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H8/38076R

Flashing Operation of LED Connected to I/O Port

Introduction

In this example the periodic interrupt function of the realtime clock (RTC) causes an LED connected to a port to flash on and off.

Target Device

H8/38076R

Contents

1. Specifications

- The timing of the turning on and off of the LED is set at 0.5 seconds using the periodic interrupt function of the realtime clock (RTC).
- LED1 is connected to output pin P92 of port 9.
- P92 is a large current port.
- LED flashing operation is illustrated in figure 1.

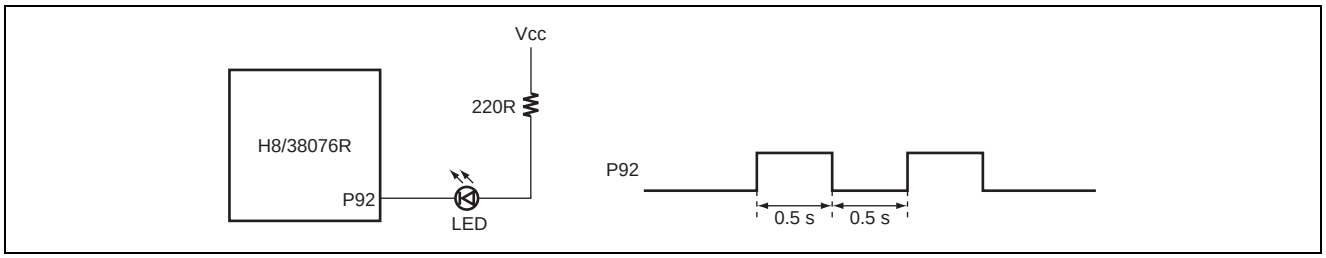


Figure 1 LED Flashing Operation

2. Functions Used

2.1 Functions for LED Flashing Operation

In this sample task an LED connected to the P92/$\overline{\text{IRQ4}}$ pin (P92) I/O port is turned on and off using the periodic interrupt function of the RTC. A block diagram of the I/O port is shown in figure 2 and is described below.

1. I/O Port Functions
   Port 92 is set as an output pin.

- Port data register 9 (PDR9)
  PDR9 is an 8-bit register that stores data for pins P93 to P90 of port 9. Reading port 9 causes the value of PDR9 to be read directly, regardless of the actual pin states.

- Port control register 9 (PCR9)
  PCR9 selects the input/output state of the pins of port 9 in bit units. Setting a bit in PCR9 to 1 makes the corresponding pin an output pin, and clearing a bit to 0 makes the corresponding pin an input pin. The settings of PCR9 and PDR9 are valid when the pins in question are set as general I/O ports. PCR9 is a write-only register. All its bits are always read as 1.

- Port mode register 9 (PMR9)
  PMR9 controls the selection of functions for port 9 pins.

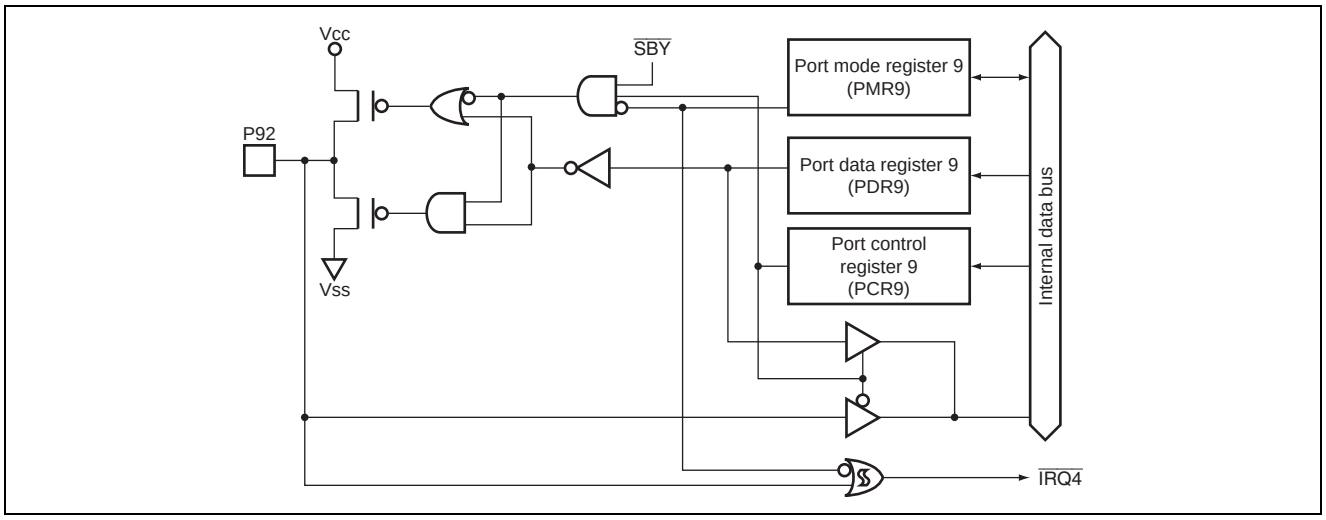


Figure 2 Block Diagram of I/O Port Functions

2. Large Current Port Usage Example
   Port 9 is a large current port that can drive 15 mA (@V_{OL} = 1.0 V) when a low level signal is output. In this sample task V_{CC} = 3.3 V and the LED is driven at 15 mA by inserting R = 220R. Drive of up to 60 mA is possible by using multiple large current ports.

3. RTC Functions
   The realtime clock (RTC) is a timer used to count durations ranging from a second to a week. It can generate interrupts at intervals ranging from 0.25 seconds to 1 week.

- RTC control register 1 (RTCCR1)
  RTCCR1 controls start/stop and reset of the clock timer.

- RTC control register 2 (RTCCR2)
  RTCCR2 controls the RTC periodic interrupts for week, day, hour, minute, 1 second, 0.5 seconds, and 0.25 seconds. Enabling interrupts every week, day, hour, minute, 1 second, 0.5 seconds, or 0.25 seconds sets the corresponding flag to 1 in the RTC interrupt flag register (RTCFLG) when an interrupt occurs.

- Clock source select register (RTCCSR)
  RTCCSR selects the clock source. A free running counter controls start/stop of counter operation by the RUN bit in RTCCR1. The RTC is disabled and operates as an 8-bit free running counter when a clock other than 32.768 kHz is selected.

- RTC interrupt flag register (RTCFLG)
  RTCFLG sets the corresponding flag when an interrupt occurs. The flag is not cleared automatically even if the interrupt is accepted. Write 0 to a flag to clear it.

2.2 Assignment of Functions

Table 1 shows the assignment of functions in this sample task. An LED connected to an I/O port is turned on and off using functions assigned as shown in table 1.

Table 1 Assignment of Functions

Elements	Description
PDR9	Stores output data for P92
PCR9	Sets P92 as an output pin
PMR9	Sets I/O pin functions for P92
RTCCR1	Controls RTC operation start/stop, operation mode, resets, and interrupt generation timing
RTCCR2	Enables 0.5-second periodic interrupt requests
RTCCSR	Selects 32.768 kHz as the clock source
RTCFLG	0.5-second periodic interrupt request flag
IENR1	Enables RTC interrupt requests

3. Principles of Operation

The principles of operation are illustrated in figure 3. In this sample task an LED connected to P92 is turned on and off by 0.5-second periodic interrupts from the RTC.

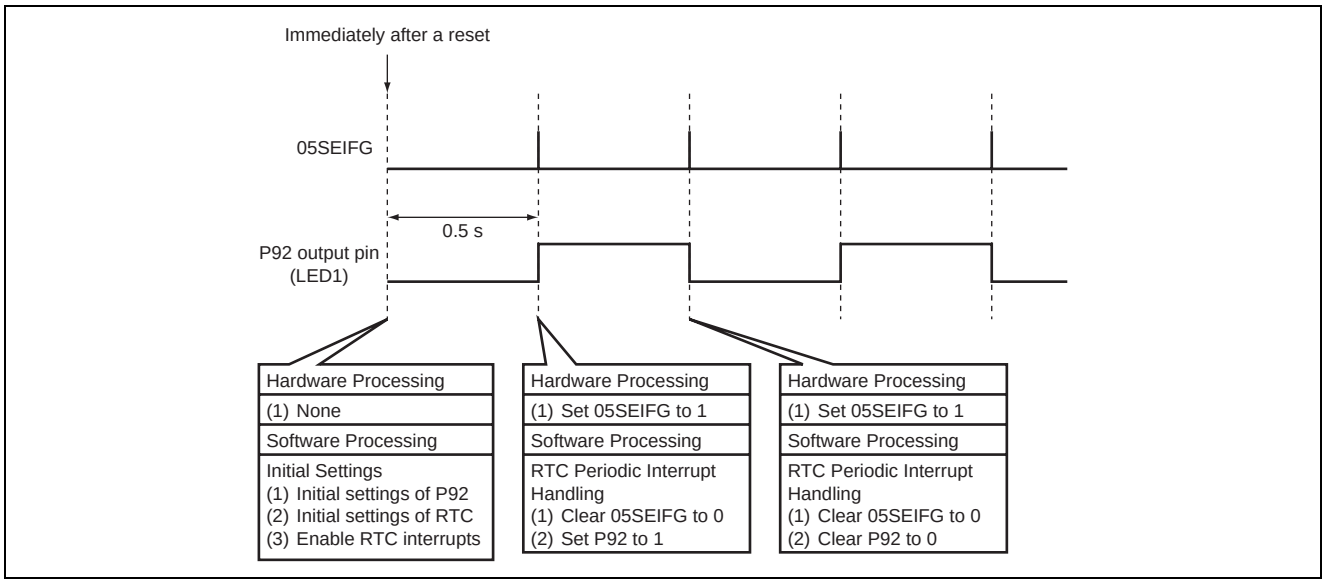


Figure 3 Principles of Operation for Flashing Operation of LED Connected to I/O Port

3.1 Initial Setting Procedure of RTC

The RTC registers that store second, minute, hour, and day-of-week data are not reset by an $\overline{\text{RES}}$ input. Therefore, all registers must be set to their initial values after power-on. Figure 4 shows the procedure for the initial setting of the RTC.

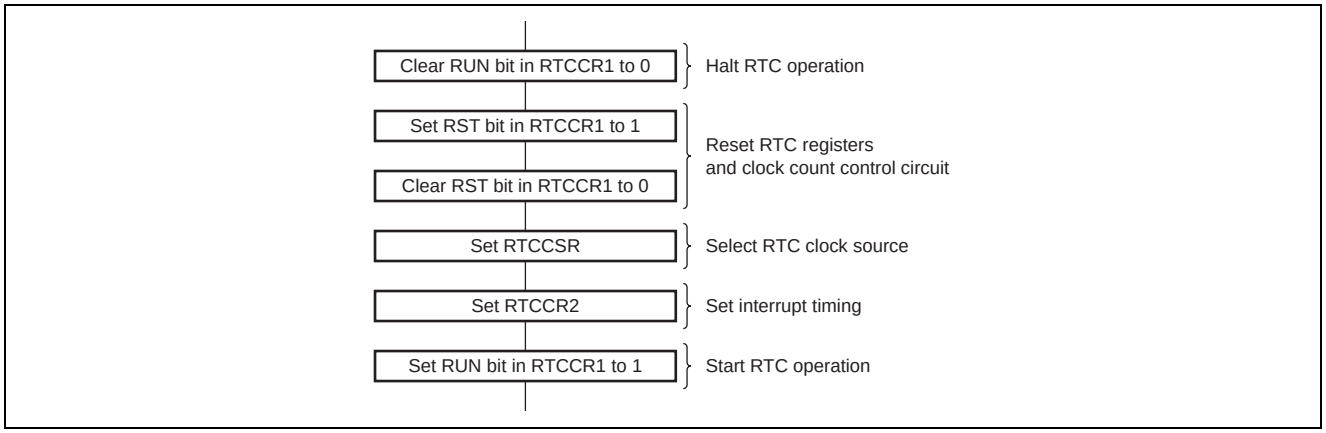


Figure 4 Initial Setting Procedure of RTC

3.2 Interrupt Sources

There are eight types of RTC interrupts: free-running counter overflow, week, day, hour, minute, one-second, 0.5-second, and 0.25-second.

When using an interrupt, initiate the RTC last after other registers are set.

When an interrupt request of the RTC occurs, the corresponding flag in RTCFLG is set to 1. To clear a flag, write 0 to it.

3.3 Note on Clock Count

The subclock must be connected to a 32.768-kHz resonator. The time cannot be counted accurately if a 38.4-kHz resonator, or the like, is connected.

4. Description of Registers

4.1 Modules

Table 2 is a list of modules used in this sample task.

Table 2 Modules

Function Name	Description
main	Makes initial RTC settings, enables 0.5-second periodic interrupt requests, makes initial settings for port 9
int_rtc	RTC 0.5-second periodic interrupt processing, P92 on/off switching

4.2 Arguments

No arguments are used in this sample task.

4.3 Internal Registers Used

The internal registers used in this sample task are shown below.

- PDR9 Port data register 9 Address: H'FFDC

Bit	Bit Name	Set Value	R/W	Description
2	P92	0	R/W	If port 9 is read while the PCR9 bit is set to 1, the corresponding value stored in PDR9 is read directly, regardless of the actual pin state. If port 9 is read while the PCR9 bit is cleared to 0, the corresponding pin state is read.

- PCR9 Port control register 9 Address: H'FFEC

Bit	Bit Name	Set Value	R/W	Description
2	PCR92	1	W	Setting a PCR9 bit to 1 makes the corresponding pin an output pin, while clearing the bit to 0 makes the pin an input pin. The settings in PCR9 and in PDR9 are valid when the corresponding pin is designated as a general I/O pin. PCR9 is a write-only register. These bits are always read as 1. 1: Output pin

- PMR9 Port mode register 9 Address: H'FFC8

Bit	Bit Name	Set Value	R/W	Description
2	IRQ4	0	R/W	P92/$\overline{\text{IRQ4}}$ pin function switch Selects whether pin P92/$\overline{\text{IRQ4}}$ is used as P92 or as $\overline{\text{IRQ4}}$. 0: Functions as P92 I/O pin

- RTCCR1 RTC control register 1 Address: H'F06C

Bit	Bit Name	Set Value	R/W	Description
7	RUN	1	R/W	RTC operation start 0: Stops RTC operation 1: Starts RTC operation
4	RST	0	R/W	Reset 0: Normal operation 1: Resets registers and control circuits except RTCCSR and this bit. Always clear this bit to 0 after setting it to 1.

- RTCCR2 RTC control register 2 Address: H'F06D

Bit	Bit Name	Set Value	R/W	Description
1	05SEIE	1	R/W	0.5-second periodic interrupt enabled 0: Disables a 0.5-second periodic interrupt 1: Enables a 0.5-second periodic interrupt

- RTCCSR Clock source select register Address: H'F06F

Bit	Bit Name	Set Value	R/W	Description
3	RCS3	1	R/W	Clock source selection
2	RCS2	0	R/W	0000: ϕ/8 (free running counter operation)
1	RCS1	0	R/W	0001: ϕ/32 (free running counter operation)
0	RCS0	0	R/W	0010: ϕ/128 (free running counter operation) 0011: ϕ/256 (free running counter operation) 0100: ϕ/512 (free running counter operation) 0101: ϕ/2,048 (free running counter operation) 0110: ϕ/4,096 (free running counter operation) 0111: ϕ/8,192 (free running counter operation) 1xxx: 32.768 kHz (RTC operation) Note: x: Don't care.

- RTCFLG RTC interrupt flag register Address: H'F067

Bit	Bit Name	Set Value	R/W	Description
1	05SEIFG	1	R/W*	[Setting condition] When a 0.5-second periodic interrupt occurs [Clearing condition] When 0 is written to 05SEIFG while 05SEIFG remains 1

Note: * Only 0 can be written to clear the flag.

- IENR1 Interrupt enable register 1 Address: H'FFF3

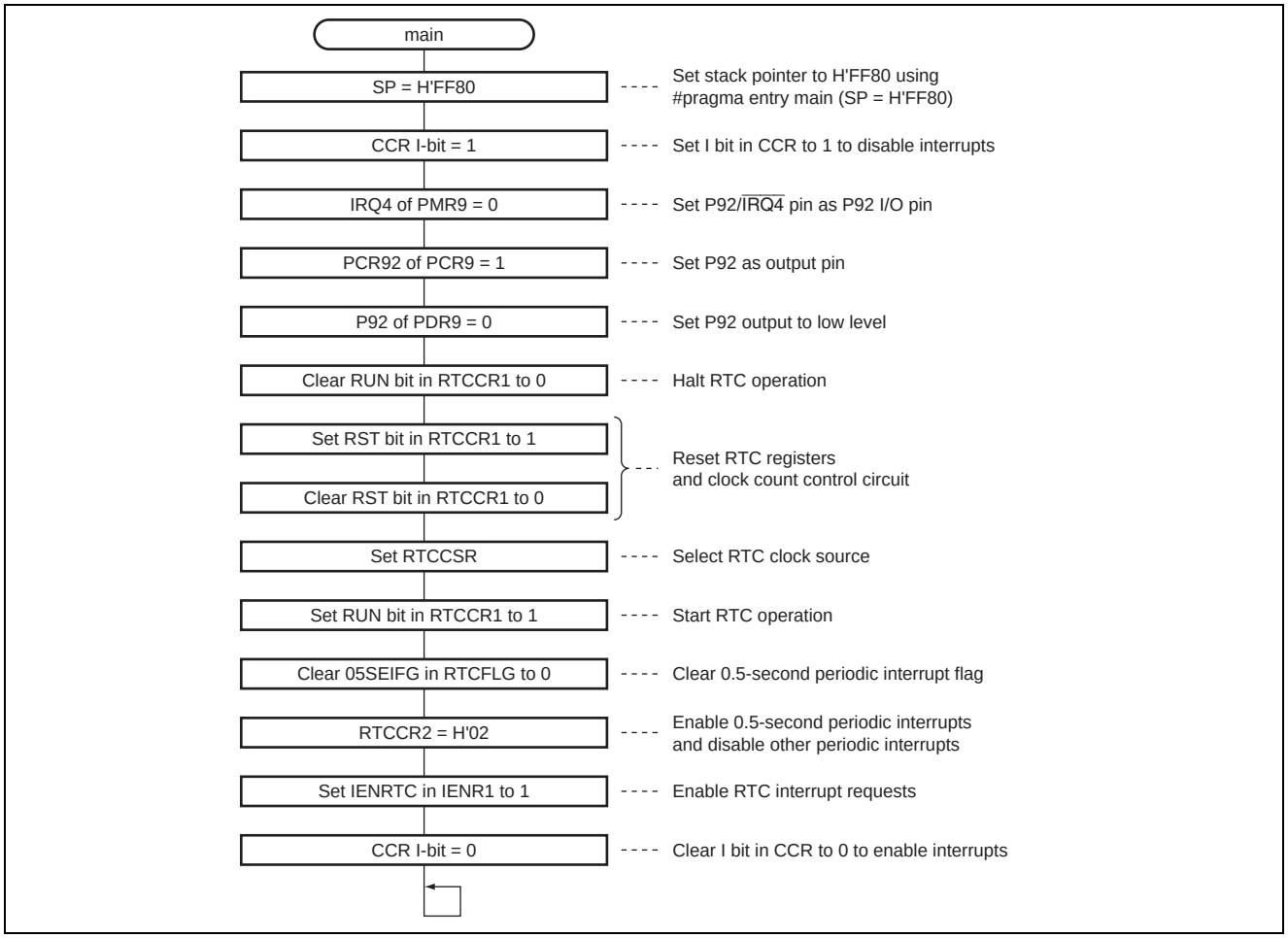
Bit	Bit Name	Set Value	R/W	Description
7	IENRTC	1	R/W	RTC interrupt request enabled RTC interrupt requests are enabled when this bit is set to 1.

4.4 RAM Usage

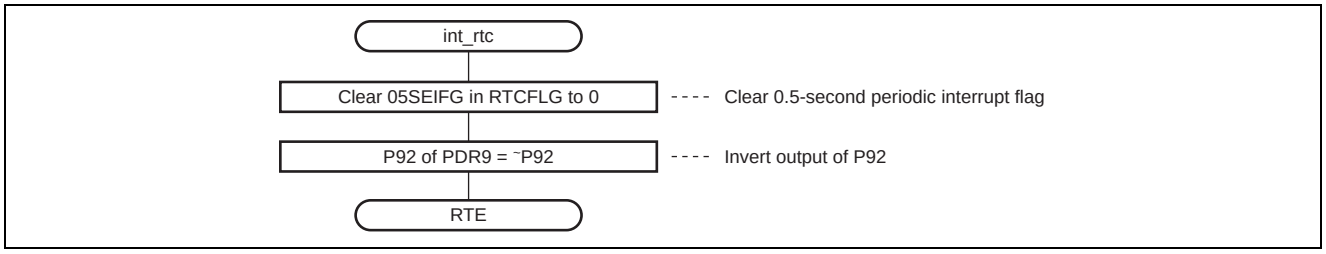
No RAM is used in this sample task.

5. Flowchart

5.1 main



5.2 int_rtc



5.3 Link Address Specifications

Section Name	Address
CVECT	H'0000
P	H'0100

Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Mar.18.05	—	First edition issued

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