

Almamoun University collage

Power electrical Engineering

المسيطرات الرقمية والمعالج الدقيق

Third year Class

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2stSemester

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Lecture 1

Programmable Logic Controller



Programmable Logic Controller “PLC”

Definition(according to NEMA* standard ICS3-1978):
“A digitally operating electronic apparatus which uses a programming memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog modules, various types of machines or process.”

* **NEMA:** “National Electrical Manufacturers Association”

Historical Background

*1-*In 1968 GM [Hydra-Matic](#) (the [automatic transmission](#) division of [General Motors](#)) issued a request for proposals for an electronic replacement for hard-wired relay systems based on a white paper written by engineer Edward R. Clark. The winning proposal came from Bedford Associates of [Bedford, Massachusetts](#). The first PLC, designated the 084 because it was Bedford Associates' eighty-fourth project, was the result.

*2-*Bedford Associates started a new company dedicated to developing, manufacturing, selling, and servicing this new product: Modicon, which stood for **MO**dular **DI**gital **CON**troller. One of the people who worked on that project was [Dick Morley](#), who is considered to be the "father" of the PLC.

*3-*The Modicon brand was sold in 1977 to [Gould Electronics](#), later acquired by German Company [AEG](#), and then by French [Schneider Electric](#), the current owner.

PLC



Dick Morley

And

MODICON 084

Development achieved

- During the past four decades, enormous progress was made in the development of micro electronics has greatly influenced PLCs design and programming methods.
 - The range of functions and application fields have grown considerably.
 - Analogue processing, and the use of a PLC in distributed control systems (DCS) networks is common in PLC systems.
 - Visualisation, which is the representation of machine statuses such as the control program being executed, via display or monitor with capability to enter commands and variables can now be integrated into many PLC systems.
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Subsequent development resulted in a system featuring:

- The **simple connection** of binary signals
- The requirements as to **how** these signals were to be **connected** was specified in the **control program**
- With the new systems it became possible for the first time to **plot signals** on a screen and to **store** these in electronic memories



Leading PLC manufacturers list

AMERICAN

1. Allen Bradley
2. Gould Modicon
3. Texas Instruments
4. General Electric
5. Westinghouse
6. Cutter Hammer
7. Square D



EUROPEAN

1. Siemens
2. Klockner & Mouller
3. Festo
4. Telemecanique

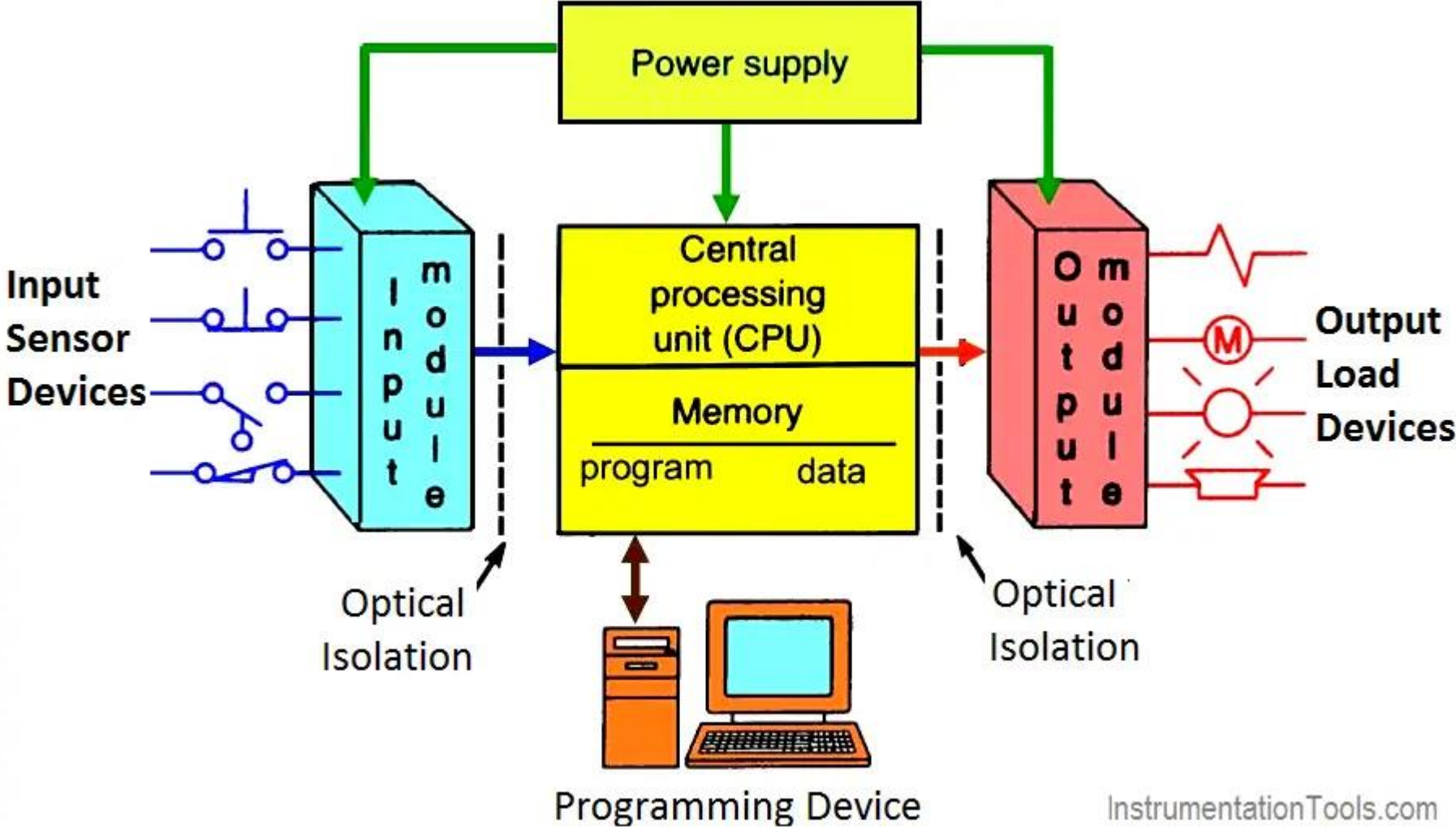


JAPANESE

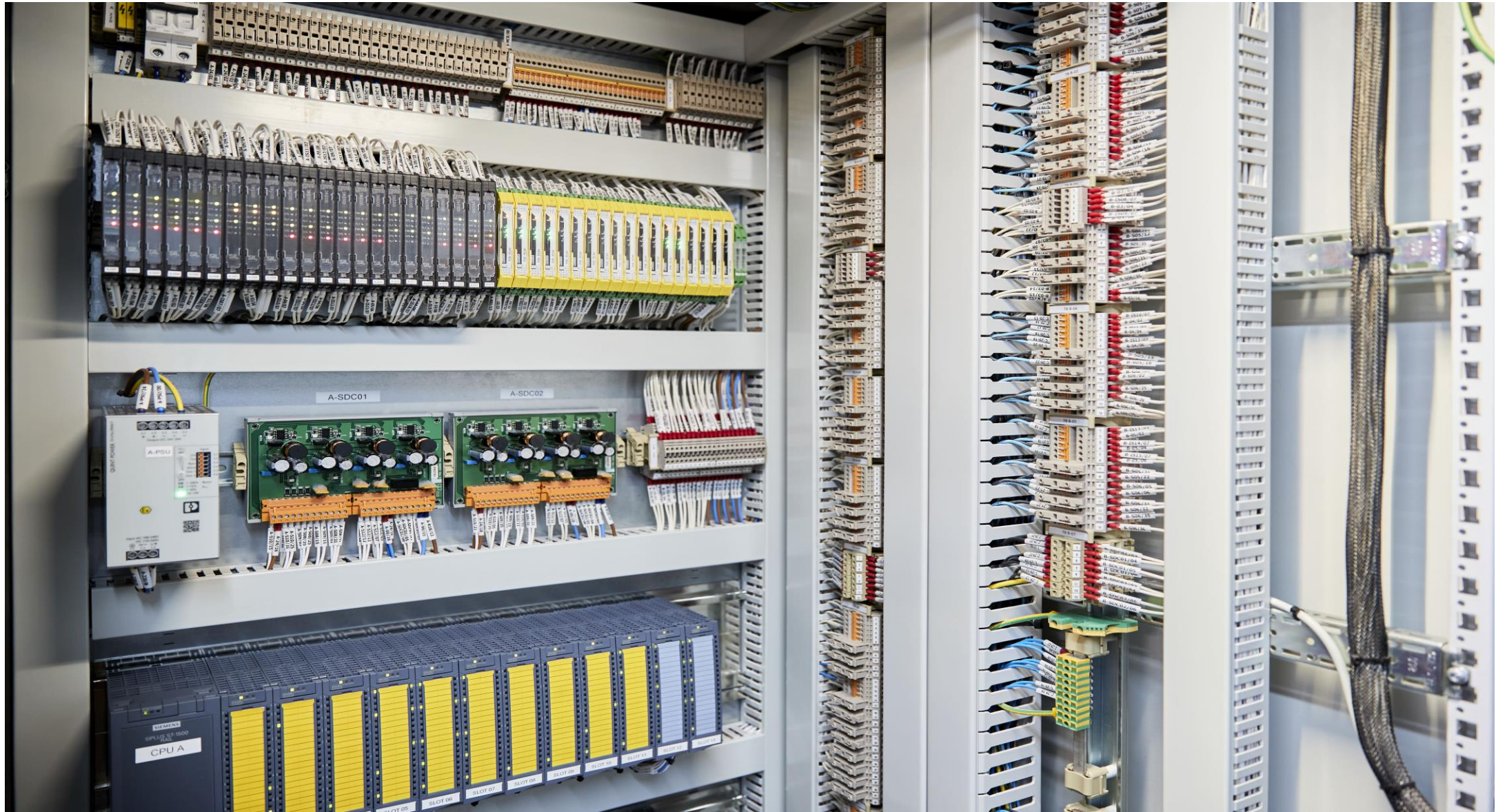
1. Toshiba
2. Omron
3. Fanuc
4. Mitsubishi



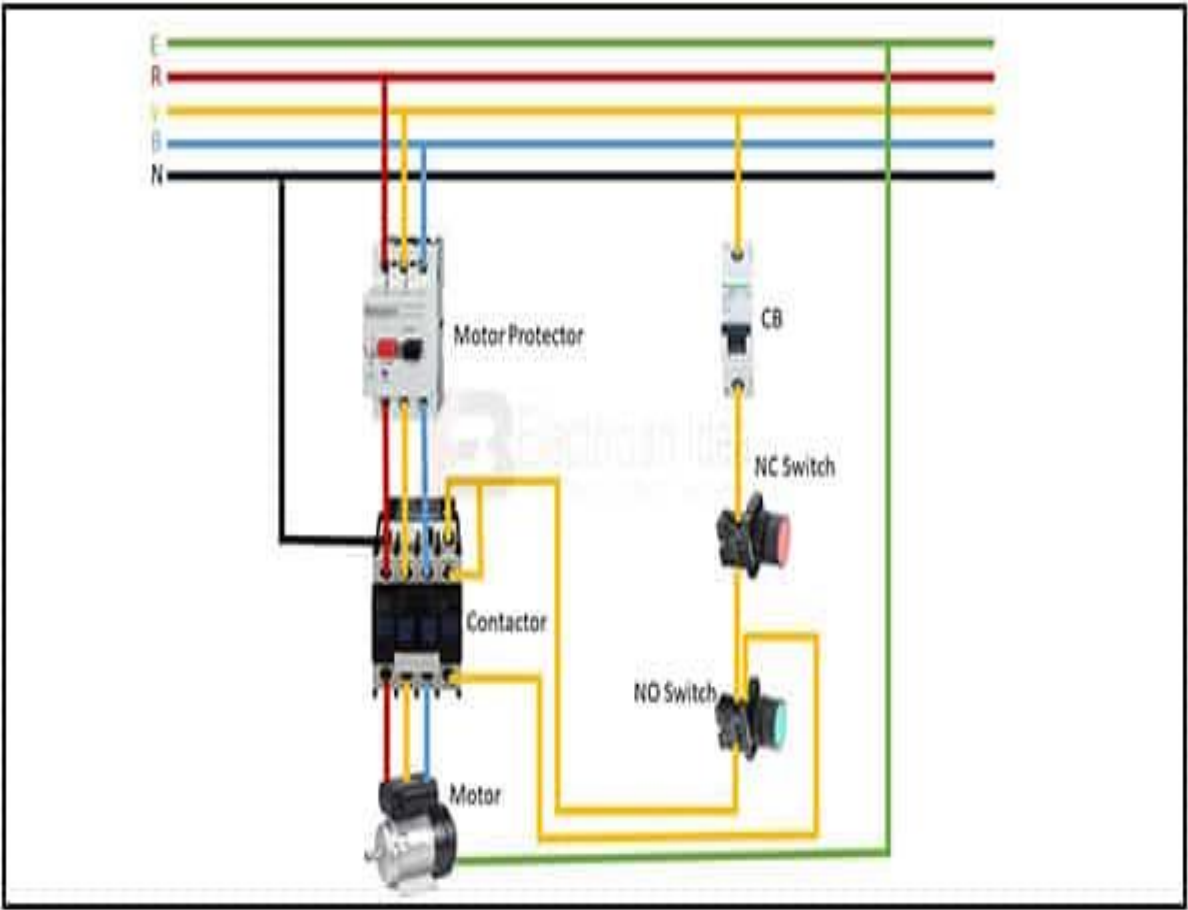
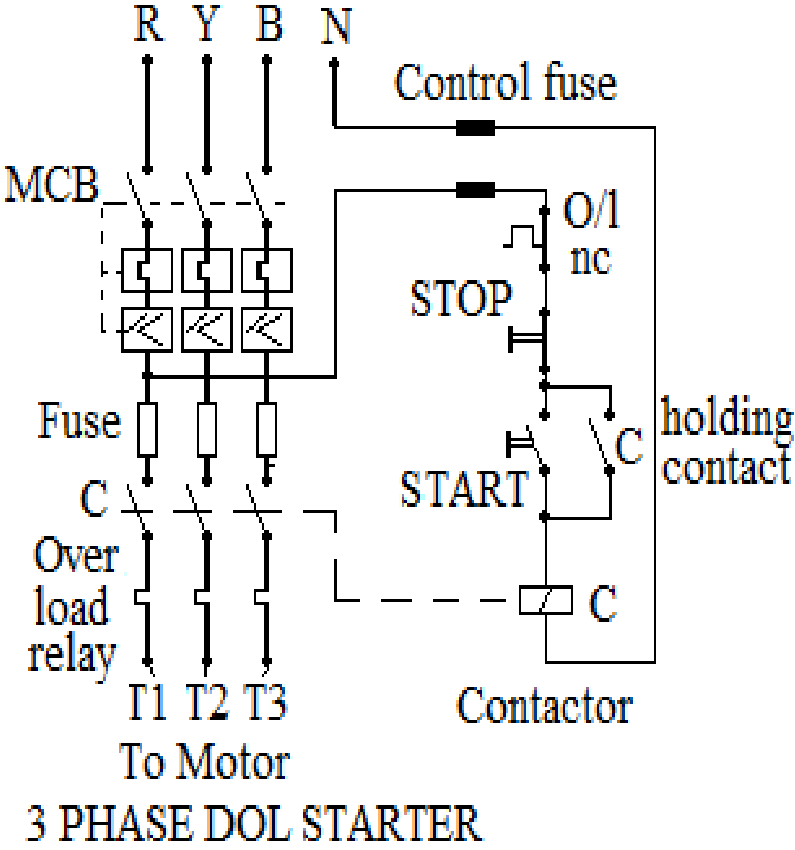
Operation principles



Operation principles



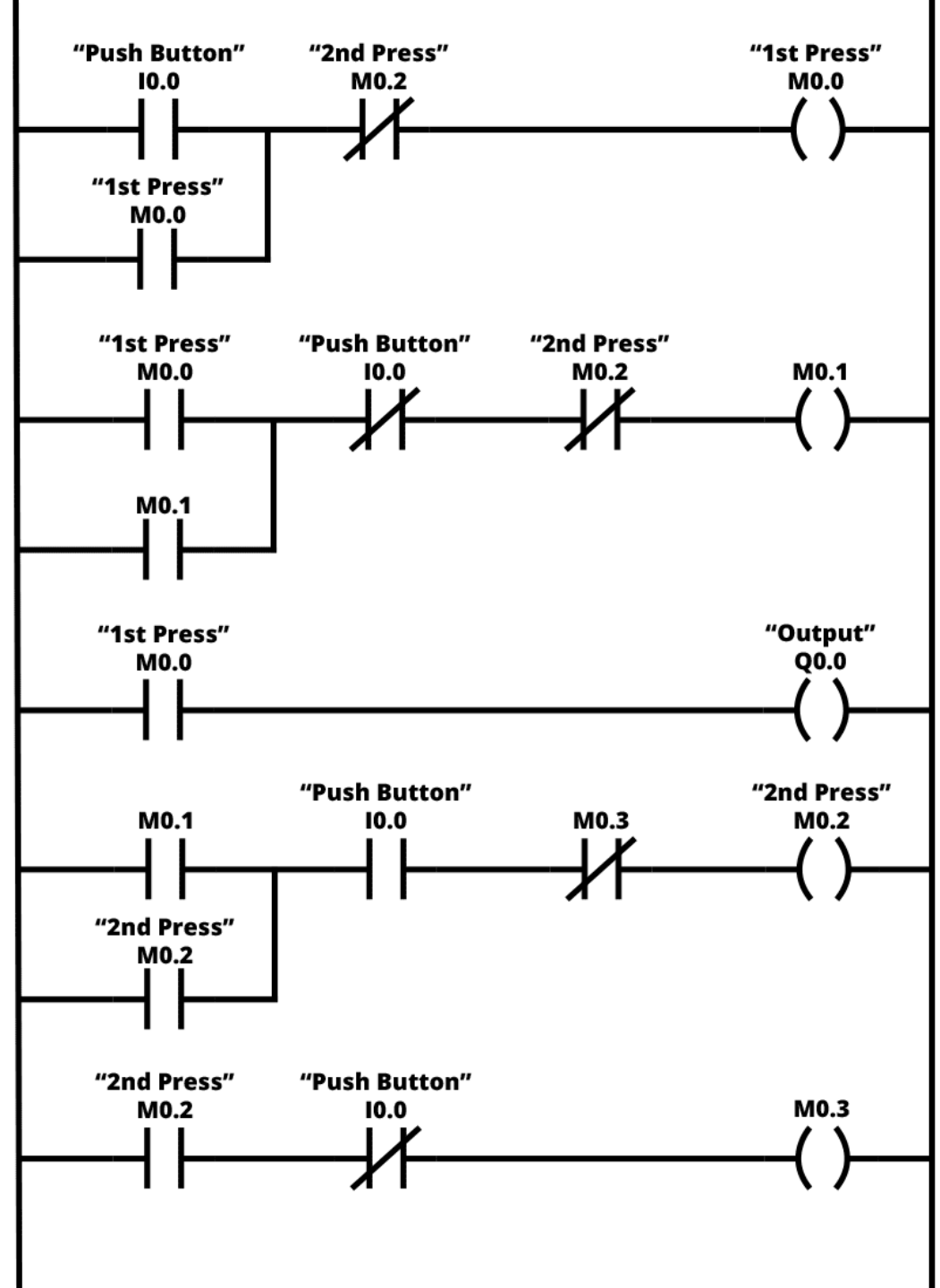
Ladder diagram



Ladder diagram



Ladder Logic Programming Examples – Ladder Latch (Reset or Unlatch)



PLC Advantages

- **Flexibility**

- In the past, each different electronically controlled production machine required its own controller; 15 machines might require 15 different controllers.
- Now it is possible to use just one model of a PLC to run any one of the 15 machines.
- Each of the 15 machines under PLC control would have its own distinct program (or a portion of one running program).

- **Implementing Changes and Correcting Errors**

- With a wired relay-type panel, any program alterations require time for rewiring of panels and devices.
- When a PLC program circuit or sequence design change is made, the PLC program can be changed from a keyboard of a program loader in a matter of minutes.
- No rewiring is required for a PLC-controlled system.
- Also, if a programming error has to be corrected in a PLC control program, a change can be typed in quickly.

- **Large Quantities of Contacts**

- The PLC has a large number of contacts for each coil available in its programming.
- Suppose that a panel-wired relay has four contacts and all are in use when a design change requiring three more contacts is made, time would have to be taken to procure and install a new relay or relay contact block.
- Using a PLC, however, only three more contacts would be typed in. Contacts are now a “software” component

PLC Advantages

(Continued)

- **Lower Cost**

- Increased technology makes it possible to condense more functions into smaller and less expensive packages.
- Now a PLC can be purchased with numerous relays, timers, and counters, a sequencer, and other functions for a few hundred dollars.

- **Pilot Running**

- A PLC programmed circuit can be evaluated in the lab. The program can be typed in, tested, observed, and modified if needed, saving valuable factory time.

- **Visual Observation**

- A PLC circuit's operation can be seen during operation directly on a screen.
- The operation or mis-operation of a circuit can be observed as it happens.
- Logic paths light up on the screen as they are energized.
- Troubleshooting can be done more quickly during visual observation.

- **Reliability and Maintainability**

- Solid-state devices are more reliable, in general, than mechanical systems or relays and timers. Consequently, the control system maintenance costs are low and downtime is minimal.

- **Documentation**

- An immediate printout of the true PLC circuit is available in minutes, if required.
- There is no need to look for the blueprint of the circuit in remote files.
- The PLC prints out the actual circuit in operation at a given moment.
- Often, the file prints for relay panels are not properly kept up to date. A PLC printout is the circuit at the present time; no wire tracing is needed for verification.

PLC Disadvantages

- **Fixed Program Applications**

- Some applications are single-function applications. It does not pay to use a PLC that includes multiple programming capabilities if they are not needed.
- Their operational sequence is seldom or never changed, so the reprogramming available with the PLC would not be necessary.

- **Fail-Safe Operation**

- In relay systems, the stop button electrically disconnects the circuit; if the power fails, the system stops.
- This, of course, can be programmed into the PLC; however, in some PLC programs, you may have to apply an input voltage to cause a device to stop. These systems may not be fail-safe.