IEEE Transactions, Journals, and Letters

Information for Authors

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IEEE

INFORMATION FOR IEEE TRANSACTIONS, JOURNALS, AND LETTERS AUTHORS

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Information for IEEE Transactions, Journals, and Letters Authors

I. IEEE Author Rights and Responsibilities

A. Author Responsibilities

A manuscript submitted for publication to IEEE Transactions, Journals, Letters, or to the PROCEEDINGS OF THE IEEE should be original work submitted to a single IEEE Journal. It should not have been previously published and should not be under consideration for publication elsewhere.

The IEEE assumes that material submitted to its publications is properly available for general dissemination for the readership of those publications. It is the responsibility of the authors, not the IEEE, to determine whether disclosure of their material requires the prior consent of other parties and, if so, to obtain it. If an author uses charts, photographs, or other graphics from previously printed material, he/she is responsible for obtaining written permission from the publisher to use the material in his/her manuscript.

Statements and opinions given in work published by the IEEE are the expressions of the authors. Responsibility for the contents of published papers rests upon the authors, not the IEEE.

B. Rights

Occasionally an author may disagree with the referees' recommendations and with the editorial decision based on those comments. In such a case, the author shall be given the opportunity to prepare a suitably worded rebuttal to the referees' criticism and to submit the rebuttal to the Editor-in-Chief. Technical disagreements often occur in such instances because the manuscript is interpreted differently by the referee than is the intended interpretation of the author. Rebuttals can correct such erroneous interpretations. In any case, the Editor-in-Chief forwards the rebuttals to the referees for their comments, acting as an intermediary to continue to preserve the referees' anonymity. The referees return their recommendations if the argument put forth is persuasive. On the other hand, the referee is free to counter the rebuttal of the author. However the referee chooses to act, he or she furnishes additional information to the Editor-in-Chief which, together with the rebuttal of the author, provides the Editor-in-Chief with additional information on which to base a decision. The Editor-in-Chief may seek advice from additional referees during such an exchange. It is understood that such occasional lengthy exchanges will require an extension to the deadline for the final decision of the submission beyond the 90-day requirement. The author should be so informed.

The editorial policy of an IEEE publication is to be determined by the entity that sponsors or controls the publication, within the framework and policies set by the IEEE Publications Board and the IEEE Board of Directors. Implementation of these policies is the responsibility of the Editor-in-Chief of the publication. The Editor-in-Chief is, in general, the final authority on matters of content and appropriateness of material in the publication. Disputes that arise over review or acceptance of the material submitted for publication are expected to be resolved by the Editorial Board of the publication.

In the event of a challenge to the review or publishing process that cannot be resolved at the sponsoring entity level, the Vice President of Publication Services and Products shall, within 30 days of receipt of written complaint, determine whether the dispute merits a formal arbitration process. For arbitration, the Vice President shall appoint an individual who will, through consultation with parties to the dispute and with the assistance of knowledgeable members of the professional community, assess the merits of the dispute and recommend a resolution. The recommendation will be presented to the Publications Board within 120 days of the receipt of the complaint, unless a time extension is granted by the Vice President of Publication Services and Products. The decision on the matter will then be made by the Vice President of Publication Services and Products and is binding on the IEEE entity that is a party to the dispute.

C. IEEE Copyright

The IEEE Intellectual Properties Department will process all permission requests and will monitor and report on electronic reuses of IEEE-copyrighted material relative to the proposed policies described here. The procedures outlined below will enable the department to carry out these responsibilities. For additional information, inqueries may be e-mailed to copyrights@ieee.org.

A completed IEEE Copyright Form should accompany any original material when it is first submitted to an IEEE technical periodical or conference publication. In any event, an author must transfer copyright to IEEE upon being notified of the acceptance of his/her paper if the transfer has not been done prior to acceptance. IEEE will not insist on a transfer of copyright rights (other than a license to print, reprint, and distribute) in any computer programs set out in the text of the material.

The following copyright notice must be displayed on the first page of any paper copy reproduction of IEEE-copyrighted material or on the initial screen displaying IEEE-copyrighted material electronically:

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Paper Copy Preprints: A paper (hard) copy preprint may be an article that an author and/or company wishes to distribute, but that either

1) has been only recently submitted for review or
2) has been reviewed and accepted but not yet published.

Paper copy preprints must carry the following notice on the first page of the reproduction:

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> This work has been submitted to the IEEE for possible publication. Copyright may be transferred without notice, after which this version may no longer be accessible.

When the IEEE accepts the work for publication, the author must add the IEEE copyright notice to any previously posted electronic versions of the particular paper submitted and provide IEEE with the electronic address (URL, ftp address, etc.) of the primary electronic posting.

When IEEE publishes the work, the author must replace the previous electronic version of the accepted paper with either

1) the full citation to the IEEE work or
2) the IEEE published version, including the IEEE copyright notice and full citation.

Prior or revised versions of the paper must not be represented as the published version.

Collected Works: IEEE copyrighted collected works, such as conference proceedings (full text and/or abstracts) and collections of published papers (including collections distributed from a single server or created through a collection of pointers or hyperlinks that refer to versions posted by IEEE authors), may not be posted for electronic distribution without prior written permission from IEEE. Such permission will be contingent upon the placement of prominently displayed copyright and reuse notices. Another condition in granting permission will be that the posted collected work include a monitoring mechanism for authorizing access to the material and for the reporting of usage data.

Personal Servers: Authors and/or their companies shall have the right to post their IEEE-copyrighted material on their own servers without permission, provided that the server displays a prominent notice alerting readers to their obligations with respect to copyrighted material and that the posted work includes the IEEE copyright notice as shown in Section I-C above. An example of an acceptable notice is:

> This material is presented to ensure timely dissemination of scholarly and technical work. Copyright and all rights therein are retained by authors or by other copyright holders. All persons copying this information are expected to adhere to the terms and constraints invoked by each author's copyright. In most cases, these works may not be reposted without the explicit permission of the copyright holder.

Classroom Use: Instructors are free to post their own IEEE-copyrighted papers on their institution's servers, provided that appropriate copyright, credit, and reuse notices appear prominently with the posted material. Other electronic distribution of IEEE-copyrighted works on university servers may be done only with prior written permission from the IEEE.

After IEEE accepts the work for publication and the copyright has been transferred, IEEE will not allow changes or revisions to the work without further review and approval.

The IEEE and many affiliated societies provide publication and society information via Internet servers. Links to society servers are encouraged, and prior consent is not required.

II. A General Overview: Steps to Publishing in an IEEE Scholarly Publication

A. Initial Decisions

IEEE Transactions, Journals, and Letters are published by the individual societies within the IEEE representing the various fields of engineering interest. Each society/publication has its own requirements and procedures for peer review, the first step towards publication of a paper. Individual publications often give details on how the manuscript should be prepared for peer review on one of their covers.

Papers submitted for publication in the IEEE Transactions, Journals, and Letters are generally to be sent directly to the Editor(s)-in-Chief, although some publications prefer that papers be delivered through a support office at a different location. The names and addresses of the EICs and support offices can be found on the inside covers of the publications or at www.ieee.org/organizations/pubs/guide.html.

The PROCEEDINGS OF THE IEEE is an IEEE general sponsored publication with paid subscription. It does not represent one particular field of engineering interest as in Transactions, Journals, and Letters. Therefore, its manuscripts are reviewed with different criteria, but follow the same general publishing procedures (or criteria) of an IEEE society-sponsored publication.

It is the responsibility of authors who either: 1) are U.S. nationals (including green card holders); 2) work for a U.S.-based organization, regardless of where they are physically located; or 3) work at a U.S. location of a non-U.S.-based organization, to ensure that papers submitted for publication do not violate the U.S. International Traffic In Arms Regulation (ITAR). ITAR oversees articles and services covered by the U.S. Munitions List. Information in the public domain is outside the purview of ITAR. (Note: Company information that is proprietary is not considered to be in the public domain.) Authors submitting papers based on defense-related contracts should be sure to

adhere to any and all information-release clauses in those contracts. IEEE assumes that meeting government contract obligations satisfies the requirements of ITAR compliance. Periodicals editors should be sure to make mention of these responsibilities when soliciting submissions. Detailed information on ITAR (including the U.S. Munitions List) can be found on-line at www.siaed.org/WebITAR.pdf. Additional information can also be found at www.ieee.org/organizations/tab/export_compliance.html. For assistance with this issue, e-mail itar@ieee.org.

B. Formats

IEEE Transactions generally contain major manuscripts approximately 8 to 10 printed pages or 24 to 30 double-spaced pages.

IEEE Journals follow the same length criteria as Transactions, but often are focused on selected topics and more specialized areas of interest.

IEEE Letters are generally short papers of approximately three to four printed pages or nine double-spaced pages.

C. Peer Review

After the Editor/Editor-in-Chief of a publication determines that a paper is suitable for his/her publication, it will be forwarded to a group of reviewers selected for their expertise in a given field.

During this process, an author is often asked to expand, rewrite, or explain further the content of his/her paper. It is not uncommon that an author is asked to provide another draft with the suggested changes for further review.

D. Final Acceptance

Once a manuscript has received the final approval of the reviewers and Editor-in-Chief, the author will be notified and sent an IEEE Copyright Form. He/she will be asked to prepare the manuscript for final electronic publication and to possibly complete an additional information form. (See details in following sections.)

E. Preparation of Electronic and Final Manuscripts

The author will need to check the electronic guidelines on final preparation for production of manuscripts and graphics.

> **Note**: A manuscript cannot enter the final production process at IEEE unless a copyright form has been signed and forwarded with the manuscript.

If an author's disk or e-mailed manuscript cannot be processed due to technical difficulties, he/she will be notified by the IEEE Transactions/Journals Department and asked to provide another copy.

If the author's graphics are not reproducible, he/she will be contacted by the IEEE Transactions/Journals Department and asked to provide a new set of graphics for the manuscript or to sign a disclaimer.

If an author cannot provide an electronic version of the manuscript, arrangements can be made to handle a paper copy version.

F. Author Proofs

The author will receive a final proof of his/her manuscript as it will appear in the printed publication. The proofs are usually accompanied by the IEEE Page Charges and Reprint Order Form dependent upon a society's requirements for its publication.

In a case where an author has four-color graphics, the society may require that the author pay the extra charges and he/she will be notified of that charge.

The author is requested to provide corrections to the final proof of his/her paper within a few days after receipt of the author proofs.

G. Reprint Requests

At the time the author receives the final proofs of his/her paper, he/she should also receive an IEEE Page Charges and Reprint Order Form. This should be completed and returned with the proofs or sent directly to the IEEE Reprints Department, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 USA; fax: +1 732 981 8062.

H. Printed Issue

Once the issue of a publication has been printed, a complimentary copy will be sent to the author.

If an author has requested reprints, these will be sent separately after the issue has been mailed.

I. No Returns

The IEEE does not return disks, graphics, photographs, or paper copies of the manuscripts used in the production process of its issues.

III. Submission Procedures for Peer Review

A. Transactions, Journals, and Letters

Papers submitted for publication in the IEEE Transactions, Journals, and Letters are generally to be sent directly to the Editor(s)-in-Chief, although some publications prefer that papers be delivered through a support office at a different location. The names and addresses of the EICs and support offices can be found on the inside covers of the publications or at www.ieee.org/organizations/pubs/guide.html. Also found on the inside covers or in the ending pages of the publications are instructions on how to prepare the manuscript for Peer Review. General manuscript preparation procedures can be found in Section IV.

B. Proceedings of the IEEE

The PROCEEDINGS OF THE IEEE publishes comprehensive, in-depth review, tutorial, and survey papers for technically knowledgeable readers who are not necessarily specialists in the subjects being treated. The papers are of long-range interest and broad significance. Applications and technological issues, as well as theory, are emphasized. The topics

include all aspects of electrical and computer engineering and science. From time to time, papers on managerial, historical, economic, and ethical aspects of technology are published. Papers are authored by recognized authorities and reviewed by experts. They include extensive introductions written at a level suitable for the nonspecialist, with ample references for those who wish to probe further. Several issues a year are devoted to a single subject of special importance.

Prospective authors, before preparing a full-length manuscript, are urged to submit a proposal containing a description of the topic and its importance to PROCEEDINGS readers, a detailed outline of the proposed paper and its type of coverage, and a brief biography showing the authors' qualifications for writing the paper. A proposal can be reviewed most efficiently if it is sent electronically to the Managing Editor at j.calder@ieee.org. If the proposal receives a favorable review, the author will be encouraged to prepare the paper for publication consideration through the normal review process.

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IV. GENERAL MANUSCRIPT PREPARATION

A. Consecutive Numbering of Parts

All manuscript pages, footnotes, equations, and references should be labeled in consecutive numerical order. Illustrations and tables should be cited in text in numerical order. See Section IV-G of this guide.

B. Manuscript Formats

See copies of the publications for examples of proper paper formats and requirements for the types of papers accepted for each publication (i.e., Full Papers, Letters, Short Papers, etc.).

Full length papers generally consist of the title, byline, author affiliation, footnote (including any financial support acknowledgment), index terms, abstract, nomenclature if present, introduction, body, conclusions, reference list, list of figures and table captions, and original figures and tables for reproduction. A paper may also include appendixes, a glossary of symbols, and an acknowledgment of nonfinancial support.

C. Abstract

The abstract should be limited to 50–200 words and should concisely state what was done, how it was done, principal results, and their significance. The abstract will appear later in various abstracts journals and should contain the most critical information of the paper.

D. References

A numbered list of references must be provided at the end of the paper. The list should be arranged in the order of citation in text, not in alphabetical order. List only one reference per reference number.

Each reference number should be enclosed by square brackets. In text, citations of references may be given simply as "in [1] . . . ", rather than as "in reference [1] . . . ". Similarly, it is not necessary to mention the authors of a reference unless the mention is relevant to the text. It is almost never useful to give dates of references in text. These will usually be deleted by Staff Editors if included.

Footnotes or other words and phrases that are not part of the reference format do not belong on the reference list. Phrases such as "For example," should not introduce references in the list, but should instead be given in parentheses in text, followed by the reference number, i.e., "For example, see [5]."

Sample correct formats for various types of references are as follows.

Books:

[1] G. O. Young, "Synthetic structure of industrial plastics," in *Plastics*, 2nd ed., vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.

[2] W.-K. Chen, *Linear Networks and Systems*. Belmont, CA: Wadsworth, 1993, pp. 123–135.

Periodicals:

[3] J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility," *IEEE Trans. Electron Devices*, vol. ED-11, pp. 34–39, Jan. 1959.

[4] E. P. Wigner, "Theory of traveling-wave optical laser," *Phys. Rev.*, vol. 134, pp. A635–A646, Dec. 1965.

[5] E. H. Miller, "A note on reflector arrays," *IEEE Trans. Antennas Propagat.*, to be published.

Articles from Conference Proceedings (published):

[6] D. B. Payne and J. R. Stern, "Wavelength-switched passively coupled single-mode optical network," in *Proc. IOOC-ECOC*, 1985, pp. 585–590.

Papers Presented at Conferences (unpublished):

[7] D. Ebehard and E. Voges, "Digital single sideband detection for interferometric sensors," presented at the 2nd Int. Conf. Optical Fiber Sensors, Stuttgart, Germany, 1984.

Standards/Patents:

[8] G. Brandli and M. Dick, "Alternating current fed power supply," U.S. Patent 4 084 217, Nov. 4, 1978.

Technical Reports:

[9] E. E. Reber, R. L. Mitchell, and C. J. Carter, "Oxygen absorption in the Earth's atmosphere," Aerospace Corp., Los Angeles, CA, Tech. Rep. TR-0200 (4230-46)-3, Nov. 1968.

E. References—Electronic Sources

The guidelines for citing electronic information as offered below are a modified illustration of the adaptation by the International Standards Organization (ISO) documentation system and the American Psychological Association (APA) style. Three pieces of information are required to complete each reference: 1) protocol or service; 2) location where the item

is to be found; and 3) item to be retrieved. It is not necessary to repeat the protocol (i.e., http) in Web addresses after "Available" since that is stated in the URL.

Books: Author. (year, month day). *Title.* (edition) [Type of medium]. *volume (issue).* Available: site/path/file

Example:

[1] J. Jones. (1991, May 10). *Networks*. (2nd ed.) [Online]. Available: http://www.atm.com

Journals: Author. (year, month). Title. *Journal*. [Type of medium]. *volume (issue)*, pages. Available: site/path/file

Example:

[2] R. J. Vidmar. (1992, Aug.). On the use of atmospheric plasmas as electromagnetic reflectors. *IEEE Trans. Plasma Sci.* [Online]. *21(3)*, pp. 876–880. Available: http://www.halcyon.com/pub/journals/21ps03-vidmar

Papers Presented at Conferences: Author. (year, month). Title. Presented at Conference title. [Type of Medium]. Available: site/path/file

Example:

[3] PROCESS Corp., MA. Intranets: Internet technologies deployed behind the firewall for corporate productivity. Presented at INET96 Annu. Meeting. [Online]. Available: http://home.process.com/Intranets/wp2.htp

Reports and Handbooks: Author. (year, month). Title. Company. City, State or Country. [Type of Medium]. Available: site/path/file

Example:

[4] S. L. Talleen. (1996, Apr.). The Intranet Architecture: Managing information in the new paradigm. Amdahl Corp., CA. [Online]. Available: http://www.amdahl.com/doc/products/bsg/intra/infra/html

Computer Programs and Electronic Documents: ISO recommends that capitalization follow the accepted practice for the language or script in which the information is given.

Example:

[5] A. Harriman. (1993, June). Compendium of genealogical software. *Humanist.* [Online]. Available e-mail: HUMANIST@NYVM Message: get GENEALOGY REPORT

F. Figures, Tables, and Captions List

All graphics should be submitted as separate items from the body of your paper on separate sheets of paper or on disk. IEEE Transactions/Journals Department does not provide drafting or art services. Thus, the better the quality of the material submitted, the better the published result.

Line art, graphs, charts, tables, drawings, photos, and gray-scale diagrams will be scanned electronically for final production or you may submit them as TIFF, PostScript, or Encapsulated PostScript files (see Section V-D for more information on electronic graphics). If submitting for scanning, all graphics should be original proofs and not photocopies. Detailed instructions on the preparation of electronic graphics may be found at www.ieee.org/organizations/pubs/transactions/eicguide.pdf.

Whenever possible photos should be glossy prints with no screening. Laser prints will not reproduce as well as original photos. All line drawings and photos should be in black and white, unless special arrangements have been made to process them in color.

If color is to be reproduced, the author must agree to accept responsibility for payment of the costs for separations and printing *before* any processing is performed. The author must provide a method of payment as well, either through their organization or by credit card. The current cost for color reproduction is a flat printing fee of US$1,045.00 plus US$125.00 per piece of color artwork. (Please note that this cost does not include the ordering of reprints.)

Please use consistent typefaces on all your figures. Figures will be reduced to make the smallest typesize 8 points. Generally one or two typefaces should suffice. It is suggested that you use either Times Roman or Sans Serif. For best results, all of your figures should be the same size (width $\times$ length) whenever possible. For scanned graphics the original material should be no larger than 22 $\times$ 28 cm.

On graphs, show only the coordinate axes, or at most the major grid lines, to avoid a dense result after reduction.

DO NOT put boxes around your figures to enclose them.

Captions should be included as a separate list at the end of the paper.

Corrections cannot be made on a graphic. New corrected copies (including tables) must be submitted by the author when returning the proofs.

G. Section Headings

Primary section headings within papers are enumerated by Roman numerals and are centered above the text. For the purpose of typing the manuscript only, primary headings should be capital letters. Sample:

I. PRIMARY HEADING

(TEXT)

Secondary section headings are enumerated by capital letters followed by periods ("A.", "B.", etc.) and are flush left above their sections. The first letter of each word is capitalized. In print the headings will be in italics. Sample:

A. Secondary Heading

(TEXT)

Tertiary section headings are enumerated by Arabic numerals followed by a parenthesis. They are indented, run into the text in their sections, and are followed by a colon. The first letter of each important word is capitalized. Sample:

1) Tertiary Heading: (TEXT)

Quaternary section headings are rarely necessary but are perfectly acceptable if required. They are identical to tertiary headings except that lowercase letters are used as labels and only the first letter of the heading is capitalized. Sample:

a) Quaternary heading: (TEXT)

Enumeration of section headings is often desirable, but is not a requirement. If an author does choose to enumerate section headings, then ALL levels of section headings in the paper should be enumerated. Similarly, if section headings are not to be enumerated, the choice should be consistent for all headings in the paper. In either case, the remaining style rules for each level of section heading should be followed.

H. Mathematical Notation

To avoid errors in editing and typesetting, authors should clearly identify subscripts, superscripts, Greek letters, and other symbols. Add margin notes or other explanations wherever necessary. It is especially important to distinguish clearly between the following terms.

a) Capital and lowercase letters when used as symbols.
b) Zero and the letter "O."
c) The lowercase letter "l," and numeral one (1), and the prime sign ($'$).
d) The letters "k" and κ (kappa), "u" and μ (mu), "v" and ν (nu), and "n" and η (eta).

A wavy line under a character or letter indicates boldface type. (Bold type should be indicated for certain vectors and matrices.)

A straight line under a character or letter indicates italic type. (Italic type should be indicated for all text variables.)

Break equations to fit in a space no wider than 21 picas or 3.5″ in width.

Avoid ambiguities in equations and fractions in text through careful use of parentheses, brackets, solidi (slants), etc. Note that in text, fractions are usually "broken down" to fit on one line and confusion can result if terms are not properly labeled. The conventional order of brackets is {[()]}.

IEEE Transactions style dictates that the only punctuation used at the end of a displayed equation is a period. There is, however, other punctuation permitted in the equation itself and between an equation and its condition; there is a comma and 2em space before the condition.

For simplicity in international usage, IEEE practice is to separate numbers of more than four digits into groups of three on either side of the decimal point, separated by a space. If the magnitude of a number is less than one, the decimal sign should be preceded by a zero. Examples:

12 531 7465 9.2163 0.102 834

Use of the multidot ($\cdot$) rather than the multi $\times$ when multiplying by powers of ten in equations or text is at the author's discretion.

I. Units and Abbreviations

The International System of Units (SI units) is advocated for use in IEEE publications. Refer to the units list provided in Appendix I of this guide for information on preferred usage of units, conversion factors, etc.

Unit symbols should be used with measured quantities, i.e., 1 mm, but not when unit names are used in text without quantities, i.e., "a few millimeters."

Acronyms and abbreviations should be defined the first time they are used in text. A list of acronyms and abbreviations, including those that need not be defined, is given in Appendix II of this guide.

V. Final Preparation for Publication

A. Electronic Disk Preparation

The IEEE requests that all authors submit their final manuscripts in electronic and hard copy (two copies) form. However, considering the myriad of word processors on the market (public domain included) and disk formats available throughout the world, the following guidelines and suggestions have been set forth in an effort to expedite the production process.

General Guidelines: The following is a list of general guidelines for the submission of electronic media by prospective authors.

- The operating system and word processing software used to produce your document should be noted on your disk or e-mail (e.g., DOS/Word). In the case of UNIX media, the method of extraction (i.e., tar, bar, restore, etc.) should also be noted.
- PostScript and Acrobat PDF files are not acceptable because the files are simply pictures of the pages and cannot be edited.
- Disks should be labeled with file name(s) relating to the manuscript.
- Check that your files are complete. Include: abstract, index terms, text, references, footnotes, biographies, and figure captions.
- The hardcopy should *exactly* match its companion disk. Any changes made to your files should be reflected on the manuscript.
- No program files should be included on the disk.
- Graphics should be on a disk separate from the text as graphics and text are processed separately and graphics cannot be extracted from the text.
- Include a flat ASCII version on the disk with the word-processor version, if possible.
- Please package disks in such a way as to minimize possible damage in the mail.
- Try to adhere to the accepted *style* of the Transactions/Journal as much as possible. Of particular importance here is the reference list. Please try to follow the format as described in Section IV-E and IV-F of this document.

Preferred Formats: For the most accurate and efficient transferral of your manuscript, especially those containing extensive mathematics, use TEX or LATEX programs. An IEEE LATEX style file can be found at www.ieee.org/organizations/pubs/authors.html.

The following points are important to remember when submitting electronic manuscripts (compuscripts) in TEX or LATEX.

- Please include all macros or definitions that are required to produce your document, references, biographies, index terms, etc., in one file.

- Remember, IEEE Transactions style dictates a 21-pica (3.5-inch) column width. If mathematical phrases are produced with this in mind, they are apt to appear more aesthetically pleasing in the final version.
- When using TEX, avoid using a matrix routine for anything other than a matrix. Use \eqalignno or \displaylines for aligning series of equations.

An IEEE Word style file can also be found at http://www.ieee.org/organizations/pubs/authors.html. When using this style file, use the Word equation editor for equations and symbols. Also, if your word file contains graphics, please remember to also submit the graphics as separate files.

Acceptable Media: The IEEE will accept the following.

- Any IBM-PC (or 100% compatible) disk format (3.5″/720k/1.44Mb).
- Macintosh disk format (low and high density).
- Zip disk.
- CD-ROM.
- E-Mail.

If you are in doubt, please do not hesitate to inquire using trans@ieee.org.

B. E-Mail Preparation

Upon completion of the review process and with the approval of the Editor-in-Chief, an author may wish to e-mail the electronic version of his or her manuscript to the Staff Editor at IEEE. The following set of guidelines should be followed to ensure a smooth transition and subsequent upload to the IEEE electronic publishing environment.

General Guidelines:

1) Files should not be e-mailed to the IEEE Staff Editor without the prior knowledge and approval of the Transactions Editor-in-Chief.
2) The transmitted file should reflect the exact content of the final manuscript, including captions, abstracts, references, and biographies.
3) A short message should accompany each transmitted file, clearly identifying the following:
   a) the name of the Transactions;
   b) author's name;
   c) software used to create manuscript, e.g., TEX, LATEX, etc.
4) No encoding is necessary to accommodate the size of files.
5) When e-mailing TEX, LATEX, etc., please remember to also e-mail any macros or definitions used to create the manuscript.
6) Two paper copies of the e-mail file along with the original figures and photos should be sent to the IEEE Staff Editor.

C. Graphics Preparation

Line art, graphs, charts, tables, drawings, photos, and grayscale diagrams will be scanned electronically for final production. To have clear, precise reproduction, all graphics should be original and not photocopies.

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APPENDIX I
TABLE OF UNITS AND QUANTITY SYMBOLS

NOTE: Asterisks (*) indicate SI units, preferred multiples of SI units, or other units acceptable for use with SI.

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
*ampere	A	amp, a	SI unit of electric current.	I U F
ampere-hour	Ah	amp-hr	Also A · h.	
*ampere (turn)	A	At	SI unit of magnetomotive force.	F
*ampere per meter	A/m		SI unit of magnetic field strength.	A H
ångström	Å	Å	Å $\triangleq 10^{-10}$ m. Deprecated (see ANSI/IEEE Std 268-1992).	
atmosphere, standard	atm		atm $\triangleq$ 101 325 Pa. Deprecated (see ANSI/IEEE Std 268-1992).	
atmosphere, technical	at		at $\triangleq$ kgf/cm^2. Deprecated (see ANSI/IEEE Std 268-1992).	
*atomic mass unit (unified)	u		The (unified) atomic mass unit is defined as one-twelfth of the mass of an atom of the carbon-12 nuclide. Use of the old atomic mass unit (amu), defined by reference to oxygen, is deprecated.	
*atto	a		SI prefix for 10^{-18}.	
*attoampere	aA			
bar	bar	b, barye	bar $\triangleq$ 100 kPa. Use of the bar is strongly discouraged (see ANSI/IEEE Std 268-1992). Except for limited use in meteorology.	
barn	b		b $\triangleq 10^{-28}$ m^2.	
barrel	bbl		bbl $= 42$ gal$_{\mathrm{US}} = 158.99$ L. This is the standard barrel used for petroleum and petroleum products. Different standard barrels are used for other commodities.	
barrel per day	bbl/d			
baud	Bd	baud (w/prefix)	In telecommunications, a unit of signaling speed equal to one element per second. The signaling speed in bauds is equal to the reciprocal of the signal element length in seconds.	$1/\tau$
bel	B	b		
*becquerel	Bq		SI unit of activity of a radionuclide.	
billion electronvolts	GeV	bev, BeV	The name *gigaelectronvolt* is preferred for this unit.	
bit	b		In information theory, the bit is a unit of information content equal to the information content of a message, the *a priori* probability of which is one-half. In computer science, the name bit is used as a short form of *binary digit*.	

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
bit per second	b/s			
British thermal unit	Btu			
byte	B		A byte is a string of bits, usually eight bits long, operated on as a unit. A byte is capable of holding one character set.	
calorie (International Table)	$\mathrm{cal_{IT}}$		$\triangleq$ $\mathrm{cal_{IT}}\,4.1868$ J. Deprecated (see ANSI/IEEE Std 268-1992).	
calorie (thermochemical)	cal		$\triangleq$ cal 4.1840 J. Deprecated (see ANSI/IEEE Std 268-1992).	
*candela	cd		SI unit of luminous intensity.	I
candela per square inch	$\mathrm{cd/in^2}$		Use of the SI unit $\mathrm{cd/m^2}$ is preferred.	
*candela per square meter	$\mathrm{cd/m^2}$	nit	SI unit of luminance.	L
candle	cd		The unit of luminous intensity has been given the name *candela*. Use of the name *candle* for this unit is deprecated.	
*centi	c (prefix)		SI prefix for 10^{-2}.	
*centimeter	cm			
centipoise	cP		cP $\triangleq$ mPa · s. The name centipoise is deprecated (see ANSI/IEEE Std 268-1992).	
centistokes	cSt		cSt $\triangleq$ $\mathrm{mm^2/s}$. The name centistokes is deprecated (see ANSI/IEEE Std 268-1992).	
*circular mil	cmil		cmil $\triangleq(\pi/4)\cdot 10^{-6}\mathrm{in^2}$.	
*coulomb	C	c	SI unit of electric charge.	Q ψ
*cubic centimeter	$\mathrm{cm^3}$	cc	Volume. (Preferred SI unit multiple.)	
cubic foot	$\mathrm{ft^3}$			
cubic foot per minute	$\mathrm{ft^3/min}$	cfm		
cubic foot per second	$\mathrm{ft^3/s}$			
cubic inch	$\mathrm{in^3}$			
*cubic meter	$\mathrm{m^3}$			
*cubic meter per second	$\mathrm{m^3/s}$			
cubic yard	$\mathrm{yd^3}$			
curie	Ci	C	Ci $\triangleq$ 3.7 x10^{10} Bq. A unit of activity of a radionuclide. Use of the SI unit, the becquerel, is preferred.	
cycle per second	Hz	c/s, cps, c/sec, cycle	See hertz.	
darcy	D		D $\triangleq$ cP·(cm/s)·(cm/atm) = 0.986923 $\mu\mathrm{m^2}$. A unit of permeability of a porous medium. By traditional definition, a permeability of one darcy will permit a flow of 1 $\mathrm{cm^3/s}$ of fluid of 1 cP viscosity through an area of 1 $\mathrm{cm^2}$ under a pressure gradient of 1 atm/cm. Deprecated (see ANSI/IEEE Std 268-1992).	
day	d		day $\triangleq$ 24 h.	
deci	d (prefix)		SI prefix for 10^{-1}.	
decibel	dB	db, DB		

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
degree (plane angle)	$\ldots^{\circ}$	deg		
degree (temperature)				
degree Celsius	$^{\circ}$C	degree centigrade	SI unit of Celsius temperature. The degree Celsius is a special name for the kelvin, used in expressing Celsius temperatures or temperature intervals.	t
degree Fahrenheit	$^{\circ}$F		Note that the symbols for $^{\circ}$C, $^{\circ}$F, and $^{\circ}$R are comprised of two elements, written with no space between the $^{\circ}$ and the letter that follows. The two elements that make the complete symbol are not to be separated.	
degree kelvin	K		See kelvin.	
degree Rankine	$^{\circ}$R			
deka	da		SI prefix for 10.	
dyne	dyn	dyne	dyn $\triangleq 10^{-5}$ N. Deprecated (see ANSI/IEEE Std 268-1992).	F
*electronvolt	eV	ev		
erg	erg		erg $\triangleq 10^{-7}$ J. Deprecated (see ANSI/IEEE Std 268-1992).	
exa	E		SI prefix for 10^{18}.	
*farad	F	f, fd	SI unit of capacitance.	C
*femto	f		SI prefix for 10^{-15}.	
femtometer	fm			
foot	ft		ft $\triangleq 0.3048$ m.	
foot of water	ftH$_2$O		ftH$_2$O = 2989.1 Pa. (ISO).[1]	
foot per minute	ft/min	fpm		
foot per second	ft/s	fps, ft/sec		
foot per second squared	ft/s^2			
foot pound-force	ft $\cdot$ lbf			
footcandle	fc		fc $\triangleq$ lm/ft^2. The name ***lumen per square foot*** is also used for this unit. Use of the SI unit of illuminance, the lux (lumen) per square meter, is preferred.	
footlambert	fL		fL$\triangleq(1/\pi)$ cd/ft^2. A unit of luminance. One lumen per square foot leaves a surface whose luminance is one footlambert in all directions within a hemisphere. Use of the SI unit, the candela per square meter, is preferred.	
gal	Gal		Gal $\triangleq$ cm/s. Deprecated (see ANSI/IEEE Std 268-1992).	
gallon	gal		1 gal $_{\mathrm{UK}} = 4.5461$ L. 1 gal$_{\mathrm{US}} \triangleq 231$ in$^3 = 3.7854$ L.	
gauss	G		The gauss is the electromagnetic CGS unit of magnetic flux density. Deprecated (see ANSI/IEEE Std. 268-1992).	B
*giga	G	kM	SI prefix for 10^9.	
gigabyte	GB		GB $\triangleq 10^9$ B.	
*gigaelectronvolt	GeV	bev, BeV		
*gigahertz	GHz	kMHz, KMC, Gc/s		

[1]The term "(ISO)" means that the definition is from ISO 31.

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
gilbert	Gb		The gilbert is the electromagnetic CGS unit of magnetomotive force. Deprecated (see ANSI/IEEE Std 268-1992).	
grain	gr		gr $\triangleq$ lb/7000.	
*gram	g	gm		m
gram per cubic centimeter	g/cm^3			
*gray	Gy		SI unit of absorbed dose in the field of radiation dosimetry.	
*hecto	h		SI prefix for 10^2.	
*henry	H	Hy, hy	SI unit of inductance.	L
*hertz	Hz	cps, c/s, cycle	SI unit of frequency.	P, P_m f, ν B
horsepower	hp		hp $\triangleq$ 550 ft · lbf/s = 746 W. The horsepower is an anachronism in science and technology. Use of the SI unit of power, the watt, is preferred.	
*hour	h	hr		
inch	in	in.	in $\triangleq$ 2.54 cm.	
inch of mercury	inHg		inHg = 3386.4 Pa (ISO).	
inch of water	inH_2O		inH_2O = 249.09 Pa (ISO).	
inch per second	in/s	ips		
*joule	J		SI unit of energy, work, and quantity of heat.	E W Q
*joule per kelvin	J/K		SI unit of heat capacity and of entropy.	S
kelvin	K		In 1967, the CPGM gave the name *kelvin* to the SI unit of temperature, which had formerly been called *degree kelvin*, and assigned it the symbol K (without the symbol °).	
*kilo	k		SI prefix for 10^3. The symbol k shall not be used for kilo. The prefix kilo shall not be used to mean 2^{10} (that is, 1024).	
*kilobit per second	kb/s			
*kilobyte	kB		kB $\triangleq$ 1000 bytes.	
kilogauss	kG		Deprecated (see ANSI/IEEE Std 268-1992).	
*kilogram	kg		SI unit of mass.	
kilogram-force	kgf		Deprecated (see ANSI/IEEE Std 268-1992). In some countries the name kilopond (kp) has been used for this unit.	
*kilohertz	kHz			
*kilohm	kΩ			R
*kilometer	km			
*kilometer per hour	km/h			
kilopound-force	klbf		Kilopound-force should not be misinterpreted as kilopond (see kilogram-force).	
*kilovar	kvar			Q
*kilovolt	kV			
*kilovoltampere	kVA	KVA, kva		
*kilowatt	kW			
kilowatthour	kWh		Also kW·h.	

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
knot	kn		kn $\triangleq$ nmi/h. 0.514 m/s.	
lambert	L		L $\triangleq (1/\pi)$cd/cm^2. A CGS unit of luminance. One lumen per square centimeter leaves a surface whose luminance is one lambert in all directions within a hemisphere. Deprecated (see ANSI/IEEE Std 268-1992).	
*liter	L		L $\triangleq 10^{-3}$ m^3. In 1979, the CGPM approved L and l as alternative symbols for the liter. Because of frequent confusion with the numeral 1, the letter symbol l is not recommended for U.S. use (see Federal Register notice of December 20, 1990, vol. 55, no. 245, p. 52242). The script *l* shall not be used as a symbol for liter.	V, v
liter per second	L/s			
*lumen	lm		SI unit of luminous flux.	Φ
lumen per square foot	lm/ft^2		A unit of illuminance and also a unit of luminous exitance. Use of the SI unit, lumen per square meter, is preferred.	
*lumen per square meter	lm/m^2		SI unit of luminous exitance.	M
*lumen per watt	lm/W		SI unit of luminous efficacy.	$K(\lambda)$ K, K_t
*lumen second	lm·s		SI unit of quantity of light.	Q
*lux	lx		1x/lm $\triangleq$ /m^2. SI unit of illuminance.	E
maxwell	Mx		The maxwell is the electromagnetic CGS unit of magnetic flux. Deprecated (see ANSI/IEEE Std 268-1992).	
*mega	M		SI prefix for 10^6. The prefix mega shall not be used to mean 2^{20} (that is, 1 048 576).	
megabit per second	Mb/s			
*megabyte	MB		MB $\triangleq$ 1 000 000 bytes.	
*megaelectronvolt	MeV			
*megahertz	MHz			
*megohm	MΩ	M		
*meter	m		SI unit of length.	l
metric ton	t		t $\triangleq$ 1000 kg. Use of the name *tonne* is deprecated in the U.S. (see ANSI/IEEE Std 268-1992).	
mho	S		Ω^{-1}. The name *mho* was formerly given to the reciprocal ohm. Deprecated; see siemens (S).	
*micro	μ		SI prefix for 10^{-6}.	
*microampere	μA			
*microfarad	μF			
*microgram	μg			
*microhenry	μH			
microinch	μin			
*microliter	μL		See note for liter.	
*micrometer	μm	μ		
micron	μm	μ	The name micron is deprecated. Use micrometer.	

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
*microsecond	μs			
*microwatt	μW			
mil	mil		mil $\triangleq$ 0.001 in.	
mile (statute)	mi		mi $\triangleq$ 5280 ft = 1609 m.	
mile per hour	mi/h	mph	Although use of mph as an abbreviation is common, it should not be used as a symbol.	
*milli	m		SI prefix for 10^{-3}.	
*milliampere	mA			
millibar	mbar		Use of the bar is strongly discouraged in ANSI/IEEE Std 268-1992, except for limited use in meteorology.	
*milligram	mg			
*millihenry	mH			
*milliliter	mL		See liter.	
*millimeter	mm			
millimeter of mercury	mmHg		mmHg = 133.322 Pa. Deprecated (see ANSI/IEEE Std 268-1992).	
millimicron	nm		Use of the name millimicron for the nanometer is deprecated.	
*millipascal second	mPa · s		SI unit-multiple of dynamic viscosity.	
*millisecond	ms			
*millivolt	mV			
*milliwatt	mW			
*minute (plane angle)	′			
*minute (time)	min		Time may also be designated by means of superscripts as in the following example: $9^{h}46^{m}30^{s}$.	
*mole	mol		SI unit of amount of substance. The mole is the amount of substance of a system that contains as many elementary entities as there are atoms in 0.012 kg of carbon 12. When the mole is used, the elementary entities shall be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.	
month	mo			
*nano	n		SI prefix for 10^{-9}.	
*nanoampere	nA			
*nanofarad	nF			
*nanometer	nm			
*nanosecond	ns			
nautical mile	nmi		nmi $\triangleq$ 1852 m.	
*neper	Np			
*newton	N		SI unit of force.	
*newton meter	N · m			
*newton per square meter	N/m^2		SI unit of pressure or stress. See pascal.	
oersted	Oe	oe	The oersted is the electromagnetic CGS unit of magnetic field strength. Deprecated (see ANSI/IEEE Std 268-1992).	
*ohm	Ω		SI unit of resistance.	
ounce (avoirdupois)	oz		oz $\triangleq$ 1/16 lb = 28.350 g.	

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
*pascal	Pa		Pa $\triangleq$ N/m^2. SI unit of pressure or stress.	
*pascal second	Pa · s		SI unit of dynamic viscosity.	
*peta	P		SI prefix for 10^{15}.	
phot	ph		ph $\triangleq$ lm/cm^2. CGS unit of illuminance. Deprecated (see ANSI/IEEE Std 268-1992).	
*pico	p		SI prefix for 10^{-12}.	
*picofarad	pF			
*picowatt	pW			
pint	pt		pt (U.K.) = 0.568 26 L. pt (U.S. dry) = 0.550 6 L. pt (U.S. liquid) = 0.473 18 L.	
poise	P		Deprecated (see ANSI/IEEE Std 268-1992).	
pound (avoirdupois)	lb		lb $\triangleq$ 0.453 592 37 kg.	
pound per cubic foot	lb/ft^3			
pound-force	lbf		lbf = 4.4482 N.	
pound-force foot	lbf · ft			
pound-force per square foot	lbf/ft^2			
pound-force per square inch	lbf/in^2	psi	Although use of the abbreviation psi is common, it should not be used as a symbol.	
poundal	pdl		pdl $\triangleq$ lb · ft/s^2 = 0.1383 N	
quart	qt		qt (U.K.) = 1.1365 L. qt (U.S. dry) = 1.1012 L. qt (U.S. liquid) = 0.946 35 L.	
rad	rd		rd $\triangleq$ 0.01 Gy. A unit of absorbed dose in the field of radiation dosimetry. Use of the SI unit, the gray, is preferred.	
*radian	rad		SI unit of plane angle.	
rem	rem		rem $\triangleq$ 0.01 Sv. A unit of dose equivalent in the field of radiation dosimetry. Use of the SI unit, the sievert, is preferred. 1 rem = 0.01 Sv.	
revolution per minute	r/min		Although use of rpm as an abbreviation is common, it should not be used as a symbol.	
revolution per second	r/s			
roentgen	R		A unit of exposure in the field of radiation dosimetry.	
*second (plane angle)	$''$		$1'' = 4.848 \cdot 10^{-6}$ rad.	
*second (time)	s		SI unit of time.	
*siemens	S		S $\triangleq \Omega^{-1}$. SI unit of conductance.	
*sievert	Sv		SI unit of dose equivalent in the field of radiation dosimetry.	
slug	slug		slug $\triangleq$ lbf · s^2/ft = 14.594 kg.	
square foot	ft^2			
square inch	in^2			
*square meter	m^2			
*square meter per second	m^2/s		SI unit of kinematic viscosity.	
*square millimeter per second	mm^2/s		SI unit-multiple of kinematic viscosity.	
square yard	yd^2			

Unit	Unit Symbol	Sometimes Occurs as: (do not use)	Applications and Notes	Quantity Symbol (for use as variables, etc.)
*steradian	sr		SI unit of solid angle.	
stilb	sb		sb $\triangleq$ cd/cm^2. A CGS unit of luminance. Deprecated (see ANSI/IEEE Std 268-1992).	
stokes	St		Deprecated (see ANSI/IEEE Std 268-1992).	
*tera	T		SI prefix for 10^{12}.	
terabyte	TB		TB $\triangleq 10^{12}$ B.	
*tesla	T		T $\triangleq$ N/(A $\cdot$ m)$^2 \triangleq$ Wb/m^2. SI unit of magnetic flux density (magnetic induction).	
therm	thm		thm $\triangleq 100\,000$ Btu.	
ton (short)	ton		ton $\triangleq 2000$ lb.	
ton, metric	t		t $\triangleq$ 1000 kg. Use of the *tonne* for this unit is deprecated in the U.S. (see ANSI/IEEE Std 268-1992).	
torr	torr		1 torr $= 1/760 = 1.333 = \cdot 10^2$ Pa. Use not recommended	
*(unified) atomic mass unit	u		The (unified) atomic mass unit is defined as one-twelfth of the mass of an atom of the carbon-12 nuclide. Use of the old atomic mass unit (amu), defined by reference to oxygen, is deprecated.	
*var	var		IEC name and symbol for SI unit of reactive power.	
*volt	V		SI unit of voltage.	
*volt per meter	V/m		SI unit of electric field strength.	
*voltampere	VA	va	IEC name and symbol for SI unit of apparent power.	
*watt	W		SI unit of power.	
*watt per meter kelvin	W/(m $\cdot$ K)		SI unit of thermal conductivity.	
*watt per steradian	W/sr		SI unit of radiant intensity.	
*watt per steradian square meter	(W/sr $\cdot$ m^2)		SI unit of radiance.	
watthour	Wh			
*weber	Wb		Wb $\triangleq$ V·s. SI unit of magnetic flux.	
yard	yd		yd $\triangleq$ 0.9144 m.	
year	a		Also W·h.	
yocto	y		SI prefix for 10^{-24}.	
yotta	Y		SI prefix for 10^{24}.	
zepto	z		SI prefix for 10^{-21}.	
zetta	Z		SI prefix for 10^{21}.	

APPENDIX II
SOME COMMON ACRONYMS AND ABBREVIATIONS

NOTE: Asterisks (*) indicate terms which must be defined the first time they are used in text. Other terms listed here may be used without definition.

ac	alternating current
A–D, A/D	analog-to-digital
AF	audio frequency*
AFC	automatic frequency control*
AGC	automatic gain control*
AM	amplitude modulation
APD	avalanche photodiode
AR	antireflection*
ARMA	autoregressive moving average*
ASIC	application-specified integrated circuit*
ASK	amplitude shift keying
ATM	asynchronous transfer mode
av	average (subscript)*
avg	average (function)
AWGN	additive white Gaussian noise*
B–E	base–emitter source
BER	bit error rate*
BPSK	binary phase-shift keying
BWO	backward-wave oscillator*
c.c.	complex conjugate (in equations)
CCD	charge-coupled device*
CDMA	code division multiple access*
CD-ROM	compact disk read-only memory
CIM	computer integrated manufacturing*
CIR	carrier-to-interference ratio*
CMOS	complimentary metal–oxide–semiconductor
CPM	continuous phase modulation*
CPFSK	continuous phase frequency-shift keying*
CPSK	continuous phase-shift keying*
CPU	central processing unit
CRT	cathode-ray tube
CT	current transformer*
CV	capacitance–voltage
CW	continuous wave*
dc	direct current
DC	directional coupler
DF	direction finder*; deuterium fluoride; degree of freedom*
DFT	discrete Fourier transform*
DMA	direct memory access*
DPCM	differential pulse code modulation*
DPSK	differential phase-shift keying*
EDP	electronic data processing
EHF	extremely high frequency*
ELF	extremely low frequency*
EMC	electromagnetic compatibility*

EMF	electromotive force*
EMI	electromagnetic interference*
ems	expected value of mean square*
FDM	frequency-division multiplexing*
FDMA	frequency-division multiple access*
FET	field-effect transistor
FFT	fast Fourier transform*
FIR	finite-impulse response*
FM	frequency modulation
FSK	frequency-shift keying*
FTP	file transfer protocol
FWHM	full-width at half-maximum*
GUI	graphical user interface
HBT	heterojunction bipolar transistor
HEMT	high-electron mobility transistor
HF	high frequency
HTML	hypertext markup language
HV	high voltage
HVdc	high voltage direct current
IC	impedance compensation*; integrated circuit
ID	inside diameter; induced draft*; interdigital*
IDP	integrated data processing*
IF	intermediate frequency
IGFET	insulated-gate field-effect transistor
i.i.d.	independent identically distributed*
IM	intermediate modulation
IMPATT	impact ionization avalanche transit time (diode)
I/O, I–O	input–output
IR	infrared
IR	current–resistance
ISI	intersymbol interference
JFET	junction field-effect transistor
JPEG	Joint Photographers Expert Group
LAN	local area network
LC	inductance–capacitance
LED	light-emitting diode
LHS	left-hand side*
LMS	least mean square
LO	local oscillator*
LP	linear programming*
LPE	liquid phase epitaxy*
LR	inductance–resistance
MESFET	metal–semiconductor field-effect transistor
MF	medium frequency*
MFSK	minimum frequency-shift keying
MHD	magnetohydrodynamics

MIS	metal–insulator–semiconductor
MLE	maximum-likelihood estimator*
MLSE	maximum-likelihood sequence estimator*
MMF	magnetomotive force
MMIC	monolithic microwave integrated circuit*
MoM	method of moments*
MOS	metal–oxide–semiconductor
MOST	metal–oxide–semiconductor transistor
MOSFET	metal–oxide–semiconductor field-effect transistor
MPEG	Motion Pictures Expert Group
NA	numerical aperture*
NIR	near infrared response*
NMR	nuclear magnetic resonance*
n-p-n	(diode)
NRZ	nonreturn to zero*
OD	outside diameter
OEIC	optoelectronic integrated circuit*
OOP	object-oriented programming
PAM	pulse-amplitude modulation*
PC	personal computer
PCM	pulse-code modulation*
pdf	probability density function*
PDM	pulse-duration modulation*
PF	power factor*
PLL	phase-locked loop*
PM	phase modulation*
PML	perfectly matched layer
p-i-n, p-n-p	(diode)
pp, p–p	peak to peak*
PPM	pulse-position modulation*
PRF	pulse-repetition frequency*
PRR	pulse-repetition rate*
PSK	phase-shift keying*
PTM	pulse–time modulation
p.u.	per unit*
PWM	pulsewidth modulation*
Q	quality factor; figure of merit
QoS	quality of service
QPSK	quaternary phase-shift keying
R&D	research and development
RAM	random access memory
RC	resistance–capacitance
RF	radio frequency
RFI	radio frequency interference*
RHS	right-hand side*
RIN	relative intensity noise*
RL	resistance–inductance
rms	root mean square

ROM	read-only memory
RV	random variable
SAW	surface acoustic wave*
SGML	standard generalized markup language
SHF	super high frequency*
SI	International System of Units; severity index*
SIR	signal-to-interference ratio
S/N, SNR	signal-to-noise ratio
SSB	single sideband*
SW	short wave*
SWR	standing-wave ratio*
TDM	time division modulation*; time division multiplexing*
TDMA	time-division multiple access*
TE	transverse electric
TEM	transverse electromagnetic
TFT	thin-film transistor*
TM	transverse magnetic
TVI	television interference*
TWA	traveling-wave amplifier*
UHF	ultrahigh frequency
UV	ultraviolet
VCO	voltage-controlled oscillator*
VHF	very high frequency*
V–I	voltage–current
VLF	very low frequency*
VLSI	very large scale integration*
WAN	wide area network
WDM	wavelength division multiplexing*

APPENDIX III
LIST OF IEEE TRANSACTIONS, JOURNALS, AND LETTERS

NOTE: * denotes past acronyms/abbreviations of journals.

Publication	Acronym	Reference Abbreviation
IEEE TRANSACTIONS ON ADVANCED PACKAGING	ADVP	*IEEE Trans. Adv. Packag.*
	CPMTB*	*IEEE Trans. Comp., Packag., Manufact. Technol. B** (1994–1998)
IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS	AES	*IEEE Trans. Aerosp. Electron. Syst.*
	ANE*	*IEEE Trans. Aeronaut. Navig. Electron.**
	ANE*	*IEEE Trans. Aerosp. Navig. Electron.**
	AS*	*IEEE Trans. Aerosp.**
	MIL*	*IEEE Trans. Mil. Electron.**
	AE*	*IEEE Trans. Airborne Electron.**
IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION	AP	*IEEE Trans. Antennas Propagat.*
IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY	ASC	*IEEE Trans. Appl. Superconduct.*
IEEE TRANSACTIONS ON AUTOMATIC CONTROL	AC	*IEEE Trans. Automat. Contr.*
IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING	BME	*IEEE Trans. Biomed. Eng.*
	BME*	*IEEE Trans. Bio-Med. Eng.**
	BME*	*IEEE Trans. Bio-Med. Electron.**
	PGME*	*IEEE Trans. Med. Electron.**
IEEE TRANSACTIONS ON BROADCASTING	BC	*IEEE Trans. Broadcast.*
	BC*	*IEEE Trans. Broadcast. Technol.**
IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—PART I: FUNDAMENTAL THEORY AND APPLICATIONS	CAS1	*IEEE Trans. Circuits Syst. I*
IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—PART II: ANALOG AND DIGITAL SIGNAL PROCESSING	CAS2	*IEEE Trans. Circuits Syst. II*
	CAS*	*IEEE Trans. Circuits Syst.** (1974–1992)
	CT*	*IEEE Trans. Circuit Theory** (until 1973)
IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY	CSVT	*IEEE Trans. Circuits Syst. Video Technol.*
IEEE TRANSACTIONS ON COMMUNICATIONS	COM	*IEEE Trans. Commun.*
	COM*	*IEEE Trans. Commun. Technol.** (through 1971)
IEEE COMMUNICATIONS LETTERS	COMML	*IEEE Commun. Lett.*
IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGY	CAPT	*IEEE Trans. Comp. Packag. Technol.*
	CPMTA*	*IEEE Trans. Comp., Packag., Manufact. Technol. A** (1994–1998)
	CHMT*	*IEEE Trans. Comp., Hybrids, Manufact. Technol.** (1978–1993)
	MFT*	*IEEE Trans. Manufact. Technol.** (1972–1977)
	PHP*	*IEEE Trans. Parts, Hybrids, Packag.** (June 1971–1977)
	PMP*	*IEEE Trans. Parts, Mater., Packag.** (until 1971)
IEEE TRANSACTIONS ON COMPUTER-AIDED DESIGN OF INTEGRATED CIRCUITS AND SYSTEMS	CAD	*IEEE Trans. Computer-Aided Design*
IEEE TRANSACTIONS ON COMPUTERS	C	*IEEE Trans. Comput.*
	EC*	*IEEE Trans. Electron. Comput.**
IEEE TRANSACTIONS ON CONSUMER ELECTRONICS	CE	*IEEE Trans. Consumer Electron.*
IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY	CST	*IEEE Trans. Contr. Syst. Technol.*
IEEE TRANSACTIONS ON DIELECTRICS AND ELECTRICAL INSULATION	DEI	*IEEE Trans. Dielect. Elect. Insulation*
	EI*	*IEEE Trans. Elect. Insulation** (until 1993)
IEEE TRANSACTIONS ON EDUCATION	E	*IEEE Trans. Educ.*
IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY	EMC	*IEEE Trans. Electromagn. Compat.*
	RFI*	*IEEE Trans. Radio Freq. Interference**

Publication	Acronym	Reference Abbreviation
IEEE TRANSACTIONS ON ELECTRON DEVICES	ED	*IEEE Trans. Electron Devices*
IEEE ELECTRON DEVICE LETTERS	EDL	*IEEE Electron Device Lett.*
IEEE TRANSACTIONS ON ELECTRONICS PACKAGING MANUFACTURING	EPM	*IEEE Trans. Electron. Packag. Manufact.*
	CPMTC*	*IEEE Trans. Comp., Packag., Manufact. Technol. C** (1996–1998)
IEEE TRANSACTIONS ON ENERGY CONVERSION	EC	*IEEE Trans. Energy Conversion*
IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT	EM	*IEEE Trans. Eng. Manage.*
IEEE TRANSACTIONS ON EVOLUTIONARY COMPUTATION	EVC	*IEEE Trans. Evol. Comput.*
IEEE TRANSACTIONS ON FUZZY SYSTEMS	FUZZ	*IEEE Trans. Fuzzy Syst.*
IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING	GRS	*IEEE Trans. Geosci. Remote Sensing*
	GE*	*IEEE Trans. Geosci. Electron.** (1962–1979)
IEEE TRANSACTIONS ON IMAGE PROCESSING	IP	*IEEE Trans. Image Processing*
IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS	IE	*IEEE Trans. Ind. Electron.*
IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS	IA	*IEEE Trans. Ind. Applicat.*
IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE	ITB	*IEEE Trans. Inform. Technol. Biomed.*
IEEE TRANSACTIONS ON INFORMATION THEORY	IT	*IEEE Trans. Inform. Theory*
IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT	IM	*IEEE Trans. Instrum. Meas.*
	I, PGI*	*IEEE Trans. Instrum.**
IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS	ITS	*IEEE Trans. Intell. Transport. Syst.*
IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING	KDE	*IEEE Trans. Knowledge Data Eng.*
JOURNAL OF LIGHTWAVE TECHNOLOGY	LT	*J. Lightwave Technol.*
IEEE TRANSACTIONS ON MAGNETICS	MAG	*IEEE Trans. Magn.*
IEEE/ASME TRANSACTIONS ON MECHATRONICS	MECH	*IEEE/ASME Trans. Mechatron.*
IEEE TRANSACTIONS ON MEDICAL IMAGING	MI	*IEEE Trans. Med. Imag.*
JOURNAL OF MICROELECTROMECHANICAL SYSTEMS	MEMS	*J. Microelectromech. Syst.*
IEEE MICROWAVE AND GUIDED WAVE LETTERS	MGWL	*IEEE Microwave Guided Wave Lett.*
IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES	MTT	*IEEE Trans. Microwave Theory Tech.*
IEEE TRANSACTIONS ON MULTIMEDIA	MM	*IEEE Trans. Multimedia*
IEEE/ACM TRANSACTIONS ON NETWORKING	NET	*IEEE/ACM Trans. Networking*
IEEE TRANSACTIONS ON NEURAL NETWORKS	NN	*IEEE Trans. Neural Networks*
IEEE TRANSACTIONS ON NUCLEAR SCIENCE	NS	*IEEE Trans. Nucl. Sci.*
IEEE JOURNAL OF OCEANIC ENGINEERING	OE	*IEEE J. Oceanic Eng.*
IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS	PDS	*IEEE Trans. Parallel Distrib. Syst.*
IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE	PAMI	*IEEE Trans. Pattern Anal. Machine Intell.*
IEEE PHOTONICS TECHNOLOGY LETTERS	PTL	*IEEE Photon. Technol. Lett.*
IEEE TRANSACTIONS ON PLASMA SCIENCE	PS	*IEEE Trans. Plasma Sci.*
IEEE TRANSACTIONS ON POWER APPARATUS AND SYSTEMS	PAS*	*IEEE Trans. Power App. Syst.** (through 1985)
IEEE TRANSACTIONS ON POWER DELIVERY	PWRD	*IEEE Trans. Power Delivery*
IEEE TRANSACTIONS ON POWER ELECTRONICS	PEL	*IEEE Trans. Power Electron.*
IEEE TRANSACTIONS ON POWER SYSTEMS	PWRS	*IEEE Trans. Power Syst.*
IEEE TRANSACTIONS ON PROFESSIONAL COMMUNICATION	PC	*IEEE Trans. Prof. Commun.*
IEEE JOURNAL OF QUANTUM ELECTRONICS	QE	*IEEE J. Quantum Electron.*
IEEE TRANSACTIONS ON REHABILITATION ENGINEERING	RE	*IEEE Trans. Rehab. Eng.*
IEEE TRANSACTIONS ON RELIABILITY	R	*IEEE Trans. Rel.*
IEEE TRANSACTIONS ON ROBOTICS AND AUTOMATION	RA	*IEEE Trans. Robot. Automat.*
	RA*	*IEEE J. Robot. Automat.** (1985–1988)
IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS	SAC	*IEEE J. Select. Areas Commun.*
IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS	STQE	*IEEE J. Select. Topics Quantum Electron.*
IEEE TRANSACTIONS ON SEMICONDUCTOR MANUFACTURING	SM	*IEEE Trans. Semiconduct. Manufact.*

Publication	Acronym	Reference Abbreviation
IEEE SENSORS JOURNAL		*IEEE Sensors J.*
IEEE TRANSACTIONS ON SIGNAL PROCESSING	SP	*IEEE Trans. Signal Processing*
	ASSP*	*IEEE Trans. Acoust., Speech, Signal Processing** (1975–1990)
	AU*	*IEEE Trans. Audio Electroacoust.** (until 1974)
IEEE SIGNAL PROCESSING LETTERS	SPL	*IEEE Signal Processing Lett.*
IEEE TRANSACTIONS ON SOFTWARE ENGINEERING	SE	*IEEE Trans. Software Eng.*
IEEE JOURNAL OF SOLID-STATE CIRCUITS	SSC	*IEEE J. Solid-State Circuits*
IEEE TRANSACTIONS ON SPEECH AND AUDIO PROCESSING	SAP	*IEEE Trans. Speech Audio Processing*
IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART A: SYSTEMS AND HUMANS	SMCA	*IEEE Trans. Syst., Man, Cybern. A*
IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART B: CYBERNETICS	SMCB	*IEEE Trans. Syst., Man, Cybern. B*
IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS	SMCC	*IEEE Trans. Syst., Man, Cybern. C*
	SMC*	*IEEE Trans. Syst., Man, Cybern.** (1971–1995)
	SSC*	*IEEE Trans. Syst. Sci. Cybernetics** (through 1970)
IEEE TRANSLATION JOURNAL ON MAGNETICS IN JAPAN	TJMJ	*IEEE Transl. J. Magn. Jpn.*
	MMS*	*IEEE Trans. Man-Mach. Syst.** (through 1970)
	HFE*	*Hum. Factors Electron.** (through 1968)
IEEE JOURNAL ON TECHNOLOGY IN COMPUTER AIDED DESIGN	JTCAD	*IEEE J. Technol. Computer Aided Design*
IEEE TRANSACTIONS ON ULTRASONICS, FERROELECTRICS, AND FREQUENCY CONTROL	UFFC	*IEEE Trans. Ultrason., Ferroelect., Freq. Contr.*
	SU*	*IEEE Trans. Sonics Ultrason.** (through 1985)
	UE*	*IEEE Trans. Ultrason. Eng.**
	PGUE*	*IEEE Trans. Ultrason. Eng.**
IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY	VT	*IEEE Trans. Veh. Technol.*
	VC*	*IEEE Trans. Veh. Commun.**
IEEE TRANSACTIONS ON VERY LARGE SCALE INTEGRATION (VLSI) SYSTEMS	VLSI	*IEEE Trans. VLSI Syst.*
IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS	VCG	*IEEE Trans. Visual. Comput. Graphics*
PROCEEDINGS OF THE IEEE		*Proc. IEEE*
		*Proc. IRE** (through 1962)

APPENDIX IV
LIST OF IEEE MAGAZINES

Magazines	**Reference Abbreviation**
IEEE Aerospace and Electronics Systems Magazine	*IEEE Aerosp. Electron. Syst. Mag.*
IEEE Annals of the History of Computing	*IEEE Annals Hist. Comput.*
IEEE Antennas and Propagation Magazine	*IEEE Antennas Propagat. Mag.*
IEEE Circuits and Systems Magazine (1979–1984)	*IEEE Circuits Syst. Mag.*
IEEE Circuits and Devices Magazine (1985–present)	*IEEE Circuits Devices Mag.*
IEEE Communications Society Magazine (through 1978)	*IEEE Commun. Soc. Mag.*
IEEE Communications Magazine (1979–present)	*IEEE Commun. Mag.*
IEEE Computation in Science and Engineering Magazine	*IEEE Comput. Sci. Eng. Mag.*
IEEE Computer	*IEEE Computer*
IEEE Computer Applications in Power	*IEEE Comput. Appl. Power*
IEEE Computer Graphics and Applications	*IEEE Comput. Graph. Appl.*
IEEE Concurrency	*IEEE Concurrency*
IEEE Control Systems Magazine	*IEEE Control Syst. Mag.*
IEEE Design and Test of Computers	*IEEE Des. Test. Comput.*
IEEE Electrical Insulation Magazine	*IEEE Electr. Insul. Mag.*
IEEE Engineering in Medicine and Biology Magazine	*IEEE Eng. Med. Biol. Mag.*
IEEE Engineering Management Review	*IEEE Eng. Manag. Rev.*
IEEE Expert (through 1997)	*IEEE Expert*
IEEE Industry Applications Magazine	*IEEE Ind. Appl. Mag.*
IEEE Instrumentation and Measurement Magazine	*IEEE Instrum. Meas. Mag.*
IEEE Intelligent Systems (formerly IEEE Expert)	*IEEE Intell. Syst.*
IEEE Internet Computing	*IEEE Internet Comput.*
IEEE IT Professional	*IEEE IT Prof.*
IEEE Micro	*IEEE Micro*
IEEE Microwave Magazine	*IEEE Microwave*
IEEE Multimedia	*IEEE Multimedia*
IEEE Network	*IEEE Network*
IEEE Personal Communications	*IEEE Pers. Commun.*
IEEE Potentials	*IEEE Potentials*
IEEE Power Engineering Review	*IEEE Power Eng. Rev.*
IEEE Robotics and Automation Magazine	*IEEE Robot. Automat. Mag.*
IEEE Signal Processing Magazine (1991–present)	*IEEE Signal Processing Mag.*
IEEE ASSP Magazine (1984–1990)	*IEEE ASSP Mag.*
IEEE Software	*IEEE Softw.*
IEEE Spectrum	*IEEE Spectr.*
IEEE Technology and Society Magazine	*IEEE Technol. Soc. Mag.*
Today's Engineer	*Today's Eng.*