The GCC Quad-Precision Math Library
Short Contents

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Introduction

This manual documents the usage of libquadmath, the GCC Quad-Precision Math Library Application Programming Interface (API).
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
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
expmlq: 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
**sinq**: sine function
**sinhq**: hyperbolic 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
**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
cтанq: complex tangent function
cтанhq: complex hyperbolic tangent function
Chapter 3: I/O Library Routines

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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