

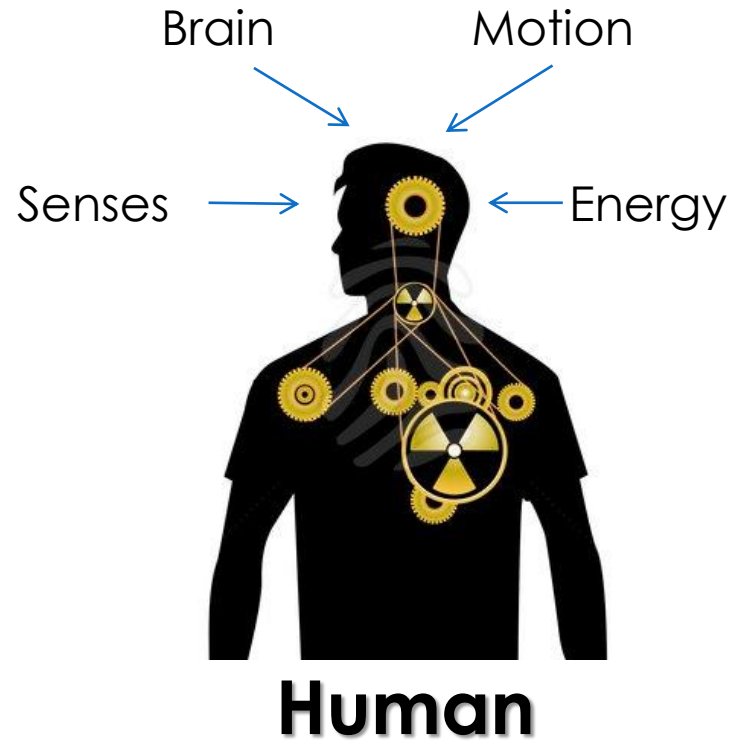
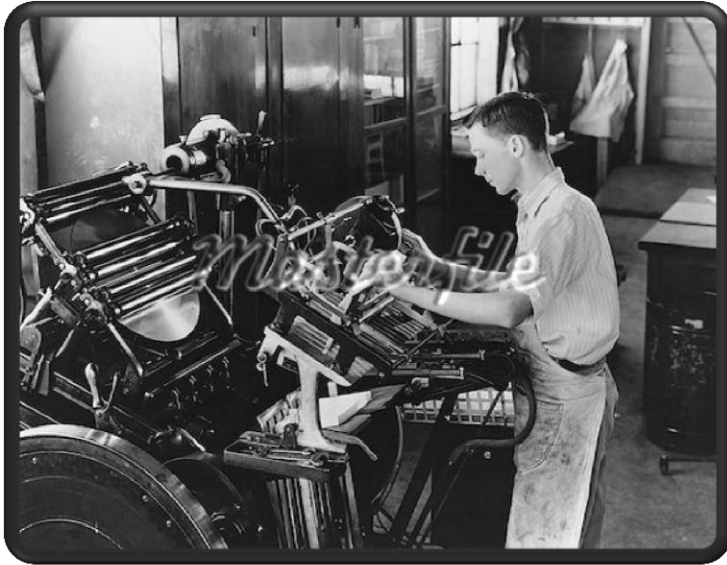


# PLC Troubleshooting & Maintenance

[www.nfiautomation.org](http://www.nfiautomation.org)



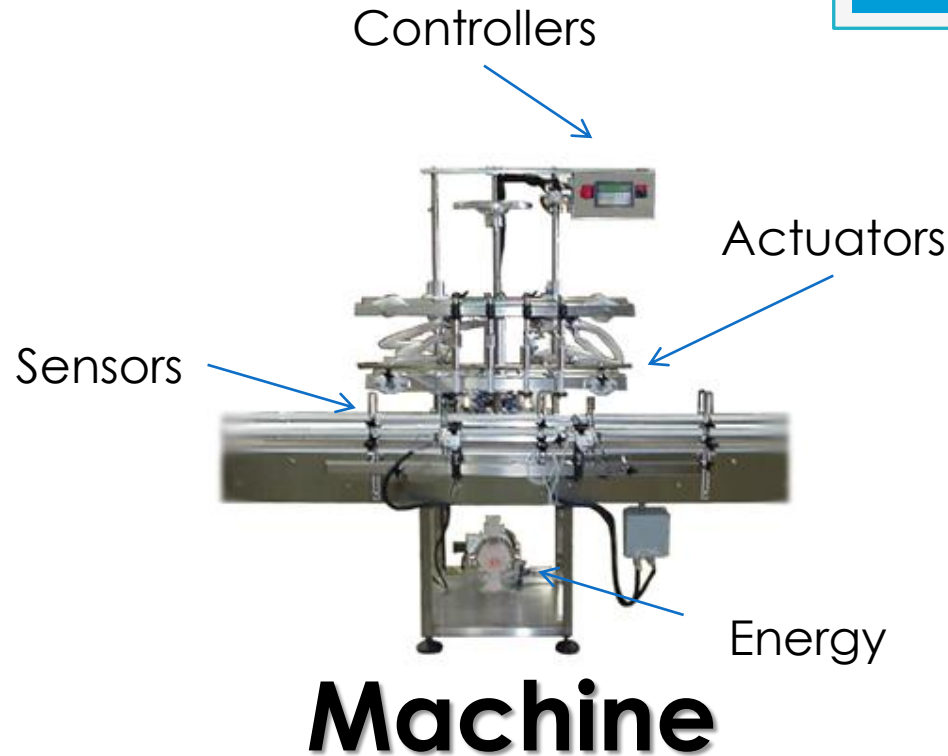
# Manual Work



## Human Lags:

- Cannot Work 24 Hours
- Cannot work with 100% Accuracy & precision
- Efficiency decreases as energy decreases

# Automatic Work



## Advantages:

- Accuracy
- No idle Time
- More Production

## Lags:

- Regular Troubleshooting & Maintenance

# What is Controllers?

Controller is a part of Automatic Control System, which **process the signal** from **sensors** & **send it** to the **actuators**

Sensors



Controller



Actuator



**A closed Loop Control System**



This is a PLC

Input Terminals

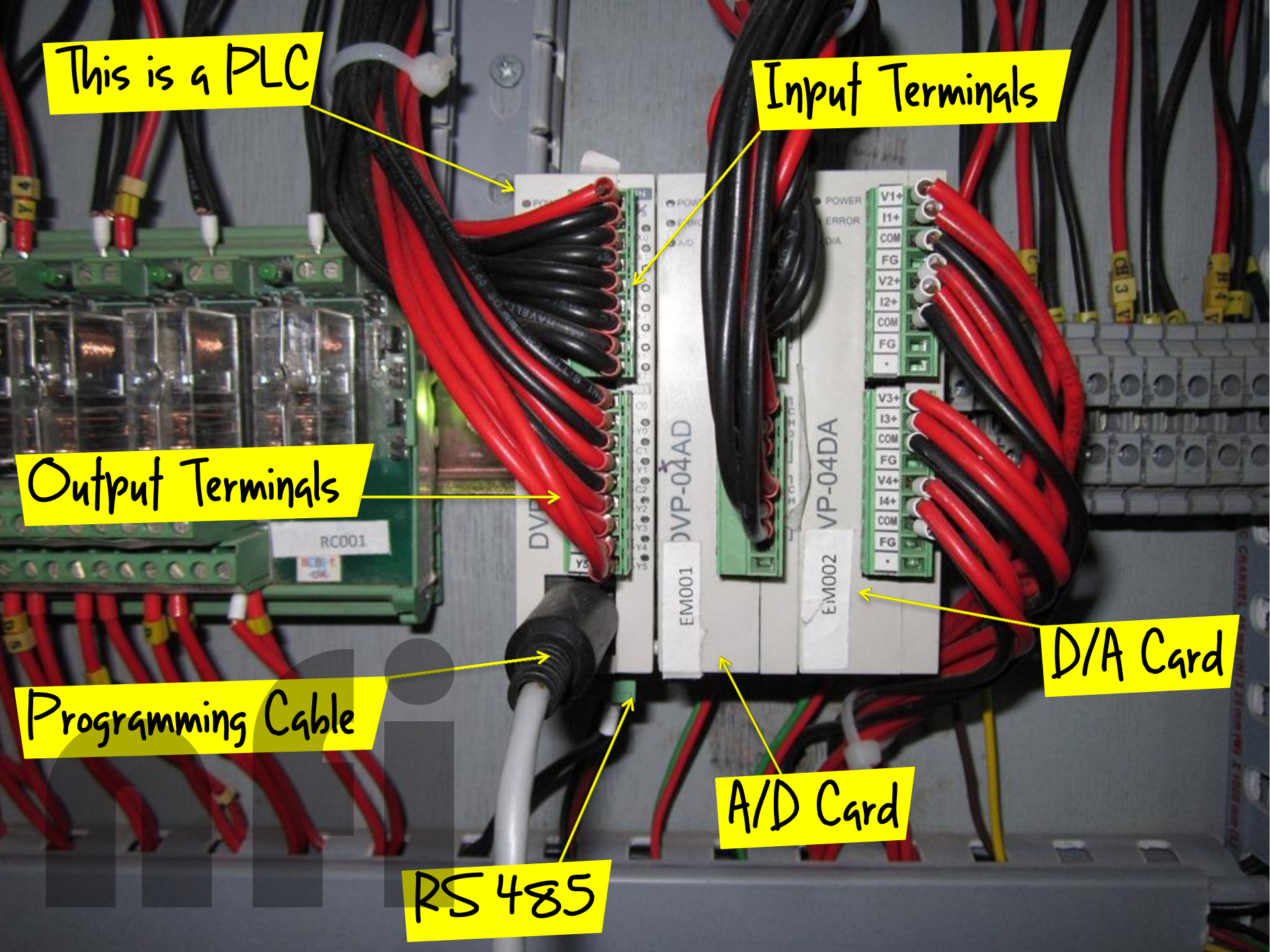
Output Terminals

Programming Cable

RS 485

A/D Card

D/A Card





This is a PLC

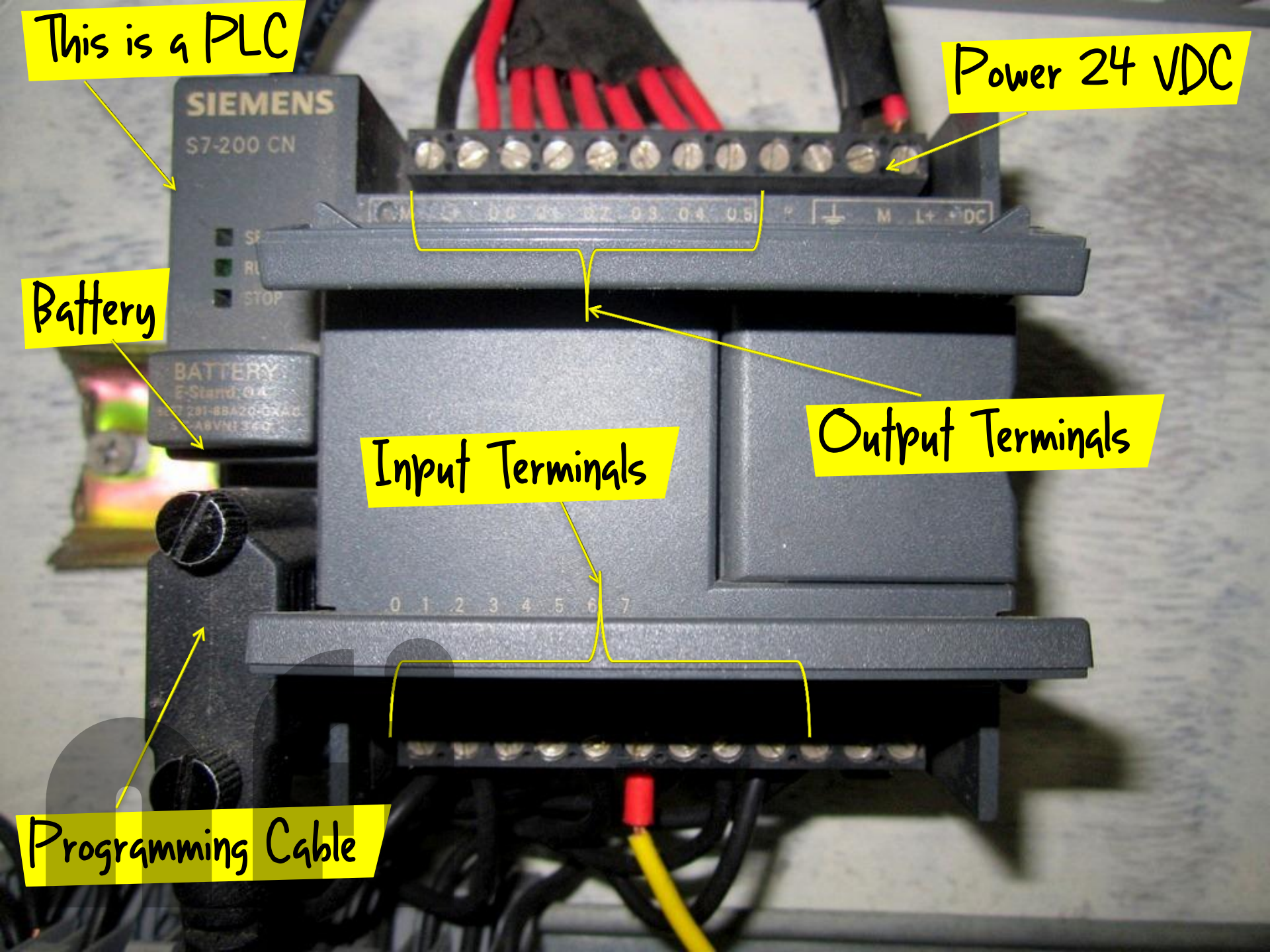
Power 24 VDC

Battery

Input Terminals

Output Terminals

Programming Cable





This is a PLC

W NOT USED NOT USED DC COM I/0 I/1 I/2 I/3 DC COM I/4 I/5 NOT USED NOT USED NOT USED NOT USED

0 1 2 3 4 5 IN

POWER  
RUN  
FAULT  
FORCE

0 1 2 3 OUT

Input Terminals

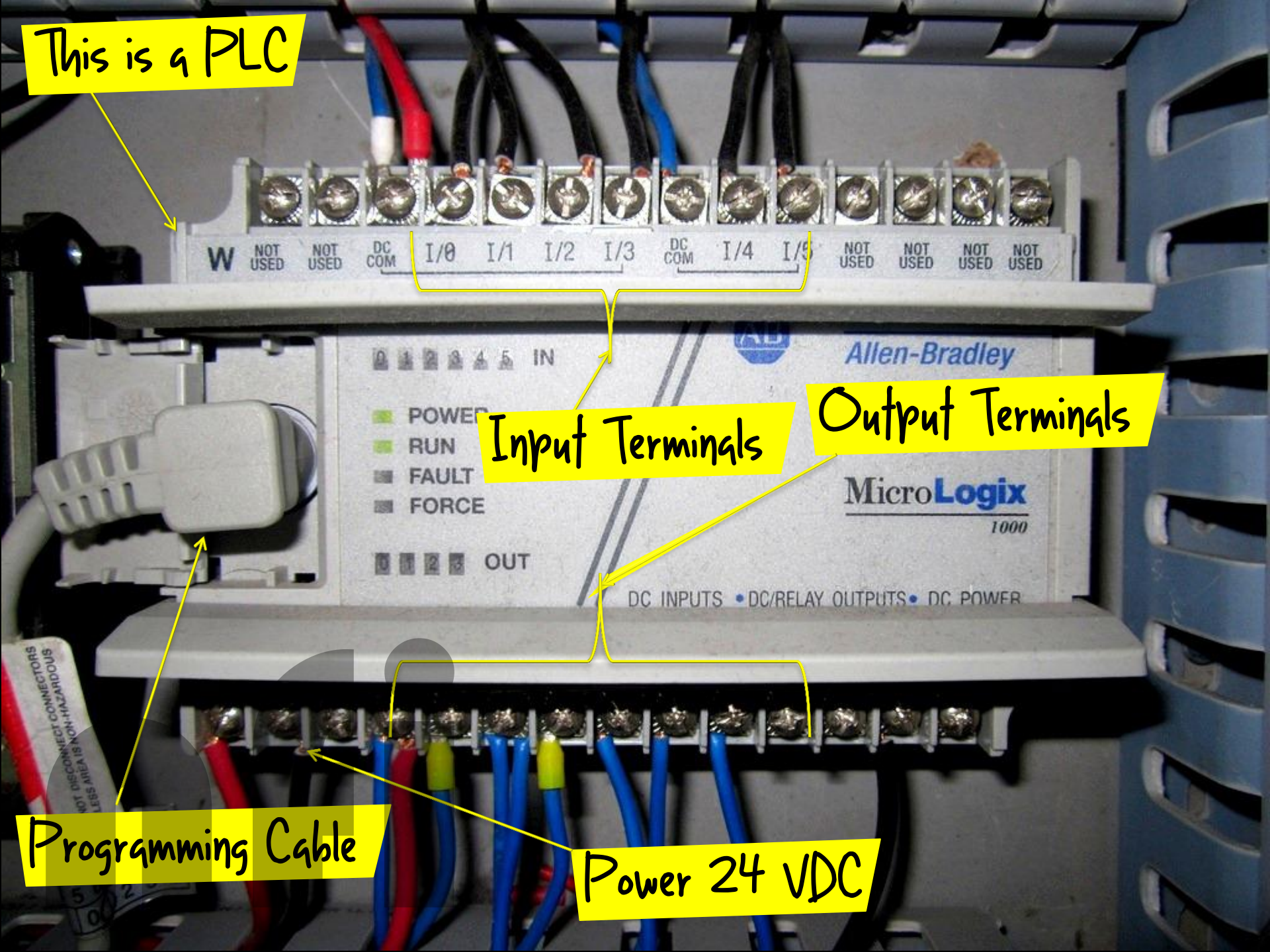
Output Terminals

Allen-Bradley  
MicroLogix  
1000

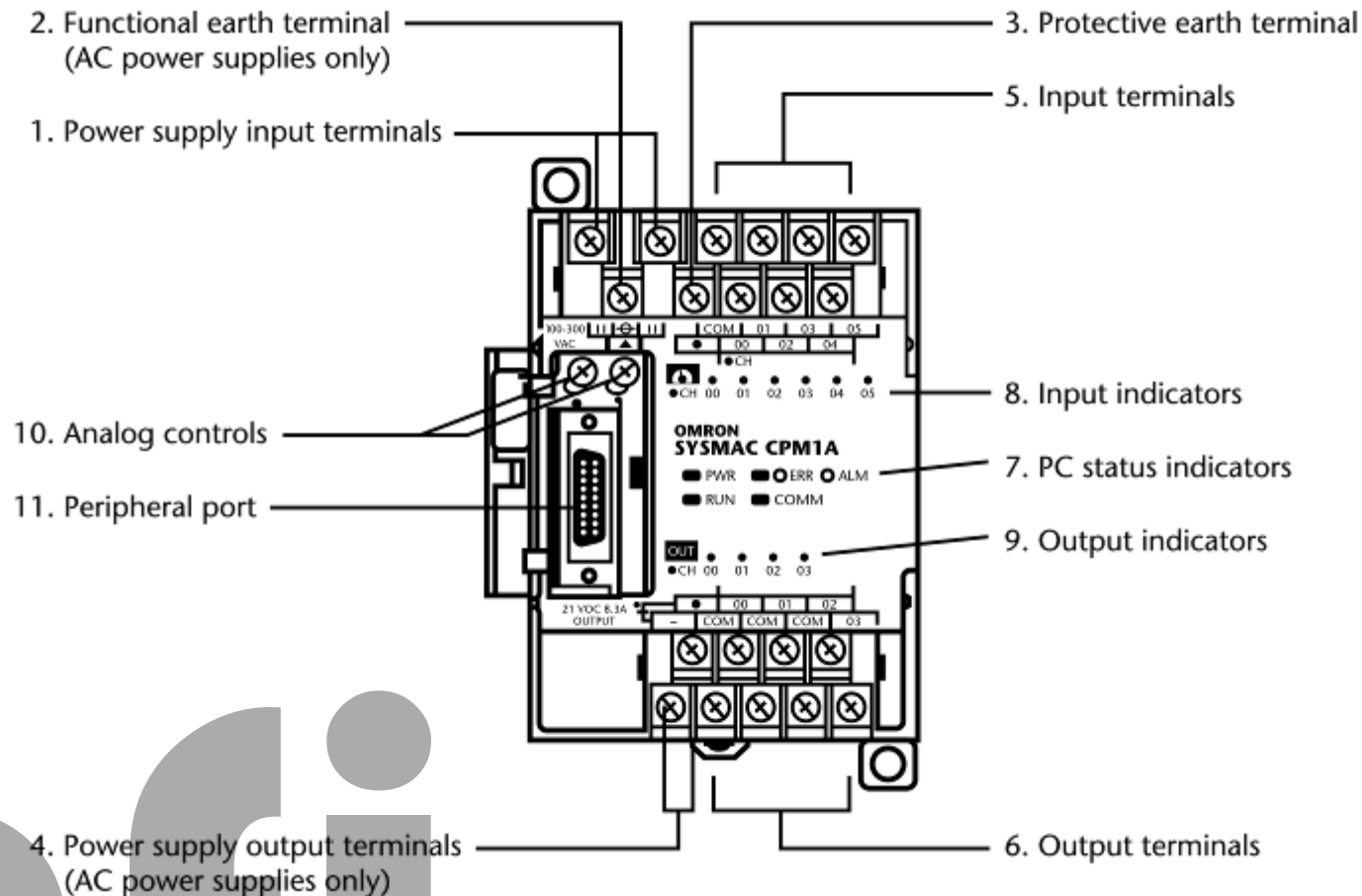
DC INPUTS • DC/RELAY OUTPUTS • DC POWER

Programming Cable

Power 24 VDC



# Understanding PLC





# Understanding PLC



| MicroLogix 1500 PLC Specifications |                    |              |                                |
|------------------------------------|--------------------|--------------|--------------------------------|
| PLC Part Number                    | 1764-24BWA         | 1764-24AWA   | 1764-28BXB                     |
| PLC Operating Power                | 85 V/265 VAC       | 85 V/265 VAC | 20.4 V 30 VDC                  |
| Inputs                             | 12                 | 12           | 16                             |
| Input Type                         | 24-VDC sink/source | 120 VAC      | 24-VDC sink/source             |
| Outputs                            | 12                 | 12           | 12                             |
| Output Type                        | Relay              | Relay        | 6 Relay<br>6 FET<br>Transistor |

# How to Select a PLC?

## Step 1:

Selecting the Inputs

- Number of Inputs
- Input Types – NPN or PNP
- Nature of Inputs– Digital or Analog
- Voltage rating of the Inputs



## Step 2:

Selecting the Outputs

- Number of Outputs
- Nature of Outputs – Digital or Analog
- Voltage rating of the Inputs

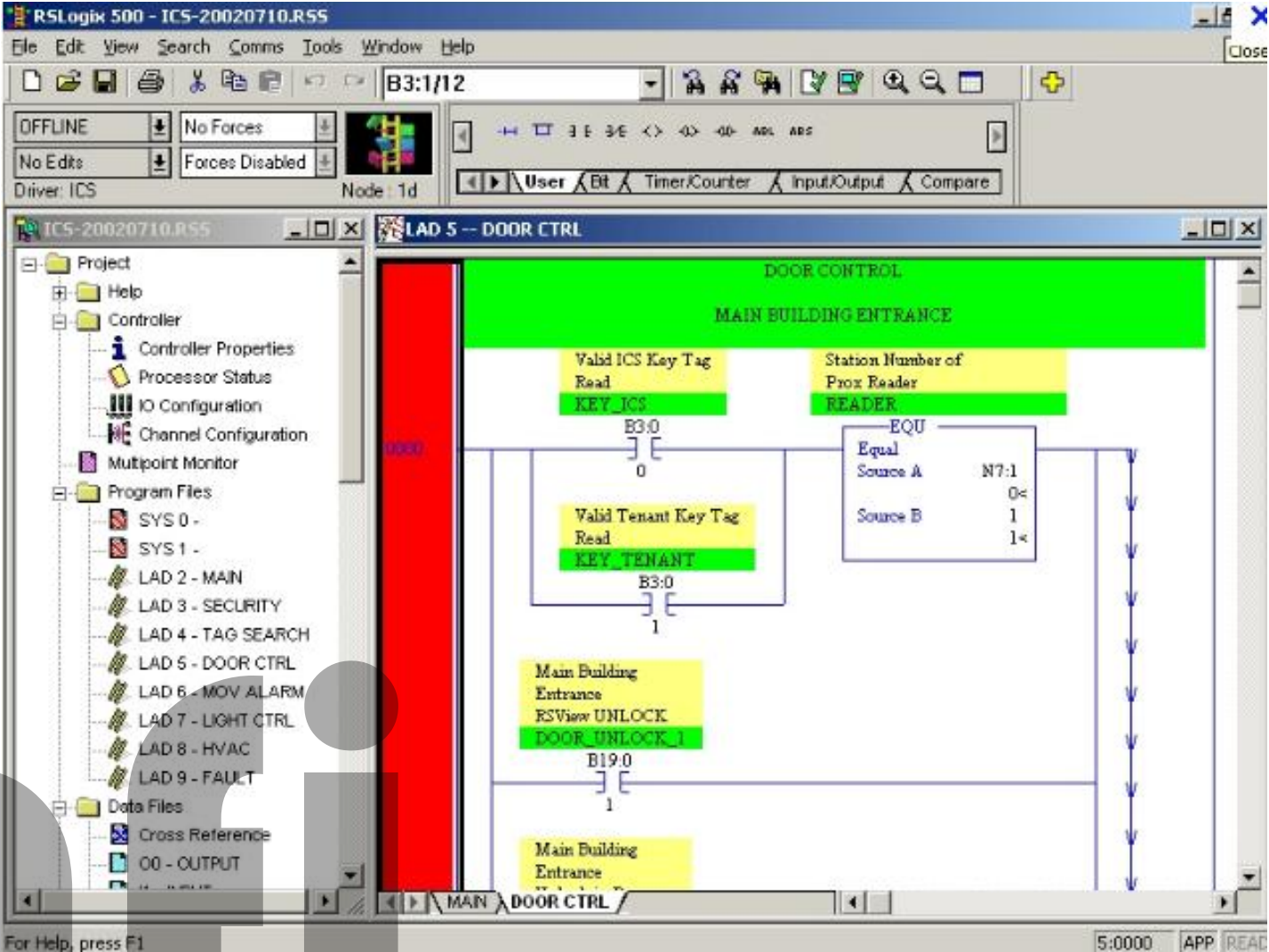
## Step 3:

Length of Program – Big or Small  
Nature of Program – Ladder Logic, SFC, Instruction List, FDB





# PLC Ladder Logic



# Common Industrial Hardware Representing the Binary Concept

| BINARY I/O DEVICES |                 |               |
|--------------------|-----------------|---------------|
| Two-State Device   | ON              | OFF           |
| Alarm bell         | Ring            | Silent        |
| Clutch             | Engaged         | Disengaged    |
| Limit switch       | Contacts closed | Contacts open |
| Motor              | Running         | Stopped       |
| Pilot light        | On              | Off           |
| Pressure switch    | Contacts closed | Contacts open |
| Proximity switch   | Part Present    | No part       |
| Push button        | Closed          | Open          |
| Temperature switch | Contacts closed | Contacts open |
| Valve              | Closed          | Open          |



# Basics of Machine Language

[www.nfiautomation.org](http://www.nfiautomation.org)

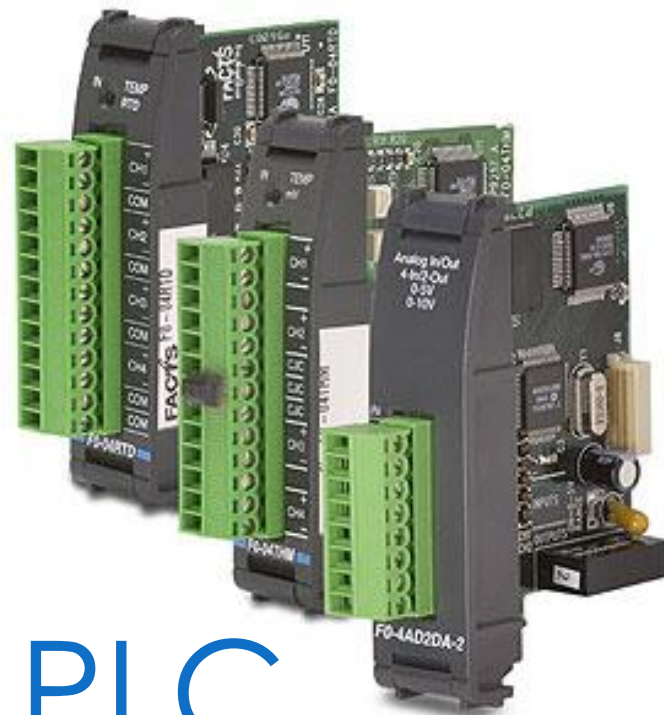


# Bits – Nibble - Byte – Word

- Unlike English, computers have only two characters available – 1 or 0.
- Each 1 or 0 is called a binary digit or bit.
- Binary is base or radix 2







# PLC

## Inputs & Outputs

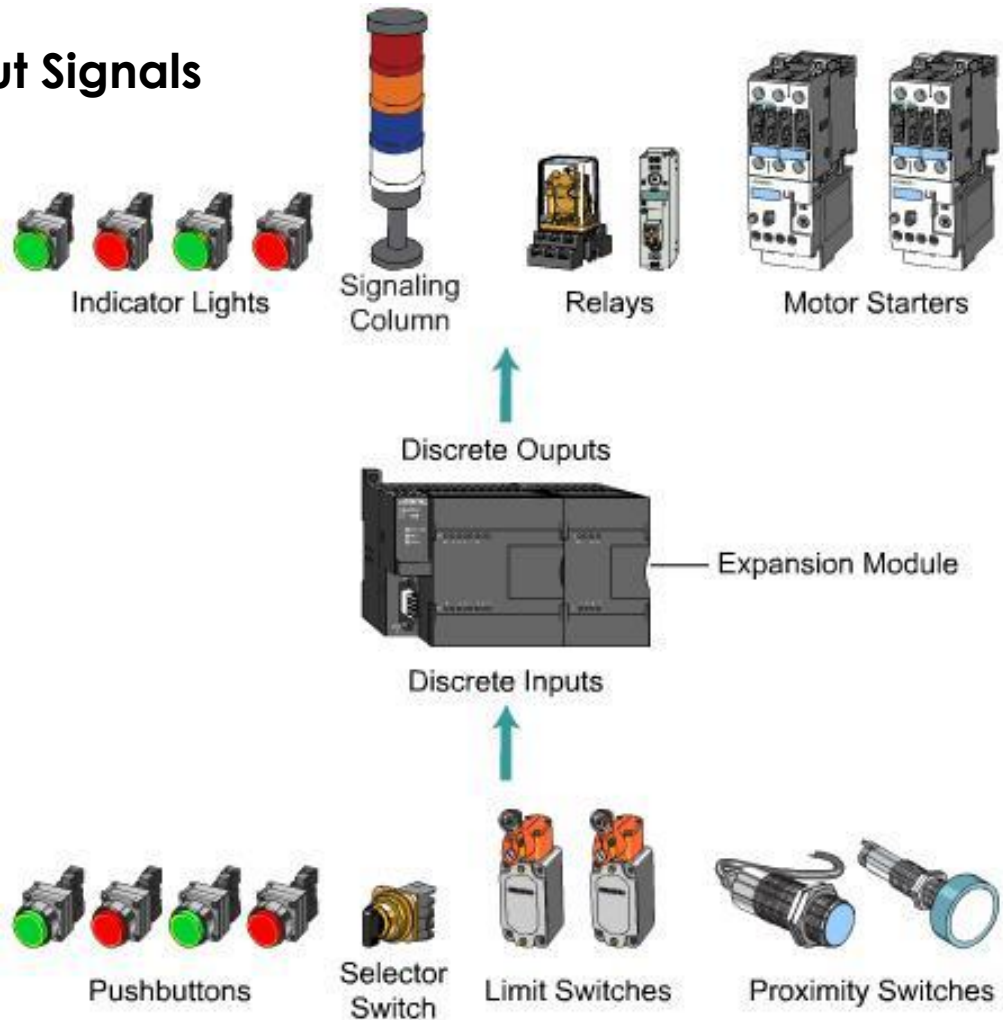
[www.nfiautomation.org](http://www.nfiautomation.org)



# Digital Inputs & Outputs

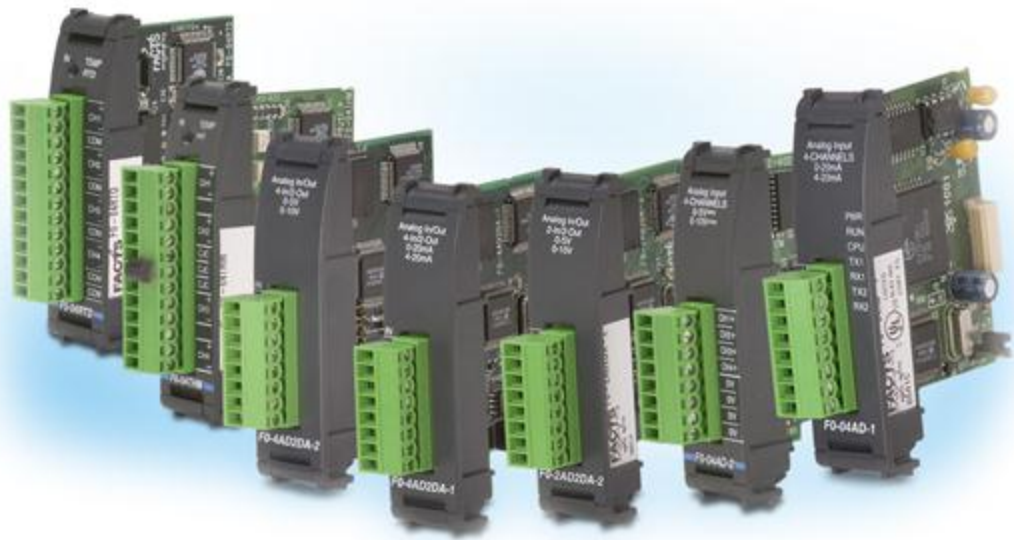
## Typical Digital Input/ Output Signals

- 12 VDC
- 24 VDC
- 120 VAC
- 240 VAC



## Analog Inputs

- Typical analog signals come from temperature, pressure, position, and motor speed.
- Analog input modules convert analog signals to digital words.
- Analog input signals are current or voltage.

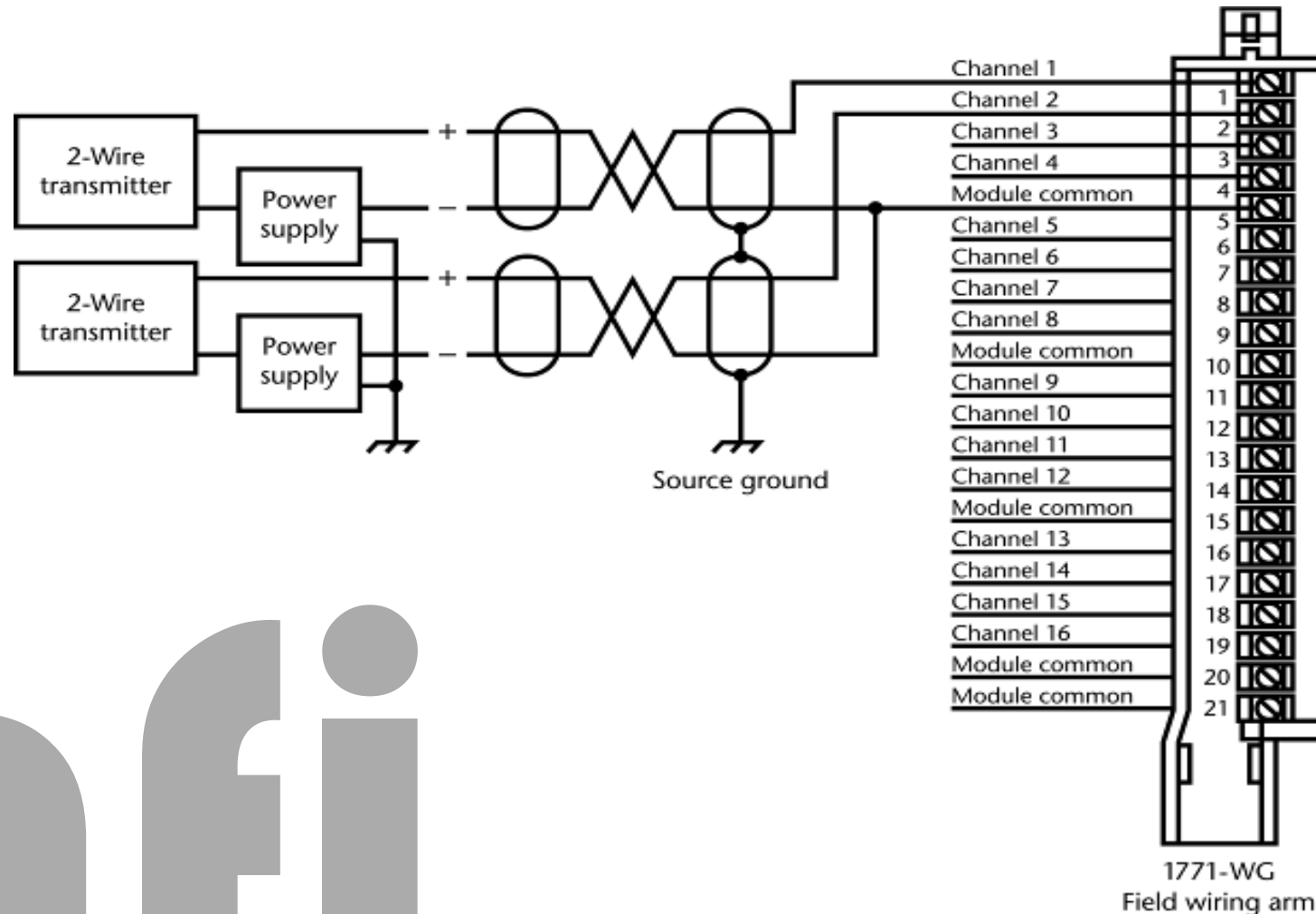


### Typical Analog input signals

0 to 10 volts DC  
-10 to +10 volts DC  
0 to 5 or 1 to 5 volts DC  
4 to 20 milliamps  
0 to 20 milliamps  
-20 to +20 milliamps

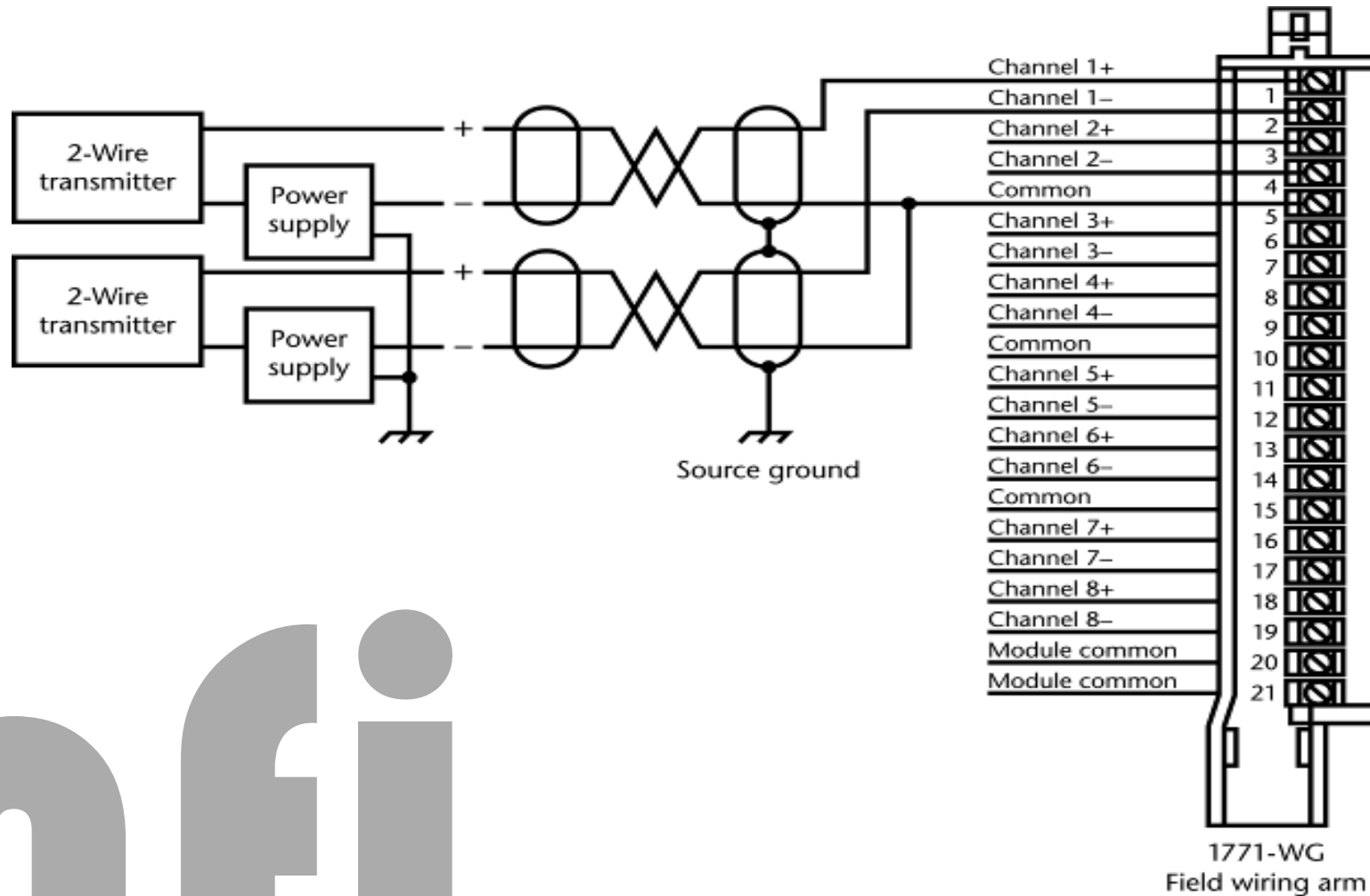


## Connections from Field Devices



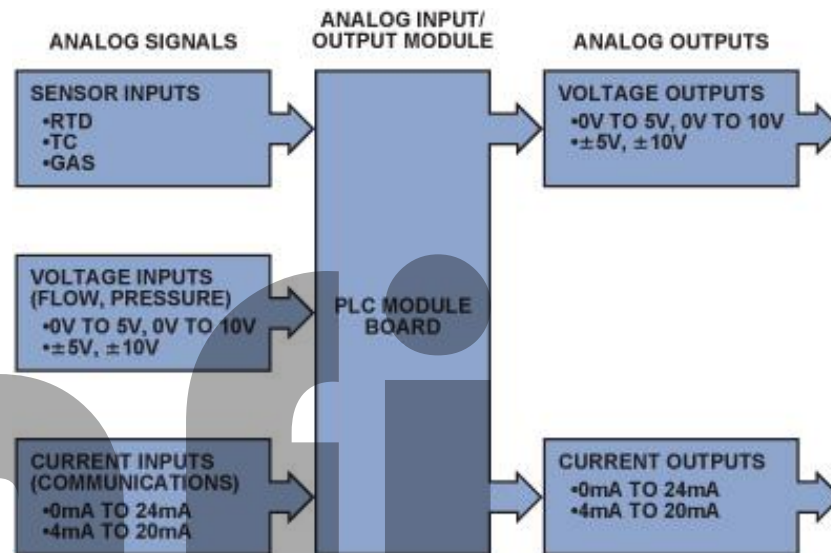


## Differential Analog Input Connections



## Analog Outputs

- Typical analog signals are required by Servo Valves, VFD's, Servo Motors, Meters
- Analog Output modules convert Digital bits to analog signal.
- Analog Output signals are current or voltage.



### Typical Analog Output signals

0 to 10 volts DC  
-10 to +10 volts DC  
0 to 5 or 1 to 5 volts DC  
4 to 20 milliamps  
0 to 20 milliamps  
-20 to +20 milliamps

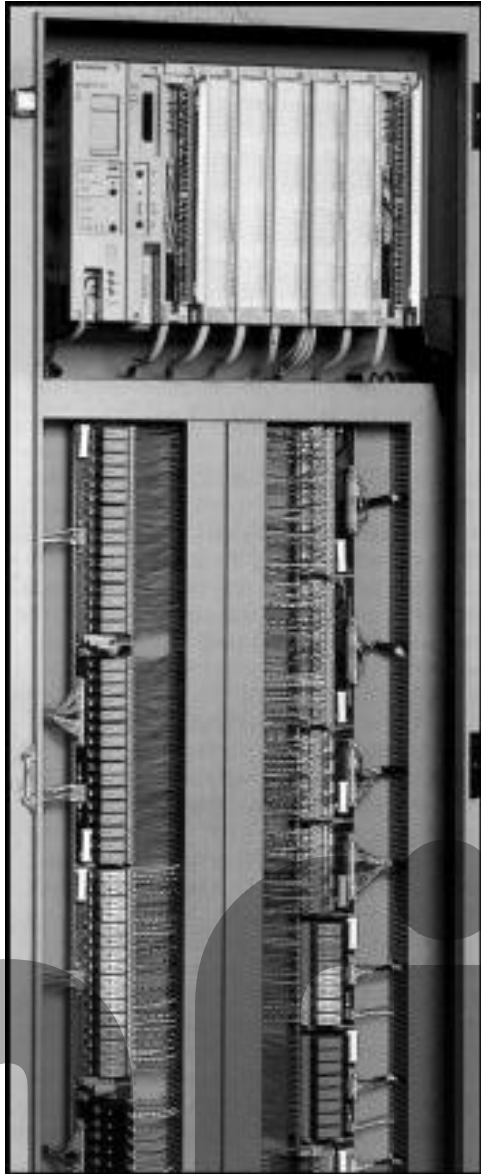


# PLC Enclosure & System Components

**NEMA – 12**

National Electric Manufacturer  
Association, USA

# PLC Enclosure



## Prevents:

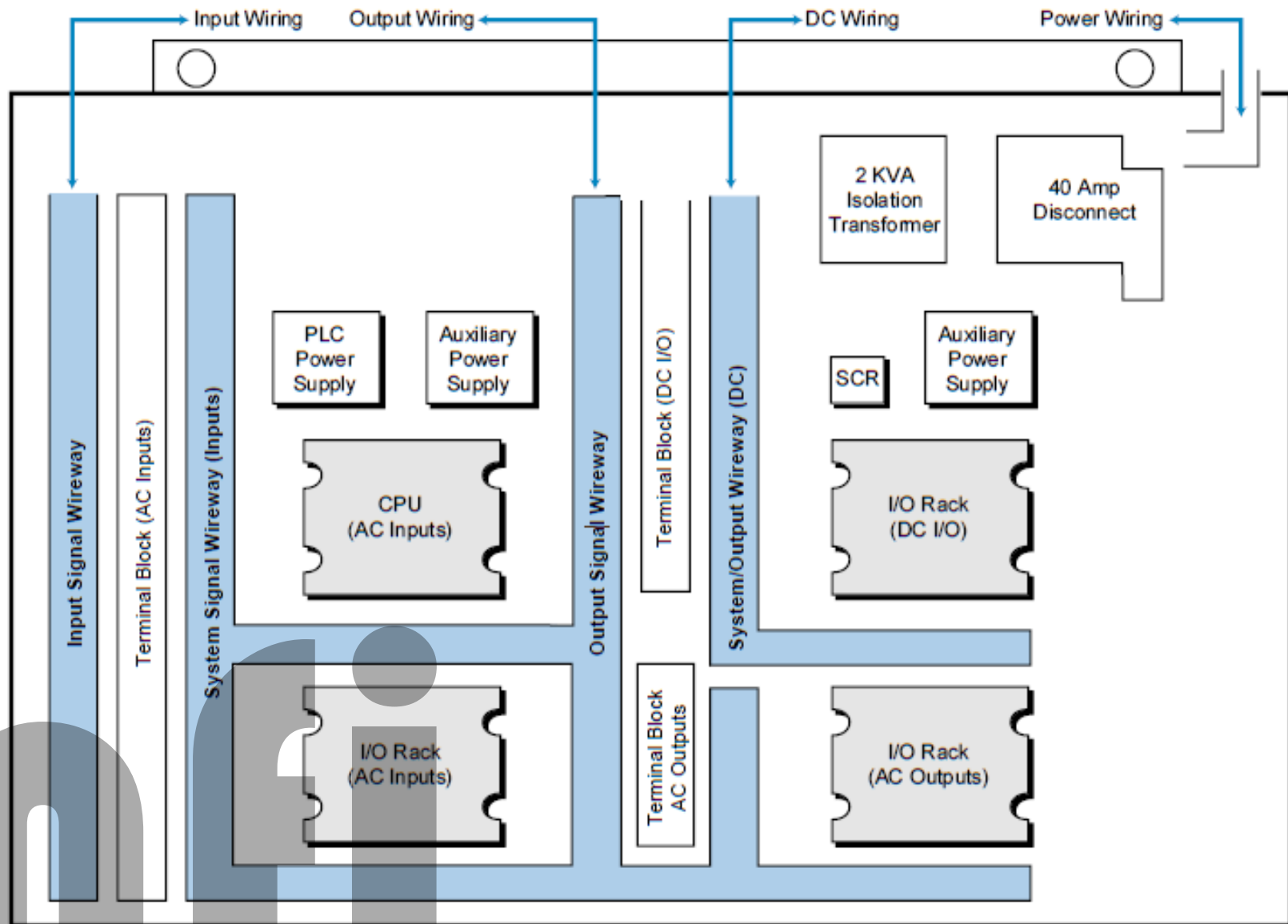
Dust  
Water  
Oil  
Mostly used for

Indoor applications of automation. Some examples are  
Packaging  
Material handling  
Non-corrosive process control.

NEMA enclosures are available in sizes from small wall mounts to multi-door freestanding models.

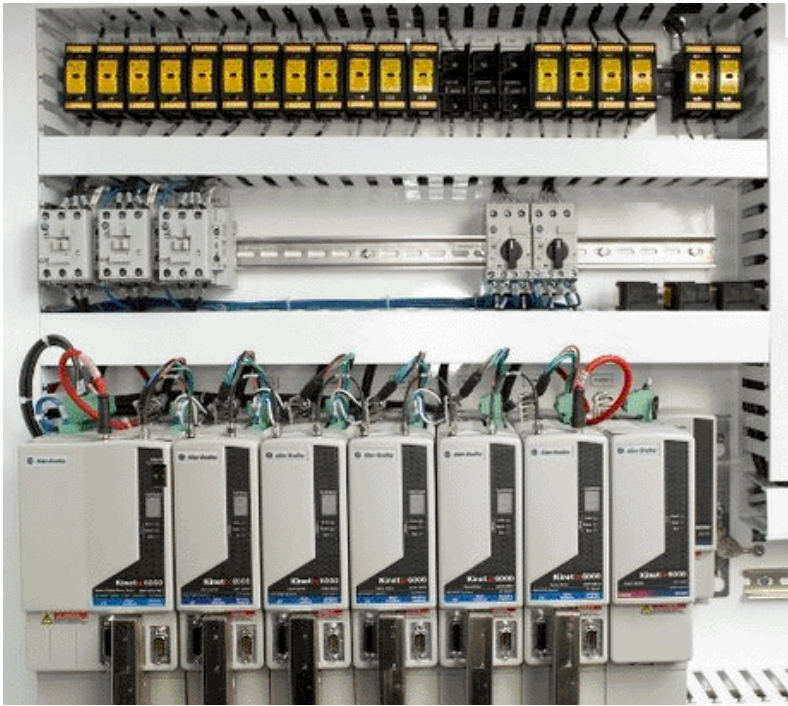


# Enclosure Layout



## Placement of PLC Components

To allow maximum cooling



All Controller components should be mounted in a vertical (upright) position.



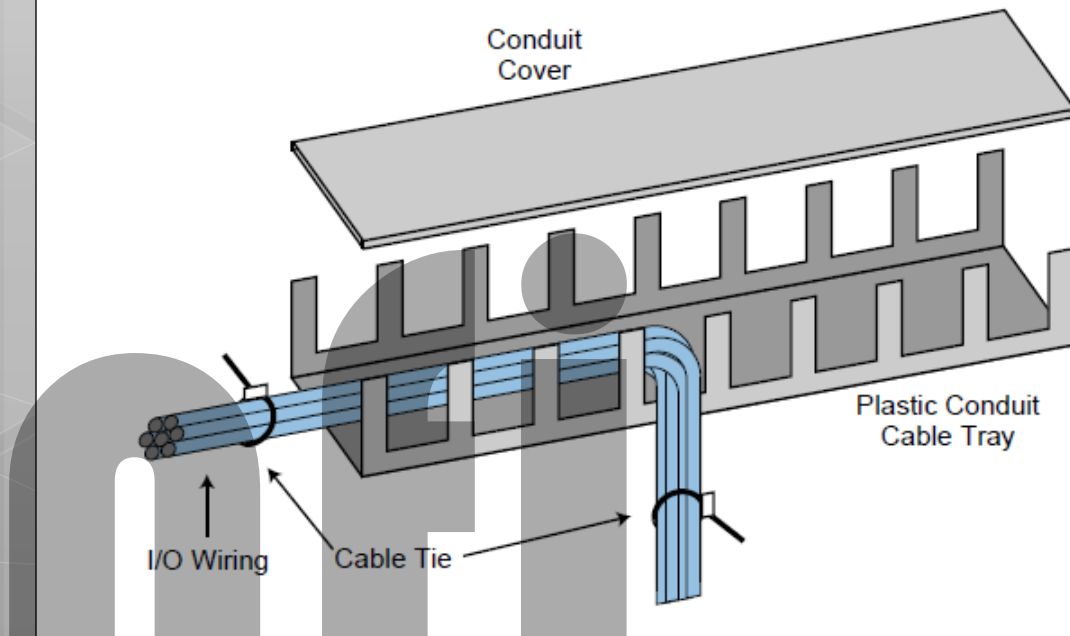
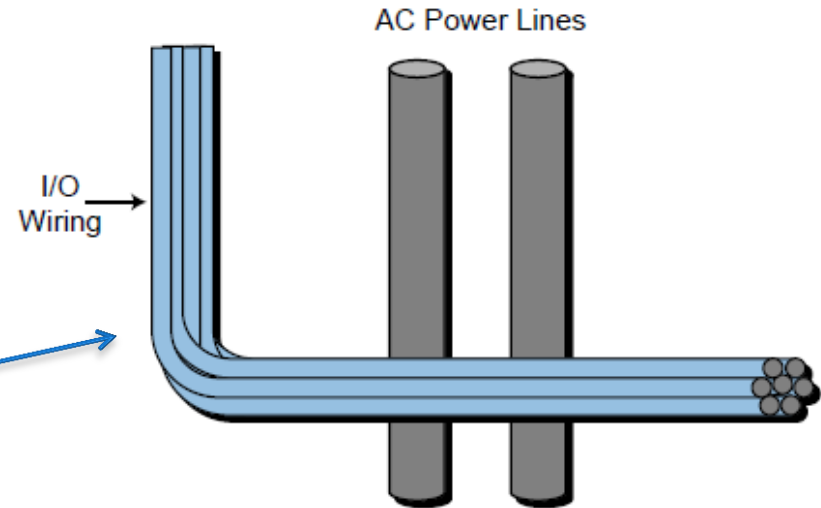
# Duck & Wire Layout

Keep **AC signals** separate from **DC Signals**

**DC Signals -**  
I/O lines, such as TTL and analog

**AC Signals -**  
Incoming Line Wires

Minimizes the possibility  
of electrical noise pickup.

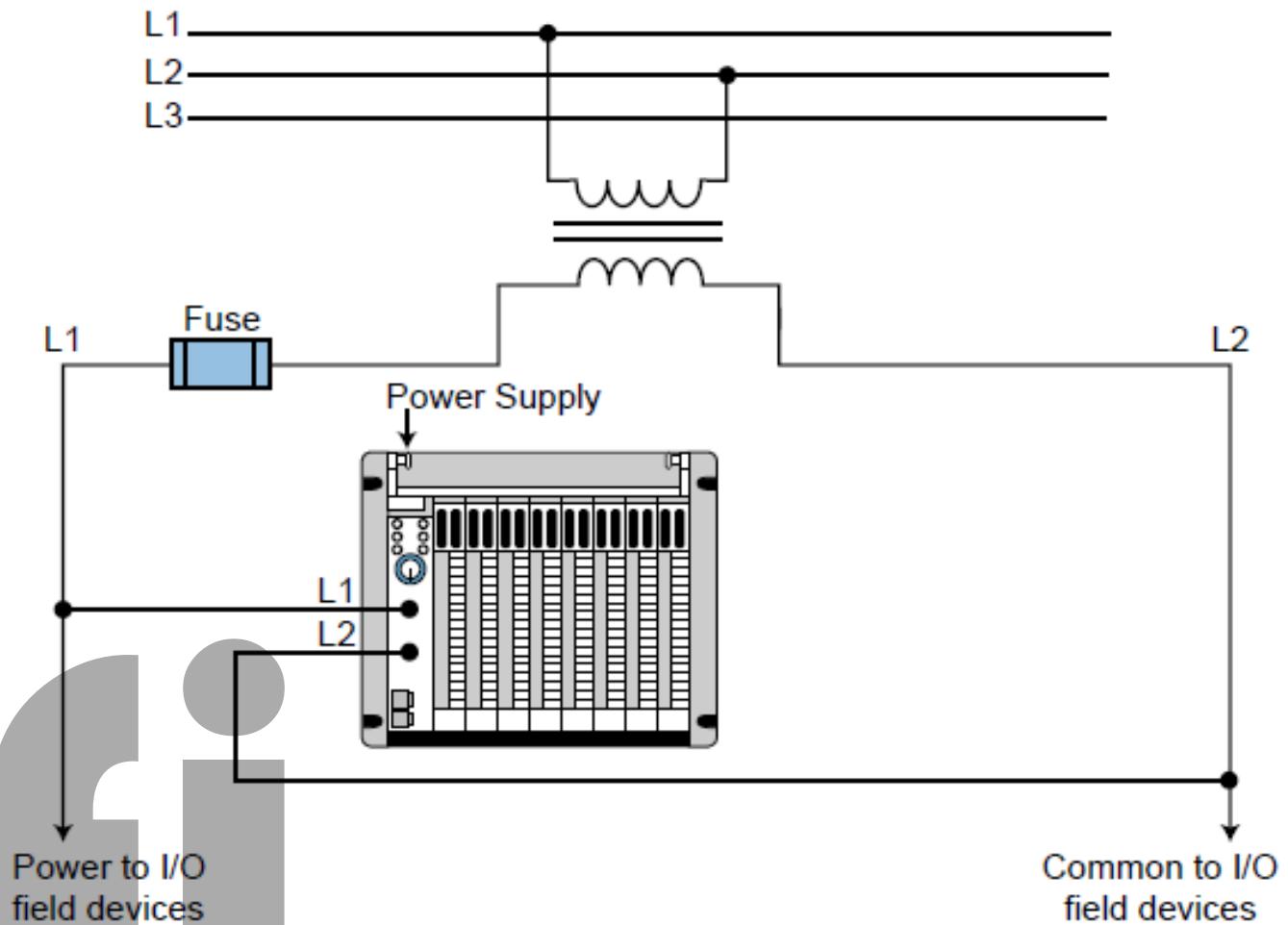




# Power Requirement & Safety Circuitry

## POWER REQUIREMENTS

Typical Power Requirement  
**220 VAC**





# SAFETY CIRCUITRY

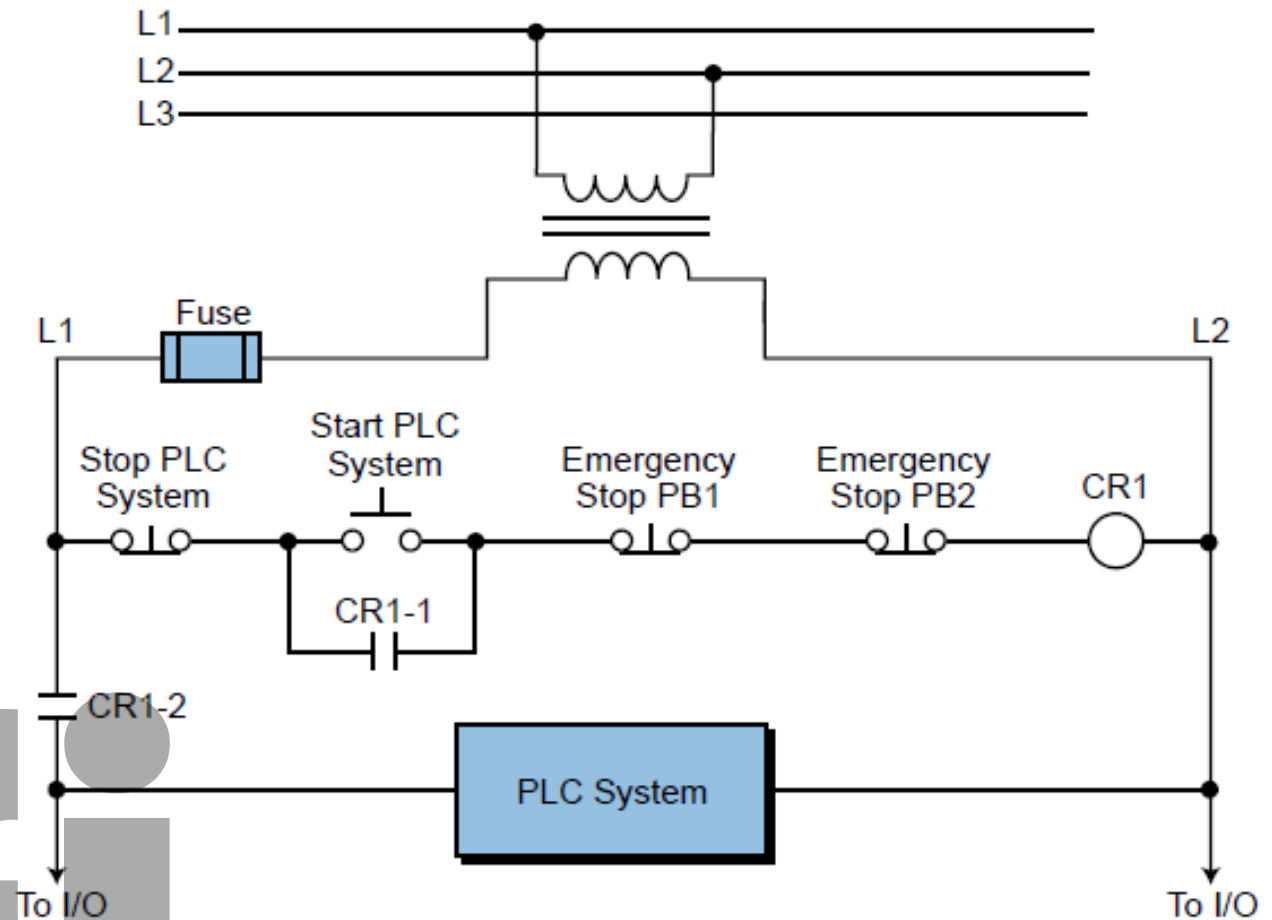
Door Switch



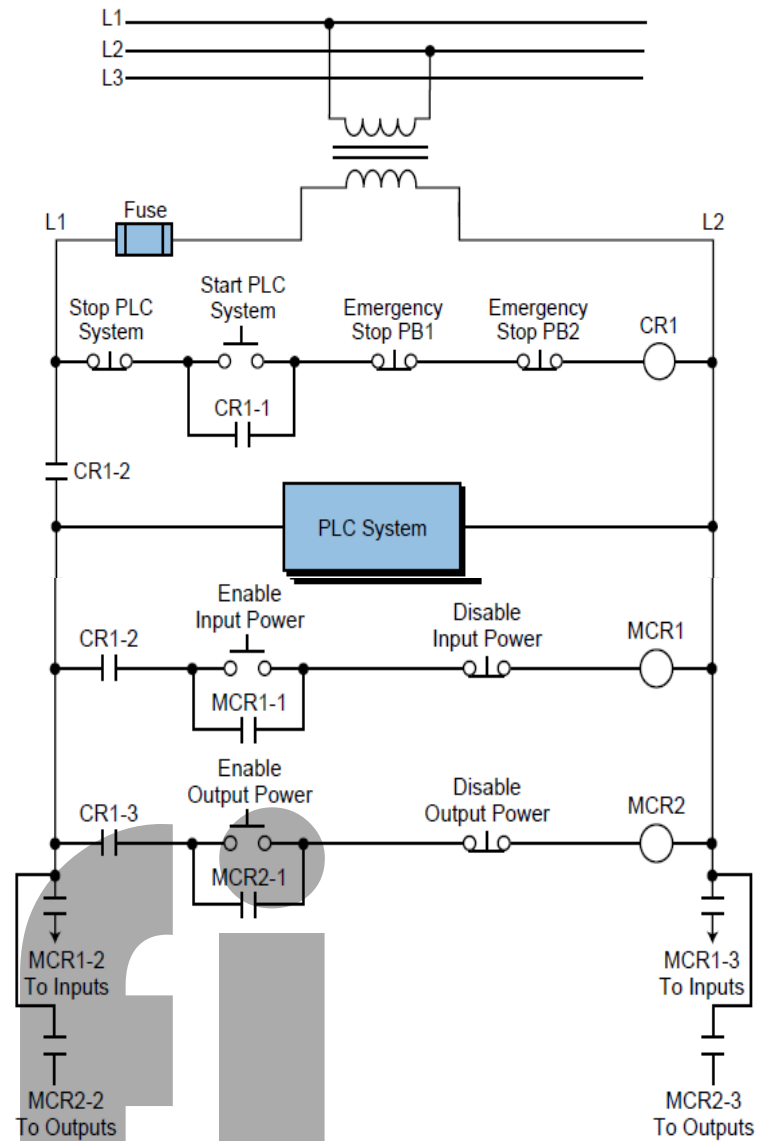
Pull Rope Switch



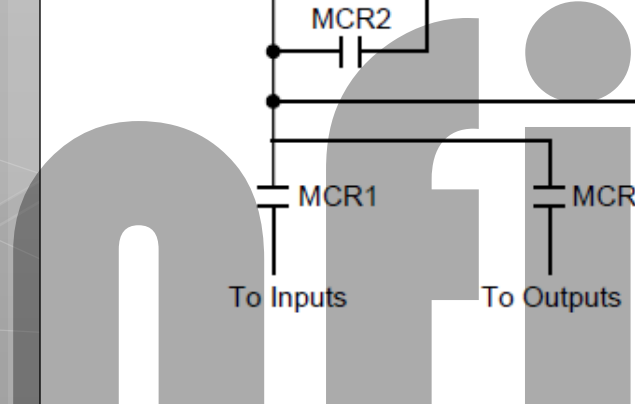
Emergency Switch



# Master or Safety Control Relays



## PLC FAULT CONTACT PROTECTION





# PLC Maintenance

**HEAT**, DUST & **NOISE**  
REGULATION

## HEAT & DUST REGULATION



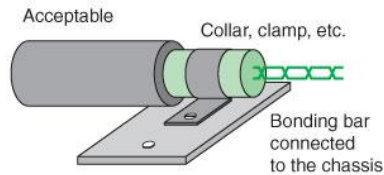
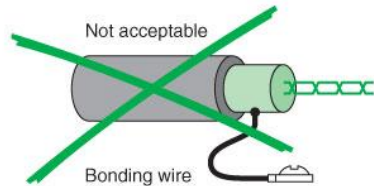
Temperature Withstand Range

0 ~ 60°C

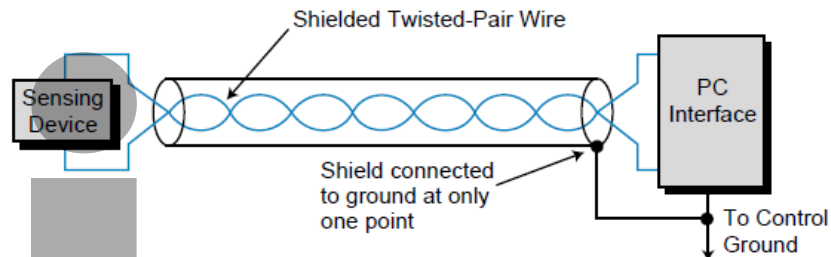
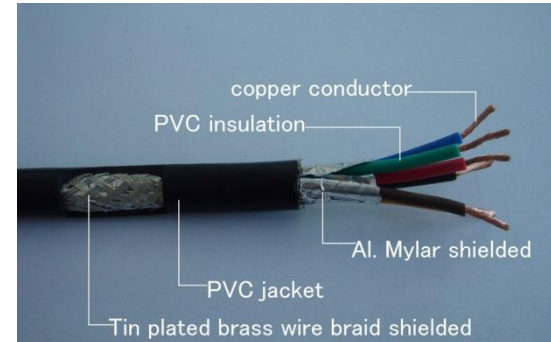
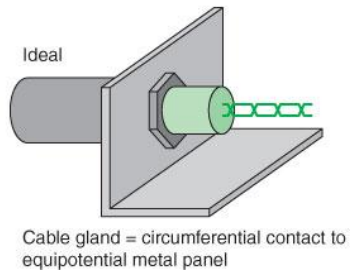
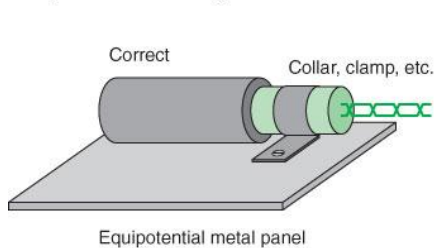


## NOISE REGULATION

All bonding connections must be made to bare metal



Poorly connected shielding = reduced effectiveness



## Shielded Cables for better communication

## NOISE GENERATING DEVICES



**MOTOR STARTERS**



**SOLENOIDS**

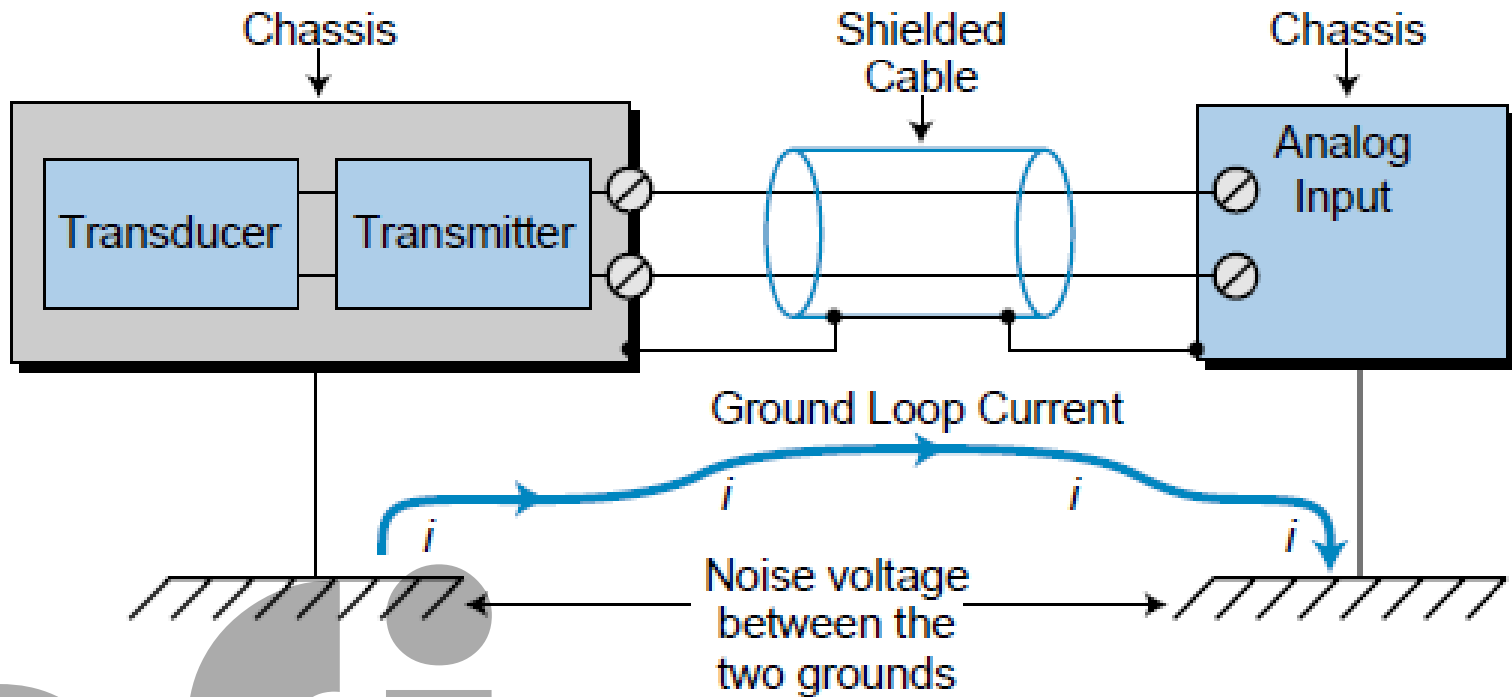


**RELAYS AND CONTACTORS**



**VARIABLE FREQUENCY DRIVES**

# NOISE FROM GROUNDING





# PLC

I/O Installation,  
Wiring & Precautions

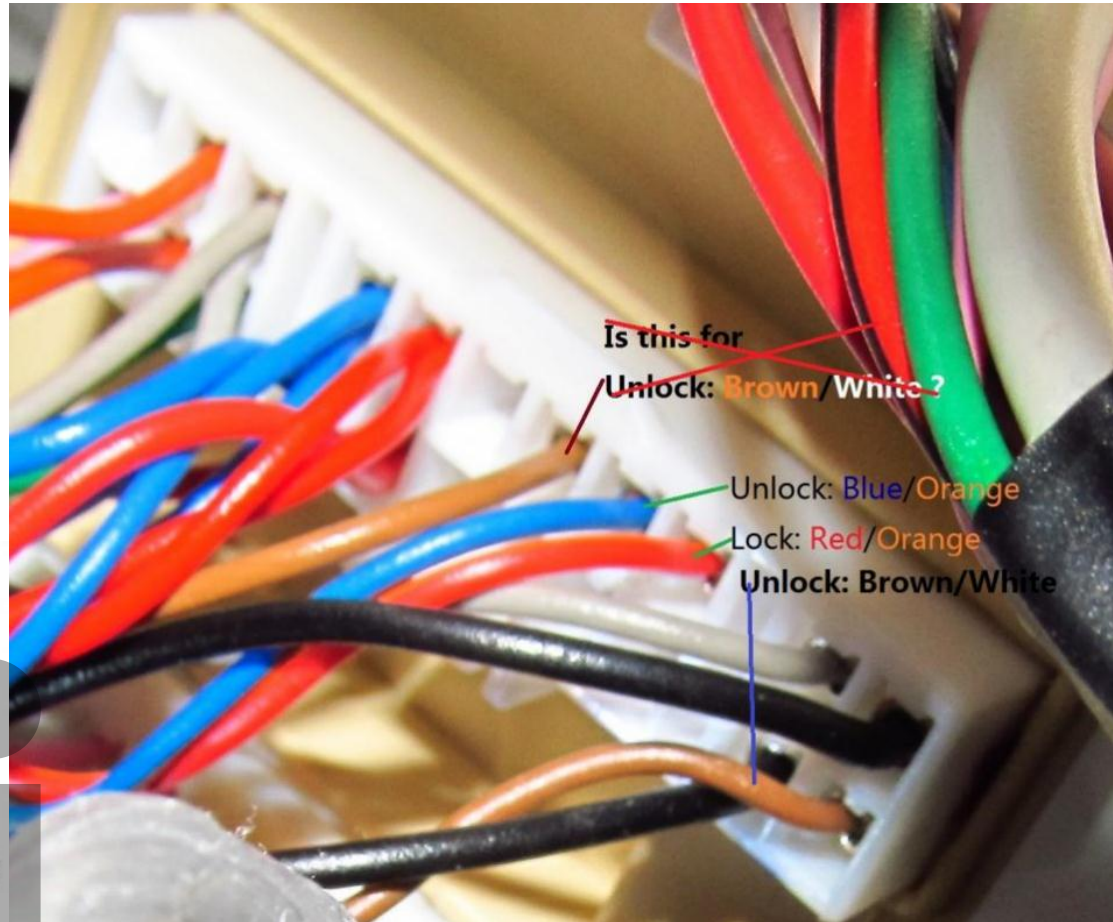
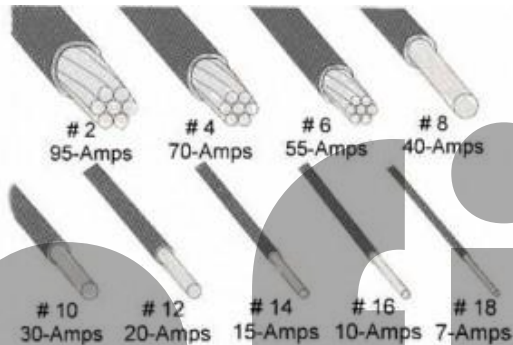
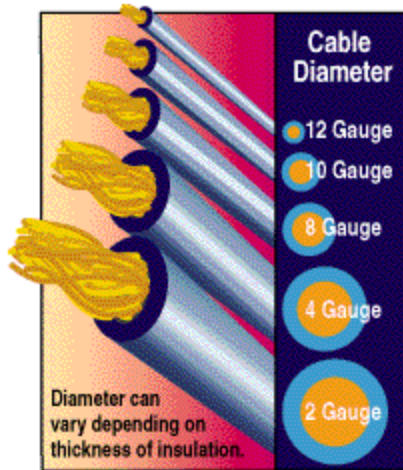
## I/O MODULE INSTALLATION

Placement and installation of the I/O modules is simply a matter of inserting the correct modules in their proper locations. This procedure involves verifying the type of module (220 VAC/ 24 VDC output, 220 VDC/ 24 VDC input, etc.) and the slot address as defined by the I/O address assignment document. Each terminal in the module is then wired to the field devices that have been assigned to that termination address. The user should remove power to the modules (or rack) before installing and wiring any module.<sup>11</sup>





# WIRE SIZE CONSIDERATION

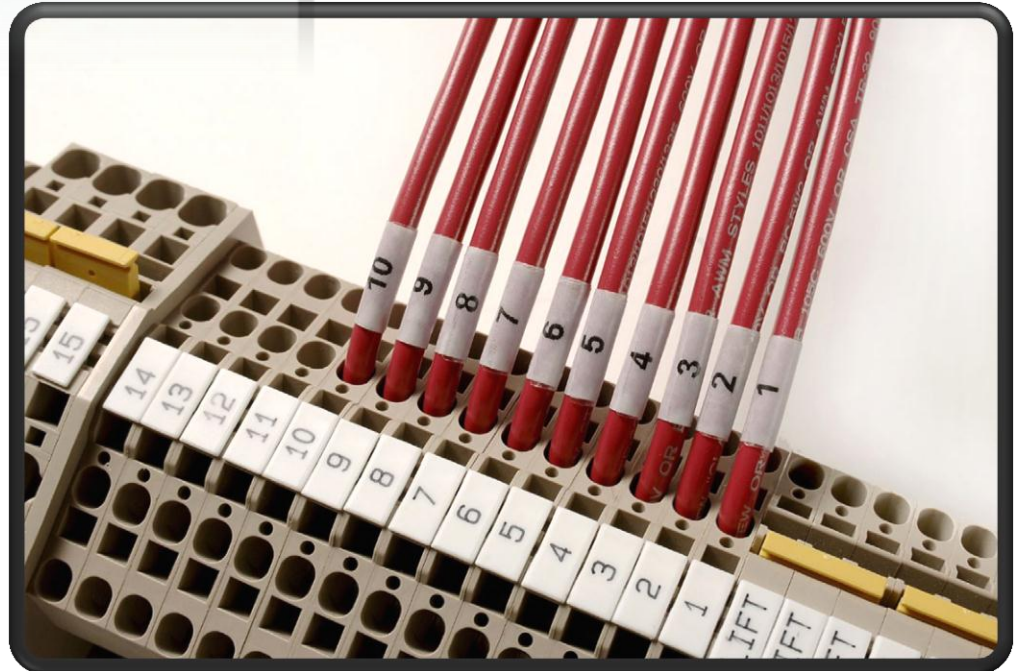
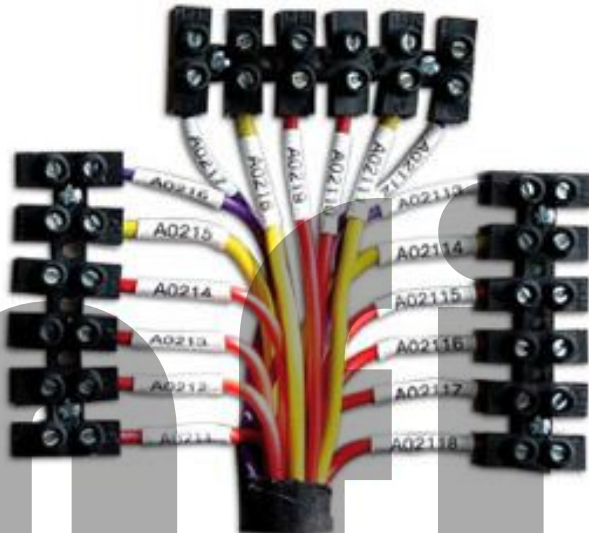
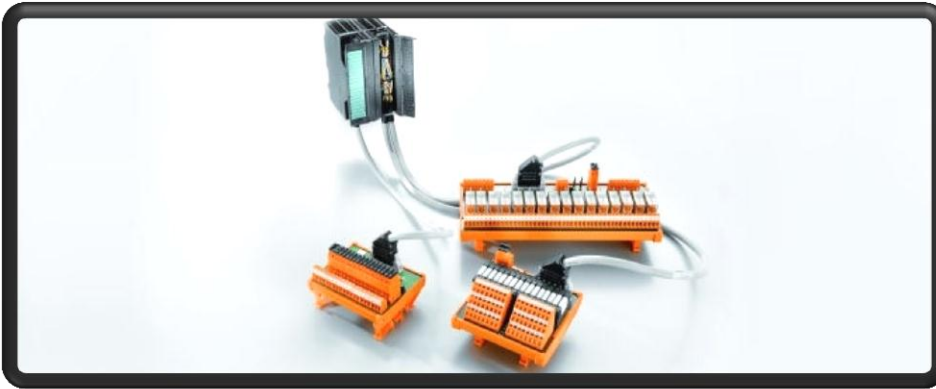


# WIRE SIZE CONSIDERATION

**Table 4.7 - Current ratings and volt drops for sheathed multi-core p.v.c.-insulated**

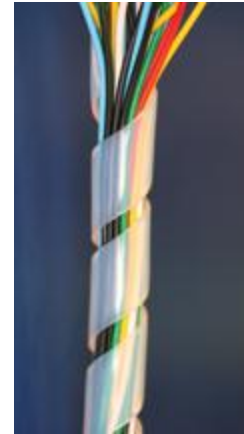
| Cross sectional area | In conduit in thermal insulation | In conduit in thermal insulation |
|----------------------|----------------------------------|----------------------------------|
| (mm <sup>2</sup> )   | (A)                              | (A)                              |
| -                    | 2 core                           | 3 or 4 core                      |
| 1.0                  | 11.0                             | 10.0                             |
| 1.5                  | 14.0                             | 13.0                             |
| 2.5                  | 18.5                             | 17.5                             |
| 4.0                  | 25.0                             | 23.0                             |
| 6.0                  | 32.0                             | 29.0                             |
| 10.0                 | 43.0                             | 39.0                             |
| 16.0                 | 57.0                             | 52.0                             |

# WIRE LABELLING





# WIRE BUNDLING

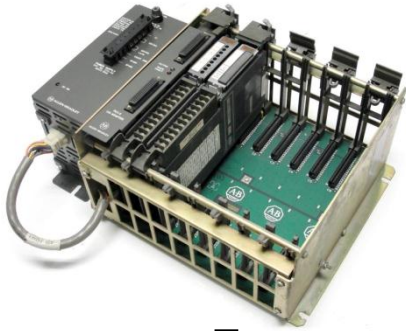




# PLC

START-UP & CHECKING  
PROCEDURES

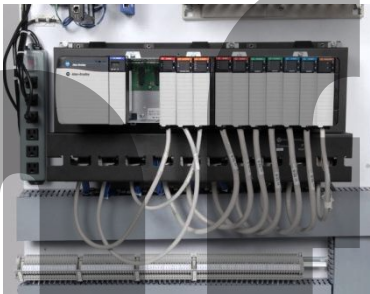
# PLC START-UP AND CHECKING PROCEDURES



Model numbers  
Placement



Power Supply  
Inspection

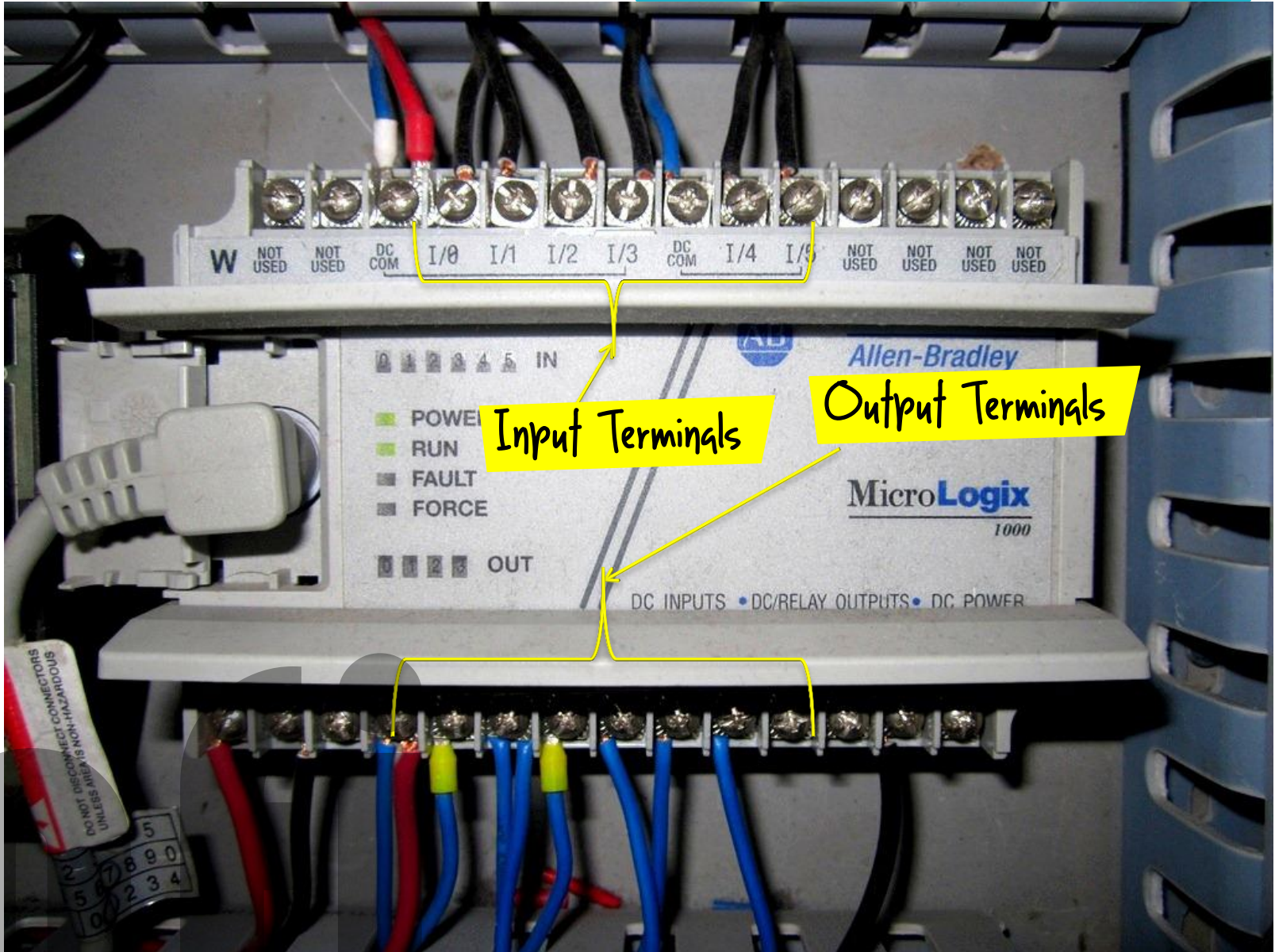


Verify Field Wiring  
&  
I/O comm. cables





## STATIC INPUT/ OUTPUT WIRING CHECK





# PLC

PREVENTIVE  
MAINTENANCE

---

# PLC PREVENTIVE MAINTENANCE



← Regular Filter Cleaning

← Regular Dusting  
Dust restricts heat dissipation  
Avoid Conductive Dust

← I/O Module Check for any  
Loose connections

← Avoid Noise generating  
Equipment close to PLC

← Avoid documentation to create  
HOT SPOT

← Install vibration Detector in  
area of high vibration

# PLC PREVENTIVE MAINTENANCE

| Inspection items         | Details                                                                                           | Criteria                                                                                                                                   | Remarks              |
|--------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Power supply             | Determine whether the voltage fluctuation at the power supply terminals is within specifications. | Within the voltage variation range (see note)                                                                                              | Tester               |
| Environmental conditions | Is the ambient temperature inside the panel appropriate?                                          | 0 to 55°C                                                                                                                                  | Thermometer          |
|                          | Is the ambient humidity inside the panel appropriate?                                             | 10% to 85% RH with no condensation                                                                                                         | Hygrometer           |
|                          | Has dirt or dust collected?                                                                       | None                                                                                                                                       | Visual inspection    |
| I/O power supply         | Is the voltage fluctuation measured at the I/O terminals within the standard range?               | Each I/O terminal must conform to the specifications                                                                                       | Tester               |
| Installation status      | Are all units securely installed?                                                                 | Nothing is loose                                                                                                                           | Phillips screwdriver |
|                          | Are all connection cables and connectors inserted completely and locked?                          | Nothing is loose                                                                                                                           | Visual inspection    |
|                          | Are any of the external wiring screws loose?                                                      | Nothing is loose                                                                                                                           | Phillips screwdriver |
|                          | Are any of the external wiring cables frayed?                                                     | No external abnormalities                                                                                                                  | Visual inspection    |
| Product service life     | Contact output relay                                                                              | Electrical:<br>Resistance load:<br>300,000 operations<br>Inductive load:<br>100,000 operations<br><br>Mechanical:<br>10,000,000 operations | ---                  |
|                          | Battery (CPM2A-BAT01)                                                                             | 5 years*                                                                                                                                   | ---                  |



# MAIN CHECK

Is **Power** Indicator Lit?

Is **Run** Indicator Lit?

**ERR/ALR** Indicator Flashing?

Is **I/O** Sequence Normal?

Is **Operating Environment**  
Normal?

**Program** cannot be written



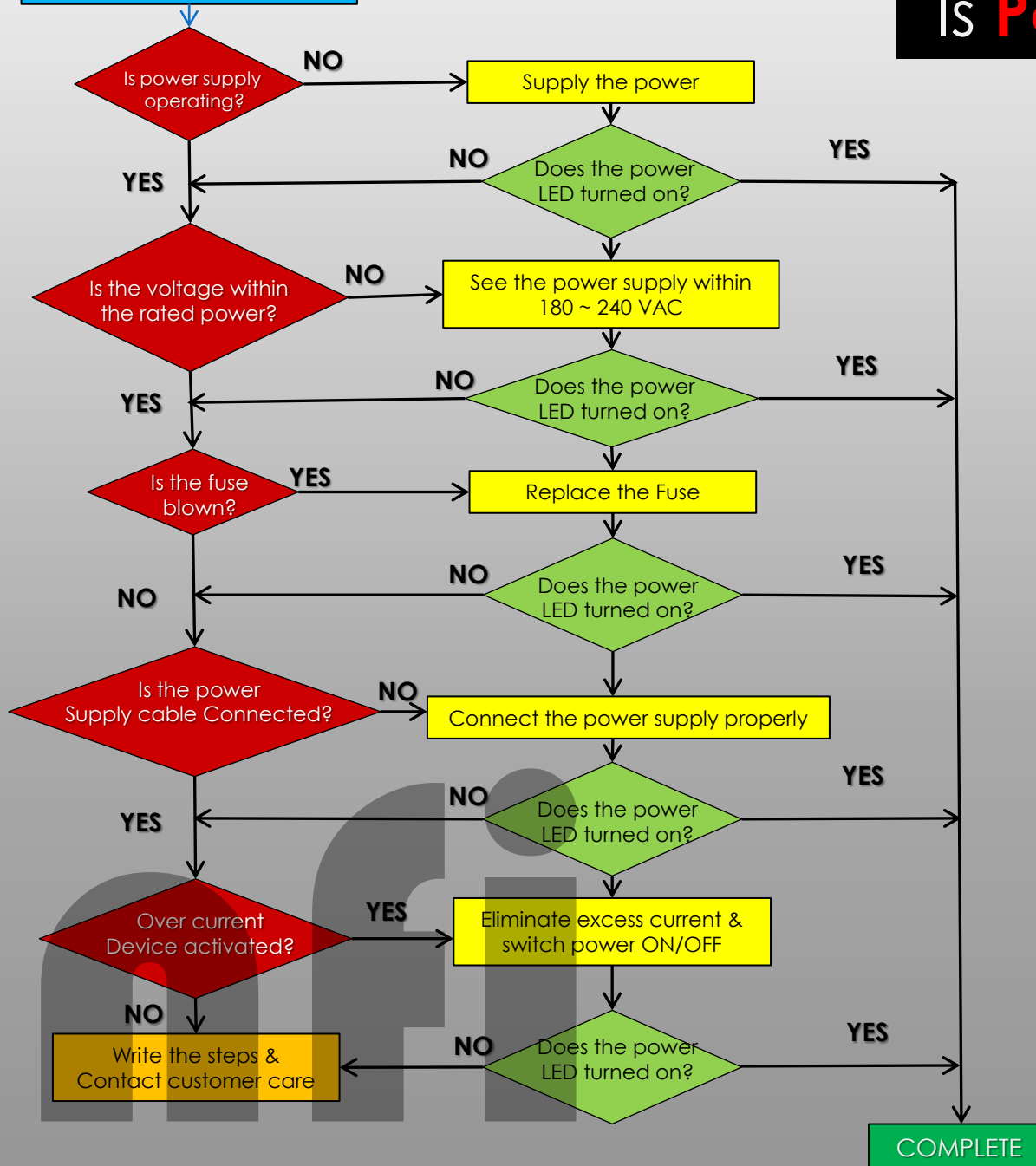
## PLC TROUBLESHOOTING AREAS





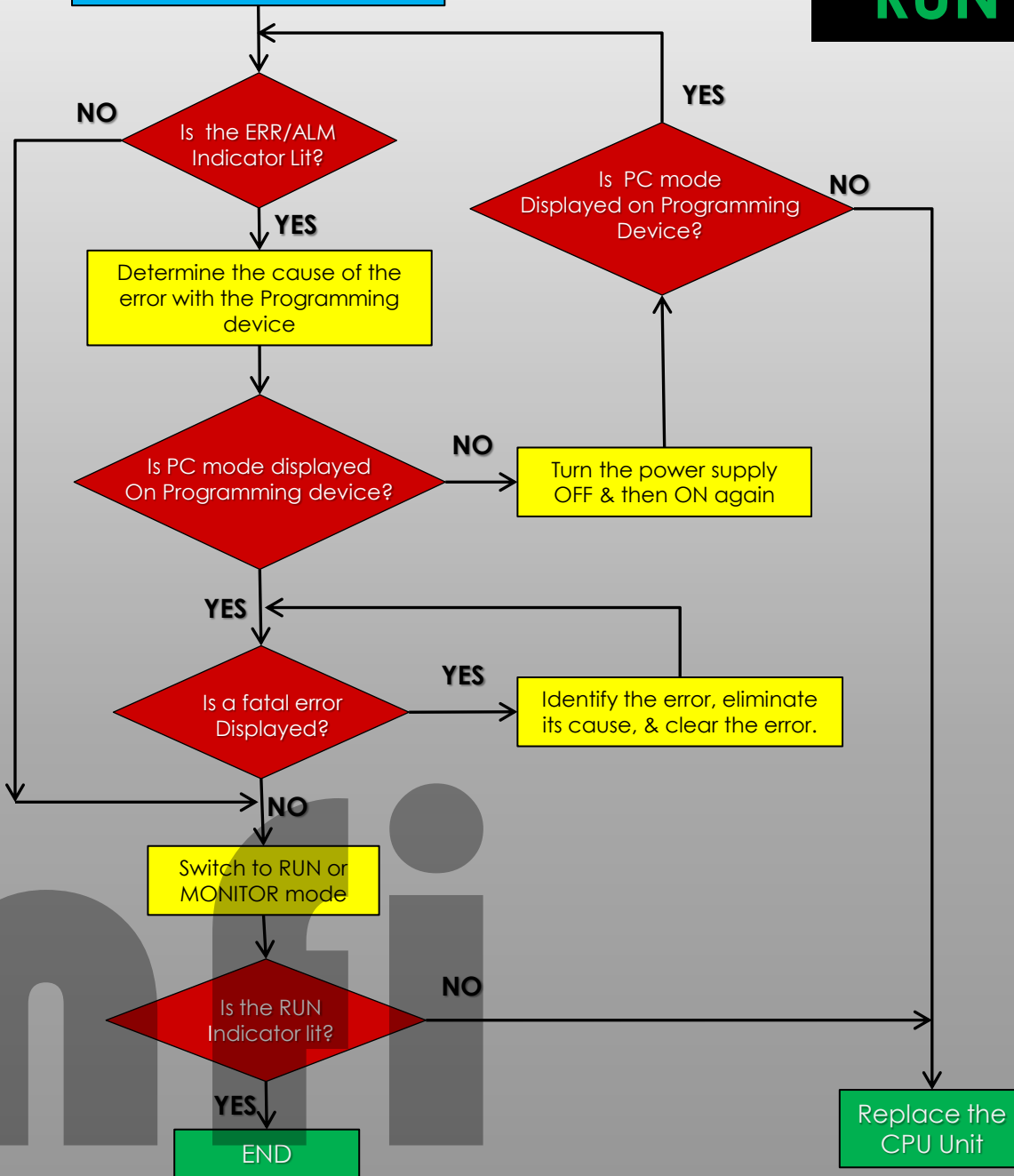
POWER LED IS TURNED OFF

# Is **Power** Indicator Lit?



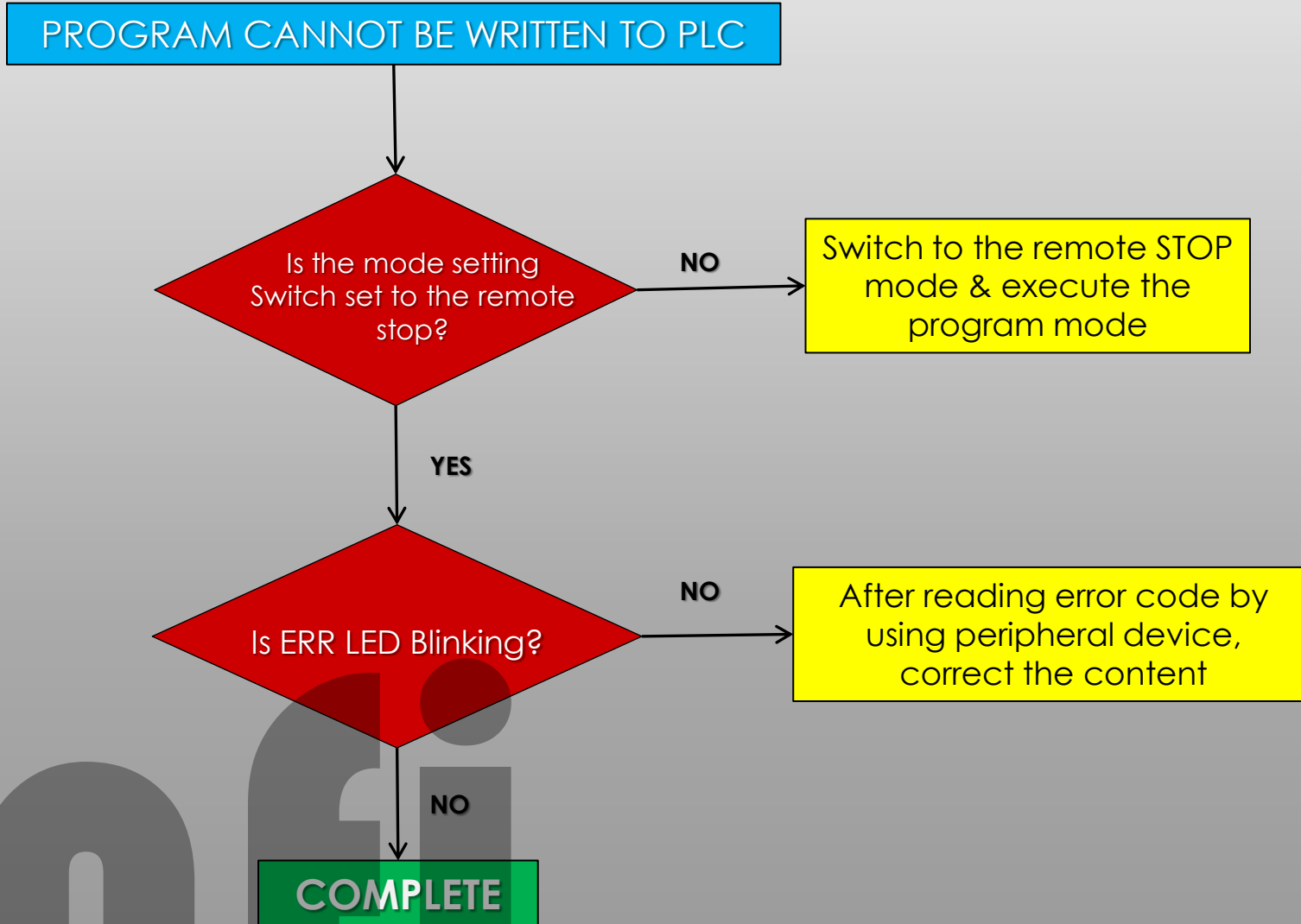
RUN INDICATOR NOT LIT

**RUN** Indicator not Lit



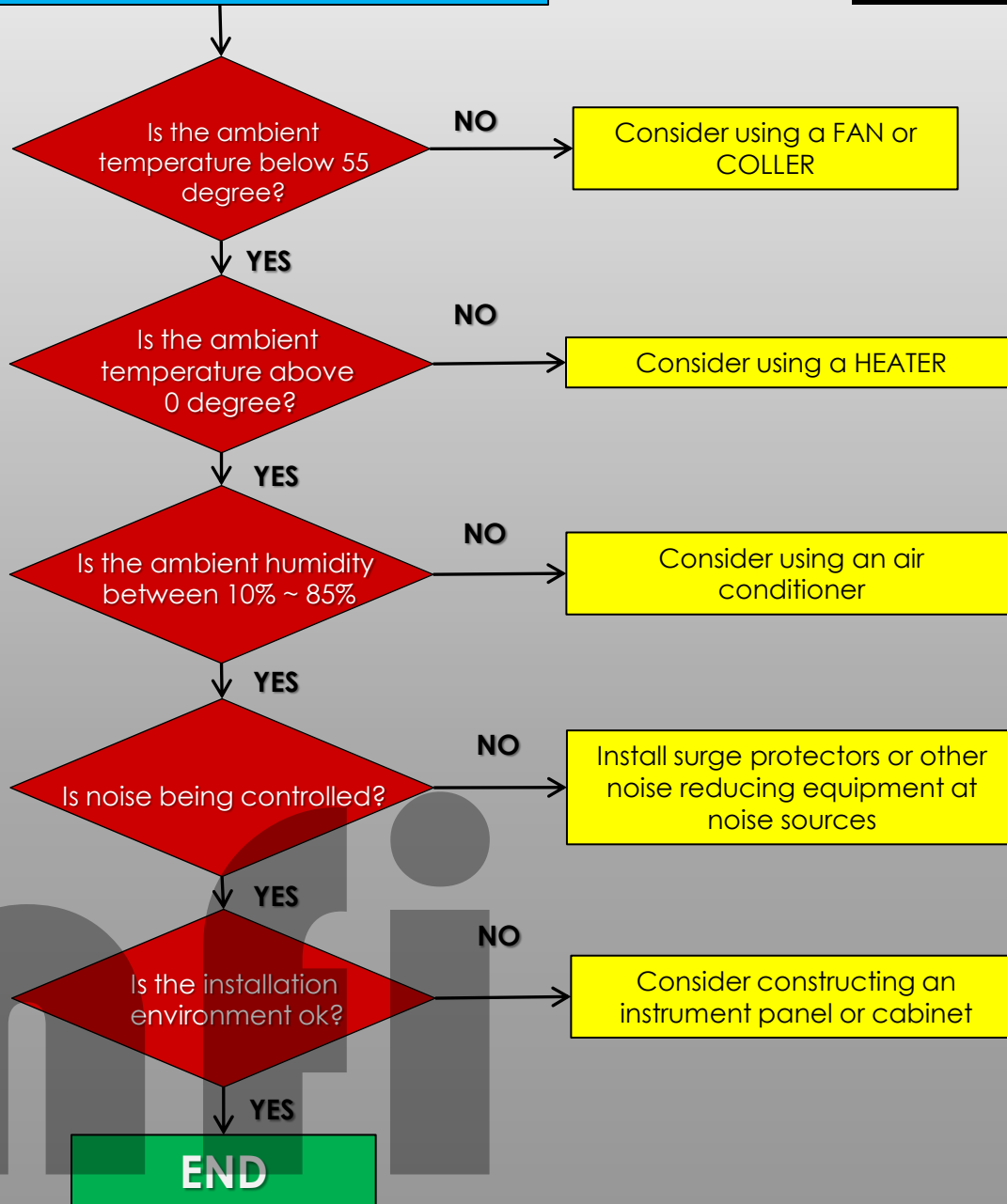
**FATAL ERROR  
CHECK**

# Program cannot be written



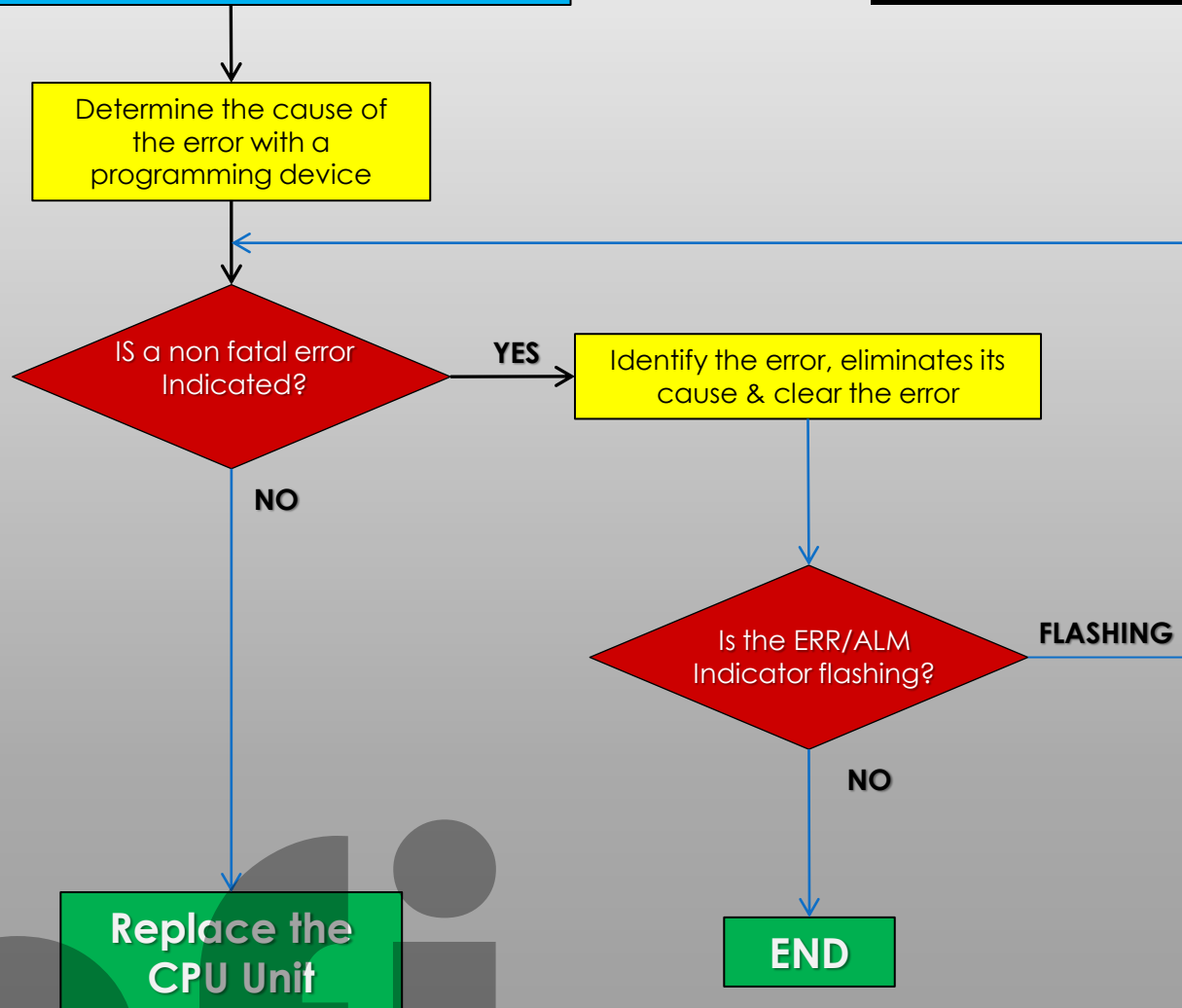
## Environment Condition Check

## ENVIRONMENT CONDITION CHECK



## ERR/ALM Indicator flashing

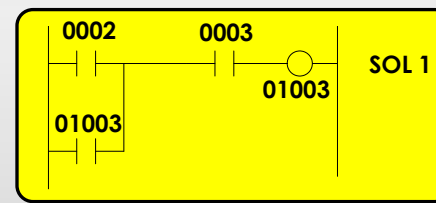
## ERR/ALM INDICATOR FLASHING



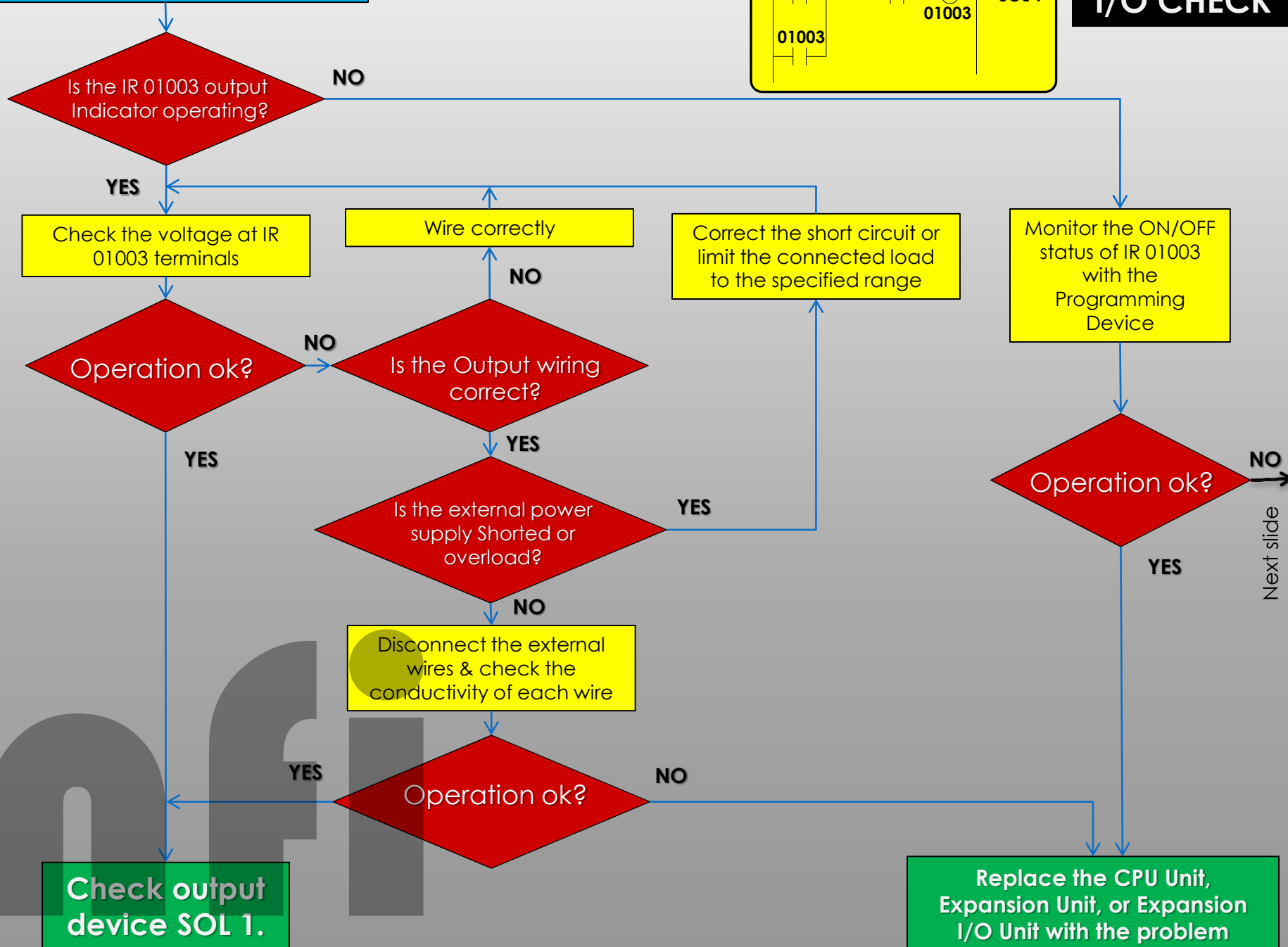
**NON- FATAL ERROR  
CHECK**



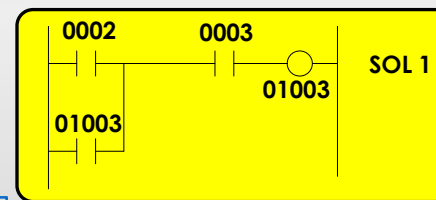
## MALFUNCTIONING OF SOL 1



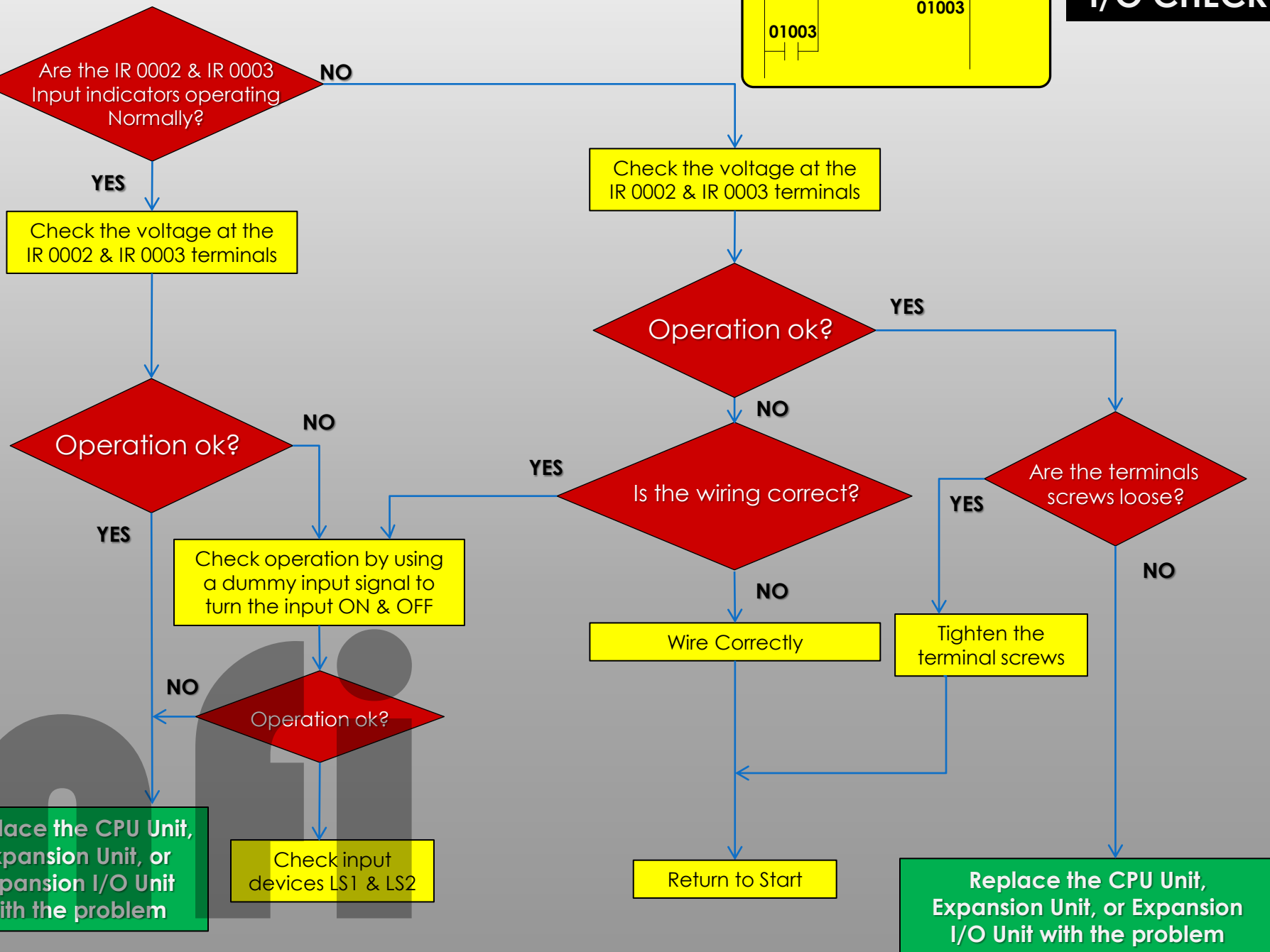
## I/O CHECK



# I/O CHECK



From previous slide



Replace the CPU Unit, Expansion Unit, or Expansion I/O Unit with the problem

Check input devices LS1 & LS2

Return to Start

Replace the CPU Unit, Expansion Unit, or Expansion I/O Unit with the problem



# Thanks

[www.nfiinnovation.org](http://www.nfiinnovation.org)

