on items or equipment, their size must be compatible with the space available for such marking.
e) The use of mnemonics (memory aids) and acronyms (words formed from the first letter(s) of the words in a compound term, such as “radar”, “maser”, etc.), often is helpful in the development of functional designations.
f) On drawings or illustrations, the functional designation shall appear in close proximity to the graphic symbol or circuit with which it is associated.
g) In text or listings, the functional designation shall be followed by the name of the graphic-symbol item, or by the descriptive name of the diagram.
h) On panels, controls, or other parts of equipment, the functional designation shall be marked at the appropriate location.
i) When both a functional designation and a reference designation apply to a specific graphic symbol, each such designation shall be shown adjacent to the applicable symbol, with the reference designation above the functional designation.

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4 Examples

Functional Designation	*As Used on Drawings or Equivalent*	*As Used in Text*	*Function*
33		No. 33 device	position switch
LJ		**LJ** relay	line-junctor relay
DET		**DET** diode	detector diode
IN		**IN** jack	incoming-connection jack
PWR **ON** **OFF**		**PWR** switch in **OFF** position	power switch in **OFF** position
SENS **LOW** **HIGH**		**SENS** switch in **HIGH** position	sensitivity switch in **HIGH** position (as shown on a panel)
OSC		**OSC** circuit	oscillator circuit (parts identifications shown are reference designations, *which see*).

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5 Reference Standards

a) *Industry.*

C37.2	American Standard Manual and Automatic Station Control, Supervisory, and Associated Telemetering Equipment

b) *Military.*

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

V GRAPHIC SYMBOLS

1 Definition: Graphic Symbol

A geometric representation used to depict graphically the generic function of an item as it normally is used in a circuit.

2 Application

A graphic symbol is used on electrical and electronic schematic diagrams to show the function of the item it represents.

3 Definitions of Related Terms

a) *Single-Line (One-Line) Schematic 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.
b) *Schematic (Elementary) Diagram*—A diagram which shows, by means of graphic symbols, the electric connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual size, shape, or location of the component devices or parts.
c) *Connection (Wiring) Diagram*—A diagram which shows the connections of an installation or its component devices or parts. It may cover internal or external connections, or both, and contains such detail as is needed to make or trace connections that are involved. The connection diagram usually shows the general physical arrangement of the component devices or parts.

4 General Rules

a) Development of a new graphic symbol shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing symbol that will meet the requirements. Proposals currently being considered by the IEEE Standards Coordinating Committee for Letter and Graphic Symbols, the ASA Sectional Committee on Graphic Symbols, Y32, and Technical Committee No. 3 on Graphic Symbols of the International Electrotechnical Commission also shall be searched, since such proposals may have already gained appreciable support in the United States and abroad. The IEEE Standards Coordinating Committee for Letter and Graphic Symbols is usually aware of all such developments even while they are still in their early stages.

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b) When a search of the sources mentioned does not reveal the desired symbol, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.

c) If no suitable standard or proposed standard symbol can be found, development work shall be based, first, upon a consistent application of basic symbols on the principles contained herein, and, second, if practicable, reflect the preponderance of current usage.

d) When work is begun in a new field, a general symbol shall be devised and, by means of standard operators, be modified to indicate either its function or the particular influences affecting the basic symbol; for example: temperature, manual adjustment, nonlinear properties, etc., as applied to basic amplifier or resistor symbols.

e) A graphic symbol shall depict the generic function of an item as it normally is used in a circuit (e.g., where a resistor is used as a fuse, the graphic symbol for a fuse shall be used).

f) Because a symbol is related to the function, different forms of construction of an item that do not affect the basic function do not justify a special symbol.

g) Because symbols are conventional signs, any pictorial or constructional drawings shall be avoided. Since the number of simple, readily differentiated geometric forms is limited, however, it may be necessary at times to devise new symbols based on universally recognized shapes.

h) Symbols shall be so designed that they can be readily recognized.

i) Symbols shall be so designed that legibility is retained upon reduction and reproduction.

j) Large solid or filled-in areas shall be avoided.

k) A graphic symbol shall be characterized generally by its form or by supplementary symbol elements distinguishing it from similar forms representing different classes of items. The use of letters in basic symbols should be avoided where possible, because letters do not always have the same meaning in all languages. The use of letters as parts of symbols shall conform to the requirements of Letter Combinations (Section VI).

l) If possible, a symbol shall be adaptable to both “single-line” (one-line) schematic drawings and “complete” schematic (elementary) drawings. If this is not feasible, symbols suitable for each technique shall be devised.

m) Drafting economy shall be considered in the design of new symbols.

n) When a new symbol is derived by combining existing symbols, the existing symbols used shall not be altered.

o) When a new symbol is derived by combining an existing symbol with new symbol elements, each of the new elements shall be defined.

p) A basic or general symbol shall be useful in all branches of electronics and electricity.

q) Drafting Practices Applicable to Graphic Symbols:

1) A symbol shall be considered as the aggregate of all its parts.

2) 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.

3) An element of a symbol buildup which serves to identify a specific part within a family of such parts (e.g., the] used to denote a tunnel diode) may be oriented as desired without affecting the meaning of the buildup.

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

5) The symbols shown in Standards Publications shall be in their correct relative sizes. This proportional relationship shall be maintained as nearly as possible on any particular drawing, regardless of the size of the symbols used.

6) 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 larger than the other symbols on a specific diagram. It is recommended that only two sizes be used on any one diagram.

7) The arrowhead of a symbol may be closed (filled) ( ) or open (→) unless otherwise noted in the Standards Publication.

8) The standard symbol for a terminal (o) may be added at each point of attachment of the connecting lines to any graphic symbol. Such added terminal symbols shall not be considered as part of the individual graphic symbol, unless the terminal symbol is included in the symbol shown in the Standards Publication.

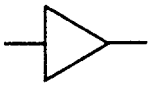
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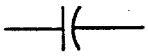
9) For simplification of a diagram, parts of the symbol for a device, such as a relay, contactor or multiple-unit electron tube, may be separated. If this is done, suitable designations must be provided to show proper correlation of the parts.
10) In general, the angle at which a connecting line is brought to a graphic symbol has no particular significance, unless otherwise noted in the Standards Publications.
11) Associated or future paths and equipment shall be shown by lines composed of short dashes (- - -).
12) Other detailed information such as: an abbreviation, functional designation, letter combination, letter symbol, or reference designation may be added, when required, adjacent to any graphic symbol. If any of these forms are used, they shall be in accordance with the Standards for each of them.

5 Examples

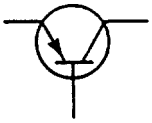
amplifier



capacitor



transistor (PNP)



6 Reference Standards

a) *Industry.*

ASA Y32.2	American Standard Graphic Symbols for Electrical and Electronics Diagrams.
ASA Y32.14	American Standard Graphic Symbols for Logic Diagrams.
ASA Y32.9	American Standard Graphic Electrical Wiring Symbols for Architectural and Electrical Layout Drawings.

IEC Publication 117 (several parts): Recommended Graphical Symbols.

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b) *Military.*

MIL-STD-15-1	Military Standard Graphic Symbols for Electrical and Electronics Diagrams.
MIL-STD-15-2	Military Standard Electrical Wiring Equipment Symbols for Ships' Plans.
MIL-STD-15-3	Military Standard Electrical Wiring Symbols for Architectural and Electrical Layout Drawings.
MIL-STD-806	Military Standard Graphic Symbols for Logic Diagrams.

VI LETTER COMBINATIONS

1 Definition: Letter Combination

One or more letters which form a part of the graphic symbol for an item and designate its distinguishing characteristic.

2 Application

A letter combination is used as part of the graphic symbol for certain classes of circuit elements to denote, more specifically, the application or properties of the device.

3 General Rules

a) Development of a new letter combination shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates there is no existing letter combination that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired letter combination, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) A letter combination should be as brief as possible, because it is often inserted within the graphic symbol.
d) A letter combination shall be sufficiently complete to avoid ambiguity. For example, PH is used for phasemeter, not P.
e) The use of mnemonics (memory aids) and acronyms (words formed from the first letter(s) of the words in a compound term, such as "radar", "maser", etc.), often is helpful in the development of letter combinations.
f) A letter combination shall consist of uppercase letters, unless this practice conflicts with other established Standards Publications.
g) The size of a letter combination should permit reduction where necessary without loss of legibility.
h) A letter combination should not be so large as to touch the outline of the symbol and possibly be mistaken for a part of the symbol configuration.

Acceptable Unacceptable

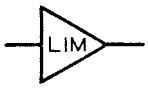
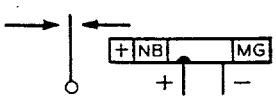


i) When a nonstandard letter combination must be used, its meaning shall be explained.

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4 Examples

Letter Combinations	*Application*	*Meaning*
LIM		limiting amplifier
COM		coupling capacitor for carrier communication
NB MG		polarized (no bias) marginal relay with transfer contacts

5 Reference Standards

a) *Industry.*

ASA Y32.2 American Standard Graphic Symbols for Electrical and Electronics Diagrams.

b) *Military.*

MIL-STD-15-1 Military Standard Graphic Symbols for Electrical and Electronics Diagrams.

VII MATHEMATICAL SYMBOLS

1 Definition: Mathematical Symbol

A graphic sign, a letter or letters (which may have letters or numbers, or both, as subscripts or superscripts, or both), used to denote the performance of a specific mathematical operation, the result of such operation, or to indicate a mathematical relationship. (*See also:* “Symbols for Quantities”, “Symbols for Units”.)

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2 Application

A mathematical symbol is used to indicate a specific mathematical operation or relationship, or the result of such an operation or relationship in an expression or equation.

3 General Rules

a) Development of a new mathematical symbol shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing mathematical symbol that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired mathematical symbol, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) In general, use the first few lower-case letters of the alphabet (*a, b, c . . .*) to denote constant terms or coefficients. In general, use the last few letters of the alphabet (*. . . x, y, z*) to indicate variables.
d) Lower-case Greek letters usually are used to indicate specific constants (e.g., π, ε) and angles (e.g., α, β, θ, and ϕ),
e) When a nonstandard mathematical symbol must be used, its meaning shall be explained.

4 Examples

$\pm$ plus or minus

$\sum_{n=1}^{\infty}$ summation from n = 1 to n = infinity

$\int_{a}^{b}$ integral from a to b

$<$ is less than

cos cosine

5 Reference Standards

a) *Industry.*

ISO R31, Part XI	Mathematical Signs and Symbols for Use in Physical Sciences and Technology.
IEEE No. 199	Standards on Letter Symbols and Mathematical Signs (Same as 57 IRE 21.S1).

b) *Military.*

MIL-STD-106	Military Standard Mathematical Symbols.

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VIII REFERENCE DESIGNATIONS

1 Definition: Reference Designation

Numbers, or letters and numbers, used to identify and locate units, portions thereof, and basic parts of a specific set. (*See also:* "Functional Designations", "Symbols for Quantities".)

2 Application

Reference designations are used on diagrams, drawings, parts lists, etc., as well as on the equipment itself, to identify a basic part, subassembly, assembly, or unit.

3 General Rules

a) Development of a new reference designation shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing reference designation that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired reference designation, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) A reference designation shall consist of a numeral(s), or a combination of upper-case letter(s) and numeral(s).
d) The size of a reference designation should permit reduction where necessary without loss of legibility.
e) Reference designations may be expanded by prefixing the part designation with the subassembly designation, and that combination with the assembly designation, etc. This is one reason why reference designations should be as brief as possible, otherwise the expanded designation can become quite formidable. Several cases of expanded designations are given in the following examples.
f) Where reference designations appear on diagrams and drawings, they should be shown adjacent to the graphic symbol for the applicable unit, portion thereof, or part.
g) A reference designation is used to identify the type of hardware or device (e.g., where a resistor is used as a fuse, the graphic symbol for a fuse shall be used, but the reference designation class letter shall be "R" for resistor).
h) When both a reference designation and a functional designation apply to a specific graphic symbol, each such designation shall be shown adjacent to the applicable symbol with the reference designation above the functional designation.
i) Reference designations often are marked on, or adjacent to, units, portions thereof, and parts wherever practicable. This is another reason for keeping such designations as brief as possible.
j) The number and letter portions of a reference designation shall be shown on the same line. The number portion shall not be shown as a subscript (for example: R2, not R_2).
k) The number and letter portions of a reference designation shall be shown "closed up" to each other, without separation by hyphens, dashes, or spaces (for example: R2, not R-2).

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4 Examples

C2	2nd capacitor (where unit and subassembly reference designations are evident or explained in a note).
K12L1	1st coil of 12th relay.
A1DS5	5th indicating device of 1st assembly.
3A1A2R26	26th resistor of 2nd subassembly of 1st assembly of 3rd unit.

5 Reference Standards

a) *Industry.*

ASA Y32.16	American Standard Electrical and Electronics Reference Designations.

b) *Military.*

MIL-STD-16	Military Standard Electrical and Electronic Reference Designations.

IX SYMBOLS FOR QUANTITIES (QUANTITY SYMBOLS)

1 Definition: Symbol for a Quantity (Quantity Symbol)

A letter (which may have letters or numbers, or both, as subscripts or superscripts, or both) used to represent a physical quantity, or a relationship between quantities. (*See also:* "Abbreviations", "Functional Designations", "Mathematical Symbols", "Reference Designations", "Symbols for Units".)

2 Application

Symbols for quantities are used primarily to designate physical quantities in text, tabulations, and mathematical expressions.

3 General Rules

a) Development of a new quantity symbol shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing quantity symbol that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired quantity symbol, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) If a combination of letters used elsewhere as an abbreviation is used as a subscript or superscript to a quantity symbol, it shall be considered as part of the symbol and shall comply with the rules governing such symbols.

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d) A quantity symbol having a superscript should be enclosed in parentheses before an exponent is affixed.
e) A superscript or subscript should be limited to as few characters as possible.
f) Care must be taken to avoid conflicts. Such conflicts may arise when different physical quantities are assigned identical symbols. Conflicts may be avoided by:
   1) Assigning a subscript to one of the symbols.
   2) Using an alternate standard symbol.
g) Use lower-case letters to represent instantaneous values of physical quantities that vary with time, intrinsic values, and dynamic values. For other kinds of values, such as constant (dc), average, root-mean-square, extrinsic, and static, use upper-case letters. Every effort should be made to maintain this distinction between upper- and lower-case letters, even if the symbol appears in applications where the other lettering is in upper-case style.
h) The style of typography to be used with quantity symbols is as follows:

Item	*Printed Page*	*Manuscript*
General use*	*E* Italic (slanted)	$\underline{\mathrm{E}}$
Scalar	*E* Italic (slanted)	$\underline{\mathrm{E}}$
Vector	(under consideration †)	
Phasor	(under consideration †)	
Numerals	1, 3 Roman (upright)	1, 3
Letter exponents	(under consideration †)	

* Where distinction among scalar, vector, or phasor is not required.
† Existing practice is shown below:

	Commonly Recommended		*IEC Publication 27 Recommendation*
Item	*Printed Page*	*Manuscript*	*Printed Page*
Vector	**E** Bold roman (upright)	$\underset{\sim}{\mathrm{E}}$	Bold italic (slanted) or italic with arrow above, $\vec{H}$
Phasor	***E*** Bold italic (slanted)	$\underset{\sim}{\mathrm{E}}$	(no recommendation)
Letter exponents, subscripts, and superscripts	E^{n}, E_{n}, E^{N}, E_{N} Italic (slated)	$\underline{\mathrm{E}}^{\underline{\mathrm{n}}}$, $\underline{\mathrm{E}}_{\underline{\mathrm{n}}}$, $\underline{\mathrm{E}}^{\underline{\mathrm{N}}}$, $\underline{\mathrm{E}}_{\underline{\mathrm{N}}}$	Italic (slanted)
	E^{n}, E_{n}, E^{N}, E_{N} Roman (upright) (recently proposed)	$\underline{\mathrm{E}}^{\mathrm{n}}$, $\underline{\mathrm{E}}_{\mathrm{n}}$, $\underline{\mathrm{E}}^{\mathrm{N}}$, $\underline{\mathrm{E}}_{\mathrm{N}}$	

4 Examples

i, $\boldsymbol{I}$	current
f_{r}	resonance frequency
$\boldsymbol{Z}_0$	characteristic impedance
$\boldsymbol{g}_{\mathrm{m}}$	intrinsic mutual conductance (or electron-tube transconductance)

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5 Reference Standards

a) *Industry.*

IEEE No. 199	Standards on Letter Symbols and Mathematical Signs. (Same as 57 IRE 21.S1).
IEC Publication 27	Letter Symbols to be Used in Electrical Technology (under revision).
ISO R31 (Various Parts)	Quantities and Units.

b) *Military.*

MIL-STD-283	Military Standard Letter Symbols, for Electrical and Mathematical Quantities.

X SYMBOLS FOR UNITS (UNIT SYMBOLS)

1 Definition: Symbol for a Unit

Unit Symbol—A letter, combination of letters or character(s) that may be used in place of the name of the unit. With few exceptions, the letter is taken from the name of the unit. (*See also:* "Abbreviations", "Mathematical Symbols", "Symbols for Quantities".)

2 Application

Symbols for units (or unit symbols) are used instead of the spelled-out names of the units. Such symbols aid in conserving space. Their use, however, presupposes that the reader will find them intelligible; otherwise the name of the unit should be written in full. Unit symbols are intended for use in text, equations, graphs, diagrams, and on panels and nameplates.

3 General Rules

a) Development of a new unit symbol shall be considered only if there is a genuine need for it, and only after a thorough search of U.S. industry and military Standards Publications, as well as international Recommendations, indicates that there is no existing unit symbol that will meet the requirements.
b) When a search of the sources mentioned does not reveal the desired unit symbol, contact the IEEE Standards Coordinating Committee for Letter and Graphic Symbols.
c) A unit symbol has the same form for both singular and plural. It is not followed by a period, even if it happens to spell an English word.
d) When confusion might result from the use of such unit symbols as "in" for inch, and "l" for liter, the name of the unit shall be spelled out.
e) A unit symbol is written in lower-case letters, except for the first letter when the name of the unit is derived from a proper name, and except for a very few that are not formed from letters. Every effort should be made to maintain this distinction between upper- and lower-case letters, even if the symbol appears in applications where the other lettering is in upper-case style.
f) Unit symbols shall be printed in roman (upright) type.

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g) When an unfamiliar unit symbol is first used in text, it should be followed by its name in parentheses. Only the symbol need be used thereafter. In tabular matter and on drawings, a note, footnote, key, or legend should be included, as appropriate.

h) When a compound unit is formed by multiplication of two or more other units, its symbol consists of the symbols for the separate units joined by a raised dot (for example, N · m for newton meter). The dot may be omitted in the case of familiar compounds (such as watthour, whose symbol is Wh), if no confusion would result.

CAUTION —

1) When a unit symbol prefix is identical with a unit symbol, special care must be taken to avoid confusion. For example, m · N indicates the product of the units *meter* and *newton*, while mN is the symbol for millinewton.
2) Hyphens should not be used in symbols for compound units.

i) Positive and negative exponents may be used with unit symbols. In such cases, care must be taken in text to avoid confusion with superscripts that indicate footnotes or references.

j) When a compound unit is formed by dividing one unit by another, its symbol consists of the symbols for the separate units either separated by a solidus (for example, m/s for meters per second), or multiplied using negative powers (for example, $m \cdot s^{-1}$ for meter per second). In simple cases, use of the solidus is preferred. In no case, however, should more than one solidus on the same line, or a solidus followed by a product, be included in such a combination, unless parentheses are inserted to avoid ambiguity. In complicated cases, negative powers should be used.

k) Prefixes for Metric System Units:
1) Symbols for those prefixes indicating decimal multiples or submultiples of metric system units shall be printed in roman type. The symbols for the most commonly used prefixes are as follows:

Multiple	*Prefix*	*Symbol*
10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d
10	deka	da
10^{2}	hecto	h
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T

2) No space is to be left between the prefix symbol and the symbol for the unit.
3) The distinctions between upper- and lower-case letters must be observed.
4) Compound prefixes should not be used.

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Use		*DO NOT Use*	
tera	(T)	megamega	(MM)
giga	(G)	kilomega	(kM)
nano	(n)	millimicro	(mμ)
pico	(p)	micromicro	(μμ)

5) When a symbol representing a unit that has a multiple or submultiple prefix (for example, km or cm) carries an exponent, this indicates that the multiple (or submultiple) unit is raised to the power expressed by the exponent. For example: $2cm^3 = 2(cm)^3 = 2(10^{-2}m)^3 = 2 \cdot 10^{-6}m^3$.

4 Examples

A	ampere
GeV	gigaelectronvolt
kΩ	kilohm
r/min	revolutions per minute

5 Reference Standards

a) *Industry.*

IEEE No. 260	Standard Symbols for Units
IEC Publication 27	Letter Symbols to be Used in Electrical Technology (under revision)

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