Using the Document Class IEEEtran.cls

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Abstract— **This article explains how to use a LaTeX style that produces a good approximation to the style used in the IEEE Transactions. The article is itself an example of the IEEEtran.cls style in action.**

Keywords— **Style file, LaTeX, IEEE Transactions.**

I. Introduction

THE Institute of Electrical and Electronics Engineers Inc. (IEEE in short) publishes a large number of journals. Some of these these are

- IEEE Transactions on Automatic Control
- IEEE Transactions on Software Engineering
- IEEE Transactions on Communications
- IEEE Transactions on Industrial Electronics
- IEEE Transactions on Systems Man and Cybernetics
- IEEE Transactions on Circuits and Systems
- IEEE Transactions on Robotics and Automation
- IEEE Transactions on Computers
- ...

Authors who have prepared their articles using LaTeX can get them formatted in a style identical to that of a typical paper in one of those journals.

The aim of the style file `IEEEtran.cls` is to allow authors of papers to estimate the page count and facilitate input-processing of the compuscript. The style file `IEEEtran.cls` can be used together with the bibliography style file `IEEE.bst`.

IEEE has sophisticated software, in house and different to LaTeX, which they use to typeset transaction papers. The single most important reason for this style file was due to the fact that many authors (using TeX and LaTeX) were supplying their compuscripts using style files that were *single column page wide*. It was obvious from the coding that many had spent time inserting commands that made the displayed equations "pretty", spreading them right across the page. But of course, IEEE transactions are *double column*, with the column width being 21 pica. Thus, the IEEE publishing staff ended up deleting these typesetting 'niceties' and breaking the page wide displayed equations so that they would *fit* inside the style-required 21 pica. By using this style file you'll find that the displayed equations, algorithms, nomenclature lists, etc. that you supply to us (on disk or via e-mail: ask the editor of your transactions) will undergo minimal change.

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Note that the "thanks" command does no longer produce footnote marks.

II. How to Use the File IEEEtran.cls

This style file has been written so to allow, with very few changes, the formatting of input that is suitable for the LaTeX `article` style. First, the `IEEEtran.cls` style file has to be selected with a command of the form

```
\documentclass[twocolumn,twoside]{IEEEtran}
```

The default font size is 10 points. The default page style has been redefined and is now set by `IEEEtran.cls` to "`headings`".

IEEE Transactions papers do not include author affiliations below or beside the name(s) of the author(s); instead, use the command `\thanks{...}` to list addresses. Note that the `\thanks{..}` command in the title no longer produce marks: the thanks-footnote should therefore be self-contained, with address and name of the author(s).

Footnotes produce a footnote mark as usual.[1]

The command "`\PARstart{X}{YYY} ZZZ`" produces a large letter `X` at the beginning of the paragraph. The string `YYY` will be automatically changed to capital letters.

The bibliography style file `IEEE.bst` allows BibTeX to include the references from the chosen bibliography file(s) according to the format required by IEEE Transactions.

Full papers should include the biography of the authour. An example of a formatted biography is given at the end of this sample article. The environment is called `biography` and requires the name of the person whose biography is presented.

In figure 1 we can see an example for the definition of the title page and of the main commands needed to compile a LaTeXfile with IEEEtran.cls.

The command `\markboth{leftTEXT}{rightTEXT}` can be used for setting the running heads. If the option `twoside` is not selected, both even and odd headers will display `leftTEXT` together with the page number. Note that the header of the title page always displays `leftTEXT` as it bears the journal name.

[1] The footnote is indicated by a footnote mark

```
\documentclass[twocolumn,twoside]{IEEEtran}

\begin{document}

\title{Using the Document Class ...}

\author{Gerry Murray\thanks{...}}
\markboth{X Jornadas}{...}
\maketitle

\begin{abstract}
This article ...
\end{abstract}

\begin{keywords}
Style file...
\end{keywords}

\section{Introduction}
\PARstart{T}{he} Institute of ...

\bibliographystyle{IEEE}
\bibliography{bib-file}


\end{document}
```

Fig. 1. Input used to produce this paper.

A. Additional Changes

Most changes resulting from the use of IEEEtran.cls should be transparent to the user. For instance, captions for figures and tables have been modified. Caption of tables, however, should be defined before the table item.

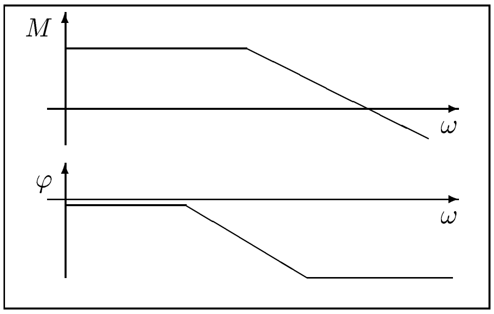

Fig. 2. This is a sample figure. The caption comes after the figure.

A.1 Environments

The environments for theorem, propositions, lemmas, etc. can be defined with the usual LaTeX [1], [2] command `\newtheorem{..}{..}`. The proof environment is already defined.

Theorem 1 (Theorem name) Consider the system

$$\begin{aligned} \dot{x} &= A.x + B.u \\ y &= C.x + D.u \end{aligned} \quad (1)$$

If A is stable, then the pair $\{A, B\}$ is stabilizable. Moreover, this holds for any B.

Proof: The proof is trivial. ■

TABLE I
THE CAPTION COMES BEFORE THE TABLE.

	title page	odd page	even page
onesided	leftTEXT	leftTEXT	leftTEXT
twosided	leftTEXT	rightTEXT	leftTEXT

B. Preparing a Technical Note

A technical note can be prepared using the additional option `technote` in the documentstyle command. Note that the default point size is still 10 points, but that 9 points should be selected. The format for a technical note can thus be selected with a command of the form

```
\documentclass[...side,9pt,technote]{IEEEtran}
```

All the definitions and commands are still valid even after the changes caused by the option `technote`.

C. Submitting a Paper

The paper can be prepared for submission by omitting the option `twocolumn` and choosing the option `draft` (this will modify the baselinestretch variable). Thus, the format for submission contains a definition of the form

```
\documentclass[...side,12pt,draft]{IEEEtran}
```

III. OPTIONAL FORMATTING

When you are happy with the *ultimate unequivocal final version*, you may perform following additional changes.

A. "Hard-Coding" Symbolics

Change the symbolics so that the file actually contains the reference numbers *i.e.* "`... \cite{fred:88} ...`" should be changed to "`... [3] ...`". One author (who used the style file) did a smart thing *after* he had decided upon a final version. He put his `\cite{..}` command and other symbolics on a line on their own and commented them out (from the formatting) by putting a `%` sign before each symbolic. Then, on the next line he just inserted the copy-matching numerical, like this:

```
Well, according the Fred Bloggs
%\cite{fred:88}
[24]
the value of $\alpha$ should be even
greater than what we think it should be.
```

Thus, *he* knows he put in the correct (copy-matching) numerical and the IEEE publishing staff can send him back an author-proof that correctly matches his submission.

The above also applies to the referencing of table and figures (and any "auto-numbering" feature, standard or synonymous with your system).

Figure captions can be part of the text (in between paragraphs) like this:

```
And in Fig. 3 we see that the
value of $\alpha$ increases
exponentially.

   Fig. 3\quad This is the caption
   for figure 3 showing some $\alpha$.

And after the caption we continue on
with the next paragraph, like this.
```

In essence, by you actually putting in the *correct copy matching* numericals so that no problems arise with incomplete files being sent to the transactions (the wrong `*.bib`, `*.bbl` files, the wrong versions of figures etc). Also, and more importantly, the numbers that are on your hard-copy (and in the reviewer's hands) will be the same ones that you receive in your author proof.

B. *Including the Bibliography into the LaTeX Source File*

You can reduce the number of files you have to send to the IEEE publishers in the following way. Run BibTeX on the `*.aux` file. This creates a `*.bbl` file: include this into your LaTeX source file at the place where you defined the `\bibliography{..}` command and comment this command out. Remove the `*.bbl` file. Then, your LaTeX file will include all the necessary information about your bibliography and no `*.bbl` or `*.bib` file will be needed.

This may seem like an awful lot of work... but not really.. This will allow to process your paper quickly and efficiently, and assure you that what you send in *will* actually be sent back to you without mistakes (cites, refs etc.).

IV. Conclusions

This sample article has presented the style file IEEEtran.cls This file can be especially useful in preparing articles for submission and for preparing the final version to be sent to the IEEE publishers.

In essence, the style file "IEEEtran.cls" is not really for formatting (paper printout) – but is for IEEE *input processing* which is chalk and cheese, frankly.

Acknowledgments

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References

[1] Leslie Lamport, *A Document Preparation System: LaTeX, User's Guide and Reference Manual*, Addison Wesley Publishing Company, 1986.
[2] Helmut Kopka, *LaTeX, eine Einführung*, Addison-Wesley, 1989.
[3] D.K. Knuth, *The TeXbook*, Addison-Wesley, 1989.
[4] D.E. Knuth, *The METAFONTbook*, Addison Wesley Publishing Company, 1986.