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_E`: the constant e (Euler’s number)
- `M_LOG2E`: binary logarithm of 2
- `M_LOG10E`: common, decimal logarithm of 2
- `M_LN2`: natural logarithm of 2
- `M_LN10`: natural logarithm of 10
- `M_PI`: pi
- `M_PI_2`: pi divided by two
- `M_PI_4`: pi divided by four
- `M_1_PI`: one over pi
- `M_2_PI`: one over two pi
- `M_2_SQRTPI`: two over square root of pi
- `M_SQRT2`: square root of 2
- `M_SQRT1_2`: 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
remainderq: 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
cacoshq: complex arc hyperbolic cosine function
cacoshq: complex arc cosine function
casinhq: complex arc hyperbolic sine function
casinhq: complex arc sine function
catanhq: complex arc hyperbolic tangent function
catanhq: complex arc tangent function
cosq complex cosine 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

**conjg**: 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

```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\n", buf);
    /* Prints: +1.41421356237309504880e+00 */
quadmath_snprintf (buf, sizeof buf, "%Qa", r);
if ((size_t) n < sizeof buf)
    printf ("%s\n", buf);
    /* Prints: 0x1.6a09e667f3bcb908b2fb1366ea96p+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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Version 1.3, 3 November 2008


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