1 The siunitx-package to typeset numbers and units in LaTeX documents

Typesetting values with units correctly is a tedious but important, and often overlooked, part of publication writing in the natural sciences. It is particularly difficult for beginners to do it right and unfortunately, LaTeX does not offer much help for this task in its standard configuration. Typesetting correct value/unit pairs is non-intuitive and requires detail knowledge on microtypography.

Let us consider the following phrase which demonstrates common issues and difficulties when dealing with values and units:

values and units with errors

The -7 dB loss ($\pm 2dB$) shown on pp. 7-9 can be attributed to the $f(t) = \sin(2\pi ft)$ signal, where t is the time and $f = 48$ Khz is the *sampling frequency*.

The phrase was typeset with the following LaTeX source code:

values and units with errors (LaTeX source)

```
The -7 dB loss ($\pm 2 dB$) shown on pp.\,7-9 can be
attributed to the $f(t) = \sin(2\pi ft)$ signal, where
$t$ is the time and $f=48$\, Khz is the \emph{sampling
frequency}.
```

If you are trained to spot typographical errors, you will discover the following issues:

- Similar to mathematical symbols in text, numbers must be typeset within a mathematical environment to be sure that they appear correctly. Outside math-mode, the *minus sign* becomes the much shorter hyphen: -7 → −7. (`-7` → `$-7$`).
- Units of measurement are typeset outside math-mode in an upright font. Math-mode italic is used for mathematical variables, not for units and constants. Moreover, there must be a *small space* between the value and the unit: $\pm 2dB$ → ±2 dB (`$\pm 2 dB$` → `$\pm 2$\,dB`).
- Number ranges are typeset with an en-dash, not with a hyphen: 7-9 → 7–9 (`7-9` → `7--9`).
- SI units have a standardized usage of uppercase versus lowercase letters. Prefixes kilo and below are abbreviated with a lowercase letter, mega and above with an uppercase letter. Symbols of base units names after a person start with an uppercase letter: Khz → kHz (`Khz` → `kHz`).

- There must be a *small space* (typeset in LaTeX with `\,`) between a value and its unit. Note than an additional space in the source code after `\,` results in a wrong spacing: $f = 48$ kHz → $f = 48\,\mathrm{kHz}$ (`$f=48$\, kHz` → `$f=48$\,kHz`).

Typeset correctly, the output and the source of the example phrase look as follows:

values and units

The $-7\,\mathrm{dB}$ loss ($\pm 2\,\mathrm{dB}$) shown on pp. 7–9 can be attributed to the $f(t) = \sin(2\pi ft)$ signal, where t is the time and $f = 48\,\mathrm{KHz}$ is the *sampling frequency*.

values and units (LaTeX source)

```
The $-7$\,dB loss ($\pm 2$\,dB) shown on pp.\,7--9 can be
attributed to the $f(t) = \sin(2\pi ft)$ signal, where
$t$ is the time and $f=48$\,kHz is the \emph{sampling
frequency}.
```

It is obvious that a LaTeX package, that takes away from the author much of the burden with this kind of microtypography, is very desirable.

siunitx is such a package. It is very powerful LaTeX-package and provides you with a consistent syntax to typeset values, ranges, lists, units, tabulated data, and uncertainties. It also handles country-specific typographic rules and it is highly configurable. In the following, we highlight some of its features with short examples. For a comprehensive manual, please see the well written documentation at `http://tug.ctan.org/macros/latex/exptl/siunitx/siunitx.pdf`.

1.1 The basic value-unit pair

In *siunitx*, one types a value with a unit using the `\SI` command. This command works in both math-mode and inline with text. In both environments the value and the unit are rendered in the same way. The syntax is fairly self-explanatory. The package supports a very large number of different units and differewnt ways to type them. For beginners, the most intuitive way is to typeset units *literally* such as `\tera\electronvolt` or `\centi\meter`. For a full list of available units check-out the *siunitx* documentation. You can also typeset composite units such as `\centi\meter\per\second` and so on. *siunitx* automatically takes care of correct spacing between units. Table 1 gives some examples.

If you need to render units or values on their own, *siunitx* provides the `\si` and `\num` commands. The former will typeset large numbers with a delimiter to group digits together to improve readability. *siunitx* also offers possibilities to typeset numbers with errors, ranges of numbers and so on. Table 1 gives a few examples but you need to consult the *siunitx*-documentation for any details.

With *siunitx*, the example phrase would be typeset and output as follows:

Table 1: Some basic *siunitx*-examples

LaTeX-input	**text output**	**comments**
`\SI{8}{\kilo\meter}`	8 km	simple unit
`\SI{8}{\kilo\meter\per\second}`	$8\,\mathrm{km\,s^{-1}}$	composed unit
`\SI{8.0e03}{\meter\second}`	$8.0 \times 10^3\,\mathrm{m\,s}$	numbers can be typeset in many different formats (here in raw program output)
`\SI{0.8e05}{\milli\second}`	0.8×10^5 ms	note the different settings of the units `\meter\second` (last example) and `\milli\second`. The first one requires a small space between `m` and `s`!
`\SI{245.6 +- 10}{\meter\squared}`	$245.6(100)\,\mathrm{m^2}$	numbers with errors
`\ang{10;5;2}`	$10°5'2''$	angles
`\num{123456789}`	123 456 789	long numbers get correct grouping
`\num{1 + 2i}`	$1 + 2\mathrm{i}$	complex numbers
`\si{\tera\electronvolt}`	TeV	units without associated numbers
`\SIrange{2}{10}{\percent}`	2 %–10 %	ranges of numbers
`\SIlist{2;9;10}{\cm}`	2 cm, 9 cm and 10 cm	lists of numbers

values and units with *siunitx* (LaTeX source)

```
The \SI{-7}{\deci\bel} loss (\SI{+- 2}{\deci\bel}) shown on
pp.\,\numrange{7}{9} can be attributed to the
$f(t) = \sin(2\pi ft)$ signal, where $t$ is the time and
$f=\SI{48}{\kilo\hertz}$ is the \emph{sampling frequency}.
```

values and units with *siunitx*

The $-7\,\mathrm{dB}$ loss ($\pm 2\,\mathrm{dB}$) shown on pp. 7–9 can be attributed to the $f(t) = \sin(2\pi ft)$ signal, where t is the time and $f = 48\,\mathrm{kHz}$ is the *sampling frequency*.

Practical Tip 1.1

Many people think that they are sufficiently comfortable with the necessary typographical rules. They quickly tend to not typeset units literally like 1 TeV (`\SI{1}{\tera\electronvolt}`) but to do it *shorter* such as 1 TeV (`\SI{1}{TeV}`).

I strongly advice you not to do so! You give away most of the assistance to typeset units correctly. Do you note the difference between 1 m N (`\SI{1}{\meter\newton}`) and 1 mN (`\SI{1}{\milli\newton}`)? How would you typeset those units without the literal approach?