

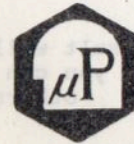


Micro-Professor Application Note

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MPF-I AS A FREQUENCY COUNTER

An Application Example of Z80-CTC.



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Purpose: Use CTC to design a frequency counter

Required Equipment: MPF-1 (included CTC)

Experiment Explanation:

1. CTC has four channels CH0 - CH3 is mapping to 40H,41H, 42H,43H. In this program, we use CH0 & CH1. The function is shown below.

CH1: used for timer interrupt, triggered by the internal clock of MPF-1 (1789772 Hz), we set CH0 to

Mode: timer

Range: 256

Time constant: 233 (0E9H)

So after interrupt 30 (01EH) times. It will be approximately 1 sec, $256 * 233 * 30 = 0FFH * 0E9H * 01EH = 1789440$. It has error $(1789772 - 1789440) / 1789772 = 0.00185\%$

CH0: used for counter interrupt, triggered by user signal

Mode: counter

And set 'down counter'=100. Each time interrupts happen, we can add frequency counter by 1. We can get signal frequency when one sec is up.

2. LED display is in decimal format (six digit). So the largest value is 999999. When frequency is over this it will get some warning message, eg., display 'over' message, and tone 2K
3. Special care should be exerted when using the CTC. To avoid burning out the CTC, you should first refer to the Z80 Handbook, Z80-CTC Technical Manual, section 8.1 D.C. Characteristics. User signal used to trigger the CTC should comply with the following characteristics:

INPUT LOW VOLTAGE: -0.3V -- 0.8V

INPUT HIGH VOLTAGE: 2.0V -- Vcc.

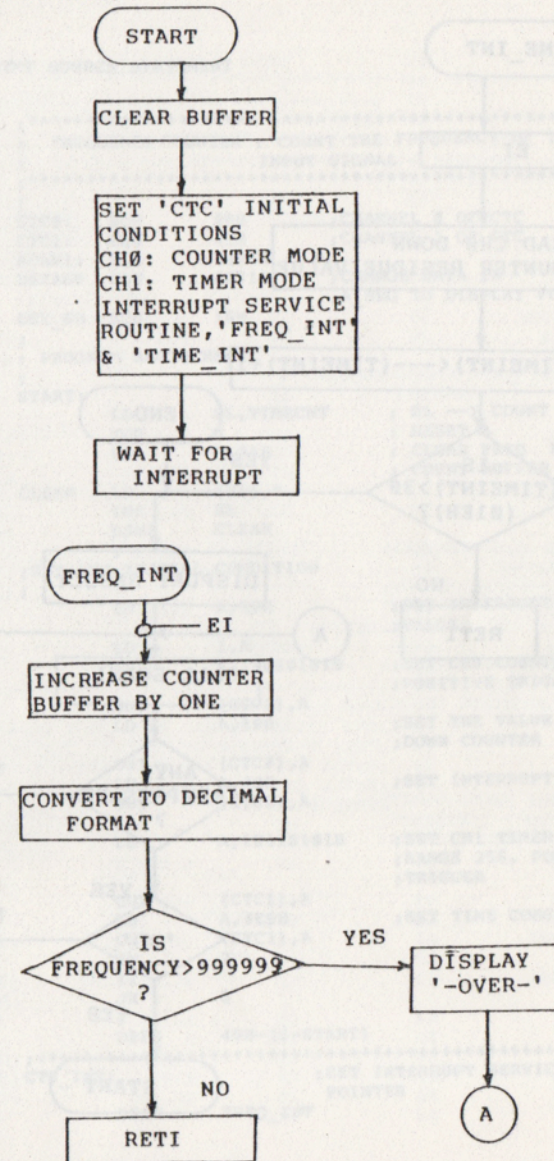
OUTPUT LOW VOLTAGE: 0.4V

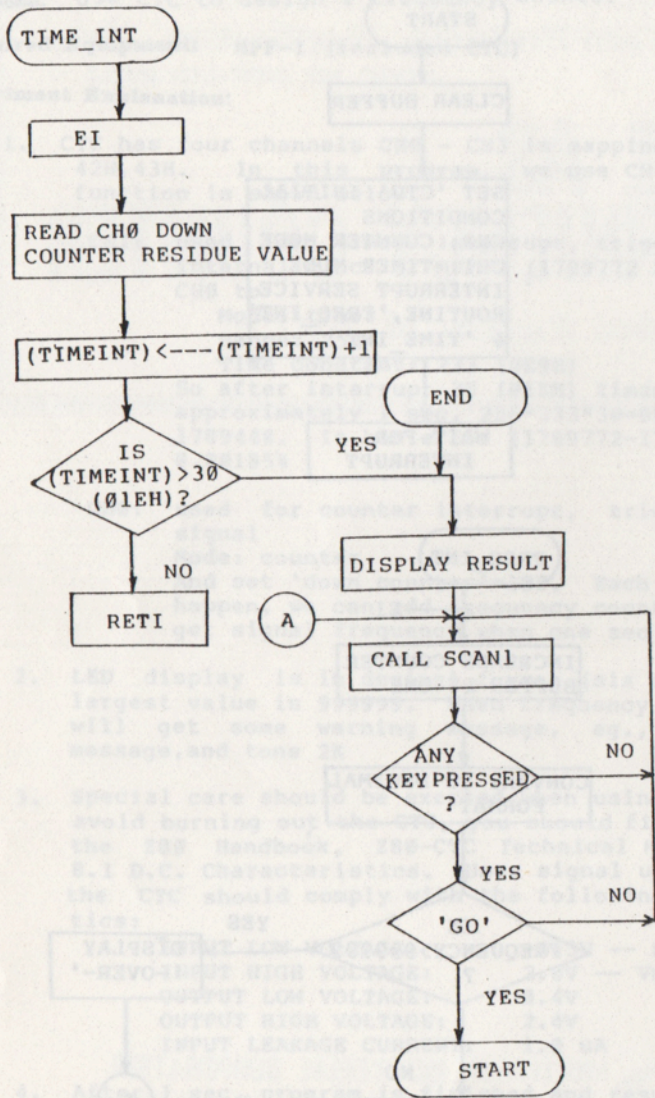
OUTPUT HIGH VOLTAGE: 2.4V

INPUT LEAKAGE CURRENT: 1.0 uA

4. After 1 sec, program is finished and result will display at LED. If user want to count again, you can pressed key 'GO' then it will count again. Othersize, it will continue to display data.

Flowchart:





LOC OBJ CODE M STMT SOURCE STATEMENT

```

1 ;*****
2 ; FREQUENCY COUNTER : COUNT THE FREQUENCY OF THE*
3 ; INPUT SIGNAL *
4 ;*****
5 ;
6 CTC0: EQU 40H ;CHANNEL 0 OF CTC
7 CTC1: EQU 41H ;CHANNEL 1 OF CTC
8 SCAN1: EQU 0624H
9 DATADP EQU 0671H ;CHANGE DATA IN
;A_REG TO DISPLAY FORMAT
10 DEY_GO EQU 16H
11 ;
12 ; PROGRAM BEGIN HERE!
13 ;
14 START:
15 LD HL,TIMECNT ; HL --> COUNT BUFFER
16 XOR A ; RESET A
17 LD B,0AH ; CLEAR FREQ & TIMER
; COUNT BUFFER
18 CLEAR LD (HL),A
19 INC HL
20 DJNZ CLEAR
21 ;
22 ;SET CTC INITIAL CONDITION
23 ;
24 LD A,20H ;SET INTERRUPT REGISTER
;VALUE
25 LD I,A
26 LD A,11010101B ;SET CH0 COUNTER MODE,
;POSITIVE TRIGGER
27 OUT (CTC0),A
28 LD A,100 ;SET THE VALUE OF
;DOWN COUNTER
29 OUT (CTC0),A
30 LD A,40H ;SET INTERRUPT VECTOR
31 OUT (CTC0),A
32 ;
33 LD A,10110101B ;SET CH1 TIMER CODE,
;RANGE 256, POSITIVE
;TRIGGER
34 OUT (CTC1),A
35 LD A,0E9H ;SET TIME CONSTANT
36 OUT (CTC1),A
37 IM 2
38 EI
39 JR $
40 ;
41 DEFS 40H-($-START)
42 ;*****
43 CTC_INT: ;SET INTERRUPT SERVICE ROUTINE
; POINTER
44 DEFW FREQ_INT
1800 21A500
1803 AF
1804 060A
1806 77
1807 23
1808 10FC
180A 3E20
180C ED47
180E 3ED5
1810 D340
1812 3E64
1814 D340
1816 3E40
1818 D340
181A 3EB5
181C D341
181E 3EE9
1820 D341
1822 ED5E
1824 FB
1825 18FE
1827
1840 4400
  
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1842 5D00      45      DEFW      TIME_INT
      46      ;
      47      ;+++++
      48      FREQ_INT:
      49      ;FREQUENCY COUNTER INTERRUPT SERVICE ROUTINE
      50      ;INCREASE COUNTER AND CONVERT TO DECIMAL FORMAT
      51      ;
1844  FB      52      EI              ;WHEN CPU ENTER THIS INTERRUPT
      53      ;SERVICE
      54      ;ROUTINE, IT WILL DISABLE
      55      ;ANOTHER INTERRUPT
      56      ;SO "EI" CAN LET COUNT_INT
      57      ;HAPPEN
1845  21A700   55      LD          HL,FREQCNT+1
1848  0602      56      LD          B,2          ;SET FREQUENCY BUFFER
      57      ADDONE:
      58      EI
      59      LD          A,(HL)
      60      ADD          A,1          ;INCREASE COUNT BY ONE
      61      DAA          ;CHANGE TO DECIMAL FORMAT
      62      LD          (HL),A       ;RESTORE VALUE
      63      JR          NC,NOTOVER   ;NOT OVER 99
      64      INC          HL          ;OVER,MUST INCREASE HIGH
      65      ;ORDER BUE ONE
1853  10F5      65      DJNZ      ADDONE
1855  DD21AF00  66      LD          IX,OVER        ;FREQUENCY LARGER THEN
      67      ;999999 DISPLAY '-OVER-'
1859  183B      67      JR          DISPLAY
185B  ED4D      68      NOTOVER:
      69      RETI
      70      ;
      71      ;+++++
      72      TIME_INT:
      73      ;CH1 (TIMER MODE) INTERRUPT SERVICE ROUTINE
      74      ;CH1: TRIGGERED BY 'MPF-1' CLOCK(1789772HZ)
      75      ;EVERY 256*233 HZ, THIS SERVICE ROUTINE WILL DO AGAIN
      76      ;UNTIL 30 TIMES (--1 SEC),PROGRAM HALT AND SIGNAL
      77      ;FREQUENCY GET
185D  FB      77      EI              ;LET ANOTHER INTERRUPT
      78      ;CAN HAPPEN ANYTIME
      79      ;GET CH0 GOWN COUNTER
      80      ;RESIDUE VALUE
185E  DB40      78      IN          A,(CTC0)
1860  D664      79      SUB          100
1862  ED44      80      NEG
1864  32A600   81      LD          (FREQCNT),A     ;SAVE THIS TO BUFFER
      82      ;
1867  21A500   83      LD          HL,TIMECNT      ;INCREASE TIME COUNTER BY
      84      ;ONE
186A  7E      84      LD          A,(HL)
186B  3C      85      INC          A
186C  77      86      LD          (HL),A       ;RESTORE VALUE
186D  FE1E     87      CP          01EH          ;CHECK ONE SEC ?
186F  3002     88      JR          NC,END        ;YES
1871  ED4D     89      RETI

```

```

90
91 ;*****
92 END:
93 DI
94 LD          B,2          ;CHANGE LOWER BYTE
      ;OF FREQUENCY COUNTER
      ;TO DECIMAL FORMAT
1873  F3
1874  0602
1876  AF      95      XOR          A
1877  21A600  96      LD          HL,FREQCNT
187A  ED67   97      CHANGE: RRD
187C  CE00   98      ADC          A,0
187E  27     99      DAA
187F  10F9   100     DJNZ      CHANGE
1881  ED67   101     RRD
      102     ;
1883  0603   103     LD          B,3
1885  11A600 104     LD          DE,FREQCNT    ;CHANGE FREQ TO DISPLAY
      105     ;PATTERN
1888  21A900 106     LD          HL,OUTBUF
      107     CONVERT:
      108     LD          A,(DE)
      109     INC          DE
      110     CALL      DATADP+3
      111     DJNZ      CONVERT
1892  DD21A900 112     LD          IX,OUTBUF    ;DISPLAY DATA TO LED
1896  CD2406  113     DISPLAY:CALL SCAN1
1899  38FB    114     JR          C,DISPLAY    ;NO KEY PRESSED,SCAN
      115     ;AGAIN
189B  FE16   115     CP          KEY_GO
189D  20F7   116     JR          NZ,DISPLAY   ;PRESSED 'GO' ?
189F  210000 117     LD          HL,START     ;NO
      118     ;RETURN TO PROGRAM
      119     ;STRTING ADDR. &
      120     ;COUNT FREQUENCY AGAIN
18A2  E3      118     EX          (SP),HL
18A3  ED4D   119     RETI
      120     ;
      121     ;
18A5  122     TIMECNT DEFS 1
18A6  123     FREQCNT DEFS 3
18A9  124     OUTBUF  DEFS 6
      125     OVER:
18AF  02     DEFB  02H ; '-'
18B0  03     DEFB  03H ; 'R'
18B1  0F     DEFB  08FH ; 'E'
18B2  B7     DEFB  0B7H ; 'V'
18B3  A3     DEFB  0A3H ; 'O'
18B4  02     DEFB  02H ; '-'

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