



8051 實習

Lab5 Timer

- 8051的Timer一共有兩組:Timer0, Timer1
- Timer能夠提供計時(timer)和計數(counter)功能
- 作計時器用時，Timer以8051內部的震盪器為基準，**Timer 暫存器**內的值每隔1個Machine cycle往上加1
- Timer 暫存器內的值往上加到**溢位(Overflow)**後產生事件
- 作計數器用的時候，由外部輸入的訊號為基準增加**Timer Register**

- Timer相關的暫存器一共有三種：
 - Timer Register
 - TMOD
 - TCON
- Timer Register依Timer0 和Timer1 各自設有Timer0 register 和Timer1 Register
- Timer Register是由兩個8位元暫存器組合而成
- 以Timer0為例：

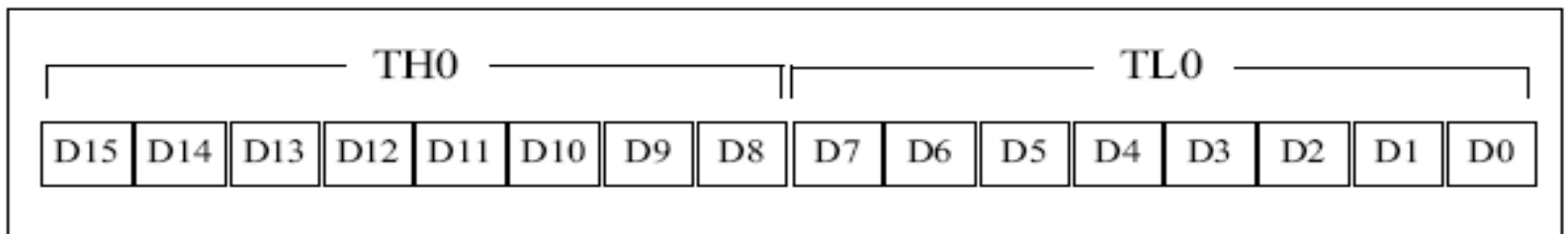
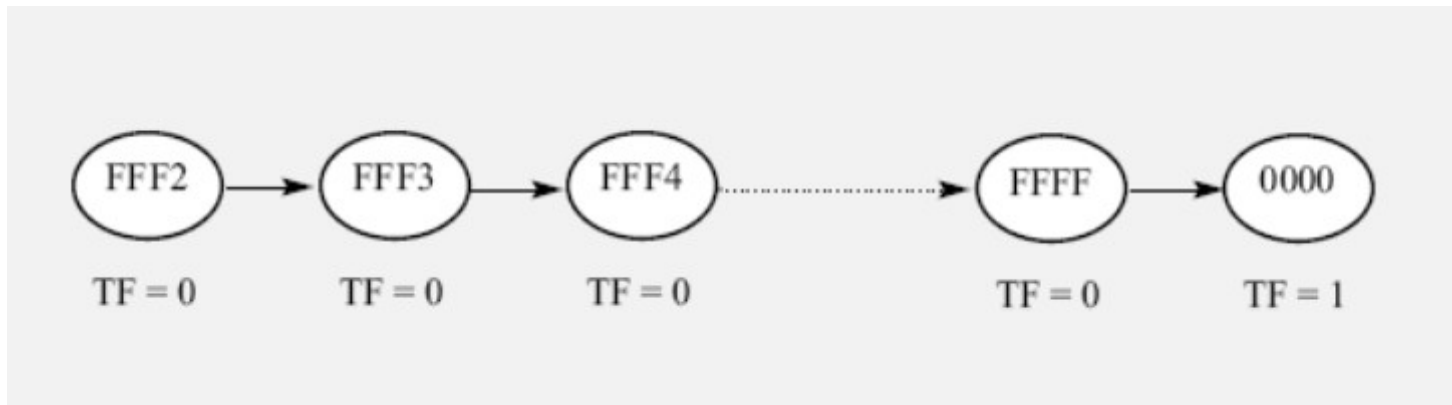


Figure 9-1. Timer 0 Registers

- Timer Register的值在TR0設值為1時，即開始上數，數到溢位(FFFF→0000)時，TF0即升起為1



- TMOD是一個8-bit暫存器，我們可以將8bits一分為二
- 高位(High nibble)的4bits用來設定Timer1, 低位(Low nibble)的4bits用來設定Timer0

(MSB)							(LSB)
GATE	C/T	M1	M0	GATE	C/T	M1	M0
Timer 1				Timer 0			

➤ 我們將M1, M0 2bits看作一個值，成為一個0~3的選項

- 模式0用作一個13-bit的計時器，即由0000~FF1F(0000 0000 ---0 0000)
- 模式1用作一個**16-bit**的計時器，由0000~FFFF(0000 0000 0000 0000)
- 模式2用作一個8-bit的Auto-reload計時
- 模式3作為分拆計時器用

<u>M0</u>	<u>Mode</u>	<u>Operating Mode</u>
0	0	13-bit timer mode 8-bit timer/counter THx with TLx as 5-bit prescaler
1	1	16-bit timer mode 16-bit timer/counters THx and TLx are cascaded; there is no prescaler
0	2	8-bit auto reload 8-bit auto reload timer/counter; THx holds a value that is to be reloaded into TLx each time it overflows.
1	3	Split timer mode

- TCON是一個8-bit bit addressable暫存器
- 同樣可以分拆為高低4-bit
- 高位4bits用作Timer控制
- 低位4bits用於interrupt功能的設定

TCON: Timer/Counter Control Register



The upper four bits are used to store the TF and TR bits of both timer 0 and 1

The lower 4 bits are set aside for controlling the interrupt bits

- TR1, TR0 即為前述用作啟動Timer計時的位元
- TF1, TF0 即為前述用來表示Timer暫存器溢位的旗標(Flag)
- TF1, TF0 不會自動清除

TCON: Timer/Counter Control Register

TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0
-----	-----	-----	-----	-----	-----	-----	-----

The upper four bits are used to store the TF and TR bits of both timer 0 and 1

The lower 4 bits are set aside for controlling the interrupt bits

➤ 範例1:

- 在P1.5產生一個50% Duty cycle的方波
- 需要的時間間隔以Timer0產生

Example 9-4

In the following program, we are creating a square wave of 50% duty cycle (with equal portions high and low) on the P1.5 bit. Timer 0 is used to generate the time delay. Analyze the program.

```

                MOV     TMOD,#01           ;Timer 0, mode 1(16-bit mode)
HERE:          MOV     TL0,#0F2H          ;TL0 = F2H, the Low byte
                MOV     TH0,#0FFH         ;TH0 = FFH, the High byte
                CPL     P1.5              ;toggle P1.5
                ACALL  DELAY
                SJMP   HERE                ;load TH, TL again
;-----delay using Timer 0
DELAY:
                SETB   TR0                 ;start Timer 0
AGAIN:         JNB    TF0,AGAIN           ;monitor Timer 0 flag until
                ;it rolls over
                CLR    TR0                 ;stop Timer 0
                CLR    TF0                 ;clear Timer 0 flag
                RET
```

➤ 範例1:

- 在Peripherals打開Timer0 視窗和I/O Port1 視窗
- 觀察程式執行時，Timer0視窗和I/O port1 視窗的變化

The screenshot displays the Keil uVision4 IDE interface with two windows open: 'Timer/Counter 0' and 'Parallel Port 1'. The 'Timer/Counter 0' window is configured with Mode '1: 16 Bit Timer/Counter', TCON: 0x10, TMOD: 0x01, TH0: 0xFF, TL0: 0xA5, and Control options checked for T0 Pin, TR0, and INT0#. The 'Parallel Port 1' window shows Port 1 pins configured with P1: 0xDF and Pins: 0xDF. The background shows the assembly code for 'lab5_001.a51*' with the 'AGAIN:' label highlighted.

```
01 ;-----EXAMPLE 9-4-----
02 ;
03 ;
04 ;
05 ;
06 ;
07 ;
08 ;
09 ;
10 ;-----Delay using Timer 0-----
11 DELAY:
12 SETB TR0
13 AGAIN: JNB TFO, AGAIN
14
15 CLR TR0
16 CLR TFO
```


➤ 實作:

- 設定石英震盪器時脈為11.0592MHz
- 以Timer0產生一個10秒Delay
- Hint: $10sec/1.085\mu sec \cong 9.22 \times 10^6$

