

Bucknell University Electrical and Computer Engineering Department Series on Technical Communication

Formatting and Referencing Equations

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Equations are essential elements of many technical documents and presentations. The mathematical expression of models, dependencies, patterns, and other conceptual relationships in the physical world forms the foundation and language of engineering and science. Just as there are many standards for expressing mathematical ideas that are second-nature to you by now (such as the multiplication, summation, and integration symbols), there are also standards for formatting and referencing equations in print. It is very likely that you will be incorporating equations into documentation throughout your career, so you should familiarize yourself with the relevant standards and begin using them now. Just as poor grammar and organization can frustrate a reader and lead them to suspect your professional competence, so can the careless presentation of equations lead to the same suspicion.

Equations in technical documents should be typeset using an equation editor. Your preferred word processing software or internet app likely has some type of built-in editor. However, equation editors vary widely in quality, so if your preferred software has an inferior editor, you should consider using an online equation editor or obtaining third-party software that can be integrated into your word processor.

Listed below are some of the most important aspects of formatting and referencing equations in documents. The information is not exhaustive since the purpose of this guide is only to highlight the fundamentals. More detailed information is available in high-quality references such as the *IEEE Editorial Style Manual* [1] and a wide variety of books on technical communication.





Equation Formatting

- Scalar variables in equations should be italicized. Alphabetical subscripts should be italicized as well, but not numerical subscripts. An exception is a subscript that is a word or abbreviation (such as "max"). Those types of subscripts are usually not italicized, but there could be exceptions in particular publication style guides.
- 2. Numbers (digits 0 through 9) and values in equations should not be italicized.
- 3. Function names or abbreviations, such as sin, cos, and exp, should not be italicized.
- 4. The formatting of variables representing vectors and matrices varies by publication, but a commonly accepted standard is to represent vector quantities in bold face and not italicized. Matrices are often represented by upper case italicized letters, but some publications use identifying marks such as double bars over the letter. Context and consistency are key; choose a system and stick to it, and explain it to the reader.
- 5. Avoid using an asterisk (*) to represent scalar or vector multiplication. Instead, express a product simply by writing the variables next to each other or, in more complicated expressions, by using parentheses. The asterisk is often used to represent other operations, such as convolution or complex conjugation, so its use to represent multiplication could cause confusion. Be careful when using a dot (·) to represent multiplication as well, since it could be confused with the vector dot product symbol. An exception to this rule applies when Matlab code (or that of other languages) is listed in the text. In that case, the language syntax should be retained. Also, dots can be used to clarify compound units (e.g., "the speed was 15 m · s⁻¹").
- 6. Equations should be centered horizontally on the page, and one line of horizontal space should be added before and after each equation.
- 7. Do not italicize units (e.g., 3 *mA*) when they appear in equations. This often happens because equation editors by default treat all alphabetical characters as variables, which should be italicized. Most equation editors provide a means for removing the default italicization for specific characters.
- 8. Calculations of numerical results obtained from formulas should be demonstrated explicitly by showing how appropriate numerical values were substituted into the equation. An example is given below. This serves several purposes. One is to save the reader from searching the text to find the values that were substituted. Another is to prevent any ambiguity or confusion over which particular values should be substituted for the various variables in the equation. A common example is the specification of AC voltages (peak-



to-peak, peak, or rms?). Still another purpose is to clarify any required scaling (e.g., 200 μ A in the equation below is expressed as 200 × 10⁻⁶).

$$R_{s} = \frac{V_{DD}}{3I_{D}} = \frac{3.3}{3(200 \times 10^{-6})} = 5.5 \text{ k}\Omega$$

Equation Numbering and Referencing

 If an equation is numbered, the number should be right justified on the same line as the equation. Equation numbers are usually placed in parentheses or, less commonly, in [square brackets]. The word "Equation" or abbreviation "Eqn." normally should not be added in front of the number, but specific publications might require it. Arabic numerals (e.g., 1, 2, etc.) should normally be used, not Roman numerals or other types. An example is given below.

$$I_{D} = \frac{1}{2} k_{n} \left(V_{GS} - V_{t} \right)^{2}$$
(1)

- 2. Although equations can be (and frequently are) numbered, they should never have captions. Put all explanations of equations in the text, not in a caption. Citations to sources of equations should be embedded in the descriptive text as well.
- 3. Equations should be explained in the body of the text. Do not assume that the equation can stand alone. The reader should not have to deduce on their own why the equation is there and what information it is supposed to convey.
- 4. When referring to an equation in the text, cite it using the same numbering scheme as that used with the equation itself. Do not spell out the equation number. An example of a proper reference is: "One expression for the voltage gain is given in (3.2)." The word "Equation" or the abbreviation "Eqn." should not normally be added in front of the equation number in a reference, but if the publication style calls for it, then it should be capitalized.
- 5. References to equations in the text should be by number or position (e.g., "The equation below expresses..." or "The result given by (3) implies that..."). References to equations by number are not usually necessary if the reference is in the immediate vicinity of the equation. For example, "The relationship is given by..." (immediately followed by the equation) would be preferred over "The relationship is given by (3) below."

Reference

[1] *IEEE Editorial Style Manual*, IEEE Periodicals, Piscataway, NJ, 2019.
- A copy is available at https://journals.ieeeauthorcenter.ieee.org/your-role-in-article-production/ieee-editorial-style-manual/



About this Guide

This guide is part of a series that has been established to provide a repository of information on technical communication for the students and faculty of the Bucknell University Electrical & Computer Engineering Department. Its primary goal is to foster consistent standards applied to the preparation of reports, presentations, and other forms of communication within the ECE curriculum. In effect, the guides in this series constitute official department policy on technical communication.

Although it is important to adhere to standards for graded class work, you should strive to maintain high standards as well in ungraded work and in day-to-day communications with your professors, other students, and professional contacts. You should view every instance of communication as an opportunity to practice your skills so that eventually they become second nature. Fair or not, your colleagues will form opinions of your professional competence based partly on how well you express yourself.