NEC

Halt Mode
Using the Subsystem Clock

On-Chip Peripheral Program Example August 1999

Description

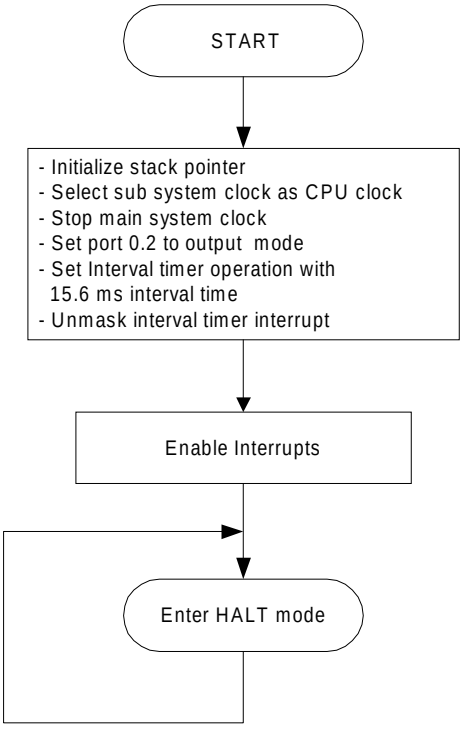
Halt mode is one of the standby functions on the 7805x/78005x subseries and is used to reduce CPU power consumption. The execution of the HALT instruction sets the HALT mode. The HALT mode stops the CPU operation clock, however, system clock oscillator continues. The HALT mode is exited upon any interrupt request. If interrupt handling is enabled (EI), the wake up starts executing the code in the ISR. In case interrupt handling is disabled (DI), the next instruction after the HALT instruction is executed.

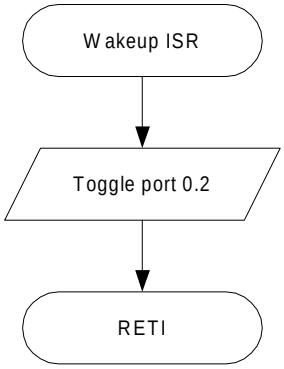
In this program, the interval timer (part of the watch timer) generates an interrupt every 15.6 ms. This interrupt wakes up the microcontroller and toggles a port in the interrupt service routine (ISR). After returning from the ISR, the micro enters the HALT mode again.

Program Specifications

- CPU runs from sub system clock (fx = 32.768 kHz)
- CPU wakes-up every 15.6 ms for toggling a port pin
- Pins used in program: P02/INTP2 (toggles every 15.6 ms)

Flowchart


START
- Initialize stack pointer
- Select sub system clock as CPU clock
- Stop main system clock
- Set port 0.2 to output mode
- Set Interval timer operation with
15.6 ms interval time
- Unmask interval timer interrupt
Enable Interrupts
Enter HALT mode


Wakeup ISR
Toggle port 0.2
RETI

Assembly Language Program

```
;*****************************************************************************
; Date:       08/24/1999
;
; Parameters: - CPU clock is subsystem clock,
;               (fx = 32.768 kHz, 1 CPU clock cycle = 61.04 µs)
;             - Interval timer clock source:   subsystem clock (32.768 kHz)
;             - Interval time:                 15.6 ms
;             - Port 0.2 toggles each time after wakeup (15.6 ms)
;*****************************************************************************

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

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

         ORG      001Eh
         DW       INTER_ISR         ; Interval timer interrupt vector

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

MAIN     CSEG
Start:   DI                         ; Disable interrupts
         MOVW     AX, #0FE20h       ; Load SP address
         MOVW     SP, AX            ; Set Stack Pointer
         MOV      PCC, #30h         ; Use sub system clock as CPU clock
         SET1     MCC               ; Stop main system clock
         CLR1     P0.2              ; Latch port 0.2 low
         CLR1     PM0.2             ; Set port 0.2 to output mode
         MOV      TCL2,#10h         ; Select counter clock to fxt = 32.768 kHz
         MOV      TMC2,#56h         ; Set TMC2 register to:
                                    ;  - Interval timer operation enable
                                    ;  - 15.6 ms interval time
         CLR1     TMMK3             ; Unmask the interval timer interrupt
         EI                         ; Enable interrupts

Loop:    NOP
         HALT                       ; Enter sub-Halt mode (standby mode)
         NOP
         BR       Loop              ; Branch back

;=======================================
;       Watch timer ISR               =
;=======================================

         INTER_ISR:
         XOR               P0,#04h  ; Toggle port 0.2 to indicate system wakeup
         RETI

         END
```

C Language Program

```
/************************************************************************
; Date:       08/24/1999
;
; Parameters: - CPU clock is subsystem clock,
;               (fx = 32.768 kHz, 1 CPU clock cycle = 61.04 µs)
;             - Interval timer clock source:   subsystem clock (32.768 kHz)
;             - Interval time:                 15.6 ms
;             - Port 0.2 toggles each time after wakeup (15.6 ms)
;************************************************************************

/* 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 HALT       /* key word for HALT instruction in C code */
#pragma NOP        /* key word for NOP instruction in C code */
#pragma DI         /* key word for DI instruction in C code */
#pragma EI         /* key word for EI instruction in C code */

/*;=====================================
;       Specify Interrupt vectors       =
;=====================================*/

/* Set interrupt vector for interval timer */

#pragma interrupt INTTM3 INTER_ISR

/*=====================================
;       Main Program                    =
;=====================================*/
void main(void)
{         DI();                       /* Disable interrupts */
          PCC = 0x30;                 /* Use sub system clock as CPU clock */
          MCC = 1;                    /* Stop main system clock
          P0.2 = 0;                   /* Latch port 0.2 to low */
          PM0.2 = 0;                  /* Set port 0.2 to output mode */
          TCL2 = 0x10;                /* Select counter clock to 32.768 kHz */
          TMC2 = 0x56;                /* Set TMC2 register to:
                                         - Interval timer operation enable
                                         - 15.6 ms interval time */
          TMMK3= 0;                   /* Unmask the interval timer interrupt */
          EI();                       /* Enable interrupts */
          while(1)
          {
                   NOP();
                   HALT();            /* Enter sub HALT mode (standby mode) */
                   NOP();
          }                           /* end of while loop */
}                                     /* end of function main() */
/*=====================================
;=       Interval timer ISR             =
;=====================================*/
void INTER_ISR(void)
{         P0 ^= 0x04;                 /* Toggle port 0.2 to indicate system wakeup */
}
```

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