

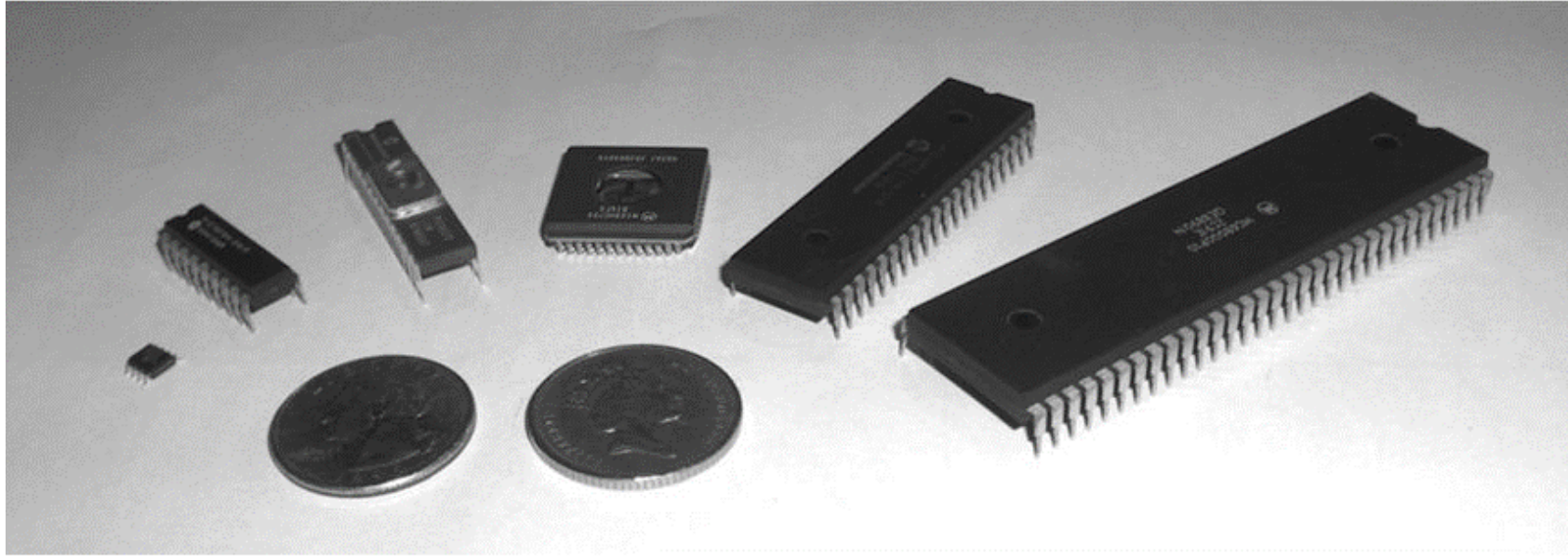


MICROCONTROLLER

What is a MICROCONTROLLER?

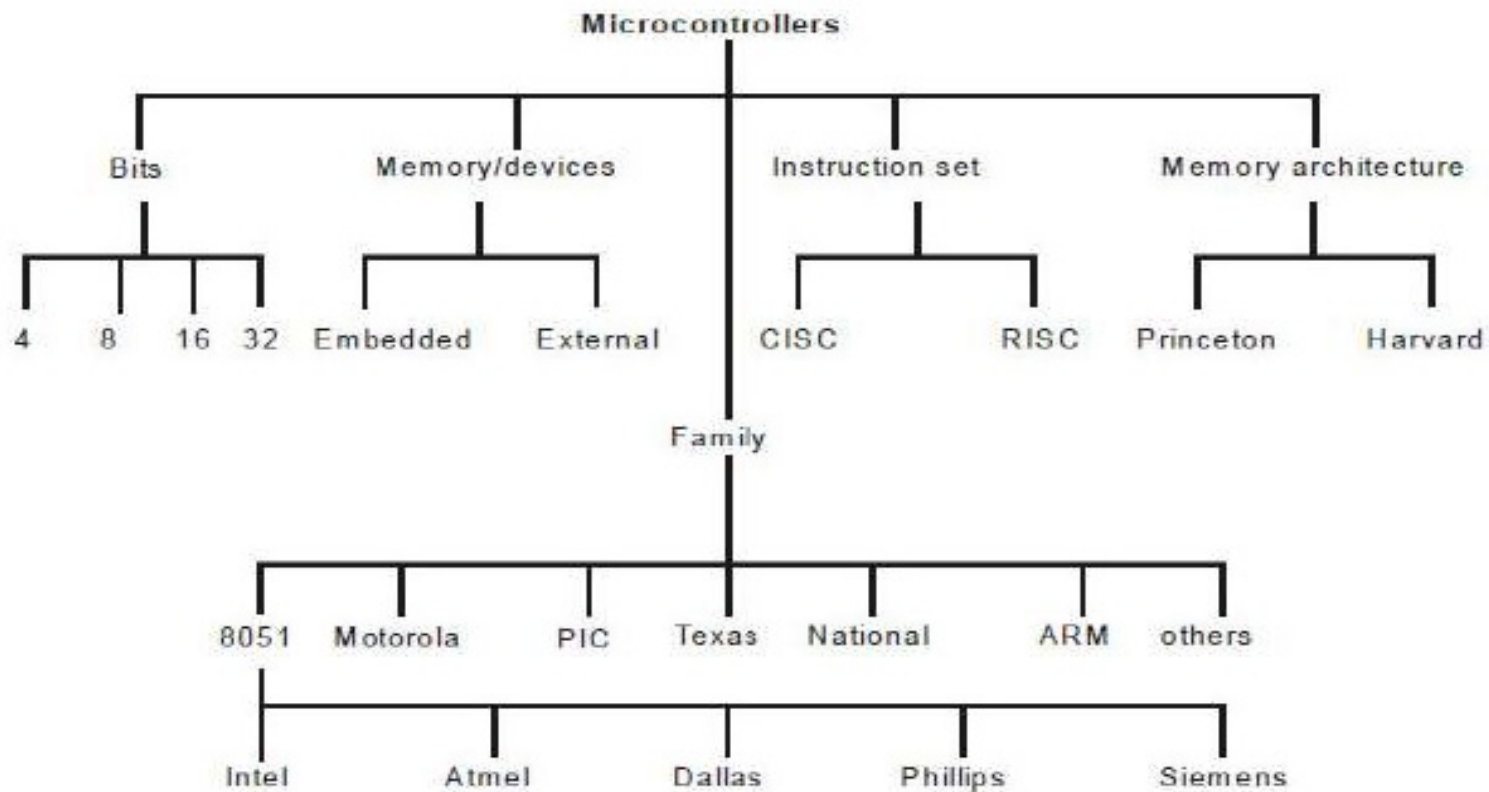
- A microcontroller is an integrated circuit (IC) that can be programmed to perform a set of functions to control a collection of electronic devices.
- A self-contained system in which a processor, support, memory, and input/output (I/O) are all contained in a single package.
- Being programmable is what makes the microcontroller unique.

Microcontroller Packaging and Appearance



From left to right: PIC 12F508, PIC 16F84A, PIC 16C72,
Motorola 68HC05B16, PIC 16F877, Motorola 68000

Types of Microcontrollers



According to Bits : 4 bit microcontroller

- ALU performs arithmetic and logical operations on a nibble (4-bits) at an instruction.
- Internal bus width of 4-bit.
- Small size, minimum pin count and low cost controllers.
- Low power consumption and used for low end applications like LED & LCD display drivers, portable battery chargers.
- Examples: Renasa M34501 256 and ATAM862 series from ATMEL.

8 bit microcontroller

- ALU performs arithmetic and logical operations on a byte (8-bits) at an instruction.
- Internal bus width of 8-bit.
- Examples: Intel 8051 family and Motorola MC68HC11 family

16 bit microcontroller

- ALU performs arithmetic and logical operations on a word (16-bits) at an instruction.
- Internal bus width of 16-bit microcontroller is of 16-bit.
- Enhanced performance, computing capability and greater precision as compared to the 8-bit microcontrollers.
- Examples: Intel 8096 family, Motorola MC68HC12 and MC68332 families.

32 bit microcontroller

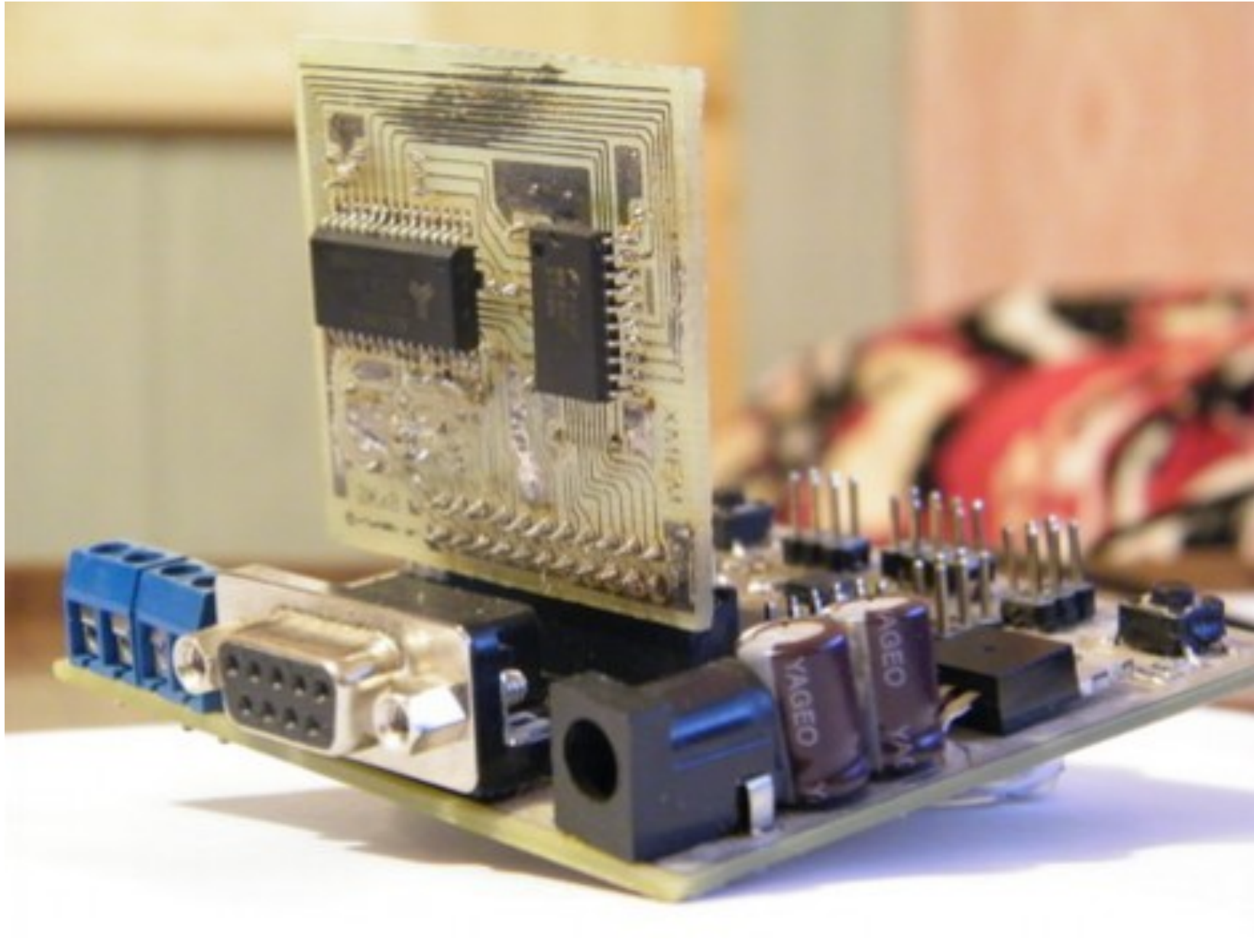
- ALU performs arithmetic and logical operations on a double word (32-bits) at an instruction.
- Internal bus width of 32-bit.
- Much more enhanced performance, computing capability with greater precision as compared to 16-bit microcontrollers.
- Examples: Intel 80960 family, Motorola M683xx and Intel/Atmel 251 family.

According to Memory/Devices : EMBEDDED MICROCONTROLLERS

- An embedded system has a microcontroller unit that has all the functional blocks (including program as well as data memory) available on a the same chip.
- Example: 8051 having Program & Data Memory, I/O Ports, Serial Communication, Counters and Timers and Interrupt Control logic on the chip.

EXTERNAL MEMORY MICROCONTROLLERS

- An external system has a microcontroller unit that does not have all the functional blocks available on a chip.
- All or part of the memory units are externally interfaced using an interfacing circuit called the glue circuit.
- Example: 8031 has no program memory on the chip.



According to Instruction Set : CISC (COMPLEX INSTRUCTION SET COMPUTER) ARCHITECTURE MICROCONTROLLERS

- Has an instruction set that supports many addressing modes for the arithmetic and logical instructions, data transfer and memory accesses instructions.
- Many of the instructions are macro like.
- Allows the programmer to use one instruction in place of many simpler instructions. } Example: Intel 8096 family.

RISC (REDUCED INSTRUCTION SET COMPUTER) ARCHITECTURE MICROCONTROLLERS

- Contains an instruction set that supports fewer addressing modes for the arithmetic and logical instructions and for data transfer instructions.
- Allows simultaneous access of program and data.
- Instruction pipelining increases execution speed
- Allow each instruction to operate on any register or use any addressing mode.
- Smaller chip and pin count.
- Very low power consumption

According to **MEMORY ARCHITECTURE**

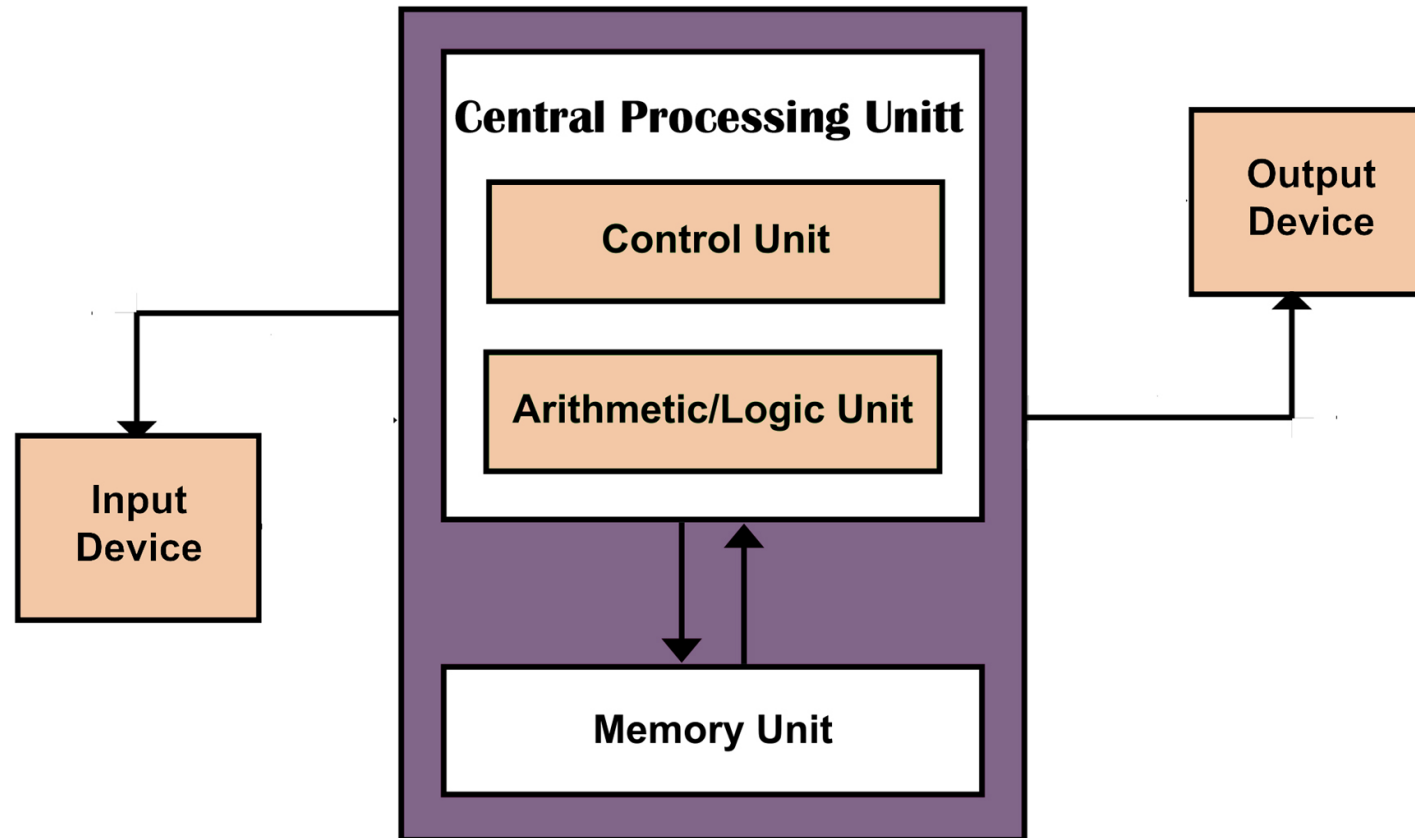
The architectures of microcontrollers differ in the way data and programs are stored and accessed.

1. Von-Neuman/Princeton Architecture
2. Harvard Architecture

1. Von-Neuman/Princeton Architecture

- Single data bus that is used to fetch both instructions and data. Program instructions and data are stored in a common main memory.
- When such a controller addresses main memory, it first fetches an instruction, and then it fetches the data to support the instruction.
- Simplifies the microcontroller design because only one memory is accessed.
- The weakness is that two separate fetches can slow up the controller's operation.
- Example: Motorola 68HC11.

Von-Neuman/Princeton Architecture

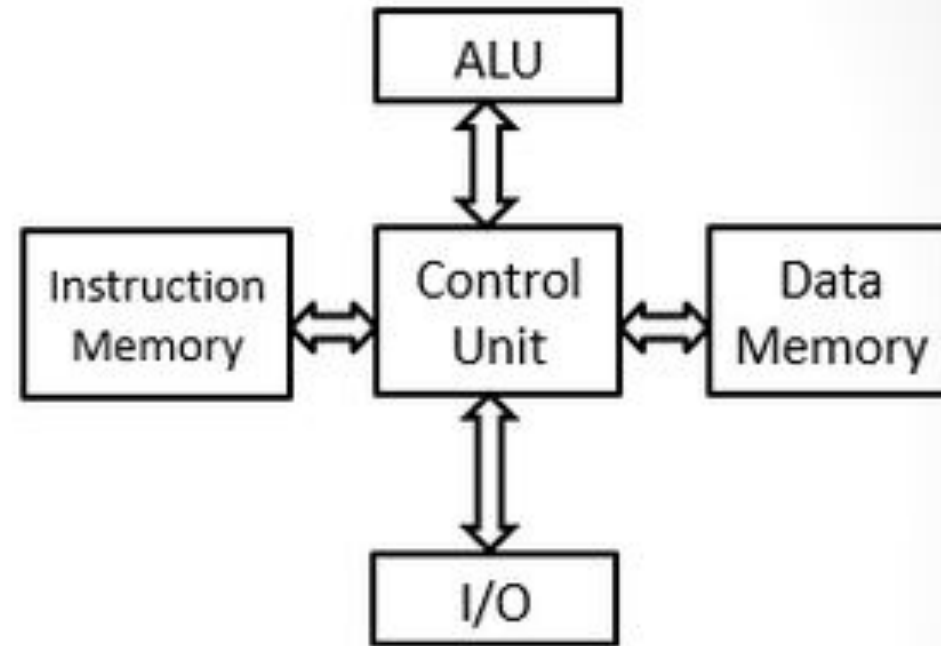


Von Neumann Architecture

2. HARVARD ARCHITECTURE

- Separate data bus and an instruction bus.
- Execution occur in parallel.
- Much faster execution than Von-Neuman architecture.
- Design complexity.
- Example: intel MCS-51 family and PIC microcontrollers

HARVARD ARCHITECTURE



Harvard Model

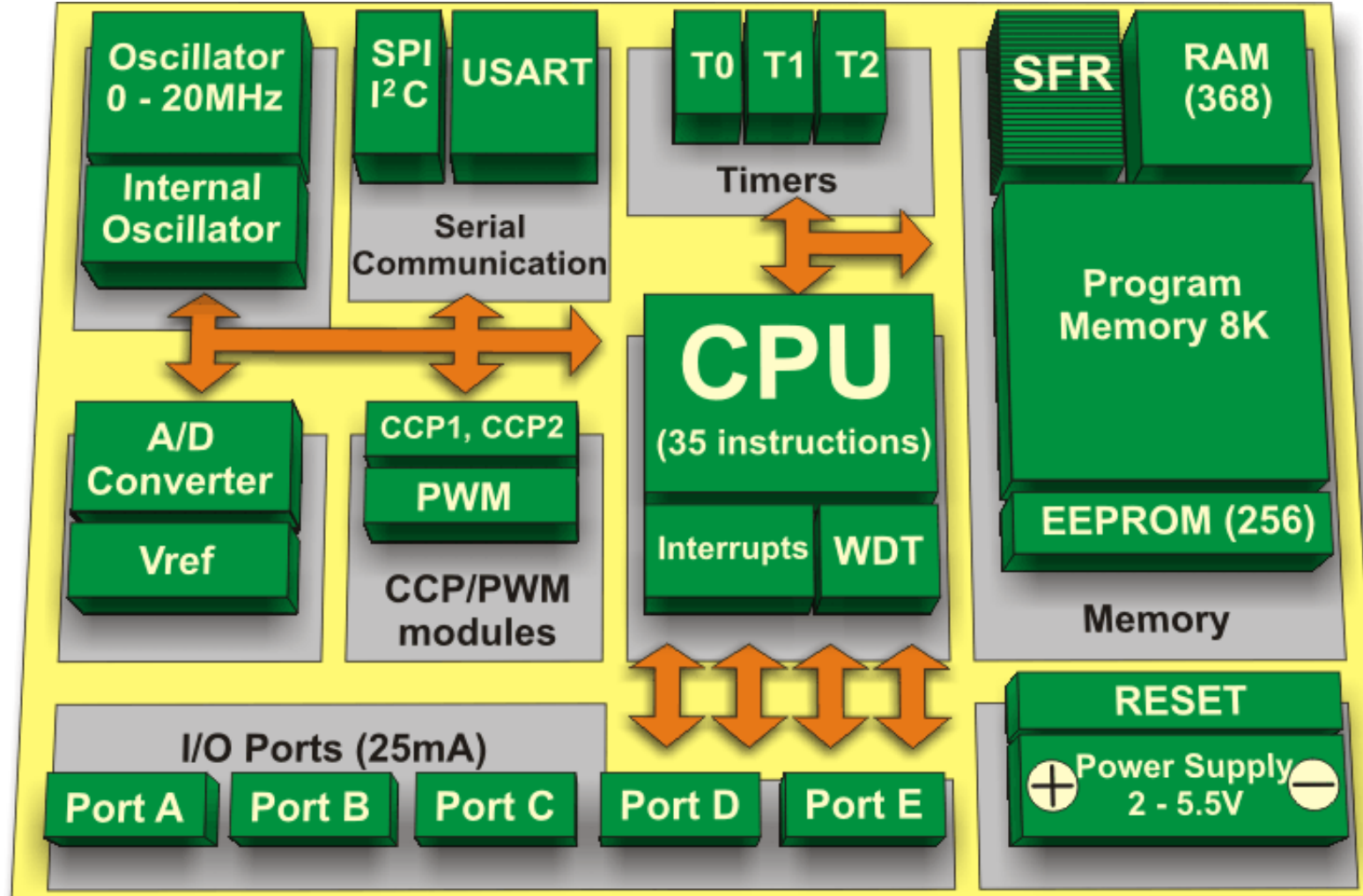
MICROCONTROLLER OPERATION

- When a microcontroller is mounted on a circuit board with other components function as a single unit, is referred as a module or a microcontroller board.
- A microcontroller module typically consists of microcontroller, a power source, an interface for connecting to a programming device, I/O ports, and additional memory

MICROCONTROLLER OPERATION

- **A power source:** powers the microcontroller and any accompanying components located on the printed circuit board.
- **An interface:** communicate with the controller.
- **A set of input/output (I/O) ports:** send and receive signals from the devices the microcontroller is designed to control.
- I/O ports when programmed as an output pin, each pin can output digital signals. When programmed as an input pin, each pin can receive digital signals.
- Digital-to-analog and analog-to-digital converters change the digital pulses into analog signals.

MICROCONTROLLER OPERATION





Internal Operation

- The microcontroller consists of thousands of digital circuits that are combined into areas to provide specific functions.
- The parts of the microcontroller are used to save data and programs, perform math and logic functions, and generate timing signals.
- The different areas are connected by a bus system. The bus system contains tiny parallel circuits that carry the digital pulse patterns from section to section.
- The ROM stores the program required for the microcontroller to function and controls how the chip components operate and how data and instructions flow through the chip.
- RAM stores programs and data temporarily.
- Ports and registers are special memory locations dedicated to a specific function such as a hardware location or a place to manipulate data.

AREAS OF MICROCONTROLLER APPLICATION

- Home monitoring system.
- Automotive applications such as robotics.
- Appliances such as microwave oven, refrigerators, television and VCRs, stereos.
- Automobiles in engine control, diagnostics, climate control. Environmental control in greenhouse, temperature, humidity, factory, home.
- Instrumentation.
- Aerospace.

Thank You