

3.3 MEMORY ORGANIZATION

Memory organization :

The 8051 microcontroller has 128 bytes of Internal RAM and 4kB of on chip ROM. The RAM is also known as Data memory and the ROM is known as program memory. The program memory is also known as Code memory .This Code memory holds the actual 8051 program that is to be executed. In 8051 this memory is limited to 64K .Code memory may be found on-chip, as ROM or EPROM. It may also be stored completely off-chip in an external ROM or, more commonly, an external EPROM. The 8051 has only 128 bytes of Internal RAM but it supports 64kB of external RAM. As the name suggests, external RAM is any random access memory which is off-chip. Since the memory is off-chip it is not as flexible in terms of accessing, and is also slower. For example, to increment an Internal RAM location by 1, it requires only 1 instruction and 1 instruction cycle but to increment a 1-byte value stored in External RAM requires 4 instructions and 7 instruction cycles. So, here the external memory is 7 times slower.

Internal RAM OF 8051 :

This Internal RAM is found on-chip on the 8051 .So it is the fastest RAM available, and it is also the most flexible in terms of reading, writing, and modifying its contents. Internal RAM is volatile, so when the 8051 is reset this memory is cleared. The 128 bytes of internal RAM is organized as below.

- (i) Four register banks (Bank0, Bank1, Bank2 and Bank3) each of 8-bits (total 32 bytes). The default register is Bank0. The remaining Banks are selected with the help of RS0 and RS1 bits of PSW Register.
- (ii) 16 bytes of bit addressable area and
- (iii) 80 bytes of general purpose area (Scratch pad memory) as shown in the diagram below. This area is also utilized by the microcontroller as a storage area for the operating stack.

The 32 bytes of RAM from address 00 H to 1FH are used as working registers organized as four banks of eight registers each. The registers are named as R0-R7 .Each register can be addressed by its name or by its RAM address.

EX : MOV A, R7 or MOV R7,#05H

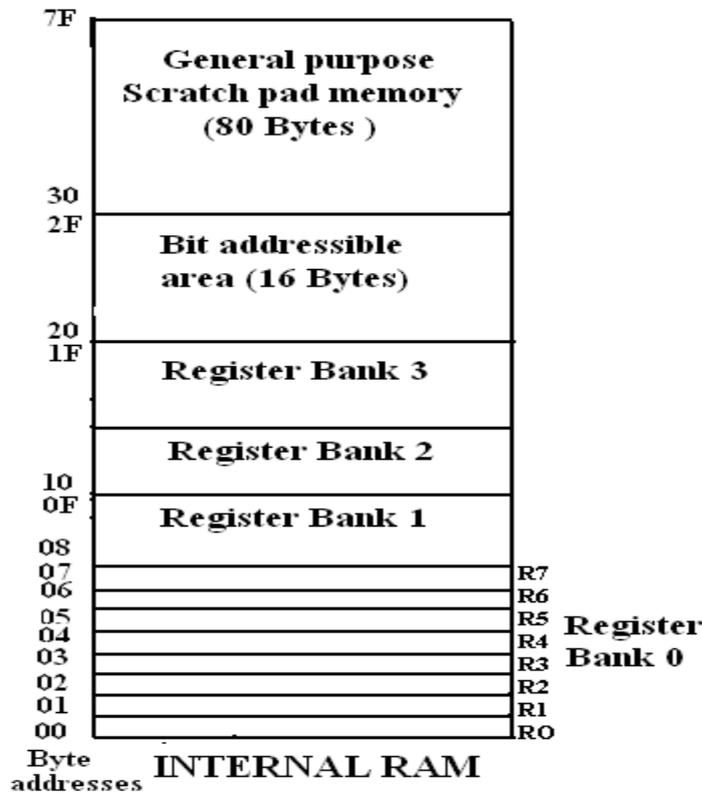


Figure 3.3.1 Internal memory8051 Microcontroller

[Source: "Microprocessor Architecture Programming and Application" by R.S. Gaonkar, page-]

Internal ROM (On –chip ROM):

The 8051 microcontroller has 4kB of on chip ROM but it can be extended up to 64kB. This ROM is also called program memory or code memory. The CODE segment is accessed using the program counter (PC) for opcode fetches and by DPTR for data. The external ROM is accessed when the EA(active low) pin is connected to ground or the contents of program counter exceeds 0FFFH. When the Internal ROM address is exceeded the 8051 automatically fetches the code bytes from the external program memory.

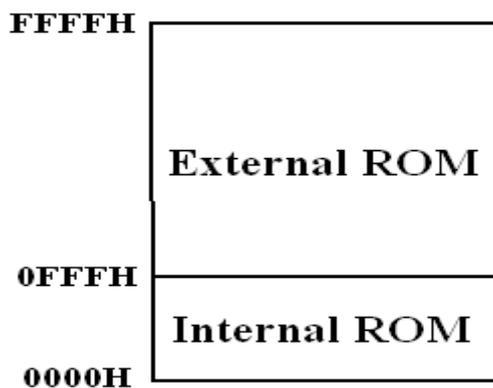


Figure 3.3.2 External memory8051 Microcontroller

[Source: "Microprocessor Architecture Programming and Application" by R.S. Gaonkar, page-]