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
lrint: round to nearest integer value
lround: round to nearest integer value away from zero
modf: decompose the floating-point number
nan: return quiet NaN
nearbyint: round to nearest integer
nextafter: next representable floating-point number
pow: power function
remquo: remainder function
rint: round-to-nearest integral value
round: remainder and part of quotient
rintq: round-to-nearest integral value
scalbln: compute exponent using FLT_RADIX
scalbn: compute exponent using FLT_RADIX
signbit: return sign bit
sincos: calculate sine and cosine simultaneously
sinq: sine function
sqrt: square root function
tan: tangent function
tanh: hyperbolic tangent function
tgamma: true gamma function
trunc: round to integer, towards zero
y0: Bessel function of the second kind, first order
y1: Bessel function of the second kind, second order
yn: Bessel function of the second kind, n-th order
cabs: complex absolute value function
carg: calculate the argument
cimag: imaginary part of complex number
creal: real part of complex number
cacosh: complex arc hyperbolic cosine function
cacos: complex arc cosine function
casinh: complex arc hyperbolic sine function
casin: complex arc sine function
catanh: complex arc hyperbolic tangent function
catan: complex arc tangent function
ccos: complex cosine function
ccosh: complex hyperbolic cosine function
cexp: complex exponential function
cexpiq: computes the exponential function of “i” times a
real value

clogq: complex natural logarithm
clog10q: complex base 10 logarithm
conjq: 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
cthanhq: 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

```
#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

```
#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: 0x1.6a09e667f3b90b2f408b2fb1366ea96p+0 */
n = quadmath_snprintf (NULL, 0, "%+-#.46Qe", prec, r);
if (n > -1)
{
  char *str = malloc (n + 1);
  if (str)
  {
    quadmath_snprintf (str, n + 1, "%+-#.46Qe", prec, r);
    printf ("%s\n", str);
    /* Prints: +1.41421356237309504880e+00 */
  }
  free (str);
}
return 0;
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