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 \texttt{typedef}.

\texttt{__complex128: \_\_float128-based complex number}

The following macros are defined, which give the numeric limits of the \texttt{\_\_float128} data type.

\begin{itemize}
  \item \texttt{FLT128\_MAX}: largest finite number
  \item \texttt{FLT128\_MIN}: smallest positive number with full precision
  \item \texttt{FLT128\_EPSILON}: difference between 1 and the next larger representable number
  \item \texttt{FLT128\_DENORM\_MIN}: smallest positive denormalized number
  \item \texttt{FLT128\_MANT\_DIG}: number of digits in the mantissa (bit precision)
  \item \texttt{FLT128\_MIN\_EXP}: maximal negative exponent
  \item \texttt{FLT128\_MAX\_EXP}: maximal positive exponent
  \item \texttt{FLT128\_DIG}: number of decimal digits in the mantissa
  \item \texttt{FLT128\_MIN\_10\_EXP}: maximal negative decimal exponent
  \item \texttt{FLT128\_MAX\_10\_EXP}: maximal positive decimal exponent
\end{itemize}

The following mathematical constants of type \texttt{\_\_float128} are defined.

\begin{itemize}
  \item \texttt{M\_Eq}: the constant e (Euler’s number)
  \item \texttt{M\_LOG2Eq}: binary logarithm of 2
  \item \texttt{M\_LOG10Eq}: common, decimal logarithm of 2
  \item \texttt{M\_LN2q}: natural logarithm of 2
  \item \texttt{M\_LN10q}: natural logarithm of 10
  \item \texttt{M\_PIq}: pi
  \item \texttt{M\_PI\_2q}: pi divided by two
  \item \texttt{M\_PI\_4q}: pi divided by four
  \item \texttt{M\_1\_PIq}: one over pi
  \item \texttt{M\_2\_PIq}: one over two pi
  \item \texttt{M\_2\_SQRTPIQq}: two over square root of pi
  \item \texttt{M\_SQR2q}: square root of 2
  \item \texttt{M\_SQR1\_2q}: one over square root of 2
\end{itemize}
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
- `erfccq`: 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
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 hyperbolic cosine 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
cllog10q: 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
cctanhq: 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 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

```
#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
", buf);
    /* Prints: +1.41421356237309504880e+00 */
quadmath_snprintf (buf, sizeof buf, "%Qa", r);
if ((size_t) n < sizeof buf)
    printf ("%s
", 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
", str);
        /* Prints: +1.41421356237309504880e+00 */
    }
    free (str);
}
return 0;
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