

1.2 Microcontroller 8051 Architecture:

It is 8-bit microcontroller, means MC 8051 can Read, Write and Process 8 bit data. This is mostly used microcontroller in the robotics, home appliances like mp3 player, washing machines, electronic iron and industries. Mostly used blocks in the architecture of 8051 are as follows:

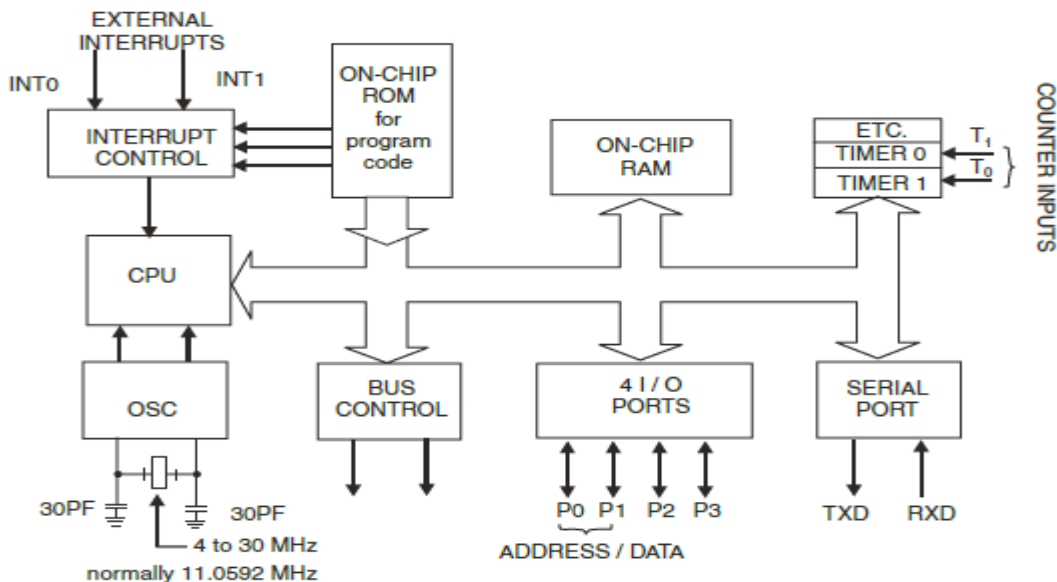


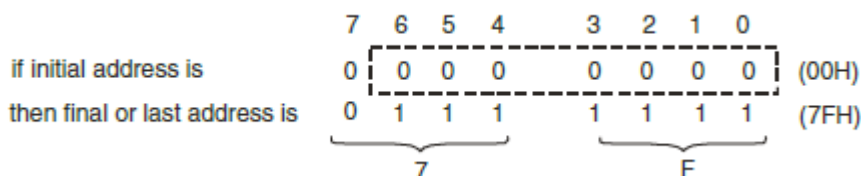
Fig. 1.2 8051 architecture

1.2.1 128 Byte RAM for Data Storage

MC 8051 has 128 byte Random Access memory for data storage. Random access memory is non volatile memory. During execution for storing the data the RAM is used. RAM consists of the register banks, stack for temporary data storage. It also consists of some special function register (SFR) which are used for some specific purpose like timer, input output ports etc. Normally microcontroller has 256 byte RAM in which 128 byte is used for user space which is normally Register banks and stack. But other 128 byte RAM which consists of SFRs. We will discuss the RAM in detail in next section.

Now what is the meaning of 128 byte RAM. What are address range which is provided for data storage. We will discuss here.

We know that 128 byte = 2⁷ byte (1byte=8bits)



Since 2⁷ bytes so last 7 bits can be changed so total locations are from 00H to 7FH. This procedure of calculating the memory address is called as “*memory mapping*”. We can save data on memory locations from 00H to 7FH. Means total 128 byte space from 00H to 7FH is provided for data storage.

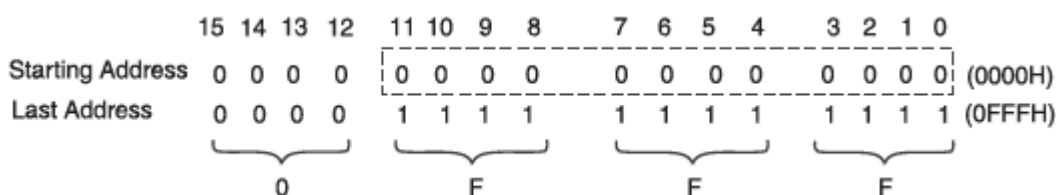
1.2.2 4KB ROM

- In 8051, 4KB read only memory (ROM) is available for program storage. This is used for permanent data storage. Or the data which is not changed during the processing like the program or algorithm for specific applications.
- This is volatile memory; the data saved in this memory does not disappear after power failure.
- We can interface up to 64KB ROM memory externally if the application is large. These sizes are specified differently by their companies.

Address Range of PC: Address range of PC means program counter (which points the next instruction to be executing) can be moved between these locations or we can save the program from this location to this location. The address range can be calculated in the same way just like the RAM which is discussed in previous section.

$$4\text{KB} = 2^2 \diamond 2^{10} \text{ B (since } 1\text{KB} = 2^{10} \text{ B)}$$

$$= 2^{12} \text{ Byte}$$



Address range of PC is 0000H to 0FFFH means total 4KB locations are available from 0000H to 0FFFH. At which we can save the program.

Difference between RAM and ROM

- RAM is used for data storage while ROM is used for program storage.
- Data of RAM can be changed during processing while data of ROM can't be changed during processing.
- We can take an example of calculator. If we want to perform addition of two numbers then we type the two numbers in calculator, this is saved in the RAM, but the Algorithms by which the calculation is performed is saved in the ROM. Data which is given by us to calculator can be changed but the algorithm or program by which calculation is performed can't be changed.

1.2.3 Timers and Counters

Timer means which can give the delay of particular time between some events. For example on or off the lights after every 2 sec. This delay can be provided through some assembly program but in microcontroller two hardware pins are available for delay generation. These hardware pins can be also used for counting some external events. How much times a number is repeated in the given table is calculated by the counter.

- In MC8051, two timer pins are available T0 and T1, by these timers we can give the delay of particular time if we use these in timer mode.
- We can count external pulses at these pins if we use these pins in counter mode.
- 16 bits timers are available. Means we can generate delay between 0000H to FFFFH.
- Two special function registers are available.



- If we want to load T0 with 16 bit data then we can load separate lower 8 bit in TL0 and higher 8 bit in TH0.
- In the same way for T1.
- TMOD, TCON registers are used for controlling timer operation.

1.2.4 Serial Port

- There are two pins available for serial communication TXD and RXD.
- Normally TXD is used for transmitting serial data which is in SBUF register, RXD is used for receiving the serial data.
- SCON register is used for controlling the operation.

1.2.5 Input Output Ports

- There are four input output ports available P0, P1, P2, P3.
- Each port is 8 bit wide and has special function register P0, P1, P2, P3 which are bit addressable means each bit can be set or reset by the Bit instructions (SETB for high, CLR for low) independently.
- The data at any port which is transmitting or receiving is in these registers.
- The port 0 can perform dual works. It is also used as Lower order address bus (A0 to A7) multiplexed with 8 bit data bus P0.0 to P0.7 is AD0 to AD7 respectively the address bus and data bus is demultiplex by the ALE signal and latch which is further discussed in details.
- Port 2 can be used as I/O port as well as higher order address bus A8 to A15.
- Port 3 also have dual functions it can be worked as I/O as well as each pin of P3 has specific function.
- P3.0 – RXD – { Serial I / P for Asynchronous communication
Serial O / P for synchronous communication.
- P3.1 – TXD – Serial data transmit.
- P3.2 – INT0 – External Interrupt 0.
- P3.3 – INT1 – External Interrupt 1.
- P3.4 – T0 – Clock input for counter 0.
- P3.5 – T1 – Clock input for counter 1.
- P3.6 – WR – Signal for writing to external memory.
- P3.7 – RD – Signal for reading from external memory.

When external memory is interfaced with 8051 then P0 and P2 can't be worked as I/O port they works as address bus and data bus, otherwise they can be accessed as I/O ports.

1.2.6 Oscillator

It is used for providing the clock to MC8051 which decides the speed or baud rate of MC.

We use crystal which frequency vary from 4MHz to 30 MHz, normally we use 11.0592 MHz frequency.

1.2.7 Interrupts

Interrupts are defined as requests because they can be refused (masked) if they are not used, that is when an interrupt is acknowledged. A special set of events or routines are followed to handle the interrupts. These special routines are known as interrupt handler or interrupt service routines (ISR). These are located at a special location in memory.

INT0 and INT1 are the pins for external interrupts.