RX Family with RXv3 CPU

Mathematics Library Function Benchmark Data

Summary

This application note lists the execution cycle counts of mathematics library functions for the RX Family C/C++ Compiler (CC-RX) V3.01.00 when using the arithmetic unit for trigonometric functions (TFU) and double-precision floating-point coprocessor (DPFPU) of RX Family MCUs built around the RXv3 CPU.

Target Device

RX Family MCUs with RXv3 CPU

Contents

1. Measurement Conditions

MCU: RX72M Group

Code location: Code flash memory (zero-wait access enabled)

Data location: On-chip RAM

ROM cache: Enabled

Compiler: RX Family C/C++ Compiler (CC-RX) V3.01.00

Compiler options: Compiler option settings are listed in Table 1.1, Compiler Option Settings.

Options not listed in Table 1.1 are left in their default settings.

The library generator option settings are basically the same as those for the compiler options. However, the library generator tfu option is disabled.

For details of option settings, refer to CC-RX Compiler User's Manual (R20UT3248).

Table 1.1 Compiler Option Settings

	Compiler Options						
Condition	**endian**	**round**	**isa**	**fpu/ nofpu**	**dpfpu/ nodpfpu***1	**dbl_size**	**tfu***2
Single-precision operations (TFU not used)	little	zero	rxv3	fpu	nodpfpu	4	—
Single-precision operations (TFU used)							tfu=intrinsic,mathlib
Double-precision operations (DPFPU not used)						8	—*3
Double-precision operations (DPFPU used)					dpfpu		

Notes: 1. The DPFPU is implemented on some devices and not on others.
For details of each device, refer to the relevant User's Manual: Hardware.
2. The TFU is implemented on some devices and not on others.
For details of each device, refer to the relevant User's Manual: Hardware.
3. The TFU is used for single-precision floating-point operations only.

2. Execution Cycle Counts

Table 2.1 lists execution cycle counts of mathematics library functions (geometric mean values).

In addition to mathematics library functions, the TFU can be used to execute intrinsic functions. Table 2.2 lists execution cycle counts of intrinsic functions executed using the TFU (geometric mean values).

Note that execution cycle counts may vary due to factors such as the code location, device settings, parameter settings, compiler option and library generator option settings, and future improvements to the compiler.

Table 2.1 Execution Cycle Counts of Mathematics Library Functions (Geometric Mean Values)

Single-Precision Operations		
	Cycle Count	
Function	TFU not used	TFU used*1
acosf	71	—
asinf	63	—
atanf	71	—
atan2f	286	23
cosf	66	21
sinf	66	21
tanf	93	—
coshf	72	—
sinhf	76	—
tanhf	80	—
expf	63	—
frexpf	13	—
ldexpf	29	—
logf	80	—
log10f	91	—
modff	29	—
powf	356	—
sqrtf	18	—
ceilf	26	—
fabsf	1	—
floorf	26	—
fmodf	88	—
hypotf	268	26

Double-Precision Operations		
	Cycle Count	
Function	DPFPU not used	DPFPU used
acos	1969	264
asin	2428	309
atan	2032	247
atan2	3484	592
cos	1522	173
sin	1556	182
tan	2212	252
cosh	1989	282
sinh	2011	298
tanh	1610	263
exp	1542	233
frexp	39	31
ldexp	31	35
log	2105	261
log10	2105	261
modf	149	74
pow	4065	596
sqrt	209	43
ceil	98	54
fabs	5	4
floor	98	59
fmod	574	204
hypot	1816	413

Note: 1. The TFU cannot be used for functions for which "—" is listed in the cycle count column.

Table 2.2 Execution Cycle Counts of Intrinsic Functions Using TFU (Geometric Mean Values)

Intrinsic Function	Cycle Count	Remarks
__sincosf	26	Uses the TFU to calculate the sine and cosine at the same time (single-precision).
__atan2hypotf	30	Uses the TFU to calculate the arc tangent and the square root of the sum of squares at the same time (single-precision).

3. Reference Document

CC-RX Compiler User's Manual (R20UT3248)

(The latest version can be downloaded from the Renesas Electronics website.)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr. 24, 2019	—	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
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   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

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8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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