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April 1st, 2010
Renesas Electronics Corporation

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Application Note

µPD780988 Subseries

8-bit Single-Chip Microcontrollers

Real Time Output Port Fundamentals

µPD780982

µPD780983

µPD780984

µPD780986

µPD780988

µPD78F0988A

Document No. U16516EE1V0AN00 (1st edition)
Date Published December 2002

[MEMO]

NOTES FOR CMOS DEVICES

1. PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note:

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 once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build 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 bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

2. HANDLING OF UNUSED INPUT PINS FOR CMOS

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to VDD or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

3. STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note:

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

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Contents

(A) Features of the Real Time Output Port (RTP)

The µPD78098x subseries incorporates two real-time output ports:

- Real-Time Output Port 0
- 8 bits x 1 channel or 4 bits x 2 channels
- Real-Time Output Port 1
- 6 bits x 1 channel or 4 bits x 1 channel

Data set in the real-time output buffer can be automatically transferred to the port outputs by:

- INTP2: external interrupt
- INTM00: 16-bit timer 00 interrupt
- INTTM52: 8-bit timer 52 interrupt.

(B) Program Description

This program demonstrates how the Real-Time Output Port 0 is used with the 16-bit timer 00 interrupt, INTTM00. The program uses the 8 bits x 1 channel mode to increment the real-time port output every 100µs.

Port 3 is set to all outputs and a value is written to the port 3 output latches. The count clock to timer 00 is selected to be 8.38MHz. The compare register is set to 838 for an interval of 100µs (838 /8.38MHz).

Before configuring the real-time port, it is first disabled. The Real-Time Output Port Mode register 0 (RTPM00) is set so all 8 bits are set to real-time outputs. The Real-Time Output Port Control register 0 (RTPC00) is set for 8 bits x 1 channel mode with INTTM00 trigger. The DC Control Register 0 (DCCTL0) is cleared to disable the PWM modulation and output inversion options. The real-time output buffer register is written to match the current port 3 output latch values before Real Time Ouput Port 0 is enabled.

The first value to be output on occurrence of the INTTM00 trigger is written to the real-time port buffer register. Then timer 00 is started and interrupts are enabled. On each INTTM00 interrupt the contents of the real-time buffer register is transferred to the outputs. The INTTM00 interrupt routine then increments the real-time output buffer register in readiness for the next interrupt.

(C) Program Specifications

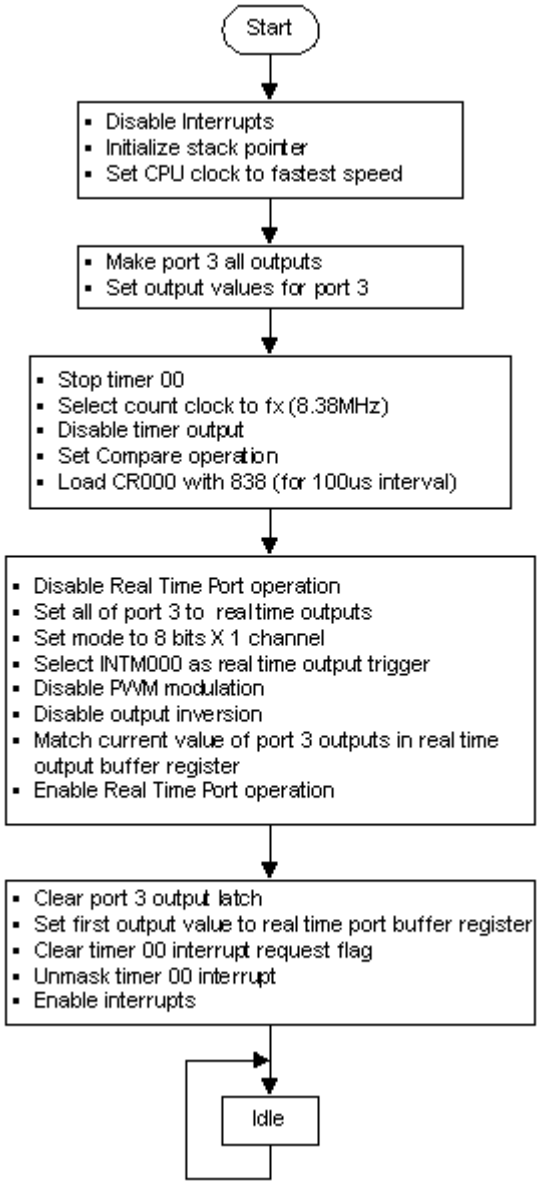
- Real-Time Output Port 0: 8 bits x 1 channel, interrupt INTTM00
- TM00 Count clock frequency: 8.38MHz
- TM00 Compare Register (CR000) value: 838 (100us interval)

(D) Used pins

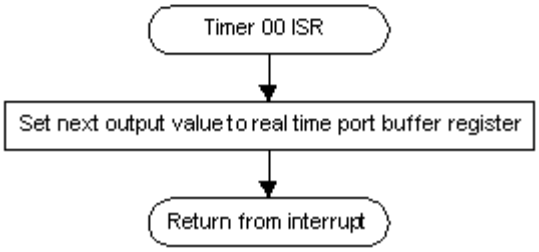
- Port 3: Output: 5kHz/2n square-wave on Port 3.n (n = 0 to 7)

(E) Software Flow Chart

Flowchart – Main Program



Flowchart – Interrupt Program



(F) Software Listing

```
/*********************************************************************
; Date:          11/13/02
;
; Parameters:    - CPU clock (fx=8.3800MHz)
;                - Real-Time Output mode: 8 bits x 1 channel
;                - Output trigger: INTTM000
;                - TM00 timer count clock: fx (8.38MHz)
;                - compare register value (CR000): 838
;                - output port: port 3 (triggered every 100us)
;
;*********************************************************************/

/*=====================================
; Include Files
;=====================================*/
#include <in78000.h>
#include "DF0988.h"

/*=====================================
; Constants/Variables
;=====================================*/
#define TRUE  1
#define FALSE 0

/*=====================================
; Main Program
;=====================================*/

void main(void)
{
_DI();                          /* Disable interrupts */
                                /* Stack pointer set by compiler */
PCC = 0x00;                     /* Set CPU clock to fastest speed */

PM3 = 0x00;                     /* Set port 3 to all outputs */
P3 = 0xaa;                      /* Set a value to port 3 outputs */

TMC00 = 0x00;                   /* Stop timer */
PRM00 = 0x00;                   /* Select 8.38MHz clock to TM00 */
TOC00 = 0x00;                   /* Disable timer output */
CRC00 = 0x00;                   /* Set Capture/Compare to Compare  */
CR000 = 838;                    /* Set CR000 to 838 (100us interval) */

RTPOE00 = 0;                    /* Disable real time port operation */
RTPM00 = 0xff;                  /* Set port 3 to 8 real time outputs */
RTPC00 = 0x20;                  /* Set mode to 8 bits x 1 channel */
                                /* Select INTTM000 trigger */
DCCTL0 = 0x00;                  /* Disable PWM modulation & inversion */
RTBH00 = 0xaa;                  /* Set value to buffer register that */
                                /*   matches current port 3 outputs */
RTPOE00 = 1;                    /* Enable real time port operation */

P3 = 0x00;                      /* Clear port 3 output latch */
RTBH00 = 0x55;                  /* Set first output value to RTBH00 */
TMIF000 = 0;                    /* Clear timer interrupt request flag */
TMMK000 = 0;                    /* Clear timer interrupt mask flag */
```

```
TMC00 = 0x0c;                   /* Start timer */
_EI();                          /* Enable interrupts */

while(TRUE)                     /* Endless loop */
{                               /* Output triggered every 100us */
        _NOP();
}

}                               /* End of function main */


/*=====================================
;       Timer 00 ISR
;=====================================*/
interrupt[INTTM000_vect] void TM00_ISR(void)

{

RTBH00++;                       /* Set next output value to RTBH00 */
                                /* Return from interrupt */
}

/*********************************************************************/
```

[MEMO]

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