

IEEE Editorial Style Manual

For Editing References, see page 5

This style manual provides editorial guidelines for IEEE Transactions, Journals, and Letters. For spelling reference, IEEE Publications uses *Webster's College Dictionary*, 4th Edition. For guidance on grammar and usage not included in this manual, please consult *The Chicago Manual of Style*, published by the University of Chicago Press.

IEEE Transactions Editing Philosophy

The IEEE's responsibility in editing papers for the Transactions is not to make any determination on or do any editing of the technical content of the papers we work with, but is instead to render the work as readable, grammatically correct, and as consistent with IEEE style as possible.

Since we are concerned with style mainly in the sense of IEEE house style, we do not try to change an author's style of writing. We do a mechanical edit to correct or question grammatical errors, obvious inconsistencies or omissions, spelling, and punctuation. Since we work with highly technical text, we also do extensive formatting of mathematical material.

Parts of a Paper

Paper Title

In the paper title, capitalize the first letter of the first and last word and all the nouns, pronouns, adjectives, verbs, adverbs, and subordinating conjunctions (*If, Because, That, Which*). Capitalize abbreviations that are otherwise lowercase (e.g., use DC, not dc or Dc) except for unit abbreviations and acronyms. Articles (*a, an, the*), coordinating conjunctions (*and, but, for, or, nor*), and most short prepositions are lowercase unless they are the first or last word. Prepositions of more than three letters (*Before, Through, With, Without, Versus, Among, Under, Between*) should be capitalized.

First Footnote

The first footnote is made up of three paragraphs. This footnote is not numbered. All other footnotes in the paper are numbered consecutively.

The first paragraph contains the *received* and (possibly) *revised* dates of the paper. When a paper has more than one revised date, list all the dates given.

The second paragraph is made up of the authors' affiliations. For two or more authors with different affiliations, use separate sentences and paragraphs for each, using all initials with a surname. Group the authors with the same affiliation together; list the affiliations according to the order of the authors in the byline.

The third or final paragraph lists the Digital Object Identifier (DOI) number, assigned by the IEEE.

All *financial support* for the work in the paper is listed next to the first paragraph and not in the Acknowledgment at the end of the paper.

Body of a Paper

Abstract

Every published paper must contain an Abstract. Abstracts appear in text in boldface type. By nature, Abstracts shall not contain numbered mathematical equations or numbered references.

Index Terms

All papers must contain Index Terms as provided by the authors. A list of keywords is available by sending a blank email to keywords@ieee.org. Index Terms appear in boldface type as in the Abstract, in alphabetical order, and as a final paragraph of the Abstract. Acronyms are defined in Index Terms if they are defined in the paper.

Nomenclature

Nomenclature lists (lists of symbols and definitions) generally follow the Abstract and Index terms and precede the Introduction.

Text Section Headings

Standard specifications have been established for Transactions text section headings. There are four levels of section headings with established specifications: primary; secondary; tertiary; and quaternary heads.

Enumeration of section heads is desirable, but not required. The author's preference may be followed. However, the choice must be consistent throughout the paper.

Primary headings are enumerated by Roman numerals and centered above the text.

Secondary headings are enumerated by capital letters followed by followed by periods, flush left, upper and lower case, and italic.

Tertiary headings are enumerated by Arabic numerals followed by parentheses. They are indented one em, and run into the text in their sections, italic, upper and lower case, and followed by a colon.

Quaternary headings are identical to tertiary headings, except that they are indented two ems, lower case letters are used as labels, and only the first letter of the heading is capitalized.

Reference and Acknowledgment headings are unlike all other section headings in text. They are never enumerated. They are simply primary headings without labels, regardless of whether the other headings in the papers are enumerated.

Appendix headings are a special case. The primary heading(s) in the Appendix or Appendixes (note spelling of plural) are set according to the usual style, except that there is flexibility in the enumeration of the heading. The author may use Roman numerals as heading numbers (Appendix I) or letters (Appendix A). The Appendix heading is not preceded by a Roman numeral. If there is only one Appendix in the paper, the Appendix heading is unnumbered and unnamed.

Text Equations

Equations within a paper are numbered consecutively from the beginning of the paper to the end. There are some Transactions in which the author's own numbering system, such as numbering by section, e.g., (1.1), (1.2.1), (A1), is permitted.

Acknowledgment

The placement of the Acknowledgment appears after the final text of the paper, just before the References section, and after any Appendix(es).

When citing names within the Acknowledgment, use first initials only, not full names. Do not use Mr., Mrs., Ms., or Miss (list first initial and last name only). Use the Dr. or Prof. title with each name separately; do not use plural Drs. or Profs. with lists of names.

All acknowledgment of financial support must be removed from the Acknowledgment section, and placed in the first paragraph of the first footnote.

Write the Acknowledgment section to be read in the third person.

References

The numbering of references is employed by citing one reference per number. Every reference in a Transactions reference list should be a separate number entry. Use of one reference number to designate a group of references is **not allowed**.

Text Citation of Figures and Tables

All citations of figure and tables in text must be in numerical order. Citations to figures in text always carry the abbreviation "Fig." followed by the figure number. The abbreviation is used even when it begins a sentence.

Biographies

IEEE Transactions' author biographies are generally divided into three paragraphs.

The *first paragraph* begins with the author's full name and IEEE membership history. If provided by the author, the first paragraph may contain a place and/or the date of birth. Next, the author's educational background is listed. Use lower case for the author's major field of study. Always use the word "degree" after a degree title.

Include the years the degrees were received. Abbreviations for common international and domestic degrees are:

Dipl.Ing., Diplom-Physiker, Dr. ing., dr. Phil., Dr. Eng., B.S., S.B., B.A., A.B., B.Sc. (Hons.), B.S.E., B.E.E., M.Eng., M.S.(tech.), M.S.E.E., M.S.E., Civilingenir, Lic.es Sci., Lic.es Lett.

The *second paragraph* should list work and military experience, including summer and fellow jobs and consultant positions. Job titles are capitalized. The current job must have a location. Previous positions may be listed without a location. List author affiliations with non-IEEE journals. List the author's current and previous fields of interest. Do not repeat the author's name in the second paragraph; use "he" or "she".

The *third paragraph* begins with the author's title and last name (e.g., Dr. Smith, Prof. Jones, Mr. Hunter

Professional Engineer. Finally, list awards and work for IEEE committees and publications. Personal notes such as hobbies are excluded.

If no photograph is available or the Transactions does not require them, the biography is set across one column.

If no biography is available, a squib is used. For example:

James A. Author (S'xx—M'xx), photograph and biography not available at time of publication.

Other Text

Footnotes

Footnotes should be numbered in consecutive order throughout the text. The footnote numbers are superscripts in text and in the actual footnotes. In text, place the superscript footnote numbers after the punctuation such as periods, commas, and parentheses, but before colons, dashes, quotation marks, and semicolons in a compound sentence. The footnotes should be placed at the bottom of the text column in which they are cited.

List in Text

The ordering of labeling for all lists is 1), 2), 3) followed by a), b), c), and then i), ii), iii).

An example of a *run-in list* is as follows.

The carrier—phonon interaction matrices are given by: 1) polar optical phonons; 2) deformation potential optical phonons; and 3) piezoelectric acoustic phonons.

Other Types of Papers

Brief Papers are set up as full-length papers, except that the paper title is set in 16-point typeface. These papers do contain Abstracts, but do not contain biographies and photographs of the authors.

Short Papers, Correspondences, and Communications are set up like full-length papers, except that usually they are 9-point typeface. These papers do contain Abstracts, but do not contain biographies and photographs of the authors.

Comments and Replies are generally published together in that the “Author’s Reply” is in response to the Comments. The “Comments” is in response to a previously published paper. These short items may appear with or without an Abstract. Begin the first sentence with, “In the above paper [1], ...” The reference, the commented paper’s citation, is the first reference in the References section of the Comments.

Obituaries/In Memoriam may carry a photo of the person being memorialized. The name of the person appears above the photograph. The photograph is generally centered above the text. The years of birth and death are generally cited at the bottom of the photo within parentheses.

Editorial Style for Transactions

The following provides a summary of the most important style distinctions to be made in the final copy of a Transactions paper.

Acronyms

Define acronyms the first time they appear in the Abstract as well as the first time they appear in the body of the paper, written out as part of the sentence, followed by the acronym in parentheses. If the acronym is not repeated in the Abstract, do not include the acronym in parentheses. Coined plurals or plurals of acronyms do not take the apostrophe (e.g., FETs). Possessive forms of the acronym do take the apostrophe (e.g., CPU’s speed).

Indefinite articles are assigned to abbreviations to fit the sound of the first letter (e.g., an FCC regulation; a BRI).

Trademarks

The trademark symbol, TM, C, R, is not used. Capitalize the first letter in the trademark only.

Plurals

Plurals of units of measure usually do not take the “s”. For example, the plural form of 3 mil is 3 mil, but 3 bits/s instead of 3 bit/s. Plural forms of calendar years do not take the apostrophe (e.g., 1990s). To avoid confusion, plural forms of variables in math do take the apostrophe (e.g., x 's).

The En, Em, or Two-Em Dash

The en dash represents the words “to,” “through,” or “and.” Use it between page numbers (e.g., pp. 5–10), reference numbers (e.g., [5]–[10]), figure citations, (e.g., Figs. 2–4), academic years (e.g., 1996–1999), proper nouns (Bose–Einstein theory), a range of values (e.g., 10–20 cm), or for opposites (e.g., in–out). Also use the en dash in chemical abbreviations such as Ni–Al–Si. When using the en dash to represent a range, if the word “from” is used, the word “to” must be used rather than an en dash (e.g., from 5 to 50 times). The em dash is used to highlight a parenthetical phrase in a sentence (e.g., “An FIB modifies a surface by sputtering with energetic ions—usually Ga for technical reasons—in a beam with half-width of the order of 10 nm.”).

Math

- 1) Variables are set in italic; vectors and matrices are usually boldface italic.
- 2) Remove commas around variables in text.
- 3) Always add a zero before decimals, but do not add after (e.g., 0.25).
- 4) Spell out units in text without quantities (e.g., where the noise is given in decibels).
- 5) Numbers and units used as compound adjectives should be hyphenated only if needed for clarity (e.g., 10-kV voltage; 5-in-thick glass).
- 6) Use thin spaces (instead of a comma) between numbers in tens or hundreds of thousands (e.g., 60 000, 100 000, but 4000).
- 7) Use zeroth, first, n th, $(k+1)$ th, not 0^{th} , 1^{st} , 2^{nd} , 99^{th} , n^{th} , $(k+1)^{\text{st}}$.
- 8) Use the word “equation” at the start of a sentence only, but in text just use the number [e.g., in (1)], unless describing an equation, e.g., see “Darlington equation (1).”
- 9) The slash is used in place of the word “per” when it leads to the clarity of the sentence (e.g., the ratio of 16 samples/s to 35 samples/s as compared to...).
- 10) Use “indices” instead of “indexes” when referring to subscripts.
- 11) Plural variables have an “s”.

Ellipses

Ellipses may be used to show continuation in an expression (e.g., x_2, \dots, x_{16}). The type of mathematical expression will determine whether the ellipses are on the baseline or centered.

Conditions

In displayed equations, there should be a comma or parentheses and a two-em space between the main expression and the condition following it. For example,

$$X=yn^{-2}, \quad \text{for all } n=3$$

$$X=yn^{-2}, \quad \forall n=3$$

$$X=yn^{-2}, \quad \text{if } n=3-y^{-4}$$

$$X=yn^{-2}, \quad y_3, \dots, m$$

NOTE: There is no comma before a “for all” (\forall) symbol.

Compound Units

Compound units should be separated by a multidot (e.g., 4 V·s). Parentheses may be used to clarify a unit: g/(cm·s) or $\text{g}\cdot\text{cm}^{-1}\cdot\text{s}^{-1}$.

Use of Period and Commas

Equations that conclude a sentence should end with a period. The only time punctuation is used to lead into an equation when the lead-in text is a complete sentence. Example:

where we had the following:

$$x=Y+Z.$$

or, where, i.e.,

$$x=Y+Z.$$

Commas appearing at the ends of equations are deleted unless they are critical to the punctuation of the sentence containing the equation.

Displayed Equations

Certain types of material in displayed equations are automatically italic. Some simple general rules apply. All variables are italic. (e.g., x , y , n). Function names and abbreviations are Roman (sin, cos, sinc, sinh), as are units or unit abbreviations (e.g., deg, Hz,) complete words (e.g., in, out), and abbreviations of words (e.g., max, min), or acronyms (e.g., SNR). Single letter superscripts and subscripts may be italic even if they are abbreviations, unless this leads to inconsistency between italic and roman characters for similar types of subscripts.

Rules of Grammar

The principles of style given below aim to concentrate on the fundamentals of modern usage. Particular emphasis is given to the rules most commonly violated.

- 1) Form the possessive singular of nouns by adding 's.
- 2) In a series of three or more terms, use a comma after each term except the last.
- 3) Enclose parenthetical expressions between commas.
- 4) Use the semicolon, not the comma, to separate two complete sentences which form a compound sentence.
- 5) Use a colon after an independent clause to introduce a list.
- 6) Punctuation always goes inside the quotation mark, except for the colon and semicolon.
- 7) Do not use double parentheses in text expression, but keep them in math.
- 8) All acronyms and numerical plurals do not use apostrophes.
- 9) Compound nouns made from a one-syllable verb and a short adverb are one word when found that way in the dictionary.
- 10) A pair of words, modifying a third word separately, does not get a hyphen.
- 11) A hyphen is not used after the comparative or the superlative.
- 12) Do not use commas between adjectives.
- 13) Do not hyphenate predicate adjectives.
- 14) Compound verbs are generally hyphenated.

EDITING REFERENCES

A. Citing References

References in Text: References need not be cited in the text. When they are, they appear on the line, in square brackets, *inside the punctuation*. Grammatically, they may be treated as if they were footnote numbers, e.g.,

as shown by Brown [4], [5]; as mentioned earlier [2], [4]–[7], [9]; Smith [4] and Brown and Jones [5]; Wood et al. [7]

NOTE: Use *et al.* when three or more names are given.

or as nouns:

as demonstrated in [3]; according to [4] and [6]–[9].

References Within a Reference: Check the reference list for *ibid.* or *op. cit.* These refer to a previous reference and should be eliminated from the reference section. In text, repeat the earlier reference number and renumber the reference section accordingly. If the *ibid.* gives a new page number, or other information, use the following forms:

[3, Th. 1]; [3, Lemma 2]; [3, pp. 5-10]; [3, eq. (2)]; [3, Fig. 1]; [3, Appendix I]; [3, Sec. 4.5]; [3, Ch. 2, pp. 5-10]; [3, Algorithm 5].

NOTE: Editing of references may entail careful renumbering of references, as well as the citations in text.

B. Style

Reference numbers are set flush left and form a column of their own, hanging out beyond the body of the reference. The reference numbers are on the line, enclosed in square brackets. In all references, the given name of the author or

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