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*: Eucledian 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
remquoq: remainder and part of quotient
rintq: round-to-nearest integral value
roundq: remainder of two numbers
scalbnq: compute exponent using FLT_RADIX
scalbinq: compute exponent using FLT_RADIX
signbitq: return sign bit
sincosq: calculate sine and cosine simultaneously
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
ccosq: complex cosine function
ccoshq: 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
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;
```
```c
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 */
quadrmath_snprintf (buf, sizeof buf, "%Qa", r);
if ((size_t) n < sizeof buf)
    printf ("%s\n", buf);
/* Prints: 0x1.6a09e667f3bcc908b2fb1366ea96p+0 */
n = quadrmath_snprintf (NULL, 0, "%+-#46.*Qe", prec, r);
if (n > -1)
{
    char *str = malloc (n + 1);
    if (str)
    {
        quadrmath_snprintf (str, n + 1, "%+-#46.*Qe", prec, r);
        printf ("%s\n", str);
        /* Prints: +1.41421356237309504880e+00 */
    }
    free (str);
}
return 0;
```
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