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April 1st, 2010
Renesas Electronics Corporation

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Application Note

µPD780988 Subseries

8-bit Single-Chip Microcontrollers

A/D-Converter Hardware Trigger

µPD780982

µPD780983

µPD780984

µPD780986

µPD780988

µPD78F0988A

Document No. U16513EE1V0AN00 (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 AD converter

The µPD78098x subseries has eight input channels for analog to digital conversion. The resolution of the conversion is 10 bits. Either a hardware or software trigger can start the analog to digital conversion. After a conversion is complete, an interrupt request is generated (INTAD0). In the case of a hardware-triggered start, the ADC will not start another conversion until the next hardware trigger. In the case of a software-triggered start, the ADC operates continuously until stopped by a software command.

(B) Program Description

This program uses the ADC (analog to digital converter) of the µPD78098x with a hardware-triggered start. Each trigger starts the conversion of analog input channel 0 (ANI0) to a 10-bit result in the ADCR0 register.

The analog voltage to be converted is input on Channel 0 (P10/ANI0). The conversion time is selected to be 14.3µs, with the start of conversion being triggered by a falling edge on port 0.3 (P03/ADTRIG). The program then polls the ADC interrupt flag (ADIF0) to determine when the conversion is complete. On completion, the 10-bit result can be found in the most significant ten bits of the ADCR0 register (the lower six bits of ADCR0 are fixed to 0).

(C) Program Specifications

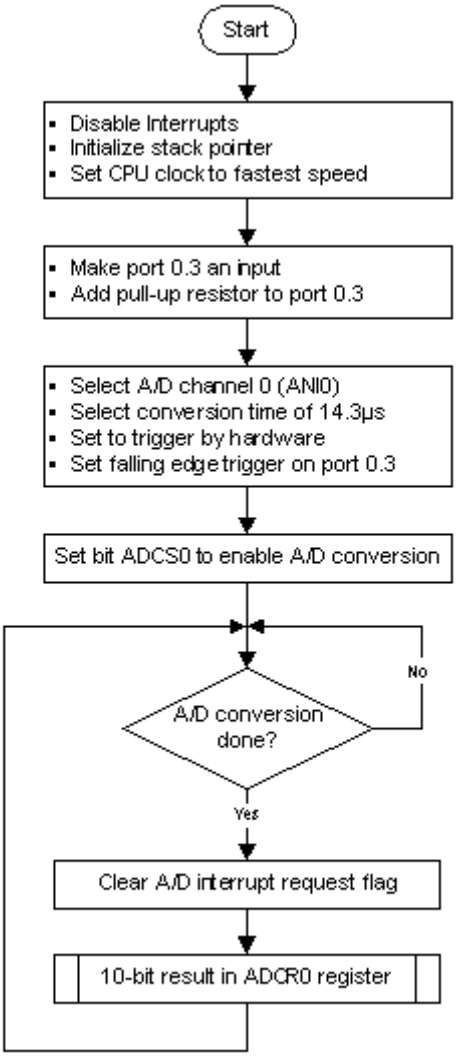
- ADC resolution: 10 bits
- ADC Start: hardware trigger (falling edge on port 0.3 (P03/ADTRIG))
- ADC stop: automatically after a conversion
- Conversion time: 14.3µs

(D) Used pins

- P0.3 (P03/ADTRIG) trigger input pulled high by internal pull-up resistor
- P1.0 (P10/ANI0) analog input to be converted

(E) Software Flow Chart

Flowchart - Main Program



(F) Software Listing

```
/*********************************************************************
; Date:             11/13/02
;
; Parameters:    - CPU clock (fx=8.3800MHz)
;                - A/D conversion time: 14.3us
;                - A/D resolution: 10 bits
;                - A/D start: falling edge on port 0.3 (P03/INTP3/ADTRG)
;                - A/D stop: automatic once a conversion is complete
;                - A/D channel: channel 0 (ANI0)
;                - A/D input pin: port 1.0 (P10/ANI0)
;*********************************************************************/

/*=====================================
; 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 */

PM0.3   = 1;                    /* Set port 0.3 to input mode */
PU0.3   = 1;                    /* Add pull-up resistor to port 0.3 */

ADS0    = 0x00;                 /* Select A/D channel 0 */
ADM0    = 0x4a;                 /* Set A/D converter mode register */
                                /*      Trigger by hardware */
                                /*      Falling edge detection */
                                /*      Conversion time = 14.3us */
ADCS0 = 1;                      /* Enable A/D conversions */

while(TRUE)                     /* main loop */
{
        while(!ADIF0)           /* Wait until conversion is complete */
        {
        _NOP();
        }
        ADIF0=0;                /* Clear A/D complete interrupt flag */
                                /* A/D conversion result in ADCR0 */
}                               /* Loop back to wait for next trigger */
}
/*********************************************************************/
```

[MEMO]

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