RL78/G13, 78K0/Kx2

Migration Guide from 78K0 to RL78: Multiplier/Divider

Introduction

This application note describes how to migrate the multiplier/divider of the 78K0/Kx2 to the multiplier and divider/multiply-accumulator of the RL78/G13.

Target Device

RL78/G13, 78K0/Kx2

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

1. Functions of Multiplier and Divider of 78K0/Kx2 and Multiplier-Divider/Multiply-Accumulator of RL78/G13

Table 1.1 shows the specification of the 78K0/Kx2 multiplier/divider functions and Table 1.2 shows the specification of the RL78/G13 multiplier and divider/multiply-accumulator functions.

Table 1.1 Functions of 78K0/Kx2 Multiplier/Divider

Function	Specification
Multiplication	16 bits × 16 bits = 32 bits (Unsigned)
Division	32 bits ÷ 16 bits = 32 bits, 16-bits remainder (Unsigned)

Table 1.2 Functions of RL78/G13 Multiplier and Divider/Multiply-Accumulator

Function	Specification
Multiplication	16 bits × 16 bits = 32 bits (Unsigned) 16 bits × 16 bits = 32 bits (Signed)
Division	32 bits ÷ 32 bits = 32 bits, 32-bits remainder (Unsigned)
Multiply-Accumulation	16 bits × 16 bits＋32 bits = 32 bits (Unsigned) 16 bits × 16 bits＋32 bits = 32 bits (Signed)

The 78K0/Kx2 multiplier/divider can handle multiplication or division. The interrupt request signal (INTDMU) is generated upon completion of multiplication or division. Note that the serial interface IIC0 and the multiplier and divider cannot be used simultaneously because they share various flags for the interrupt request sources in the 78K0/Kx2.

The RL78/G13 multiplier and divider/multiply-accumulator can handle multiplication, division, or multiply-accumulation. Basically no interrupt request signal is generated upon completion of operation. However, the interrupt request signal (INTDMU) is generated if the division end interrupt is selected or the multiply-accumulation result overflows.

2. Summary of Differences between Functions

Table 2.1 summarizes the differences between the functions of the multiplier-divider of the 78K0/Kx2 and the functions of the multiplier and divider/multiply-accumulator of the RL78/G13.

Table 2.1 Summary of Differences between Functions

Item	78K0/Kx2 Multiplier/Divider (Note1)	RL78/G13 Multiplier and Divider/Multiply-Accumulator
Multiplication	16bits × 16bits = 32bits (Unsigned)	16bits × 16bits = 32bits (Unsigned, signed (two's complement))
Number of clock cycles for multiplication	f_{PRS} × 16 clocks	f_{CLK} × 1 clock
Division	32bits ÷ 16bits = 32bits, 16-bit remainder (division)	32bits ÷ 32bits = 32bits, 32-bits remainder (Unsigned)
Number of clock cycles for division	f_{PRS} × 32 clocks	f_{CLK} × 16 clocks
Multiply-accumulator mode	Not supported	16bits × 16bits + 32bits = 32bits (Unsigned, signed (two's complement))
Number of clock cycles for multiplication and accumulation	Not supported	f_{CLK} × 2 clocks
Interrupt request	End of IIC0 communication/End of multiply/divide operation (Note2)	End of division operation/Overflow of multiply-accumulation result occurs

Note1. Provided only in the products whose internal flash memory is at least 48 Kbytes.

Note2. The serial interface IIC0 and multiplier/divider cannot be used simultaneously because they share various flags for the interrupt request sources in the 78K0/Kx2.

3. Comparison between Registers

Table 3.1 compares the registers for the 78K0/Kx2 multiplier/divider and the registers for the RL78/G13 multiplier and divider/multiply-accumulator.

Table 3.1 Comparison between Registers

Setting Items		78K0/Kx2 Multiplier/Divider (Note1)	RL78/G13 Multiplier and Divider/Multiply-accumulator
Multiplication	Multiplier	MDA0H = 00H MDA0L (16 bits)	MDAH (16 bits)
	Multiplicand	MDB0L (16 bits)	MDAL (16 bits)
	Multiplication result (product)	MDA0H (higher 16 bits) MDA0L (lower 16 bits)	MDBH (higher 16 bits) MDBL (lower 16 bits)
Division	Dividend	MDA0H (higher 16 bits) MDA0L (lower 16 bits)	MDAH (higher 16 bits) MDAL (lower 16 bits)
	Divisor	MDB0H (higher 16 bits) MDB0L (lower 16 bits)	MDBH (higher 16 bits) MDBL (lower 16 bits)
	Division result (quotient)	MDA0H (higher 16 bits) MDA0L (lower 16 bits)	MDAH (higher 16 bits) MDAL (lower 16 bits)
	Remainder	SDR0 (16 bits)	MDCH (higher 16 bits) MDCL (lower 16 bits)
Multiply-accumulator	Multiplier	Not supported	MDAH
	Multiplicand	Not supported	MDAL
	Multiplication result	Not supported	MDBH (higher 16 bits) MDBL (lower 16 bits)
	Addend (Initial accumulated value)	Not supported	MDCH (higher 16 bits) MDCL (lower 16 bits)
	Multiply-accumulation Result (Accumulated value)	Not supported	MDCH (higher 16 bits) MDCL (lower 16 bits)
Operation start		Set the DMUE bit in the DMUC0 register to 1.	- Multiplication Write data to the MDAL or MDAH register. - Division Set the DIVST bit in the MDUC register to 1. - Multiplication-accumulation Write data to the MDAH register.
Operation stop		Set the DMUE bit in the DMUC0 register to 0.	Not supported
Operation mode selection		DMUC0 register DMUSEL0 bit	MDUC register DIVMODE bit, MACMODE bit, MDSM bit
Overflow flag of multiply-accumulation result (accumulated value)		Not supported	MDUC register MACOF bit
Sign flag of multiply-accumulation result (accumulated value)		Not supported	MDUC register MACSF bit

Note1. Provided only in the products whose internal flash memory is at least 48 Kbytes.

Note2. The serial interface IIC0 and multiplier/divider cannot be used simultaneously because they share various flags for the interrupt request sources in the 78K0/Kx2.

4. Documents for Reference

User's Manual:

- RL78/G13 User's Manual: Hardware (R01UH0146)
- 78K0/Kx2 User's Manual: Hardware (R01UH0008)
  The latest versions can be downloaded from the Renesas Electronics website.

Technical Update/Technical News:
The latest information can be downloaded from the Renesas Electronics website.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Mar.29, 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.
4. Handling of unused pins
   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
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
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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