RL78/G14

How to Use the ELC for the RL78/G14

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Abstract

This document describes an overview of the event link controller (ELC), and a setting method for the RL78/G14. Usable events differ depending on the product. Refer to the hardware user's manual for details.

Product

RL78/G14

Contents

1. ELC

The ELC interconnects (links) events output from each peripheral function. By linking events, it becomes possible to coordinate operation between peripheral functions directly without going through the CPU. Peripheral functions linked by the ELC will perform the operation corresponding to the event receive peripheral function after reception of an event.

Figure 1.1 shows a Comparison between Using and Not Using the ELC.

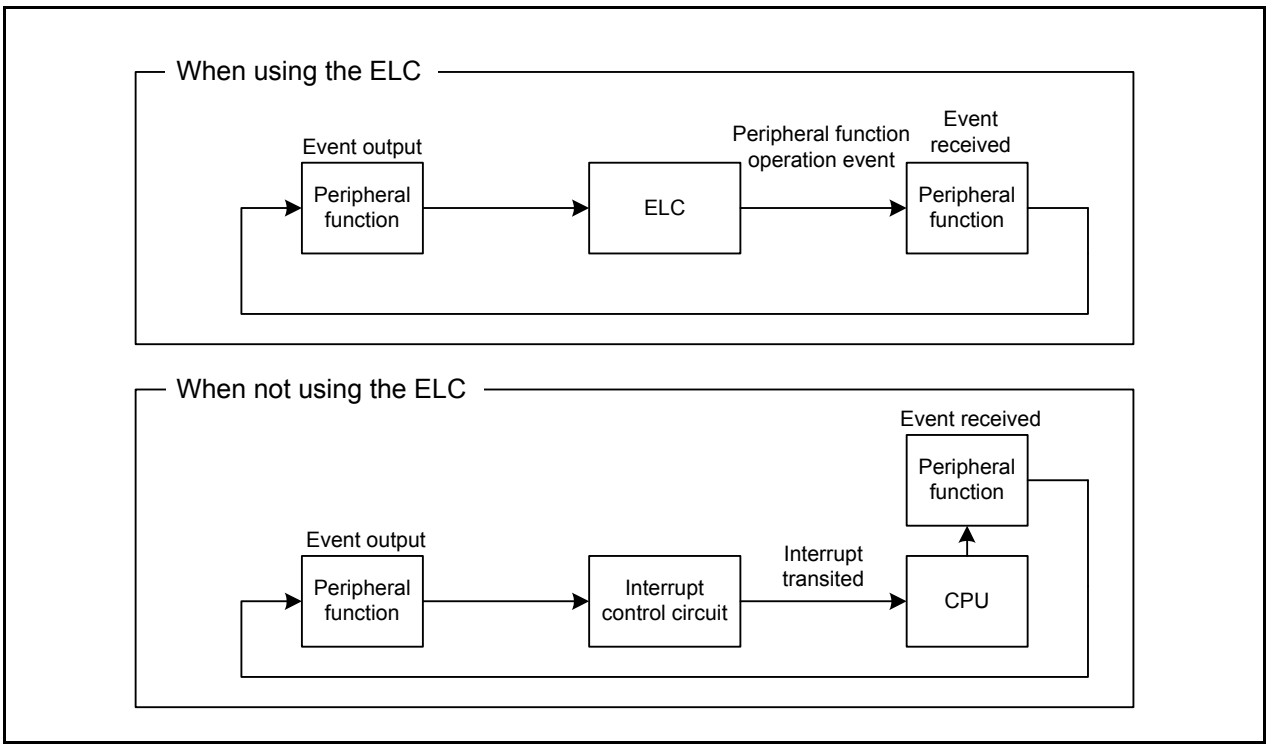

Figure 1.1 Comparison between Using and Not Using the ELC

The path for using an event signal generated by peripheral functions as an interrupt request to the interrupt control circuit is independent from the path for using it as an ELC event. Therefore, each event signal can be used as an event signal for operation of an event receive peripheral function, regardless of interrupt control.

Figure 1.2 shows the Relationship between Interrupt Handling and the ELC.

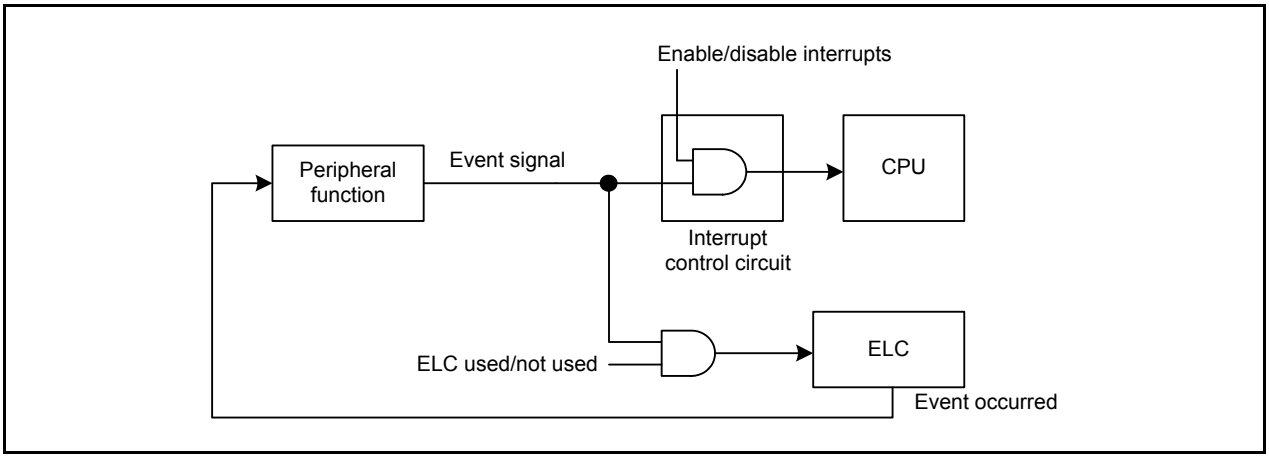

Figure 1.2 Relationship between Interrupt Handling and the ELC

2. Advantages of the ELC

The figure below shows differences when peripheral functions are activated using the ELC and when the CPU activates a module without using the ELC. Since the ELC directly activates peripheral functions without going through the CPU using an event link, the CPU is not suspended by interrupts and continues processing. The ELC can be used while in wait mode without going through the CPU.

Figure 2.1 shows a Timing Diagram of CPU Processing Comparison.

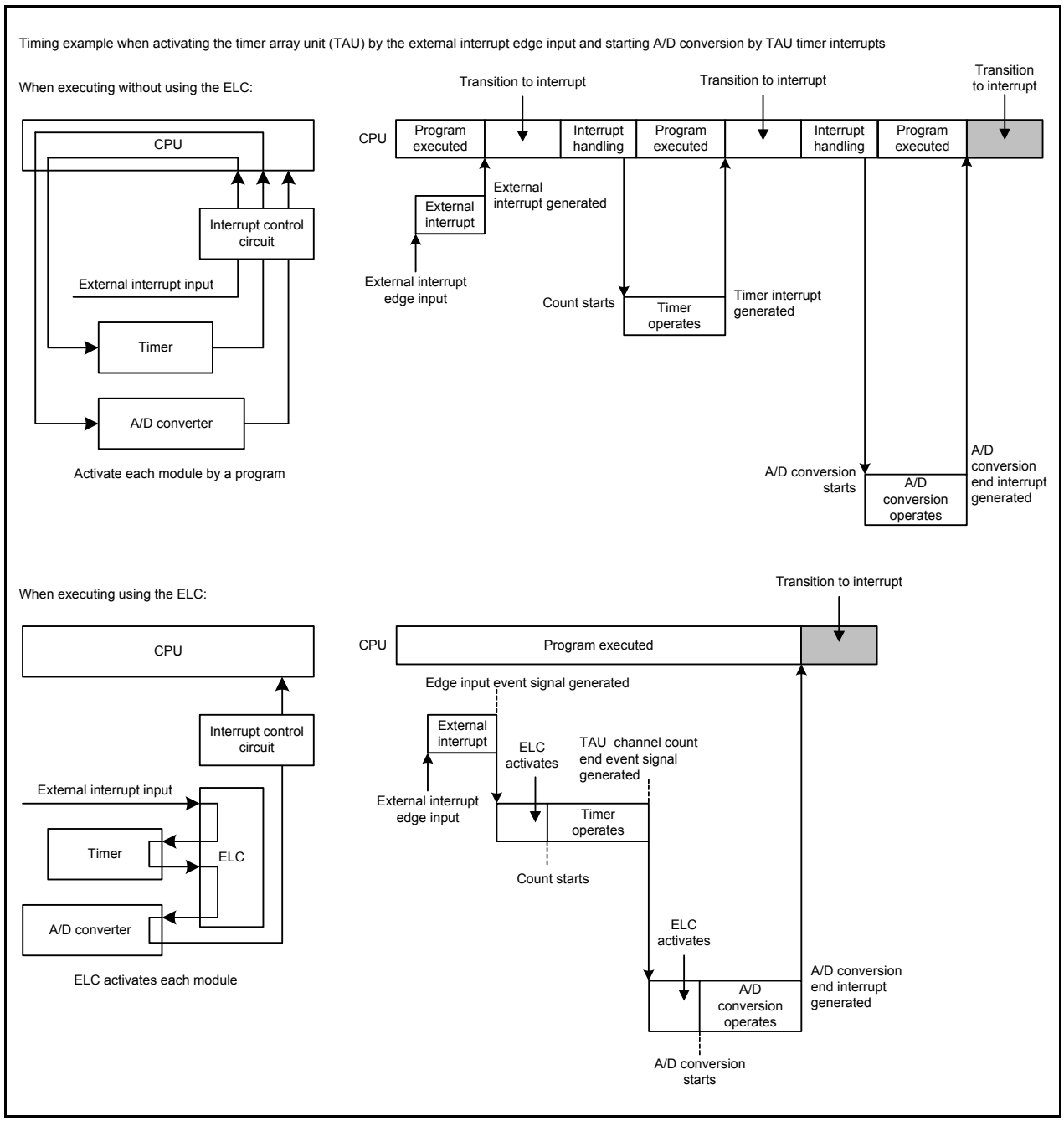

Figure 2.1 Timing Diagram of CPU Processing Comparison

3. Event Output Peripheral Function and Event Receive Peripheral Function

Linking can be performed by specifying the event output peripheral function and event receive peripheral function.

3.1 Event Output Peripheral Function

In the RL78/G14 ELC, events are selectable from up to 26 kinds of event output peripheral functions.

Tables 3.1 and 3.2 list Event Output Peripheral Functions of RL78/G14.

Table 3.1 Event Output Peripheral Functions of RL78/G14 (1/2)

Event Output Peripheral Function	Event Description	Corresponding Register
External interrupt 0	Edge detection	ELSELR00
External interrupt 1		ELSELR01
External interrupt 2		ELSELR02
External interrupt 3		ELSELR03
External interrupt 4		ELSELR04
External interrupt 5		ELSELR05
Key interrupt	Key return signal detection	ELSELR06
Real-time clock	• RTC fixed-cycle signal • Alarm match detection	ELSELR07
Timer RD0	• Input capture A of timer mode input capture function • Compare match A of timer mode output compare function	ELSELR08
	• Input capture B of timer mode input capture function • Compare match B of timer mode output compare function	ELSELR09
Timer RD1	• Input capture A of timer mode input capture function • Compare match A of timer mode output compare function	ELSELR10
	• Input capture B of timer mode input capture function • Compare match B of timer mode output compare function	ELSELR11
	Underflow	ELSELR12
Timer RJ0	Underflow	ELSELR13
Timer RG	• Input capture A of timer mode input capture function • Compare match A of timer mode output compare function	ELSELR14
	• Input capture B of timer mode input capture function • Compare match B of timer mode output compare function	ELSELR15

Table 3.2 Event Output Peripheral Functions of RL78/G14 (2/2)

Event Output Peripheral Function	Event Description	Corresponding Register
TAU unit 0 channel 0	• Count end • Capture end	ELSELR16
TAU unit 0 channel 1	• Count end • Capture end	ELSELR17
TAU unit 0 channel 2	• Count end • Capture end	ELSELR18
TAU unit 0 channel 3	• Count end • Capture end	ELSELR19
TAU unit 1 channel 0	• Count end • Capture end	ELSELR20 (1)
TAU unit 1 channel 1	• Count end • Capture end	ELSELR21 (1)
TAU unit 1 channel 2	• Count end • Capture end	ELSELR22 (1)
TAU unit 1 channel 3	• Count end • Capture end	ELSELR23 (1)
Comparator	Comparator detection 0	ELSELR24 (2)
	Comparator detection 1	ELSELR25 (2)

Notes:
1. Only for 80-pin and 100-pin packages.
2. Only for products with a code flash memory size of 96 KB or more.

3.2 Event Receive Peripheral Function

In the RL78/G14 ELC, operation is selectable when receiving a single event from up to nine kinds of event receive peripheral functions. Operation when receiving peripheral functions which can be set to the event output destination select register (ELSELRn) is described below (n = 00 to 25).

Table 3.3 Setting of RL78/G14 ELC and Event Receive Peripheral Functions

Event Receive Peripheral Function	ELC Setting (Bits ELSEL3 to ELSEL0 in the ELSELRn register)	Bit Which Enable or Select Event Input from the ELC (1)	Link Operation
A/D converter	0001B	Bits ADTRS1 and ADTRS0	Start A/D conversion
Timer array unit 0	0010B	TIS04 bit	Delay count: Start decrementing Input pulse interval measurement: Measure input pulse interval External event counter: Count event input
Timer array unit 1	0011B	Bits TIS02 to TIS00	
Timer RJ0	0100B	Bits TCK2 to TCK0	Count the rising edge of event input from the ELC (each mode excluding event counter mode)
Timer RG	0101B	TRGELCICE bit	Input capture of TRGIOB
Timer RD0	0110B	ELCOBE0 bit	Forcibly cut off pulse output
		ELCICE0 bit	Input capture operation D0
Timer RD1	0111B	ELCOBE1 bit	Forcibly cut off pulse output
		ELCICE1 bit	Input capture operation D1
DA0 (2)	1000B	DAMD0 bit	Start D/A conversion
DA1 (2)	1001B	DAMD1 bit	

Notes:
1. Refer to each chapter in the RL78/G14 hardware user's manual for details of bit functions.
2. Only for products with a code flash memory size of 96 KB or more.

4. ELC Setting Example

4.1 Setting

This section describes the settings necessary to activate the ELC. It is necessary to set the ELC while no event signal of the event output peripheral function is being generated. Therefore, after an initial setting of peripheral functions is performed, set the ELC. Then perform the function operation setting for peripheral functions.

Figure 4.1 shows the ELC Activation Setting.

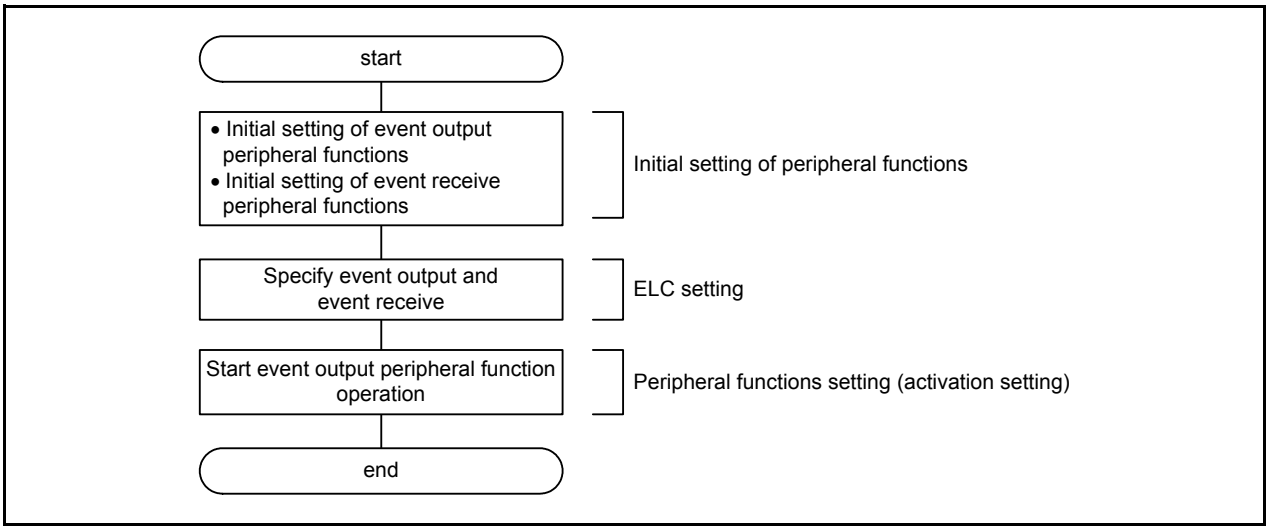

Figure 4.1 ELC Activation Setting

4.1.1 Example of Using the ELC

This section describes how to use the DTC, A/D converter, and serial array unit (SAU) in conjunction.

Figure 4.2 shows an Example of Using the ELC.

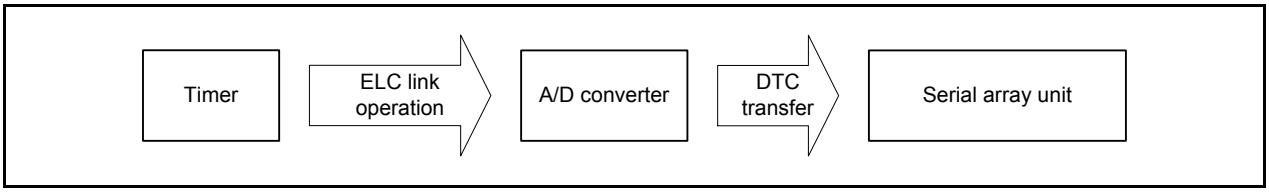

Figure 4.2 Example of Using the ELC

Start the timer RJ0 count by a program. The A/D converter starts A/D conversion by an ELC link operation every time timer RJ0 underflows. When A/D conversion is completed, activate the DTC and perform DTC transfer for the A/D converted value to the SAU serial data register. Transmit data of the A/D converted value is output from the SAU.

Table 4.1 lists the ELC Settings, and Table 4.2 lists the DTC Control Data Settings.

Table 4.1 ELC Settings

Setting Item	Setting Value
ELC setting (bits ELSEL3 to ELSEL0 in the ELSELR13 register)	0001B
Event output peripheral function	Timer RJ0 underflow
Operation when receiving event	Start A/D conversion of the A/D converter

Table 4.2 DTC Control Data Settings

Setting Item	Setting Value
	Control data 0
Transfer mode	Repeat mode
Transfer source address control	Fixed
Transfer destination address control	Repeat area
Chain transfer	Disabled
Transfer block size	1 byte
Number of DTC transfers	1
Transfer source address	A/D converted result register (ADCR register) address
Transfer destination address	Serial data register 02 (SDR02 register) address
Repeat mode interrupt	Disabled
Activation source	A/D conversion completed

(1) Perform an initial setting of timer RJ0, the A/D converter, the DTC, and the SAU. Set timer RJ0 to the event output peripheral function and A/D converter to the event receive peripheral function using the ELC.
(2) Start the timer RJ0 count by a program.
(3) Activate the ELC using the timer RJ0 underflow signal.
(4) The A/D converter starts A/D conversion by ELC link operation.
(5) An interrupt source is generated when A/D conversion is completed and the DTC is activated.
(6) The DTC transfers the data of the A/D converted result from the ADCR register to the SDR02 register.
(7) The SAU outputs the data of the A/D converted result from the TxD1 pin by transferring (writing) to the SDR02 register.
(8) Repeat steps (3) to (7).

Figure 4.3 shows Data Transmission Using the ELC and DTC.

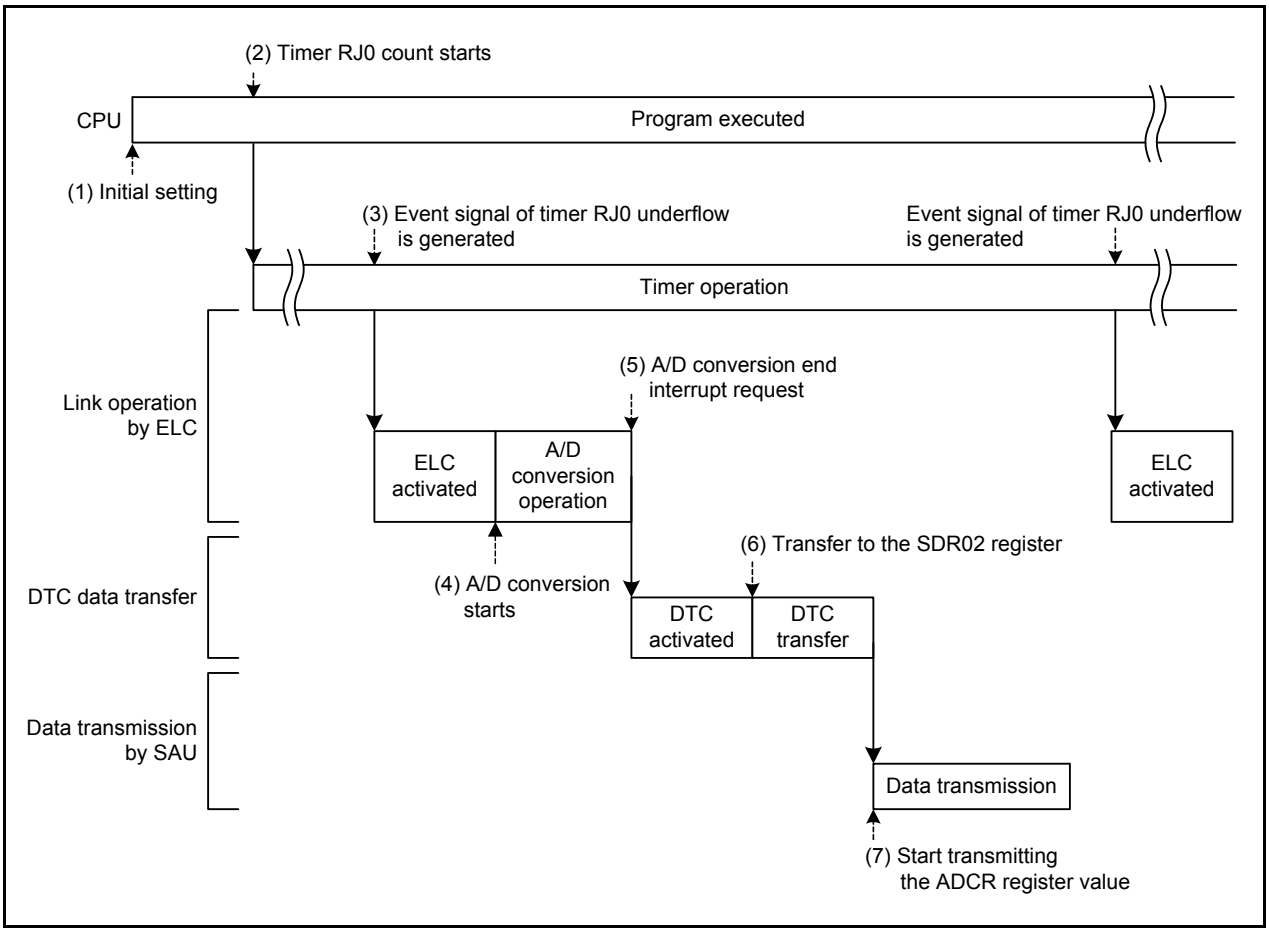

Figure 4.3 Data Transmission Using the ELC and DTC

5. Reference Documents

RL78/G14 User's Manual: Hardware Rev.0.02
The latest version can be downloaded from the Renesas Electronics website.

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

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Revision History	RL78/G14 How to Use the ELC for the RL78/G14

Rev.	Date	Description	
		Page	Summary
1.00	Oct. 4, 2011	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins

   Handle unused pins in accord 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

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