The GCC Quad-Precision Math Library
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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:

acosq: arc cosine function
acoshq: inverse hyperbolic cosine function
asinq: arc sine function
asinhq: inverse hyperbolic sine function
atanq: arc tangent function
atanhq: inverse hyperbolic tangent function
atan2q: arc tangent function
cbrtq: cube root function
ceilq: ceiling value function
copysignq: copy sign of a number
coshq: hyperbolic cosine function
cosq: cosine function
erfq: error function
erfcq: complementary error function
exp2q: base 2 exponential function
expq: exponential function
expm1q: exponential minus 1 function
fabsq: absolute value function
fdimq: positive difference function
finiteq: check finiteness of value
floorq: floor value function
fmaq: fused multiply and add
fmaxq: determine maximum of two values
fminq: determine minimum of two values
fmodq: remainder value function
frexpq: extract mantissa and exponent
hypotq: Euclidean distance function
ilogbq: get exponent of the value
isinfq: check for infinity
isnanq: check for not a number
issignalingq: check for signaling not a number
j0q: Bessel function of the first kind, first order
j1q: Bessel function of the first kind, second order
jnq: Bessel function of the first kind, n-th order
ldexpq: load exponent of the value
lgammaq: logarithmic gamma function
llrintq: round to nearest integer value
llroundq: round to nearest integer value away from zero
logbq: get exponent of the value
logq: natural logarithm function
log10q: base 10 logarithm function
log1pq: compute natural logarithm of the value plus one
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
scalblnq: 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
cacosq: complex arc cosine function
casinhq: complex arc hyperbolic sine function
casinq: complex arc sine function
catanhq: complex arc hyperbolic tangent function
catanq: complex arc tangent function
cosq complex cosine function:
ccosq: complex hyperbolic cosine function
cexpq: complex exponential function
**cexpq:** 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

**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  
__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;
```
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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