GOVERNMENT POLYTECHNIC, DHANGAR (FATEHABAD)

ELECTRICAL ENGINEERING DEPARTMENT

SUBJECT – PLCM

SEMESTER- 4th

Department of Electrical Engineering

Subject: PLCM

Semester: 4th

PLC is ...

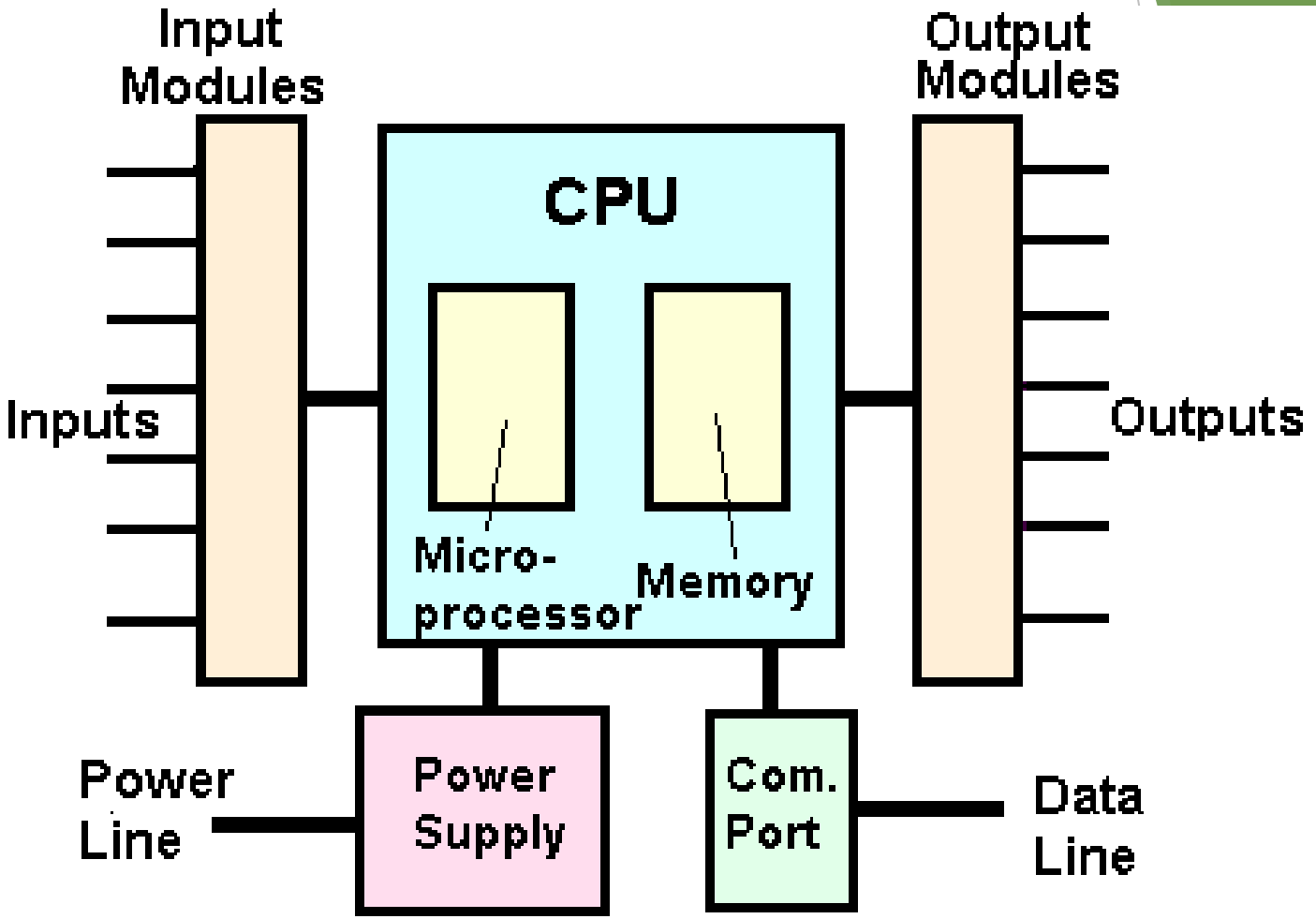
- Similar to a Microcontroller:
  - Microprocessor Based
  - Onboard Memory for Storing Programs
  - Special Programming Language: Ladder Logic
  - Input/Output Ports

- **Dissimilar to Microcontrollers:**
  - Intended for Industrial Applications
  - I/O Designed to interface with Control Relays
  - Emphasis on Maximum Reliability

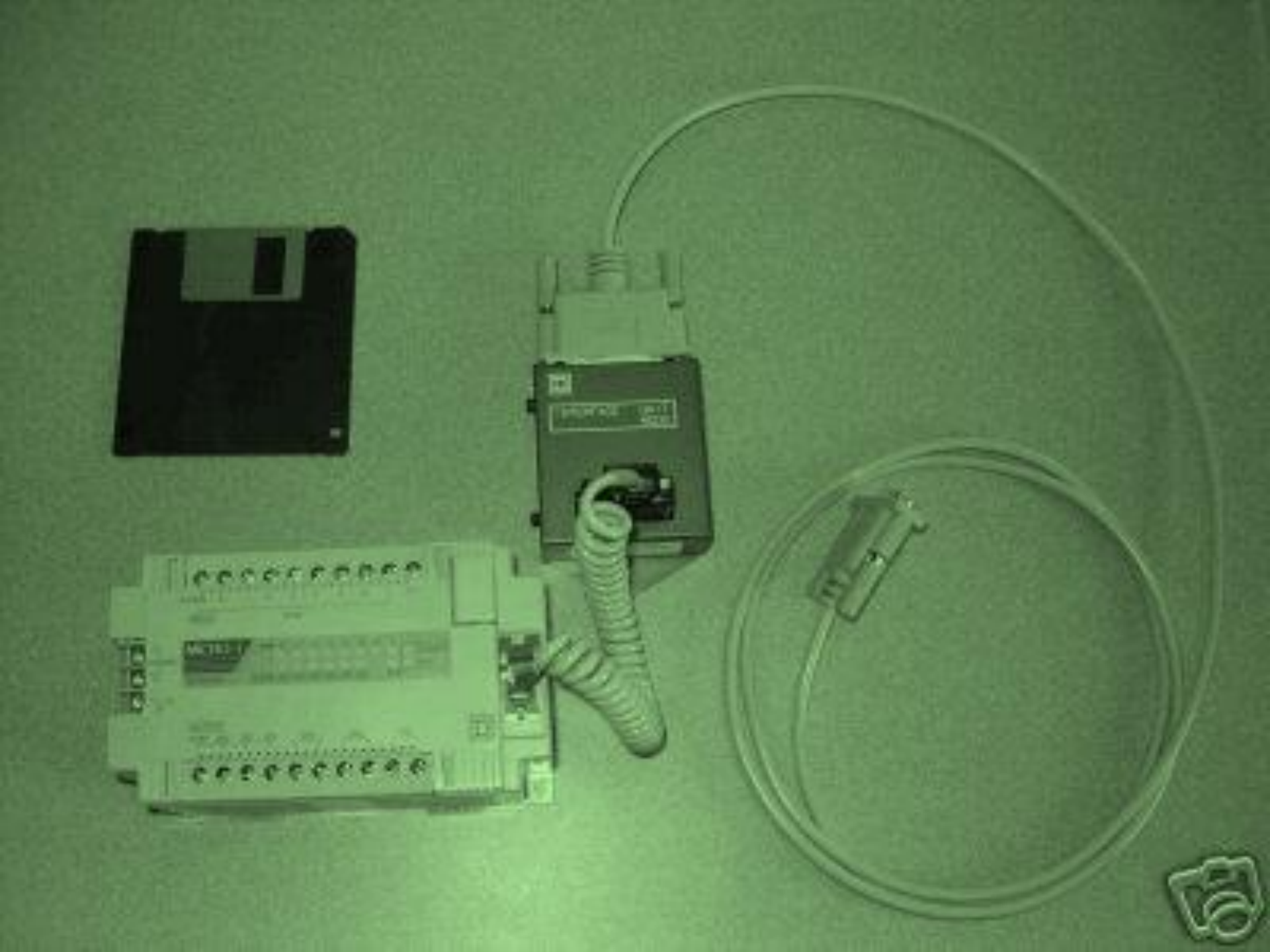
PLC's APPLICATIONS

- Widely Applied in Every Industry
- Were Developed to Simplify the Implementation of Control Automation Systems in Plants and Assembly Lines
- Designed to Minimize the Number of Control Relays in a Process and Maximize the Ways Relays can be Used
- First Applied to Automobile Industry in the Late 1960's
- Flexible, Reliable and Low Cost

Key Components of PLC



PLC Components



I/O Modules

- Input Modules: Input Signals can be AC or DC, Analog or Digital
- Output Modules: Outputs are either AC or DC Analog Signals (Although it is possible to ‘Construct’ Digital Outputs)
- Modern PLC’s have Expansion Ports to Increase the Number of Available Inputs and Outputs

Examples of I/O Signals

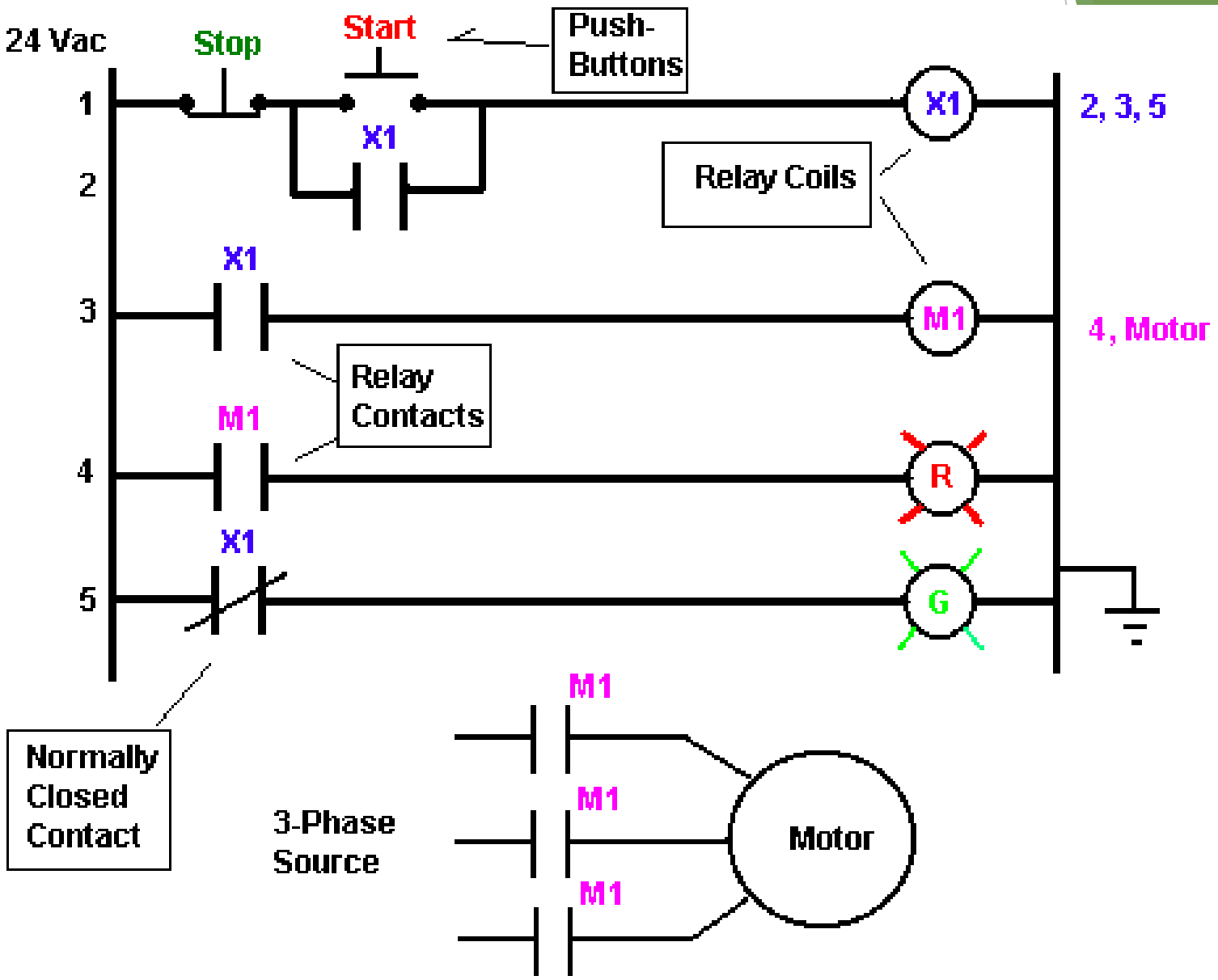
- **Inputs:**
  - Pushbutton (Energizing or Grounding an Input)
  - Relay Contact Output
  - DC Voltage Level
  - Digital Logic Signal (+5V or 0 V, etc)

- **Outputs:**
  - 24 V ac
  - 120 V ac
  - 120 Vdc
  - etcetera

PLC's Use Ladder Logic

- Ladder Logic Diagrams Provide a Method to Symbolically Show How Relay Control Schemes are Implemented
- Relay Contacts and Coils, Inputs and Outputs lie on "Rungs" Between the Positive and Ground Rails

Example of Ladder Diagram



Relays

- In General, Relays Transform a Control Signal into a Control Action

- Relays Provide:
  - Isolation Between Input and Output
  - Leverage (Small Signal Can Control Large Action)
  - Automation (Minimize Human Interaction with a Control Process)

Relay Applications

- Relays can be Designed to Perform Many Functions
  - Detect Out of Limit Conditions on Voltages and Currents
  - Start Motors
  - Prevent Motors from Over Heating
  - Control Assembly Lines
  - Adjust Lighting

PLC Timers and Motor Protection

Industrial Communications

- RS-422 (EIA 422): Asynchronous Serial Communications , similar in many respects to RS-232
- Faster (up to 100 Kbps) than RS-232
- Better Noise Immunity
  - Differential (Balanced signal) Protocol
  - Makes use of Twisted Pair lines - 1 pair for transmit, one pair for receive (4 Lines vs. 3)

EIA-422 Basics

- Can be 1 Master Transmitter feeding up to 10 Slave Receivers
- Can be Peer-to-Peer, like RS-232
- Data is sent and received via Differential Ports - Common Mode Rejection (Noise common to both inputs is attenuated)
- Twisted Pair also reduces EMI at low cost

EIA 485 (RS-485)

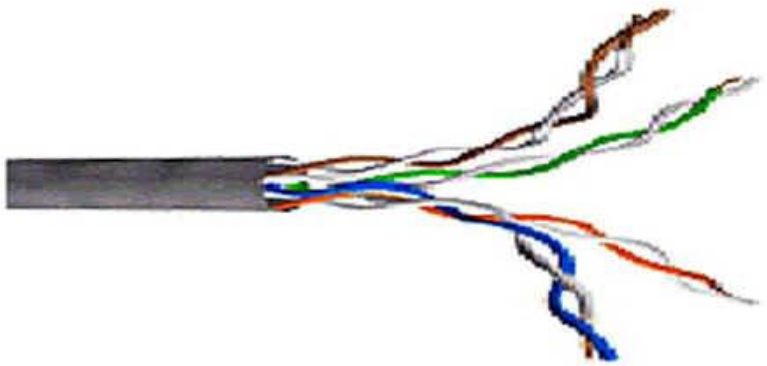
- More Modern, Faster and Flexible (supports TCP/IP)
- Since it uses a differential balanced line over twisted pair (like EIA-422), it can span relatively large distances (up to 4000 feet or just over 1200 metres).
- In contrast to EIA-422, which has a single driver circuit which cannot be switched off, EIA-485 drives need to be put in transmit mode explicitly by asserting a signal to the driver. This allows EIA-485 to implement linear topologies using only two lines.

IEEE 802.3 (Ethernet)

- Star Topology (Hub and spokes)
- Standard for computer networks since the 1990's
- Becoming more and more popular in Industrial settings
- Uses twisted pair data cables terminated in 8P8C (sometimes incorrectly called RJ45) modular plugs, wired according to TIA/EIA-568-B

Twisted Pair Cables

- Twisting a pair of wires that act as a communication channel will:
  - Minimize the loop area between the pair (minimize the self-inductance and capacitance)
  - Which in turn tends to cancel out much of the electromagnetic interference from external sources and crosstalk from adjacent pairs
  - Improve the efficiency of the channel



PLC Special Features

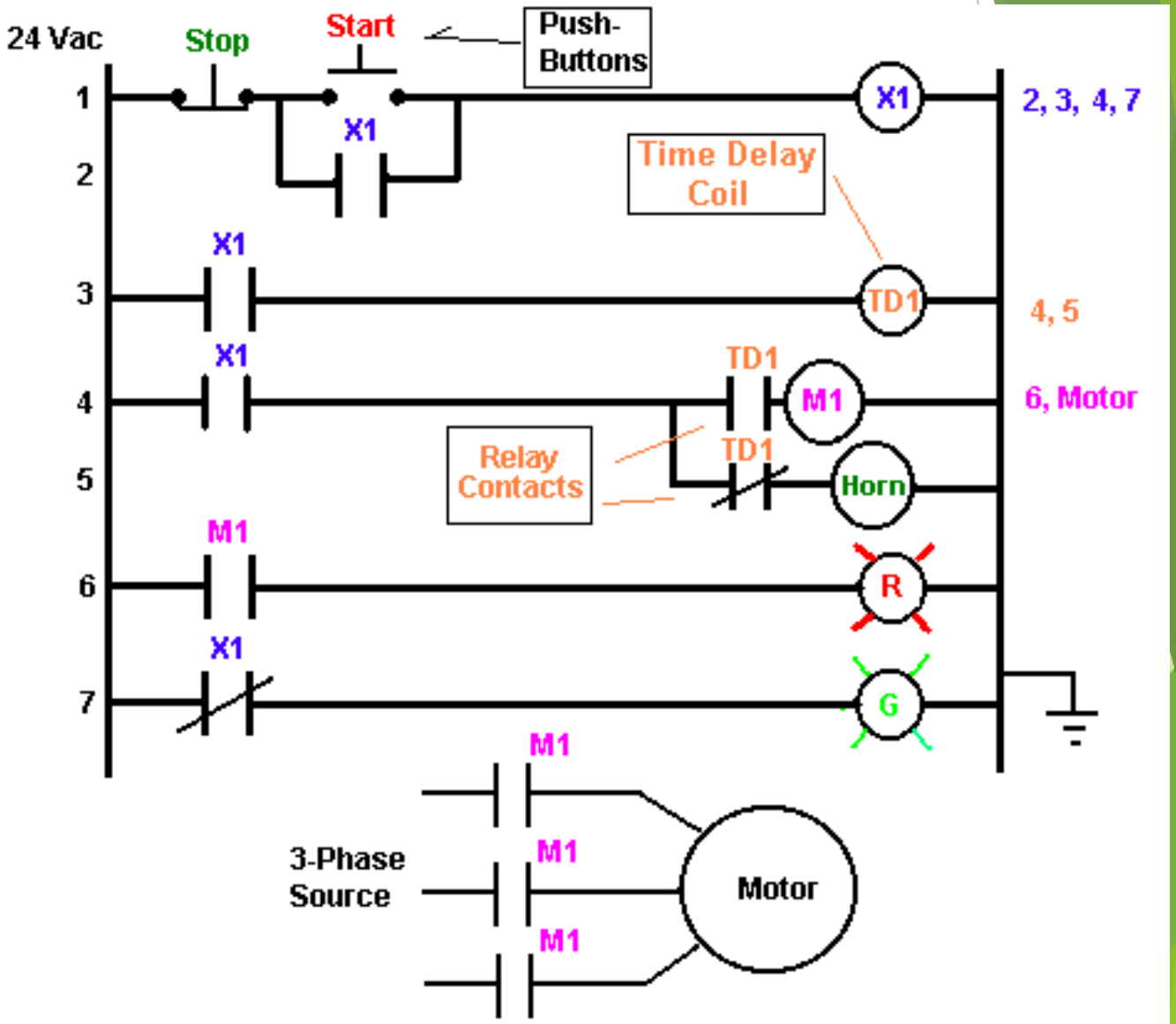
- Time Delay Relays
- Counter Relays
- Special Functions
- User Defined Functions
- Special Bits

Time Delay Relays

- When TD Relay Pick-Up Coil is Energized, a Delay is Initiated
- Normally Open Contacts Wait to Close until Delay is Completed
- Normally Closed Contacts Wait to Open until Delay is Completed
- Very Useful for Creating a Sequence of Control Events

Making Use of Delays

- Delay Motor Start While Alarm Sounds for Safety



Counters

- Counter Relays must “Count” a pre-determined number of events before changing contact status
- Can Count Up (UpCounter) or Count Down (DownCounter)
- e.g. An UpCounter is set to 8 and is programmed to detect every occurrence of a 5 Volt pulse. When it has detected 8 such occurrences, the NO Contacts close and the NC contacts open.
- Great for making Real-Time Clocks, etc

Special Functions

- Modern PLCs can perform many Math and Logic Functions without additional Ladder Logic Programming
  - Differentiation, Integration
  - +, -, *, /
  - Boolean Logic Functions (AND, NOT, OR)
  - Master Control Functions (Reset, etc)

Motor Protection

- Essential Part of Motor Control
- Protect against:
  - Under Voltage
  - Under Frequency (AC Machines Only)
  - Over Current
  - Over Heating
  - Over Speed
  - Over Load

Motor Protection Schemes

- Incorporated Directly in Ladder Logic Control Schemes