

Programmable Logic Controllers

Workshop at LPU , Phagwara

Day - 02



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Agenda: Workshop at LPU Day 2

- Hardware Contacts Vs Software Contacts
 - Communication Between PLC to PC
 - Ladder Logic Programs and ISP Software for Ladder Programming
 - Loading Program to PLC
 - **Demonstration on PLC**
 - First Program in PLC
 - Concept of Memory Bit , Holding
 - Interlocking between two switches
 - Implementation of Digital Gates
 - Timer , Type and Applications
-

Programmable Logic Controller

A **Programmable Logic Controller, PLC** or **Programmable Controller** is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. Unlike general- purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. A PLC is an example of a *hard* real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result

or

It is an industrial computer which is used to control inputs and outputs of a system according to custom program inside the processor of PLC.

PLC: History

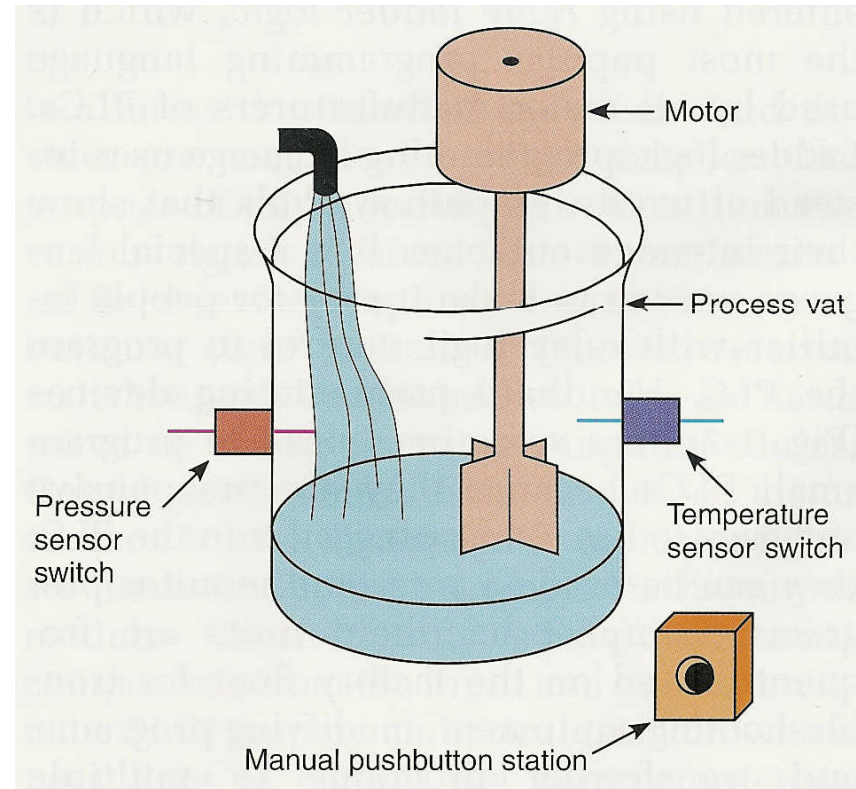
- First Programmable Logic Controllers was designed and developed by **Modicon** as a relay replacer for General Motors.
- The first PLC, model name 084, was invented by Morley in 1969 who is considered to be the "father" of the PLC.
- The first commercial successful PLC, the 184, was introduced in 1973 which was designed by Michael Greenberg.

Basic Parts of a PLC:

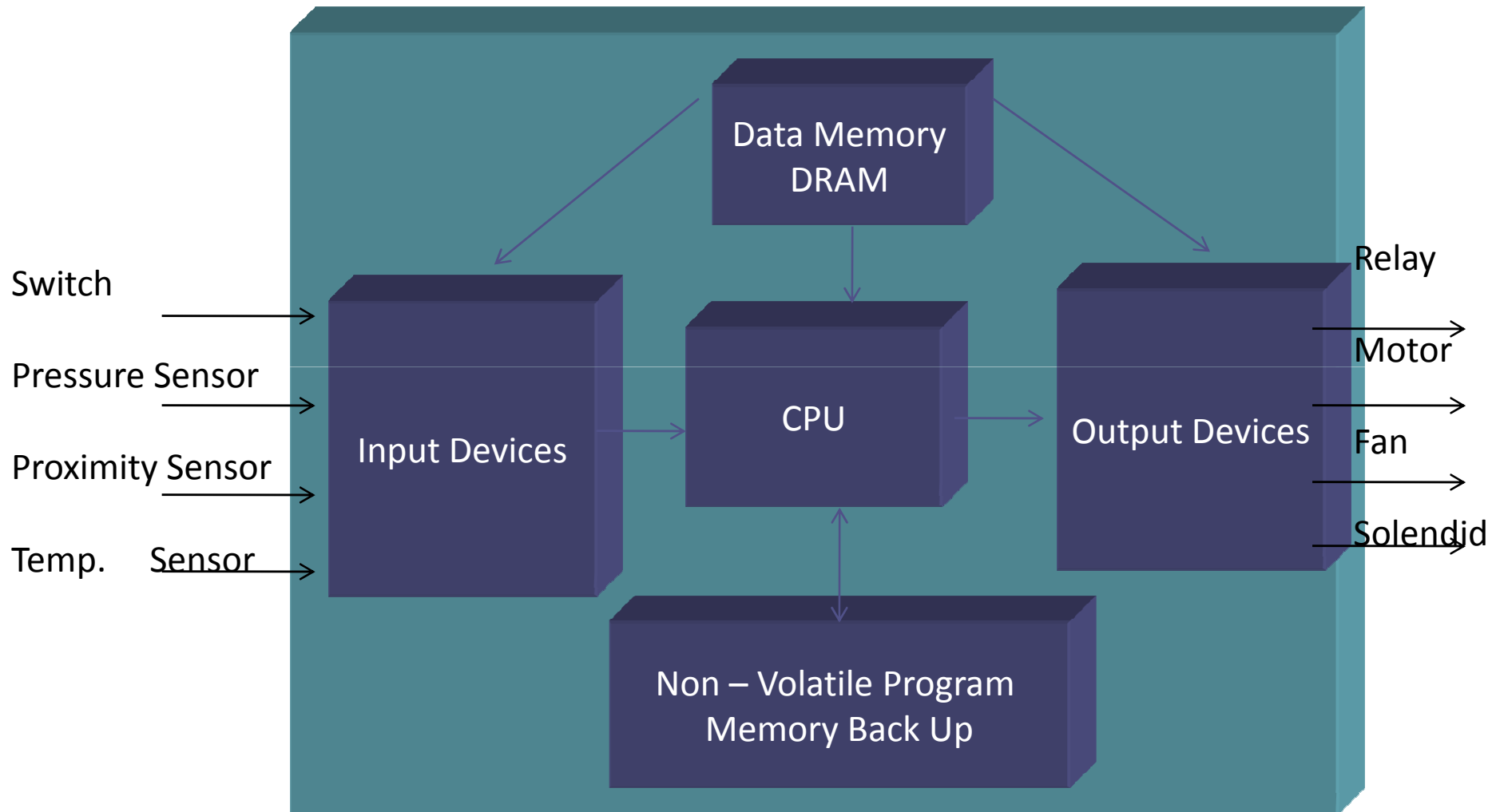
- 1) Central Processing Unit (CPU)
- 2) Memory
- 3) Input modules
- 4) Output modules
- 5) Power supply
- 6) I/O Bus

Principles of Operation

To get an idea on how PLC operates lets consider the following simple process control problem.

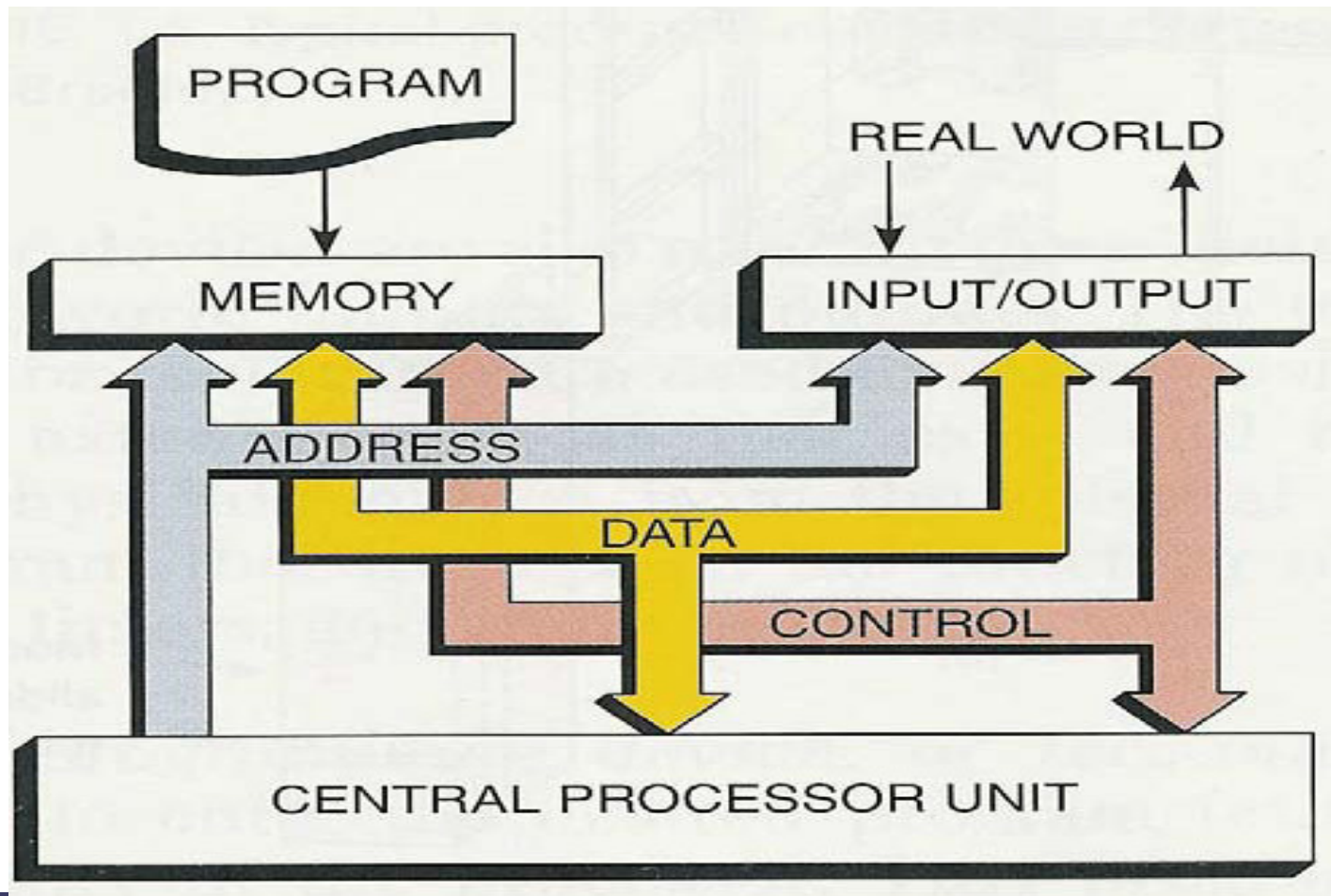


PLC Block Diagram:



Detailed Diagram of PLC

Block Diagram of PLC - Cont'd



Selection of PLC

- Number of logical inputs and outputs.
- Memory - Often 1K and up. Need is dictated by size of ladder logic program. A ladder element will take only a few bytes, and will be specified in manufacturers documentation.
- Number of special I/O modules - When doing some exotic applications, a large number of special add-on cards may be required.

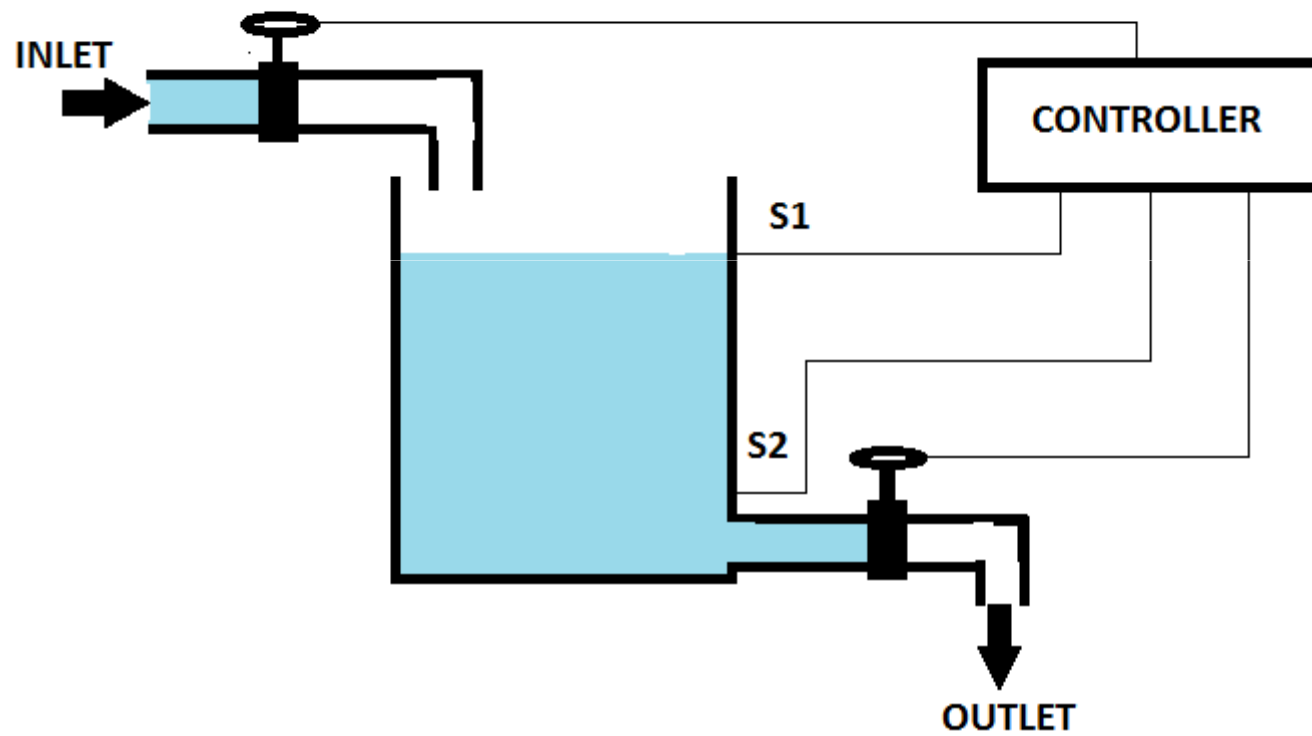
Selection of PLC – Cont'd

- Scan Time - Big programs or faster processes will require shorter scan times. And, the shorter the scan time, the higher the cost. Typical values for this are 1 microsecond per simple ladder instruction
- Communications - Serial and networked connections allow the PLC to be programmed and talk to other PLCs. The needs are determined by the application.
- Software - Availability of programming software and other tools determines the programming and debugging ease.

Automation System

The word automation is derived from the word automatic. Automation means to analyze and control all the process parameters in an industry or a plant automatically with the help of automation devices.

Automation System: Basic Example



Advantages of Automation System:

- Time saving
- Reduced work force
- Increase quantity of finish product
- Improved quality
- Cost reduction.
- Improved safety at the work place.

Push buttons

Push buttons are mainly of two types.

- NO (Normally Open)
- NC (Normally Closed)

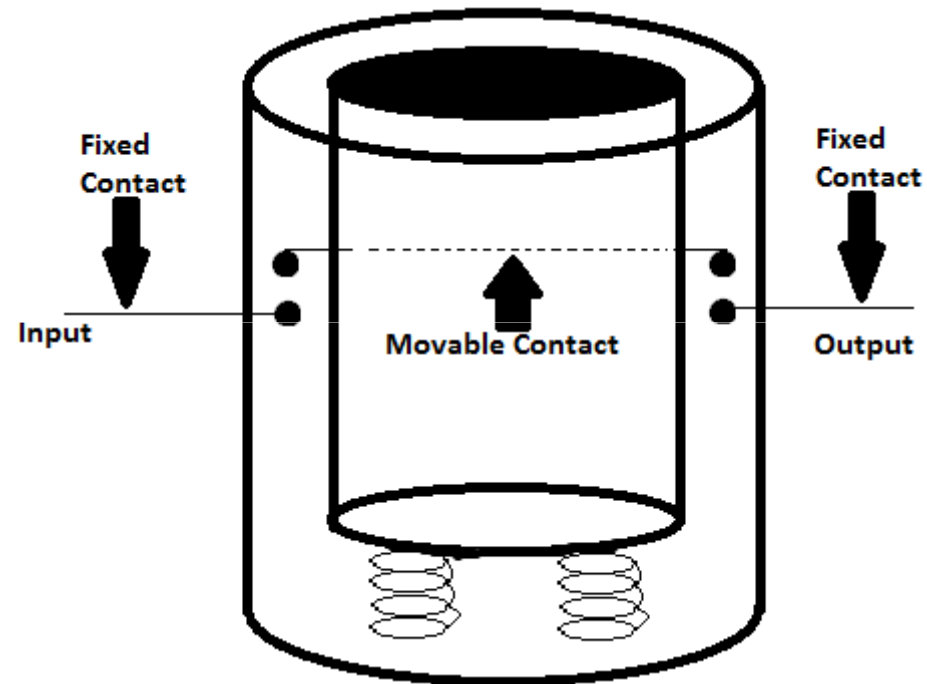


NO (Normally Open Push Button)

A normally open push button is the one which when pressed would complete or closed the circuit. Upon releasing the push button, it returns back to its initial position i.e. open position under the action of spring.

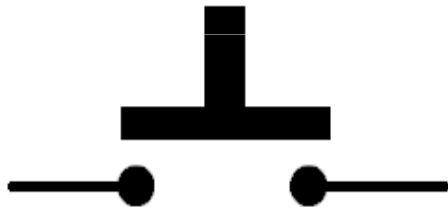


Hardware structure of Normally Open - Push Button.

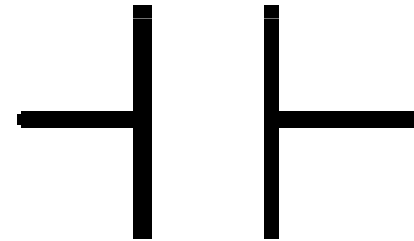


Representation of Normally Open - Push Button.

Electrical symbol



ladder symbol

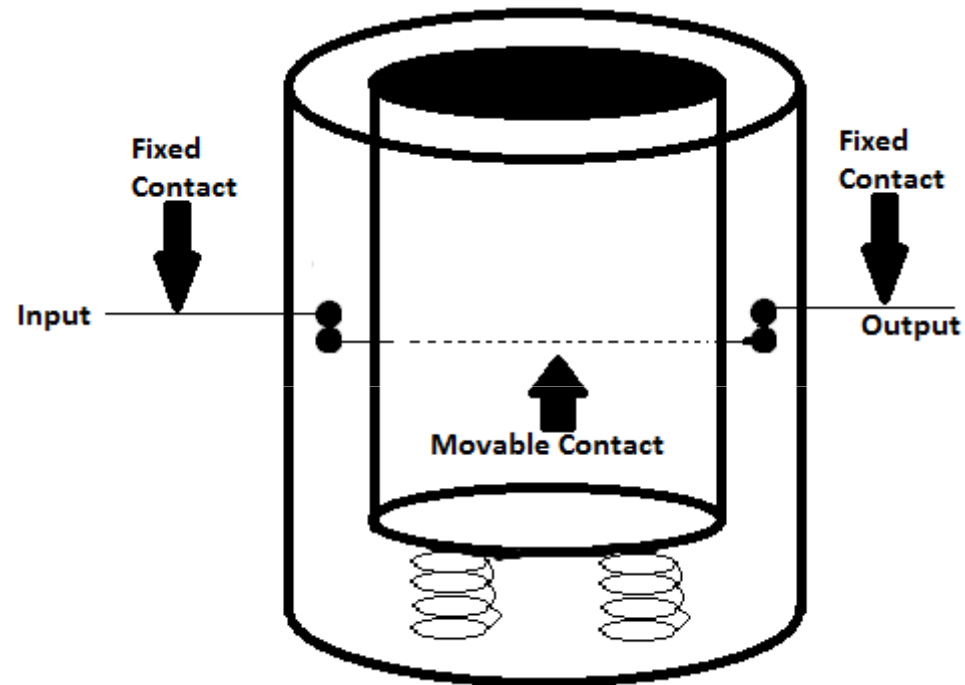


NC (Normally Closed Push Button)

Normally closed push buttons are the one which when pressed would cause circuit To circuit Open or break. When the push button is released it returns back to its initial position i.e. closed position under the action of spring.



Hardware structure : Normally open push button.



Push Button NC

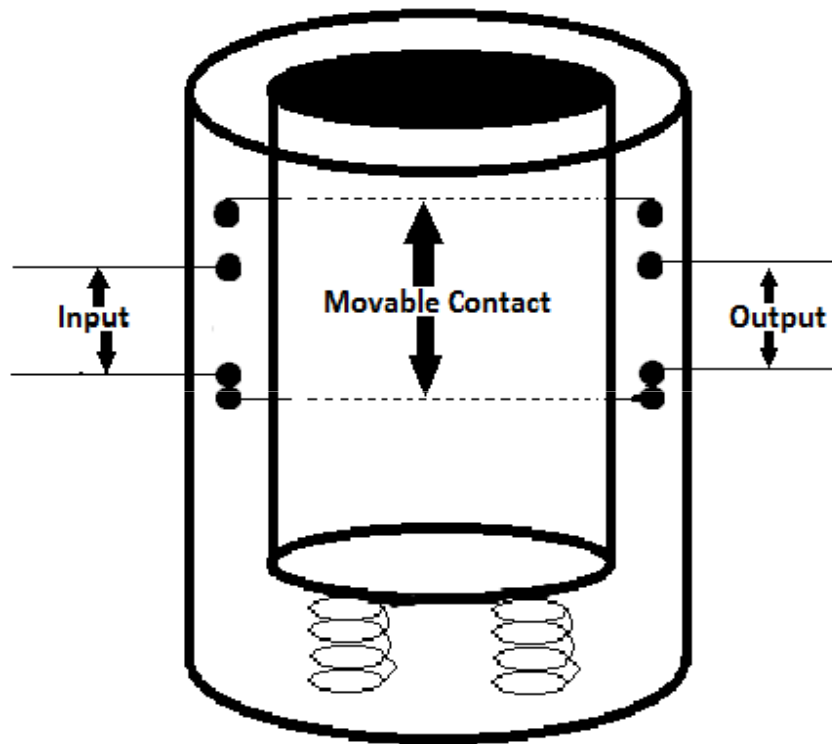
Electrical symbol



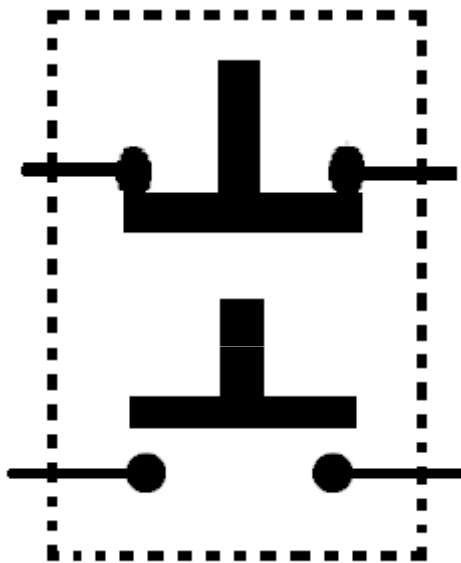
:adder symbol



Hardware structure of Interlocking push button.



Push Button: Electrical symbol (Interlocking Push button)



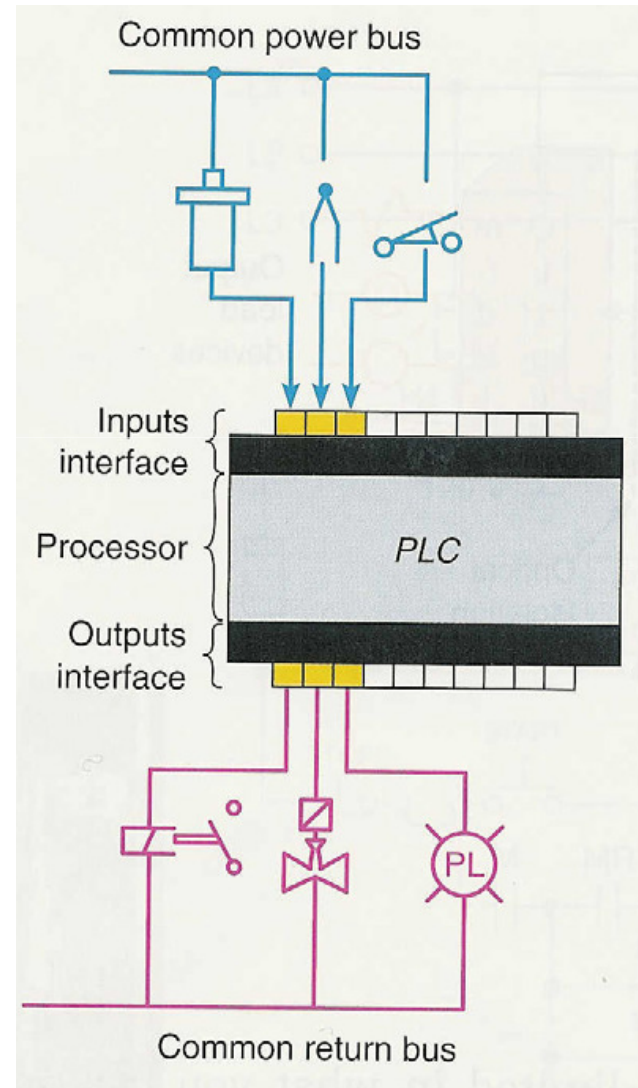
PLC's Today

There are two PLC basic configurations that commercial manufacturers offer.

- Fixed Configuration
- Modular Configuration

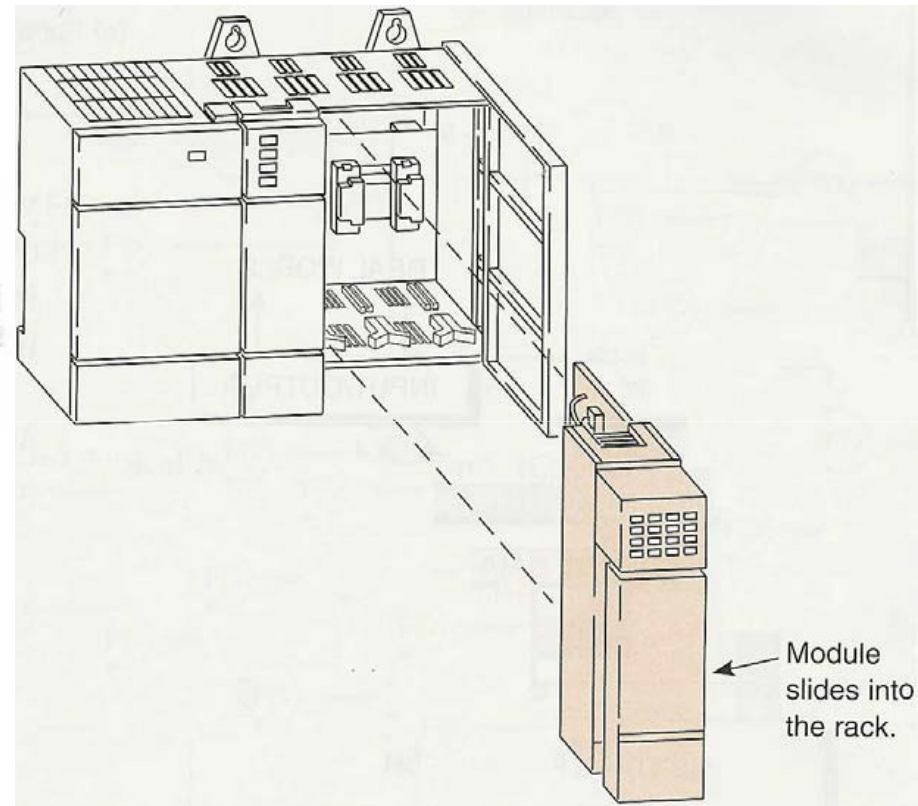
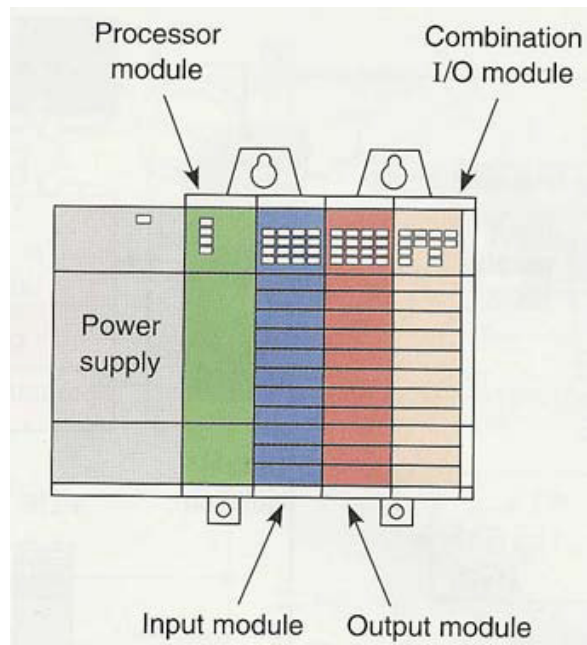
PLC's Today

Fixed Configuration



PLC's Today : Cont'd

Modular Configuration



PLC Manufacturers



The screenshot displays the Delta Electronics website interface. At the top, the Delta logo is on the left, and the date "19 February 2014" and a language selector "中文版" are in the center. A Google Custom Search bar is on the right. Below the header, a navigation bar includes links for "About Delta", "Press Releases", "Products & Services", "Investor Services", "Corporate Social Responsibility", and "Human Resources". The "Products & Services" section is expanded, showing a list of categories: "Industrial Automation", "Motor & Drive", "Motion & Control", "Control", "Power Quality", "Download", and "Technical Support". The "Control" category is selected, leading to a page titled "Programmable Logic Controllers". The page features a large image of various PLC units. Below the image, a breadcrumb trail reads: "Home > Products & Services > Industrial Automation > CONTROL > Programmable Logic Controller". A green bar with the word "CONTROL" is followed by a grid of product categories: "Programmable Logic Controller", "Human Machine Interface", "Text Panel", "Temperature Controller", "Industrial Fieldbus Solutions", "Timer/Counter/Tachometer", "Industrial Power Supply", "Pressure Sensor", "Industrial Ethernet", and "Machine Vision System". The "Programmable Logic Controller" category is highlighted with a green square. Below this, a paragraph defines a PLC: "Programmable logic controller (PLC) is a control system using electronic operations. Its easy storing procedures, handy extending principles, functions of sequential/position control, timed counting and input/output control are widely applied to the field of industrial automation control."

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■ **Programmable Logic Controller**

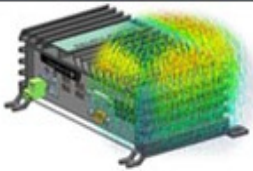
Programmable logic controller (PLC) is a control system using electronic operations. Its easy storing procedures, handy extending principles, functions of sequential/position control, timed counting and input/output control are widely applied to the field of industrial automation control.

PLC Manufacturers


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Product and service categories: 1 - 15 of 50

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[Programmable Logic Controllers \(PLC\)](#) (710 companies)

Programmable logic controllers (PLC) are the control hubs for a wide variety of automated systems and processes. They use a wide variety of inputs and outputs and provide network capability. [Search by Specification](#) | [Learn More about Programmable Logic Controllers \(PLC\)](#)

PLC Power:	PLC Programming Language:	Number of Inputs:
12V DC	IEC 61131-3	Less than 8
24V DC	Sequential Function Chart (SFC)	8 to 20
Other DC	Function Block Diagram (FBD)	20 to 50
115V AC	Ladder Diagram (LD)	50 to 330
230V AC	Structured Text (ST)	330 and up

Product Announcements



MasterLogic PLC
Optimizes Plant Operations
Honeywell Process Solutions

PLC Manufacturers



MicroLogix 1000 System

- ▶ MicroLogix 1000 System Overview
- ▶ MicroLogix 1000 Controllers
- ▶ Communication Interfaces
- ▶ Hand-Held Programmer
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MicroLogix 1000 Controllers

- [Introduction](#) [Product Design](#) [Communication](#) [Typical Configurations](#) [Specifications](#)



[Product Overview](#)

System Overview

The MicroLogix 1000 family provides small, economical programmable controllers. They are available in configurations of 10 digital I/O (6 inputs and 4 outputs), 16 digital I/O (10 inputs and 6 outputs), 25 I/O (12 digital inputs, 4 analog inputs, 8 digital outputs, and 1 analog output), or 32 digital I/O (20 inputs and 12 outputs) in multiple electrical configurations of digital I/O. The I/O options and electrical configurations make them ideal for many applications.

Benefits

- *Compact design*—Lets the MicroLogix 1000 controller thrive in limited panel space.
- *Choice of communication networks*—An RS-232-C communication port is configurable for: DF1 protocol for direct connection to a programming device or operator interface; DH-485 networking through a 1761-NET-AIC converter; DeviceNet networking through a 1761-NET-DNI interface; EtherNet/IP networking through a 1761-NET-ENI interface; or for half-duplex slave protocol in SCADA applications.



PLC Manufacturers

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PLC Programmable Controls

Automation Control Products

- ▶ **PLC Controls**
 - Communication Interfaces
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 - FP0R
 - FPΣ
 - FPX
 - FP2
 - FP Impulse Controller
 - FPWIN-PRO Software
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Programmable logic controllers

power, speed, and flexibility

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▶ [FP Impulse Controller](#)
First Compact Impulse Controller PLC



▶ [FP0R](#)
Advanced functionality and performance - superior to basic ultra-compact models.



▶ [FP2](#)
The functions for a medium-scale PLC are packed into a compact body



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Comparison of PLC with Other Control Mechanism in Industry

PLC vs RELAY

Characteristic	PLC	Relay
Price per function	Low	Low – if equivalent relay program uses more than ten relays
Physical size	Very compact	Bulky
Operating speed	Fast	Slow
Electrical noise immunity	Good	Excellent
Construction	Easy to program	Wiring – time-consuming
Advanced instructions	Yes	No
Changing the control sequence	Very simple	Very difficult – requires changes to wiring
Maintenance	Excellent – PLCs rarely fail	Poor – relays require constant maintenance

PLC vs COMPUTER

PLC

- Designed for extreme industrial environments
- Can operation in high temperature and humidity
- High immunity to noise High noise
- Integrated command interpreter (proprietary)
- No secondary memory available (in the PLC)
- Optimized for Single task Optimized task

Computer

- Designed mainly for data processing and calculation
- Optimized for speed
- Can't operate in extreme environments
- Can be programmed in different languages
- Lost of secondary memory available
- Multitasking capability

PLC vs MICROCONTROLLER

A microcontroller is only a small computer in a chip (an IC "integrated circuit") with inputs and outputs of low level. Thus to control something with a microcontroller you need to do a lot of work to interface it with the system to control and a lot of low level programming and to know very well the hardware and software of the specific microcontroller you are using. Microcontrollers are suitable for small project if you have a background in electronics and programming. They are very cheap.

PLC vs MICROCONTROLLER

A PLC is also a computer with inputs and outputs, but in a very different level. They are very robust and can work in an industrial environment without problem. They are scalable and can be distributed to control remote systems. They can control hundreds of input and outputs at the same time.

They can have many different types of inputs and outputs. Programming and interfacing are easy if you compare it with microcontrollers. PLC's are the standard control equipment in the industry.

Advantages of PLC

- Increased Reliability
- More Flexibility
- Lower Cost
- Faster Response
- Easier to troubleshoot
- Remote control capability
- Communication Capability

Limitations of PLC

- In contrast to microcontroller systems that have what is called an open architecture, most PLCs manufacturers offer only closed architectures for their products
- PLC devices are proprietary, which means that parts and software from one manufacturer can't easily be used in combination with parts of another manufacturer, which limits the design and cost options can't

PLC Size

Manufacturers offer five sizes of PLCs

- Nano (up to 16 I/O points)
- Micro (more than 16 I/O points, up to 64 I/O points)
- Small (up to 960 I/O points)
- Medium (multitasking - control of several processes)
- Large (control management of several PLCs -PLC's)

PLC Applications

- Originally hardwired arrays of relays were used to control the operation of heavy machines that contain motors and other high power devices.
- PLCs were originally used to substitute the switching relay networks used in industrial applications, but now they can also be used implement other tasks such as timing, delaying counting, calculating, comparing and processing of analog signals.

Lab - 1_2_3_4_5_6

THANKS

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