Standards

on

ABBREVIATIONS, GRAPHICAL SYMBOLS, LETTER SYMBOLS, AND MATHEMATICAL SIGNS

1948

Price, 75 cents

THE INSTITUTE OF RADIO ENGINEERS

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The Institute of Radio Engineers
1 East 79 Street
New York 21, N. Y.

CONTENTS

INTRODUCTION

The Technical Committee on Symbols has prepared these Standard Abbreviations, Graphical Symbols, Letter Symbols, and Mathematical Signs under the general guidance of the Standards Committee. Published with the approval of the Board of Directors, the report embodies the Institute's official recommendations to its members, the industry at large, and the armed services. Particular attention is directed to Section III, which for the first time provides standard symbols for waveguide elements.

CONCERNING THE INSTITUTE AND ITS STANDARDS ACTIVITIES

The Institute appointed its first standards committee in 1912, and the next year published a report dealing with definitions of terms, letter and graphical symbols, and methods of testing and rating equipment. Expanded reports appeared in 1915, 1922, 1926, 1928, 1931, and 1933, each of which combined, in a single document, data on all branches of the art.

Publication of the current series of standards, of which this one is a part, was begun in 1938.* It differs from earlier reports in that each individual booklet deals with a separate field. Under present policies, subdivision is being carried even farther and separate booklets are being issued in each field for definitions of terms, for symbols, and for measuring and testing methods.

Beginning with 1942, all standards are being published in the 8×11-inch size to conform with the format for the PROCEEDINGS OF THE I.R.E.

Co-operation with Other Organizations

Throughout its life, the Institute has co-operated with other bodies in the establishment of standards. Last year, for instance, there were more than 50 official IRE delegates to other standardization groups. The Institute is also the sponsor for the American Standards Association's Sectional Committee on Radio.

The Institute of Radio Engineers

The Institute of Radio Engineers was founded in 1912 to advance the theory and practice of radio and allied branches of engineering and of the related arts and sciences, their application to human needs, and the maintenance of a high professional standing among its members. Although mostly located in the United States of America, the Institute membership of over 21,000 persons has representation in some seventy countries throughout the world.

The PROCEEDINGS OF THE I.R.E., which has been published since 1913, is issued monthly and contains contributions from the leading workers in the theoretical and practical fields of radio communication.

Applications for membership are invited from those interested in radio. Full information may be obtained from the Executive Secretary.

* For a detailed list of current standard reports, see the inside back cover.

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Acknowledgement is made of the work of the following members of the Technical Committee on Symbols in previous years:

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FOREWORD FOR SECTION I

These Standards are intended to cover those abbreviations, letter symbols, and mathematical signs which are necessarily used in writing about electrical devices in communications and allied electronic fields. The alphabetical lists in Paragraphs 104 and 105 are not intended to be glossaries but to offer a preferred list for use in papers intended for publication by The Institute of Radio Engineers.

FOREWORD FOR SECTIONS II, III, AND IV

These Standards are intended to cover basic and symbol components which are necessary to depict electrical devices on schematic drawings in communications and allied electronic fields.

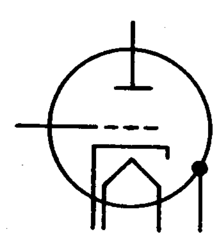
When new symbols are necessary, they should be formed where possible from basic or symbol components which are shown in these Standards.

Drafting Practices

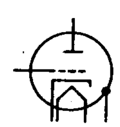
a. The orientation of a symbol on a drawing does not alter the meaning of the symbol.

b. As reproduced in these standards, the symbols are shown in the sizes customarily used for publication with all lines of equal weight (width). In drafting, the symbols are normally drawn two or three times this size. The examples below show the size of symbols as drawn and as reduced 2 to 1.

As drawn:



As reduced:



c. Where lines cross, as in Paragraph 254.2, the crossing should be as near a right angle as possible to prevent imperfections in reproduction processes from making the crossing look like a dot.

SECTION I

ABBREVIATIONS, LETTER SYMBOLS, AND MATHEMATICAL SIGNS

101. GENERAL PRINCIPLES OF LETTER SYMBOL STANDARDIZATION

101.1. General

In preparing manuscripts, it is suggested that authors give careful attention to the use of symbols from this and other standard lists and to the principles here given. Symbols used should be defined clearly. When a table of symbols is not given, it is desirable to make reference to the standard lists from which the symbols are taken. The many numbers, letters, and signs which are similar in appearance should be distinguished carefully.

101.2. Definitions

A magnitude letter symbol is a single letter, with subscript or superscript if required, used to designate the magnitude of a physical quantity in mathematical equations and expressions. Two or more magnitude symbols printed together always represent a product. Magnitude letter symbols are to be distinguished from the following:

101.21. Abbreviations, which are shortened forms of names and expressions employed in texts and tabulations. Neither the abbreviation of the name of the unit of a physical quantity nor the single-letter designation of the unit should ever be used in place of the magnitude symbol in an equation.

101.22. Mathematical signs and operators, which are characters used with magnitude symbols to denote mathematical operations and relations.

101.23. Graphical symbols, which are conventionalized diagrams and letters used on plans and drawings.

101.24. Chemical symbols, which are letters and other characters designating chemical elements and groups.

101.3. Units

The same symbol should be used for the magnitude of the same physical quantity regardless of the units employed and regardless of special values occurring for different states, points, parts, times, etc. The units employed and the special values may be designated when necessary by subscripts, superscripts, or by upper- and lower-case letters when both are specifically included as symbols in a standard list. The units used should be indicated when necessary. Sometimes different symbols are used for the components of a vector.

101.4. Subscripts

A subscript preferably should be a single character. It is commonly employed to indicate a specified value of a physical quantity, such as pressure or temperature. A multiple subscript, sometimes divided by a comma, refers to more than one state, point, part, time, etc. A subscript should not be attached to a subscript except in extreme cases.

101.5. Superscripts

A symbol with a superscript, such as a prime (′) or a double prime (″), should be enclosed in parentheses, braces, or brackets before affixing an exponent. A complicated exponent (or any other expression frequently repeated) may be replaced by a single symbol selected to represent it. Reference marks should not be attached to symbols.

101.6. Conflicts

Conflicts which would occur when different physical quantities are assigned identical magnitude symbols in the same or different standard symbol lists may be resolved in one of the following ways:

101.61. For one or more of the conflicting uses, the given symbol may be employed with subscript or superscript selected by the author.

101.62. If one of the quantities has an alternate symbol in a standard list, it may be used.

101.63. A slight change in the name of the quantity may remove the conflict. For instance, one may use l for "length of radius" when r for "radius" conflicts with r used for the magnitude of another quantity.

101.7. Unlisted Quantities

The symbol chosen by an author for a physical quantity not appearing in any standard list should be one that does not already have a different meaning in the field of the text.

101.8. Typography

101.81. Letter symbols and letter subscripts, whether upper or lower case, should be printed in italic type unless definitely specified otherwise. On manuscript this is indicated by underlining each symbol which is to be italicized.

101.82. Letter symbols for scalar quantities are printed in italic type. When special type is used for vector quantities, the same letter in italic type should be used for the corresponding scalar magnitude of the vector quantity.

101.83. Letter symbols for vector quantities should be printed in bold roman type, unless the text deals only with the magnitudes of the vector quantities and not with their vector relations. On manuscript, bold roman type is indicated by wavy underlining.

101.84. Letter symbols for phasor quantities are printed in bold italic type. Phasor quantities are quantities whose values are expressed by complex numbers. The conjugate of a phasor may be designated by a star

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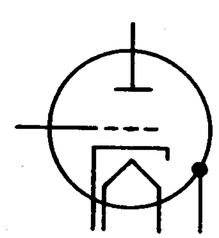

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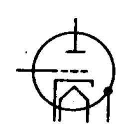

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101.85. Numerals are printed in roman type whether appearing as terms in equations, coefficients, exponents, or subscripts.

101.86. Abbreviations and names of units should be printed in roman type.

101.87. Mathematical signs and operators should be printed in roman type except when they are single letters, in which case they should be printed in italics.

101.88. Examples of typographical standards:

Root-mean-square or effective values may be represented by the upper-case letter without subscript.

Example: E, I, E_g, I_p.

102.2. Applications to Electron Tube Circuits

102.21. External. Values of resistance, impedance, admittance, etc., in the external circuit of an electrode may be represented by the upper-case symbols for the quantities with the proper electrode subscripts.

Example: R_j $\boldsymbol{Z_j}$, $\boldsymbol{Y_j}$, R_p, Z_p, Y_p, C_{gp}.

102.22. Inherent. Values of resistance, impedance, admittance, etc., inherent in the tube may be represented

Item	Standard for Printed Page		Standard for Manuscript
Scalars	E	(italic)	E
Vectors	$\mathbf{E}$	(bold roman)	E
Phasors	$\boldsymbol{E}$	(bold italic)	E
Conjugate phasors	$\boldsymbol{E}^*$	(bold italic)	E*
Absolute magnitude of phasor	E or	(italic)	E or
	$\lvert\boldsymbol{E}\rvert$	(bold italic)	|E|
Letter exponents and subscripts	E^h, E_h	(italic)	Eh, Eh
Numbers	4	(roman)	4
Names and abbreviations of units	amp, m	(roman)	amp, m
Names of functions and operators	cos, exp, curl, log, div, grad	(roman)	cos, exp, curl, log, div, grad
Exceptions to preceding item: Single-letter designations of functions and operators	d, D_x, $f(x)$ $Jo(x)$, j, a, $P(n, r)$	(italic)	d, Dx, f(x) Jo(x), j, a, P(n, r)

102. SPECIAL PRINCIPLES

102.1. Applications to Electrical Circuits

102.11. Instantaneous values of current, voltage, and power which vary with time are represented by the lower-case letter of the proper symbol.

Example: i, e, p, i_g, e_p.

102.12. Maximum, average, and root-mean-square values are represented by the upper-case letter of the proper symbol.

Example: I, E, P, I_p, E_p.

If necessary to distinguish between maximum, average, or root-mean-square values:

Maximum values may be represented by the subscript "*m*."

Example: E_m, I_m, E_{pm}.

Average values may be represented by the subscript "*av*."

Example: E_{av}, I_{pav}.

by the lower-case symbol with the proper electrode subscripts.

Example: r_{jk}, z_j, y_j, r_p, z_p, y_p, c_{gp}.

102.3. Applications for Electron Tubes

102.31. Symbols for quantities in electrode circuits of electron tubes are developed from the proper quantity symbol and subscripts representing the electrodes concerned. When one of the electrodes concerned is the cathode, the subscript "*k*" may be omitted and the single subscript understood to mean "with respect to the cathode."

102.32. The electrode abbreviations to be used as subscripts are:

- *j* general (convention for any electrode)
- *f* filament
- *h* heater
- *k* cathode

- *g* grid (*c* also used; see 102.36)
- *p* plate or anode (*b* also used; see 102.36)
- *s* metal shell, or other self-shielding envelope
- *d* deflecting, reflecting, or repelling electrode (electrostatic type).

Example: e_{jk}, e_j, E_{pk}, $\dot{E}_p$, C_{gp}.

102.33. Grid subscripts for multigrid tubes are developed by a numerical addition to the subscript. Grids are numbered according to position out from the cathode. When no numerical subscript appears, reference to the control grid is assumed.

Example: e_{g1}, e_{g2}, c_{g1g2}, e_g.

102.34. Deflection electrode subscripts for cathode-ray tubes are developed by a numerical addition to the subscript.

Example: c_{d1d2}, e_{d1d2}, e_{d3d4}.

102.35. In a double-subscript symbol, when the direction of the relationship is significant, the first subscript should designate the electrode circuit in which the effect (product of the multiplying operation) is measurable; and the second subscript should designate the electrode circuit in which the cause (operand or multiplicand) is measurable. This subscript sequence conforms to the mathematical convention for writing determinants from a set of fundamental Kirchhoff's equations.

Example: g_{f2f1}, g_{pg}, g_{gp}.

102.36. When necessary to distinguish between components of current and voltage encountered in electron-tube circuits, the following symbols may be used. Their application to the case of a tube having a small varying component in the plate circuit is illustrated in the accompanying diagram in Fig. 1.

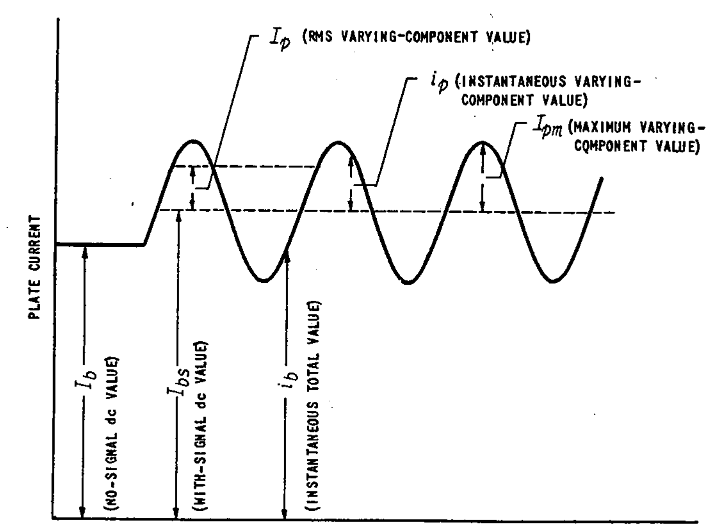


Fig. 1

102.361. Instantaneous current and voltage values of a varying component may be represented by lower-case symbols with the subscripts "*g*" and "*p*" for grid and plate, respectively.

Example: e_p, i_g, e_{g3}.

102.362. Instantaneous total values of current and voltage (no-signal dc value plus varying-component value) may be represented by lower-case symbols and the subscripts "*b*" for plate and "*c*" for grid.

Example: i_b, e_c, i_{c2}.

102.363. Root-mean-square and maximum current and voltage values of a varying component may be represented by upper-case symbols and the subscripts given in paragraph 102.361.

Example: E_g, I_p, E_{pm}.

102.364. Values of current and voltage for the no-signal or static condition may be represented by upper-case symbols and the subscripts given in paragraph 102.362.

Example: E_{c3}, I_b, E_c.

102.365. Average values of current and voltage for the with-signal condition may be represented by the addition of the subscript "*s*" to symbols determined in accordance with paragraph 102.364.

Example: I_{bs}, E_{c3s}, E_{bs}.

102.366. Supply voltages for electron tube elements may be represented by upper-case symbols and doubling the electrode subscripts indicated in paragraph 102.362 plus "*ff*" for the case of heater or filament supply.

Example: E_{ff}, E_{cc}, E_{bb}, E_{cc2}.

103. PRINCIPLES OF ABBREVIATIONS

The abbreviations for basic electrical units of measurement may be extended to more convenient ranges by prefixing abbreviations for multipliers.

103.1. Such abbreviated multipliers are:

μμ	micromicro	10^{-12}
μ	micro	10^{-6}
m	milli	10^{-3}
c	centi	10^{-2}
d	deci	10^{-1}
k or K	kilo	10^3
M	mega	10^6
kM or KM	kilomega	10^9
MM	megamega	10^{12}

103.2. These may be applied to the units such as:

amp	ampere (further abbreviated to a in combinations)
bel	bel (abbreviated to b in combinations)
cps	cycles per second (further abbreviated to c or C in combinations)
f	farad
h	henry
Ω	ohm
v	volt
va	voltampere
w	watt
wh	watthour

103.3. Examples:

kc or KC	kilocycles per second
Mc or MC	megacycles per second
kMc or KMC	kilomegacycles per second
MΩ	megohm
db	decibel
mh	millihenry
μf	microfarad
μμf	micromicrofarad
kwh	kilowatthour

103.4. Abbreviations should be used only when the meaning will be clear. Short words such as bel, day, and mho should be spelled out.

103.5. The same abbreviation is used for both the singular and plural of a name.

103.6. The same abbreviation is used as both a noun and an adjective.

103.7. The period should be omitted except in cases where the omission would result in confusion.

103.8. The letters of such abbreviations as IRE, FCC, RMA, etc., should not be separated by spaces or periods.

103.81. A name of an organization or a periodical in which abbreviations occur and in which periods are incorporated by registry or other act of the organization shall not be further shortened by the omission of the periods.

Example: PROCEEDINGS OF THE I.R.E.

104. LIST OF ABBREVIATIONS, LETTER SYMBOLS, AND MATHEMATICAL SIGNS (IN ALPHABETICAL ORDER OF QUANTITY)*

α	absorption factor
$\mathbf{Y}$, Y, y	admittance
$\boldsymbol{\alpha}$	acceleration, angular
$\mathbf{a}$	acceleration, linear
ac*	alternating current
amp*	ampere
μ	amplification factor of an electron tube ($\mu=\mu_{pg}$) (see μ factor)
AM*	amplitude modulation
ω	angle, solid
θ	angle, transit
Å*	Angstrom unit
ω	angular frequency ($\omega=2\pi f$)
ω_r	angular frequency, resonance
A	area
α	attenuation constant ($\gamma=\alpha+j\beta$)
af*	audio frequency
e	base of Naperian or natural logarithms ($e=2.718\cdots$)
B	brightness, luminance $\left(B=\dfrac{dI}{dA\cos\theta}\right)$
c*	candle
C, c	capacitance, (permittance)
X_C	capacitive reactance
ϵ	capacitivity, dielectric constant, dielectric coefficient
Z_0	characteristic impedance, surge impedance
e	charge, electronic ($e=1.602\cdots\times10^{-19}$ coulombs)
λ	charge, line density
Q, q	charge, quantity of electricity (electric)
σ,	charge, surface density of
ρ	charge, volume density of (electric)
p	complex frequency, oscillation constant ($p=\delta+j\omega$)
G, g	conductance
σ, ν	conductivity
k	conductivity, thermal
k	coupling coefficient
$\mathbf{I}$, I, i	current, electric
$\mathbf{J}$, J	current density, electric
A	current density, sheet (linear current density)
I_s, i_s	current, saturation of a cathode, total electron emission
cps*	cycles per second
δ	damping constant, damping coefficient (decay constant) ($p=\delta+j\omega$)
db*	decibel
dbm*	decibels of power referred to 1 milliwatt
t_d	deionization time
$\mathbf{J}$, J	density, current
$\mathbf{B}$	density, magnetic flux
λ	density of charge, linear
σ	density of charge, surface
ρ	density of charge, volume
$\mathbf{W}$	density of radiant flux
A	density, sheet current (linear current density)
D	derivative operator
d, D	diameter
$\boldsymbol{\varepsilon}_0$	dielectric constant, complex ($\boldsymbol{\varepsilon}_0\approx\epsilon_r+j60\lambda\sigma$)
ϵ	dielectric constant, dielectric coefficient, capacitivity
ϵ_v	dielectric constant of evacuated (free) space ($\epsilon_v=8.855\cdots\times10^{-12}$ farad per meter)
ϵ_r	dielectric constant, relative (specific inductive capacitance)
ψ	dielectric flux, displacement flux (flux of electric displacement)
$\mathbf{D}$	dielectric flux density, electric displacement
ϵ_i, η	dielectric susceptibility (intrinsic capacitivity) ($\epsilon_i=(\epsilon_r-1)\epsilon_v$)
d	differential operator
∂	differential operator, partial
α	diffusivity, thermal
dc*	direct current
$\mathbf{D}$	displacement, electric (dielectric flux density)
ϕ, θ	displacement, phase (phase angle)
D	duty factor, duty cycle ($D=t_p f_p$)

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

η	efficiency
S	elastance, self-elastance $\left(S=\dfrac{1}{c}\right)$
$\mathbf{E}$	electric field, electric field strength, electric intensity, electric field intensity
$\mathbf{p}$	electric moment of a dipole
E, e, V, v	electromotive force, electric potential difference, voltage
ϵ	emissivity
ϵ_λ	emissivity, spectral
ϵ_t	emissivity, total
W	energy, work
U	energy, internal or intrinsic
U	energy, radiant
H	enthalpy, heat content
S	entropy
α	expansion, temperature coefficient of linear
exp	exponential function
f*	farad
F	Faraday constant
$\mathbf{H}$	field strength, magnetic (magnetic intensity, magnetizing force)
Q	figure of merit of a reactor
$\mathbf{W}$	flux density, radiant
ψ	flux, dielectric (displacement flux, flux of electric displacement)
F	flux, luminous
Φ	flux, magnetic (flux of magnetic induction)
Φ	flux, radiant $\left(\Phi=\dfrac{dU}{dt}\right)$
ft-c*	foot-candle
ft-L*	foot-lambert
$\mathbf{F}$	force
f	frequency
ω	frequency, angular ($\omega=2\pi f$)
f_c	frequency, critical or cutoff
FM*	frequency modulation
f_p	frequency, pulse recurrence
f_r	frequency, resonance
ω_r	frequency, resonance angular
$\mathbf{g}$, g	gravitational acceleration
G	gravitational constant
H	heat content, enthalpy
Q	heat, quantity of
q	heat, rate of flow of
t_k	heating time, cathode
h*	henry
E	illuminance, amount of illumination $\left(E=\dfrac{dF}{dA}\right)$
Z_0	impedance, characteristic (surge impedance)
η	impedance of a medium, intrinsic
$\mathbf{Z}$, Z, z	impedance, self-impedance
Δ	increment
L_{12}, etc.	inductance, mutual
L	inductance, self-inductance
$\mathbf{B}$	induction, magnetic (magnetic flux density) ($\mathbf{B}=\mu_r\mu_v\mathbf{H}$)
X_L	inductive reactance
$\mathbf{E}$	intensity, electric (electric field strength, electric field intensity, electric field)
I	intensity, luminous (candle power) $\left(I=\dfrac{dF}{d\omega}\right)$
$\mathbf{H}$	intensity, magnetic (magnetizing force, magnetic field strength)
J	intensity, radiant $\left(J=\dfrac{d\Phi}{d\omega}\right)$
if*	intermediate frequency
$\mathbf{B}_i$	intrinsic induction, magnetic polarization ($\mathbf{B}_i=\mathbf{B}-\mu_v\mathbf{H}$)
U	internal or intrinsic energy
L*	lambert
l	length
s	length of path
Q	light, quantity of
ln	logarithm to base e
log	logarithm to base 10
lm*	lumen
B	luminance (see brightness)
K	luminosity factor $\left(K=\dfrac{F_\lambda}{\Phi_\lambda}\right)$
F	luminous flux
I	luminous intensity $\left(I=\dfrac{dF}{d\omega}\right)$
S_F, s_F	luminous sensitivity of a phototube
Φ	magnetic flux (flux of magnetic induction)
$\mathbf{B}$	magnetic flux density (magnetic induction), ($\mathbf{B}=\mu_r\mu_v\mathbf{H}$)
$\mathbf{H}$	magnetic intensity, magnetizing force (magnetic field strength)
$\mathbf{m}$	magnetic moment
μ	magnetic permeability
μ_o	magnetic permeability, initial
μ_v	magnetic permeability of evacuated (free) space
μ_r	magnetic permeability, relative
$\mathbf{B}_i$	magnetic polarization (intrinsic induction) ($\mathbf{B}_i=\mathbf{B}-\mu_v\mathbf{H}$)
μ_i	magnetic susceptibility (intrinsic magnetic permeability) ($\mu_i=(\mu_r-1)\mu_v$)
$\mathbf{A}$	magnetic vector potential
$\mathbf{A}_r$	magnetic vector potential, retarded

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

$\mathbf{H}$	magnetizing force, magnetic intensity (magnetic field strength)
$\mathcal{F}$	magnetomotive force, magnetic potential
m	mass
T_{Hg}	mercury condensate, temperature of
m*	meter
mL*	millilambert
$\mathbf{p}$	moment of a dipole, electric
I	moment of inertia
$\mathbf{m}$	moment, magnetic
AM*	modulation, amplitude
FM*	modulation, frequency
μ_{j3j2}	μ factor of an electron tube, relative effect of change on electrode "$j3$" to change on electrode "$j2$" (conditions of other electrodes to be specified) (see amplification factor)
L_{12}, etc.	mutual inductance
e	Naperian or natural logarithms, base of ($e=2.718\cdots$)
p	number of poles
N	number of turns or conductors
n	number per unit of measurement
Ω*	ohm
D	operator, derivative
d	operator, differential
∇	operator, vector
∂	operator, partial differential
j	operator, 90° rotational, or $\sqrt{-1}$
a	operator, 120° rotational
p	oscillation constant, complex frequency ($p=\delta+j\omega$)
T	period
μ_0	permeability, initial magnetic
μ	permeability, magnetic
μ_i	permeability, intrinsic magnetic (magnetic susceptibility), ($\mu_i=(\mu_r-1)\mu_v$)
μ_r	permeability, relative magnetic
μ_v	permeability, magnetic, evacuated (free) space
$\mathcal{P}$	permeance
C, c	permittance, capacitance
β	phase constant, (wave number) wavelength constant $\left(\beta=\frac{2\pi}{\lambda}\right)$
ϕ, θ	phase displacement, phase angle
π	pi, a ratio ($\pi=3.14159\cdots$)
h	Planck constant ($h=6.624\cdots\times10^{-34}$ joule sec)
$\mathbf{P}$	polarization, electric ($\mathbf{P}=(\epsilon_r-1)\epsilon_v\mathbf{E}$)
p	poles, number of
V, v, E, e	potential difference, electric; electromotive force; voltage
V_r	potential, electric scalar, retarded

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

$\mathcal{F}$	potential, magnetic; magnetomotive force
$\mathbf{A}$	potential, magnetic vector
$\mathbf{A}_r$	potential, magnetic vector, retarded
P, p	power, active power
P_p	power, anode or plate dissipation
F_p	power factor
pf*	power factor
P_g	power, grid dissipation
dbm*	power in decibels referred to 1 milliwatt
P_i	power, input
P_o	power, output
p	pressure
γ	propagation constant ($\gamma=\alpha+j\beta$)
f_p	pulse-recurrence frequency
Q, q	quantity of electricity
	quantity of electric charge
Q	quantity of heat
Q	quantity of light
U	radiant energy
Φ	radiant flux $\left(\Phi=\frac{dU}{dt}\right)$
$\mathbf{W}$	radiant flux density
J	radiant intensity $\left(J=\frac{d\Phi}{d\omega}\right)$
rf*	radio frequency
R, r	radius
q	rate of flow of heat
X_C	reactance, capacitive
X_L	reactance, inductive
X, x	reactance, self-reactance
F_q	reactive factor
P_q	reactive voltamperes (reactive power)
ρ	reflection coefficient
ρ	reflection factor
$\mathcal{R}$	reluctance
ν	reluctivity $\left(\nu=\frac{1}{\mu}\right)$
R, r	resistance
α	resistance, temperature coefficient of
ρ	resistivity or specific resistance
f_r	resonance frequency
λ_r	resonance wavelength
V_r	retarded electric scalar potential
$\mathbf{A}_r$	retarded magnetic vector potential
rms*	root-mean-square
rss*	root-sum-square
I_s, i_s	saturation current of a cathode, total electron emission
δ	secondary-emission ratio
$\mathbf{Z}, Z, z$	self-impedance, impedance
L	self-inductance, inductance
X, x	self-reactance, reactance
s	sensitivity of a phototube, dynamic
S_F, s_F	sensitivity of a phototube, luminous

S	sensitivity of a phototube, static
S_{2870}, s_{2870}	sensitivity of a phototube, 2870° Kelvin tungsten
s	slip (in electrical machinery)
c	specific heat, thermal capacity of unit mass
ρ	specific resistance or resistivity
ϵ	spectral emissivity
S	standing-wave ratio
SWR*	standing-wave ratio (voltage or current)
Σ	summation
σ	surface density of charge
$\mathbf{Z}_0$	surge impedance, characteristic impedance
B, b	susceptance ($\mathbf{Y}=G+jB$)
ϵ_i, η	susceptibility, dielectric (intrinsic capacitivity) ($\epsilon_i=(\epsilon_r-1)\epsilon_v$)
μ_i, κ	susceptibility, magnetic (intrinsic magnetic permeability)
T	temperature
α	temperature coefficient of linear expansion
α	temperature coefficient of resistance
T_{Hg}	temperature of mercury condensate
c	thermal capacity of unit mass, specific heat
k	thermal conductivity
α	thermal diffusivity
t	time
τ	time constant
t_k	time of cathode heating
t_d	time of deionization
t_p	time of pulse duration
t_f	time of pulse fall
t_r	time of pulse rise
ϵ_t	total emissivity
g_c	transconductance, conversion
g_{j2j1}	transconductance, effect in circuit of electrode "$j2$" to a change on electrode "$j1$"
g_n (also g_{gp})	transconductance, inverse (inverse mutual conductance), effect in grid circuit to change on plate
g_m (also g_{pg})	transconductance, grid-plate (mutual conductance) effect in plate circuit to change on control grid
θ	transit angle
τ	transmission factor
∇	vector operator
$\mathbf{i}$	vector, unit (X-axis)
$\mathbf{j}$	vector, unit (Y-axis)
$\mathbf{k}$	vector, unit (Z-axis)
$\mathbf{v}$	velocity
c	velocity of light in vacuum ($c=2.998\cdots\times10^5$ kmps)
v*	volt
V, v, E, e	voltage, electromotive force, electric potential difference
P_s	voltamperes (apparent power)

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

P_q	voltamperes, reactive (reactive power)
V	volume
ρ	volume density of electric charge
w*	watt
β	wavelength constant, phase constant (wave number) $\left(\beta=\frac{2\pi}{\lambda}\right)$
λ_c	wavelength, critical or cutoff
λ	wavelength in free space
λ_r	wavelength, resonance
W	work, energy
E	Young's modulus of elasticity

105. LIST OF ABBREVIATIONS, LETTER SYMBOLS, AND MATHEMATICAL SIGNS (IN ALPHABETICAL ORDER)*

$\mathbf{a}$	linear acceleration
a	120° rotative operator
ac*	alternating current
af*	audio frequency
amp*	ampere
A	area
A	sheet current density (linear current density)
$\mathbf{A}$	magnetic vector potential
Å*	Angstrom unit
AM*	amplitude modulation
$\mathbf{A}_r$	retarded magnetic vector potential
α	absorption factor
$\boldsymbol{\alpha}$	angular acceleration
α	attenuation constant
α	temperature coefficient of linear expansion
α	temperature coefficient of resistance
α	thermal diffusivity
B	brightness, luminance $\left(B=\frac{dI}{dA\cos\theta}\right)$
$\mathbf{B}$	magnetic flux density, magnetic induction ($\mathbf{B}=\mu_r\mu_v\mathbf{H}$)
B, b	susceptance ($\mathbf{Y}=G+jB$)
$\mathbf{B}_i$	magnetic polarization, intrinsic induction ($\mathbf{B}_i=\mathbf{B}-\mu_v\mathbf{H}$)
β	wavelength constant, phase constant (wave number) $\left(\beta=\frac{2\pi}{\lambda}\right)$
c*	candle
C, c	capacitance (permittance)
c	specific heat, thermal capacity of unit mass
c	velocity of light in vacuum ($c=2.998\cdots\times10^5$ kmps)
cps*	cycles per second
D	derivative operator
d, D	diameter
d	differential operator

D	duty factor, duty cycle ($D=t_pf_p$)
$\mathbf{D}$	electric displacement, dielectric flux density
db*	decibel
dbm*	power in decibels referred to 1 milliwatt
dc*	direct current
∇	vector operator
δ	damping constant, damping coefficient (decay constant) ($p=\delta+j\omega$)
δ	secondary-emission ratio
Δ	increment
∂	partial differential operator
e	base of Naperian or natural logarithms ($e=2.718\cdots$)
$\mathbf{E}$	electric field, electric field strength, electric intensity, electric field intensity
E, e, V, v	electromotive force, electric potential difference, voltage
e	electronic charge ($e=1.602\times10^{-19}$ coulombs)
E	illuminance, amount of illumination $\left(E=\frac{dF}{dA}\right)$
E	Young's modulus of elasticity
ϵ	capacitivity, dielectric constant, dielectric coefficient
ϵ	emissivity
ϵ_i, η	dielectric susceptibility (intrinsic capacitance) ($\epsilon_i=(\epsilon_r-1)\epsilon_v$)
ϵ_λ	spectral emissivity
ε_0	complex dielectric constant ($\varepsilon_0\approx\epsilon_r+j60\lambda\sigma$)
exp	exponential function
ϵ_r	relative dielectric constant (specific inductive capacitance)
ϵ_t	total emissivity
ϵ_v	dielectric constant of evacuated (free) space ($\epsilon_v=8.855\cdots\times10^{-12}$ farad per meter)
η	efficiency
η	intrinsic impedance of a medium
η, ϵ_i	dielectric susceptibility (intrinsic capacitance) ($\epsilon_i(\epsilon_r-1)\epsilon_v$)
f*	farad
F	Faraday constant
$\mathbf{F}$	force
f	frequency
F	luminous flux
$\mathcal{F}$	magnetomotive force, magnetic potential
f_c	critical or cutoff frequency
FM*	frequency modulation
f_p	pulse-recurrence frequency
F_p	power factor
F_q	reactive factor
f_r	resonance frequency
ft-c*	foot-candle
ft-L*	foot-lambert

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

G, g	conductance
$\mathbf{g}, g$	gravitational acceleration
G	gravitational constant
g_c	conversion transconductance
g_{j2j1}	transconductance, effect in circuit of electrode "$j2$" to a change on electrode "$j1$"
g_m also g_{pg}	grid-plate transconductance (mutual conductance), effect in plate circuit to change on control grid
g_n also g_{gp}	inverse transconductance (inverse mutual conductance), effect in grid circuit to change on plate
γ, σ	conductivity
γ	propagation constant ($\gamma=\alpha+j\beta$)
H	heat content, enthalpy
h*	henry
$\mathbf{H}$	magnetic intensity, magnetizing force (magnetic field strength)
h	Planck constant ($h=6.624\cdots\times10^{-34}$ joule sec)
$\mathbf{I}, I, i$	current
I	luminous intensity $\left(I=\frac{dF}{d\omega}\right)$
I	moment of inertia
$\mathbf{i}$	unit vector (X-axis)
if*	intermediate frequency
I_s, i_s	saturation current of a cathode, total electron emission
$\mathbf{J}, J$	current density
$\mathbf{j}$	unit vector (Y-axis)
J	radiant intensity $\left(J=\frac{d\Phi}{d\omega}\right)$
j	90° rotative operator or $\sqrt{-1}$
k	coupling coefficient
K	luminosity factor $\left(K=\frac{F_\lambda}{\Phi_\lambda}\right)$
κ, μ_i	magnetic susceptibility
k	thermal conductivity
$\mathbf{k}$	unit vector (Z-axis)
L	inductance, self-inductance
L*	lambert
l	length
lm*	lumen
ln	logarithm to the base e
log	logarithm to the base 10
L_{12}, etc.	mutual inductance
λ	line density of charge
λ	wavelength in free space
λ_c	critical or cutoff wavelength
λ_r	resonance wavelength
$\mathbf{m}$	magnetic moment
m	mass

m*	meter
mL*	millilambert
μ	amplification factor of an electron tube ($\mu=\mu_{pg}$) (see μ factor)
μ	magnetic permeability
μ_i, κ	magnetic susceptibility, intrinsic magnetic permeability ($\mu_i=(\mu_r-1)\mu_v$)
μ_{j3j2}	μ factor of an electron tube, relative effect of change on electrode "$j3$" to change on electrode "$j2$" (conditions of other electrodes to be specified)
μ_0	initial magnetic permeability
μ_r	relative magnetic permeability
μ_v	magnetic permeability of evacuated (free) space
N	number of turns or conductors
n	number per unit of measurement
ν	reluctivity $\left(\nu=\frac{1}{\mu}\right)$
ω	angular frequency ($\omega=2\pi f$)
Ω*	ohm
ω	solid angle
ω_r	resonance angular frequency
$\mathbf{p}$	electric moment of a dipole
$\mathbf{P}$	electric polarization ($\mathbf{P}=(\epsilon_r-1)\epsilon_v\mathbf{E}$)
p	number of poles
p	oscillation constant, complex frequency ($p=\delta+j\omega$)
$\mathcal{P}$	permeance
P, p	power, active power
p	pressure
pf*	power factor
P_g	grid dissipation power
P_i	input power
P_o	output power
P_p	anode or plate dissipation power
P_q	reactive voltamperes (reactive power)
P_s	voltamperes (apparent power)
Φ	magnetic flux (flux of magnetic induction)
ϕ, θ	phase displacement, phase angle
Φ	radiant flux $\left(\Phi=\frac{dU}{dt}\right)$
π	pi, a ratio ($\pi=3.14159\cdots$)
ψ	dielectric flux, displacement flux (flux of electric displacement)
Q	figure of merit of reactor
Q, q	quantity of electricity
	quantity of electric charge
q	rate of flow of heat
Q	quantity of heat
Q	quantity of light

* Items indicated by * are abbreviations and should not be used in equations and should not be confused with letter symbols for the magnitude of quantities.

R, r	radius
$\mathcal{R}$	reluctance
R, r	resistance
rf*	radio frequency
rms*	root-mean-square
rss*	root-sum-square
ρ	reflection coefficient
ρ	reflection factor
ρ	resistivity or specific resistance
ρ	volume density of electric charge
s	dynamic sensitivity of a phototube
S	elastance, self-elastance $\left(S=\frac{1}{C}\right)$
S	entropy
s	length of path
S	standing-wave ratio
s	slip (in electrical machinery)
S	static sensitivity of a phototube
S_F, s_F	luminous sensitivity of a phototube
SWR*	standing-wave ratio (voltage or current)
S_{2870}, s_{2870}	2870° Kelvin tungsten sensitivity of a phototube
σ, γ	conductivity
$\sum$	summation
σ	surface density of charge
T	temperature
t	time
T	period
t_d	deionization time
t_f	time of pulse fall
T_{Hg}	temperature of mercury condensate
t_k	cathode heating time
t_p	time of pulse duration
t_r	time of pulse rise
τ	time constant
τ	transmission factor
θ, ϕ	phase displacement, phase angle
θ	transit angle
U	internal, intrinsic energy
U	radiant energy
V, v, E, e	electric potential difference, voltage, electromotive force
$\mathbf{v}$	velocity
v*	volt
V	volume
V_r	retarded electric scalar potential
$\mathbf{W}$	radiant flux density
w*	watt
W	work, energy
X, x	reactance, self-reactance
X_C	capacitive reactance
X_L	inductive reactance
$\mathbf{Y}, Y, y$	admittance
$\mathbf{Z}, Z, z$	impedance, self-impedance
Z_0	characteristic impedance, surge impedance

SECTION II

GRAPHICAL SYMBOLS FOR CIRCUIT ELEMENTS

201. ADJUSTABLE (See CONTACT or VARIABLE)

202. AMPLIFIER

202.1. In single-line diagrams

202.2. For use when more leads are shown

203. ANTENNA, GENERAL

203.01. *Characteristics may be indicated.*

203.1. Counterpoise

203.2. Dipole

203.201. *Polarization may be indicated by "HORIZONTAL POLARIZATION" or "VERTICAL POLARIZATION" near symbol.*

203.3. Loop

204. ARRESTOR or PROTECTOR, GENERAL

204.1. Carbon block

204.2. Horn gap

205. BALLAST LAMP (See LAMP)

206. BATTERY

206.01. *Long line always positive but polarity may be indicated in addition.*

206.02. *Voltage may be indicated.*

207. BINDING POST (See TERMINAL)

208. CABLES

208.1. Coaxial

208.2. Pair — P OR P

208.3. Pair with grounded shield

208.4. Switchboard

208.5. Twin-conductor coaxial

209. CAPACITOR, GENERAL

209.1. Differential, variable

209.2. Electrolytic

209.3. Split-stator, variable

209.4. Variable

210. CIRCUIT BREAKER

211. CIRCUIT ELEMENT, GENERAL

211.01. *Indicate type of apparatus by appropriate words or abbreviations in box.*

212. CONNECTING BLOCK (See TERMINAL)

213. CONTACT

213.1. General

213.11. Normally closed — OR

213.12. Normally open — OR

213.2. Adjustable or sliding contact for resistors, inductors, etc., also fixed contact for jacks, keys, plugs, relays, switches, etc. — OR

213.3. Moving contact for jacks, keys, plugs, relays, switches, etc.

213.31. Locking

213.32. Nonlocking

213.33. Vibrator reed

214. CORE, MAGNET OR RELAY

214.01. *Abbreviations in box may be used to indicate specific characteristics.*

214.1. Air — No symbol

214.2. Iron

214.3. Nonferrous

214.4. Powdered iron

214.5. Variable or movable core

214.501. *Dot indicates variable or movable core.*

215. CRYSTAL

215.1. Detector

215.101. *Arrow points in direction of forward current flow.*

215.2. Piezoelectric

215.3. Rectifier (See RECTIFIER)

216. DETECTOR (See CRYSTAL)

217. DIPOLE (See ANTENNA)

218. ELEMENT (See CIRCUIT ELEMENT, GENERAL)

219. FUSE

220. SOURCE OF ELECTROMOTIVE FORCE

220.1. Ac

220.2. Dc (See BATTERY)

221. GROUND

222. HANDSET, TELEPHONE

223. HEADSET (See RECEIVER)

224. HEATER, ELEMENT FOR THERMOSTAT, OVEN, ETC. (Also see THERMISTOR, THERMOCUTOUTS)

225. INDUCTOR, GENERAL

225.1. Applications

225.11. Inductor with variable powdered-iron core

225.12. Inductor with powdered-iron and nonferrous metal core

226. JACK

226.1. Three-conductor

226.2. Two-conductor

227. KEY SWITCH (See SWITCH)

228. KEY, TELEGRAPH

229. LAMP

229.1. Illuminating

229.2. Resistance

229.3. Switchboard

230. LOOP (See ANTENNA)

231. METER

231.01. *Indicate specific type of meter by abbreviation in the circle.*

A	*Ammeter*	PF	*Power factor*
AH	*Ampere-hour*	TT	*Total time*
F	*Frequency*	V	*Voltmeter*
G	*Galvanometer*	VA	*Volt-ampere*
MA	*Milliammeter*	W	*Wattmeter*
μA	*Microammeter*	WH	*Watthour*

232. MICROPHONE, GENERAL

232.1. Capacitor

232.2. Crystal

232.3. Handset (See HANDSET)

232.4. Moving coil

232.5. Velocity

233. NETWORK (See CIRCUIT ELEMENT, GENERAL)

234. PICK-UP (See MICROPHONE or REPRODUCER)

235. PLUG

235.1. For use with jack

235.11. Three-conductor

235.12. Two-conductor

235.2. For use with receptacles

235.21. Polarized three-conductor

235.22. Polarized two-conductor

235.23. Two-conductor

236. PROTECTOR (See ARRESTOR)

237. RECEIVER, GENERAL

237.1. Double headset

237.2. Single or hearing-aid headset

238. RECEPTACLES

238.1. Polarized three-conductor

238.2. Polarized two-conductor

238.3. Two-conductor

239. RECTIFIER

239.01. *Arrow points in direction of forward current flow.*

240. RELAY WINDING

240.1. Inductive — OR

240.101. *Dot indicates inner end of winding.*

240.2. Noninductive

240.3. Applications

240.31. With break contacts

240.32. With make contacts

240.33. With multiple contacts

241. REPEATER (For single line diagrams)

241.1. Four-wire

241.2. Two-wire

242. REPRODUCER (PICK-UP), GENERAL

242.1. Crystal

242.2. Electromagnetic

243. RESISTOR, GENERAL

243.1. Tapped, with leads

243.2. Tapped, with terminals

243.3. Variable

244. SHIELD, GENERAL

244.1. Enclosing

244.2. Grounded — OR

245. SPEAKER OR LOUDSPEAKER, GENERAL

245.1. Electromagnetic moving coil

245.2. Permanent-magnet moving coil — PM

246. SWITCH

246.1. Key

246.11. Break

246.12. Make

246.13. Multiple

246.2. Knife

246.21. Double pole—single throw

246.22. Single pole—single throw

246.33. Triple pole—double throw

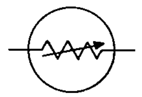
246.3. Multipoint

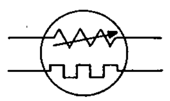
247. TERMINAL

247.1. Terminal or binding post

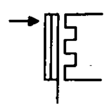
247.2. Terminal strip or connecting block 

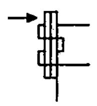
248. THERMISTOR

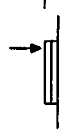
248.1. Integral heater 

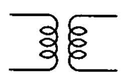
248.2. Separate heater 

249. THERMAL CUTOUT

249.1. External Heater 

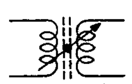
249.2. Integral Heater 

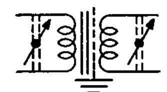
249.3. Self-heated 

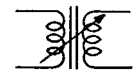
250. TRANSFORMER, GENERAL 

250.01. *Polarity may be indicated by "+" and "−".*

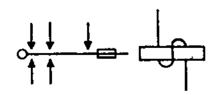
250.1. Applications

250.11. Adjustable powdered-iron core 

250.12. Magnetic core, individually adjustable powdered-iron cores with grounded shield on one winding only 

250.13. Magnetic core, variable coupling 

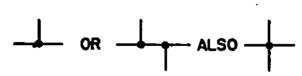
251. VARIABLE 

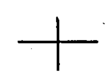
252. VIBRATOR 

252.01. *Fixed contacts (5, 4, 3, 2, or 1) should be shown.*

253. WINDING, RELAY (See RELAY)

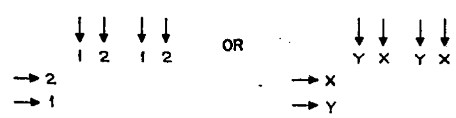
254. WIRING, DRAFTING CONVENTIONS

254.1. Wires connected 

254.2. Wires crossing but not connected 

254.3. Wiring omitted

254.301. *Wiring between like letters or numbers is understood.*



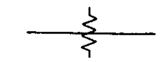
SECTION III

GRAPHICAL SYMBOLS FOR COAXIAL AND WAVEGUIDE ELEMENTS

301. GENERAL NOTES

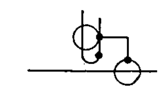
301.01. *Single-line schematics are standard for coaxial and waveguide circuits.*

301.02. *A recognition symbol is to be used at the beginning and the end of each kind of transmission path. Recognition symbols may be used at intermediate points if needed for clarity. The recognition symbols are shown in 320.*

302. ATTENUATOR 

303. COUPLING BY LOOP, COUPLING BY LOOP TO SPACE

303.1. Coupling by loop to guided transmission path 

303.11. Application. Coupling by loop from coaxial to circular waveguide with dc grounds connected 

304. COUPLING BY APERTURE WITH AN OPENING OF LESS THAN FULL WAVEGUIDE SIZE

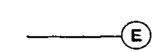
304.01. *Designate E, H, or HE.*

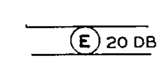
304.011. *"E" indicates that the physical plane of the aperture is perpendicular to the transverse component of the major E lines.*

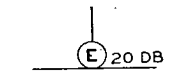
304.012. *"H" indicates that the physical plane of the aperture is parallel to the transverse component of the major E lines.*

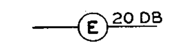
304.013. *"HE" indicates coupling by all other kinds of apertures.*

304.014. *Transmission loss may be indicated.*

304.1. Coupling by aperture to space 

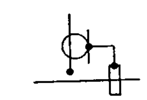
304.2. Four ends of transmission path available 

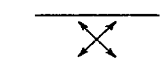
304.3 Three ends of transmission path available 

304.4. Two ends of transmission path available 

305. COUPLING BY PROBE, COUPLING BY PROBE TO SPACE (See OPEN)

305.1. Coupling by probe to a guided transmission path 

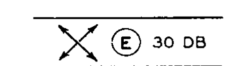
305.11. Application. Coupling by probe from coaxial to rectangular waveguide with grounds connected 

306. DIRECTIONAL COUPLER, GENERAL 

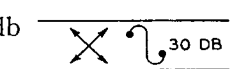
306.01. *Arrows indicate direction of power flow.*

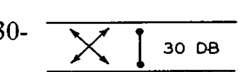
306.02. *Number of coupling paths may be indicated.*

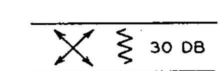
306.03. *Transmission loss may be indicated.*

306.1. Aperture coupling 

306.101. *Designate E, H or HE.*

306.2. Coaxial loop coupling, 30-db attenuation 

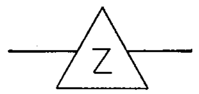
306.3. Coaxial probe coupling, 30-db attenuation 

306.4. Resistance coupling 

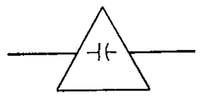
307. DISCONTINUITY

307.01. *To be drawn for a component that exhibits the properties of one of the kinds of circuit elements throughout the frequency range of interest.*

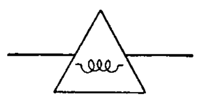
307.1. Equivalent series element, general



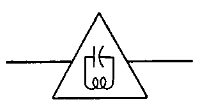
307.11. Capacitive reactance



307.12. Inductive reactance



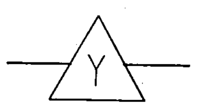
307.13. *LC* circuit with infinite reactance at resonance



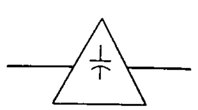
307.14. *LC* circuit with zero reactance at resonance

307.15. Resistance

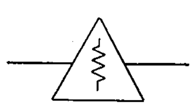
307.2. Equivalent shunt element, general



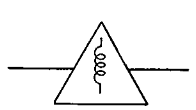
307.21. Capacitive susceptance



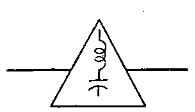
307.22. Conductance



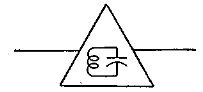
307.23. Inductive susceptance



307.24. *LC* circuit with infinite susceptance at resonance

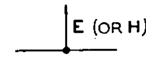


307.25. *LC* circuit with zero susceptance at resonance

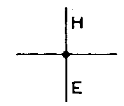


308. JUNCTION (APERTURE FULLY OPEN)

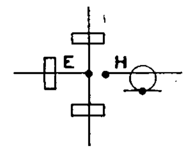
308.1. Tee or wye



308.2. Hybrid



308.21. Application. Waveguide and coaxial couplings



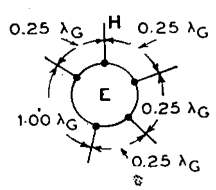
308.3. Hybrid, circular

308.301. *Letter inside circle indicates that the plane of the field in the ring is normal to the axis of the ring.*

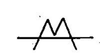
308.302. *If the arm has coupling different from 308.301, it should be marked accordingly.*

308.303. *Critical distances should be labeled in terms of guide wavelengths.*

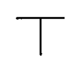
308.31. Application. Five-arm circular hybrid



309. MODE SUPPRESSION

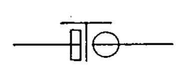


310. MODE TRANSDUCER

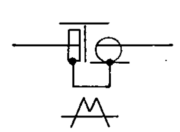


310.1 Applications

310.11. Transducer from rectangular to circular waveguide



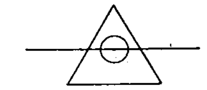
310.12. Transducer from rectangular waveguide to coaxial with dc grounds connected and mode suppression



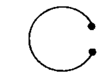
311. MOVABLE

312. OPEN (See COUPLING BY PROBE)

313. PHASE SHIFTER

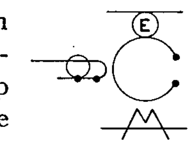


314. RESONATOR (EXCLUDING PIEZOELECTRIC AND MAGNETOSTRICTION DEVICES)

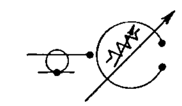


314.1 Applications

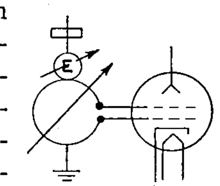
314.11. Resonator coupled by an aperture to a guided transmission path and by a loop to a coaxial. With mode suppression.



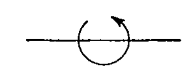
314.12. Resonator coupled by a probe to a coaxial. With tuning. Variable *Q*.



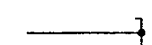
314.13. Resonator, attached to an electron device, with variable coupling by an aperture to rectangular waveguide. With variable tuning and dc ground connected.



315. ROTATION

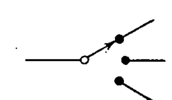


316. SHORT (TRANSMISSION PATH TERMINATED IN A SHORT)



316.1. Movable short

317. SWITCH (ANY NUMBER OF TRANSMISSION PATHS MAY BE USED)

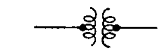


318. TEST POINT (WHERE IT IS INTENDED THAT THE GUIDED TRANSMISSION PATH MAY BE BROKEN FOR TEST OR MEASUREMENT)

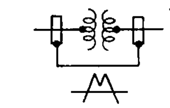
318.01. *If it is important that dc paths be open, a note may be added.*

318.02. *Connector types may be indicated.*

319. TRANSFORMATION FOR TAPERS AND STEP TRANSFORMERS WITHOUT MODE CHANGE



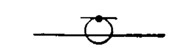
319.1. Application. Transformer with dc ground connections and mode suppression



320. TRANSMISSION PATH, GUIDED

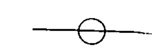
320.01. *A single line represents a transmission path and extends for its entire length. The recognition symbol is used at the beginning and the end of each kind of transmission path, and at intermediate points as needed for clarity. Mode may be indicated.*

320.1. Coaxial

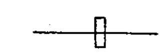


320.2. Single conductor

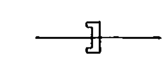
320.3. Waveguide, circular



320.4. Waveguide, rectangular



320.5. Waveguide, ridged



SECTION IV

GRAPHICAL SYMBOLS FOR ELECTRON TUBE ELEMENTS

401. GENERAL NOTES

401.01. *A type having more than one cathode is shown symbolically as having one cathode unless separate cathode connections are made.*

401.02. *Two or more grids, internally connected, are shown separately when separate functions are performed and the multiplicity is not due to a physical division.*

401.03. *Two or more heaters are shown as a single heater unless the heaters have entirely separate connections. A tap is shown from the vertex of the symbol regardless of the actual voltage division.*

401.04. *The note in 401.03 applies to filaments also. A tap, when present, is shown from the vertex of the filament symbol regardless of the actual voltage division.*

401.05. *A type having a grid adjacent to a plate, but internally connected to the plate to form a part of it, is shown as having a plate only.*

401.06. *Component symbols may be rotated on the drawing to fit the circuit being prepared.*

401.07. *Standard symbols such as the inclined arrow for tunability, connecting dotted lines for ganged components, etc., may be added to a tube symbol to extend the meaning of the tube symbol provided such added feature or component is permanent to the tube. Associated components which are not a permanent part of the tube, although possibly inherent to the operation, such as focusing coils, magnetron fields, demountable resonators, etc., are not shown as a part of the tube symbol but may be added to the circuit combination as standard symbols as required.*

402. COUPLING FROM AN ELECTRON TUBE TO A COAXIAL OR WAVEGUIDE ELEMENT

402.1. Aperture (see 304)

402.2. Loop (see 303)

402.3. Probe (see 305)

403. ELECTRODES

403.1. Collecting

403.11. Anode or plate, including collector

403.12. Collecting and emitting

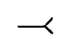
403.121. Dynode

403.13. Target, X-ray

403.14. Target, X-ray, rotating

403.2. Controlling

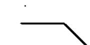
403.21. Deflecting, reflecting or repelling electrode, electrostatic



403.22. Excitor, contactor type

403.23. Grid, including beam-confining or beam-forming electrodes

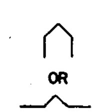
403.24. Ignitor



403.3. Emitting

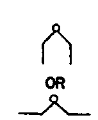
403.31. Cathode, cold, including ionic-heated cathode

403.32. Cathode, directly heated, filamentary type



403.33. Cathode, indirectly heated

403.34. Cathode, ionic-heated with supplementary heater

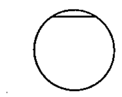


403.35. Cathode, photoelectric

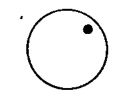
403.36. Cathode, pool

404. ENVELOPES

404.1. Cathode-ray tube, fluorescent screen

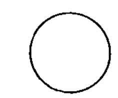


404.2. Gas filled

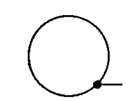


404.201. *Locate dot as convenient.*

404.3. High vacuum



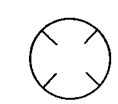
404.4. Metal, with connection



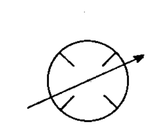
404.5. Resonator, integral cavity type

404.501. *Electrodes associated with external cavity resonators are shown as functional symbols; as, grid or collector or plate.* (See 408.22 and 314.13).

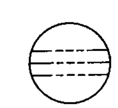
404.51. Anode, multiple cavity



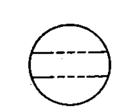
404.52. Anode, multiple cavity, tunable



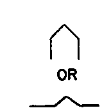
404.53. Cavity, multiple, grid-type associated electrodes



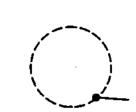
404.54. Cavity, single, grid-type associated electrodes



405. HEATER, INCLUDING HEATER FOR THERMO-ELEMENTS

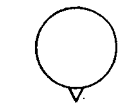


406. SHIELD, EXTERNAL OR INTERNAL

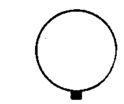


407. TERMINALS AND ORIENTATION

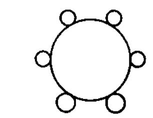
407.1. Bayonet, boss, or other reference, base



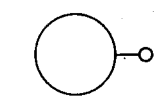
407.2. Key, base



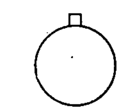
407.3. Terminals, base



407.4. Terminal, envelope, flexible

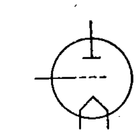


407.5. Terminal, envelope, rigid

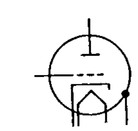


408. APPLICATIONS

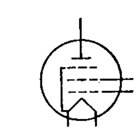
408.10. Triode with filamentary cathode



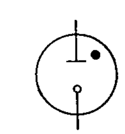
408.11. Triode with indirectly heated cathode and envelope connection



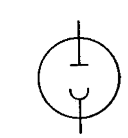
408.12. Pentode with suppressor or beam-confining electrodes internally connected



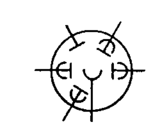
408.13. Cold cathode, gas-filled diode



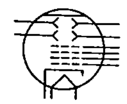
408.14. Vacuum phototube



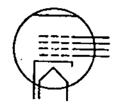
408.15. Multiplier phototube



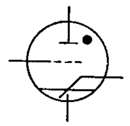
408.16. Cathode-ray tube with electrostatic deflection electrodes



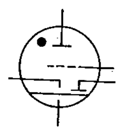
408.17. Cathode-ray tube for magnetic deflection



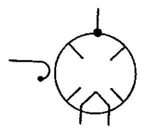
408.18. Mercury-pool tube with ignitor and control grid



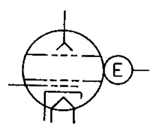
408.19. Mercury-pool tube with excitor, control grid, and holding anode



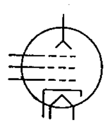
408.20. Integral-cavity magnetron, loop-coupled



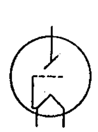
408.21. Reflex klystron, integral cavity, aperture-coupled



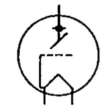
408.22. Reflex klystron, demountable-cavity type



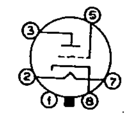
408.23. X-ray tube with filamentary cathode and focusing grid



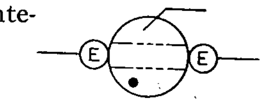
408.24. X-ray tube with rotating anode



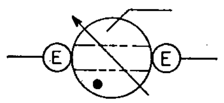
408.25. Triode with base connections indicated, keyed base



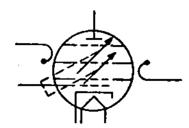
408.26. Gas-filled T-R tube, integral cavity, aperture-coupled, with ignitor



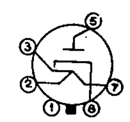
408.27. Gas-filled T-R tube, tunable integral cavity, aperture-coupled, with ignitor



408.28. Double-cavity klystron, integral cavity, permanent external ganged tuning, loop-coupled

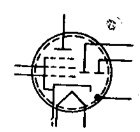


408.29. Rectifier with filament tap, base connections indicated, with base key



408.30. Gas-filled ballast tube

408.31. Pentode with two diode plates and internal shield



GREEK ALPHABET

LETTERS		NAME
Capital	Small	
Α	α	alpha
Β	β	beta
Γ	γ	gamma
Δ	δ	delta
Ε	ϵ	epsilon
Ζ	ζ	zeta
Η	η	eta
Θ	θ, ϑ	theta
Ι	ι	iota
Κ	κ	kappa
Λ	λ	lambda
Μ	μ	mu
Ν	ν	nu
Ξ	ξ	xi
Ο	ο	omicron
Π	π	pi
Ρ	ρ	rho
Σ	σ, ς	sigma
Τ	τ	tau
Υ	υ	upsilon
Φ	ϕ, φ	phi
Χ	χ	chi
Ψ	ψ	psi
Ω	ω	omega

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	Price
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