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M32C/84, 85, 86, 87, and 88 Groups

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: M32C/84, 85, 86, 87, and 88 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 M32C/84, 85, 86, 87, and 88 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.
 $X_{cin} = 32.768 \text{ kHz}$
- 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 M32C/85 group. The applicable products of the technical update, No.TN-16C-119A are the M32C/84, 85, 86, 87, and 88 Groups.

Table 2. Register Description

Register Name		Address	Setting Value	Function
PRCR	Protect register	000Ah	01h 00h	Enables writing to registers CM0, CM1, CM2, MCD, PLC0, and PLC1. PRC0 bit: 0 (write disabled) PRC0 bit: 1 (write enabled) *The PRC2 bit is set to 0 by writing into a desired 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.
CM0	System clock control register0	0006h	18h 10h	-Main clock -Watchdog timer interrupt -Main clock oscillation -Xcin-Xcout oscillation function -Xcin-Xcout drive High/Low -Peripheral function clock is not stopped -Clock output function: P5_3 * Refer to technical update (TN-16C-119A)
MCD	Main clock division register	000Ch	12h	Divide-by-1 (no division) mode
TABSR	Count start flag	0340h	00h 01h	-Timer A0 stops counting -Timer A0 starts counting
TA0MR	Timer A0 mode register	0356h	C0h	Count source of fc32 selected, gate function disabled, no pulse output, timer mode
TA0	Timer A0 register	0346h	03FFh	Set the timer to (400-1)h to generate a timer A0 interrupt request every one second
TA0IC	Timer A0 interrupt control register	006Ch	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

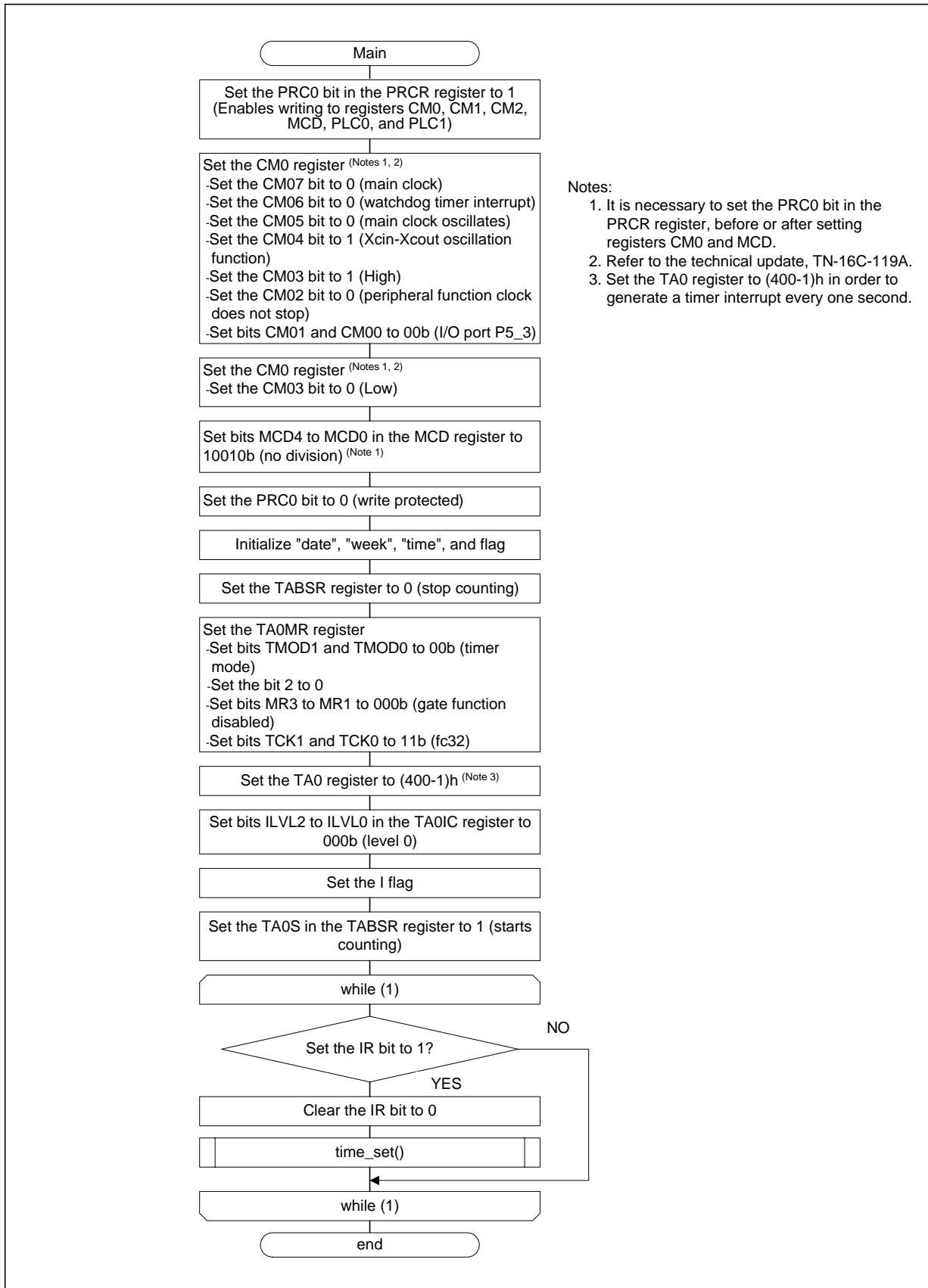
Table 4 lists ROM memories and their specifications.

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 (31 days) [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 M32C/85 Group is used as an example.



- Notes:
1. It is necessary to set the PRC0 bit in the PRCR register, before or after setting registers CM0 and MCD.
 2. Refer to the technical update, TN-16C-119A.
 3. Set the TA0 register to (400-1)h in order to generate a timer interrupt every one second.

Figure 1. Flowchart (Main)

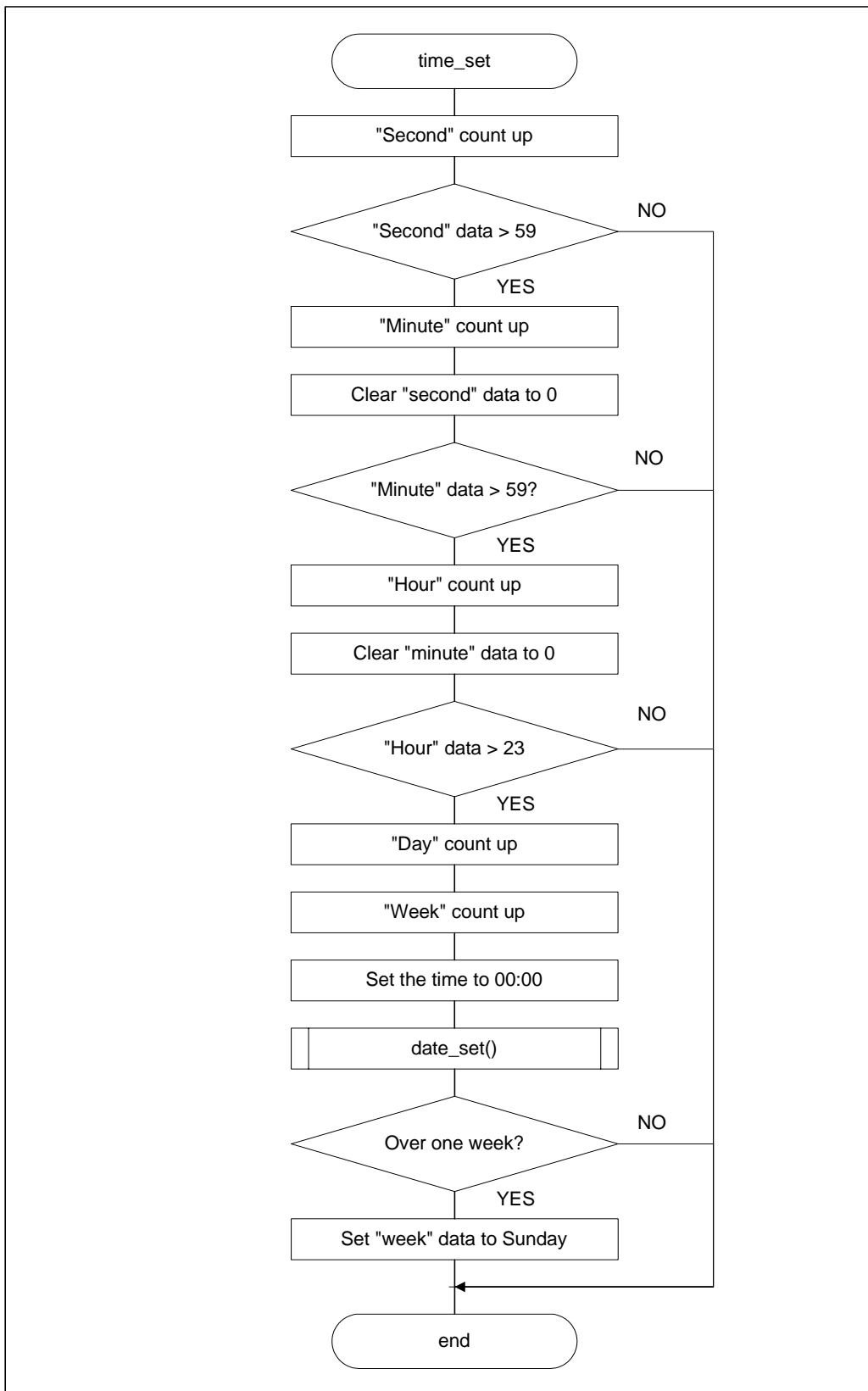


Figure 2. Flowchart (time_set)

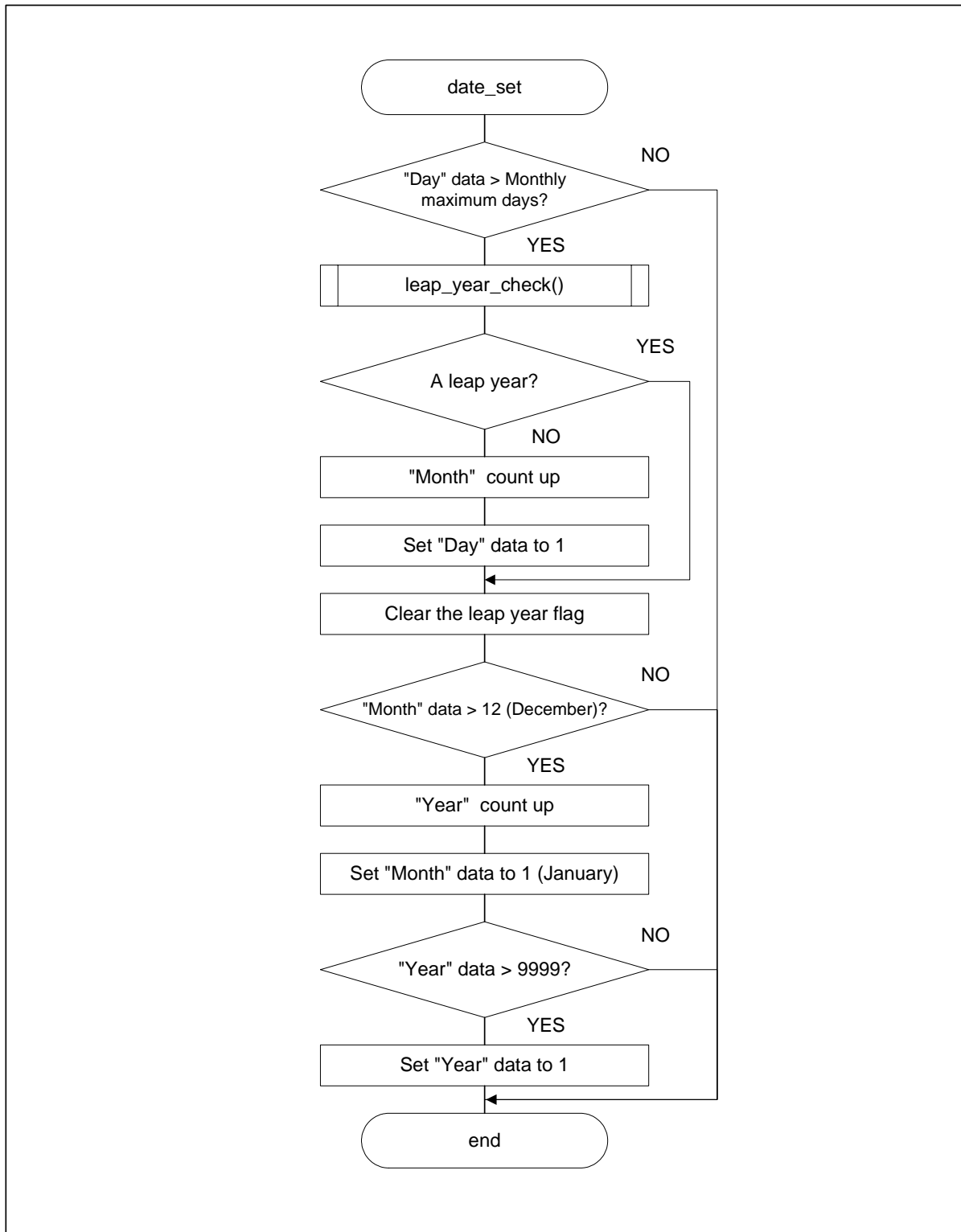


Figure 3. Flowchart (date_set)

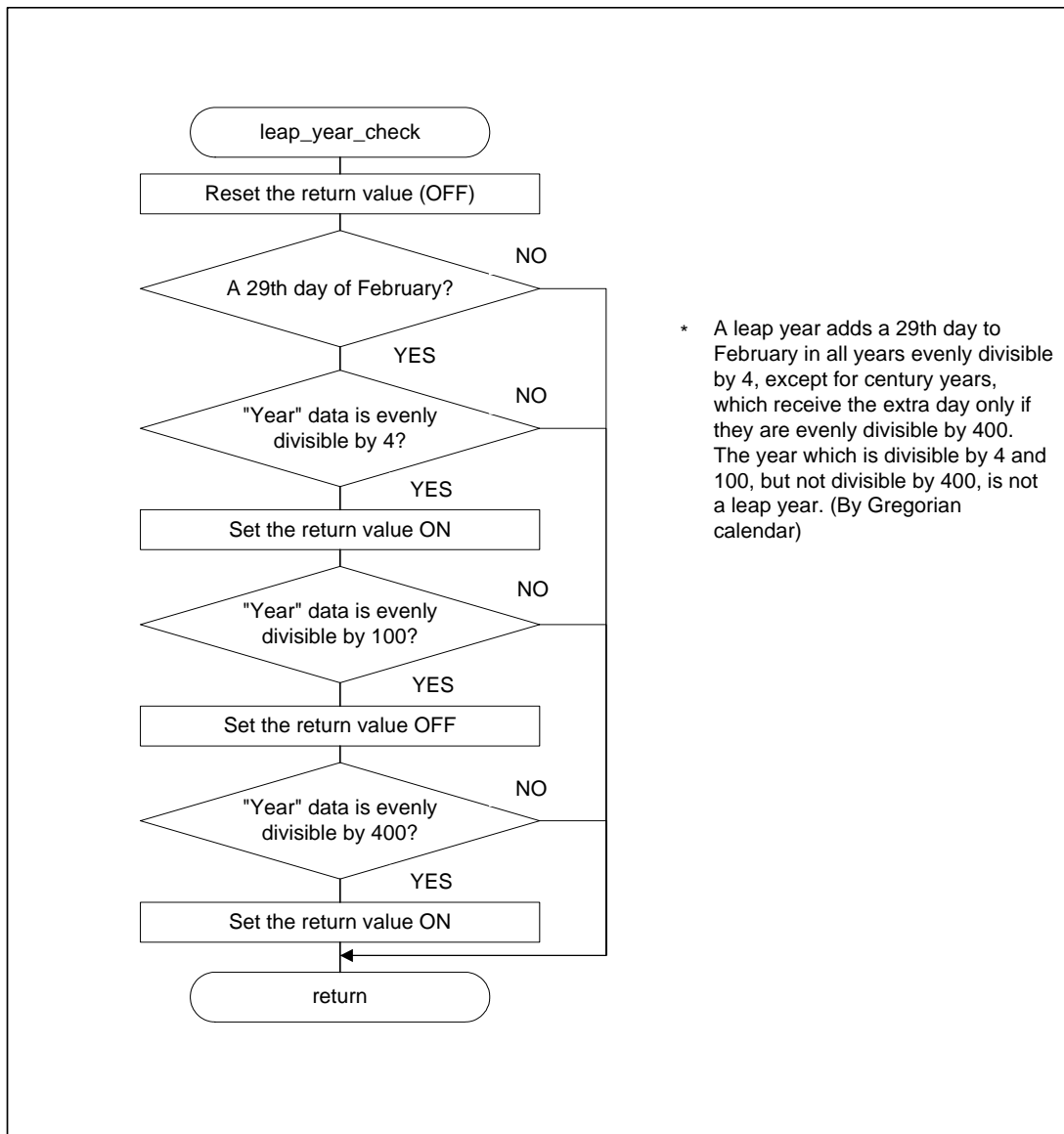


Figure 4. Flowchart (leap_year_check)

6. Reference Program

Please find the reference program from the Renesas Technology Web site.
Click Application Note in the left menu of the M32C/80 Series top page.
The M32C/85 Group is used for the sample program.

7. Reference Documents

Hardware manual

M32C/84, M32C/85, M32C/86, M32C/87, and M32C/88 Group Hardware Manuals
(Use the most recent version of the document on the Renesas Technology Web site.)

Technical news/Technical update

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