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  `strtof1t128` — 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_MINEXP`: maximal negative exponent
- `FLT128_MAXEXP`: maximal positive exponent
- `FLT128_DIG`: number of decimal digits in the mantissa
- `FLT128_MIN10EXP`: maximal negative decimal exponent
- `FLT128_MAX10EXP`: 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:

- **acos**: arc cosine function
- **acosh**: inverse hyperbolic cosine function
- **asin**: arc sine function
- **asinh**: inverse hyperbolic sine function
- **atan**: arc tangent function
- **atanh**: inverse hyperbolic tangent function
- **atan2**: arc tangent function
- **cbrt**: cube root function
- **ceil**: ceiling value function
- **copysign**: copy sign of a number
- **cosh**: hyperbolic cosine function
- **cos**: cosine function
- **erf**: error function
- **erfc**: complementary error function
- **exp2**: base 2 exponential function
- **expq**: exponential function
- **expm1**: exponential minus 1 function
- **fabs**: absolute value function
- **fdim**: positive difference function
- **finite**: check finiteness of value
- **floor**: floor value function
- **fma**: fused multiply and add
- **fmax**: determine maximum of two values
- **fmin**: determine minimum of two values
- **fmod**: remainder value function
- **frexp**: extract mantissa and exponent
- **hypot**: Euclidean distance function
- **ilogb**: get exponent of the value
- **isinf**: check for infinity
- **isnan**: check for not a number
- **issignaling**: check for signaling not a number
- **j0**: Bessel function of the first kind, first order
- **j1**: Bessel function of the first kind, second order
- **jn**: Bessel function of the first kind, n-th order
- **ldexp**: load exponent of the value
- **lgamma**: logarithmic gamma function
- **llrint**: round to nearest integer value
- **llround**: round to nearest integer value away from zero
- **logb**: 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
scalbnq: 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
ccosq: complex cosine function
csinhq: complex arc hyperbolic sine function
csinq: complex 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
cepiq: computes the exponential function of “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
csqinq: 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  
```
__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 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("%Qf", 1.20);` 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\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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