

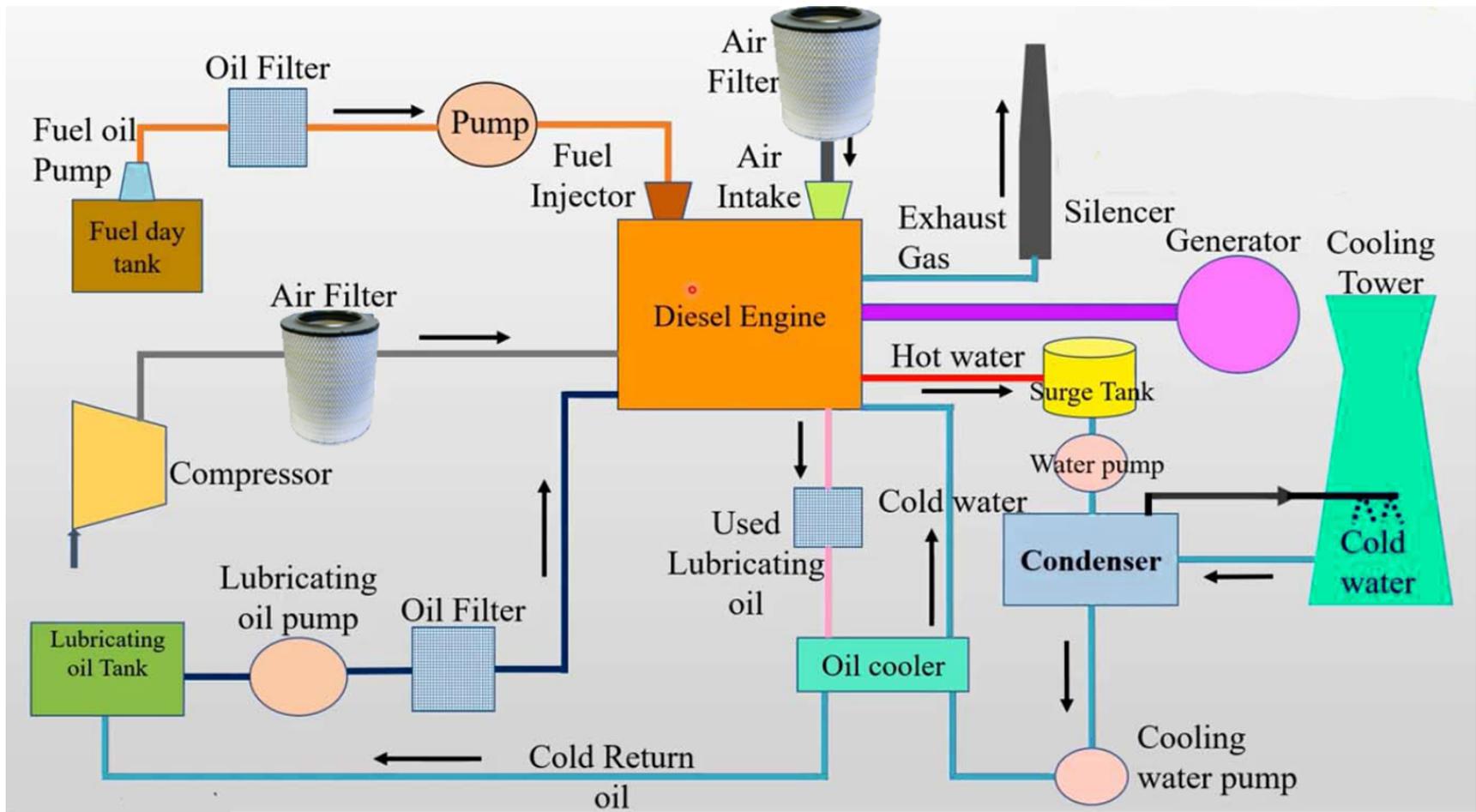
# Presentation on Industrial Automation and PLC (26872) Lecture: 1-8

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# Automation

- Process/System Automation fully or partially. No manual/handmade operation
- Application field: Industry, Household, It sectors etc.
- Automation Process:
  - Sensor/Switch→Sense/collect data (digital/analog) from physical parameters/environment/outputs.
  - Input Module→converts other voltage (from sensor/switch) to 5 vol.(dig.-dig.)
    - converts analog voltage to digital vol(8/16/32 etc. bit stream(word))
    - isolation(electrical)
  - Processor→ produces outputs(signal) to control outputs according to program/algorithm set by user.
  - Output Module→opposite to Input Module

# Diesel Engine Power plant Layout



# Relay

→ Electromagnet Switch energized state

→ An Electromagnet & Two types Switch (NO & NC) are used

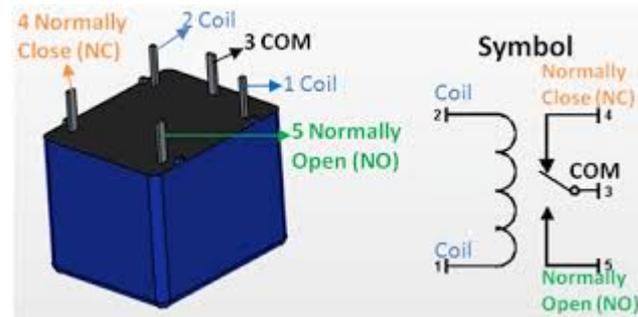
→ Two state → 1.

Normal/Un energized state (no I/EM) 2. Energized State (I flow & Create EM)

→ NC → Closed at Un

→ NO → Open at Un energized state

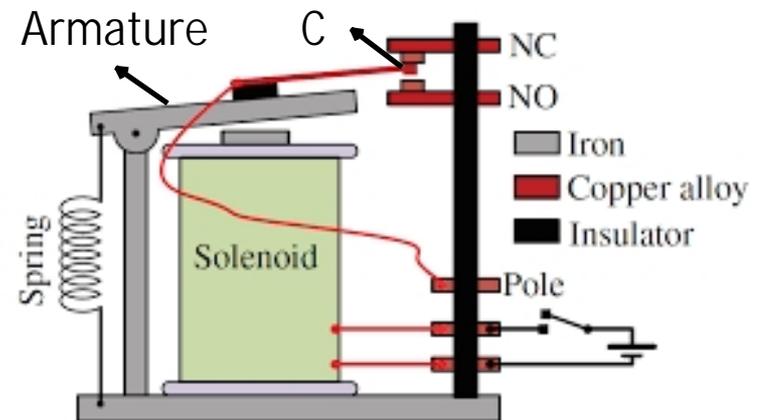
→ NO & NC → State change at energized state



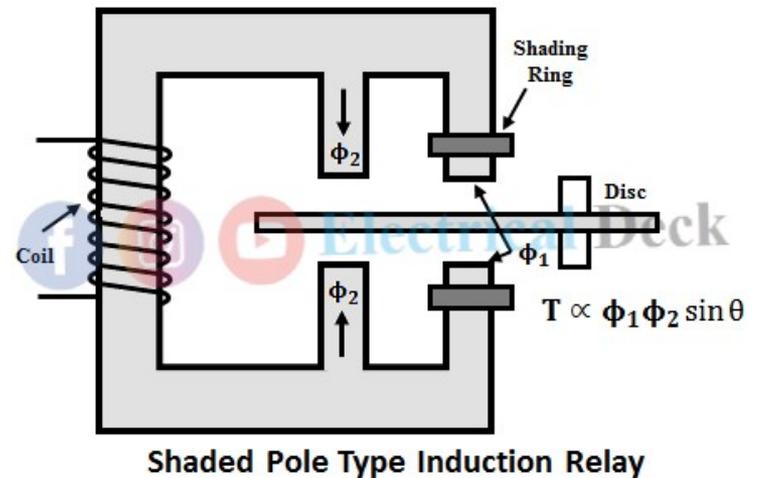
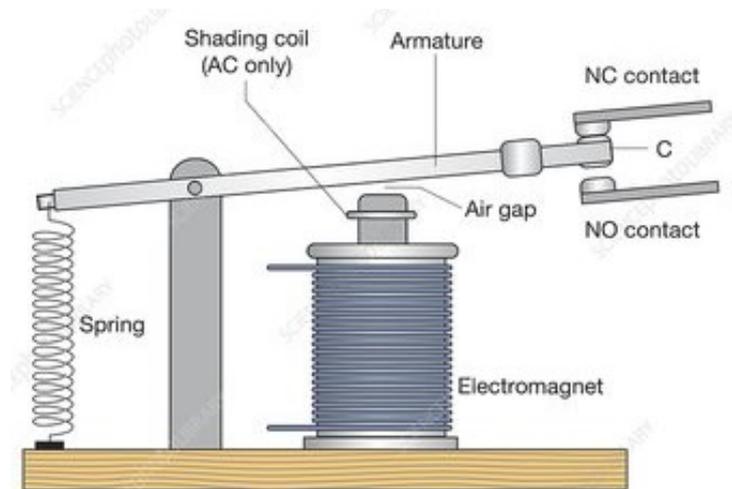
# Working Principle of Electromagnetic Relay

- ✓ An Electromagnet(Relay Coil), Spring, Armature, a NC & NO contact/switch
- ✓ At Un energized state → Armature (position) like → connects with one contact(NC) & detached with other(NO)
- ✓ At Un energized state → V apply(I Flow) → Electromagnetic field

generate → Armature (loaded spring) attracts towards coil (till V applied to coil)  
→ Armature contact detached NC contact and connected NO contact



- ✓ Pull in  $V/I \rightarrow V/I$  req. to pull armature towards coil
- ✓ Minimum holding voltage, Scaled current  $\rightarrow$  Minimum  $v$  &  $I$  required to hold armature with coil.
- ✓ Coil  $v \rightarrow$  specified either AC/DC
- ✓ For AC  $\rightarrow$  shaded pole coil used  $\rightarrow$  a metal ring in pole phase is used  $\rightarrow$  holds the relay at closed state at 0 degree AC cycle.

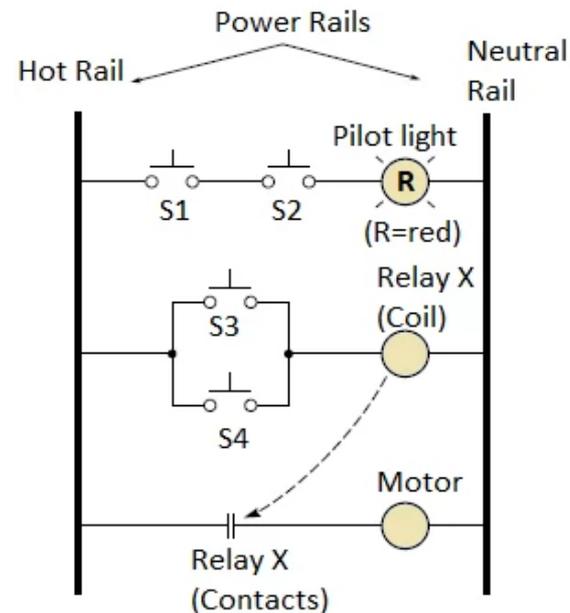


# Relay Logic in Ladder Diagram

- Wiring Diagram for switching control ckt.
- Two power rail(hot& neutral-vertical) & Rung(between these two-horizon.)
- Hot rail→left rail →V, Neutral rail→right rail → Neutral for AC &

Ground for DC.

- Each rung is between these two rails.



# PLC

- Programmable logic Controller → Processor for Industrial Automation
- Brands of PLC and Software used → Allen Bradley → RS Logix; Delta → WPL Soft; Simens S7-300,400,1200 etc. → Step7, Tia Portal; Siemens Logo → Logo soft ; Mitsubishi → GX Works 2; Omron → CX-one etc.



# Types of PLC

- Compact → Fixed no. of I/Os, Limited Expansion
- Modular → Expansion and customization possible
- Distributed → Expansion & Remote access

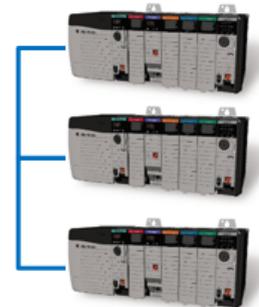
FIXED



MODULAR



DISTRIBUTED



# Basic Components and architecture

- Basic Components: 1. CPU: Execute Program and generate control signal
- 2. I/O Module: Input Module
  - Connects Sensors and Actuators with PLC
  - converts other voltage (from sensor/switch) to 5 vol.(dig.-dig.)
  - converts analog voltage to digital vol. (8/16/32 etc. bit stream(word))
  - isolation(electrical) & Output Module Vice versa

3. Power Supply Unit: PLC require power as manufacturer designed(Datasheet/written in PLC body). After power up, PSU Supply Required power to CPU , I/O module.

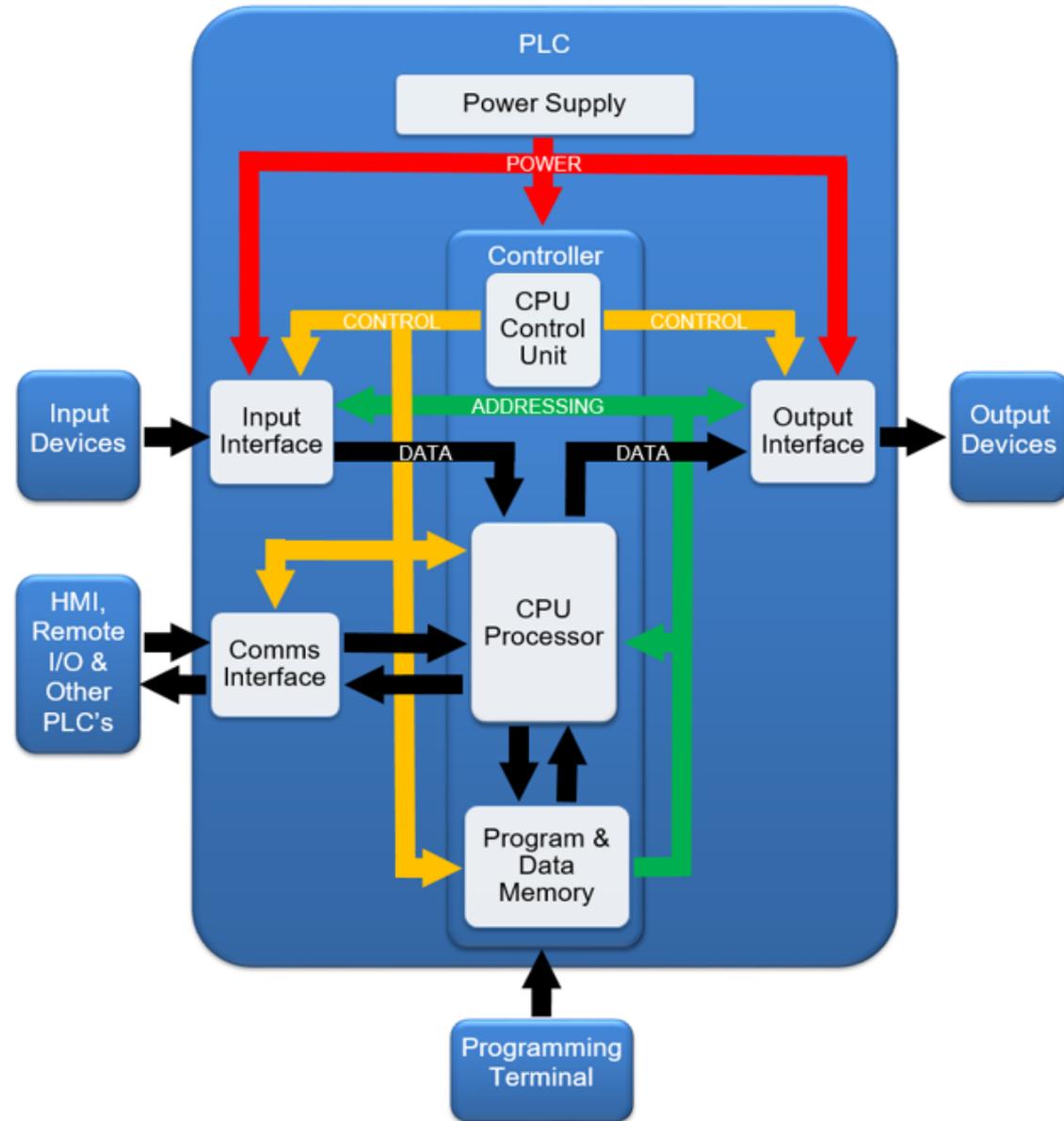
4. Programming Device: Create and Load Control Program to PLC ROM.(PC with installed Software, Comm. Cable/wireless comm.)

5. Memory Unit: 2 parts: 1. Program/Execution memory → ROM(Non Volatile)→Store PLC Control/main Program

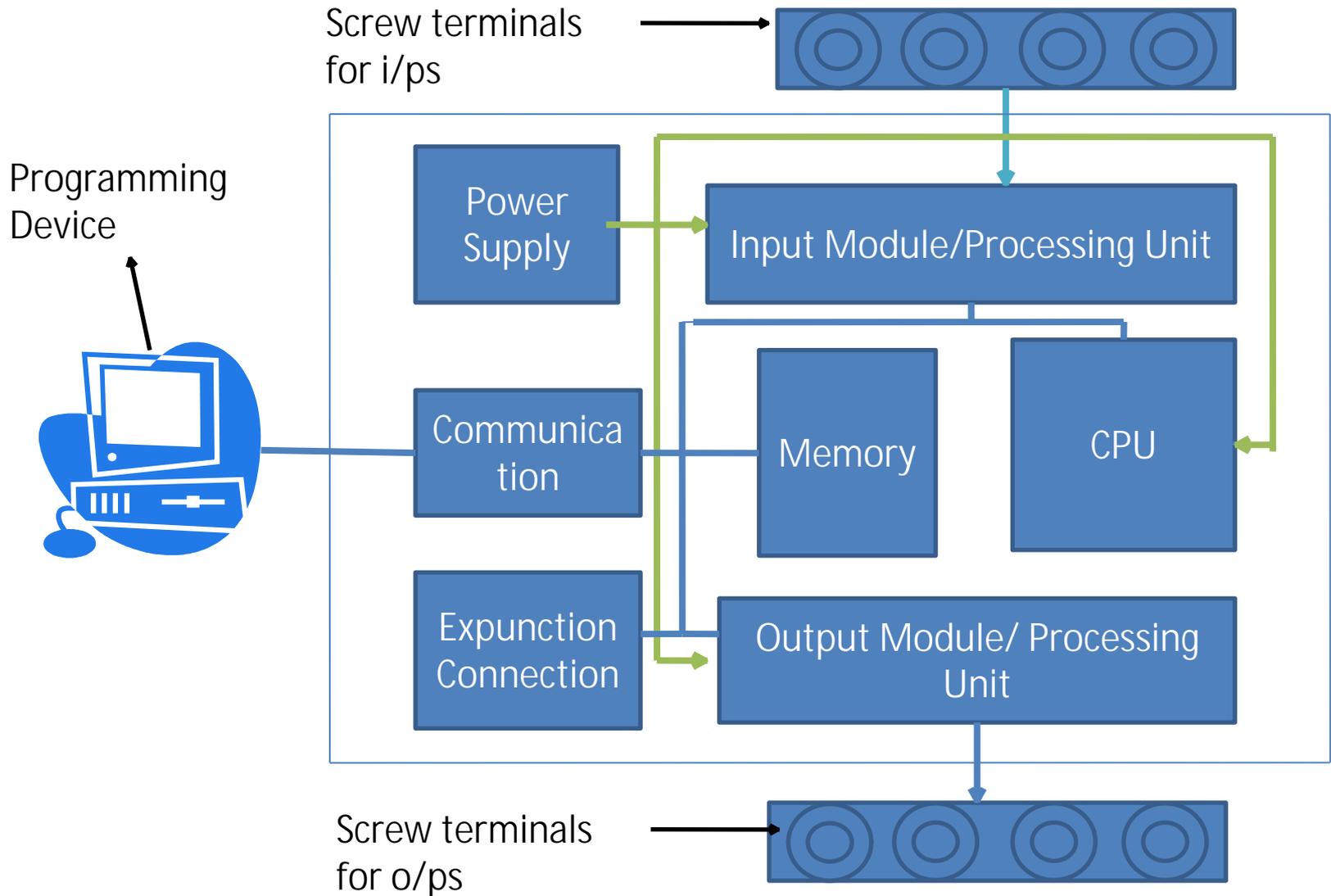
2. Data/Variable/Application Memory →RAM(Volatile) →State of I/O, Timer/Counter value etc.(bit/Byte)

# Basic Architecture of PLC

- CPU: 3 parts:  
ALU, Memory & Control unit
- CPU-control & process all operation
- Clock Fr.: 1-8MHz →Speed, Timing & Synchron.
- 4 Bus: Data, address, Control & System.



# Configuration of PLC

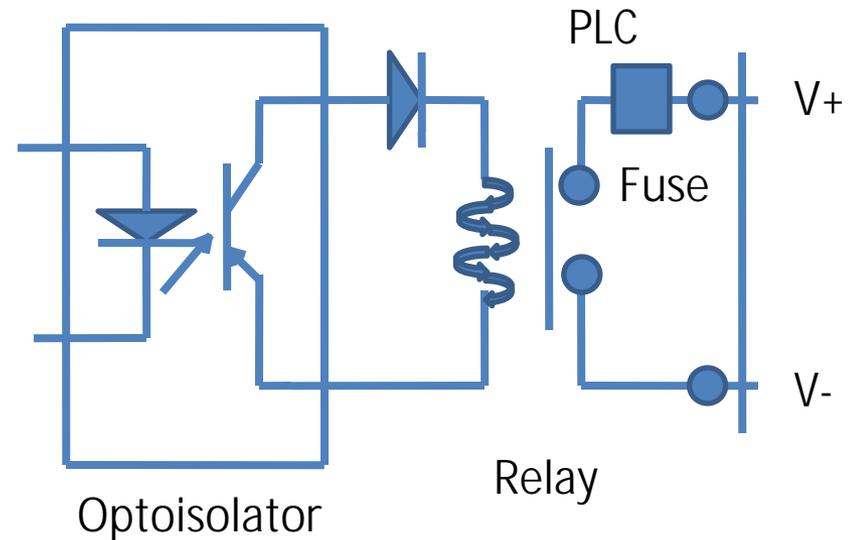


# Some Important Specifications of PLC

1. Power Supply: 110-120/220-240V AC(Range) Single Phase 50/60(any one), 24V DC(Fixed 24), 110-120 AC/DC(Range & For Both)
  2. Execution Time: 7 $\mu$ s/step, Max. Steps: 1000
  3. Prog. Memory: CMOS(complimentary MOS)-RAM built in, EPROM can be added
  4. # inputs: 12( optoisolated)
  5. Input Voltage: Built in 24V DC(PLC sourcing), External 24V DC(PLC Sinking & active at 24V)
  6. #Outputs: 8  $\rightarrow$ if specified then only at that voltage range, for other case Driver will run Actuator.
  7. Choice of O/p: Relay o/p(isolated) $\rightarrow$ ac/dc, Trans. o/p(optoiso.)  $\rightarrow$ DC, Triac o/p(optoiso.)  $\rightarrow$ AC/DC
-

# Types of PLC Output

- ❖ Relay Type: → Use Relay For o/p Switching
- Both AC/DC
- Electrical Isolation
- High Current dealing
- Response time  $\geq 10\text{ms}$



❖ Transistor Type:

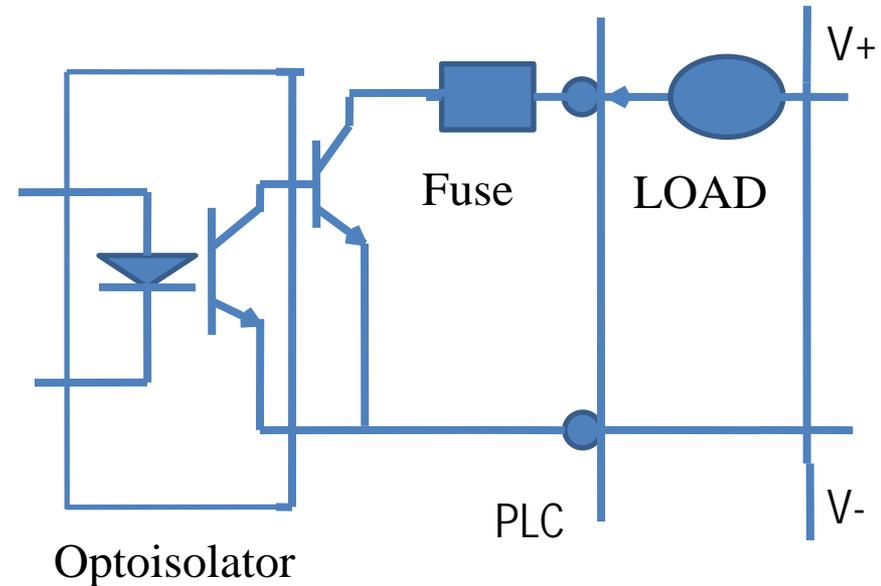
→ use solid state (Trns./Mosf.)  
for switching

→ Comparatively less Current  
deal

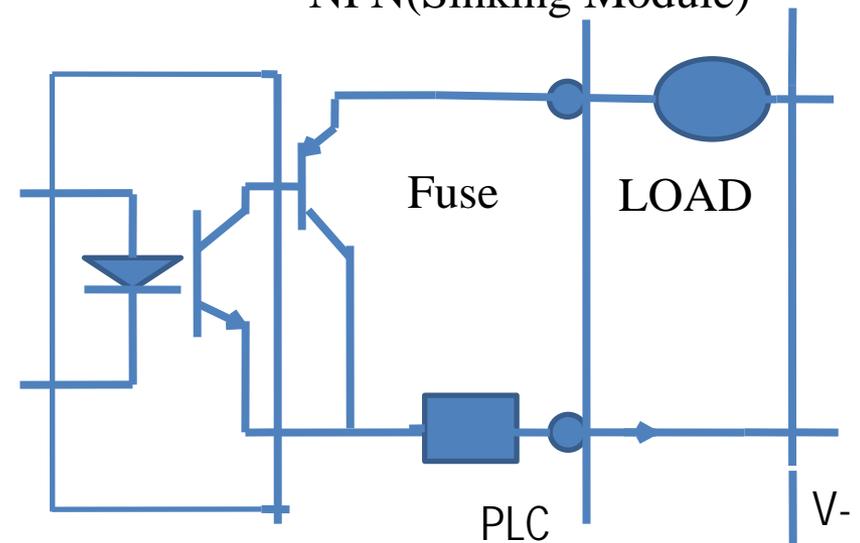
→ Fast Response time (no  
mechanical part)

→ Only DC

→ Two Config → PNP (sourcing  
module) & NPN (sinking  
module)

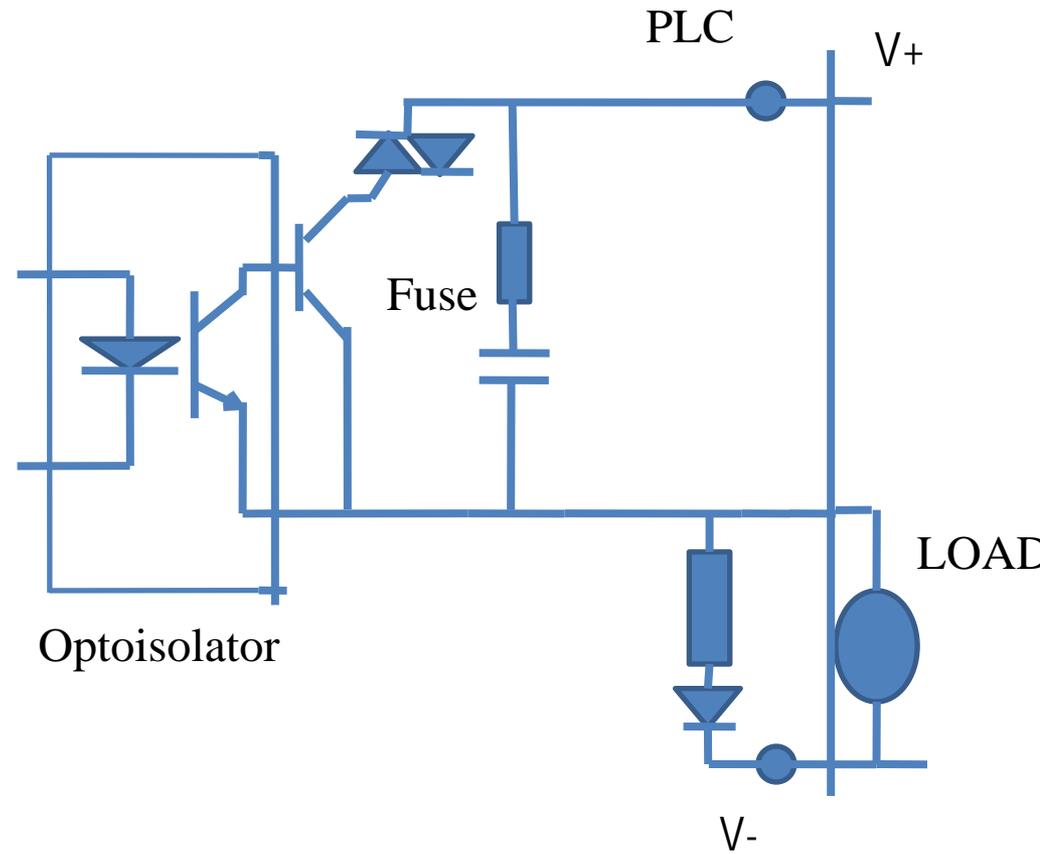


NPN (Sinking Module)



PNP (Sourcing Module)

❖ Triac Type:  
→ Both AC/DC



# I/O Modules of PLC

## ➤ Input Module

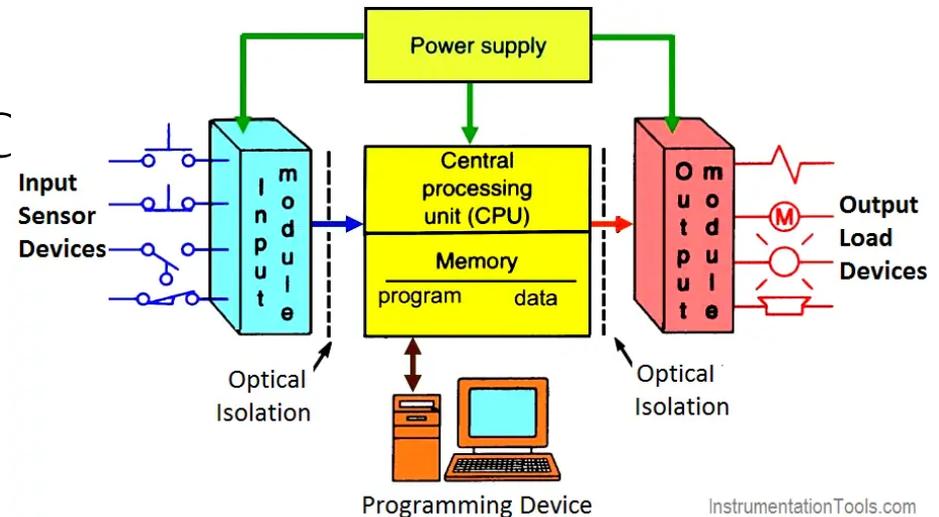
→ Connects Sensors and Actuators with PLC

→ converts other voltage like 24V/48 AC/DC, 120 V AC/DC etc. (from sensor/switch) to 5 vol.(dig.-dig.)

→ converts analog voltage to digital vol. (8/16/32 etc. bit stream(word))

→ isolation(electrical)

## ➤ Output Module: Vice versa



# Discrete & Analog Modules of PLC

- Discrete Module: Connects → One state (on/off) with PLC (Process Discrete/Digital data from sensor to PLC and PLC to o/p Loads)
- Analog Module: use → A/D or D/A converter  
→ Represent by BCD  
→ more bit for more accuracy, less error.

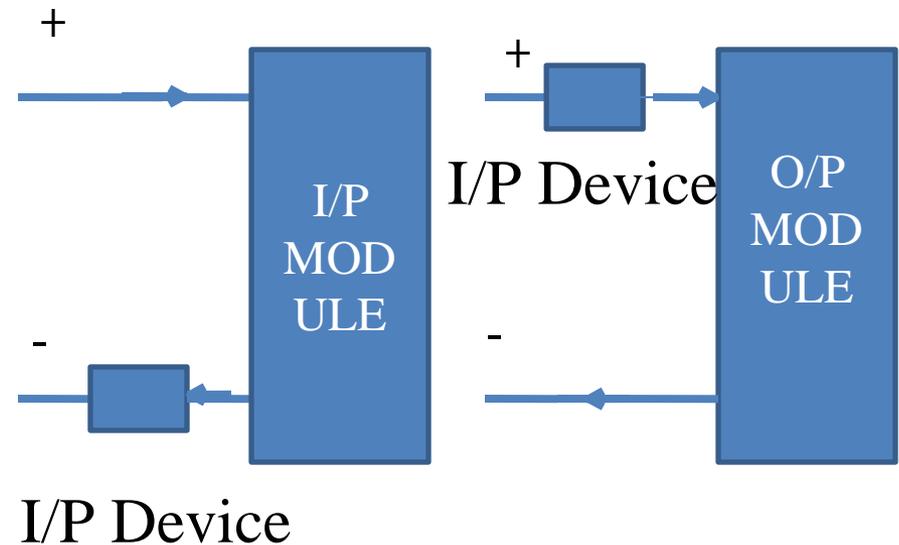
# Sinking and Sourcing in PLC

In case of Input module(/PLC):  
(conventional I)

Sourcing:

→ Current flow from input module(/PLC) to i/p device(sensor/switch)

Sinking: vice versa



Sourcing i/p  
Module

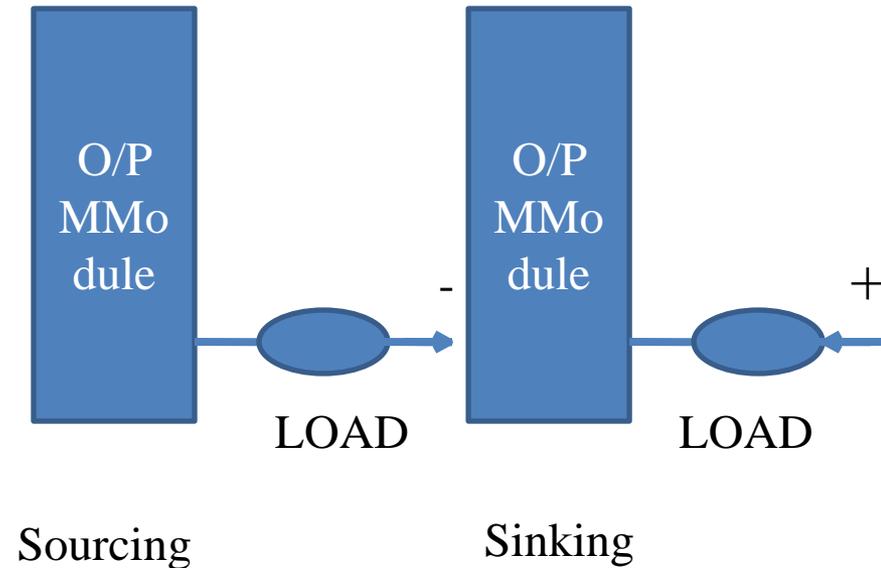
Sinking o/p  
Module

In case of Output module (/PLC):  
(conventional I)

Sourcing:

→ Current flow from output module (/PLC) to o/p load (actuator)

Sinking: vice versa



# Programming Language used in PLC

- ❑ Ladder Logic: → Graphical Language  
→ Similar to Electrical Schematics
- ❑ Sequential Function Chart(SFC): Graphical Language used for sequence control
- ❑ Function Block Diagram(FBD): → Graphical Language  
→ Used for Function & Connection
- ❑ Structured Text: Text based, High level
- ❑ Instruction List: Text based, Low level

Thank You