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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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## Application Note

# **μPD780988 Subseries**

## **8-bit Single-Chip Microcontrollers**

### **Interrupt Control Fundamentals**

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**μPD780982**

**μPD780983**

**μPD780984**

**μPD780986**

**μPD780988**

**μPD78F0988A**

[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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## **(A) Kinds of Interrupts**

The  $\mu$ PD78098x subseries has three different kinds of interrupts: non-maskable interrupts, maskable interrupts, and software interrupts.

## **(B) Program Description**

This program demonstrates a maskable interrupt using the 8-bit timer/event counter TM51. Every 200 $\mu$ s the timer generates an interrupt that toggles port pin 0.2.

The count clock to the timer is selected to be 262kHz (8.38MHz / 25 ). The compare register is set to 52. When the timer count reaches the value set in the compare register (a count of 52 takes 200 $\mu$ s), the timer interrupt INTTM51 is generated. The interrupt service routine simply toggles port 0.2 before returning to the main program.

## **(C) Program Specifications**

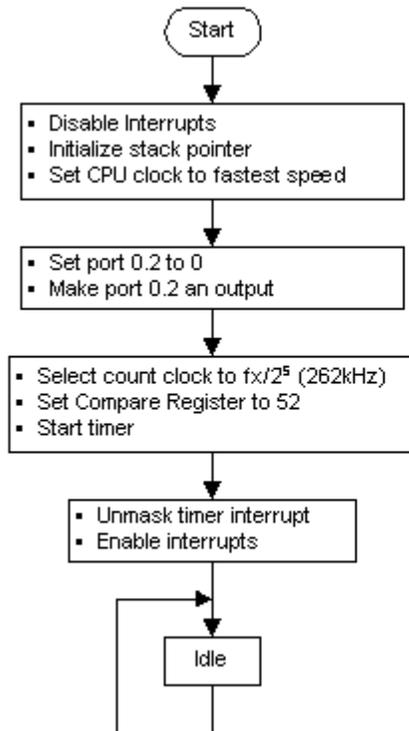
- Timer: 8-bit timer/event counter TM51
- Timer count clock frequency: 262kHz (at 8.38MHz main system clock)
- Compare Register (CR51) value: 52
- Interrupt: INTTM51
- Interrupt interval: 200 usec

## **(D) Used pins**

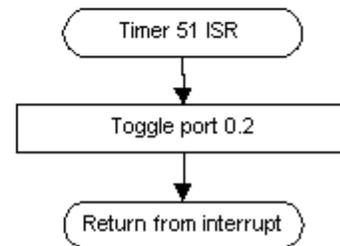
- P0.2 (port pin toggles every 200 usec)

## (E) Software Flow Chart

Flowchart – Main Program



Flowchart – Interrupt Program



## (F) Software Listing

```
/******  
; Date:          11/13/02  
; .  
; .  
; Parameters:   - CPU clock (fx=8.3800MHz)  
;               - timer: 8-bit timer/event counter TM51  
;               - timer count clock: fx/32 (262kHz)  
;               - compare register value (CR51): 52  
;               - interrupt: INTTM51  
;               - output port: port 0.2 (toggles every 200us)  
;*****  
; .  
; .  
/*=====  
; 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 */  
  
  P0.2 = 0;       /* Set port 0.2 latch output low */  
  PM0.2 = 0;     /* Set port 0.2 to output mode */  
  
  TCL51 = 0x07;  /* Select 262kHz count clock */  
  CR51 = 52;     /* Set Compare Register to 52 */  
  TMC51 = 0x84;  /* Start timer */  
  
  TMMK51 = 0;    /* Clear timer 51 interrupt mask flag */  
  _EI();        /* Enable interrupts */  
  
  while(TRUE)   /* Loop here */  
  {  
    _NOP();  
  }  
  
}                /* End of function main */
```

```
/*=====
;      Timer 51 ISR
;=====*/
interrupt[INTTM51_vect] void TM51_ISR(void)
{
P0    ^= 0x04;          /* Toggle port 0.2 */
                          /* Return from interrupt */
}
/*****/
```

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