

# PLC Theory – Types of PLCs

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# What is a PLC?

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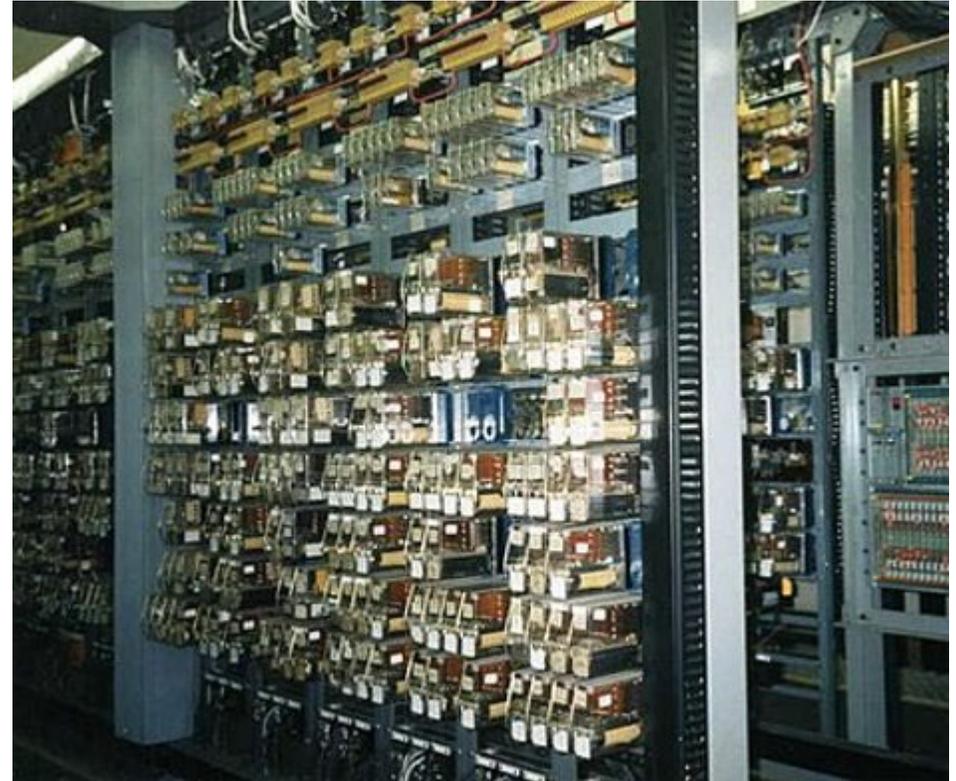
- A Programmable Logic Controller, or PLC, is a ruggedized computer used for industrial automation.
- These controllers can automate a specific process, machine function, or even an entire production line.
- It is less powerful than traditional computers



# History of PLCs

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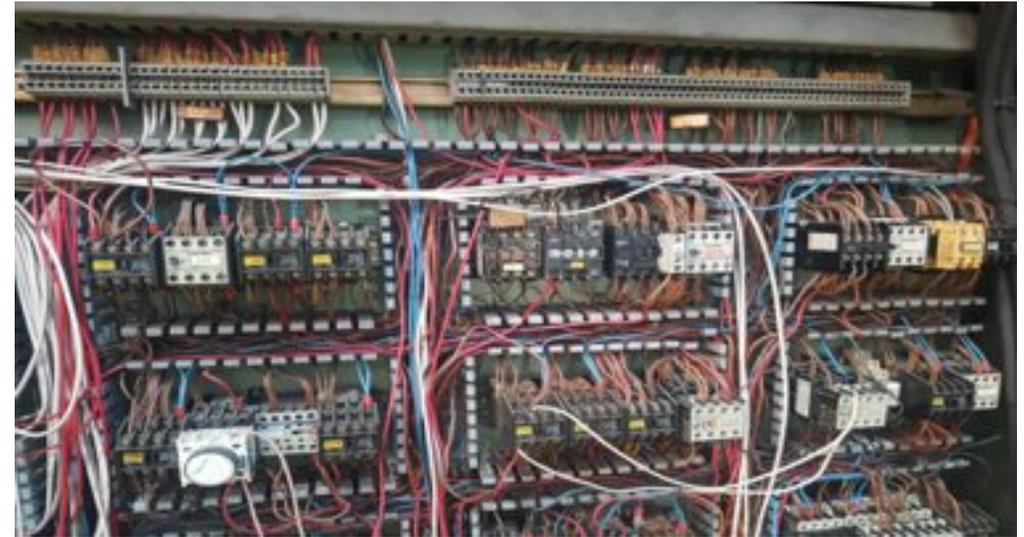
- Before PLCs were commonplace industrial systems would be controlled by relay control panels
- These controllers used many relays, mechanical switches, timers and counters



# History of PLCs

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- The relay control panels took up a lot of space
- They were subject to wear and tear
- There was often wiring issues, and they would take a long time to solve as you had to trace wires
- They were also very time consuming to upgrade
- And upgrading or fixing would mean the shutting down of operation for a period for debugging



# History of PLCs

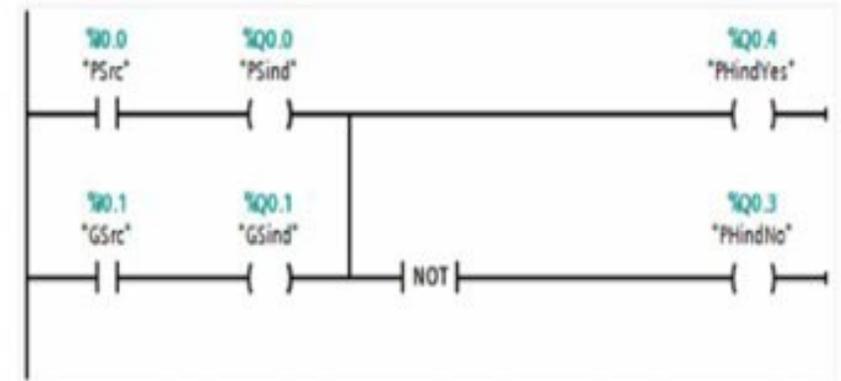
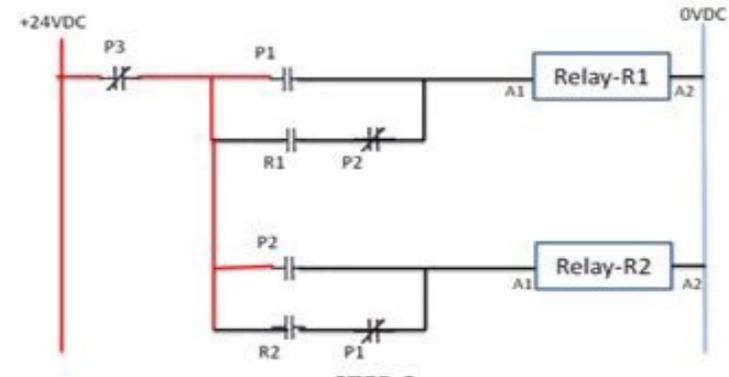
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- In the 1960s General motors identified the requirement of a computer-controlled system
- They highlighted these requirements:
  - Solid state not mechanical
  - Easily modifiable inputs/outputs
  - Ease of programming
  - Be able to function in an industrial environment



# History of PLCs

- They developed a graphical programming language based on Relay Logic Diagrams
- This made the adaptation much easier and meant not a lot of retraining had to be done
- This programming language became known as “Ladder Logic”



# Advantages of PLCs

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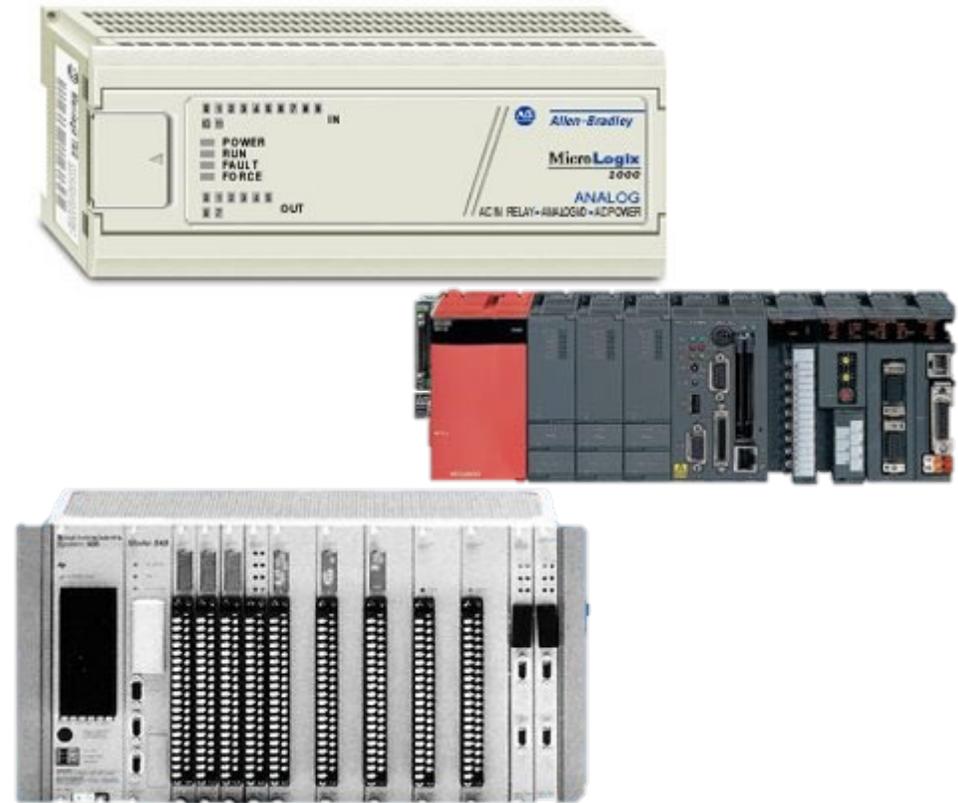
- **The main advantages of using a PLC are:**

- Less time consuming to reprogram than conventional control panels
- Take up less space than conventional control panels
- Can do more complex tasks than conventional control panels
- PLCs are robust and less likely to break down
- PLCs are easier to troubleshoot than conventional control panels
- PLCs are scalable, they can do very small tasks right up to very large tasks

# Types of PLCs

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- There are several different types of PLCs:
  - Unitary
  - Modular
  - Rack Mounted



# Unitary PLCs

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- A compact Programmable Logic Controller (PLC) with all components in a single housing.
- Features
  - Built-in processor, power supply, and input/output (I/O) interfaces.
  - Typically limited I/O capacity
  - Non-expandable – I/O count is fixed.



# Unitary PLCs

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- Advantages:
  - Simple to install and configure.
  - Cost-effective for small automation tasks.
  - Ideal for space-constrained applications.
- Limitations:
  - Not suitable for complex or large-scale systems.
  - Limited programming and communication options.



# Modular PLCs

- A type of PLC system made up of separate, interchangeable modules (CPU, power supply, I/O, communication, etc.).
- Features
  - Expandable I/O – modules can be added as needed.
  - Customizable to suit specific applications.
  - Typically mounted on a rack or chassis.



# Modular PLCs

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- Advantages:

- Scalable – suitable for medium to large automation systems.
- Easier maintenance and upgrades (modules can be swapped).
- Supports advanced communication and networking..

- Limitations:

- Higher cost compared to unitary PLCs.
- Requires more installation space and setup time.



# Rack Mounted PLCs

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- A type of modular PLC where all modules are mounted into a standardized rack or chassis.
- Features
  - Centralized backplane allows modules to communicate and share power/data.
  - Supports a wide range of module types (CPU, analog/digital I/O, comms, etc.).
  - High-performance and highly customizable.



# Rack Mounted PLCs

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- Advantages:
  - Ideal for large, complex, or mission-critical systems.
  - Simplified wiring and module replacement.
  - High reliability and robust design.
- Limitations:
  - Expensive initial investment.
  - Requires significant panel space and skilled installation.



# Comparison

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<b>Feature</b>	<b>Unitary PLC</b>	<b>Modular PLC</b>	<b>Rack-Mounted PLC</b>
<b>Structure</b>	All-in-one, compact housing	Separate, interchangeable modules	Centralized rack for modules
<b>Expandability</b>	Fixed I/O, no expansion	Expandable by adding modules	Highly expandable with many module options
<b>Installation Space</b>	Small, compact	Moderate space required	Requires significant space for rack and modules
<b>Applications</b>	Small to medium systems	Medium to large systems	Large, complex, and critical systems
<b>Cost</b>	Lower cost, cost-effective for small tasks	Moderate to high cost	High cost, typically used in large installations
<b>Maintenance</b>	Basic maintenance, limited modularity	Easy module replacement and upgrades	Centralized maintenance and module swapping
<b>Typical Use Cases</b>	Simple tasks like lighting control or HVAC	Manufacturing lines, conveyor systems	Power plants, large factory-wide systems

# Unitary with Modular Capabilities

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- A compact PLC with built-in components that also supports limited expansion through add-on modules.
- Features
  - All-in-one base unit (CPU, I/O, power supply).
  - Expansion ports or slots for limited I/O or communication modules.
  - Often DIN-rail mountable like standard unitary PLCs.



# Unitary with Modular Capabilities

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- Advantages:
  - Maintains compactness while offering some flexibility.
  - Cost-effective upgrade path from basic to more advanced control.
  - Easier to scale than pure unitary PLCs.
- Limitations:
  - Expansion capacity is limited compared to full modular or rack-mounted systems.
  - Add-on modules are often proprietary.



# Which PLC to use?

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- When deciding which PLC to use for a project we have several considerations:
  - PLC speed of operation
  - I/O count
  - Power requirements
  - Communications
  - Company standards
  - PLC cost
  - Versatility

