

Programmable Logic Controllers

Lecture 01

Introduction to PLCs

Definition And History Of The PLC

- A PLC is a user-friendly, microprocessor-based specialized computer that carries out control functions of many types and levels of complexity.
 - Its purpose is to monitor crucial process parameters and adjust process operations accordingly.
 - Used extensively because the PLC – Is easy to set up and program
 - Behaves predictably
 - Ruggedized
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Definition And History Of The PLC

- It can be programmed (to a degree), controlled, and operated by a person unskilled in operating (programming) computers.
- Essentially, a PLC's operator draws the lines and devices of ladder diagrams with a keyboard/mouse onto a display screen.
- The resulting ladder diagram is converted into computer machine language and run as a program.



Example PLCs



Allen-Bradley PLC5 Allen-Bradley SLC500

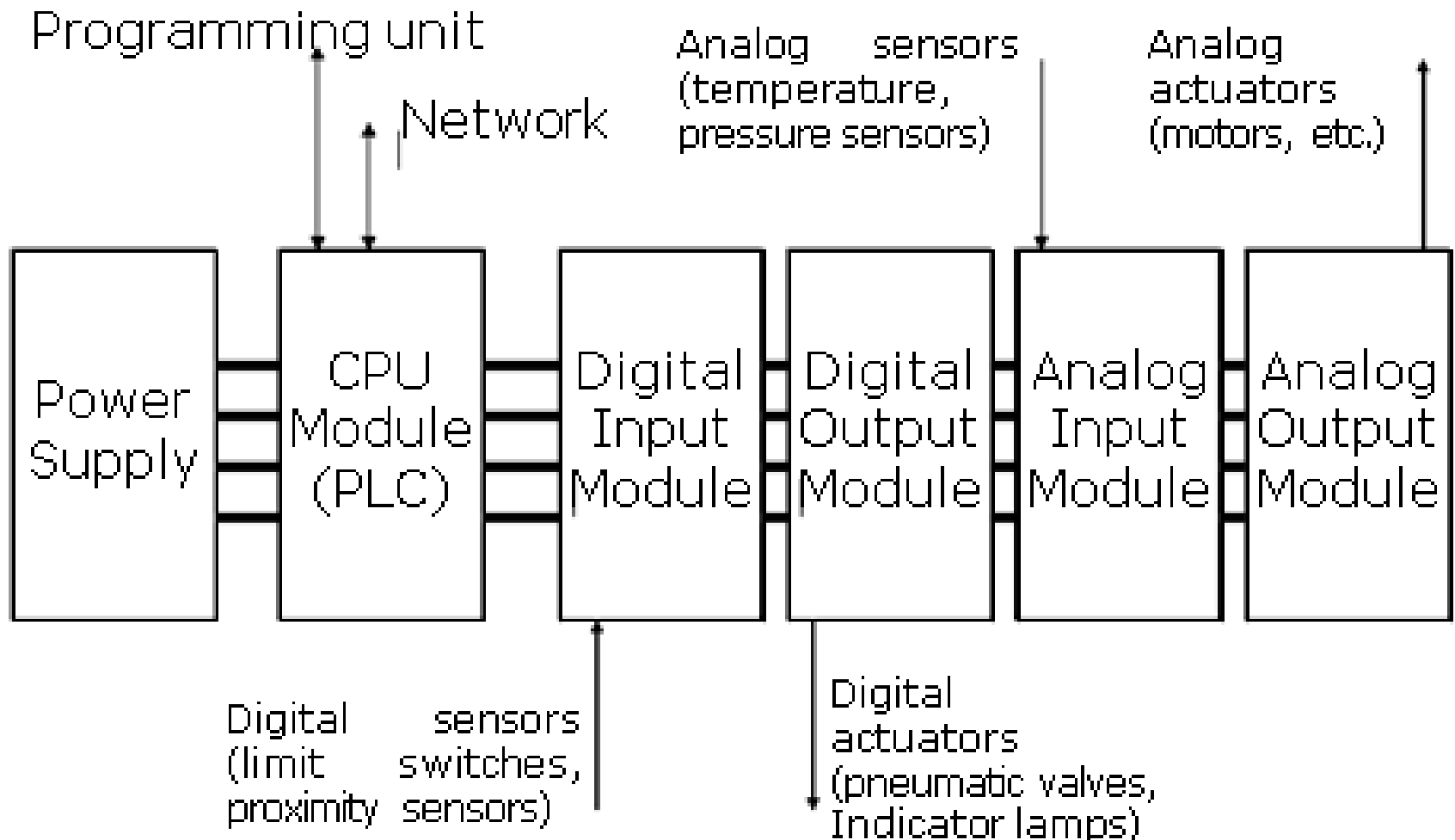


Allen-Bradley Micrologix Allen-Bradley Picocontroller

Components in a PLC system

- CPU module, containing the processor and memory
- Input and output modules, to allow the PLC to read sensors and control actuators
 - A wide variety of types are available
- Power supply for the PLC, and often sensors and low power actuators connected to I/O modules
- A rack or bus so the PLC can exchange data with I/O modules

PLC in a automated system



Additional PLC components

- A **programming unit** is necessary to create, edit and download a user program to the PLC
 - Additional components can include:
 - **Network interfaces**: to allow PLCs to function in a networked environment
 - **Communication adapters** for remote I/O devices: so I/O devices do not have to be physically close to the CPU module
 - **Operator interface** devices: allow monitoring and/or data entry by operators
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- The PLC takes the place of much of the external wiring required for control of a process.

- <http://www.as-uk.co.uk/projectupgrade.html>

- The PLC will operate any system that has output devices that go on and off (known as discrete, or digital, outputs).

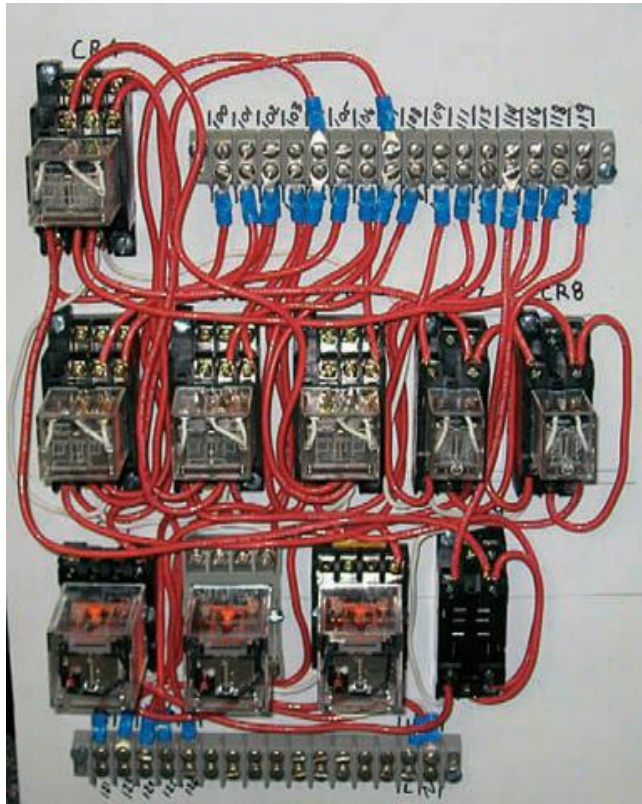
- It can also operate any system with variable (analog) outputs.

- The PLC can be operated on the input side by on-off devices (discrete, or digital) or by variable (analog) input devices.

Definition And History Of The PLC

- The first PLC systems evolved from conventional computers in the late 1960s and early 1970s.
 - These first PLCs were installed primarily in automotive plants.
 - Traditionally, the auto plants had to be shut down for up to a month at model changeover time.
 - The early PLCs were used along with other new automation techniques to shorten the changeover time.
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- One of the major time-consuming changeover procedures had been the wiring of new or revised relay and control panels.



- The PLC keyboard reprogramming procedure replaced the rewiring of a panel full of wires, relays, timers, and other components.
- The new PLCs helped reduce changeover time to a matter of a few days.

PLC Advantages

- **Flexibility**

- In the past, each different electronically controlled production machine required its own controller; 15 machines might require 15 different controllers.
 - Now it is possible to use just one model of a PLC to run any one of the 15 machines.
 - Furthermore, you would probably need fewer than 15 controllers, because one PLC can easily run many machines.
 - Each of the 15 machines under PLC control would have its own distinct program (or a portion of one running program).
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PLC Advantages

- **Implementing Changes and Correcting Errors**

- With a wired relay-type panel, any program alterations require time for rewiring of panels and devices.
 - When a PLC program circuit or sequence design change is made, the PLC program can be changed from a keyboard sequence in a matter of minutes.
 - No rewiring is required for a PLC-controlled system.
 - Also, if a programming error has to be corrected in a PLC control ladder diagram, a change can be typed in quickly.
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PLC Advantages

- **Large Quantities of Contacts**

- The PLC has a large number of contacts for each coil available in its programming.
- Suppose that a panel-wired relay has four contacts and all are in use when a design change requiring three more contacts is made.
 - Time would have to be taken to procure and install a new relay or relay contact block.
- Using a PLC, however, only three more contacts would be typed in.
 - Contacts are now a “software” component

PLC Advantages

- **Lower Cost**

- Increased technology makes it possible to condense more functions into smaller and less expensive packages.
- Now you can purchase a PLC with numerous relays, timers, and counters, a sequencer, and other functions for a few hundred dollars.

- **Pilot Running**

- A PLC programmed circuit can be evaluated in the lab. The program can be typed in, tested, observed, and modified if needed, saving valuable factory time.
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PLC Advantages

• Visual Observation

- A PLC circuit's operation can be seen during operation directly on a CRT screen.
 - The operation or mis-operation of a circuit can be observed as it happens.
 - Logic paths light up on the screen as they are energized.
 - Troubleshooting can be done more quickly during visual observation.
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PLC Advantages

- **Ladder or Boolean Programming Method**

- The PLC programming can be accomplished in the ladder mode by an engineer, electrician or possibly a technician. Alternatively, a PLC programmer who works in digital or Boolean control systems can also easily perform PLC programming.

- **Reliability and Maintainability**

- Solid-state devices are more reliable, in general, than mechanical systems or relays and timers. Consequently, the control system maintenance costs are low and downtime is minimal.

PLC Disadvantages

- **Fixed Program Applications**

- Some applications are single-function applications. It does not pay to use a PLC that includes multiple programming capabilities if they are not needed.
- Their operational sequence is seldom or never changed, so the reprogramming available with the PLC would not be necessary.

- **Fail-Safe Operation**

- In relay systems, the stop button electrically disconnects the circuit; if the power fails, the system stops.
 - This, of course, can be programmed into the PLC; however, in some PLC programs, you may have to apply an input voltage to cause a device to stop. These systems may not be fail-safe.
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PLC Advantages

• Documentation

- An immediate printout of the true PLC circuit is available in minutes, if required.
- There is no need to look for the blueprint of the circuit in remote files.
- The PLC prints out the actual circuit in operation at a given moment.
- Often, the file prints for relay panels are not properly kept up to date. A PLC printout is the circuit at the present time; no wire tracing is needed for verification.