

# 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`).

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`\fpeval` ★

The expandable command `\fpeval` takes as it's 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:  $x < y$ ,  $x \leq y$ ,  $x >? y$ ,  $x != y$  *etc.*
- Boolean logic: sign `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 `sind  $x$` , `cosd  $x$` , `tand  $x$` , `cotd  $x$` , `secd  $x$` , `cscd  $x$`  expecting their arguments in degrees.
- Inverse trigonometric functions: `asin  $x$` , `acos  $x$` , `atan  $x$` , `acot  $x$` , `asec  $x$` , `acsc  $x$`  giving a result in radians, and `asind  $x$` , `acosd  $x$` , `atand  $x$` , `acotd  $x$` , `asecd  $x$` , `acscd  $x$`  giving a result in degrees.
- Extrema: `max( $x, y, \dots$ )`, `min( $x, y, \dots$ )`, `abs( $x$ )`.
- Rounding functions ( $n = 0$  by default,  $t = \text{NaN}$  by default): `trunc( $x, n$ )` rounds towards zero, `floor( $x, n$ )` rounds towards  $-\infty$ , `ceil( $x, n$ )` rounds towards  $+\infty$ , `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: `rand()`, `randint( $m, n$ )` (requires pdfT<sub>E</sub>X or LuaT<sub>E</sub>X).
- Constants: `pi`, `deg` (one degree in radians).
- Dimensions, automatically expressed in points, *e.g.*, `pc` is 12.

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- 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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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.

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