Appendix B: SI Unit Notation (taken from IET guidelines)

B.1 UNIT SYMBOLS

Unit symbols are printed in upright roman characters and are used after numerical values (e.g. 10 A, but 'a few amperes'). They are the same in singular and plural, and are not followed by a full point except for normal punctuation, e.g. at the end of a sentence. A space is set between the number and its unit symbol (e.g. 240 V, not 240V). The decimal multiples and submultiples given below are prefixed, without a space, to the unit symbols (e.g. 6.6 kV). Compound decimal prefixes should not be used (e.g. pF, not µµF).

1018	exa	E				10-3	milli	m
1015	peta	P	102	hecto	h	10-6	micro	µ
1012	tera	T	101	deca	da	10-9	nano	n
109	giga	G	10-1	deci	d	10-12	pico	p
106	mega	M	10-2	centi	c	10-15	femto	f
103	kilo	k				10-18	atto	a

Powers in steps of 3 are preferred, but some others have common usage (e.g. centimetre cm, decibel dB).

Compound symbols

In a compound unit symbol, multiplication is denoted by either a dot or a space (e.g. N·m, N.m, N m). The last form may also be written without a space, provided that special care is taken when the symbol for one of the units is the same as the symbol for a prefix, e.g. mN means millinewton, not metre newton. Unit division may be indicated by a solidus (e.g. V/m). Not more than one solidus should appear in a combination (e.g. 5 m/s^2, not m/s/s). In some cases parentheses or negative powers may be used for clarity (e.g. 1/s or s^{-1}; J/(m s K) or J m^{-1} s^{-1} K^{-1}).

B.2 THE INTERNATIONAL SYSTEM OF UNITS

The International System of Units (SI) establishes three kinds of units: base, supplementary, and derived. In addition, various other units are recognised for continued use alongside SI units.

SI base units and supplementary units

There are seven base units and two supplementary units, as shown below.

Quantity	*Name of base unit*	*Unit symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd
Plane angle	radian	rad
Solid angle	steradian	sr

The definitions of these units are as follows:

metre (m):
The metre is the length of the path travelled in vacuum by light during (1/299 792458) second.

kilogram (kg):
The mass of the international prototype of the kilogram.

second (s):
The duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

ampere (A):
That constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

kelvin (K):
The unit of thermodynamic temperature is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water (but see footnote)*

candela (cd):
The luminous intensity, in a given direction, of a source which emits monochromatic rays with a frequency 540×10^{12} hertz and whose energy intensity in that direction is (1/683) watt per steradian.

mole (mol):
The amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

radian (rad):
The plane angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius.

steradian (sr):
The solid angle which, having its apex at the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

The supplementary units 'radian' and 'steradian' are to be regarded as dimensionless derived units which may be used or omitted in the expressions for derived units.

* In addition to the thermodynamic temperature (symbol T), expressed in kelvins, use is also made of Celsius temperature (symbol t) defined by the equation $t = T - T_0$, where $T_0 = 273.15$ K by definition. The unit 'degree Celsius' is equal to the unit 'kelvin', but 'degree Celsius' is a special name in place of 'kelvin' for expressing Celsius temperature. A temperature interval or a Celsius temperature difference can be expressed in degrees Celsius as well as kelvins but kelvins is to be preferred.

SI derived units

The units of all physical quantities are derived from the base an supplementary SI units, and certain of them have been named. These, together with some common compound units, are given here:

Quantity	*Unit name*	*SI Units*	*Unit symbol*
Force	newton	kg m/s^2	N
Energy	joule	N m	J
Power	watt	J/s	W
Pressure, stress	pascal	N/m^2	Pa
Electrical potential	volt	J/C, W/A	V
Electric charge, electric flux	coulomb	A s	C
Magnetic flux	weber	V s	Wb
Magnetic flux density	tesla	Wb/m^2	T
Resistance	ohm	V/A	Ω
Conductance	siemens	A/V	S
Capacitance	farad	C/V	F
Inductance	henry	Wb/A	H
Celsius temperature	degree celsius	K	^{o}C
Frequency	hertz	s^{-1}	Hz
Luminous flux	lumen	cd sr	1m
Illuminance	lux	lm/m^2	lx
Activity (radiation)	becquerel	s^{-1}	Bq
Absorbed dose	gray	J/kg	Gy
Dose equivalent	sievert	J/kg	Sv

Mass density	kilogram per cubic metre	kg/m^3
Torque	newton metre	N m
Electric field strength	volt per metre	V/m
Magnetic field strength	ampere per metre	A/m
Thermal conductivity	watt per metre	Wm^{-1}
Luminance	candela per square metre	cd/m^2

Non-SI units

Some commonly used units not within the SI range are:

Angle	degree ($1^{o} = \pi/180$ rad); minute $1' = (1/60)^{o}$); second $1'' = (1/60)'$); revolution (1 r = 2 π rad)
Energy	calorie (cal); electronvolt(eV); watt-hour (W h)
Length	ångström (Å)
Mass	ton (ton); tonne (=metric ton) (t); unified atomic mass mass unit (u)
Pressure, stress	atmosphere (atm); bar (bar); torr (Torr)
Rotational frequency	revolution per minute (r/min)*, revolution per second (r/s)*
Time	minute (min; hour (h); day (d); year (a)
Volume	litre (L, 1 or litre)

* These are widely used for rotational frequency in specifications of rotating machinery

B.3 QUANTITY SYMBOLS FOR ELECTROTECHNICS

Quantity	***Symbol***	***SI unit***
Admittance	Y	S
Attenuation	A	Np† dB†
Attenuation coefficient	α	m^{-1}
Bandwidth	B	Hz
Capacitance	C	F
Charge	Q	C
Charge density, surface volume	σ	C/m^2
	ρ	C/m^3
Conductance	G	S
Conductance, mutual	g_m	S
Conductivity	γ, σ	S/m
Control angle, rectifier	α	rad
inverter	β	rad
Coupling factor	k	-
Current	I	A
Current density, area	J	A/m^2
linear	A	A/m
Current linkage	θ	A
Damping coefficient	δ	s^{-1}
Decrement, logarithmic	λ	-
Dipole moment electric	p	C m
magnetic	j	Wb m
Dissipation factor	d	-

Distortion factor	d	-
Electric (space) constant	ε_0	F/m
Electric field strength	E	V/m
level	L_E	dB†
Electric flux	Ψ	C
Electric flux density	D	C/m^2
Electric polarisation	P	C/m^2
Electric susceptibility	χ, $\chi e\chi$, χe	-
Electromotive force	E	V
Energy	E,We	J
Energy, Fermi	ε_F	J‡
Feedback factor	ß	-
Frequency	f	Hz
Frequency, angular	ω	rad/s
deviation	Δf	Hz
complex angular	π	s^{-1}
Gain	G	-
Group velocity	c_g,v_g	m/s
Group delay	t_g	s
Hall coefficient	R_H, A_H	m^3/C
Impedance	Z	Ω
Impedance characteristic	Z_0	Ω
surge	Z_0	Ω
Inductance, self	L	H
mutual	L_{jk},M	H
Leakage factor	σ	-
Loss angle	d	rad
Magnetic (space) constant	μ_0	H/m
Magnetic field strength	H	A/m
Magnetic flux	Φ	Wb
density	B	T
linkage	ψ	Wb, wB-t†
Magnetic (area) moment	m	A m^2
Magnetic polarisation	B_i, J	T
Magnetic susceptibility	ξ, K	-
Magnetic vector potential	A	Wb/m
Magnetisation	H_i,M	A/m
Magnetomotive force	F,f_m	A
Mobility	μ	m^{2}V^{-1}s^{-1}

Appendix B

Modulation factor (a.m)	m	-
index (f.m.)	δ	rad
Noise factor	F, F_n	-
power	P_n	W
temperature	T_n	K
Number of density of particles	n	m^{-3}
Number of phases	m	-
Number of pole pairs, pulses	p	-
Number of turns	N	-
Period	T	s
Permeability, absolute	μ	H/m
relative	μ_r	-
Permeance	Λ	H, Wb/A
Permittivity, absolute	ε	F/m
relative	ε_r	-
Phase angle	ϕ	rad
delay	τ_ϕ	rad
deviation	$\Delta\phi$	rad
Phase change	B	rad
Phase-change coefficient	P	rad/m
Phase velocity	c_ϕ, v_ϕ	m/s
Polarisation, electric	P	C/m^2
magnetic	B_i, J	T
Potential	V	V
Potential difference	U,V	V
Power, active	P	W
apparent	S	V A
reactive	Q	var‡
Power factor	λ	-
Power factor, sinusoidal	$\cos\phi$	-
Power-level difference	-	Np,† dB†
Poynting vector	S	W/m^2
Propagation coefficient	Q	-
Q factor, magnification	Q	-
Radiant energy	Q,W	J
Radiation resistance	R_r	Ω
Rating	S	V A,W
Reactance	X	Ω
Reflection coefficient	r,ρ	-
Refractive index	n	-

Regulation	ε	p.u.†
Reluctance	R, R_m	H^{-1}, A/Wb
Resistance	R	½
Resistance-temperature coefficients	α	K^{-1}
Resistivity	ρ	Ω m
Signal	Σ	
Slip	σ	-
Standing-wave ratio	σ	-
Susceptance	B	S
Susceptibility, electric	χ, χe	-
magnetic	χ, K	-
Transconductance	g_m	A/V,S
Transfer function	H	
Transmission factor	τ	-
Turn-, turn-off-off time	t_{on}, t_{off}	s
Voltage	V	V
Wavelength	λ	m
Work function	ϕ	J‡

Unit symbol appropriate to the physical quantity concerned
†Not an SI unit but in common use
‡More usually expressed in eV

B.4 SUBSCRIPTS AND OTHER USES OF LETTERS AND NUMBERS

It is recommended as a guiding principle for the printing of subscripts that, when these are symbols for physical quantities, they should be printed in italic type. Numbers as subscripts should be printed in roman type; numerical variables (e.g. running subscripts) should be printed in italic type. All other subscripts should be printed in roman type.

Appendix B

Some commonly used abbreviations, often occurring as subscripts, are as follows:

General

a	absolute
	acoustic
	active
	additional
	alternating
	ambient
	anode
	anti-resonance
	axial
amb	ambient
as	asynchronous
av	average
b	backward
	base
br	breakdown
c	calculated
	carrier
	case
	coercive
	collector
	correction
	critical
	cut-off
ch	chemical
cp	composite
cr	critical
d	d-axis
	damped
	delay
	deviation
	diameter
	difference
	diffuse
	direct
	dissipation
	distortion
	dynamic
dem	demodulation

e	effective
	electric
	emitter
	equivalent
	error
	external
exp	experimental
f	field
	filament, heater
	final
	forward
	frequency
fl	floating
g	airgap
	gate
	grid
	group
h	hysteresis
	height, depth
	hybrid
i	ideal
	image
	induced
	initial
	input
	instantaneous
	intermediate
	internal
	intrinsic
im	image
in	insertion
ind	indirect
j	junction
k	cathode
	knee
	iterative
	short circuit
K	transformation ratio

l	leakage
	limiting
	line
	local
	longitudinal
L	load
	large signal
m	magnetic
	magnetising
	maximum
	measured
	mechanical
	mutual
	peak value
max	maximum
med	median
min	minimum
mod	modulation
n	natural
	noise
	nominal
o	output
	spherical characteristic
	in vacuo
oc	open circuit
opt	optical
or	original
ov	overload
p	parallel, shunt
	parasitic
	pole, or pair of poles
	primary
	psophometric
	pulse
pd	pull down
ph	phase
pk	peak
pt	punch through
pu	pull up
p-p	peak-to-peak

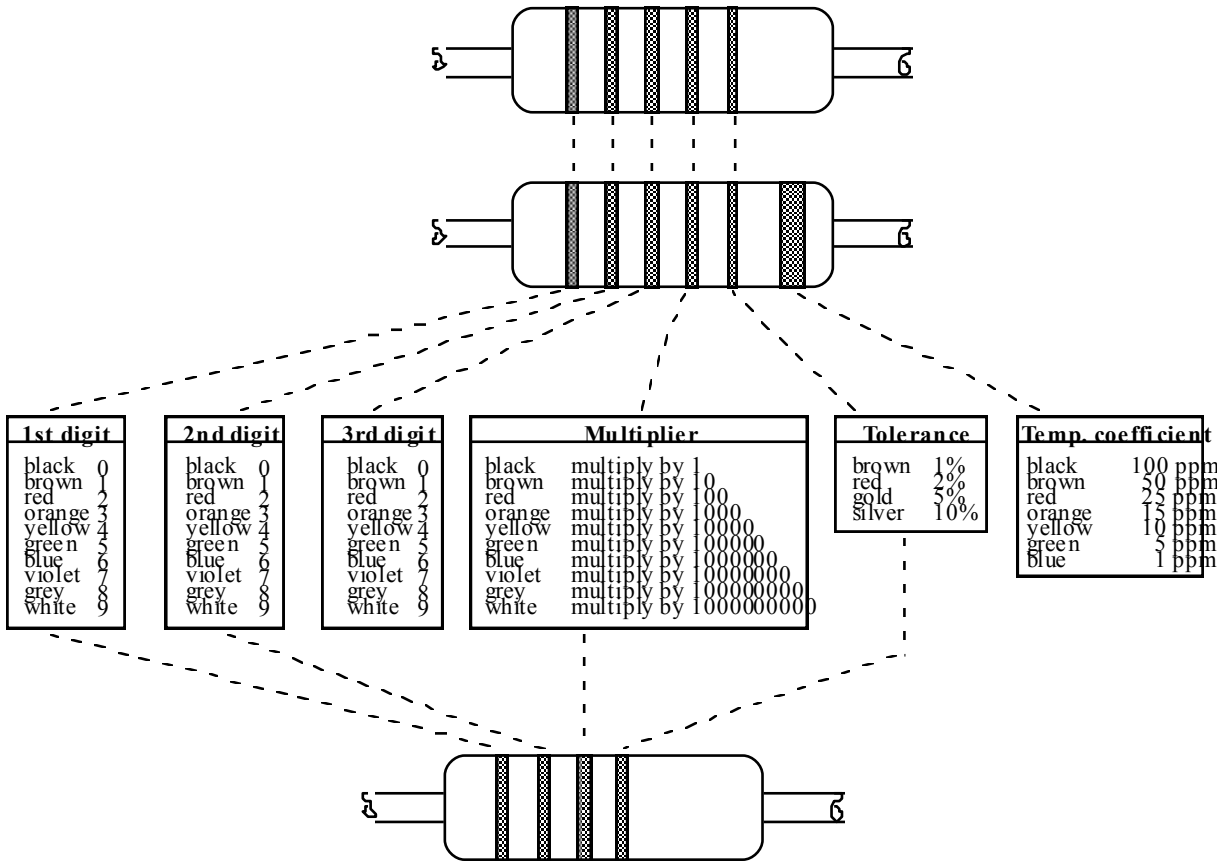
q	q-axis
	quadrature
	quiescent
	turn off
r	radial
	radiation
	rated
	real
	relative
	reflection
	remanent
	residual
	resonance
	resulting
	reverse
	reverse transfer
	rotational
	rotor
ref	reference
rms	r.m.s. value
s	secondary
	segment
	series
	signal
	spherical
	standardised
	static
	stator
	steady state
	storage
	synchronous
sat	saturation
sc	short circuit
sim	simultaneous
sin	sinusoidal
stg	storage
suc	successive
t	tangential
	total
	transient
	transmission
	transverse
th	thermal

	theoretical
tot	total
u	usual
	useful
v	luminous
	varying
	vacuum
	valley
x	reactive
	crosstalk
0	characteristic
	free space
	no load
	zero frequency
1	full load
	fundamental
	input
	port 1
	positive sequence
	primary
2	negative sequence
	output
	port 2
	second harmonic
	secondary
3	tertiary
∥ , p	parallel
P, n	perpendicular
0, s	spherical

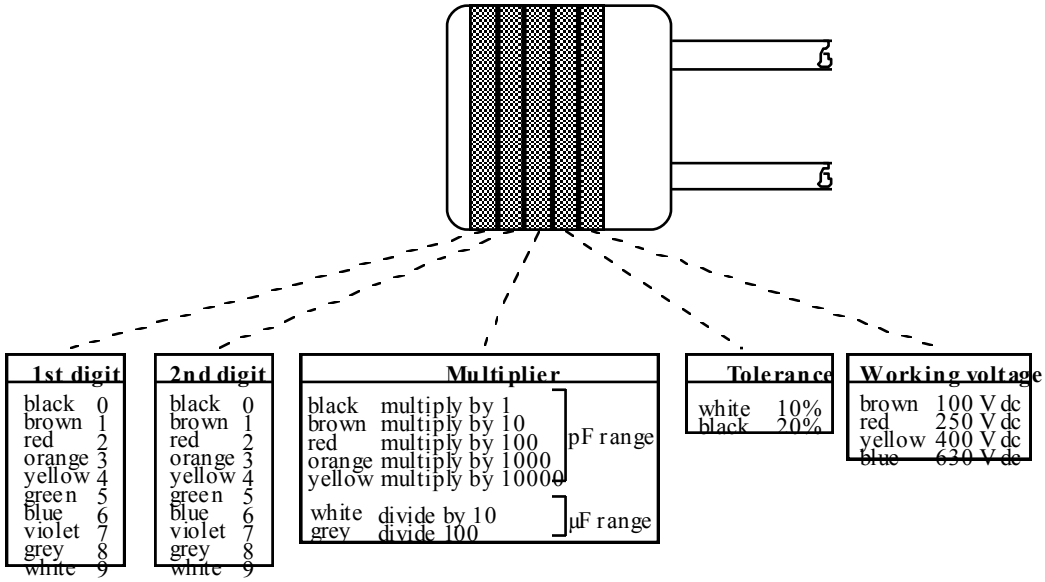
— at infinity

Appendix B

Resistor colour codes



Capacitor colour codes



Some standard decade values

E24 :	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
E12 :	10		12		15		18		22		27		33		39		47		56		68		82	
E6 :	10				15				22				33				47				68			