SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Sub: Microcontroller Programming And Interfacing

Subcode:23ECB202
Unit-I

PIC Microcontrollers: History, Features, & Architecture
Topic: PIC16F877A Block Diagram

Introduction

- ## What is PIC?

  - A family of Harvard architecture microcontrollers made by Microchip Technology

  - Derived from the PIC1650 originally developed by General Instrument Microelectronics Division.

  - The name PIC was originally an acronym for "**Programmable Intelligent Computer**".

Introduction

Why PIC is popular?

- low cost, wide availability with high clock speed
- availability of low cost or free development tools
- Only 37 instructions to remember
- serial programming and re-programming with flash memory capability
- Its code is extremely efficient, allowing the PIC to run with typically less program memory than its larger competitors
- PIC is very small and easy to implement for non-complex problems and usually accompanies to the microprocessors as an interface
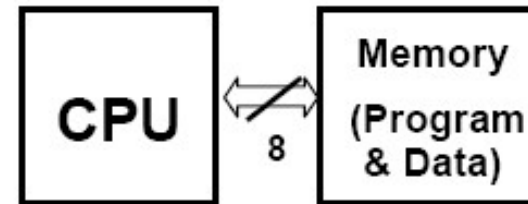
Two Different Architectures

- Harvard Architectures
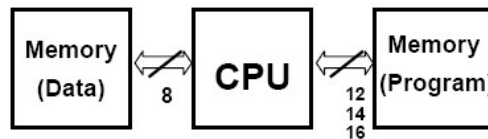 (newer arch.)

- Von-Neumann Architecture
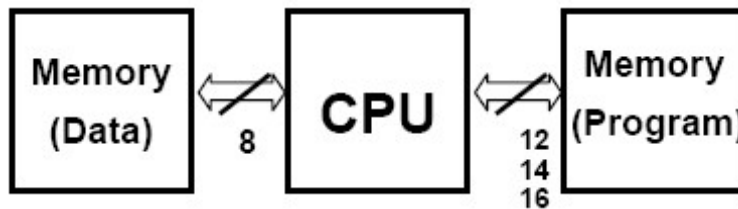
Harvard Architecture

Von–Neumann Architecture
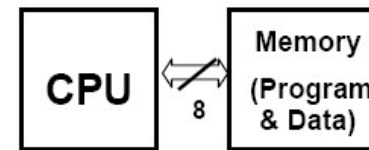
Two Different Architectures

- Harvard Architectures

Harvard Architecture

- Used mostly in RISC CPUs

- Separate program bus and data bus: can be of different widths

- For example, PICs use:
  - Data memory (RAM): a small number of 8bit registers
  - Program memory (ROM): 12bit, 14bit or 16bit wide (in EPROM, FLASH, or ROM)

- Von-Neumann Architecture

Von-Neumann Architecture

- Used in: 80X86 (CISC PCs)

- Only one bus between CPU and memory

- RAM and program memory share the same bus and the same memory, and so must have the same bit width

- **Bottleneck**: Getting instructions interferes with accessing RAM

ARCHITECTURE

- IC Microcontroller architecture is based on Harvard architecture and supports RISC architecture (Reduced Instruction Set Computer).

- The PIC microcontroller architecture consists of memory organization (RAM, ROM, STACK), CPU, timers, counters, ADC, DAC, serial communication, a CCP (Capture, Compare, PWM) module, and I/O ports.

- PIC microcontroller also supports protocols like CAN, SPI, and UART for interfacing with other peripherals.

PIC MICROCONTROLLER ARCHITECTURE
block diagram
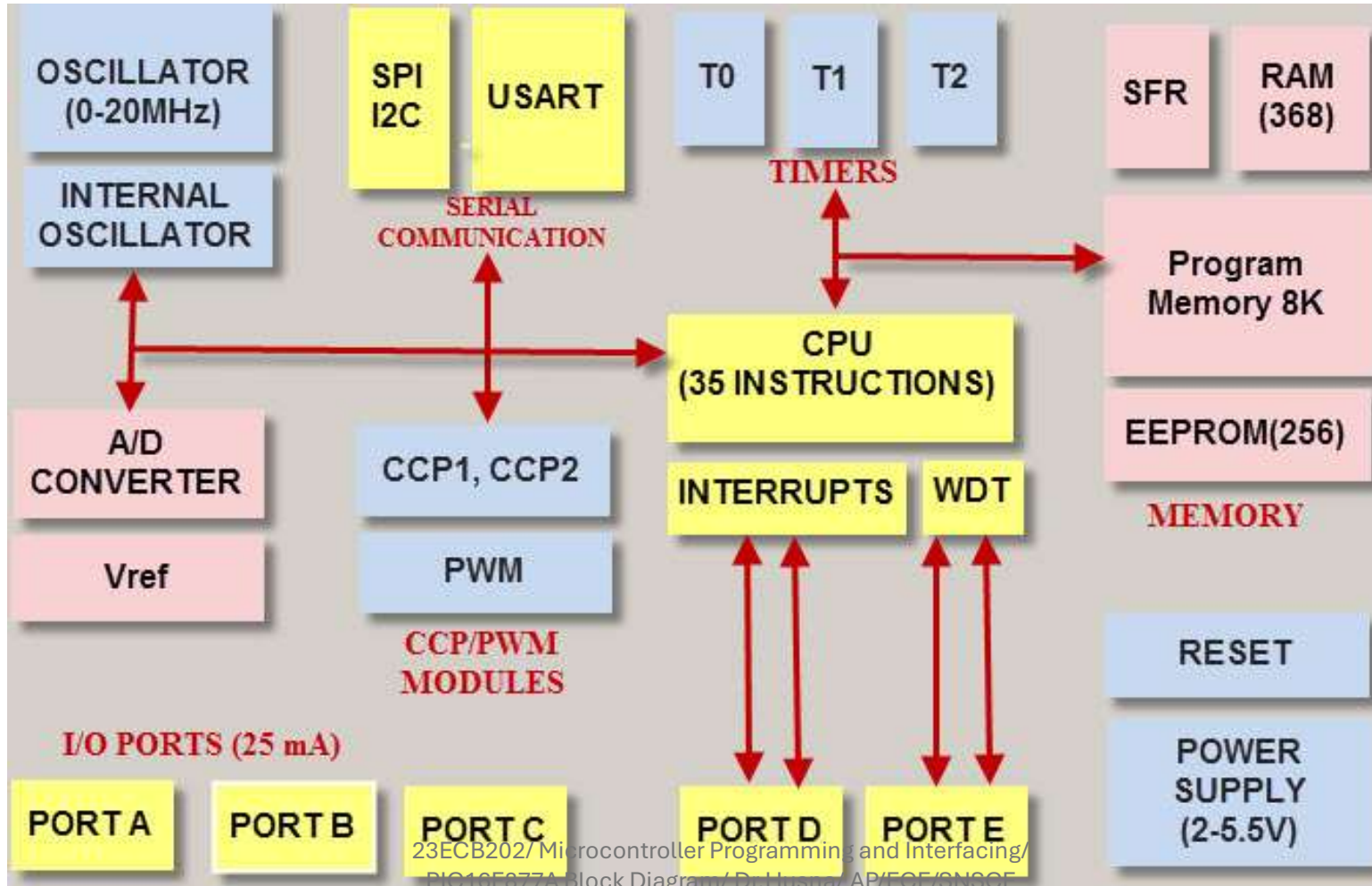
CPU (Central Processing Unit):

PIC microcontroller's CPU consists of

1. Arithmetic logic unit (ALU)
2. Memory unit (MU)
3. Control unit (CU)
4. Accumulator

- ALU is used for arithmetic operations and for logical decisions.
- Memory is used for storing the instructions after processing.
- Control unit is used to control the internal and external peripherals which are connected to the CPU and accumulator is used for storing the results.

MEMORY ORGANIZATION:

- PIC microcontroller memory module consists of mainly 3 types of memories:
1. Program memory
2. Data memory

PROGRAM MEMORY:

- It contains the written program after we burned it in microcontroller.

- Program Counter executes commands stored in the program memory, one after the other.

- PIC microcontroller can have 8K words x 14 bits of Flash program memory that can be electrically erased and reprogrammed.

- Whenever we burn program into the micro, we erase an old program and write a new one.

DATA MEMORY:

- It is a RAM type which is used to store the data temporarily in its registers.

- The RAM memory is classified into banks. Each bank extends up to 7Fh (128 bytes).

- Number of banks may vary depending on the microcontroller.

- PIC16F84 has only two banks. Banks contain Special Function Registers (SFR) and General Purpose Registers (GPR).

- The lower locations of each bank are reserved for the Special Function Registers and upper locations are for General Purpose Registers.

General Purpose Registers (GPR):

o These registers don't have any special function.

o These are used for general purpose for multiplying, addition or subtraction and then storing the results in other registers.

o CPU can easily access the data in these registers.

Special Function Registers (SFR):

o These registers are used for special purposes and they cannot be used as normal registers.

o Their function is set at the time of manufacturing.

o They perform the function assigned to them and user cannot change the function of SFR.

o Three important SFRs for programming are:

1. STATUS register   : It changes the bank
2. PORT registers   : It assigns logic values 0 or 1 to the ports
3. TRIS registers   : It is a data direction register for input and output
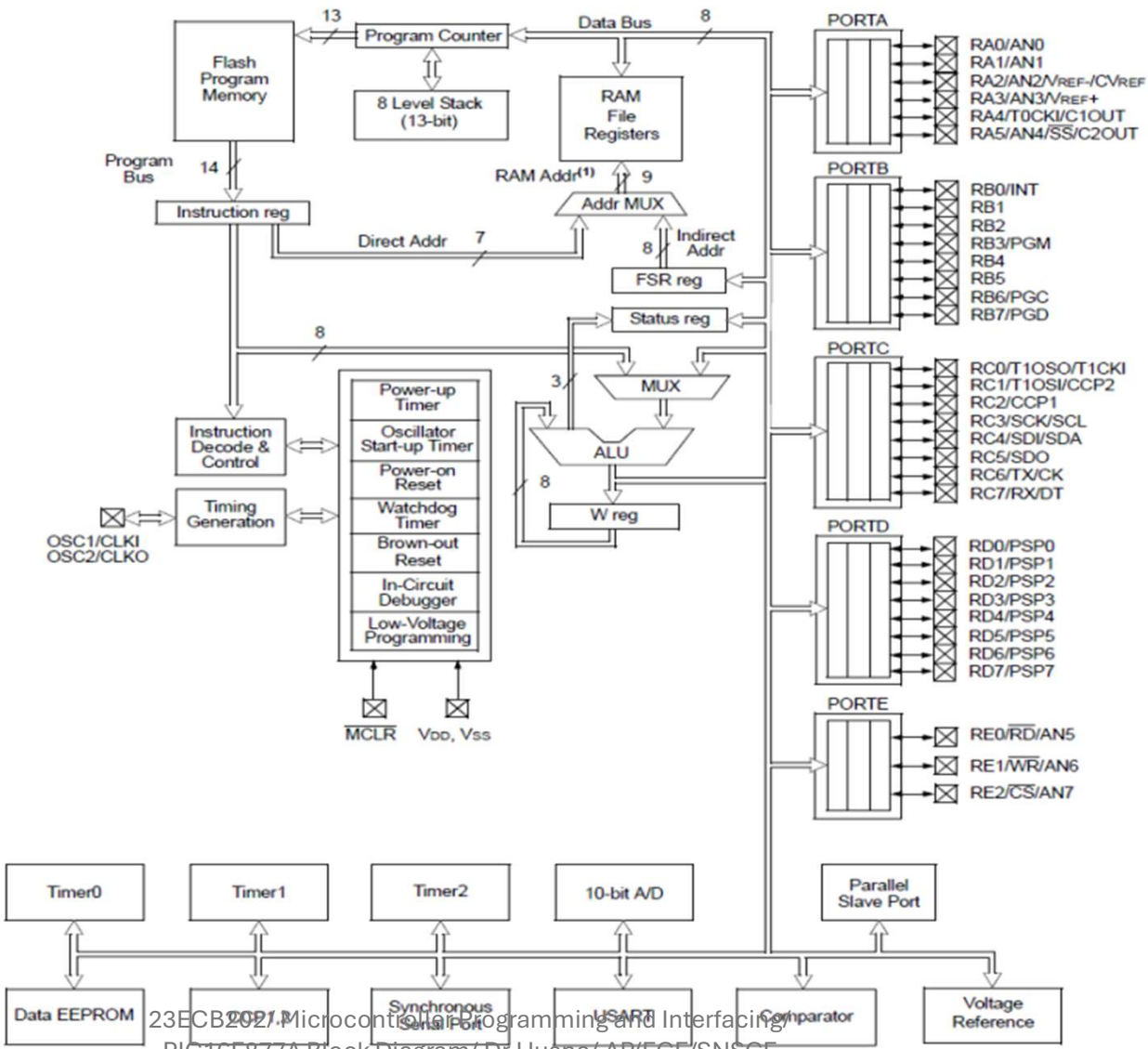
DATA EEPROM:

- This memory allows storing the variables as a result of burning the written program.

- It is readable and writable during normal operation (over the full VDD range).

- This memory is not directly mapped in the register file.

- It is indirectly addressed through the SFRs.

- There are six SFRs which are used to read and write to this memory (EECON1, EECON2, EEDATA, EEDATH, EEADR, EEADRH).
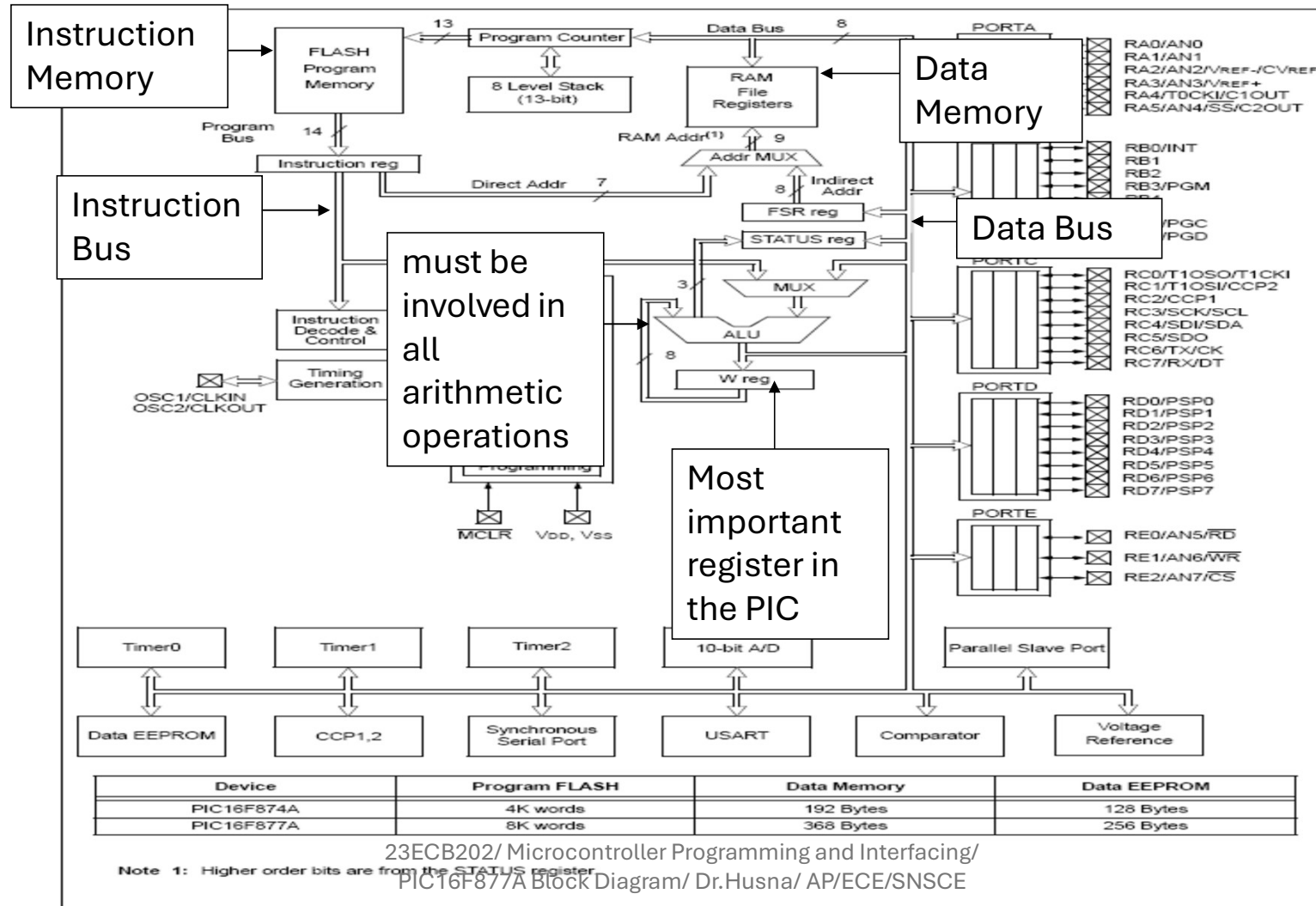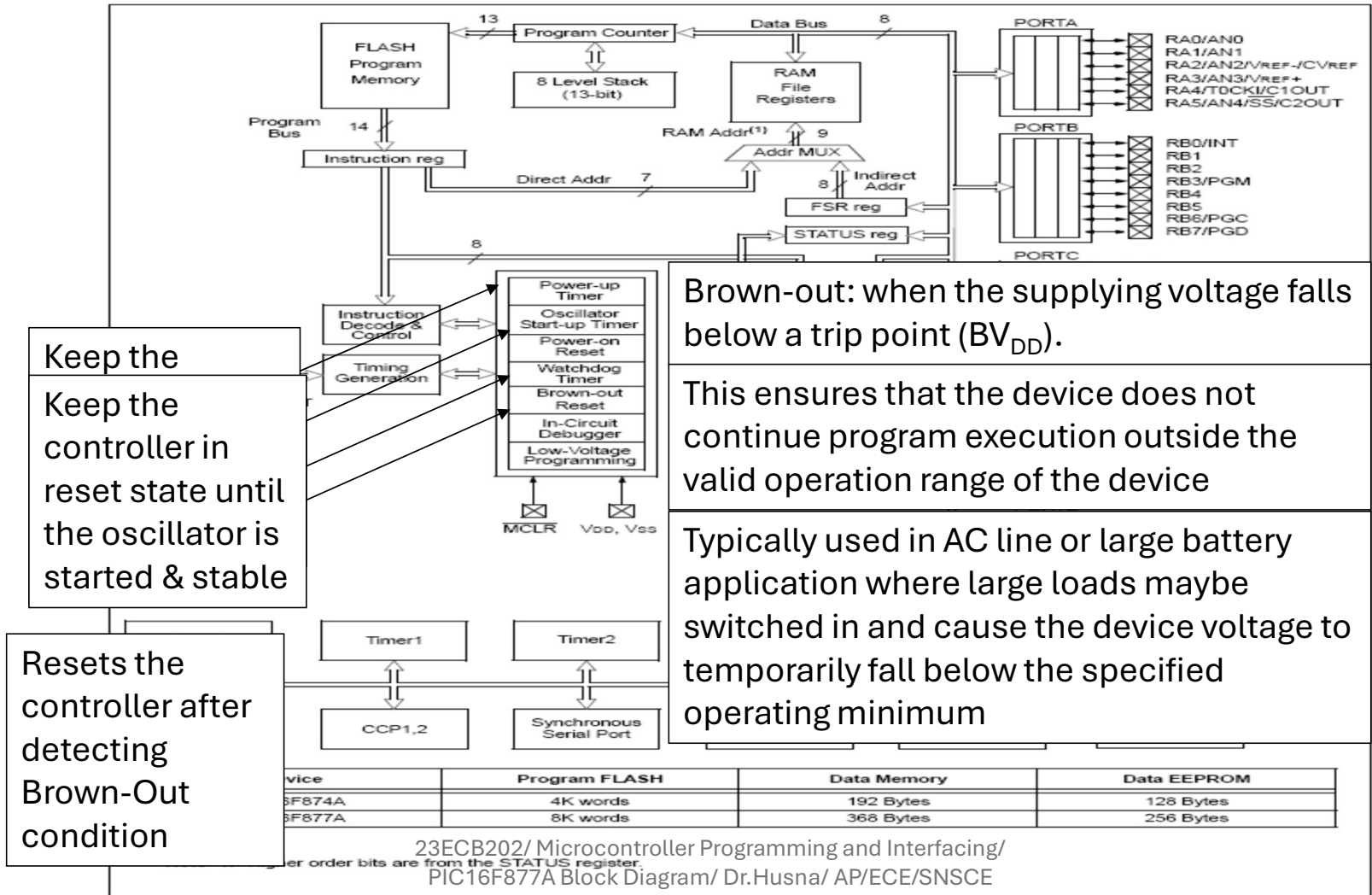
PIC16F877a Architecture

PIC16F877A Block Diagram

PIC16F877A Block Diagram

Brown-out: when the supplying voltage falls below a trip point (BV_{DD}).

This ensures that the device does not continue program execution outside the valid operation range of the device

Typically used in AC line or large battery application where large loads maybe switched in and cause the device voltage to temporarily fall below the specified operating minimum

Keep the

Keep the controller in reset state until the oscillator is started & stable

Resets the controller after detecting Brown-Out condition

vice	Program FLASH	Data Memory	Data EEPROM
6F874A	4K words	192 Bytes	128 Bytes
6F877A	8K words	368 Bytes	256 Bytes