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Renesas Electronics Corporation

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4552 Group

Timer 1, Timer 2 (PWM Signal Output Control: Remote-Control Carrier Wave Output Control)

1. Abstract

The following article introduces and shows an application example of the PWM signal (remote-control carrier wave) output from CNTR pin by Timer 1 or Timer 2 of the 4552 Group.

2. Introduction

The explanation of this issue is applied to the following condition:

- Applicable MCU: 4552 Group
- Oscillation frequency: 3.64 MHz
- Operation mode: Frequency/4 mode

3. Contents

3.1 Application Example of PWM Signal Output Control

Outline

- Generate the PWM signal (remote-control carrier wave) by Timer 2.
- Control the output of the PWM signal to the CNTR pin by Timer 1.
- Switch the ON/OFF of the output of the CNTR pin every Timer 1 underflow.
- Timer 1 count source: PWM signal
  Change the interval of ON/OFF of the output of the CNTR pin by change of the Timer 1 set value.
- Even when the output of the PWM signal to the CNTR pin is not performed, the PWM signal is generated internall

Specifications

- PWM signal : 37.9 kHz, Duty 1/3
- CNTR output: Standard interval T = 0.55 ms, 8T output ON - 4T output OFF - T output ON

Figure 1 shows the auto-control of CNTR output by Timer 1, and Figure 2 shows the connection of Timer and the dividing ratio.

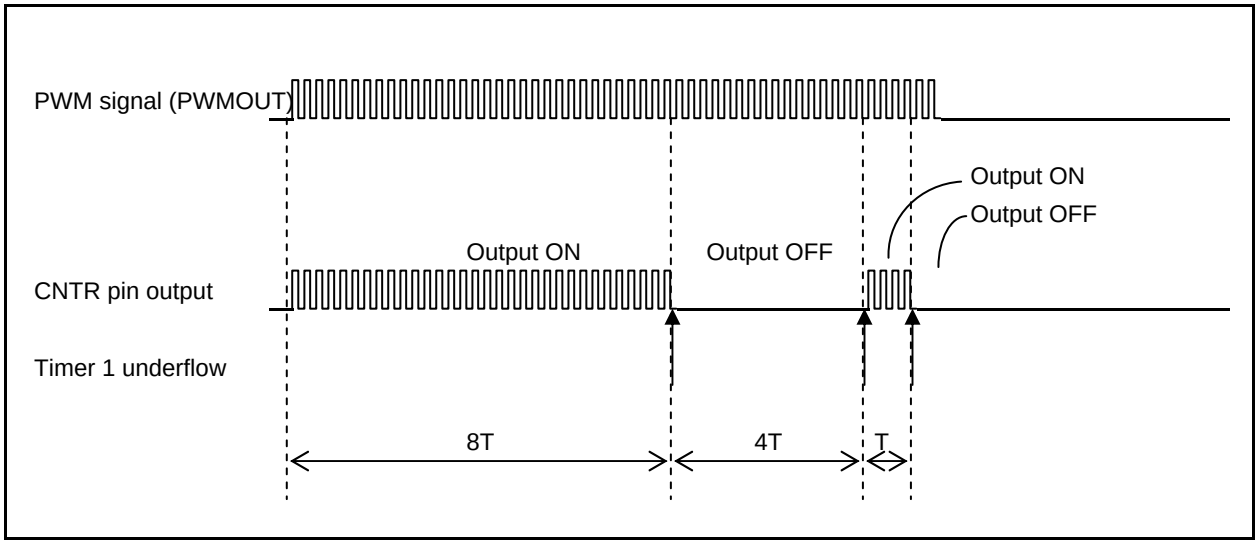

Figure 1 Auto-Control of CNTR Output by Timer 1

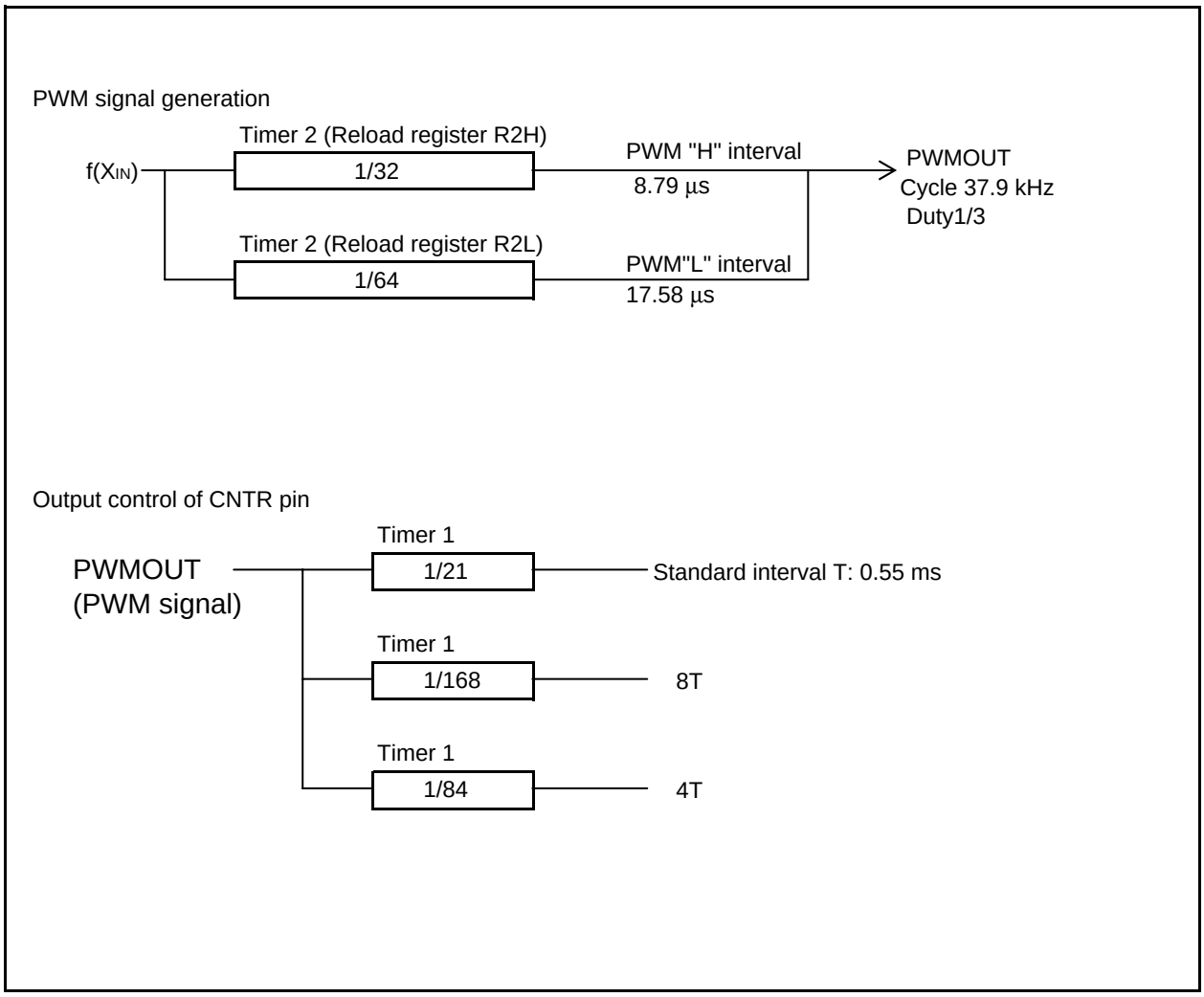

Figure 2 Connection Diagram of Timer and Dividing Ratio

3.2 Relevant Register Setting

Figure 3 shows the relevant register setting.

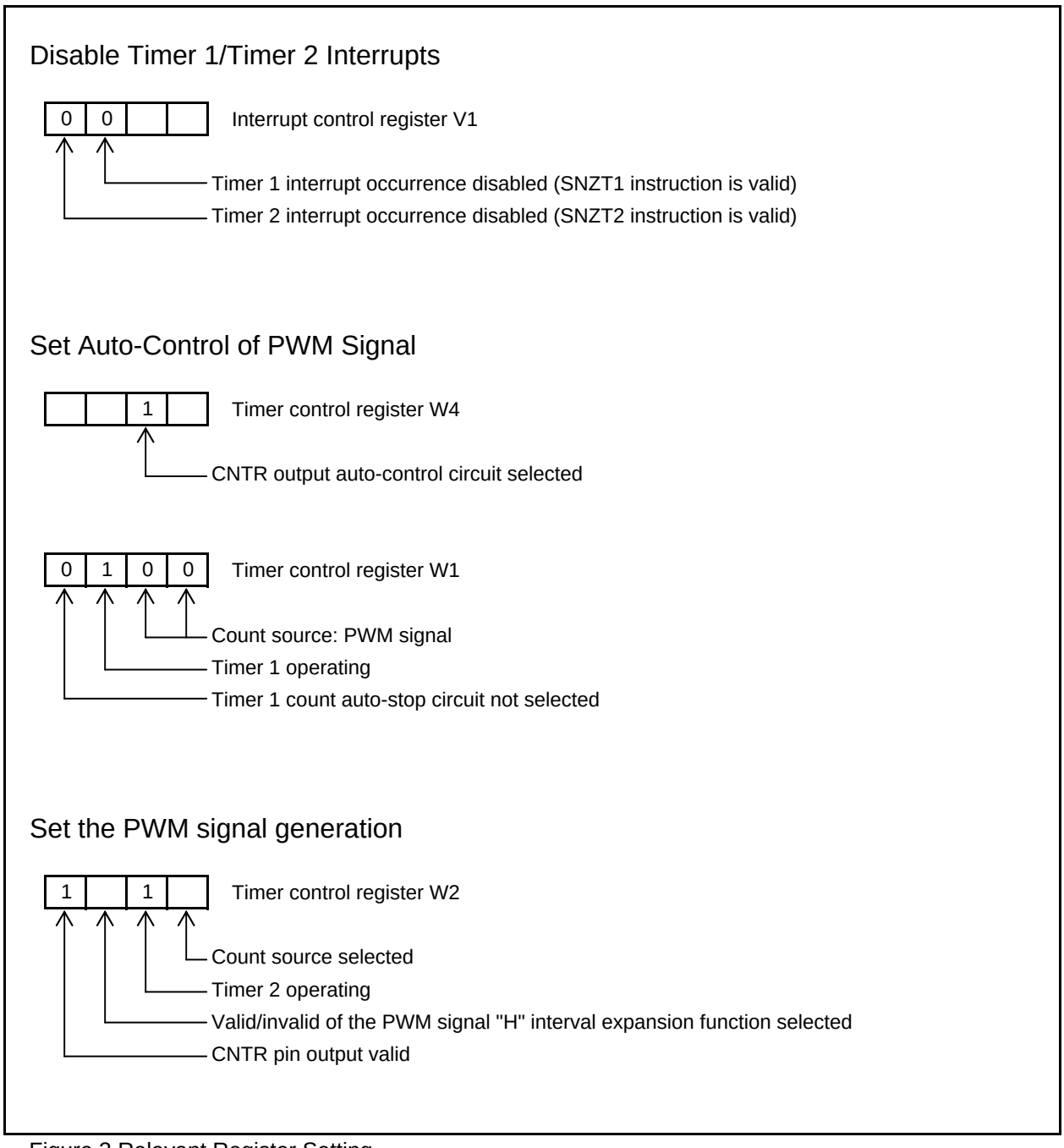

Figure 3 Relevant Register Setting

3.3 Control Procedure

Figure 4 and Figure 5 show the control procedure.

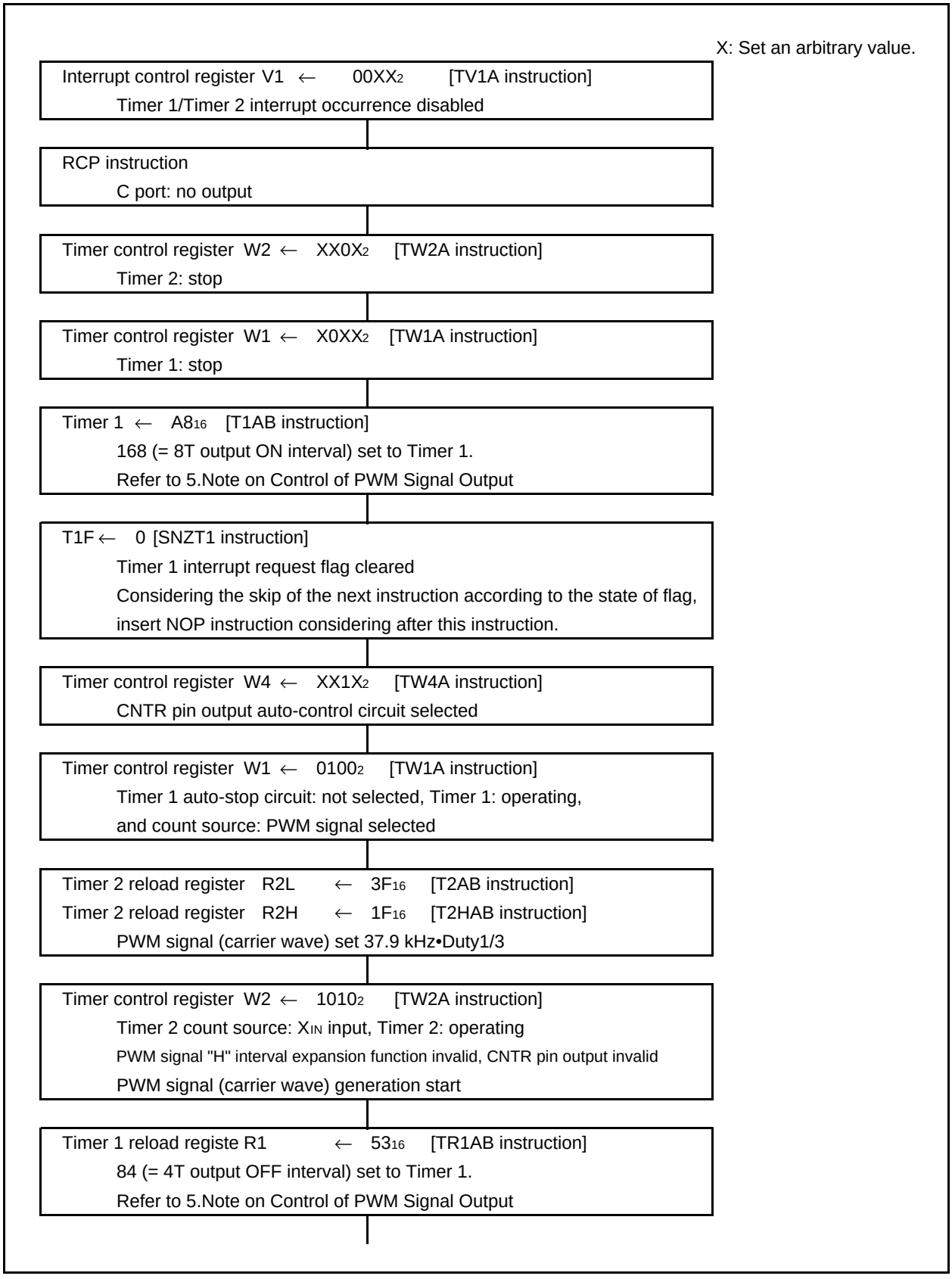

Figure 4 Control Procedure (1)

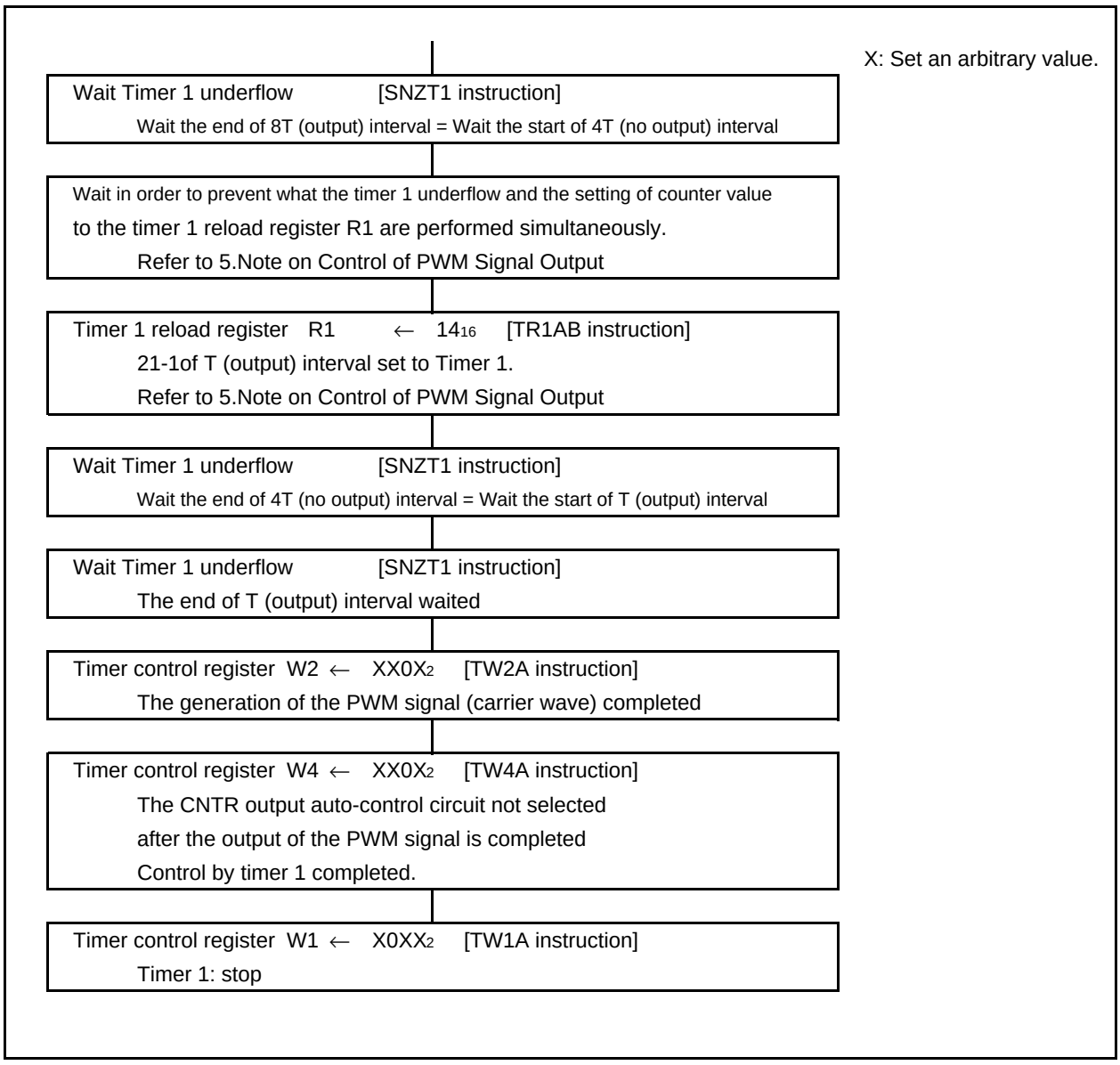

Figure 5 Control Procedure (2)

4. Sample Programming Code

Figure 6 and Figure 7 show the sample programming code.

```
EX_CNTR:  LA      0000b     ; Disable Timer 1• Timer 2 interrupts
          TV1A              ; Set 0 to bit 2 of register V1 to use SNZT1 instruction

          RCP               ; C(/CNTR) no output
                            ;  * Even if CNTR is used, H output function of port C is valid

          LA      0000b     ; CNTR output: invalid • PWM signal "H" interval expansion function: invalid •
                            ; Timer 2: stop
          TW2A

          LA      0000b     ; Switch the Timer 1 auto-stop circuit from "not select state" to "selected state"
          TW1A

          LA      0Ah       ; Set the counter value for the first output interval 4.4 ms (8T)
          TBA
          LA      08h       ; As T is carrier wave 21 counts,
          T1AB              ; 21 X 8 = 168 = A8h

          SNZT1             ; Clear Timer 1 underflow (interrupt request) flag
          NOP

          LA      0010b     ; In order that the CNTR output auto-control circuit is selected state,
          TW4A              ; set 1 to bit 1 of register W4.

          LA      0100b     ; Timer 1 auto-stop circuit: not selected • Timer 1: operating •
                            ; Count source: PWM signal
          TW1A              ; Start operation of Timer 1 for the output control first

          LA      03h       ; Set for the waveform of the PWM signal
          TBA               ; L • 64 counts
          LA      0Fh       ; (3Fh = 64–1)
          T2AB              ; 64/3.64 MHz = 17.58 µs

          LA      01h       ; H • 32 count
          TBA               ; (1Fh = 32–1)
          LA      0Fh       ; 32/3.64 MHz = 8.79 µs
          T2HAB

          LA      1010b     ; Timer 2 • CNTR output: vaild•"H" interval expansion: invalid
          TW2A              ; Timer 2: operating • Count source: XIN
                            ; PWM signal cycle      17.58 µs + 8.79 µs = 26.37 µs  ∴37.92 kHz
                            ; XIN/96                Duty1/3
```

Figure 6 Sample Programming Code (1)

```
            LA      05h         ; Set the counter value for the no output interval 2.2 ms (4T)
            TBA                 ; of the next PWM signal is set to reload register R1.
            LA      03h         ; As T is carrier wave 21 counts,
            TR1AB               ;       21 X 4 = 84 = 54h = 53h + 1

WAIT_NH:    SNZT1               ; Wait the output interval 4.4 ms of the PWM signal
            BL      WAIT_NH
                                ; Wait more than one cycle of the PWM signal
            NOP                 ; One cycle of PWM signal (26.37 μs)  ≤ Wait time (3.30 μs X 8 = 26.40 μs)
            NOP
            NOP

            LA      01h         ; Set the counter value for the output interval 0.55 ms (T)
            TBA                 ; of the next PWM signal to reload register R1.
            LA      04h         ; As T is carrier wave 21 counts,
            TR1AB               ; 21 = 15h = 14h + 1

WAIT_L:     SNZT1               ; Wait the end of the no output interval 2.2 ms of the PWM signal
            BL      WAIT_L

WAIT_END:   SNZT1               ; Wait the end of the output interval 0.55 ms of the PWM signal
            BL      WAIT_END

            LA      0000b       ; Stop Timer 2 (PWM signal generating side)
            TW2A

            NOP
            NOP                 ; Wait more than one cycle of the PWM signal
            NOP                 ; One cycle of PWM signal (26.37 μs)  ≤ Wait time (3.30 μs X 8 = 26.40 μs)
            NOP
            NOP
            NOP
            NOP

            LA      0000b       ; In order that the CNTR output auto-control circuit is unselected state,
            TW4A                ; set 0 to bit 1 of register W4

            LA      0000b       ; Stop Timer 1 (CNTR output control side)
            TW1A
```

Figure 7 Sample Programming Code (2)

5.Note on Control of PWM Signal Output

- The port C “H” output function is valid even when CNTR (output) pin is valid.
  Clear "0" to the output latch of port C with the RCP instruction before the PWM signal is output.

- When the CNTR output auto-control by timer 1 is performed, set the frequency division to Timer 1 at the first time.
  Set (frequency division - 1) to the reload register R1 after second times.
  Also, the PWM signal is started at output, and it becomes the no-output state by the first Timer 1 underflow.

- Even when the CNTR pin output is set to be invalid by the CNTR pin output signal selection bit W23,
  the generation of the PWM signal is not stopped internally by timer 2 until the end of the one cycle of the PWM signa

- When writing data to the reload register R1 with the TR1AB instruction while Timer 1 is operating, avoid a timing when Timer 1 underflows.
  In particular, wait one cycle or more of the timer 1 count source after underflow, and then,
  set a value to the reload register R1.
  Note is especially required when the cycle of the count source is longer than the machine cycle.

6. Reference

Data Sheet
4552 Group Data sheet

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Revision Record	4552 Group (PWM signal output control) APPLICATION NOTE

Rev.	Date	Description	
		Page	Summary
1.00	2005.03.25	-	First edition issued

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