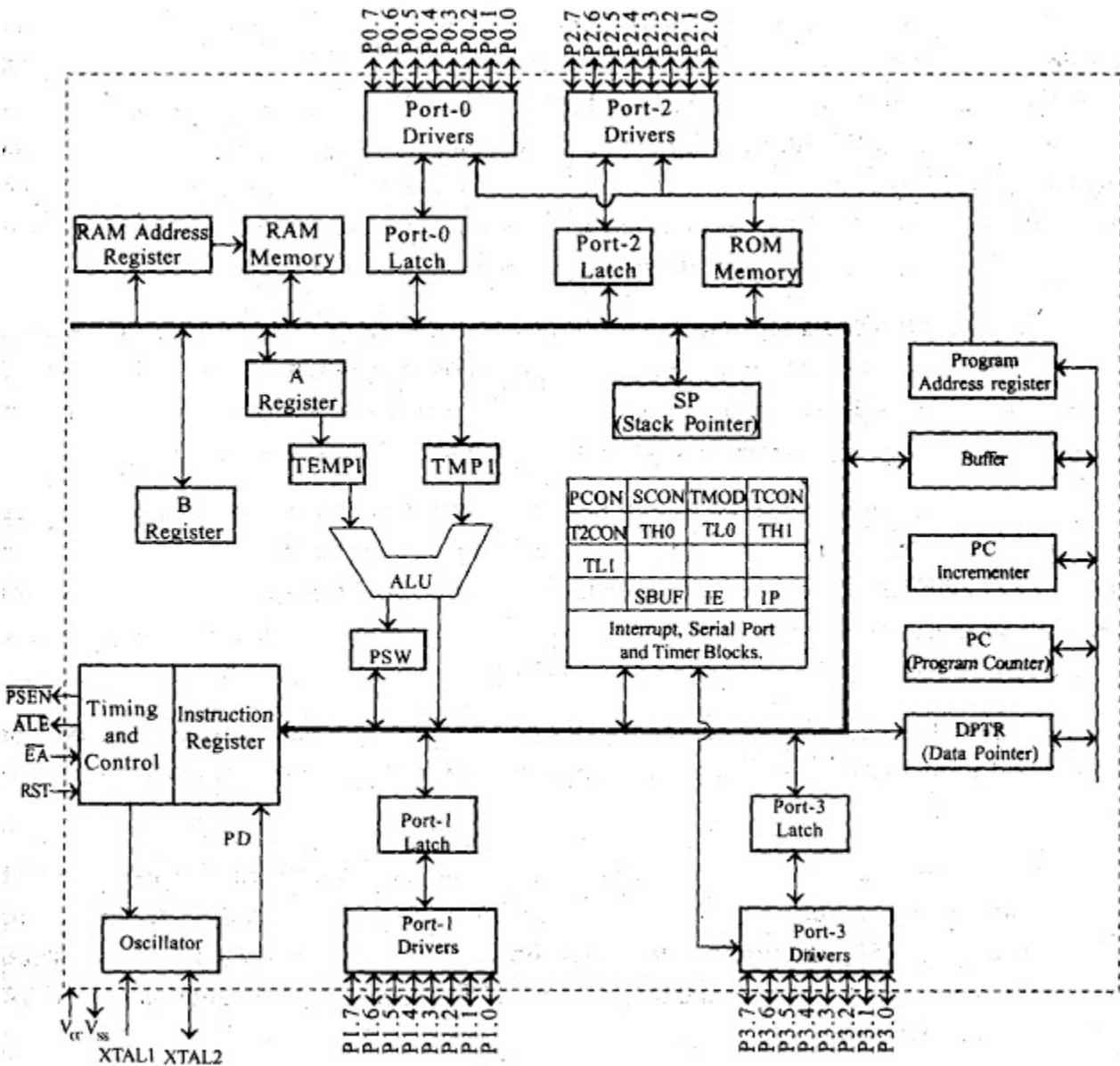


ARCHITECTURE OF 8031/8051 MICROCONTROLLER



ARCHITECTURE OF 8031/8051

CPU - Central processing Unit:

1. ALU:

- It performs the arithmetic operations such as addition, subtraction, multiplication and division.

- The unit can perform logical operations such as AND, OR; and Exclusive-OR, as well as rotate, clear, and complement.
- The ALU can also manipulate one bit as well as eight-bit data types.
- Individual bits may be set, cleared, complemented, tested, and used in logic computation.

2. Accumulator:

- It is an 8-bit register.
- It holds a data and receives the result of the arithmetic instructions.

3. B register:

An 8-bit general-purpose register.

4. Program Status Word:

- Many instructions implicitly or explicitly affect (or are affected by) several status flags, which are grouped together to form the Program Status Word.
- It also used to select the memory bank.

B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀
CY	AC	F0	RS1	RS0	OV	-	P

CY	Bit 7	-	Carry flag
AC	Bit 6	-	Auxiliary carry flag for BCD operations
F0	Bit 5	-	User defined flag (Flag zero)
RS1, RS0	Bit 4-3	-	Select the working register banks

as follows :

RS1	RS0	BANK SELECTION	
0	0	00H - 07H	Bank 0
0	1	08H - 0FH	Bank 1
1	0	10H - 17H	Bank 2
1	1	18H - 1FH	Bank 3

Fig. 6.3 Program status word

OV	Bit 2	-	Overflow flag
-	Bit 1	-	Reserved
P	Bit 0	-	Parity flag (1 = Even parity)

5. Stack Pointer (SP):

- The stack pointer register is 8 bit wide.
- It is incremented before data is stored during PUSH and CALL instructions.
- After reset the value of SP is 07H.

6. Data Pointer (DPTR):

- The data pointer is a 16-bit register used to hold the 16-bit address of data memory.
- This can also be used as two numbers of 8-bit data pointer namely DPH and DPL.
- The 8-bit data pointers are used for accessing internal RAM and SFR.

- The 16-bit data pointer is used for accessing external data memory.
- The contents of data pointer are programmable using instructions.

7. Program Counter (PC):

- It is a 16 bit register.
- PC is used, as address pointer to access program instructions and it is automatically incremented after every byte of instruction fetch.

I/O Devices:

- The 8051 has four numbers of 8-bit ports namely port-0, port- 1, port-2 and port-3.
- Each port has a latch and driver (or buffer).
- When external memory is employed the port-0 lines will function as multiplexed low byte address/data lines and port-2 lines will function as high byte address lines.
- Also the port pins P3.7 and P3.6 are used to output read and write control signals respectively.
- The port-1 is dedicated I/O port and does not have any alternate function.
- The ports are also mapped as internal memory in the controller and so they can be addressed as memory locations for 8-bit operation.

Instruction Register (IR) & timing and control unit:

- The 8051 has 8-bit ALU, which performs arithmetic and logical operations on binary data.
- The A and B registers are used to hold the input data and the result of ALU operation.
- The controller will fetch the instructions one by one, starting from the address stored in PC and store in IR, which decodes the instructions and give information to timing and control unit.
- Using the information supplied by the IR unit the control signals necessary for internal and external operations are generated by the timing and control unit.

Timer/Counter & Serial port:

- The 8031/8051 has two 16-bit programmable timer/counter namely timer-1 and timer 0.
- In the counter mode of operation they can count the number of high to low transitions of the signal applied to the timer pins.
- In timer mode of operation they can be independently programmed to work in any one of the four operation modes. They are called mode-0, mode-1, mode-2 and mode-3.
- In mode-0 the serial port can either receive or transmit at fixed baud rate.
- In mode-2 it can simultaneously transmit and receive at any one of the two selectable baud rate.
- In mode-1 and mode-3 it can work as full duplex serial port with variable baud rate, which is programmed using timer-1.

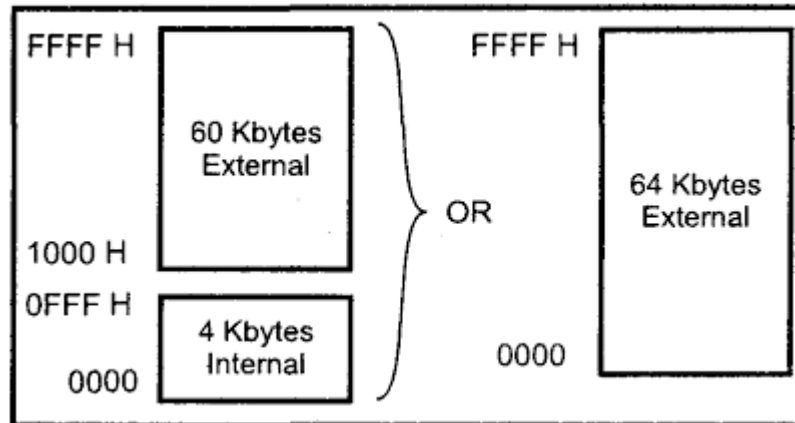
Memory Organization:

- Since the size of address pointers are 16-bit they can address up to $2^{16} = 64\text{kb}$ memory locations.
- A microcontroller based system requires both EPROM and RAM. The EPROM is required for permanent program and permanent data storage. The RAM is required for temporary data storage and stack. The 8031/8051 has 64kb program memory address space and 64kb data memory address space.
- The microcontroller can only read from program memory such as ROM/EPROM/ EEPROM and the signal PSEN (Low) is used as read control for reading program memory.
- The microcontroller can read and write with data memory RAM. It has separate read control signal RD(Low), and write control signal WR(Low) for reading and writing with data memory respectively.
- In 8031/8051 based system only memory mapped I/O is possible.

Program Memory:

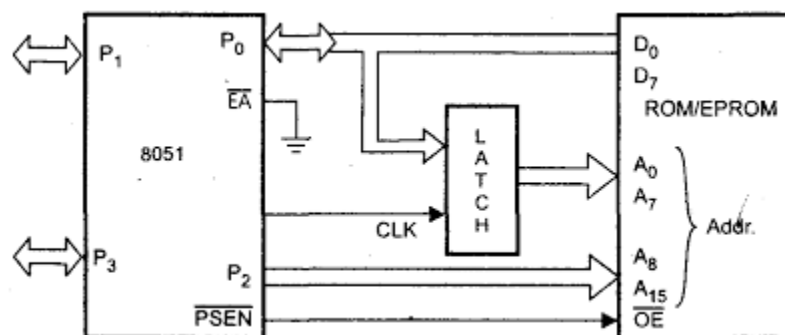
- In 8031 there is no internal ROM/EPROM and so the entire 64 kb program memory space in the range 0000H to FFFFH is external. Therefore in 8031 based systems the pin EA(Low) is always tied low or grounded (0V).
- The 8051 has 4kb internal ROM which can be mapped to first 4kb address space of program memory.

- If EA(Low) pin is tied high or tied to VCC (+5V), then the internal 4kb ROM be mapped as program memory in the address range 0000H to 0FFFH and the external program memory 60kb will have the address range 1000H to FFFFH.
- If EA(Low) pin is tied low or grounded (0V), then the internal ROM is ignored or cannot be accessed. The entire 64 kb program memory address space is external with address range 0000H to FFFFH.



The 8051 Program Memory

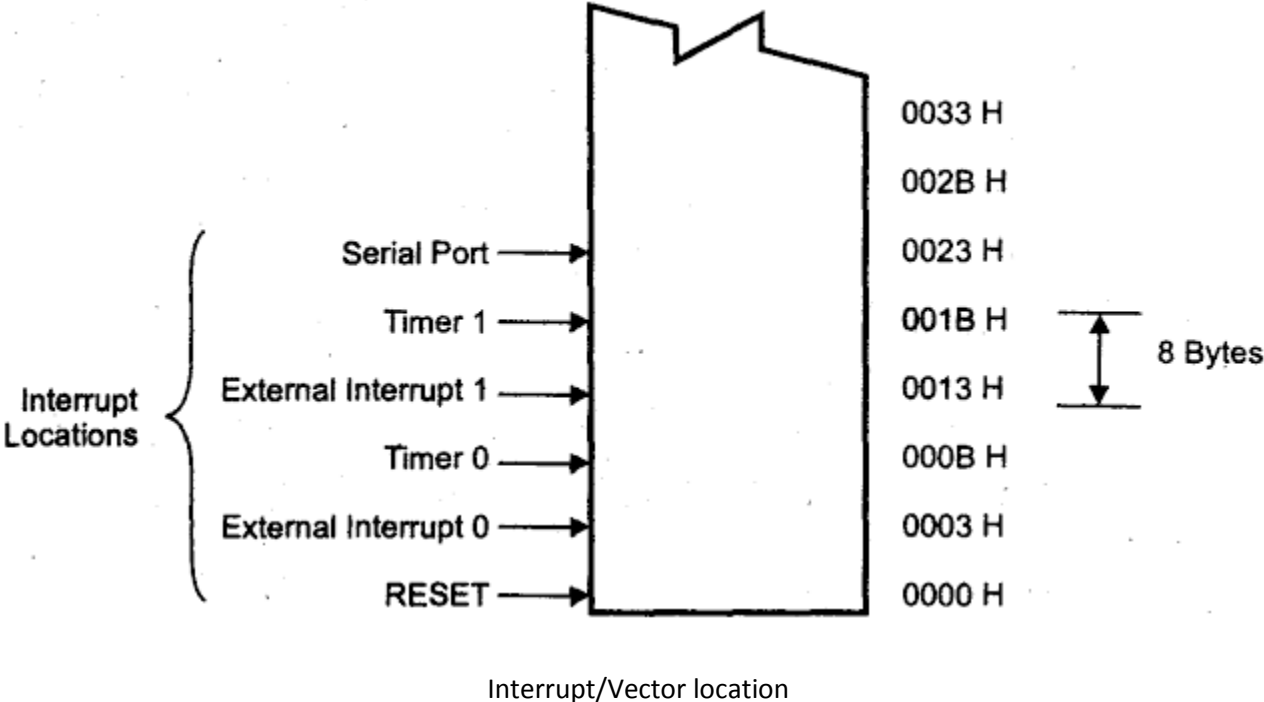
- The PSEN (Low) signal is used to activate output enable signal to access the external ROM/EPROM, as shown.



Accessing External Program Memory

- The port 0 is used as a multiplexed address/bus. It gives lower order 8-bit address in the initial T-cycle and later it is used as a data bus.

- The 8-bit address is latched using external latch and ALE signal generated by 8051.
- The port 2 provides the higher order 8-bit address.
- The lower part of program memory stores the vector addresses for various interrupt service routines.
- Each interrupt is assigned with a fixed location in program memory.



Source : <http://mediatoget.blogspot.in/2013/03/architecture-of-80318051-microcontroller.html>