

To our customers,

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Renesas Electronics Corporation

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# Manual for Using Sample Program Functions Timer M (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2)

This manual explains the sample program functions of the 16-bit interval timer (TMM) for the V850E/IA4 microcontroller.

The explanations are based on usage with the V850E/IA4 microcontroller. Refer to this manual when using the V850E/IA3, V850ES/IK1, and V850ES/IE2 microcontrollers.

## Caution

**This sample program is provided for reference purposes only and operations are therefore not subject to guarantee by NEC Electronics Corporation. When using this sample program, customers are kindly advised to sufficiently evaluate this product based on their system before usage.**

### ① 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, etc., 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).

### ② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

### ③ PRECAUTION AGAINST ESD

A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that 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 should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

### ④ STATUS BEFORE INITIALIZATION

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

### ⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

### ⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. 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. Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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## INTRODUCTION

- Cautions**
1. Download the program used in this manual from the NEC Electronics Website (<http://www.necel.com/>).
  2. When using this sample program, reference the following startup file and link directive file and adjust them if as necessary.
    - Startup file: IA4\_start.s
    - Link directive file: IA4\_link.dir

**Conventions** The function lists are structured as follows.

### Hardware name (symbol)

[Function]	Function description
[Function name]	Name of sample function
[Argument(s)]	Type and overview of argument(s)
[Processing content]	Processing content of sample function
[Starting method]	Conditions for calling a function
[SFR(s) used]	Register name and setting content
[call function(s)]	Name and function of call function(s)
[Variable(s)]	Type, name, and overview of variable(s) used in sample function
[Interrupt(s)]	Name of function
[Interrupt source(s)]	Name
[File name]	Name of corresponding sample program file
[Caution(s)]	Caution(s) upon function usage

### Interrupt function

[Function name]	Name of interrupt function
[Overview]	Processing content
[Factor(s)]	Name of interrupt and conditions for occurrence
[call function(s)]	None
[Variable(s)]	Name of variable, function
[File name]	Name of corresponding sample program file
[Caution(s)]	None

**Product Differences** The differences between the V850E/IA4 and the V850E/IA3, V850ES/IK1, and V850ES/IE2 related to the 16-bit interval timer (TMM) are shown below.

Item	V850E/IA4	V850E/IA3	V850ES/IK1	V850ES/IE2
Count clock	f <sub>xx</sub> /2, f <sub>xx</sub> /4, f <sub>xx</sub> /8, f <sub>xx</sub> /16, f <sub>xx</sub> /32, f <sub>xx</sub> /64, f <sub>xx</sub> /128, f <sub>xx</sub> /256	f <sub>xx</sub> /2, f <sub>xx</sub> /4, f <sub>xx</sub> /8, f <sub>xx</sub> /16, f <sub>xx</sub> /32, f <sub>xx</sub> /64, f <sub>xx</sub> /128, f <sub>xx</sub> /256	f <sub>xx</sub> , f <sub>xx</sub> /2, f <sub>xx</sub> /4, f <sub>xx</sub> /8, f <sub>xx</sub> /16, f <sub>xx</sub> /32, f <sub>xx</sub> /64, f <sub>xx</sub> /128	

**Remark** f<sub>xx</sub>: Peripheral clock frequency

**Related Documents** The related documents indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

**Documents related to the V850E/IA3, V850E/IA4, V850ES/IK1, and V850ES/IE2**

Document Name	Document No.
V850E1 Architecture User's Manual	U14559E
V850E/IA3, V850E/IA4 Hardware User's Manual	U16543E
V850ES Architecture User's Manual	U15943E
V850ES/IK1 Hardware User's Manual	U16910E
V850ES/IE2 Hardware User's Manual	U17716E
Inverter Control by V850 Series Vector Control by Hole Sensor Application Note	U17338E
Inverter Control by V850 Series Vector Control by Encoder Application Note	U17324E
Inverter Control by V850 Series 120° Excitation Method Control by Zero-Cross Detection Application Note	U17209E
Manual for Using Sample Program Functions Serial Communication (UARTA) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18233E
Manual for Using Sample Program Functions Serial Communication (CSIB) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18234E
Manual for Using Sample Program Functions DMA Functions (V850E/IA3, V850E/IA4) Application Note	U18235E
Manual for Using Sample Program Functions Timer M (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	This manual
Manual for Using Sample Program Functions Watchdog Timer (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18237E
Manual for Using Sample Program Functions Timer P (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18238E
Manual for Using Sample Program Functions Timer Q (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18239E
Manual for Using Sample Program Functions Timer ENC (V850E/IA3, V850E/IA4) Application Note	U18240E
Manual for Using Sample Program Functions Port Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18241E
Manual for Using Sample Program Functions Clock Generator (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18242E
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Manual for Using Sample Program Functions Interrupt Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18244E
Manual for Using Sample Program Functions A/D Converters 0 and 1 (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18245E
Manual for Using Sample Program Functions A/D Converter 2 (V850E/IA3, V850E/IA4) Application Note	U18246E



## 16-bit interval timer (TMM0)

### Startup

[Function]	Clears 16-bit counter if values of 16-bit counter and TM0CMP0 register match, and an interrupt request signal is generated.	
[Function name]	timer_interval	
[Arguments]	unsigned char set_TM0CTL0	Sets count clock.
	unsigned short set_TM0CMP0	Sets compare register.
[Processing content]	Calls an interrupt function every millisecond.	
[Starting method]	Starts by calling timerm_interval_st function.	
[SFRs used]	TM0CTL0	Controls mode of 16-bit counter.
	TM0CMP0	Compare register of 16-bit counter
[call function]	main main function	
[Variable]	None	
[Interrupt]	timerm_interval_int	
[Interrupt source]	INTTM0EQ0	
[File name]	timerm_interval\timerm_1.c, timerm_interval\MAIN.C	
[Cautions]	<ul style="list-style-type: none"><li>• Call when operation of 16-bit counter is stopped.</li><li>• Operate in clock-through mode (8 MHz).</li><li>• Set port 1 before calling.</li><li>• Set TM0CTL0 (count clock setting) when TMM0 is stopped.</li><li>• Bits 3 to 6 of TM0CTL0 must be set to 0.</li><li>• Rewriting of TM0CMP0 (compare register) during operation of TMM0 is prohibited.</li></ul>	

The setting time is determined by the following formula (during clock-through mode (8 MHz)).

Synchronizing clock:  $8 \text{ MHz} = 1/8 \Rightarrow 0.125 \mu\text{s}$

Count clock frequency (for  $f_{xx}/32$ ):  $0.125 \mu\text{s} \times 32 \Rightarrow 4 \mu\text{s}$

Value of compare register when generating an interrupt every millisecond:  $1000 \mu\text{s} / 4 \mu\text{s} \Rightarrow 250 - 1 = 249$

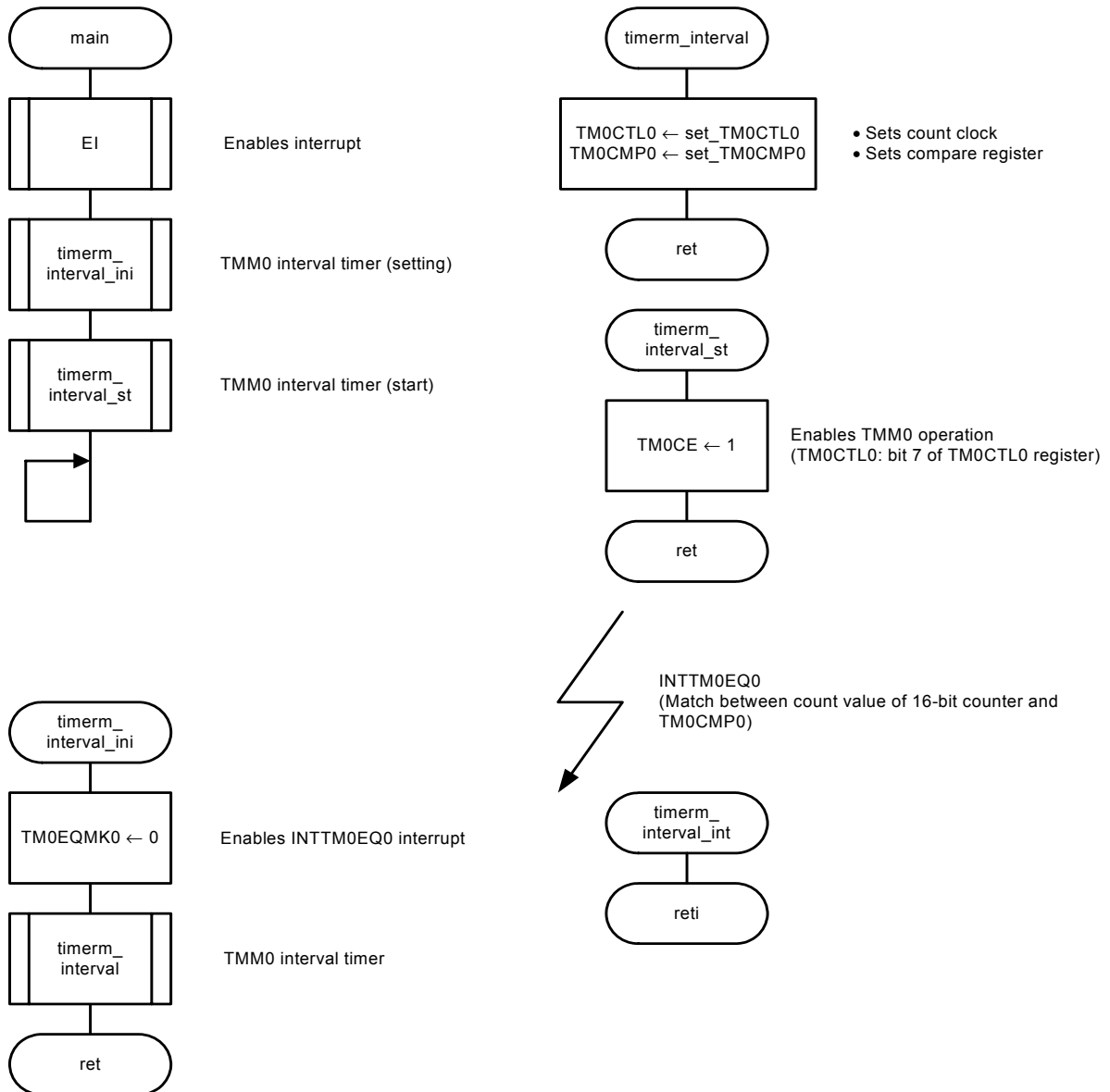
[Function name]	timerm_interval_st
[Argument]	None
[Processing content]	Starting function of timerm_interval
[Starting method]	Call after timerm_interval function.
[SFR used]	TM0CTL0.TM0CE                      Operation control of 16-bit counter.
[call function]	None
[Variable]	None
[Caution]	None

## Interrupt function

[Function name]	timerm_interval_int
[Overview]	User definition
[Factor]	INTTM0EQ0              Match between count value of 16-bit counter and TM0CMP0
[call function]	None
[Variable]	None
[File name]	timerm_interval\timerm_1.c
[Caution]	None

16-bit interval timer (TMM0)

Startup



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