SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Coimbatore-35

DEPARTMENT OF BIOMEDICAL ENGINEERING

8051 timer

III Year/ VI Sem

Dr. K. Manoharan,
ASP / BME / SNSCT

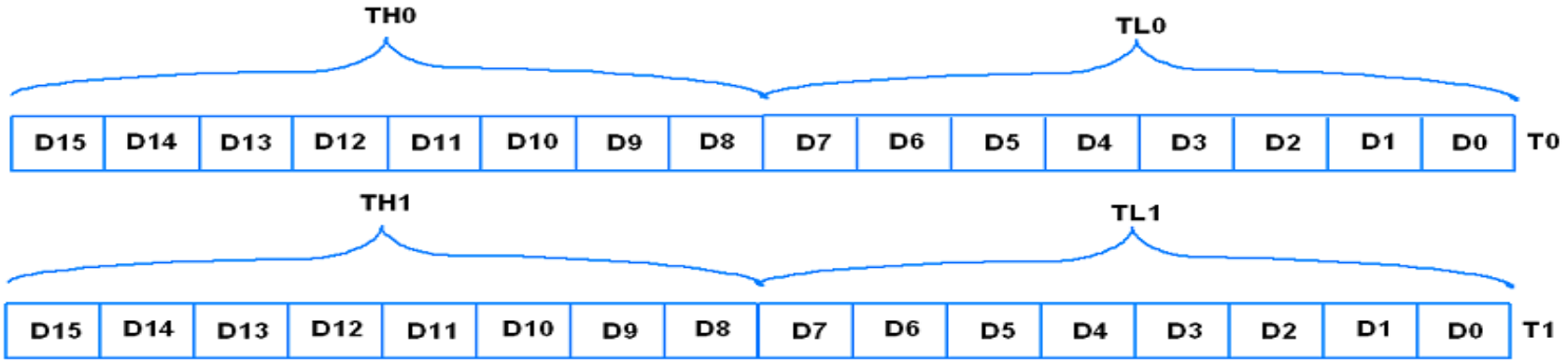
8051 timer

- Every Timer needs a clock to work, and 8051 provides it from an external crystal which is the main clock source for Timer.

- The internal circuitry in the 8051 microcontrollers provides a clock source to the timers which is 1/12th of the frequency of crystal attached to the microcontroller, also called Machine cycle frequency.

8051 timer

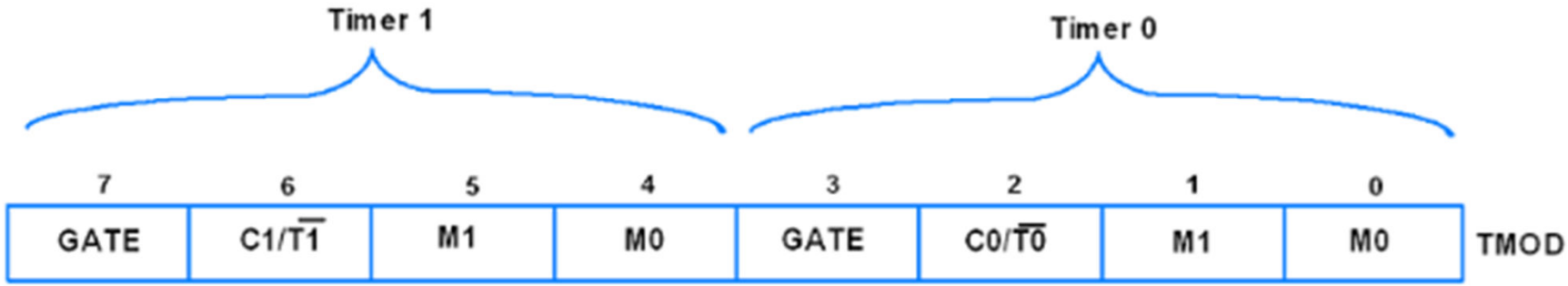
- 8051 has two timers Timer0 (T0) and Timer1 (T1), both are 16-bit wide. Since 8051 has 8-bit architecture, each of these is accessed by two separate 8-bit registers as shown in the figure below. These registers are used to load timer count.



TMOD

TMOD register

TMOD is an 8-bit register used to set timer mode of timer0 and timer1.



Its lower 4 bits are used for Timer0 and the upper 4 bits are used for Timer1

TMOD

M1	M0	Mode	Operation
0	0	0 (13-bit timer mode)	13-bit timer/counter, 8-bit of THx & 5-bit of TLx
0	1	1 (16-bit timer mode)	16-bit timer/counter, THx cascaded with TLx
1	0	2 (8-bit auto-reload mode)	8-bit timer/counter (auto-reload mode), TLx reload with the value held by THx each time TLx overflow
1	1	3 (split timer mode)	Split the 16-bit timer into two 8-bit timers i.e. THx and TLx like two 8-bit timer

TCON

TCON : Timer/Counter Control Register (Bit Addressable)

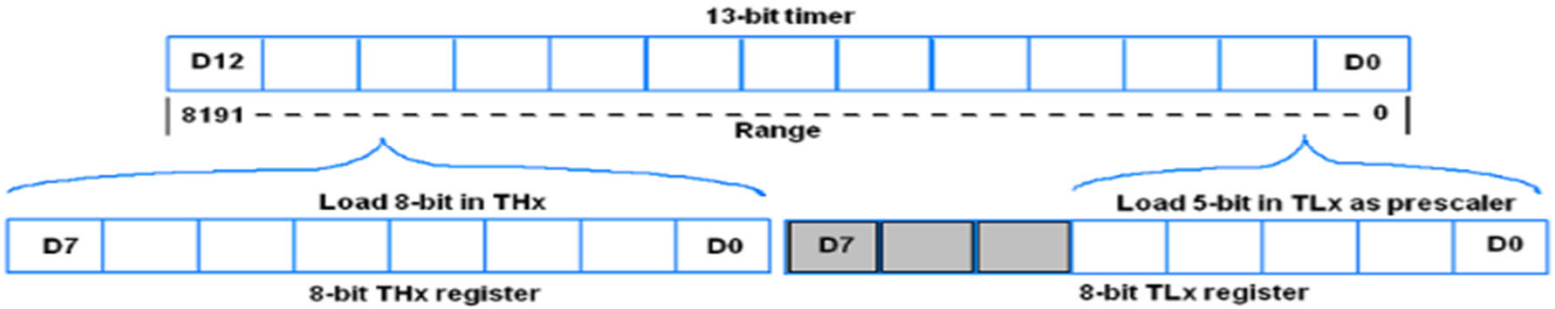
TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0

TF1	TCON.7	Timer 1 overflow flag. Set by hardware when the Timer/Counter 1 overflows. Cleared by hardware as processor vectors to the interrupt service routine.
TR1	TCON.6	Timer 1 run control bit. Set/cleared by software to turn Timer/Counter ON/OFF.
TF0	TCON.5	Timer 0 overflow flag. Set by hardware when the Timer/Counter 0 overflows. Cleared by hardware as processor vectors to the service routine.
TR0	TCON.4	Timer 0 run control bit. Set/cleared by software to turn Timer/Counter 0 ON/OFF.
IE1	TCON.3	External Interrupt 1 edge flag. Set by hardware when External interrupt edge is detected. Cleared by hardware when interrupt is processed.
IT1	TCON.2	Interrupt 1 type control bit. Set/cleared by software to specify falling edge/flow level triggered External Interrupt.
IE0	TCON.1	External Interrupt 0 edge flag. Set by hardware when External Interrupt edge detected. Cleared by hardware when interrupt is processed.
IT0	TCON.0	Interrupt 0 type control bit. Set/cleared by software to specify falling edge/low level triggered External Interrupt.

Timer Mode 0

Mode 0 (13-bit timer mode)

Mode 0 is a 13-bit timer mode for which 8-bit of THx and 5-bit of TLx (as Prescaler) are used. It is mostly used for interfacing possible with old MCS-48 family microcontrollers.

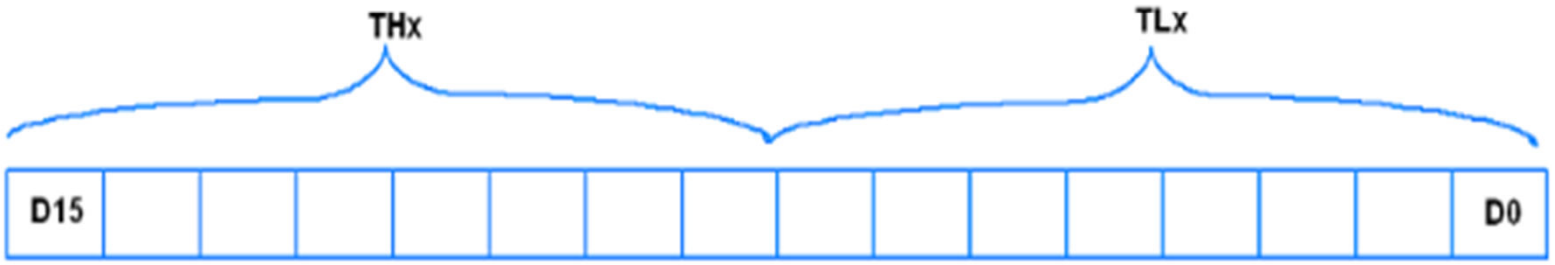


As shown in the above figure, 8-bit of THx and lower 5-bit of TLx used to form a total 13-bit timer. Higher 3-bits of TLx should be written as zero while using timer mode0, or it will affect the result.

Timer Mode 1

Mode1 (16-bit timer mode)

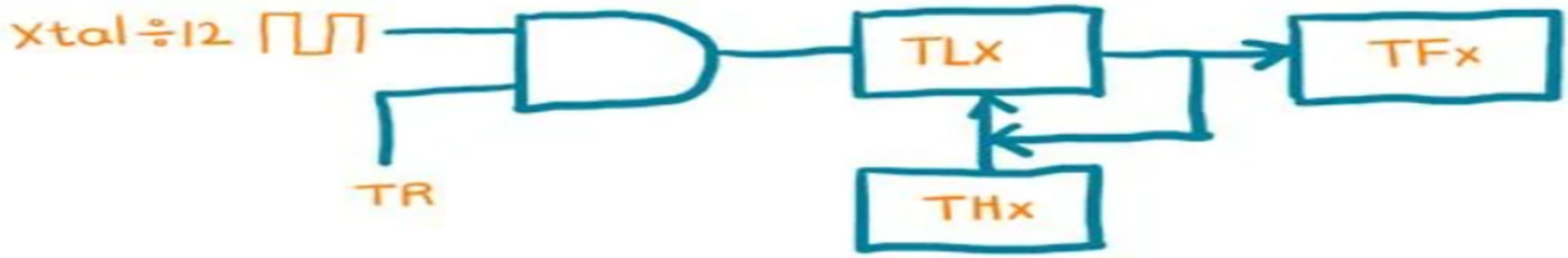
Mode 1 is a 16-bit timer mode used to generate a delay, it uses 8-bit of THx and 8-bit of TLx to form a total 16-bit register.



Timer Mode 2

Mode2 (8-bit auto-reload timer mode)

in 8051 mcu mode 2 is an 8-bit auto-reload timer mode. In this mode, we have to load the THx-8 bit value only. when the Timer gets started, the THx value gets automatically loaded into the TLx and TLx starts counting from that value. After the value of TLx overflows from the 0xFF to 0x0, the TFx flag gets set and again value from the THx gets automatically loaded into the TLx register. That's why this is called the auto-reload mode.

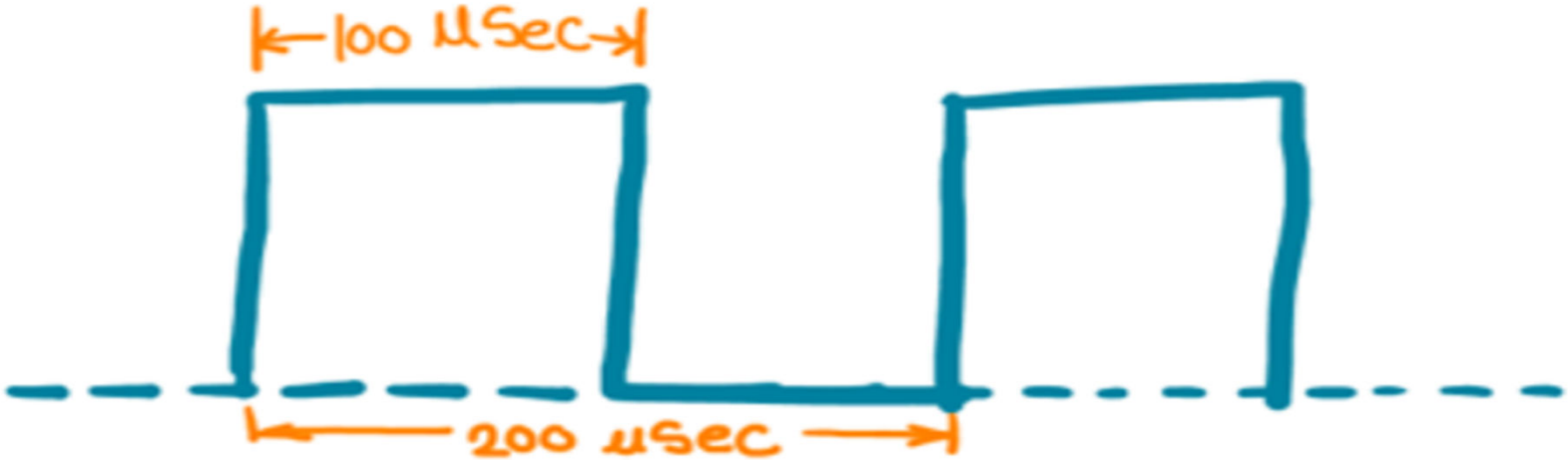


8051 Timer Auto Reload Mode

8051 Timer Example

Example

Here we are generating a square wave on PORT1.0 with 200uSec. time period using Timer1 in mode2. We will use 11.0592 MHz Xtal oscillator frequency.



8051 Timer Example

As Xtal is 11.0592 MHz we have a machine cycle of 1.085uSec. Hence, the required count to generate a delay of 1mSec. is,

$$\text{Count} = (100 \times 10^{(-6)}) / (1.085 \times 10^{(-6)}) \approx 92$$

And mode2 has a max count is 2^8 (0 - 255) and it increment from 0 – 255 so we need to load value which is 92 less from its max. count i.e. 255. Hence value need to be load is,

$$\text{Value} = (255 - \text{Count}) + 1 = 164 = 0xA4$$

So we need to load A4 Hex value in a higher byte as,

TH1 = 0xA4

8051 Timer Example

Programming steps for delay function in 8051 MCU

1. Load Tmod register value i.e. TMOD = 0x20 for Timer1 mode2 (8-bit timer auto reload mode).
2. Load calculated THx value i.e. here TH1 = 0xA4.
3. Load same value for TLx i.e. here TL1 = 0xA4.
4. Start the timer by setting a TRx bit. i.e. here TR1 = 1.
5. Poll TFx flag till it does not get set.
6. Clear timer flag TFx bit i.e. here TF1 = 0.
7. Repeat from step 5 and 6 for the delay again.