The GCC Quad-Precision Math Library
## Short Contents

1. Typedef and constants ........................................... 1  
2. Math Library Routines ........................................... 3  
3. I/O Library Routines ............................................. 7  
   GNU Free Documentation License ................................. 9  
4. Reporting Bugs .................................................. 17  

# Table of Contents

1 Typedef and constants .............................. 1

2 Math Library Routines ............................. 3

3 I/O Library Routines ............................... 7
   3.1 `strtoflt128` — Convert from string ...................... 7
   3.2 `quadmath_snprintf` — Convert to string .................. 7

GNU Free Documentation License ..................... 9
   ADDENDUM: How to use this License for your documents .... 16

4 Reporting Bugs ................................. 17
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
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: 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
remainderq: remainder function
remquoq: remainder and part of quotient
rintq: round-to-nearest integral value
roundq: round-to-nearest integral value, return __float128
scalbinq: 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
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
cosq complex cosine function:
coshq: complex hyperbolic cosine function
cexpq: complex exponential function
**Chapter 2: Math Library Routines**

- **cexpq**: 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
- **ctanq**: complex tangent function
- **ctanhq**: complex hyperbolic tangent function
3 I/O Library Routines

3.1 strtoflt128 — Convert from string

The function \texttt{strtoflt128} converts a string into a \texttt{__float128} number.

Syntax \texttt{__float128 strtoflt128 (const char *s, char **sp)}

\textit{Arguments}:
\begin{itemize}
  \item \texttt{s} input string
  \item \texttt{sp} the address of the next character in the string
\end{itemize}

The argument \texttt{sp} contains, if not NULL, the address of the next character following the parts of the string, which have been read.

Example

\begin{verbatim}
#include <quadmath.h>

int main ()
{
  __float128 r;
  r = strtoflt128 ("1.2345678", NULL);
  return 0;
}
\end{verbatim}

3.2 quadmath_snprintf — Convert to string

The function \texttt{quadmath_snprintf} converts a \texttt{__float128} floating-point number into a string. It is a specialized alternative to \texttt{snprintf}, where the format string is restricted to a single conversion specifier with \texttt{Q} modifier and conversion specifier \texttt{e}, \texttt{E}, \texttt{f}, \texttt{F}, \texttt{g}, \texttt{G}, \texttt{a} or \texttt{A}, with no extra characters before or after the conversion specifier. The \texttt{%m$} or \texttt{*m$} style must not be used in the format.

Syntax \texttt{int quadmath_snprintf (char *s, size_t size, const char *format, \ldots)}

\textit{Arguments}:
\begin{itemize}
  \item \texttt{s} output string
  \item \texttt{size} byte size of the string, including trailing NUL
  \item \texttt{format} conversion specifier string
\end{itemize}

\textit{Note} On some targets when supported by the C library hooks are installed for \texttt{printf} family of functions, so that \texttt{printf ("\%Qe", 1.2Q);} etc. works too.

Example

\begin{verbatim}
#include <quadmath.h>
#include <stdlib.h>
#include <stdio.h>

int main ()
{
  __float128 r;
  int prec = 20;
}\end{verbatim}
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: 0x1.6a09e667f3bce908b2fb1366ea96p+0 */
n = quadmath_snprintf (NULL, 0, "%+-##.Qe", prec, r);
if (n > -1)
{
    char *str = malloc (n + 1);
    if (str)
    {
        quadmath_snprintf (str, n + 1, "%+-##.Qe", prec, r);
printf ("%s\n", str);
        /* Prints: +1.41421356237309504880e+00 */
    }
    free (str);
}
return 0;
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