

Special Instructions for the *IEEE Sensors Letters* L^AT_EX Class, IEEE_Isens

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Abstract—This article describes the special features of the IEEE_Isens L^AT_EX class to produce high quality typeset papers that are suitable for submission to the *Institute of Electrical and Electronics Engineers (IEEE) Sensors Letters*, which accepts papers on sensors at all length scales including macro, micro and nano. Only behavior/features that are unique to IEEE_Isens are discussed here along with any applicable helpful supplementary information about the submission process from the *IEEE Sensors Letters* Microsoft Word template. Refer to the comprehensive IEEEtran HOWTO documentation for other topics that are common to all IEEE style L^AT_EX work. This document was produced using IEEE_Isens.

Index Terms—IEEE, IEEE_Isens, IEEE Sensors Letters, L^AT_EX, LSENS, paper, template.

I. INTRODUCTION

The purpose of this article is to serve as a user guide for the *IEEE Sensors Letters* L^AT_EX class, IEEE_Isens, and to document its unique features and behavior. Although IEEE_Isens is derived from the standard IEEE L^AT_EX class, IEEEtran, only the notable changes and differences are covered here in addition to information specific to the *IEEE Sensors Letters* submission process. Thus, this article can be considered to be a supplement to, not a complete replacement of, the IEEEtran_HOWTO manual. So, IEEE L^AT_EX authors who are already familiar with IEEEtran can quickly come up to speed with IEEE_Isens using this relatively short guide.

IEEE Sensors Letters uses the standard IEEE style bibliography/reference format which is produced by the IEEEtran.bst BibT_EX style. The full IEEEtran_HOWTO documentation as well as the IEEEtran BibT_EX style can be obtained at the journal author support section within the main site of the IEEE [1], or at the IEEEtran package distribution page on the CTAN site [2].

This document applies to version 1.0 and later of IEEE_Isens (based on IEEEtran version 1.8b). IEEE_Isens will display the version number on the user's console when a document using it is being compiled. The latest version of IEEE_Isens can be obtained at the *IEEE Sensors Letters* web site [3].

Complementary to this document is the file `bare_lsens.tex`, which is a “bare bones” example (template) file of an *IEEE Sensors Letters* paper. Authors can quickly obtain a functional document by using this file as a starter for their own work.

A. Publication Rules and Limits

1) Page Limits: *IEEE Sensors Letters* has a hard four page limit, including the references. Do not attempt to alter the font sizes or spacing to get around this limit. The IEEE will reformat

and verify your paper after submission and so any custom spacing or formatting changes will be rendered null and void. Four pages is approximately equal to 3600 words, and the average figure is approximately equivalent to 140 words.

2) *Sectioning:* Despite the relatively short page limit, please divide the paper into sections and subsections to improve readability. Although rarely needed, subsubsection (as shown here) and paragraph sections are available for third and fourth level divisions.

3) *Units:* Use either SI (MKS) or CGS as primary units. SI units are strongly encouraged. English units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write “15 Gbit/cm² (100 Gbit/in²).” An exception is when English units are used as identifiers in trade, such as “3½ in disk drive.” Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refer to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., “A · m².”

B. Key Differences from IEEEtran

The most important differences from the standard IEEEtran L^AT_EX class include:

- There are far fewer class options available.
- Smaller font sizes tend to be used to allow more content per page. The main text font size is fixed at 9pt and the interword spacing is allowed to become smaller than is typical with IEEE journal work.
- A Times-compatible math font is required.
- The header format is different. There are no footers other than that produced by \IEEEpubid on the title page. There are no page numbers at all.
- The title page format is quite different from that of IEEEtran. **This is perhaps the single most significant difference as it**

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(For the real e-mail address, see <http://www.michaelshell.org/contact.html>).

Associate Editor: Alan Smithee.

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requires the use of additional commands to support the extra features of the title page.

- The main title is rendered in color, but such color effects are internally produced by IEEE_lsen and do not depend on, and should not interfere with, any L^AT_EX color packages.
- There is no initial large “drop cap” for the first letter of the very first paragraph. \IEEEPARstart has no effect.
- Some sections (acknowledgment and references) are rendered in scriptsize font. **Because it is a user-declared section (rather than resulting from an internally defined environment, such as that of the references), the acknowledgment section will require the manual specification of \scriptsize to obtain this size font. See the acknowledgment section at the end of this article for an example.**

II. CLASS OPTIONS

Most of the standard IEEEtran class options are not available as they are not needed for *IEEE Sensors Letters*. It is almost always the case that authors should load the IEEE_lsen class without any options at all:

```
\documentclass{IEEE_lsen}
```

That said, the following limited options are available. For each available option category below, the default is shown in bold.

A. 9pt

As is the typical case with IEEE correspondence/brief/letter/technote papers, the standard font size is 9pt. No other main text size is needed or supported under IEEE_lsen.

B. letterpaper, a4paper

The standard US letter (8.5in × 11in) size should be used when submitting to the IEEE unless you are specifically requested by IEEE editorial staff to do otherwise. An option for the international standard A4 (210mm × 297mm) paper size is provided primarily to allow authors outside the United States to format and print their papers for personal review and use. **However, be forewarned that, unlike the standard IEEEtran class, changing the paper size under IEEE_lsen will alter the formatting of the document (the page margins are what are held relatively constant). Therefore, page counts are not consistent between the different paper sizes.**

C. coloroff

IEEE_lsen automatically renders some text, specifically the paper title, in color. The coloroff option will disable this feature and is provided primarily to allow authors to format their papers for printing on devices without color capability for personal review and use. The coloroff option should normally not be invoked when submitting to the IEEE unless you are specifically requested by IEEE editorial staff to do so.

III. TIMES-COMPATIBLE MATH FONT REQUIREMENT

IEEE Sensors Letters requires the use of a math font that closely matches the Times Roman main text (as is the case with IEEEtran under comsoc mode). Either Michael Sharpe’s freely available newtxmath package [4] (version 1.451, July 28, 2015 or later is recommended) or the commercial MathTime [5] math fonts (as mtpro2.sty, mt11p.sty or mathtime.sty) are acceptable. If one of these packages has not been loaded by the user at the start of the document, IEEE_lsen will attempt to enforce their use based on what is available on the system.

The recommended loading procedure and order for newtxmath is:

```
\usepackage[T1]{fontenc} % optional
\usepackage{amsmath}
\usepackage{cmintegrals}{newtxmath}
\usepackage{bm} % optional
```

where the cmintegrals option¹, which IEEE_lsen sets as a default upon loading newtxmath, is needed to obtain the specific style of integral symbol used by the *IEEE Sensors Letters*. The optional bm package [6] provides for selective bold math. Be aware that the AMS Math amssymb.sty package [7] is not needed and should not be loaded as that functionality is built into and provided by newtxmath as well as MathTime. Also, do not load the newtxtext.sty package as doing so would alter the main text font.

IV. HEADERS AND FOOTERS

The paper headers are set as usual using the \markboth command:

```
\markboth{Vol.~1, No.~3, July~2017}{0000000}
```

The information consists simply of the (reasonable author guess) volume, number, month, year and a seven digit paper number whose digits should be set to zeros. The actual information will later be determined and (re)set by the IEEE publications department after paper submission. *IEEE Sensors Letters* papers do not employ footers.

V. TITLE PAGE

The setup of the title page is where IEEE_lsen differs most from the traditional IEEEtran. All of the information that is to appear in the single column title area must be declared before calling the \maketitle command. In the case of *IEEE Sensors Letters*, this also includes the abstract and index terms information (like as is done under The IEEE Computer Society mode of IEEEtran).

A. Article Subject Line

On the title page, below the traditional header is an “article subject” line. Popular article subjects include “Electromagnetic Wave Sensors,” “Microwave/Millimeterwave Sensors” and “Sensor Applications.” This line is declared using the command:

```
\IEEESENSArticlesubject{Sensor Applications}
```

¹As of version 1.5 of the newtxmath package, released on 2016/08/12, the correct integral symbol is now invoked by default and the cmintegrals option is no longer needed and is silently ignored.

B. Paper Title

The title itself is declared in the traditional way:

```
\title{Bare Demo of IEEE\lsens.cls for IEEE Sensors Letters}
```

Avoid long formulas with sub/superscripts in the title, although short formulas to identify elements are fine. Do not begin a title with the word “On” and avoid starting titles with articles such as “The.”

C. Author Information

The `\author{}` information of *IEEE Sensors Letters* papers uses separate name and affiliation blocks, like that of the conference mode of IEEEtran, but with only one of each type of block as the single name/affiliation block contains all of the names/affiliations. The author information of this article was produced using:

```
\author{\IEEEauthorblockN{Michael~Shell\IEEEauthorrefmark{1}\IEEEauthorieemembermark{1}, John~Doe\IEEEauthorrefmark{2}\IEEEauthorieemembermark{2}}, and~Jane~Doe\IEEEauthorrefmark{2}\IEEEauthorieemembermark{2}}%
\IEEEauthorblockA{\IEEEauthorrefmark{1}Department of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA, 30332, USA\IEEEauthorrefmark{2}The Institute of Electrical and Electronics Engineers, Piscataway, NJ 08854, USA\IEEEauthorieemembermark{1}Member, IEEE\IEEEauthorieemembermark{2}Senior Member, IEEE}%
\thanks{Corresponding author: M. Shell (e-mail: nospam@nospam.org).}%
\thanks{Associate Editor: Alan Smithee.}%
\thanks{Digital Object Identifier 10.1109/LSSENS.2017.0000000}}
```

As is the case with IEEEtran, and \LaTeX in general, a % (or if you prefer, `\relax`) is used at the end of lines that end in a brace `{}` to prevent the end of line characters from being interpreted as an unwanted space between the elements.

Full author names are much preferred over initials. Asian authors may also include their native character names in parentheses after their Romanized names, if they wish. For more information on this topic see http://www.ieee.org/publications_standards/publications/authors/auth_names_native_lang.pdf. Please avoid courtesy authorship. Use the acknowledgment section to thank colleagues for their contributions.

Note that IEEE_{lsens} uses two different types of marks to indicate author affiliation and IEEE membership — `\IEEEauthorrefmark{}` and `\IEEEauthorieemembermark{}`, respectively. Each command uses a single integer argument to specify an affiliation or IEEE membership group. Affiliation groups are indicated by superscript arabic digits while IEEE membership groups are indicated by one or more successive superscript asterisks.

Each affiliation group and each type of IEEE membership group should be specified once, and only once, in the affiliation block and each author listed in the name block should have both an affiliation and (if applicable) an IEEE membership mark to create the needed linkage between the authors and their respective affiliation/IEEE membership status. Omit the `\IEEEauthorieemembermark` for authors who are not IEEE members.

Affiliation groups should be listed and numbered according to the order they (first) occur in the ordering of the author names.

Then, again likewise for the IEEE membership groups. Do not order IEEE membership groups according to IEEE membership prestige or seniority, e.g., if the first author is an IEEE student member, an IEEE student membership group will be the first to be listed regardless of the IEEE membership status of the other authors.

Department names are optional in the affiliations. Street addresses should not appear in the affiliations (unless the author does not have an institutional affiliation).

As with IEEEtran, `\thanks{}` is used within `\author{}` to access the “first footnote” area. Such information includes the corresponding author with e-mail address, the name of the associate editor, and the paper’s digital object identifier (DOI). The last seven digits of the DOI should be set to zeros as those digits will be replaced with the actual DOI number that is assigned to the paper by the IEEE publishing department. If desired, the first footnote area can also be used to declare equal author contributions, e.g., “A. Jones and B. Smith contributed equally” (after the corresponding author’s name).

For the attentive reader, not shown in the `\author{}` code is this document’s added <http://www.michaelshell.org/contact.html> contact information URL line which this author uses to provide IEEE authors a way to obtain technical support, but to prevent the displaying of contact information in robot/spam collecting “clear text” form. This is particularly important here given the wide scale public distribution of this document. The corresponding author of an actual *IEEE Sensors Letters* paper must provide a valid e-mail address.

Incidentally, although not normally needed, new lines can be used within `\thanks{}` if they are preceded by a `\protect`, e.g., `\thanks{... (nospam@nospam.org) .\protect\}`. A preceding `\protect` may also be needed for `\url` depending on which particular package is providing the `\url` command.

D. Manuscript Received Information

IEEE Sensors Letters places manuscript received date information just after the author information and not in the first footnote area as is typically done in IEEE papers. To accommodate this, IEEE_{lsens} provides the `\IEEESENSmanuscriptreceived{}` command:

```
\IEEESENSmanuscriptreceived{Manuscript received June 7, 2017; revised June 21, 2017; accepted July 6, 2017. Date of publication July 12, 2017; date of current version July 12, 2017.}
```

Correct dates will be inserted/changed by the IEEE. The publication and current version dates are the respective dates the preprint and final versions are posted on IEEE Xplore®.

E. Abstract and Index Terms

As with the Computer Society (compsoc) mode under IEEEtran, *IEEE Sensors Letters* places the abstract and index terms in the title area and so these must be declared within `\IEEEtitleabstractindextext{}` prior to calling `\maketitle`:

```
\IEEEtitleabstractindextext{\relax
\begin{abstract}
This article describes ...
\end{abstract}}
```

```
\begin{IEEEkeywords}
IEEE, IEEElsens, IEEE Sensors Letters, LaTeX, LSENS
```

S, paper, template.
`\end{IEEEkeywords}`

Define all symbols used in the abstract and again in the main text. Do not cite references in the abstract.

The index terms should consist of about four to eight words and/phrases separated by commas.

F. Publication ID and Copyright Lines

It is recommended that the IEEE copyright lines be declared because the resulting loss of three main text lines on the title page reflects how the paper will actually appear when published.

Use the `\IEEEpubid{}` command for this as is normally done under IEEEtran:

```
\IEEEpubid{1949-307X \copyright\ 2017 IEEE. Persona
l use is permitted, but republication/redistributio
n requires IEEE permission.\\
See \url{http://www.ieee.org/publications\_standar
s/publications/rights/index.html} for more informat
ion.}
```

Note that *IEEE Sensors Letters* requires a second line here for the IEEE URL. Change the year as needed, but the rest of the information such be applicable as-is. Remember, as always, when using `\IEEEpubid`, you will have to place a `\IEEEpubidadjcol` somewhere in the second column of the first page to prevent that text from intruding into the pubid area.

The `\IEEEpubid` command normally completes the title page information and so

```
\maketitle
```

can then be issued.

VI. FIGURES AND TABLES

Figures and tables (“floats”) under IEEE_{lsens} are much like that under IEEEtran. However, under IEEE_{lsens}:

- The default figure and table text size is `scriptsize` while their default caption text size is `footnotesize`.
- Floats are almost always of “top” placement.
- In some cases, an entire column can be totally filled with floats without any main text at all.
- Tables generally are of an “open” form (i.e., do not contain any vertical lines). See Table 1 as an example of this style (from [8]). The \LaTeX code that produced this table can be found in the `bare_lsens.tex` file.

Tables and figures are referenced in the main text as Table 1 and Fig. 1, respectively. Double column floats should not appear on the first (title) or very last page.

Be aware of the naming requirements for figure/graphic files that must be uploaded during the final submission process. See Section VIII-B for details.

Remember that for line art (e.g., plots, charts, tables) a vector format (i.e., scalable without pixelation or degradation, e.g., nonbitmapped PDF or EPS), should be used. Bitmap-only formats (e.g., JPG, PNG) should be reserved for images that are bitmapped/pixelized by nature (e.g., photos, picture-like graphs with continuous/nebulous gradients, etc.). Any drawing/plotting application used (e.g., GNUplot, MATLAB®, Inkscape, LibreOffice Draw, etc.) should be capable of

TABLE 1. Comparison of the HMSIW Semi-Circular Antenna With That of a Conventional Semi-Circular Patch Antenna.

Antenna parameters	Semi-cicular patch antenna	HMSIW semi-circular antenna
Frequency	3.67 GHz	5.22 GHz
Return Loss	-20 dB	-25 dB
Co-polarization Gain	E-plane: 5.8 dBi H-plane: 5.8 dBi	E-plane: 6.4 dBi H-plane: 5.3 dBi
Directivity	7.2	6.9
Radiation Efficiency	82%	92%
Mutual Coupling	-17 dB	-23 dB

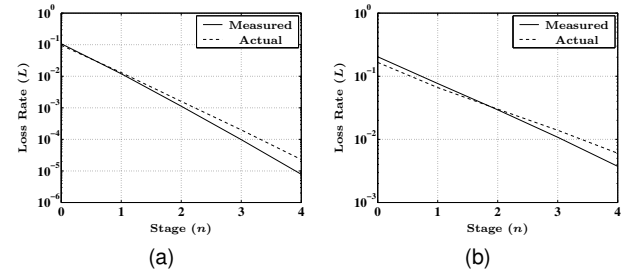


Fig. 1. Measured and actual loss rates for each stage. (a) $p = 0.30$. (b) $p = 0.60$.

exporting directly in EPS/PDF vector form. Beware that once a graphic object is converted/saved to a bitmap form it will forever remain so (i.e., the vector description is lost) even if later “converted” to a format that supports vector objects (e.g., a JPG object “converted” to PDF is still a bitmap object — the versatile EPS/PDF formats are also capable of containing bitmaps in addition to vector objects).

For an example of vector EPS/PDF graphics, view the plots in Fig. 1 under very high magnification (800% or beyond) and note how clear and sharp their features remain (and each of these PDF files is less than 10K bytes in size). A bitmap graphic, because it is based on pixels of a finite resolution, will degrade as the magnification is increased, but a vector object, because it is described directly by the pure mathematics of curves, will not. Tables produced within \LaTeX (e.g., via `tabular`, `IEEEeqnarray`) will also be in vector form as can be seen in Table 1.

A. Subfigures

In *IEEE Sensors Letters*, subfigures are normally labeled as (a), (b), etc. without any additional description. They may be placed vertically and/or horizontally to each other within the main float. The main caption then describes all the subfigures.

The recommended way to obtain the correct subfigure formatting under IEEE_{lsens} is to load the subfig package [9] using

```
\usepackage[caption=false,font=footnotesize,labelfont=
sf,textfont=sf]{subfig}
```

and then creating subfigures like

```
\begin{figure}[!t]
\centering
\subfloat[]{\includegraphics[width=1.5in]{fig1a}%
\label{fig_lossrate_a}}
\hfil
```

```

\subfloat[]{\includegraphics[width=1.5in]{fig1b}%
\label{fig_lossrate_b}}
\caption{Measured and actual loss rates for each st
age. (a)  $\$p=0.30\$$ . (b)  $\$p=0.60\$$ .}
% or (a), (b) can each carry a complete description:
%\caption{(a) First description. (b) Second descrip
tion.}
\label{fig_lossrate}
\end{figure}

```

the result of which is shown in Fig. 1. The empty optional argument to `\subfloat[]` is needed for the (a), (b) labels to be produced, but without any further description.

VII. THIRD PARTY EDITING SERVICES

Papers submitted to *IEEE Sensors Letters* must be written in correct English in order to be considered suitable for publication. Authors, especially those who are not native English speakers, might wish to consider the use of third party editing services to assist in ensuring correct English grammar and usage. Please note these services are fee-based and do not guarantee acceptance. American Journal Experts offers a 10% discount to IEEE members. See <http://www.aje.com/go/ieee/> for details (a link to which also appears on the *IEEE Sensors Letters* submission page). Cost estimates are available online, and are typically about \$100 for a four-page article. Processing time is usually within two weeks.

VIII. PAPER SUBMISSION PROCEDURE

A. ScholarOne® Manuscripts

Contributions to *IEEE Sensors Letters* must be submitted electronically on IEEE's online manuscript submission and peer-review system, ScholarOne® Manuscripts, at <https://mc.manuscriptcentral.com/sensors-letters>. First check if you have an existing account. If there is none, please create a new account. Be aware that *IEEE Sensors Journal* and *IEEE Sensors Letters* use separate login credentials — please set-up an account for *IEEE Sensors Letters* even if you have one for *IEEE Sensors Journal*. After logging in, go to your Author Center and click “Start a New Submission.”

Along with other information, you will be asked to select the subject (“Type”) from a pull-down list of two choices (i) Regular Letter or (ii) Perspectives Article. Almost all work should be submitted as a regular letter, except for the unusual case of short articles providing a perspective on a given topic. There are 7 steps to the submission process, and all of them must be completed to obtain a successful submission. At the end of each step you must click “Save and Continue” — just uploading the paper is not sufficient. After step 7, you should receive a confirmation message on the screen, and also shortly thereafter by e-mail, that your submission is complete. For inquiries regarding the submission of your paper on ScholarOne® Manuscripts, please contact oprs-support@ieee.org or call +1 732 465 5861.

When using L^AT_EX, you must generate a PDF or PS file to upload to ScholarOne® Manuscripts. Whatever format you upload, your figures should be embedded in the file.

You will be asked to file an electronic copyright form during the submission process. Authors are responsible for obtaining any required approvals/clearances. You will also have the opportunity to designate your article as “open access” in perpetuity if you agree to pay the IEEE open access fee.

1) *ORCID Instructions:* All IEEE journals require an Open Researcher and Contributor ID (ORCID) for all authors. ORCIDs enable accurate attribution and improved discoverability of an author's published work. The corresponding author will need a registered ORCID in order to submit a manuscript or review a proof. Follow these steps to link a ScholarOne® account to a registered ORCID:

- Login to ScholarOne® and click on your name in the top right corner of the screen.
- Click E-mail/Name in the dropdown menu.
- In the ORCID section at the top of the page, click the appropriate link to either register for a new ORCID or associate the account with an existing ORCID.
- A new page will open to create and/or validate your ORCID. Once the validation is complete, the new page will close and you will return to ScholarOne®.
- Save the changes to your ScholarOne® user account. Authors who do not have an ORCID in their ScholarOne® user account will be prompted to provide one during submission.

B. Final Submission

After your paper is accepted, you will be asked to upload final files to ScholarOne® Manuscripts. These will include your L^AT_EX (.tex) document source file; the (pdf)L^AT_EX PS or PDF output file; and separate, individual graphic/figure files, which for L^AT_EX work will generally be in either EPS, PDF, JPG or PNG format. Remember the vector versus bitmap format issue discussed in Section VI. Graphic/figure files should be named following this convention: fig1.pdf, fig2a.pdf, fig2b.pdf, fig3.jpg, etc.

There should be only one .tex document file. Please merge any multiple L^AT_EX “part/include” files into a single file before submission. This includes any B^IB^TE_X produced bibliographies — the contents of the generated .bbl file should be imported into the document .tex file to replace the

```

\bibliographystyle{IEEEtran}
\bibliography

```

lines.

Designate the author who submitted the manuscript on ScholarOne® Manuscripts as the “corresponding author.” This is the only author to whom proofs of the paper will be sent.

C. Publication

When the files for your accepted manuscript are all uploaded and checked by the *IEEE Sensors Letters* editorial office, your paper will be sent to the IEEE, where it will be posted as a preprint on the IEEE's Xplore® platform, which will represent the official publication. Thus, your final submitted manuscript will be readable by others and so you should ensure that it is of high quality and in final form. PDF page proofs will be sent by e-mail to the corresponding author in 2 to 3 weeks. The typeset article, with its article number, should appear on Xplore® a few days after the author approves the proofs.

IX. CONCLUSION

Using the IEEE_lsens class under the L^AT_EX typesetting system, IEEE authors can quickly produce high quality documents that are suitable for publication in *IEEE Sensors Letters*.

The author wishes you the best of success in your publication endeavors.

ACKNOWLEDGMENT

This work was supported by the IEEE. The author would like to thank Kevin Lisankie and Jeffrey Cichocki of the IEEE for their assistance in obtaining and verifying the *IEEE Sensors Letters* format specification. Note that the acknowledgment section is rendered in scriptsize. Therefore, you should start this section like:

```
\section*{Acknowledgment}
% need an \addcontentsline for PDF bookmarks
\addcontentsline{toc}{section}{Acknowledgment}
\scriptsize
```

and then end it with a blank line (to end the paragraph ensuring the line spacing used is indeed for scriptsize text), followed by a return to normal text size:

```
\normalsize
```

REFERENCES

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