

Design of an Integrated Modular Motor Drive

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Abstract

In this study, design of an Integrated Modular Motor Drive (IMMD) System is performed. Design of a modular fractional slot concentrated winding (FSCW) permanent magnet brushless direct current (PM-BLDC) motor and the modular motor drive power stage is performed based on Gallium nitride (GaN) technology. The efficiency of the motor drive is increased by 2% compared to conventional motor drive system. Selection of optimum DC bus capacitor suitable for the IMMD is achieved. DC Link capacitor bank size is reduced to its half in terms of both capacitance and current requirement with the utilization interleaving technique. The performance of the designed system is obtained via the simulations carried on MATLAB/Simulink. Power density values larger than 15 W/cm³ is achieved with the IMMD system which is not possible for a conventional drive.

1. Introduction

ELECO is organized as international conferences in odd numbered years and as national conferences in even numbered years. As such ELECO'2017 is the 10th international conference, with participants coming from various countries, presenting papers from the rich spectrum of electrical and electronics engineering. ELECO'2017 is jointly organized by Uludag University, Bursa; Istanbul Technical University (ITU); and the Chamber of Turkish Electrical Engineers (EMO), Bursa Section.

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Five pages are allowed for each paper (including title, author(s), abstract, text, figures, tables and references).

2. Page arrangement

The manuscripts must be prepared in a two-column format on A4 size paper. The margins on the first page must be as follows: top = 3 cm, bottom = 3.7 cm, left = 2 cm, right = 2 cm. All margins on the second and subsequent pages: top = 2.5 cm, bottom = 3.7 cm, left = 2 cm, right = 2 cm. The text of the paper must be written in two columns with a space of 0.5 cm between them (Fig. 1). The width of each column must be 8.25 cm. On the last page of the paper, the lengths of the columns must be adjusted so that they are equal. Do not add page numbers.

All the text must be written in Times New Roman fonts, single line spacing. The exception may be done for the contents of tables and figures, where Arial as well as Times New Roman font may be used. Font sizes and styles are listed in Table 1.

All paragraphs should be indented 0.4 mm. Please do not place any additional blank lines between paragraphs. Be sure your text is fully justified.

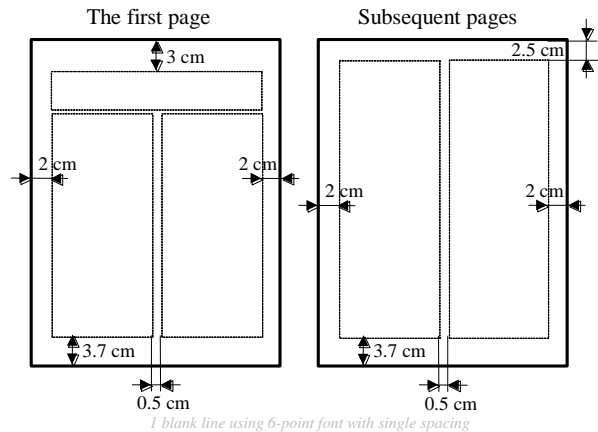


Fig. 1. Arrangement of printing area on an A4 size page for the first and subsequent pages of the manuscript

1 blank line using 9-point font with single spacing

Table 1. Font sizes and styles

1 blank line using 6-point font with single spacing

	Size	Style
Title of the Paper	14 pt*	Bold, Initially capitalized
Name of Author(s)	11 pt	Regular
Affiliation(s)	10 pt	Regular
Text of the Abstract	9 pt	Bold
Text of the Paper	9 pt	Regular
Headings of chapters and subsections	10 pt	Bold, Initially capitalized
Caption of Table	9 pt	Regular (The word "Table" and number – Bold)
Contents of Table	9 pt	Regular
Caption of Figure	9 pt	Regular (The word "Fig." and number – Bold)
Subscripts and Superscripts	7 pt	Regular

* 1 point (pt) is about 0.35 mm.

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2.1. First Page

1 blank line using 9-point font with single spacing

The first page of the manuscript must contain the title of the paper, author(s) name(s) and affiliation(s) all centered on the top of the page and spanning both columns. The title should be written using 14-point Times, boldface type with single spacing. Initially capitalize nouns, pronouns, verbs, adjectives, and adverbs; do not capitalize articles, coordinate conjunctions, or prepositions (unless the title begins with such a word).

Full names of authors are preferred, but initials may be used instead. There must be one-line separations between the title and author name(s), and between the authors and their affiliation(s). A two-line separation is required between the author affiliation(s) and the start of the main text.

2.2. Headings

Headings of chapters should be written in 10-point bold type font with single spacing. They should be numbered by successive Arabic numerals and centered in lines. Titles of subsections are to be written in 10-point bold type font with single-spacing as well, but they should be aligned with the left edge of the column. Full-stop symbol follows the number of chapter or subsection. All titles must be separated from the text by one (9-point) blank line above, and one (9-point) blank line below the title.

3. Figures and Tables

Figures and tables should be not more than 8.25 cm wide and ought to be centered in column. If possible, position figures and tables at the tops and bottoms of columns. Large figures and tables (maximum 17 cm width) may span across both columns. In such cases they should be centered on the full width of page together with captions or headings.

3.1. Figures

Captions of figures should be aligned with both edges of the column below the figures, in 9-point font, single spacing. The word "Fig." and the successive Arabic number with the full-stop symbol (".") must be written in bold. There should not be a full-stop symbol in the end of the caption of figure or table. Above each figure and below its caption should be 1 blank line spacing (9-point). The space between figure and its caption should have the size of approximately 6-point font.

All figures must be cited in the text in a consecutive order using abbreviations, e.g. "Fig. 1". In figure axis labels, use words rather than symbols. Put units in parentheses. For example, write "Time (s)". Do not label axes only with units.

3.2. Tables

Every table must have a descriptive title. Captions of tables should be aligned with both edges of the column above the tables, in 9-point font, single spacing. The word "Table" and the successive Arabic number with the full-stop symbol (".") must be written in bold. Below each table and above its caption should be 1 blank line spacing (9-point). The caption should be separated from the table by one 6-point empty line. Tables must be cited consecutively in the text, e.g. "Table 1".

4. Equations

Equations ought to be centrally arranged in lines and numbered by successive Arabic numerals using parentheses aligned with the right-side edge of the column. Symbols and variables in the equations as well as in the text should be written in italics, while vectors and matrices in ordinary bold type.

The equations ought to be separated from the text by 1 blank line (9-point):

$$u(t) = U_m \sin \omega t. \quad (1)$$

Symbols in the equation should be defined before the equation appears or immediately following.

5. Abbreviations and Units

Define abbreviations and acronyms the first time they are used in the text, even if they have been defined in the abstract. Commonly used abbreviations such as IEC, IEEE, SI, AC, and RMS do not have to be defined. Use SI units where possible.

6. Conclusions

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7. References

All references must be numbered consecutively by Arabic numerals. All references should be cited within the text using numbers in square brackets, e.g. "[1, 2]". All references must be listed in 9-point Times, single-spaced, at the end of the paper as following examples:

- [1] J. K. Author, "Name of paper", *Abbrev. Title of Periodical*, vol. x, no. x, pp. x-x, Abbrev. Month, year.
- [2] J. K. Author, "Title of book", *Abbrev. of Publisher*, City of Publisher, Country, year.
- [3] J. K. Author, "Title of paper", in *Unabbreviated Name of Conf.*, City of Conf., Abbrev. State (if given), year, pp. x-x.
- [4] J. K. Author, "Title of thesis", M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.
- [5] *Title of Standard*, Standard number, date.
- [6] J. K. Author. (year, month day). *Title* (edition) [Type of medium]. Available: [http://www.\(URL\)](http://www.(URL))