The GCC Quad-Precision Math Library
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1 Typedef and constants

The following data type has been defined via \texttt{typedef}.

\texttt{__complex128}: \texttt{__float128}-based complex number

The following macros are defined, which give the numeric limits of the \texttt{__float128} data type.

\texttt{FLT128\_MAX}: largest finite number
\texttt{FLT128\_MIN}: smallest positive number with full precision
\texttt{FLT128\_EPSILON}: difference between 1 and the next larger representable number
\texttt{FLT128\_DENORM\_MIN}: smallest positive denormalized number
\texttt{FLT128\_MANT\_DIG}: number of digits in the mantissa (bit precision)
\texttt{FLT128\_MIN\_EXP}: maximal negative exponent
\texttt{FLT128\_MAX\_EXP}: maximal positive exponent
\texttt{FLT128\_DIG}: number of decimal digits in the mantissa
\texttt{FLT128\_MIN\_10\_EXP}: maximal negative decimal exponent
\texttt{FLT128\_MAX\_10\_EXP}: maximal positive decimal exponent

The following mathematical constants of type \texttt{__float128} are defined.

\texttt{M\_Eq}: the constant e (Euler’s number)
\texttt{M\_LOG2Eq}: binary logarithm of 2
\texttt{M\_LOG10Eq}: common, decimal logarithm of 2
\texttt{M\_LN2q}: natural logarithm of 2
\texttt{M\_LN10q}: natural logarithm of 10
\texttt{M\_PIq}: pi
\texttt{M\_PI\_2q}: pi divided by two
\texttt{M\_PI\_4q}: pi divided by four
\texttt{M\_1\_PIq}: one over pi
\texttt{M\_2\_PIq}: one over two pi
\texttt{M\_2\_SQRTPIQ}: two over square root of pi
\texttt{M\_SQRT2q}: square root of 2
\texttt{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{expm1q}: 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 integral 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
remainderq: remainder function
remquoq: remainder and part of quotient
rintq: round-to-nearest integral value
roundq: round-to-nearest integral value, return __float128
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
ccosq: complex cosine function
cacoshq: complex arc hyperbolic sine function
casinq: complex arc sine function
catanq: complex arc tangent function
coshq: complex hyperbolic cosine function
cexpq: complex exponential function
cexpiq: computes the exponential function of “i” times a real value

clogq: complex natural logarithm
clog10q: complex base 10 logarithm
conjgq: complex conjugate function
cpowq: complex power function
cprojq: project into Riemann Sphere
csinq: complex sine function
csinhq: complex hyperbolic sine function
csqrtq: complex square root
ctanq: complex tangent function
cтанhq: 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**

```
__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**

```
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;
    return 0;
}
```
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\n", buf);
    /* Prints: +1.41421356237309504880e+00 */
quadmath_snprintf (buf, sizeof buf, "%Qa", r);
if ((size_t) n < sizeof buf)
    printf ("%s\n", 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\n", str);
            /* Prints: +1.41421356237309504880e+00 */
        } 
        free (str);
    }
return 0;
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