

# The **xfp** package

## Floating Point Unit

The L<sup>A</sup>T<sub>E</sub>X3 Project\*

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This package provides a L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> document-level interface to the L<sup>A</sup>T<sub>E</sub>X3 floating point unit (part of expl3). It also provides a parallel integer expression interface for convenience.

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**\fpeval** ★

The expandable command **\fpeval** takes as its argument a floating point expression and will produce a result using the normal rules of mathematics. As this command is expandable it can be used where T<sub>E</sub>X requires a number and for example within a low-level **\edef** operation to give a purely numerical result.

Briefly, the floating point expressions may comprise:

- Basic arithmetic: addition  $x + y$ , subtraction  $x - y$ , multiplication  $x * y$ , division  $x / y$ , square root  $\sqrt{x}$ , and parentheses.
- Comparison operators:  $x < y$ ,  $x <= y$ ,  $x >? y$ ,  $x != y$  *etc.*
- Boolean logic: sign  $\text{sign } x$ , negation  $!x$ , conjunction  $x \&\& y$ , disjunction  $x || y$ , ternary operator  $x ? y : z$ .
- Exponentials:  $\exp x$ ,  $\ln x$ ,  $x^y$ .
- Trigonometry:  $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\csc x$  expecting their arguments in radians, and  $\text{sind } x$ ,  $\text{cosd } x$ ,  $\text{tand } x$ ,  $\text{cotd } x$ ,  $\text{secd } x$ ,  $\text{cscd } x$  expecting their arguments in degrees.
- Inverse trigonometric functions:  $\text{asin } x$ ,  $\text{acos } x$ ,  $\text{atan } x$ ,  $\text{acot } x$ ,  $\text{asec } x$ ,  $\text{acsc } x$  giving a result in radians, and  $\text{asind } x$ ,  $\text{acosd } x$ ,  $\text{atand } x$ ,  $\text{acotd } x$ ,  $\text{asecd } x$ ,  $\text{acscd } x$  giving a result in degrees.
- Extrema:  $\max(x, y, \dots)$ ,  $\min(x, y, \dots)$ ,  $\text{abs}(x)$ .
- Rounding functions ( $n = 0$  by default,  $t = \text{NaN}$  by default):  $\text{trunc}(x, n)$  rounds towards zero,  $\text{floor}(x, n)$  rounds towards  $-\infty$ ,  $\text{ceil}(x, n)$  rounds towards  $+\infty$ ,  $\text{round}(x, n, t)$  rounds to the closest value, with ties rounded to an even value by default, towards zero if  $t = 0$ , towards  $+\infty$  if  $t > 0$  and towards  $-\infty$  if  $t < 0$ .
- Random numbers:  $\text{rand}()$ ,  $\text{randint}(m, n)$  (requires pdfT<sub>E</sub>X or LuaT<sub>E</sub>X).
- Constants: **pi**, **deg** (one degree in radians).

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- Dimensions, automatically expressed in points, *e.g.*, `pc` is 12.
- Automatic conversion (no need for `\number`) of integer, dimension, and skip variables to floating points, expressing dimensions in points and ignoring the stretch and shrink components of skips.

An example of use could be the following.

`\LaTeX{}` can now compute:  $\frac{\sin(3.5)}{2} + 2 \cdot 10^{-3}$   
`= \fpeval{sin(3.5)/2 + 2e-3}` \$.

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### `\inteval` ★

The expandable command `\inteval` takes as its argument an integer expression and produces a result using the normal rules of mathematics. The operations recognised are +, -, \* and / plus parentheses. Division occurs with *rounding*, and ties are rounded away from zero. As this command is expandable it can be used where T<sub>E</sub>X requires a number and for example within a low-level `\edef` operation to give a purely numerical result.

An example of use could be the following.

`\LaTeX{}` can now compute: The sum of the numbers is  $\inteval{1 + 2 + 3}$ \$.

## Index

The italic numbers denote the pages where the corresponding entry is described, numbers underlined point to the definition, all others indicate the places where it is used.

E		I	
<code>\edef</code>	..... <i>1, 2</i>	<code>\inteval</code>	..... <i>2</i>
F		N	
<code>\fpeval</code>	..... <i>1</i>	<code>\number</code>	..... <i>2</i>