The GCC Quad-Precision Math Library
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Short Contents

1  Typedef and constants ....................................... 1
2  Math Library Routines ....................................... 3
3  I/O Library Routines ......................................... 7
4  Reporting Bugs ................................................. 17

GNU Free Documentation License ............................... 9
Table of Contents

1 Typedef and constants .................................. 1

2 Math Library Routines ................................. 3

3 I/O Library Routines ..................................... 7
   3.1 strtoflt128 — Convert from string .................... 7
   3.2 quadmath_snprintf — Convert to string ............... 7

GNU Free Documentation License ....................... 9
   ADDENDUM: How to use this License for your documents ...... 16

4 Reporting Bugs ......................................... 17
1 Typedef and constants

The following data type has been defined via typedef.
__complex128: __float128-based complex number

The following macros are defined, which give the numeric limits of the __float128 data type.
FLT128_MAX: largest finite number
FLT128_MIN: smallest positive number with full precision
FLT128_EPSILON: difference between 1 and the next larger representable number
FLT128_DENORM_MIN: smallest positive denormalized number
FLT128_MANT_DIG: number of digits in the mantissa (bit precision)
FLT128_MIN_EXP: maximal negative exponent
FLT128_MAX_EXP: maximal positive exponent
FLT128_DIG: number of decimal digits in the mantissa
FLT128_MIN_10_EXP: maximal negative decimal exponent
FLT128_MAX_10_EXP: maximal positive decimal exponent

The following mathematical constants of type __float128 are defined.
M_Eq: the constant e (Euler’s number)
M_LOG2Eq: binary logarithm of 2
M_LOG10Eq: common, decimal logarithm of 2
M_LN2q: natural logarithm of 2
M_LN10q: natural logarithm of 10
M_PIq: pi
M_PI_2q: pi divided by two
M_PI_4q: pi divided by four
M_1_PIq: one over pi
M_2_PIq: one over two pi
M_2_SQRTPIq: two over square root of pi
M_SQRT2q: square root of 2
M_SQRT1_2q: one over square root of 2
2 Math Library Routines

The following mathematical functions are available:

- \texttt{acosq} : arc cosine function
- \texttt{acoshq} : inverse hyperbolic cosine function
- \texttt{asinq} : arc sine function
- \texttt{asinhq} : inverse hyperbolic sine function
- \texttt{atanq} : arc tangent function
- \texttt{atanhq} : inverse hyperbolic tangent function
- \texttt{atan2q} : arc tangent function
- \texttt{cbrtq} : cube root function
- \texttt{ceilq} : ceiling value function
- \texttt{copysignq} : copy sign of a number
- \texttt{coshq} : hyperbolic cosine function
- \texttt{cosq} : cosine function
- \texttt{erfq} : error function
- \texttt{erfcq} : complementary error function
- \texttt{exp2q} : base 2 exponential function
- \texttt{expq} : exponential function
- \texttt{expmq} : exponential minus 1 function
- \texttt{fabsq} : absolute value function
- \texttt{fdimq} : positive difference function
- \texttt{finiteq} : check finiteness of value
- \texttt{floorq} : floor value function
- \texttt{fmaq} : fused multiply and add
- \texttt{fmaxq} : determine maximum of two values
- \texttt{fminq} : determine minimum of two values
- \texttt{fmodq} : remainder value function
- \texttt{frexpq} : extract mantissa and exponent
- \texttt{hypotq} : Euclidean distance function
- \texttt{iologbq} : get exponent of the value
- \texttt{isinfq} : check for infinity
- \texttt{isnanq} : check for not a number
- \texttt{issignalingq} : check for signaling not a number
- \texttt{j0q} : Bessel function of the first kind, first order
- \texttt{j1q} : Bessel function of the first kind, second order
- \texttt{jnq} : Bessel function of the first kind, \( n \)-th order
- \texttt{ldexpq} : load exponent of the value
- \texttt{lgammaq} : logarithmic gamma function
- \texttt{llrintq} : round to nearest integer value
- \texttt{llroundq} : round to nearest integer value away from zero
- \texttt{logbq} : get exponent of the value
- \texttt{logq} : natural logarithm function
- \texttt{log10q} : base 10 logarithm function
- \texttt{log1pq} : compute natural logarithm of the value plus one
- \texttt{log2q} : base 2 logarithm function
lrintq: round to nearest integer value
lroundq: round to nearest integer value away from zero
modfq: decompose the floating-point number
nanq: return quiet NaN
nearbyintq: round to nearest integer
nextafterq: next representable floating-point number
powq: power function
remq: remainder function
remquoq: remainder and part of quotient
rintq: round-to-nearest integral value
roundq: round-to-nearest integral value, return __float128
scalbinq: compute exponent using FLT_RADIX
scalbnq: compute exponent using FLT_RADIX
signbitq: return sign bit
sincosq: calculate sine and cosine simultaneously
sinhq: hyperbolic sine function
sinq: sine function
sqrtq: square root function
tanq: tangent function
tanhq: hyperbolic tangent function
tgammaq: true gamma function
truncq: round to integer, towards zero
y0q: Bessel function of the second kind, first order
y1q: Bessel function of the second kind, second order
ynq: Bessel function of the second kind, n-th order
cabsq complex absolute value function
cargq: calculate the argument
cimagq imaginary part of complex number
crealq: real part of complex number
cacoshq: complex arc hyperbolic cosine function
cacoshq complex arc hyperbolic cosine function
cosq: complex cosine function
coshq: complex hyperbolic cosine function
csinhq: complex arc hyperbolic sine function
csinhq: complex arc cosine function
csinhq: complex sine function
catanhq: complex arc hyperbolic tangent function
catanq: complex arc tangent function
cosq: complex cosine function:
coshq: complex hyperbolic cosine function
cexpq: complex exponential function
\textbf{cexpiq}: computes the exponential function of \textit{“i”} times a real value

\textbf{clogq}: complex natural logarithm

\textbf{clog10q}: complex base 10 logarithm

\textbf{conjgq}: complex conjugate function

\textbf{cpowq}: complex power function

\textbf{cprojq}: project into Riemann Sphere

\textbf{csinq}: complex sine function

\textbf{csinhq}: complex hyperbolic sine function

\textbf{csqrtq}: complex square root

\textbf{ctanq}: complex tangent function

\textbf{ctanhq}: complex hyperbolic tangent function
3 I/O Library Routines

3.1 strtoflt128 — Convert from string
The function `strtoflt128` converts a string into a `__float128` number.

Syntax

```c
__float128 strtoflt128 (const char *s, char **sp)
```

Arguments:

- `s`: input string
- `sp`: the address of the next character in the string

The argument `sp` contains, if not `NULL`, the address of the next character following the parts of the string, which have been read.

Example

```c
#include <quadmath.h>

int main ()
{
    __float128 r;
    r = strtoflt128 ("1.2345678", NULL);
    return 0;
}
```

3.2 quadmath_snprintf — Convert to string
The function `quadmath_snprintf` converts a `__float128` floating-point number into a string. It is a specialized alternative to `snprintf`, where the format string is restricted to a single conversion specifier with Q modifier and conversion specifier e, E, f, F, g, G, a or A, with no extra characters before or after the conversion specifier. The `%m$ or *m$ style must not be used in the format.

Syntax

```c
int quadmath_snprintf (char *s, size_t size, const char *format, ...)
```

Arguments:

- `s`: output string
- `size`: byte size of the string, including trailing NUL
- `format`: conversion specifier string

Note

On some targets when supported by the C library hooks are installed for `printf` family of functions, so that `printf ("%Qe", 1.2Q);` etc. works too.

Example

```c
#include <quadmath.h>
#include <stdlib.h>
#include <stdio.h>

int main ()
{
    __float128 r;
    int prec = 20;
```
int width = 46;
char buf[128];

r = 2.0q;
r = sqrtq (r);
int n = quadmath_snprintf (buf, sizeof buf, "%+-#*.20Qe", width, r);
if ((size_t) n < sizeof buf)
    printf ("%s
", buf);
    /* Prints: +1.41421356237309504880e+00 */
quadmath_snprintf (buf, sizeof buf, "%Qa", r);
if ((size_t) n < sizeof buf)
    printf ("%s
", buf);
    /* Prints: 0x1.6a09e667f3bcc908b2fb1366ea96p+0 */
n = quadmath_snprintf (NULL, 0, "%+-#46.*Qe", prec, r);
if (n > -1)
{
    char *str = malloc (n + 1);
    if (str)
    {
        quadmath_snprintf (str, n + 1, "%+-#46.*Qe", prec, r);
        printf ("%s
", str);
        /* Prints: +1.41421356237309504880e+00 */
    }
    free (str);
}
return 0;
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