The 8051 Microcontroller and Embedded Systems

8051 TIMER PROGRAMMING IN ASSEMBLY

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PROGRAMMING 8051 TIMERS

Finding values to be loaded into the timer

XTAL = 11.0592 MHz (12MHz)

divide the desired time delay by 1.085ms (1ms) to get n

65536 – n = N

convert N to hex yyxx

set TL = xx and TH = yy

Assuming XTAL = 11.0592 MHz, write a program to generate a square wave of 50 Hz frequency on pin P2.3.

- T = 1/50 Hz = 20 ms
- 1/2 of it for the high and low portions of the pulse = 10 ms
- 10 ms / 1.085 us = 9216
- 65536 - 9216 = 56320 in decimal = DC00H
- TL = 00 and TH = DCH
- The calculation for 12MHz crystal uses the same steps

Assuming XTAL = 11.0592 MHz, write a program to generate a square wave of 50 Hz frequency on pin P2.3.

```
01  MOV TMOD,#10H              ;Timer 1 mode 1 (16-bit)
02  AGAIN: MOV TL1,#00         ;TL1 = 00, Low byte
03  MOV TH1,#0DCH              ;TH1 = 0DCH, High byte
04
05  SETB TR1                   ;start Timer 1
06  BACK: JNB TF1,BACK         ;stay until timer rolls over
07  CLR TR1                    ;stop Timer 1
08  CPL P2.3                   ;compliment P2.3 to get hi, lo
09  CLR TF1                    ;clear Timer 1 flag
10  SJMP AGAIN                 ;reload timer since
11                             ;mode 1 is not auto reload
12
13  END
```

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Generating a large time delay

size of the time delay depends

crystal frequency

timer's 16-bit register in mode 1

largest time delay is achieved by making both TH and TL zero

what if that is not enough?

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Using Windows calculator to find TH, TL

Windows scientific calculator can be use to find the TH, TL values

Lets say we would like to find the TH, TL values for a time delay that uses 35,000 clocks of 1.085ms

1. **open scientific calculator and select decimal**
2. **enter 35,000**
3. **select hex - converts 35,000 to hex 88B8H**
4. **select +/- to give -35000 decimal (7748H)**
5. **the lowest two digits (48) of this hex value are for TL and the next two (77) are for TH**

Examine the following program and find the time delay in seconds. Exclude the time delay due to the instructions in the loop.

```
01 MOV TMOD,#10H              ;Timer 1, mode 1(16-bit)
02 MOV R3,#200                ;counter for multiple delay
03
04 AGAIN: MOV TL1,#08H        ;TL1 = 08, Low byte
05 MOV TH1,#01H               ;TH1 = 01, High byte
06 SETB TR1                   ;start Timer 1
07 BACK: JNB TF1,BACK         ;stay until timer rolls over
08 CLR TR1                    ;stop Timer 1
09 CLR TF1                    ;clear Timer 1 flag
10 DJNZ R3,AGAIN              ;if R3 not zero then
11                            ;reload timer
12 END
13
14 ;TH-TL=0108H=264 in decimal
15 ;65536-264=65272
16 ;65272x1.085us=70.820ms
17 ;200x70.820ms=14.164024s
18
```

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Mode 0

works like mode 1

13-bit timer instead of 16-bit

13-bit counter hold values 0000 to 1FFFH

when the timer reaches its maximum of 1FFFH, it rolls over to 0000, and TF is set

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Mode 2 programming

8-bit timer, allows values of 00 to FFH
TH is loaded with the 8-bit value
a copy is given to TL
timer is started by ,"SETB TR0" or "SETB TR1“
starts to count up by incrementing the TL register
counts up until it reaches its limit of FFH
when it rolls over from FFH to 00, it sets high TF
TL is reloaded automatically with the value in TH
To repeat, clear TF
mode 2 is an auto-reload mode

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Steps to program in mode 2

1. **load TMOD, select mode 2**
2. **load the TH**
3. **start timer**
4. **monitor the timer flag (TF) with "JNB”**
5. **get out of the loop when TF=1**
6. **clear TF**
7. **go back to Step 4 since mode 2 is auto-reload**

Assuming that XTAL = 11.0592 MHz, find (a) the frequency of the square wave generated on pin P1.0 and (b) the smallest frequency achievable in this program, and the TH value to do that.

```
01  MOV TMOD,#20H          ;T1/mode 2/8-bit/auto-reload
02  MOV TH1,#5             ;TH1 = 5
03  SETB TR1               ;start Timer 1
04  BACK: JNB TF1,BACK     ;stay until timer rolls
05  CPL P1.0               ;comp. P1.0 to get hi, lo
06  CLR TF1                ;clear Timer 1 flag
07  SJMP BACK              ;mode 2 is auto-reload
08
09  END
10
11  ;(a)T = 2 x 272.33 gs = 544.67 us and the frequency = 1.83597 kHz
12  ;(b)smallest frequency, T = 00, T = 2 x 256 x 1.085 us = 555.52 us
13  ;   frequency = 1.8 kHz
```

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Assemblers and negative values

can let the assembler calculate the value for TH and TL which makes the job easier

"MOV TH1, # -100", the assembler will calculate the -100 = 9CH

"MOV TH1,#high(-10000) "

"MOV TL1,#low(-10000) "