The GCC Quad-Precision Math Library
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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_MAX_10_EXP: maximal positive 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
expmq: 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
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
\texttt{lrintq}: round to nearest integer value
\texttt{lroundq}: round to nearest integer value away from zero
\texttt{modfq}: decompose the floating-point number
\texttt{nanq}: return quiet NaN
\texttt{nearbyintq}: round to nearest integer
\texttt{nextafterq}: next representable floating-point number
\texttt{powq}: power function
\texttt{remainderq}: remainder function
\texttt{remquoq}: remainder and part of quotient
\texttt{rintq}: round-to-nearest integral value
\texttt{roundq}: round-to-nearest integral value, return \texttt{__float128}
\texttt{scalblnq}: compute exponent using \texttt{FLT\_RADIX}
\texttt{scalbnq}: compute exponent using \texttt{FLT\_RADIX}
\texttt{signbitq}: return sign bit
\texttt{sincosq}: calculate sine and cosine simultaneously
\texttt{sinhq}: hyperbolic sine function
\texttt{sinq}: sine function
\texttt{sqrtq}: square root function
\texttt{tanq}: tangent function
\texttt{tanhq}: hyperbolic tangent function
\texttt{tgammaq}: true gamma function
\texttt{truncq}: round to integer, towards zero
\texttt{y0q}: Bessel function of the second kind, first order
\texttt{y1q}: Bessel function of the second kind, second order
\texttt{ynq}: Bessel function of the second kind, \texttt{n}-th order
\texttt{cabsq}: complex absolute value function
\texttt{cargq}: calculate the argument
\texttt{cimagq}: imaginary part of complex number
\texttt{crealq}: real part of complex number
\texttt{cacoshq}: complex arc hyperbolic cosine function
\texttt{ccosq}: complex cosine function
\texttt{casinhq}: complex arc hyperbolic sine function
\texttt{casinq}: complex arc sine function
\texttt{catanhq}: complex arc hyperbolic tangent function
\texttt{catanq}: complex arc tangent function
\texttt{ccoshq}: complex hyperbolic cosine function
\texttt{cexpq}: complex exponential function
\texttt{cexpiq}: computes the exponential function of \texttt{“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**

```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 tailing 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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