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April 1st, 2010
Renesas Electronics Corporation

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M16C/Tiny Series

Real Time Clock Function

1. Abstract

This application note describes the real-time clock programming with timer function.

2. Introduction

This application note is applied under the following condition:
Applicable MCU: M16C/26A, 26, 28, and 29 Groups

The program on this application note can also be used when operating other MCUs within the M16C Family, provided they have the same SFRs (Special Function Registers) as the M16C/26A, 26, 28, and 29 Groups. However, some functions may have been modified. Refer to each device's hardware manual for details. Use functions covered in this application note only after careful evaluation.

3. Operation Description

A) Set bits TMOD1 and TMOD0 in the TA0MR register to 00b (timer mode), bits TCK1 and TCK0 to 11b (fc32). Moreover, set the timer value to (400-1)h to generate a timer interrupt every one second.
Xcin = 32.768 kHz
B) Set the TA0S bit in the TABSR register to 1 (starts counting) so that timer A0 decrements a counter value.
C) The IR bit in the TA0IC register is set to 1 (interrupt requested) when the timer A0 counter underflows.
D) While one second is incremented every time the IR bit is set to 1, data for date and time are stored into RAM in hexadecimal.
E) Counting starts from January 01, 0001, Sunday, 00:00:00 immediately after the timer starts counting.

4. Software Description

4.1 Function Description

Table 1 lists the functions used in the sample program.

Table 1 Function Description

Function Name	Label Name	Function
Main	main	Register setting, RAM initialization, interrupt enabled, and time setting process function call
Time Setting	time_set	Data setting for “second”, “minute”, “hour”, “date”, “a day of a week”, and “week”; date setting process function call
Date Setting	date_set	Data setting for “day”, “month”, and “year”; leap year checking process function call
Leap Year Check	leap_year_check	Leap year check

4.2 Register Description

Table 2 lists the registers used in the sample program.
*The setting values are for the M16C/26A Group. The applicable products of the technical update, No.TN-16C-119A are the M16C/26, 28, and 29 Groups.

Table 2. Register Description

Register Name		Address	Setting Value	Function
PRCR	Protect register	000Ah	01h 04h 00h	-Enables writing to registers PD9, PACR, S4C, and NDDR. PRC2 bit: 0 (write protected) PRC2 bit: 1 (write enabled) -Enables writing to registers CM0, CM1, CM2, ROCR, PLC0, PCLKR, and CCLKR. PRC0: 0 (write protected) PRC0: 1 (write enabled) *The PRC2 bit is set to 0 by writing into a given address after the PRC2 bit is set to 1. Bits PRC0, PRC1, and PRC3 are not automatically set to 0. Set them to 0 by program.
PACR	Pin assignment control register	025Dh	04h	Setting values of bits PACR2 to PACR0 -001: 42-pin version (M16C/26A) -010: 64-pin version (M16C/28, 29) -011: 80-pin version (M16C/28, 29) -100: 48-pin version (M16C/26A) * Write to the PACR register immediately after setting the PRC2 bit to 1. The M16C/26 Group does not have the PACR register.
IFSR2A	Interrupt request select register 2	035Eh	01h	-The IFSR20 bit must be set to 1. (M16C/26A, 28) -The IFSR20 bit must be set to 0. (M16C/29) *Complete setting the IFSR20 bit before allowing an interrupt. The M16C/26 Group does not have the IFSR2A register.
CM0	System clock control register 0	0006h	18h	Main clock, no division, main clock oscillation, Xcin-Xcout oscillation function, Xcin-Xcout drive high, peripheral function clock is not stopped, clock output function: P9_0 (P9_0 in the M16C/28 Group is reserved) * Refer to the technical update (TN-16C-119A)
TABSR	Count start flag	0380h	00h 01h	-Timer A0 stops counting -Timer A0 starts counting
TA0MR	Timer A0 mode register	0396h	C0h	Count source of fc32 selected, gate function disabled, no pulse output, timer mode
TA0	Timer A0 register	0386h	03FFh	Set the timer to (400-1)h to generate a timer A0 interrupt request every one second
TA0IC	Timer A0 interrupt control register	0055h	00h	Interrupt level 0, interrupt request bit setting

4.3 RAM Description

Table 3 lists RAM memories and their specifications.

Table 3. RAM Memory

RAM Code	Specifications	Data Length	Functions
sec_cnt	"Second" data is stored in hexadecimal	1 byte	main, time_set
min_cnt	"Minute" data is stored in hexadecimal	1 byte	main, time_set
hour_cnt	"Hour" data is stored in hexadecimal	1 byte	main, time_set
day_cnt	"Date" data is stored in hexadecimal	1 byte	main, time_set, date_set, leap_year_check
week_cnt	"Week" data is stored in hexadecimal 0x00: Sunday 0x01: Monday 0x02: Tuesday 0x03: Wednesday 0x04: Thursday 0x05: Friday 0x06: Saturday	1 byte	main, time_set
month_cnt	"Month" data is stored in hexadecimal	1 byte	main, date_set, leap_year_check
year_cnt	"Year" data is stored in hexadecimal	2 bytes	main, date_set, leap_year_check

4.4 ROM Description

Table 4 lists ROM memories and their specifications.

Table 4. ROM Memory

ROM Code	Specifications	Data Length	Functions
day_max_tbl[12]	"Maximum monthly days" data is stored in hexadecimal. [0] (January)… 0x1F (31days) [1] (February)… 0x1C (28 days) [2] (March)… 0x1F (31 days) [3] (April)… 0x1E (30 days) [4] (May)… 0x1F (31 days) [5] (June)… 0x1E (30 days) [6] (July)… 0x1F (31 days) [7] (August)… 0x1F (31 days) [8] (September)… 0x1E (30 days) [9] (October)… 0x1F (31 days) [10] (November)… 0x1E (30 days) [11] (December)… 0x1F (31 days)	12 bytes	leap_year_check

5. Set-up procedure

The M16C/26A Group is used as an example.

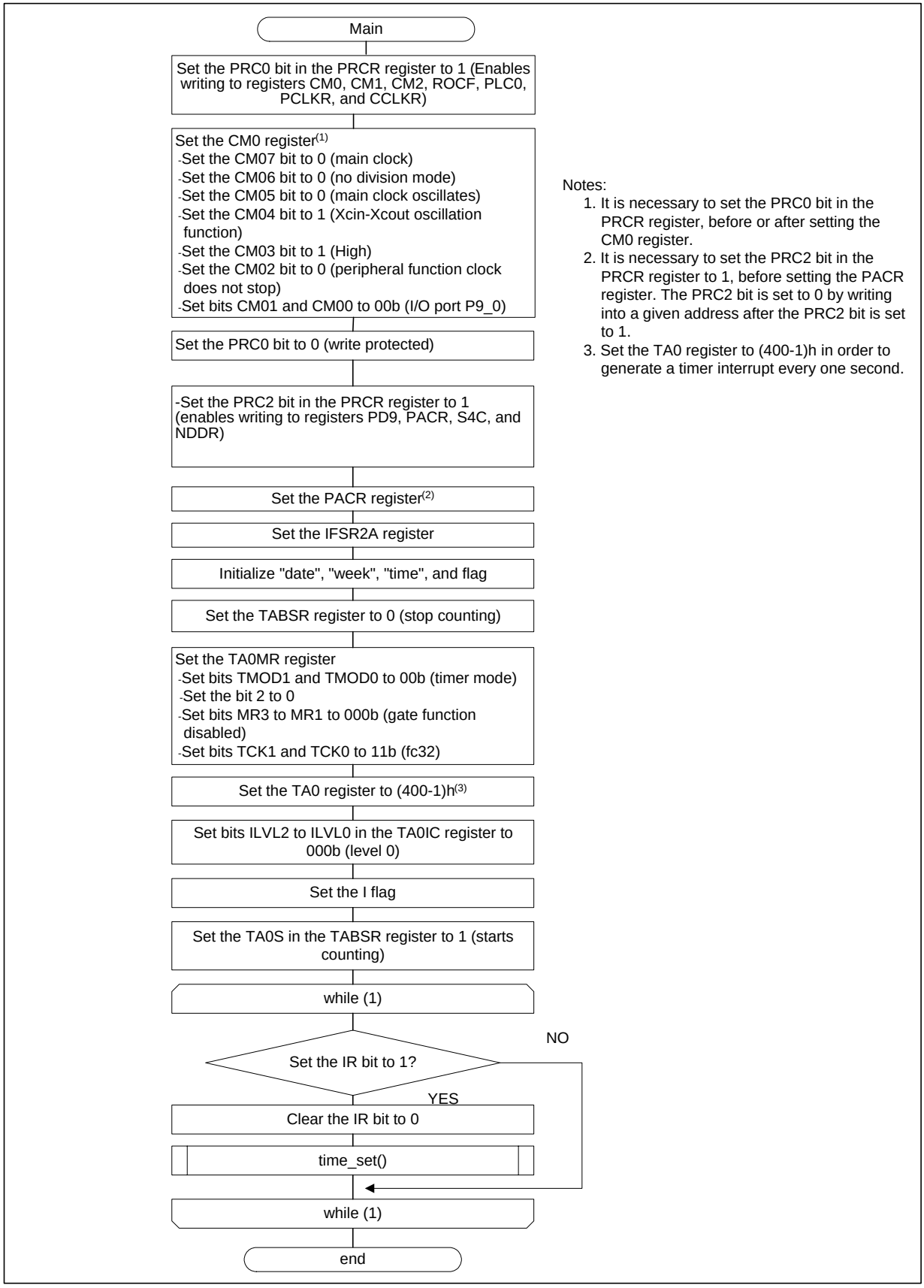

Figure 1. Flowchart (Main)

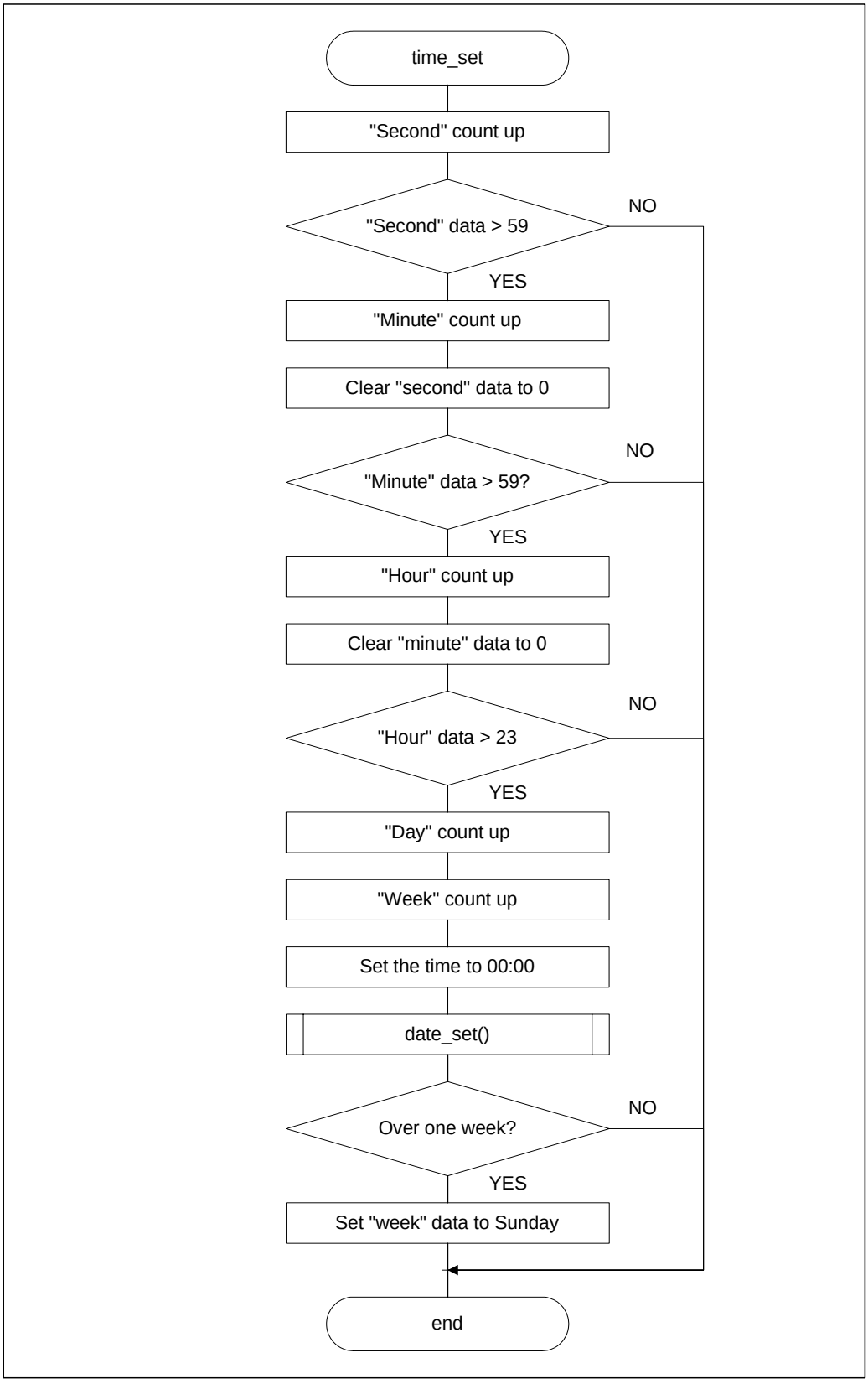

Figure 2. Flowchart (time_set)

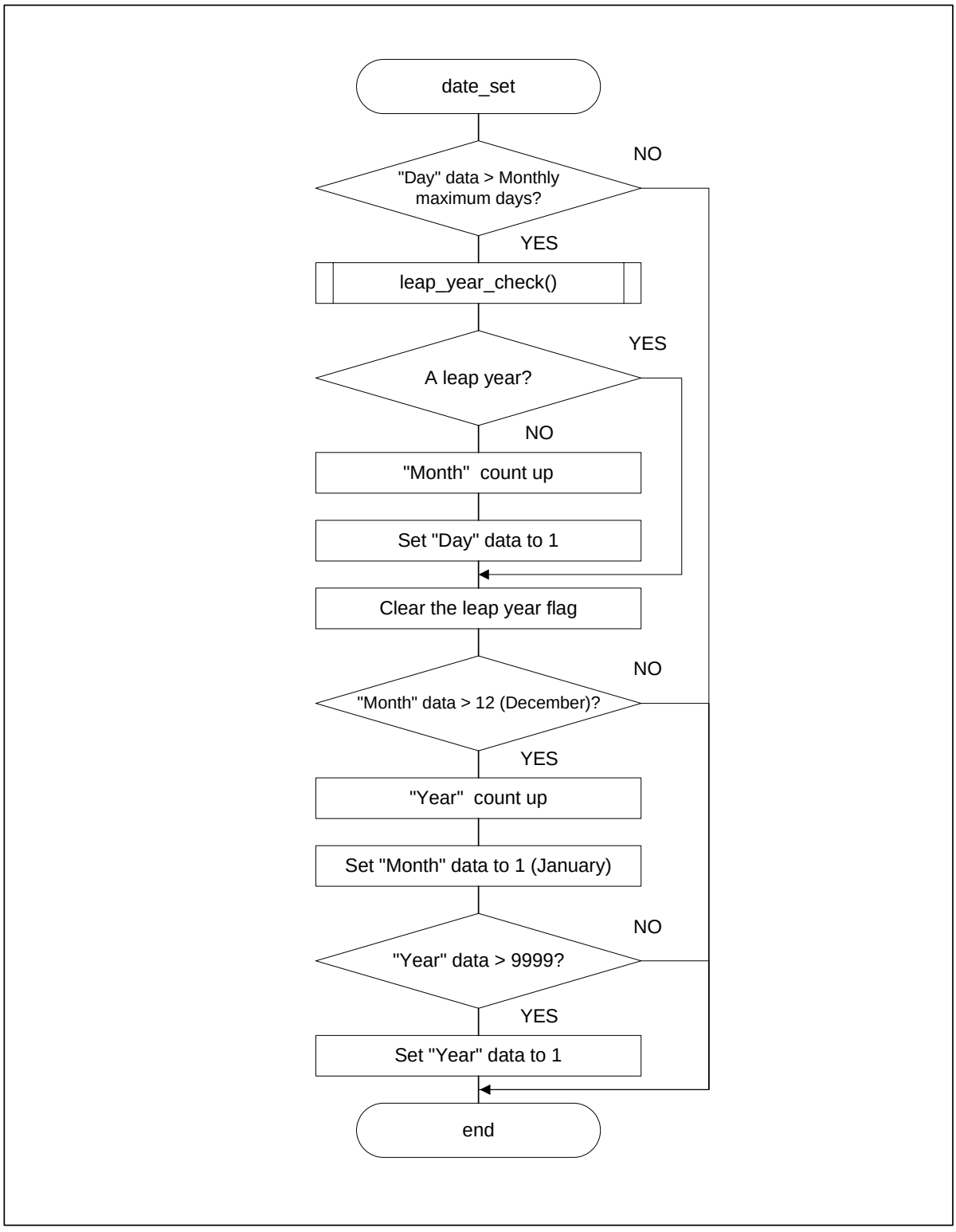

Figure 3. Flowchart (date_set)

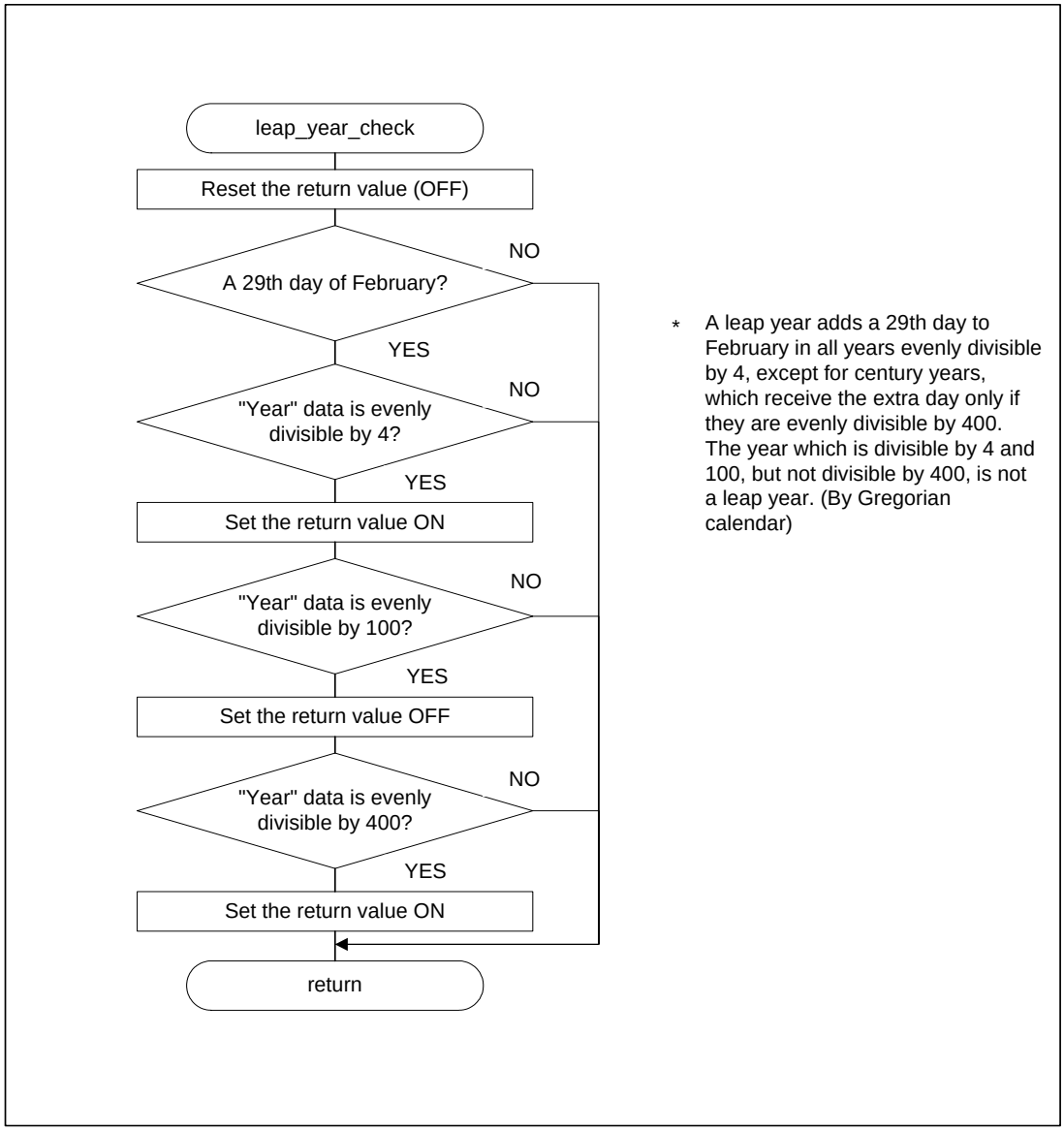

Figure 4. Flowchart (leap_year_check)

6. Reference Program

Please find the reference program from the Renesas Technology Web site.
Click Application Note in the left menu of the M16C/Tiny Series top page.

7. Reference Documents

Hardware manual
M16C/26A, M16C/26, M16C/28, and M16C/29 Group Hardware Manuals
(Use the most recent version of the document on the Renesas Technology Web site.)

Technical news/Technical update
(Use the most recent version of the document on the Renesas Technology Web site.)

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REVISION HISTORY

Rev.	Date	Description	
		Page	Summary
1.00	2006.06.01	-	First edition issued

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