Microcontrollers

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PIC Microcontroller

Peripheral Interface Controller

- Introduced in 1989
- small amounts of data RAM
- few hundred bytes of on-chip ROM for the program
- one timer
- few pins for I/O ports
- 8 pin IC

PIC Microcontroller

- They have become leaders in 8-bit microcontroller
- Microchip is number 1 supplier of 8-bit microcontroller
- PIC Families include 10xxx, 12xxx, 14xxx, 16xxx, 17xxx, and 18xxx.
- all 8-bit processors, meaning that the CPU can work on only 8 bits of data at a time.
- Data larger than 8 bits has to be broken into 8-bit pieces to be processed by the CPU.

PIC versions

- PIC with UV - EPROM
  - Can be reprogrammed by using UV light to clear the code
- PIC with flash memory
  - Used for development and testing. Usually has the letter F in the name
- PIC with OTP (One time Programmable) memory
  - Cannot be reprogrammed once program data is written. Used for final production

Block Diagram of PIC

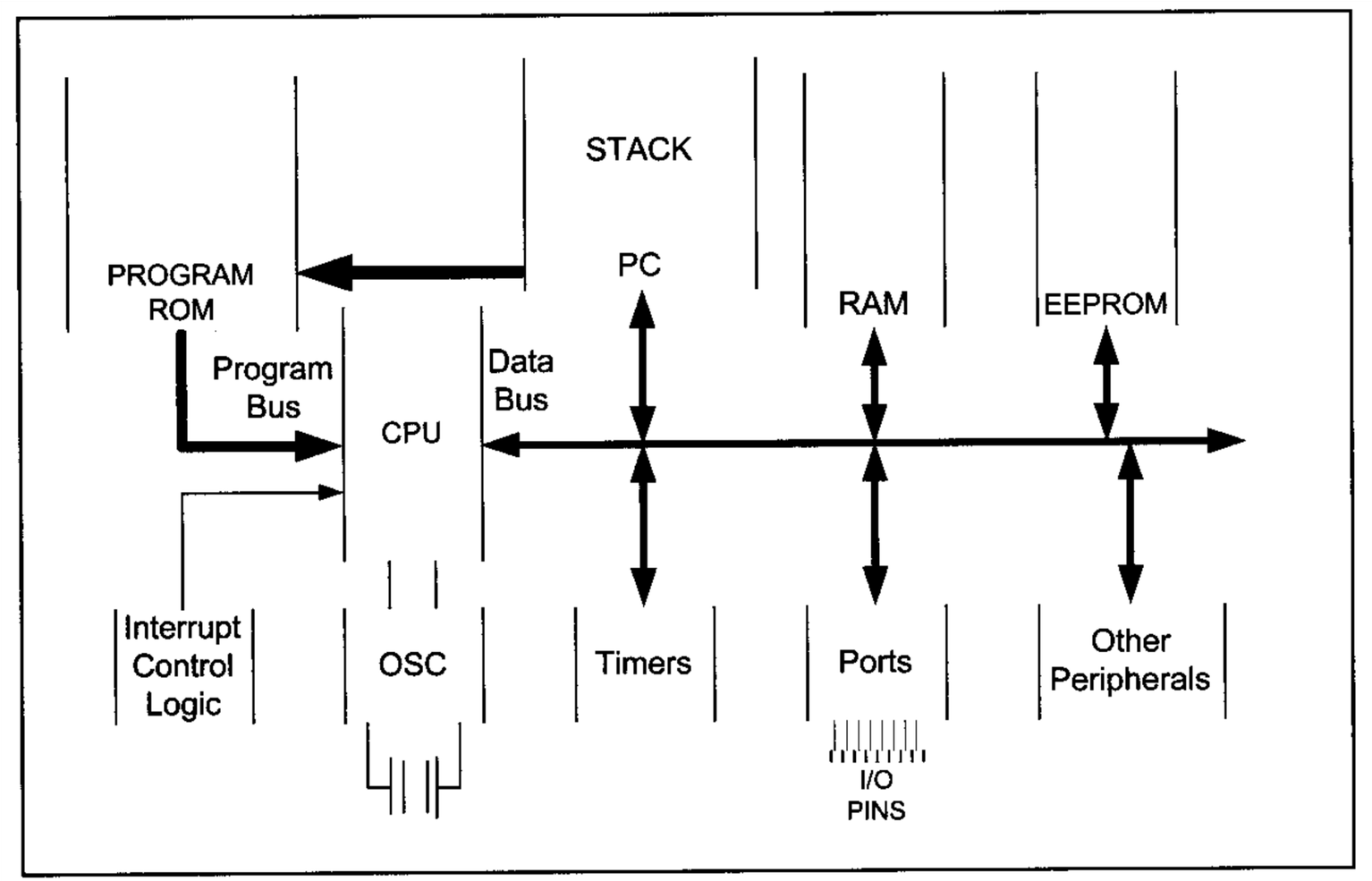
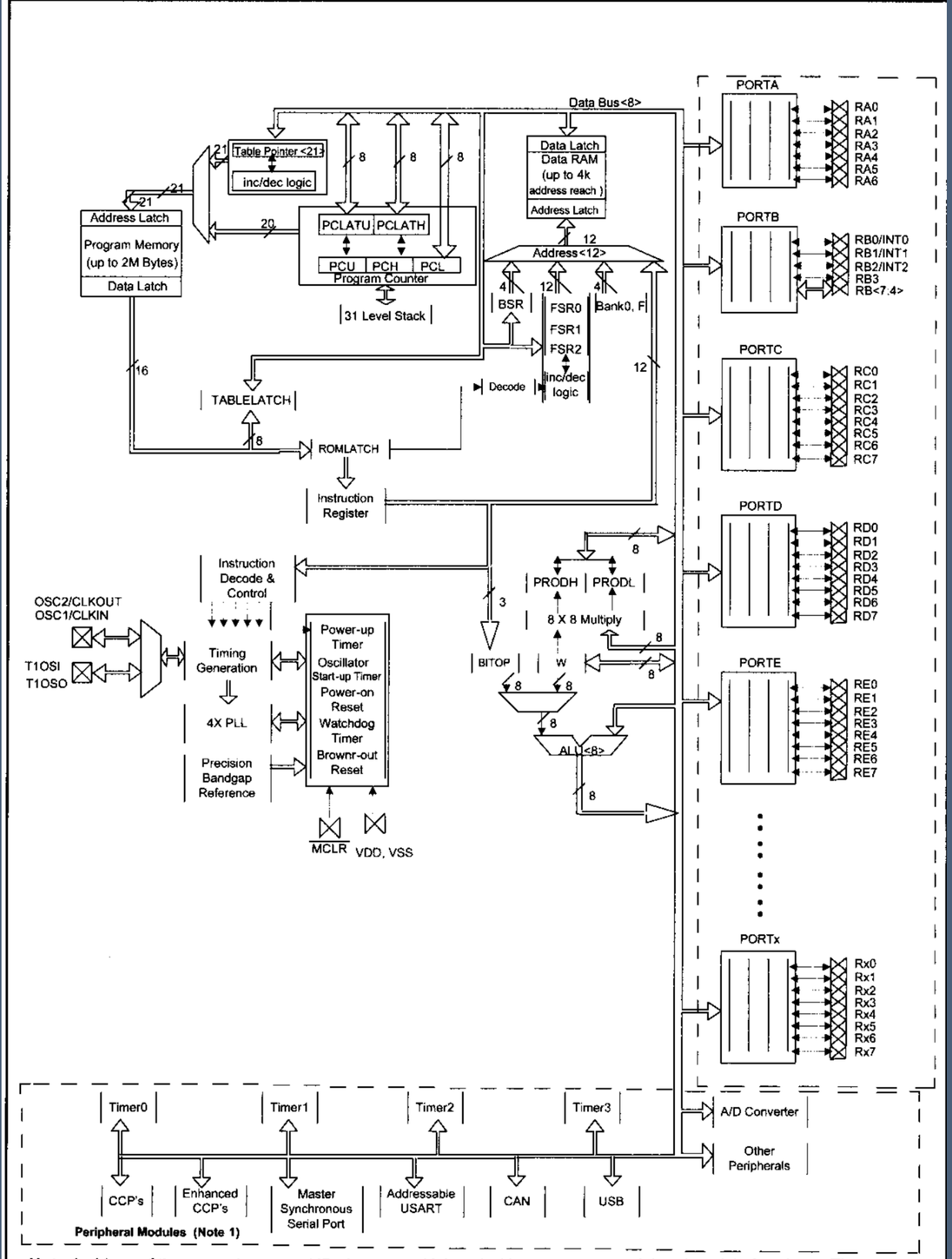


Figure 1-2. Simplified View of a PIC Microcontroller

Architecture of PIC



File Register and SFR in PIC

- read/write memory used by the CPU for data storage, scratch pad, and registers for internal use and functions.
- Size of RAM varies chip to chip
- RAM divided into two sections: GPR (general purpose Register) and Special function Register

SFR

- The Special Function Registers (SFRs) are dedicated to specific functions such as ALU status, timers, serial communication, I/O ports, ADC, and so on.
- The function of each SFR is fixed by the CPU designer at the time of design because it is used for control of the microcontroller or peripheral.
- The number of locations in the file register set aside for SFR depends on the pin numbers and peripheral functions supported by that chip

GPR

- group of RAM locations in the file register that are used for data storage and scratch pad.
- 8 bit storage
- the space that is not allocated to the SFRs typically is used for general-purpose registers.

Table 2-1: File Register Size for PIC Chips

	File Register (Bytes)	=	SFR (Bytes)	+	Available space for GPR (Bytes)
PIC12F508	32		7		25
PIC16F84	80		12		68
PIC18F1220	512		256		256
PIC18F452	1792		256		1536
PIC18F2220	768		256		512
PIC18F458	1792		256		1536
PIC18F8722	4096		158		3938

SFR and GPR examples

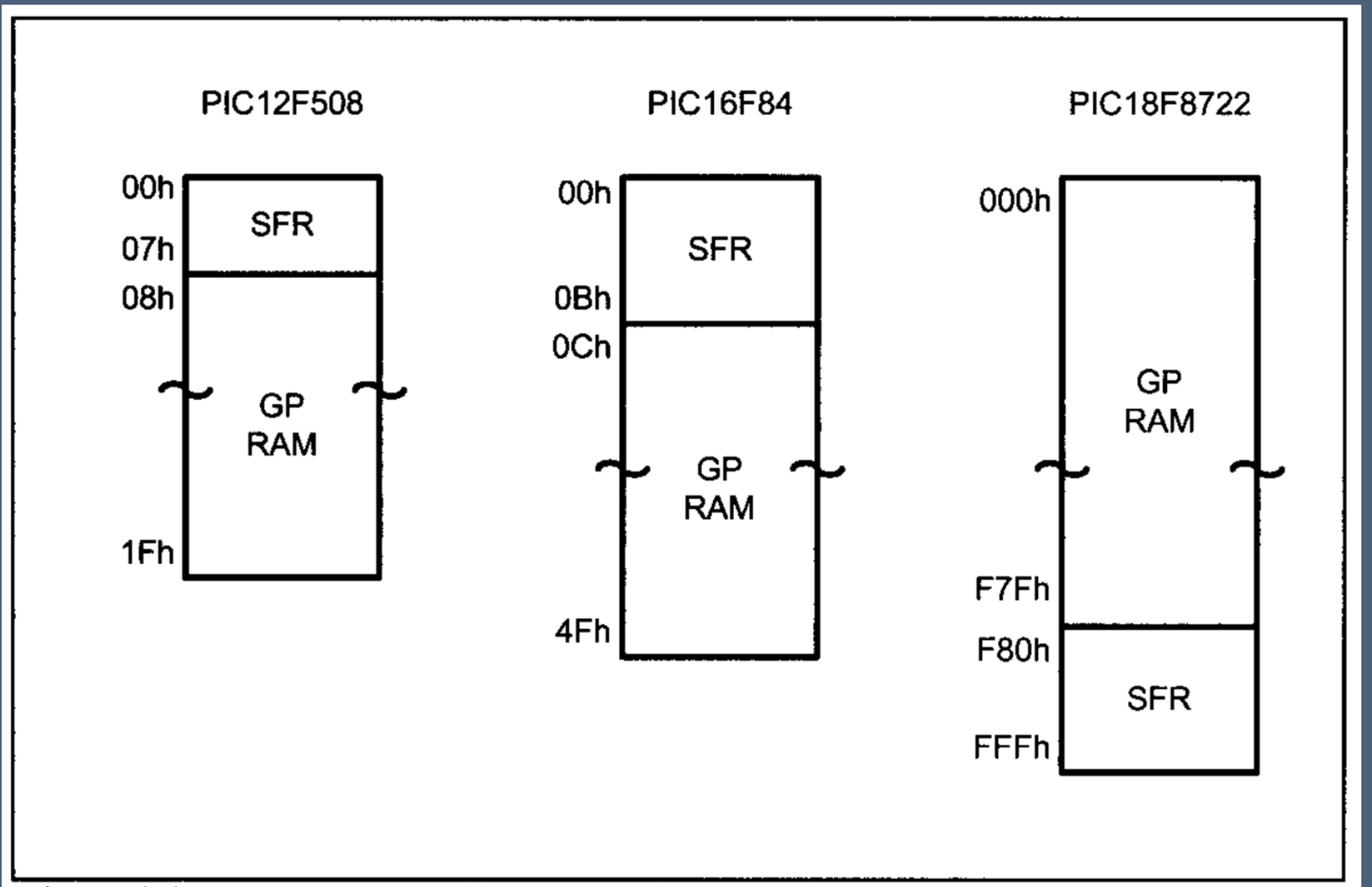


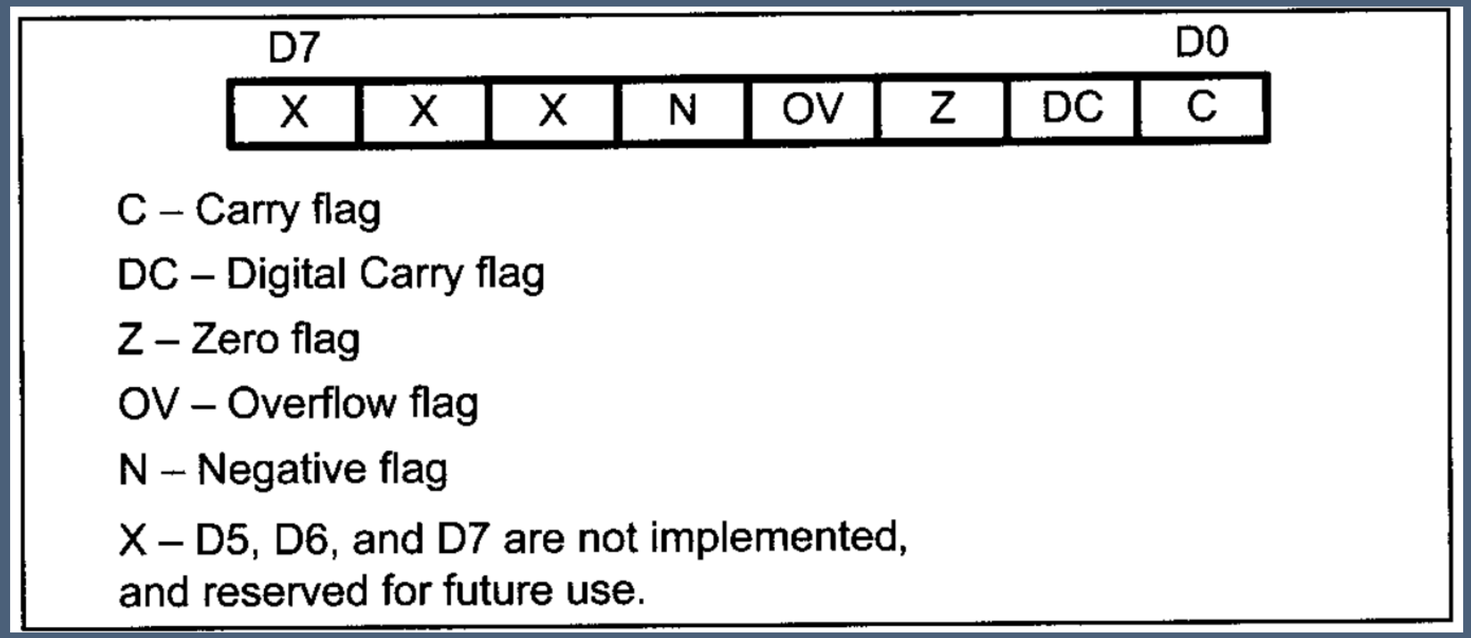
Figure 2-2. File Registers of PIC12, PIC16, and PIC18

Common SFRs

- WREG (Working Register)
- most widely used register in the PIC microcontroller.
- WREG register is the same as the accumulator in other microprocessors
- WREG register is used for all arithmetic and logic instructions.

Common SFRs

- PIC18 status register
- also referred to as the flag register.
- Only 5 bits are used



Stack

- The stack is read/write memory (RAM) used by the CPU to store some very critical information temporarily.
- The stack in the PIC18 is 21-bit because the program counter is 21-bit.
- This means that it is used for the CALL instruction to make sure that the PIC knows where to come back to after execution of the called subroutine
- The PIC18 has a 5-bit stack pointer, which can take values of 00 to 1FH.
- That gives us a total of 32 locations where each location is 21 bits wide.
- stack location 1 is the first location used for the stack because the SP points to the last-used location.
- That means that location 0 of the stack is not available and we have only 31 stack locations in the PIC18.

Register Banks and Bank switching

- Addresses only 8-bit for storage = Max access range = 256 bytes
- PIC18 can have 4096 bytes of RAM. How to access the rest of the storage?
- Use Register Banks each of 256 bytes.
- IF nothing is specified in instruction access bank (default is selected)
- If its specified to use a specific bank we use the Bank Select register to access a specific register bank
- Bank select register only uses lower 4 bits to select bank. i.e only 16 banks possible.

Addressing Modes

- Immediate Adressing
  - Load data from the command itself: The data is provided in the code
  - Eg. MOVLW 0x20　; here literal value is put in WREG
- Direct Adressing
  - Load data from another location where the address is provided directly
  - Eg. MOVWF 0x20　; here data is put into location 0x20 from WREG (data is not direcltly put)

Addressing Modes

- Register Indirect Addressing
  - In this mode the address of a location is stored in another register.
  - LFSR registers are used as pointers for storing addresses
- Indexed ROM
  - If you have fixed data as part of your ROM then you use Indexed ROM addressing mode to get that data from the ROM