SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PIC16F877Architecture

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Features of PIC 16F877

The PIC microcontroller was introduced by **Microchip Technologies** in the year 1993. Hence the PIC gets its name as for **Peripheral Interface Controller.**

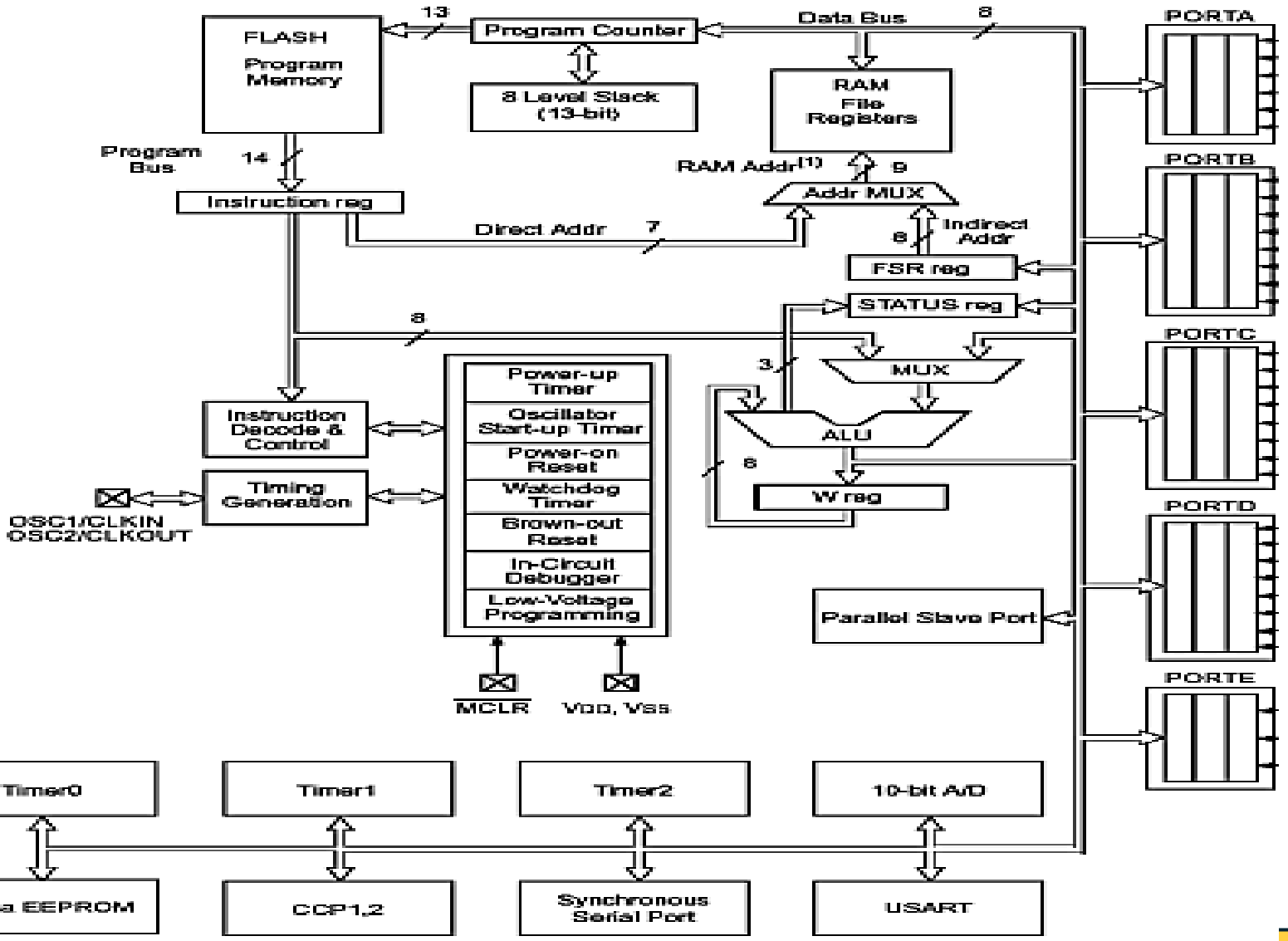
High-Performance RISC CPU:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory

Difference between RISC and CISC Processor

S.No.	RISC	CISC
1.	RISC is a reduced instruction set.	CISC is a complex instruction set.
2.	The number of instructions is less as compared to CISC.	The number of instructions is more as compared to RISC.
3.	The addressing modes are less.	The addressing modes are more.
4.	It works in a fixed instruction format.	It works in a variable instruction format.
5.	The RISC consumes low power.	The CISC consumes high power.
6.	The RISC processors are highly pipelined.	The CISC processors are less pipelined.
7.	It optimizes the performance by focusing on software.	It optimizes the performance by focusing on hardware.
8.	Requires more RAM.	Requires less RAM.

Architecture



OSCILLATOR TYPES

The PIC16F87XA can be operated in four different oscillator modes.

- LP Low-Power Crystal
- XT Crystal/Resonator
- HS High-Speed Crystal/Resonator
- RC Resistor/Capacitor

CPU (Central Processing Unit)

PIC microcontroller's CPU consists of

- Arithmetic logic unit (ALU)
- Memory unit (MU)
- Control unit (CU)
- Accumulator

MEMORY

The memory of a PIC 16F877 chip is divided into 3 sections:

- ✓ Program memory
- ✓ Data memory and
- ✓ Data EEPROM

REGISTERS

GENERAL PURPOSE REGISTERS (GPR):

- ✓ Don’t have any special function.
- ✓ Used for general purpose for multiplying, addition or subtraction and then storing the results in other registers.
- ✓ CPU can easily access the data in these registers.

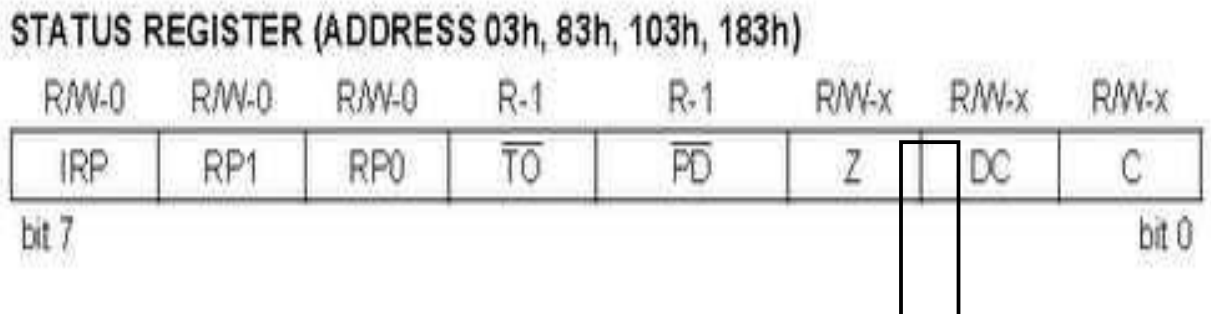
SPECIAL FUNCTION REGISTERS (SFR):

- ✓ Used for special purposes and they cannot be used as normal registers.
- ✓ Their function is set at the time of manufacturing.
- ✓ They perform the function assigned to them and user cannot change the function of SFR.

SFR

Three important SFRs for programming are:

STATUS register: It changes the bank



PORT registers: It assigns logic values 0 or 1 to the ports

TRIS registers: It is a data direction register for input and output

INTERRUPTS

INTERRUPTS

There are 20 internal interrupts and three external interrupt sources in PIC microcontrollers which are related with different peripherals like ADC, USART, Timers, and CCP etc.,

SERIAL COMMUNICATION

The transfer of one bit of data at time consecutively over a communication channel is called Serial Communication. There are three protocols of serial communication:

- USART
- SPI Protocol
- I2C Protocol

I/O PORTS:

it consists of five ports, such as Port A, Port B, Port C, Port D and Port E. with TRISA, TRISB, TRISC, TRISD, TRISE as the direction register.

CCP MODULE:

A CCP module works in the following three modes:

- Capture Mode
- Compare Mode
- PWM Mode

TIMERS:

Timers and counters are important as timers can tell the time and count. PIC microcontroller can have up to four timers (depending upon the family) Timer0, Timer1, Timer2 and Timer3. Timer0 and Timer2 are of 8-bits while the Timer1 and Timer3 are of 16-bits, which can also be used as a counter. These timers work according to the selected modes.

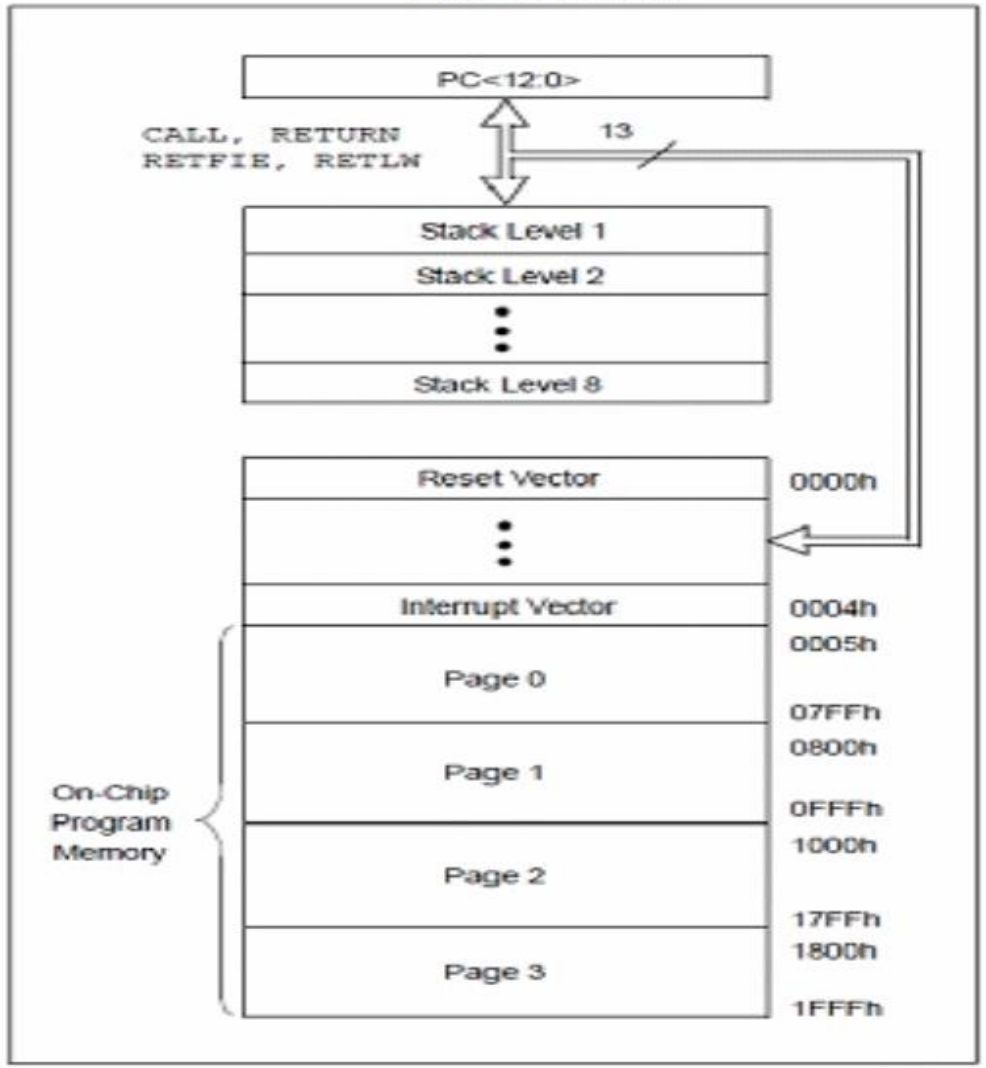
D/A CONVERTER:

There are no **analog outputs in PIC Microcontroller.** To get analog output we have to use external Digital-to-Analog Converter (DAC). It can convert 8 bits of digital number from the eight digital outputs of PIC microcontroller.

PROGRAM MEMORY

- ✓ Program memory contains the programs that are written by the user.
- ✓ The program counter (PC) executes these stored commands one by one.
- ✓ Usually PIC16F877 devices have a 13 bit wide program counter that is capable of addressing 8K×14 bit program memory space.
- ✓ This memory is primarily used for storing the programs that are written (burned) to be used by the PIC.
- ✓ These devices also have 8K*14 bits of flash memory that can be electrically erasable /reprogrammed.

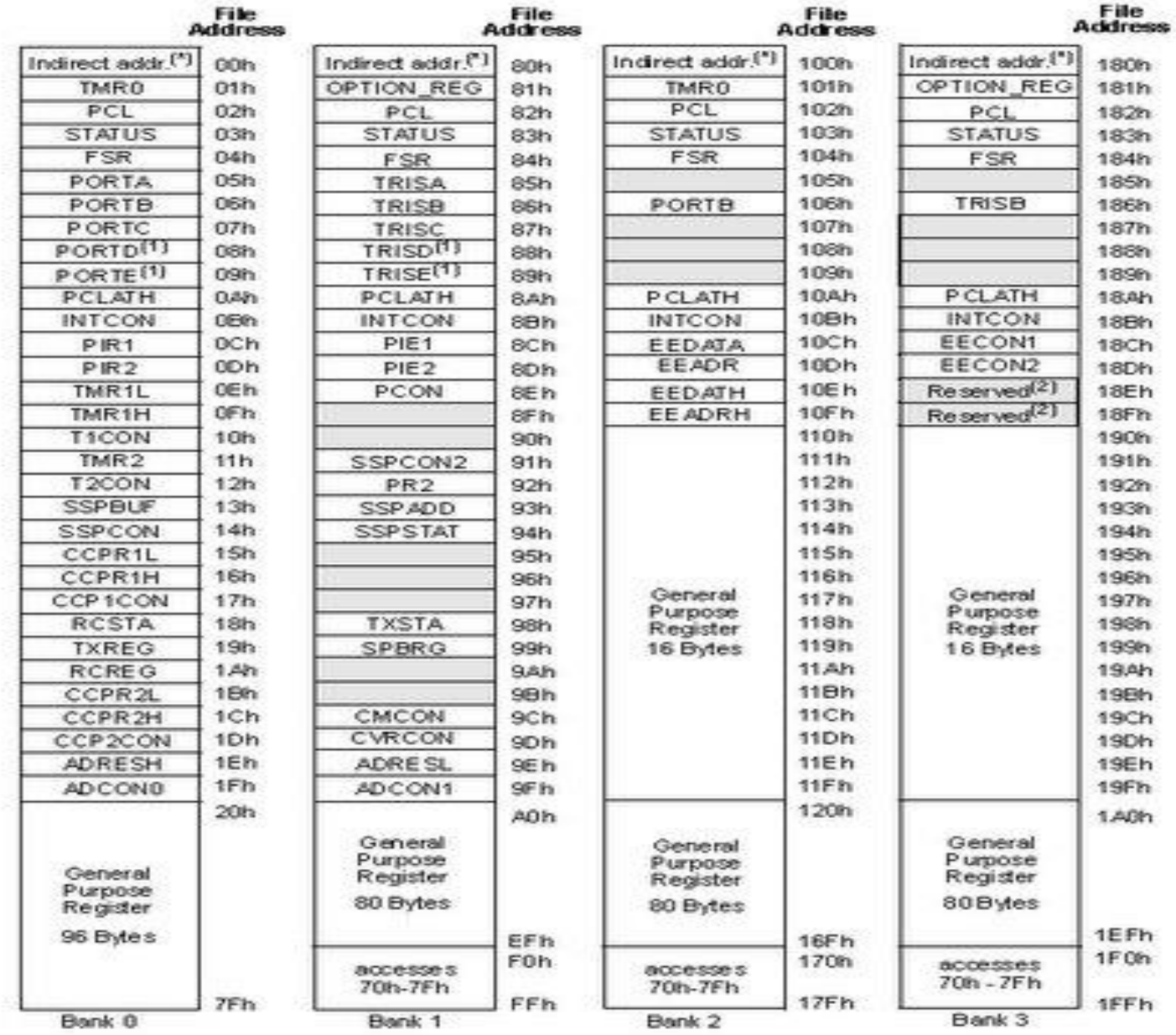
PROGRAM MEMORY MAP AND STACK



DATA MEMORY

- ✓ The data memory of PIC16F877 is separated into multiple banks which contain the general-purpose registers (GPR) and special function registers (SPR).
- ✓ According to the type of the microcontroller, these banks may vary.
- ✓ The PIC16F877 chip only has four banks (BANK 0, BANK 1, BANK 2, and BANK4).
- ✓ Each bank holds 128 bytes of addressable memory.

DATA MEMORY



File Address	Bank 0	File Address	Bank 1	File Address	Bank 2	File Address	Bank 3
00h	Indirect addr.(*)	80h	Indirect addr.(*)	100h	Indirect addr.(*)	180h	Indirect addr.(*)
01h	TMR0	81h	OPTION_REG	101h	TMR0	181h	OPTION_REG
02h	PCL	82h	PCL	102h	PCL	182h	PCL
03h	STATUS	83h	STATUS	103h	STATUS	183h	STATUS
04h	FSR	84h	FSR	104h	FSR	184h	FSR
05h	PORTA	85h	TRISA	105h		185h	
06h	PORTB	86h	TRISB	106h	PORTB	186h	TRISB
07h	PORTC	87h	TRISC	107h		187h	
08h	PORTD(1)	88h	TRISD(1)	108h		188h	
09h	PORTE(1)	89h	TRISE(1)	109h		189h	
0Ah	PCLATH	8Ah	PCLATH	10Ah	PCLATH	18Ah	PCLATH
0Bh	INTCON	8Bh	INTCON	10Bh	INTCON	18Bh	INTCON
0Ch	PIR1	8Ch	PIE1	10Ch	EEDATA	18Ch	EECON1
0Dh	PIR2	8Dh	PIE2	10Dh	EEADR	18Dh	EECON2
0Eh	TMR1L	8Eh	PCON	10Eh	EEDATH	18Eh	Reserved(2)
0Fh	TMR1H	8Fh		10Fh	EEADRH	18Fh	Reserved(2)
10h	T1CON	90h		110h	General Purpose Register 16 Bytes	190h	General Purpose Register 16 Bytes
11h	TMR2	91h	SSPCON2	111h		191h	
12h	T2CON	92h	PR2	112h		192h	
13h	SSPBUF	93h	SSPADD	113h		193h	
14h	SSPCON	94h	SSPSTAT	114h		194h	
15h	CCPR1L	95h		115h		195h	
16h	CCPR1H	96h		116h		196h	
17h	CCP1CON	97h		117h		197h	
18h	RCSTA	98h	TXSTA	118h		198h	
19h	TXREG	99h	SPBRG	119h		199h	
1Ah	RCREG	9Ah		11Ah		19Ah	
1Bh	CCPR2L	9Bh		11Bh		19Bh	
1Ch	CCPR2H	9Ch	CMCON	11Ch		19Ch	
1Dh	CCP2CON	9Dh	CVRCON	11Dh		19Dh	
1Eh	ADRESH	9Eh	ADRESL	11Eh		19Eh	
1Fh	ADCON0	9Fh	ADCON1	11Fh		19Fh	
20h	General Purpose Register 96 Bytes	A0h	General Purpose Register 80 Bytes	120h	General Purpose Register 80 Bytes	1A0h	General Purpose Register 80 Bytes
7Fh		EFh	accesses 70h-7Fh	16Fh	accesses 70h-7Fh	1EFh	accesses 70h - 7Fh
		F0h		170h		1F0h	
	Bank 0	FFh	Bank 1	17Fh	Bank 2	1FFh	Bank 3


Thank
you