PLC Based Motor Control Using VFD

by

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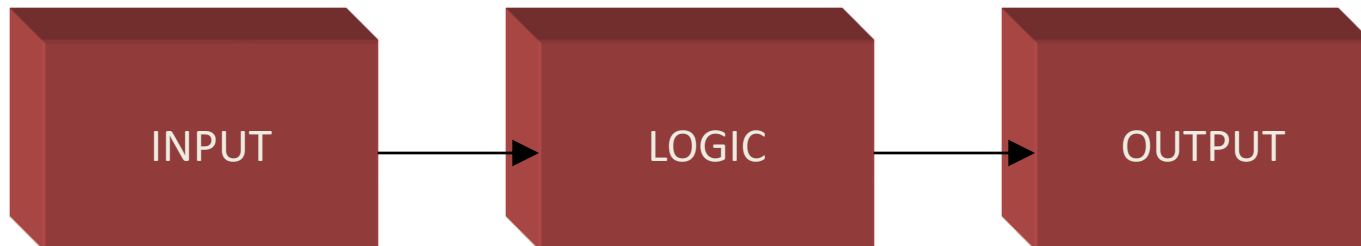
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72 units Motors Variators

Basic Control System

Open Loop System

INPUT	→	LOGIC	→	OUTPUT

-Pushbuttons

-Limit Switches

-Level Switches

-Flow Switches

-Relays

-Timers

-Counters

-Motors

-Solenoid valves

-Lamps

PLC

Basic Control System

Closed Loop System

PLC

Error

Set value

+

−

Controller

Final Control Element

Process Variable

Valves
VFD/Motors

Temperature

Flow

Pressure

Level

Transmitter

Process Variable

Temperature Transmitter

Flow Transmiiter

Pressure Transmitter

Primary

Element / Transducer
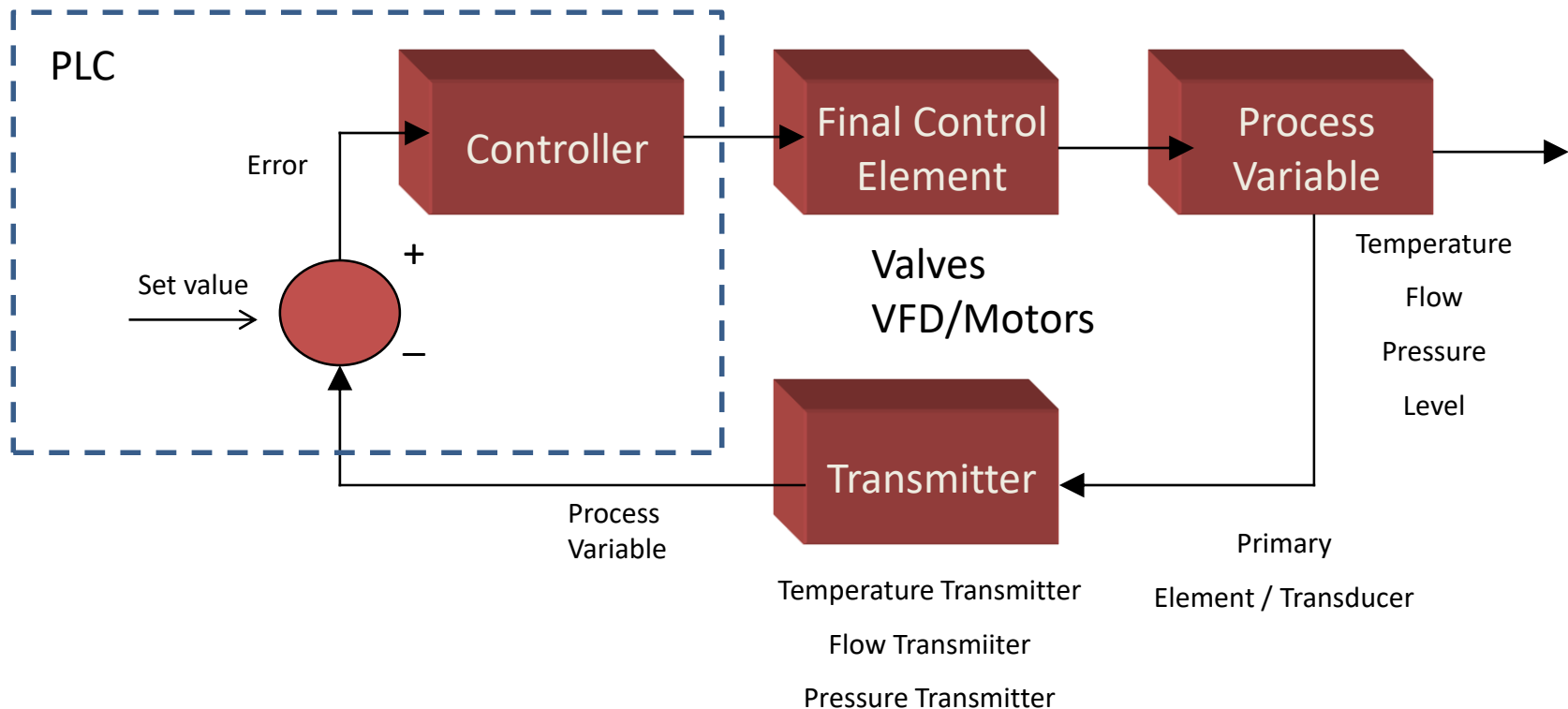
WHAT IS A PLC?

- *PLC is a digitally operating electronic system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital or analog inputs and outputs, various types of machines or processes.*

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WHAT IS A PLC?

- Industrial-based Computer

- Brain of the Control System

- Heart of Control System
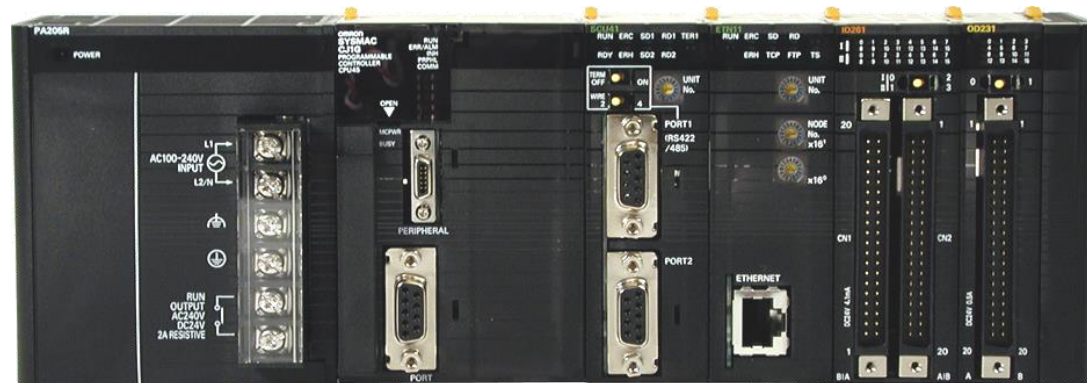
TYPES OF PLCs

COMPACT TYPE	MODULAR TYPE

- Small and compact
- Fix number of I/Os
- Designed for simple applications
- Suitable for stand-alone systems

- Flexible and versatile
- Huge I/O capabilities
- Designed for complex and sophisticated applications
- Suitable for centralized control systems

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ROLE OR FUNCTION OF PLCs

>> **SEQUENTIAL CONTROL**

- Relay Logic Control

- Timer/Counter Functions

- Auto / Manual Control

BASIC MACHINE CONTROL

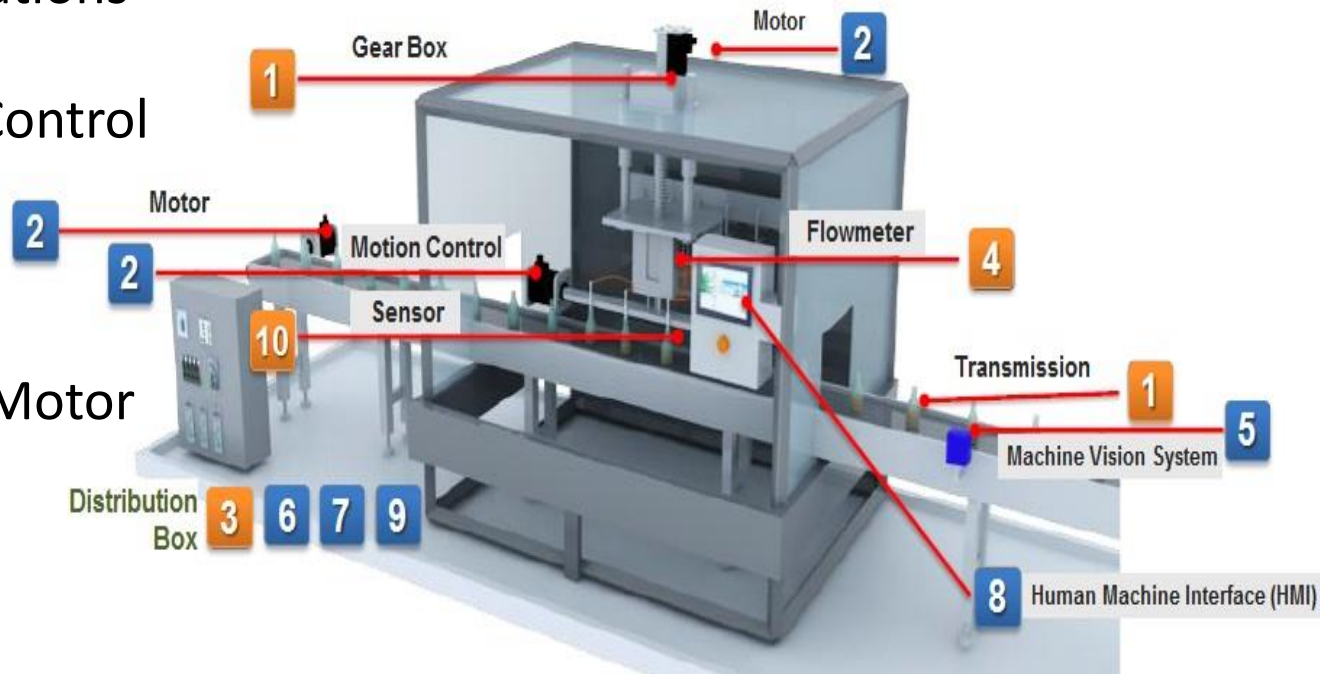- MOTOR CONTROL

- ELETRO-PNEUMATICS

- ELECTRO HYDRAULICS

ROLE OR FUNCTION OF PLCs

>> SOPHISTICATED CONTROL

- Arithmetic Operations

- Analog Process Control

- PID Control

- Servo / Stepper Motor Control

Gear Box — 1
Motor — 2
Motor — 2
Motion Control
Sensor
10
Flowmeter — 4
Transmission — 1
Machine Vision System — 5
Distribution Box — 3 6 7 9
Human Machine Interface (HMI) — 8

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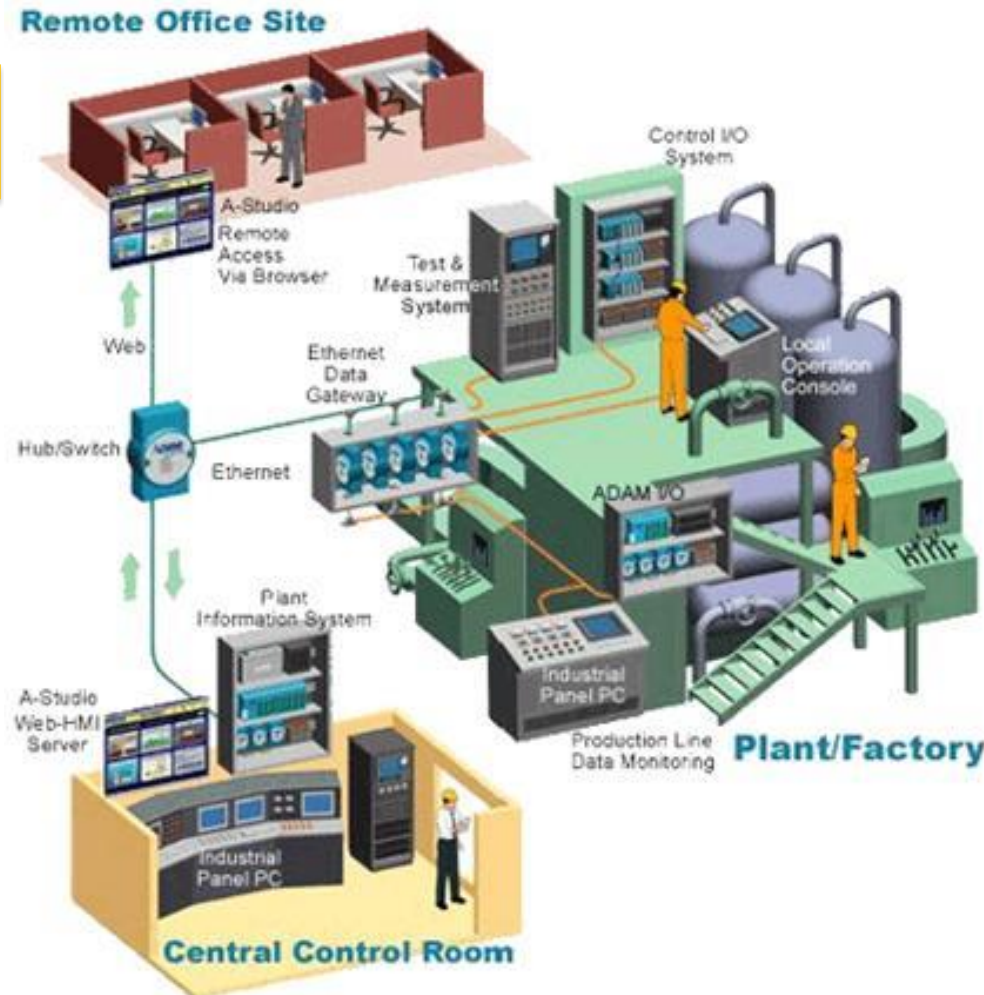# ROLE OR FUNCTION OF PLCs

>> SOPHISTICATED CONTROL

- Blow Moulding Machine/Extruder

- Retort

- AHU

- Industrial Robots
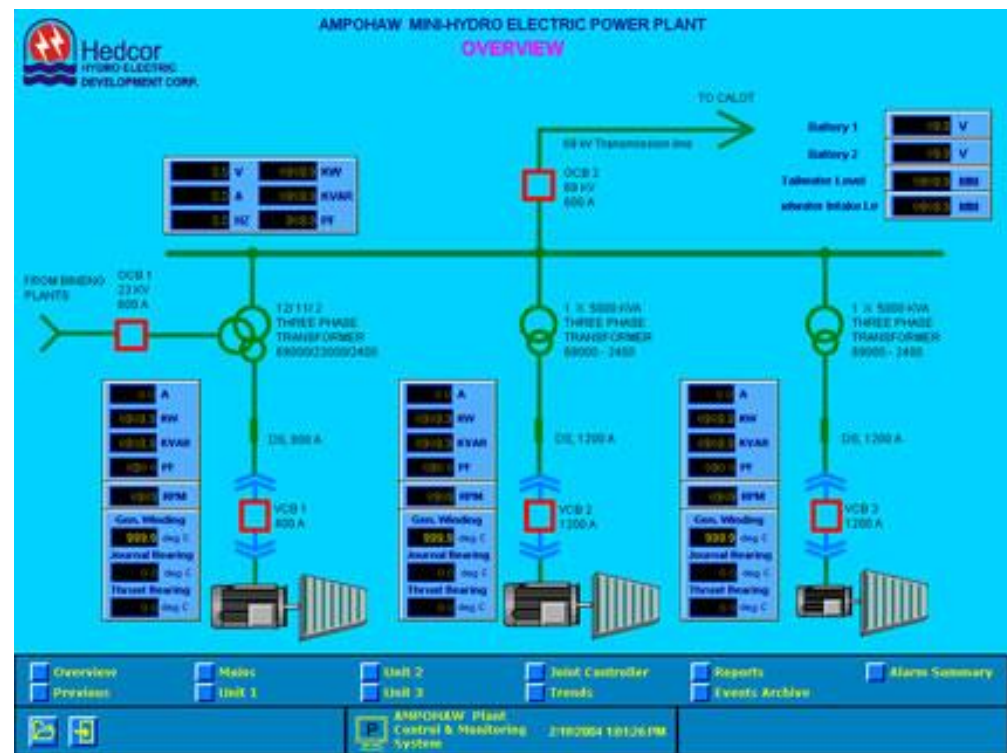
ROLE OR FUNCTION OF PLCs

>> SUPERVISORY CONTROL

- Process Monitoring and Alarm

- Computer Interfacing

- Visualization

- PLC Networking
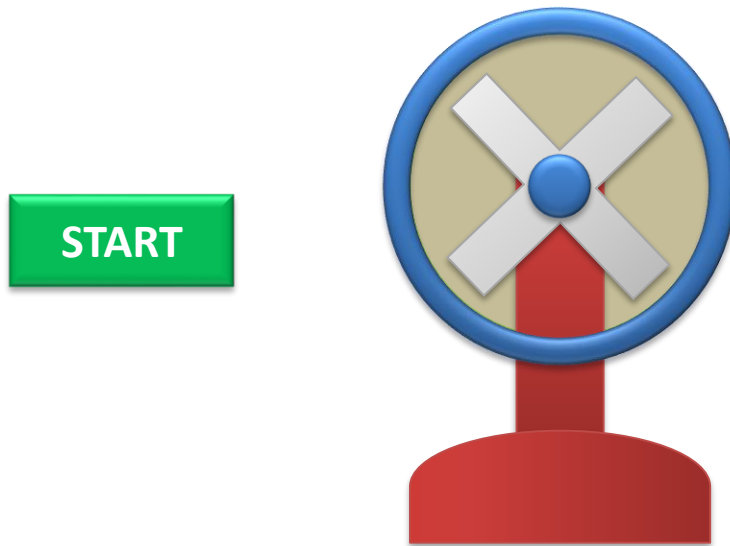
ROLE OR FUNCTION OF PLCs

>> SUPERVISORY CONTROL

- Water and Waste Water

- Power Plant

- HVAC Control/BMS

- PLC Networking

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MOTOR CONTROL

- Motor Control defines the methods of controlling the operation and performance of electric motors.

START

MOTOR CONTROL

Motor Starting

1. Across the Line / Direct On-Line

2. Reduced Voltage Starters

   a) Primary Resistance Starters

   b) Auto-transformers Starters

   c) Wye-Delta Starters

   d) Variable Frequency Drives

MOTOR CONTROL

Motor Protection

1. Overcurrent Protection

2. Overload Protection

MOTOR CONTROL

Motor Operational Control

1. Speed Control

2. Reversing

3. Jogging

4. Sequence Control

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Motor Control

Control Components

Fuse/Circuit Breakers

Fuses and Circuit breakers are components that protects the motor circuits against short circuits, ground faults and overloads.

Overload Relays

Overload relays are designed to meet protection needs of the motor circuits. It is designed to TRIP and OPEN a circuit if the current is high enough to cause motor damage over a period of time.

Contactors/Starters

These are devices that makes/breaks of your motor. They are used to control power in a variety of applications. For motor applications, contactors/starters used for Start/Stop of motors.

Motor starters

Motor starters is the combination of contactors & overload relays.

Control Relays

Operation of control relays is the same as contactors. However, they only operate in light loads such as starting coils, audible alarms and pilot lamps.

Timing Relays

Timing relays are used in control switching operations which require delayed switching. It is has 2 types of delay, Time Delay – ON and Time Delay – OFF functions.
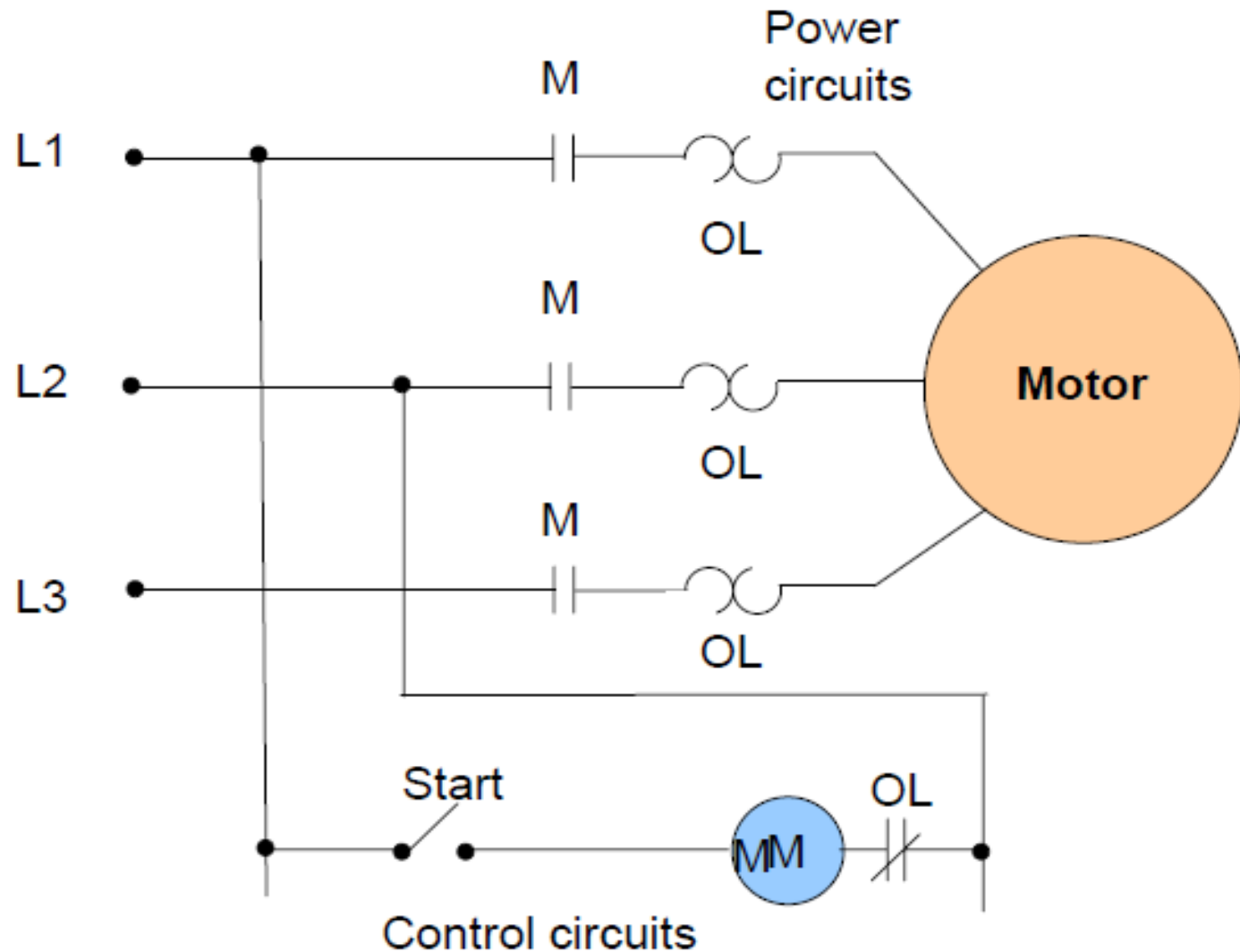
Mecha

Contactor basic operation

There are two circuits involved in the contactor operation, the control circuit and the power circuit.

The control circuit is connected to the coil of an electromagnet, while the power circuit is connected to the stationary contacts.
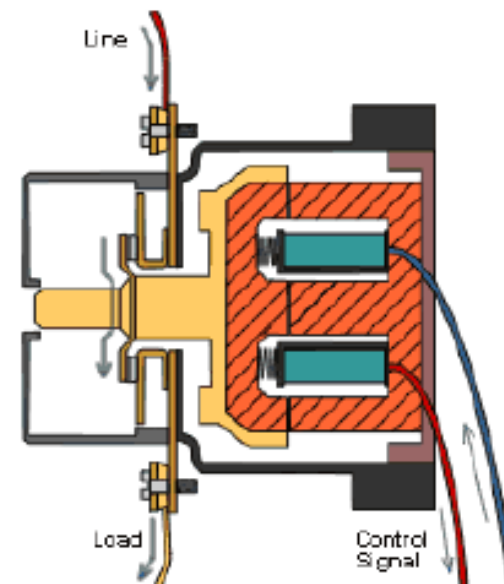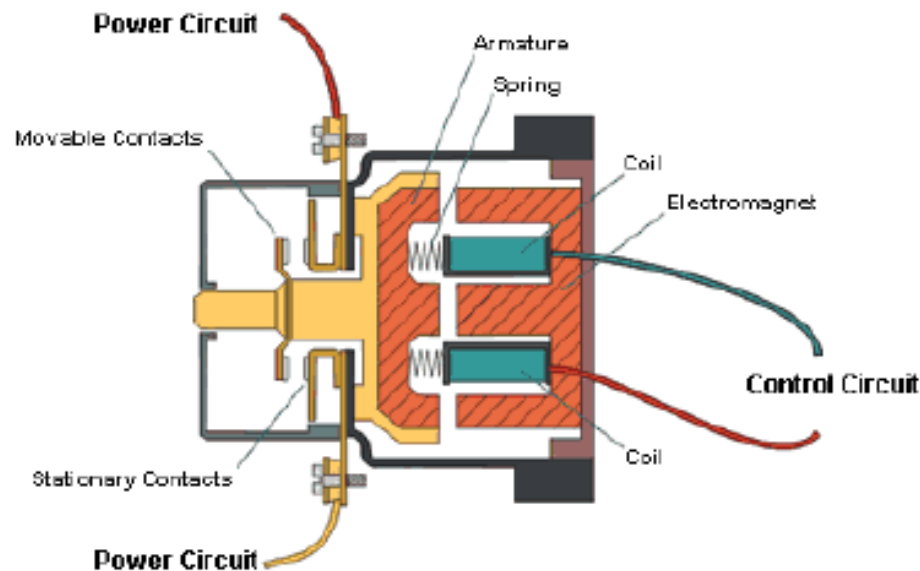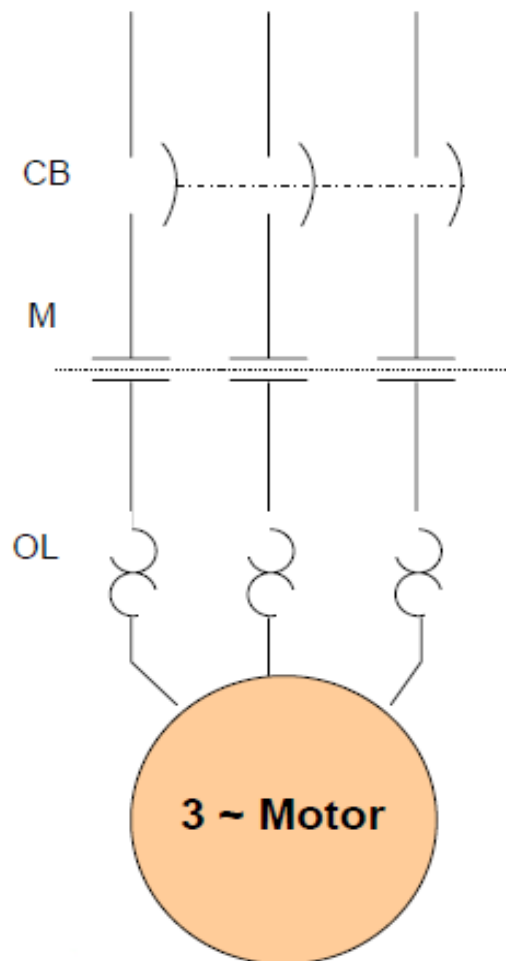
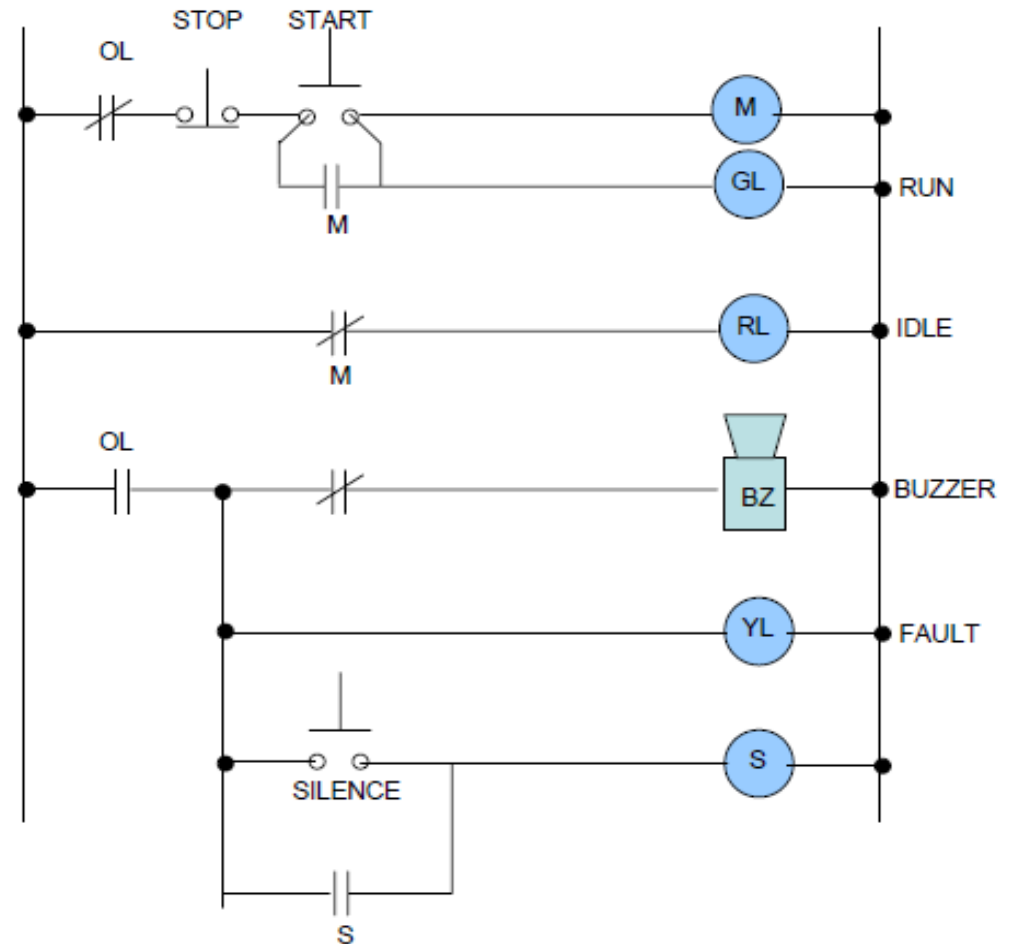## Exercises : Full Voltage starting

Power circuits

M

L1

OL

M

L2

Motor

OL

M

L3

OL

Start

OL

MM

Control circuits

Exercises : Start-Stop, Full-Voltage Starter (w/alarm silencing)

POWER CIRCUIT

CB

M

OL

3 ~ Motor

CONTROL CIRCUIT

STOP   START

OL

M

GL — RUN

M

RL — IDLE

M

OL

BZ — BUZZER

YL — FAULT

S

SILENCE

S

Wye-Delta Starters
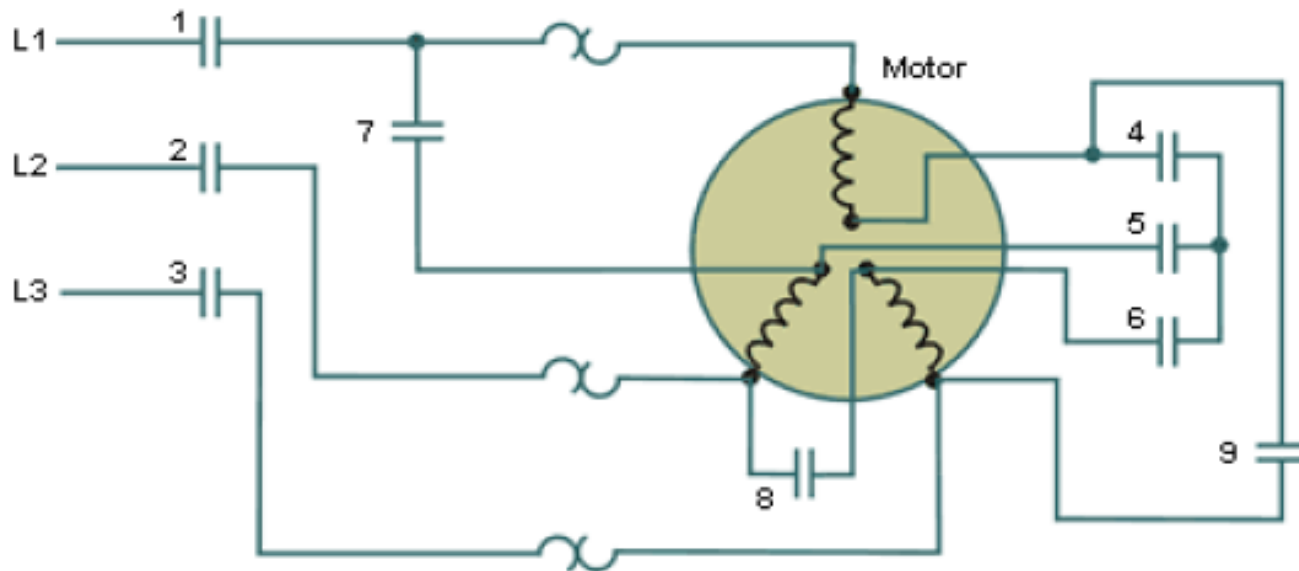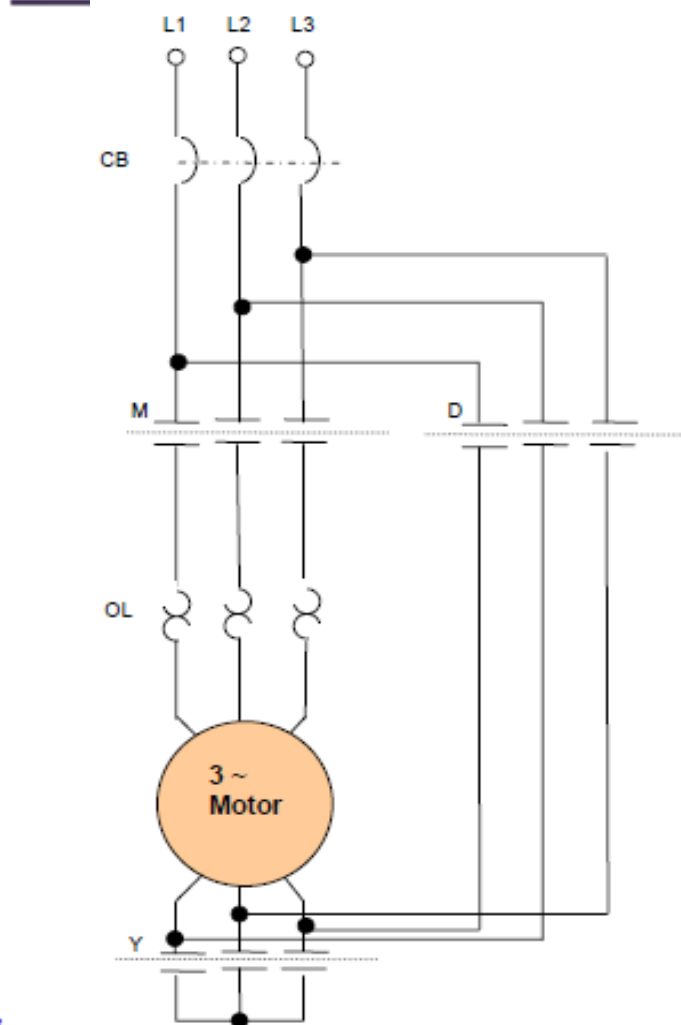
This method is applicable only with motors having stator windings not connected internally and all six motor leads available. This type of starter is a good method for applications requiring frequent starts.
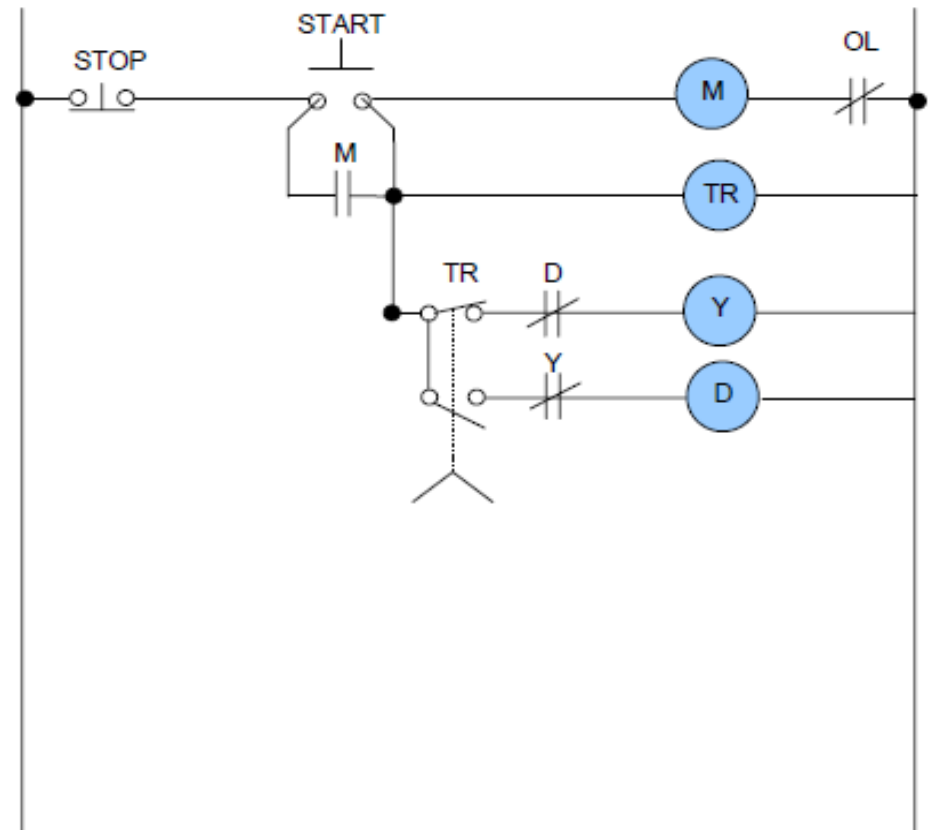

To Start : Close 1, 2, 3, 4, 5, 6

Open 7, 8, 9

To Run : Open 4, 5, 6

Close 7, 8, 9

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Exercises : WYE-DELATA STARTER(open transition)

POWER CIRCUIT

CONTROL CIRCUIT

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Actual Inverter Circuit

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PLC Control VFD

POWER CIRCUIT

CONTROL CIRCUIT

Control Signal

Programmable Logic Controller (PLC)

3 ~ Motor

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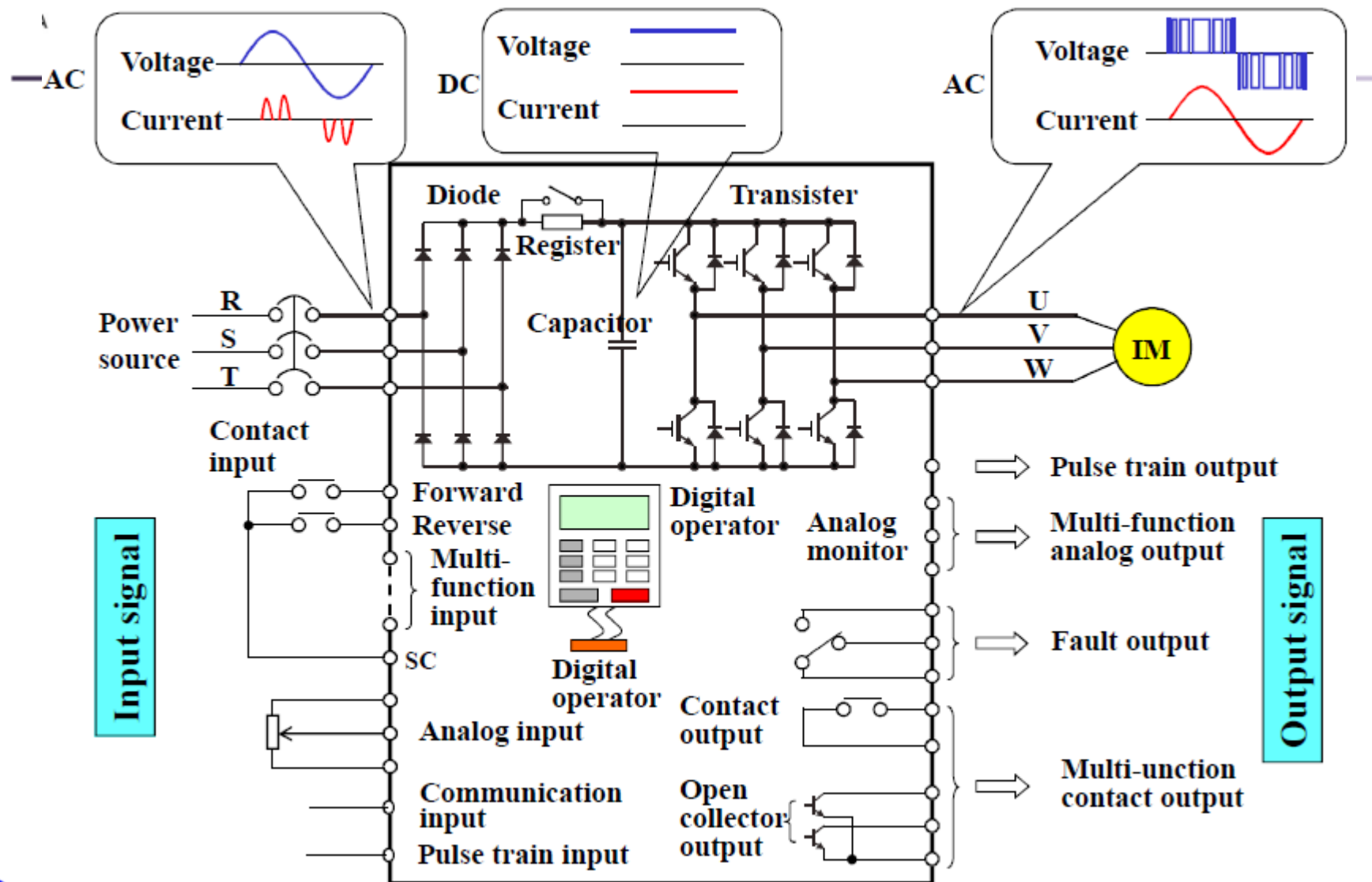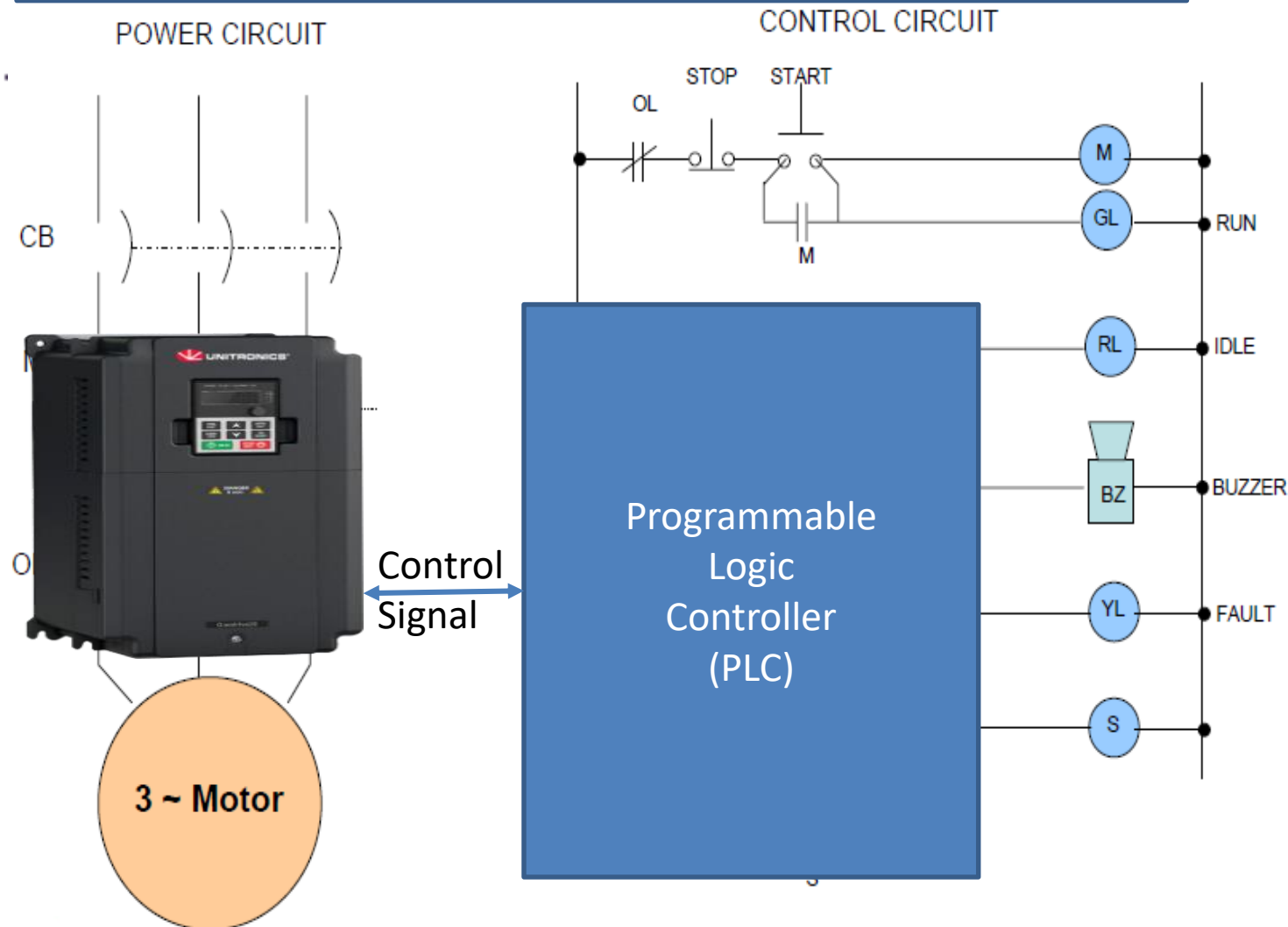
Peripheral Devices and Their Connections

(1) Power supply transformer

(2) Circuit breaker or
(3) Leakage breaker

(7) DC reactor

(4) Contactor

(6) Noise filter

(8) Noise filter

(12) Zero phase reactor

(5) AC reactor

(9) Contactor

(11) Contactor for commercial power backup

(10) Braking resistor unit

(13) Thermal relay

(14) Motor

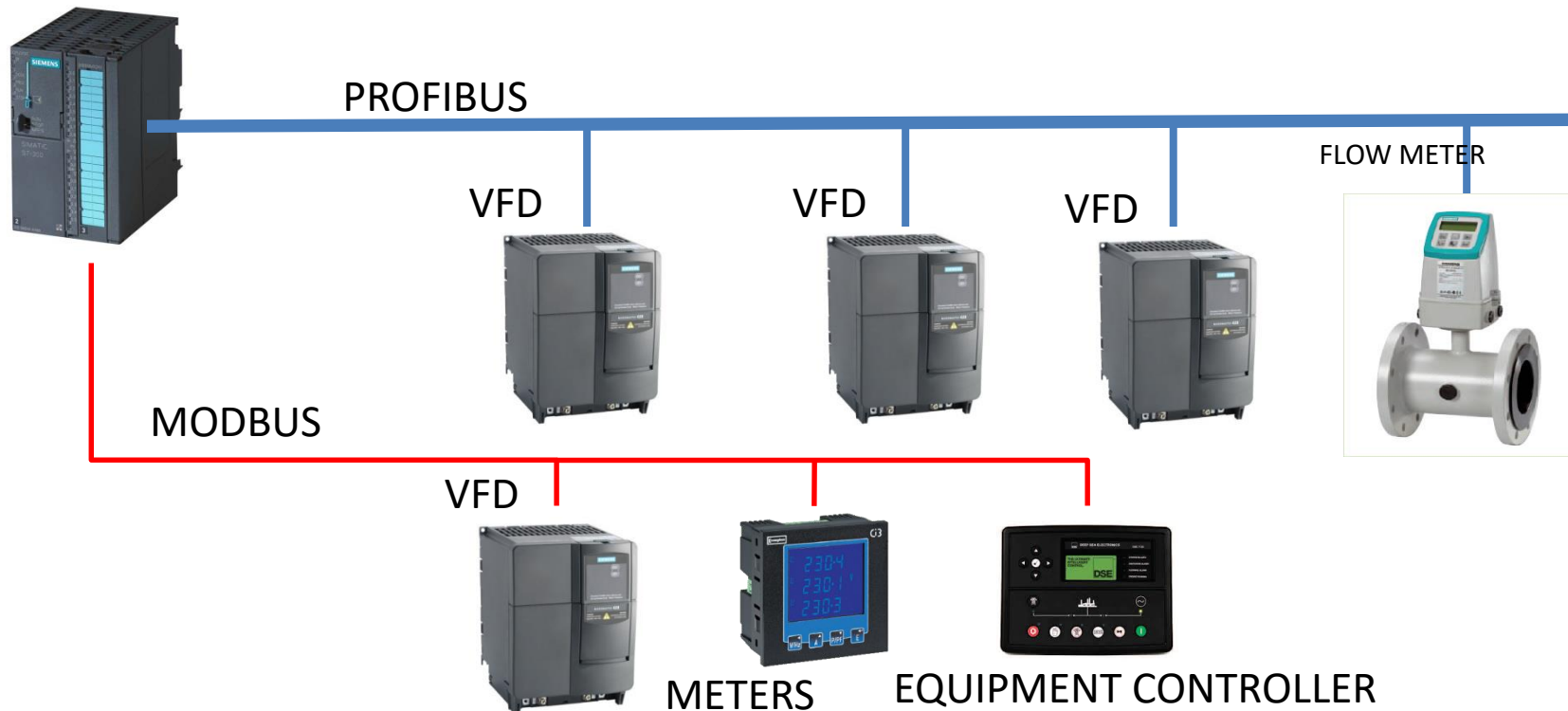Mechatronics Technologies Corporation

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Smart VFD

VFDs have become more intelligent by Utilizing <u>Bus Technology –</u> Fieldbus/ Devicenet

PROFIBUS

FLOW METER

VFD   VFD   VFD

MODBUS

VFD

METERS   EQUIPMENT CONTROLLER

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SCADA System Architecture

SCADA WORKSTATION

SWITCH/HUB

CAT5e

ETHERNET

CAT5e

SIEMENS PLC

ETHERNET

On-Off or 4-20mA

PROFIBUS

OMRON PLC

VFD

PLC/RTU

VALVE
ACTUATOR

FLOW METER

VFD

VFD

REMOTE
I/O

MODBUS

VFD

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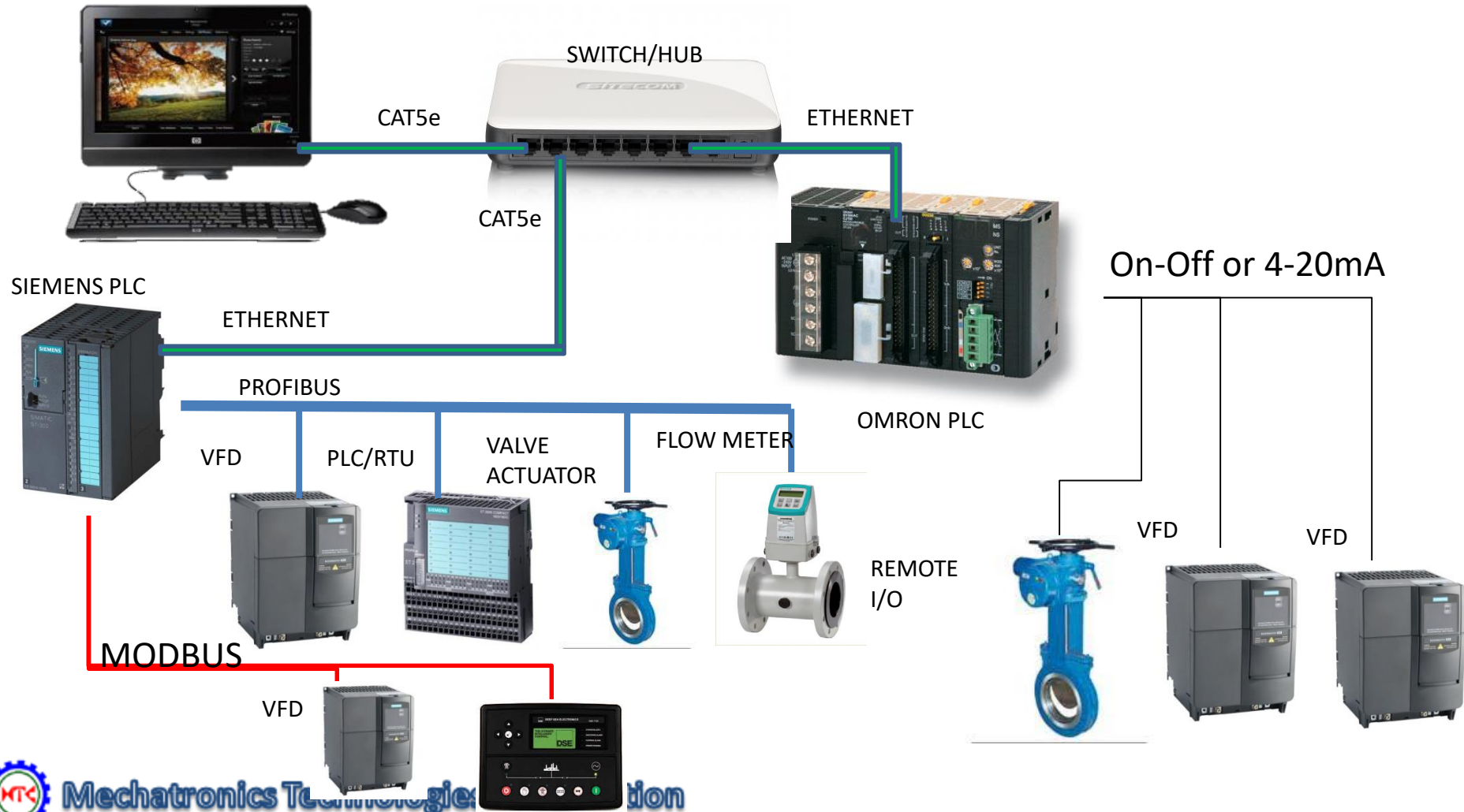
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THANK YOU VERY MUCH!!!

QUESTIONS???

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