Processors, Power Supply, and Programming Devices

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Introduction

- The CPU forms what can be considered to be the “brain” of the system.

- The three components of the CPU are:
  - The processor
  - The memory system
  - The power supply

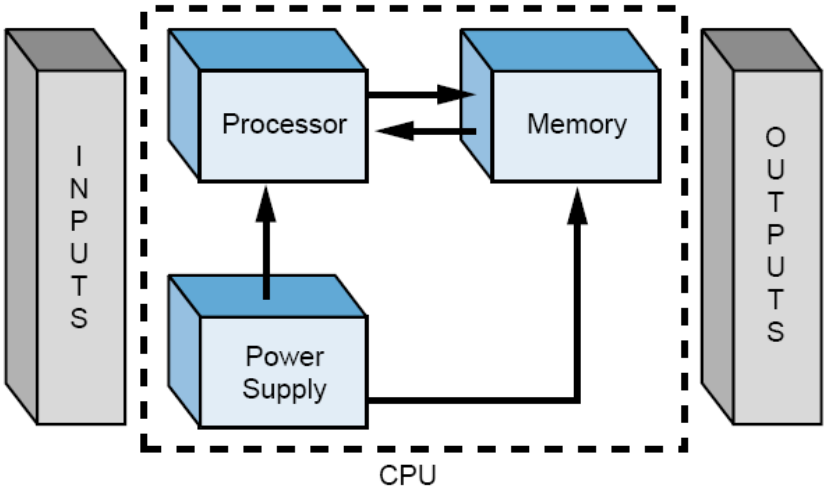


Figure 4-1. CPU block diagram.

Introduction

- The processor executes the control program stored in the memory system in the form of ladder diagrams.
- The system power supply provides all of the necessary voltage levels to ensure proper operation of the processor and memory components.

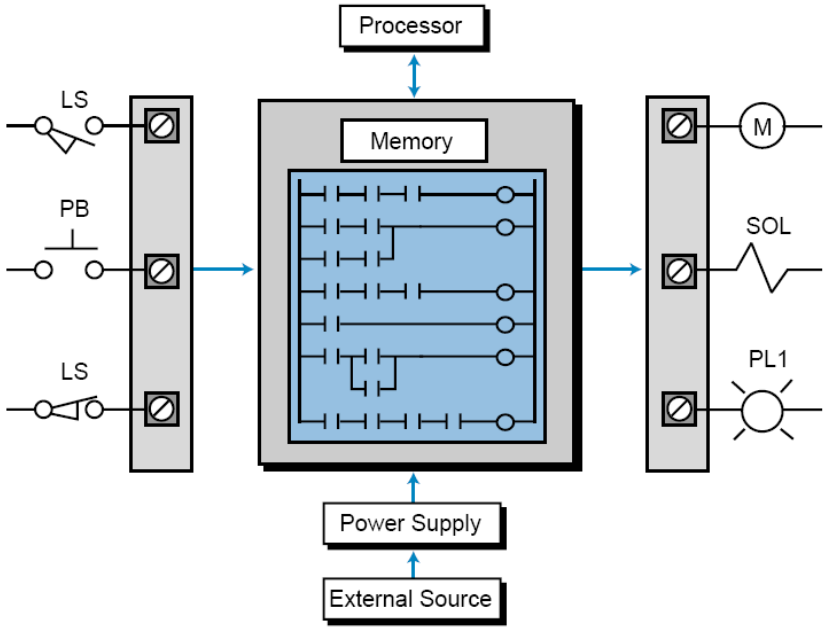


Figure 4-3. Functional interaction of a PLC system.

Processors

- **microprocessors ,** integrated circuits, provide the intelligence of today's programmable controllers.
- They perform mathematical operations, data handling, and diagnostic routines.
- The principal function of the processor is to command and govern the activities of the entire system.
  - It performs this function by interpreting and executing a collection of system programs known as the executive.
- Microprocessors are categorized according to their word size, or the number of bits that they use simultaneously to perform operations.
  - Standard word lengths are 8, 16, and 32 bits. This word length affects the speed at which the processor performs most operations.

Processors

Courtesy of Allen-Bradley, Highland Heights, OH

Figure 4-4. Allen Bradley's PLC processors—models 5/12, 5/15, and 5/25.

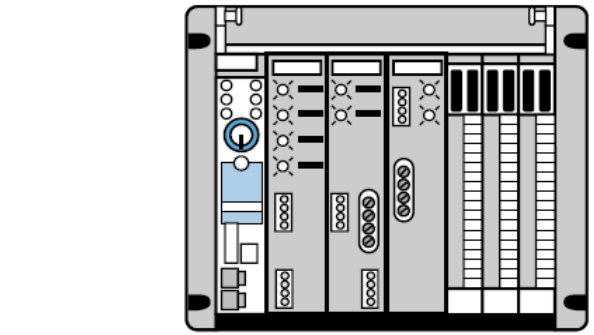


Figure 4-5. A multiprocessor configuration.

Processor Scan

- The basic function of a programmable controller is to the field input devices, execute the control program, and then turn the field output devices ON or OFF accordingly.

- Turning the output devices ON or OFF occurs in two steps.
  - First, as the processor executes the internal programmed logic, it will turn each of its programmed internal output coils ON or OFF. The energizing or de-energizing of these internal outputs will not, however, turn the output devices ON or OFF.

  - Next, when the processor has finished evaluating all of the control logic program that turns the internal coils ON or OFF, it will perform an update to the output interface modules, thereby turning the field devices connected to each interface terminal ON or OFF.

Processor Scan

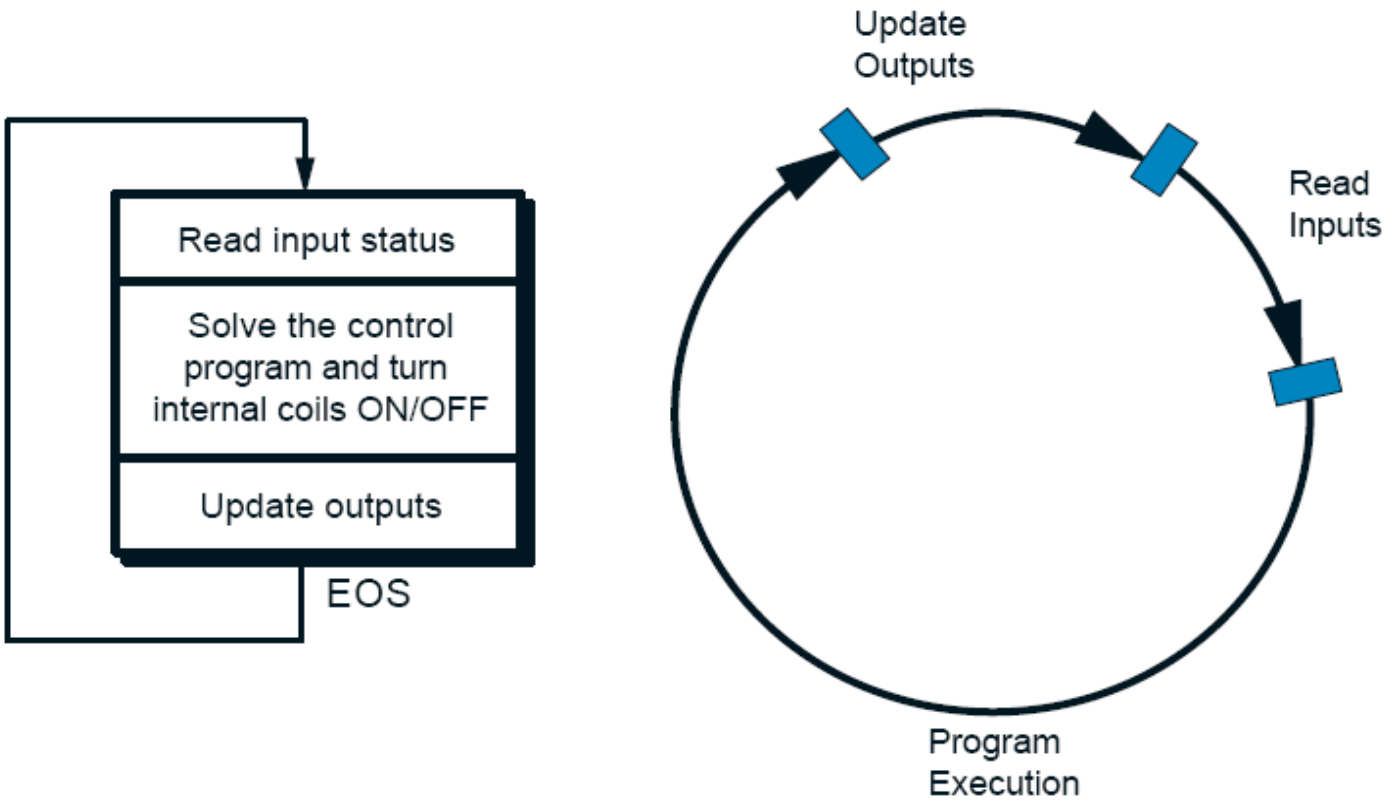
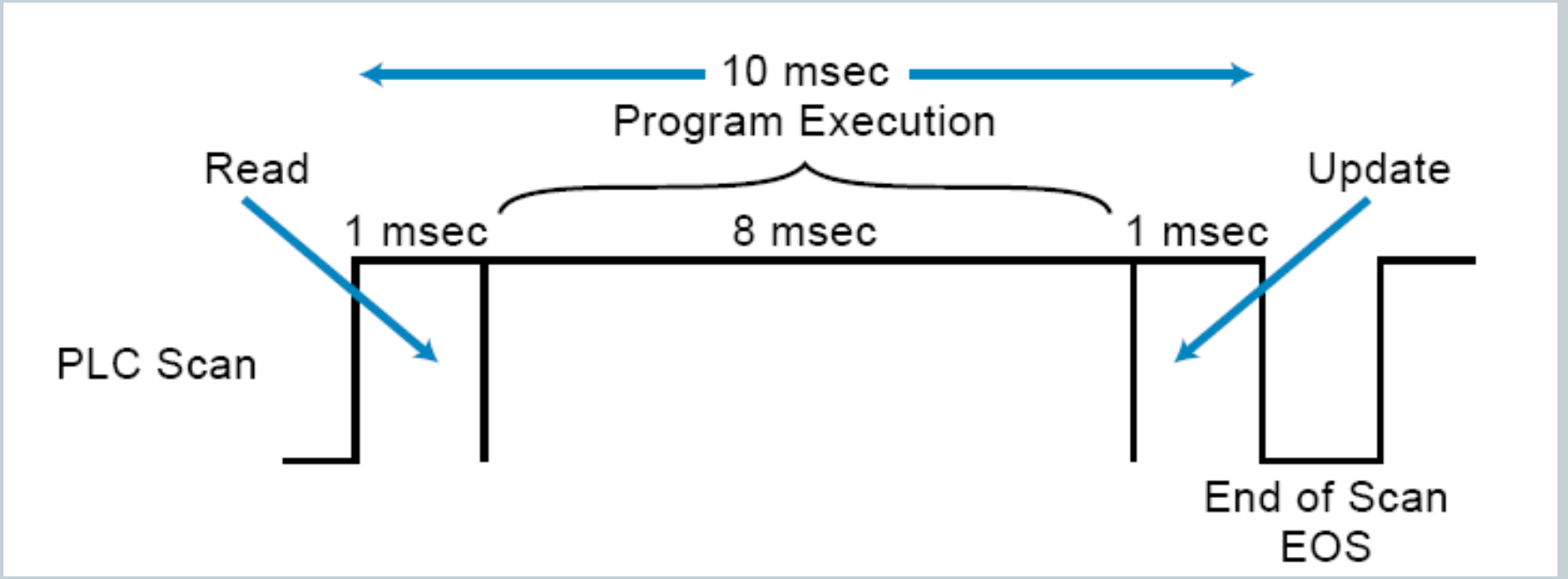


Figure 4-7. PLC total scan representation.

Processor Scan



Processor Scan Example

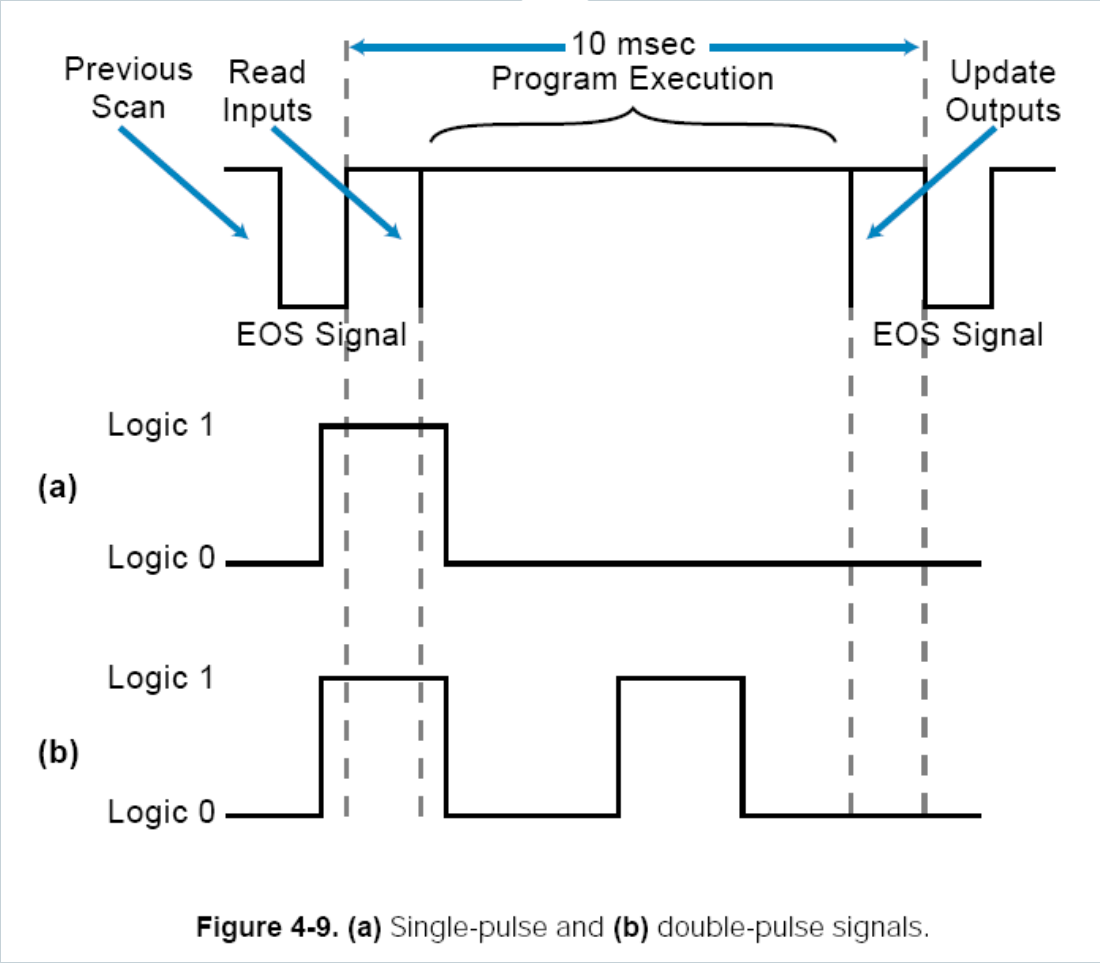


Figure 4-9. (a) Single-pulse and **(b)** double-pulse signals.

The System Power Supply

- The system power supply responsibility is:
  - Provide internal DC voltages to the system components (i.e., processor, memory, and input/output interfaces).
  - Monitor and regulate the supplied voltages
  - Warn the CPU if something is wrong.

- Usually, PLC power supplies require input from an AC power source (120 VAC or 220 VAC).

The System Power Supply

- A **constant voltage transformer** compensates for voltage changes at its input (the primary) to maintain a steady voltage to its output (the secondary).

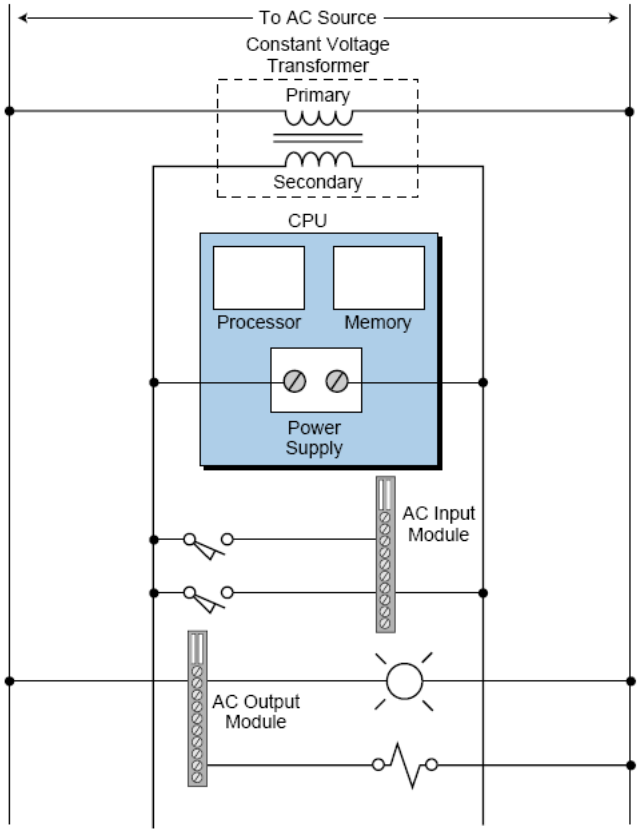
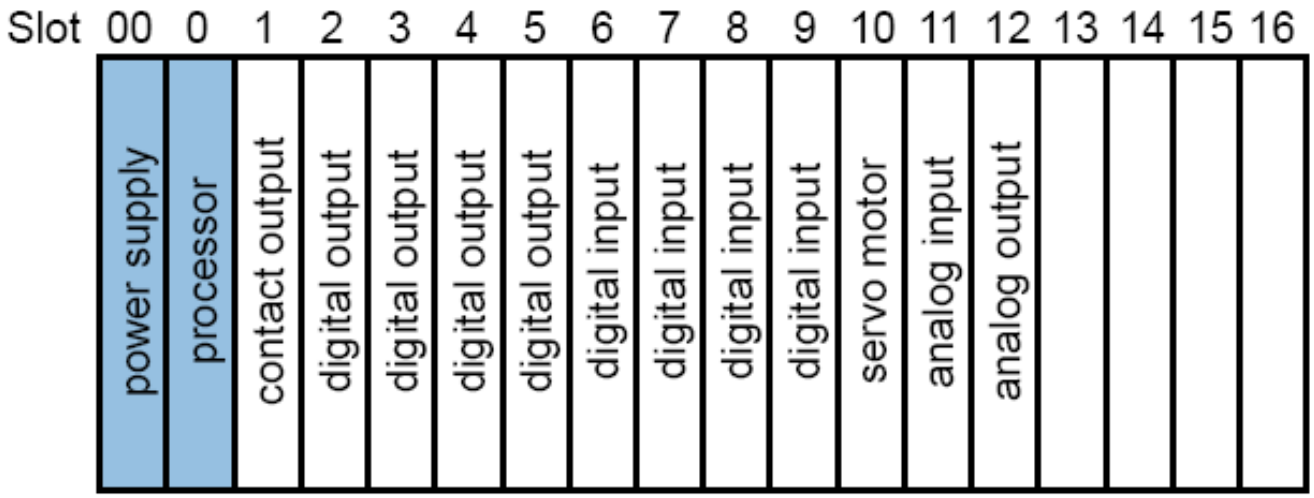


Figure 4-20. A constant voltage transformer connected to a PLC system (CPU and modules).

The System Power Supply

- Loading Consideration
- The system power supply provides the DC power required by the logic circuits of the CPU and the I/O circuits.
- The power supply has a maximum amount of current that it can provide at a given voltage level (e.g., 10 amps at 5 volts), depending on the type of power supply.

Power Supply Loading Example



Application Note

Power supply requires one slot (slot 00).
Processor requires one slot (slot 0).
Twelve I/O slots are used, four are spare.
Auxiliary power supplies, if required, must be placed in slot 8.

Figure 4-22. Configuration of an example PLC.

Power Supply Loading Example

Module Type	I/O Devices Connected	Connections per Module	# of Modules Required	Module Current @ On State	Total Current Required
Discrete in	50	16	4	250 mA	1000 mA
Discrete out	25	8	4	220 mA	880 mA
Contact	5	4	1	575 mA	575 mA
Analog in	3	4	1	600 mA	600 mA
Analog out	3	4	1	1200 mA	1200 mA
Servo motor	1	1	1	400 mA	400 mA
				TOTAL	4655 mA

Processor's current:	1.2 amps	
Power supplies available:	Type A	3 amps
	Type B	5 amps
	Type C	6 amps
Auxiliary power supply: (placement in slot 8)	Type AA	3 amps
	Type BB	5 amps

Table 4-1. Listing of modules and their current requirements.

Programming Devices

Figure 4-23. A typical miniprogrammer and a small PLC.

Figure 4-24. A removable memory card for a miniprogrammer.

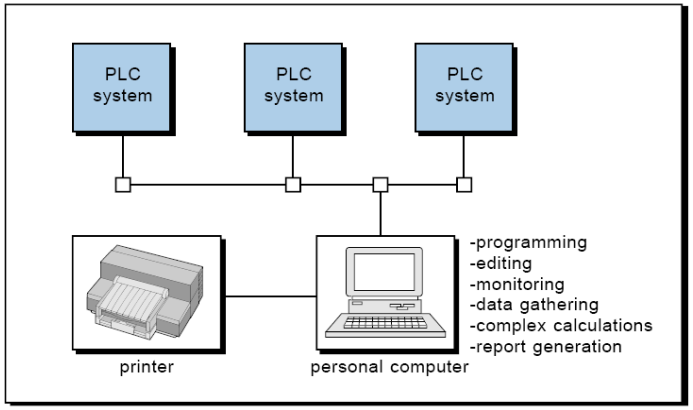


Figure 4-26. A PC connected to a PLC's local area network.

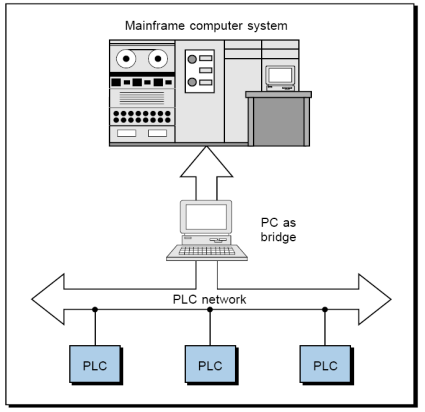


Figure 4-27. A PC acting as a bridge between a PLC network and a mainframe computer system.

Reference: Programmable Controllers: Theory and Implementation by Bryan and Bryan