Units, Symbols and Style Guide for Power Electronics Documents

This document is intended as a guide for writers of specifications, catalogs, application notes and correspondence in power electronics. It is derived from the current international standard, ANSI/IEEE Std 260.1-1993, used by the electronics industry world-wide when writing in English. The standard was prepared by the Standards Coordinating Committees of the following societies of the IEEE: Circuits and Devices, Communications Technology, Computer, Electromagnetics and Radiation, Energy and Power, Industrial Applications, and Signals and Applications. The initial section, *Style*, was derived from the IEEE Standards Style Manual.

The Power Sources Manufacturer's Association has prepared this guide in hope that it will lead to more uniform documentation and correspondence in the power electronics industry. This will enhance communication between vendors, customers and all other related businesses. Clearer communication will reduce the cost of doing business and benefit the industry in its entirety.

Style

Throughout this guide, square brackets [ ] will be used for examples of the topic.

Separation of quantity and unit --- In the expression for a quantity, leave a space between the numerical value and the unit symbol. [1 V, not 1V]

Abbreviations and acronyms --- Technical abbreviations and acronyms should be used to save time and space, but only if their meaning is unquestionably clear to the reader. The first use shall be spelled out, followed by the abbreviation or acronym itself in parentheses. Exceptions to this are approved Systeme International (SI) units. [The power factor correction (PFC) section is 95% efficient.]

Hyphenation --- In most cases, compound adjectives should be hyphenated. Exceptions can be made when strong preferences exist. [Switched-mode power supplies are generally more efficient than linear power supplies.]

Capitalization --- The initial letter shall be capitalized in:

Clause, subclause and annex headings in documents [1. Introduction, 2. Scope, 3.6 Schedule]
Specific cross-references in text [e.g., Table 1, Figure 12, Note 2, Equation (3)]
Captions for figures and tables [Figure 3. Voltage waveform under full-load conditions.]
Column and line headings in tables [Load current, Ripple, Spikes]
Numbered list entries, as in a column of accessories or features

Units

Leading zeros --- For quantities less than 1, place a zero in front of the decimal [0.1 μF]

Numerals --- Arabic numerals shall be used for all units of measure, time, and quantity. In general text, numbers of less than 10 shall be spelled out, except before a unit of measurement. [Five power supplies were tested, and in all cases the peak-to-peak output ripple was less than 5 mV.]

Tolerances --- If tolerances are provided, the unit shall be given with both the basic value and the tolerance. [150 m ±5 mm]

Ranges --- Except in text, ranges may be written with a dash and without repeating the unit. [115-125 V] Text and dashed representations of ranges shall not be combined ["from 25 V to 50 V," not "from 25 V-50 V"]

Metric system --- In 1995, the IEEE implemented a new metric policy (IEEE Policy 9.20), which calls for measured and calculated values of quantities to be expressed in metric (SI) units in IEEE publications.

Letter symbols vs. abbreviations --- For expressing the units in which quantities are measured, letter symbols are preferred to abbreviations. Letter symbols are independent of language; abbreviations are not. [A, not amp]

Quantity symbols are usually a single letter, and are expressed in italic type.

A	area
I	current
x, y, z	Cartesian coordinates
i, j, k, n	indexes
f(x)	function of *x*

Unit symbols are used in place of the name of a unit and are printed in roman (upright) type.

cm	centimeter

e	base of natural logarithms
sin *x*	sine of *x*
$J_2(z)$, $J_n(z)$	Bessel functions
d*x*	differential of *x*

Subscripts and superscripts are governed by the above principles. Those that are letter symbols for quantities or for indexes are printed in italic type, while all others are printed in roman type.

I_o, V_i	Output current, input voltage
x_{av}	Average value of x

Mathematical expressions with numerator and denominator terms are to be unambiguous. Do not use sequential slashes. [(*a*/*b*)/*c*), *not* *a*/*b*/*c*]

SI prefixes are as follows.

Multiple	SI prefix	Symbol	Multiple	SI prefix	Symbol
10^{15}	peta	P	10^{-1}	deci	d
10^{12}	tera	T	10^{-2}	centi	c
10^{9}	giga	G	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	μ
10^{3}	kilo	k	10^{-9}	nano	n
10^{2}	hecto	h	10^{-12}	pico	p
10	deca	da	10^{-15}	femto	f

Symbols

Unit symbols useful in power electronics are as follows:

Unit	Symbol	Notes
ampere	A	SI unit of electric current
ampere (turn)	A	SI unit of magnetomotive force
ampere-hour	Ah	Also A·h
ampere per meter	A/m	SI unit of magnetic ield strength
coulomb	C	SI unit of electric charge
degree Celsius	°C	SI unit of Celsius temperature
farad	F	SI unit of capacitance
henry	H	SI unit of inductance
hertz	Hz	SI unit of frequency
joule	J	SI unit of energy, work, and quantity of heat
kilogram	kg	SI unit of mass
newton	N	SI unit of force
ohm	Ω	
second	s	SI unit of time
siemens	S	SI unit of conductance (Ω^{-1})
tesla	T	SI unit of magnetic flux density
var	var	IEC name and symbol for the SI unit of reactive power
volt	V	SI unit of voltage
volt per meter	V/m	SI unit of field strength
voltampere	VA	IEC name and symbol for the SI unit of apparent power
watt	W	SI unit of power
watt per meter kelvin	W/(m·K)	SI unit of thermal conductivity
watthour	Wh	
weber	Wb	SI unit of magnetic flux Wb Δ V·s

Unit	Symbol
kilohertz	kHz
kilohm	kΩ
kilovar	kvar
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW
kilowatthour	kWh
liter	L
liter per second	L/s
megahertz	MHz
megohm	MΩ
microsecond	μs
millisecond	ms
millivolt	mV
minute (time)	min
nanofarad	nF
nanosecond	ns
picofarad	pF

Note that names of units are not capitalized.

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