8051 AND ADVANCED PROCESSOR ARCHITECTURES –

Lesson-3: Counters and Timers

Timing and counting devices

- Two T0 and T1 in classic 8051 family and three T0, T1 and T2 in 8052 family (an extension of 8051).

Counting/timing device as timer

- A device for timing when the inputs to counting are given by a clock. The clock pulses are internally given at the specific time intervals in case of functioning as timer.

Counting/timing device as counter

- A device for counting when the inputs to count are given externally. Counter is given the input to count from external input pin.

Counting/timing device External controls for activation or deactivation of running

- When timing or counting devices is externally controlled by the gate input, when GT0 or GT1 is externally activated the device can function else it deactivates in gate input mode.
- GT0 or GT1 signals are given at P3.2 and P3.3.

Counting/timing device External count inputs in counter mode

- T0 counts the T0 is given the input to count from external input pin T0 at P3.4.
- T1 counts when T1 is given the input to count from external input pin T1 at P3.5.

Four Port P3 Pin functions

P3.2, P3.3, P3.4 and P3.5 *When TMOD SFR bits 3, 7, 2 and 6 set = 1, function as*

- GT0 (gate for starting/stopping T1),
- GT1 (gate for starting/stopping T1),
- T0 (count input to T0) and
- T1 (count input to T1) inputs

, respectively.

Two SFRs TH1-TL1

- For accessing the counts or time higher and lower 8 bits of T1 device
- The SFRs hold the T1-device 16-bits.

Two SFRs TH0-TL0

- For accessing the count or time higher and lower 8 bits
- The SFRs hold the T0 device 16-bits

SFR TMOD

- Controls the T1 and T0 modes using the upper and lower 4 bits each, which program the counting/timing of T1 and T0.
- A bit in each controls the function that external gate input controls or not.
- A bit controls the function that counter or timer mode is used.
- Two bits controls the functional mode of timer/counter as mode 0 or 1 or 2 or some other action

SFR TCON T1 and T0 control and status bits

- Upper four 4 bits program the modes of counting/timing devices T1 and T0.
- TCON.7 and TCON.5 show the timer/counter overflow status for T1 and T0 respectively.
- TCON.6 and TCON.4 control the start and stop of the timer/counter
- Lower bits of TCON are for the interrupt control for INT0 and INT1(Refer Lesson 5)

Timer/Counter T0

- 8-bit SFRs— **TMOD** (lower 4 bits), **TCON** (bit 5 and 4), **TL0** (count/time bits), **TH0** (count/time bits)
- Counter with inputs at P3.4 when bit 2 TMOD =1, timer with internal clock timed inputs when bit 2 TMOD = 0
- When mode set = 0, 8-bit timer/Counter mode and TH0 is used and TL0 is used for prescaling (dividing) inputs by 32
- When mode set = 1, 16-bit timer/counter mode with TH0-TL0 is used for timing or counting

Timer/Counter T0

- When mode set = 2, 8-bit timer/Counter TH0 is used and TL0 is used for auto-reloading the TH0 after timeout using a preset value at TL0
- When mode set = 3, two 8-bit timer/Counters mode TH0 and TL0 are independent 8-bit timer/counter and T1 does not function.

Timer/Counter T1

- 8-bit SFRs used **TMOD** (upper 4 bits), **TCON** (bit 7 and 6), **TL1** (count/time bits), **TH1** (count/time bits)
- Counter with inputs at P3.5 when bit 6 TMOD =1, timer with internal clock timed inputs when bit 6 TMOD = 0
- When mode set = 0, 8-bit timer/Counter mode and TH1 is used and TL1 is used for prescaling (dividing) inputs by 32
- When mode set = 1, 16-bit timer/counter mode with TH1-TL1 is used for timing or counting

Timer/Counter T1

- When mode set = 2, 8-bit timer/Counter TH1 is used and TL1 is used for auto-reloading the TH1 after timeout using a preset value at TL1
- When mode set = 3, T1 stops as TH0 now functions in place of T1.

Summary

We learnt

- Timer-Counter T0 and T1
- TMOD SFR
- TCON SFR upper Four bits
- External four P3 pins for external control and external count inputs
- Modes 0, 1, 2, 3 of T0
- Mode 0, 1 and 2 of T1

End of Lesson 3 of Chapter 2