NEC

D/A Converter in Normal Output Mode

On-Chip Peripheral Program Example August 1999

Description

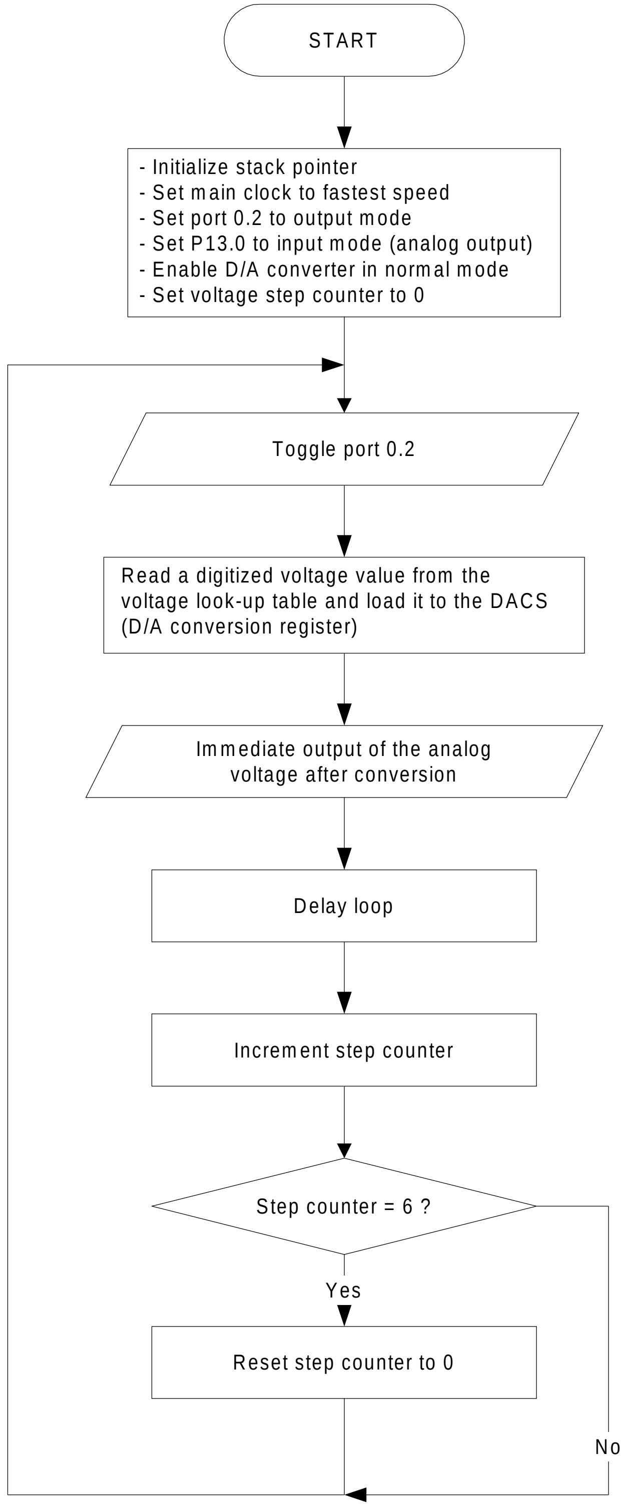
The 8-bit D/A converter in the µPD7805x/78005x subseries can be used in normal output mode or real-time output mode.

This program demonstrates the D/A converter in normal mode, where the conversion result is output immediately after the conversion is completed. The program outputs a voltage ladder with 0-, 1-, 2-, 3-, 4- and 5-volt steps. After reaching the 5-volt step, the program starts outputting from 0 volts again. Each step is 36 µs (Assembly program) or 170 µs (C program) long.

Program Specifications

- D/A converter channel 0 in normal output mode
- D/A output triggered after conversion is completed
- D/A outputs analog voltages from 0 to 5 volts in 1-volt steps
- Pins used in program:
  - P02/INTP2: toggles every time, a new analog voltage is output
  - ANO0/P130: outputs the analog voltage from D/A converter

Flowchart


START
- Initialize stack pointer
- Set main clock to fastest speed
- Set port 0.2 to output mode
- Set P13.0 to input mode (analog output)
- Enable D/A converter in normal mode
- Set voltage step counter to 0
Toggle port 0.2
Read a digitized voltage value from the voltage look-up table and load it to the DACS (D/A conversion register)
Immediate output of the analog voltage after conversion
Delay loop
Increment step counter
Step counter = 6 ?
Yes
Reset step counter to 0
No

Assembly Language Program

```
;**************************************************************************
; Date:       08/31/1999
;
; Parameters: - fastest CPU clock
;               (fx = 5 MHz; 1 CPU clock cycle = 200 ns)
;             - 8-bit D/A channel 0
;             - Normal output operation mode (Writing to DACS0 register)
;             - Output ladder voltage:         0 V, 1 V, 2 V, 3 V, 4 V, 5 V, 0 V…
;             - Output ladder frequency:       13.9 kHz (each step is 36 µs)
;             - Reference voltages:            5 V (must be attached to Vref1 pin)
;             - Port 0.2:                      Toggles before each conversion
;*************************************************************************

;========================================
;=      Digitized voltage values        =
;========================================

VoltageTable:      db 0 * 255 /Vref1           ; 0 volt
                   db 1 * 255 /Vref1           ; 1 volt
                   db 2 * 255 /Vref1           ; 2 volt
                   db 3 * 255 /Vref1           ; 3 volt
                   db 4 * 255 /Vref1           ; 4 volt
                   db 5 * 255 /Vref1           ; 5 volt

;========================================
;=      Constants/Variables             =
;========================================

Vref1              equu     5                  ; Reference voltage value
TableSize          equ      $ - VoltageTable

;========================================
;=      Data Segment                    =
;========================================

DATA     DSEG      saddr
StepCounter:       ds       1                  ; Voltage step counter

;========================================
;=      Specify Interrupt Vectors       =
;========================================

Res_Vec  CSEG AT 0000h                         ; Set main program start vector
         DW        Start

;========================================
;=      Main Program                    =
;========================================

MAIN     CSEG
Start:   DI                                    ; Disable interrupts
         MOVW      AX, #0FE20h                 ; Load SP address
         MOVW      SP, AX                      ; Set stack pointer
         MOV       OSMS,#01h                   ; Don't use scaler
         MOV       PCC, #00h                   ; Main system clock at fastest setting
         CLR1     P0.2                         ; Latch port 0.2 to low
         CLR1     PM0.2                        ; Set port 0.2 to output mode
         CLR1     P13.1                        ; Latch port 13.1 to low
         CLR1     PM13.1                       ; Set port 13.1 to output
         SET1     PM13.0                       ; Set port 13.0 to input mode
                                               ;  (analog output)
         MOV      DAM,#01H                     ; Enable D/A conversion in normal mode
         MOV      StepCounter,#0               ; Set voltage output step counter to 0

Loop:    XOR      P0, #04h                     ; Toggle port 0.2
         MOV      A,StepCounter                ; Load step counter value to C register
         MOV      C,A
         MOVW     HL,#VoltageTable             ; Load look-up table start address
         MOV      A,[HL+C]                     ; Read digital value of the voltage
         MOV      DACS0,A                      ;  and write value to DACS0 register
         MOV      B, #10h                      ; Load 16d in loop counter
DELAY:   NOP                                   ; Delay sets the step width in µs
         DBNZ     B,$DELAY                     ; Branch back, if B is not 0
         INC      StepCounter                  ; Increment step counter
         CMP      StepCounter,#TableSize       ; Compare step counter with size of table
         BNZ      $Loop                        ; Branch back if step counter is not 4
         MOV      StepCounter,#0               ; Clear step counter
         BR       Loop                         ; Branch back
         END
```

C Language Program

```
/***************************************************************************
; Date:       08/31/1999
;
; Parameters: - fastest CPU clock
;               (fx = 5 MHz; 1 CPU clock cycle = 200 ns)
;             - 8-bit D/A channel 0
;             - Normal output operation mode (Writing to DACS0 register)
;             - Output ladder voltage:         0 V, 1 V, 2 V, 3 V, 4 V, 5 V, 0 V…
;             - Output ladder frequency:       2.9 kHz (each step is 170 µs)
;             - Reference voltages:            5 V (must be attached to Vref1 pin)
;             - Port 0.2:                      Toggles before each conversion
;************************************************************************/
/* extension functions in K0/K0S compiler */
#pragma sfr        /* key word to allow SFR names in C code */
#pragma asm        /* key word to allow ASM statements in C code */
#pragma NOP        /* key word for NOP instruction in C code */

/*======================================
;=      Constants/Variables            =
;=====================================*/
#define TRUE       1
#define FALSE      0
#define Vref1      5                           /* Reference voltage value */
#define Volts(n)   255 * n / Vref1
const unsigned char VoltageTable[] =
{
         Volts(0),                             /* 0 Volt */
         Volts(1),                             /* 1 Volt */
         Volts(2),                             /* 2 Volt */
         Volts(3),                             /* 3 Volt */
         Volts(4),                             /* 4 Volt */
         Volts(5)                              /* 5 Volt */
};
unsigned char StepCounter;                     /* Voltage output step counter */
unsigned char I;                               /* Variable for delay loop */

/*=======================================
;=      Main Program                    =
;======================================*/
void main(void)
{
         OSMS = 0x01;                 /* Don't use scaler */
         PCC = 0x00;                  /* Main system clock at fastest setting */
         P0.2 = 0;                    /* Latch port 0.2 low */
         PM0.2 = 0;                   /* Set port 0.2 to output mode */
         P13.1  = 0;                  /* Latch  port 13.1 to low */
         PM13.1 = 0;                  /* Set port 13.1 to output mode */
         PM13.0 = 1;                  /* Set port 13.0 to input mode (analog output) */
         DAM = 0x01;                  /* Enable D/A conversion in normal mode */
         StepCounter = 0;             /* Set voltage output step counter to 0 */
         while(TRUE)                                        /* Loop here */
         {
            P0 ^= 0x04;                                     /* Toggle port 0.2 */
            DACS0 = VoltageTable[StepCounter];              /* Output current step */
            for(i=1; i<20; i++);                            /* Delay loop for conversion
```

```
    time */
            StepCounter++;                             /* increment step counter */
            if(StepCounter == sizeof VoltageTable )    /* Test step counter */
                StepCounter = 0;                       /* clear step counter */
         }                                             /* end of while(TRUE) loop */
}                                                      /* end of function main() */
```

For literature, call **1-800-366-9782** 7 a.m. to 6 p.m. Pacific time
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