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RISE UP  
WE WILL  
SHINE

## Design & Implementation Liquid Syrup Processing Plant With PLC

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## DECLARATION

It is declared hereby that thesis paper or any part of that has not been submitted to anywhere else for the award of any degree

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## CRETIFIATION

This is to certify that, project entitled “Design & Implementation Liquid Syrup Processing Plant With PLC” is done by following students under my direct supervision. This project work has been carried out by them in the laboratory of the department of Electrical & Electronic Engineering under the faculty of Engineering. Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical & Electronic Engineering.

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At first we would like to show our guide line to the university authority to permit us to do our practicum. Especially we would like to thank our honorable teacher **Md. Ferdous Khan**, Lecturer & Co-ordinator, Electrical & Electronic Engineering, Sonargaon University (SU), Dhaka, for his valuable and patient advice, sympathetic assistance, co-operation, contribution of new idea. Deep theoretical and hardware & keen interest of our supervisor in this field influenced us to carry out this project. His Endless patient, scholarly guidance , continual encouragement, constant and energetic supervision, constructive criticism, reading many inferior draft and correcting them at all stage have made it possible to complete this project.

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## INTRODUCTION

Automatic-control-instrumentation plays the most important role in any modern industrial plant, but unfortunately this field has been neglected in BANGLADESH, not only in industrial sector but also in engineering educational sector. As a result most of instrumentation, control units and even machinery are imported from foreign countries. However, these automatic plants can be developed locally by the coordination of industrial sector and engineering educational institutions.

This paper gives a design and development of a low cost “Design & Implementation Liquid Syrup Processing Plant With PLC”, which can replace old manual operations. By doing this local industries can get an error free mechanism, which can increase their production with a greater economy.

## OBJECTIVE

**An Appropriate Solutions to Industrial Problems :** By using this system the local industries can solve many problems such as : Automatic type Filling machinery are usually imported from foreign countries which are very expensive. Local industries are not in reach to purchase them because they have to pay large amount of tax and duties. If these type of machines can be developed in BANGLADESH, local industries can easily buy them without paying large amount of money.

By using advanced data management system, record of production can be easily maintain it make the system more economical then the manual type. By using no bottle sensor we can save liquid if there is no bottle present on the machine.

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# CHAPTER II :

## INTRODUCTION TO PROJECT EQUIPMENTS

### Chapter Overview

This chapter includes the total overview of the equipments, those has been used in this project. In this chapter we have followed-up the introduction of PLC, Magnetic Contactor, Sensor, Relay, Power Supply Unit, Digital Timer, Circuit Breaker, Fuse, Push Button Switch, Indicator Lamp , Lamp Holder

### What is a PLC?

A PROGRAMMABLE LOGIC CONTROLLER (PLC) is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.

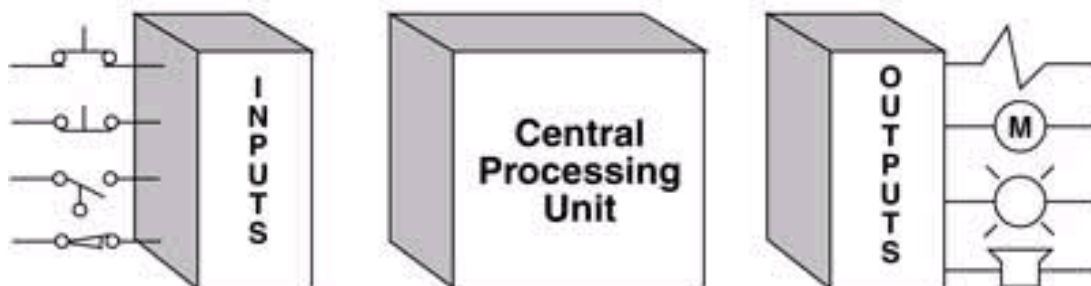
Almost any production line, machine function, or process can be greatly enhanced using this type of control system. However, the biggest benefit in using a PLC is the ability to change and replicate the operation or process while collecting and communicating vital information.

### History of PLC

The first Programmable Logic Controllers were designed and developed by Modicon as a relay replacer for GM and Landis.

- These controllers eliminated the need for rewiring and adding additional hardware for each new configuration of logic.
- The new system drastically increased the functionality of the controls while reducing the cabinet space that housed the logic.
- The first PLC, model 084, was invented by **Dick Morley** in **1969**
- The first commercial successful PLC, the 184, was introduced in 1973 and was designed by Michael Greenberg.

### What is Inside A PLC?





The Central Processing Unit, CPU, contains an internal program that tells the PLC how to perform the following functions:

- Execute the Control Instructions contained in the User's Programs. This program is stored in "nonvolatile" memory, meaning that the program will not be lost if power is removed
- Communicate with other devices, which can include I/O Devices, Programming Devices, Networks, and even other PLCs.
- Perform Housekeeping activities such as Communications, Internal Diagnostics, etc.

## How Does A PLC Operate?

There are four basic steps in the operation of all PLCs; Input Scan, Program Scan, Output Scan, and Housekeeping. These steps continually take place in a repeating loop.

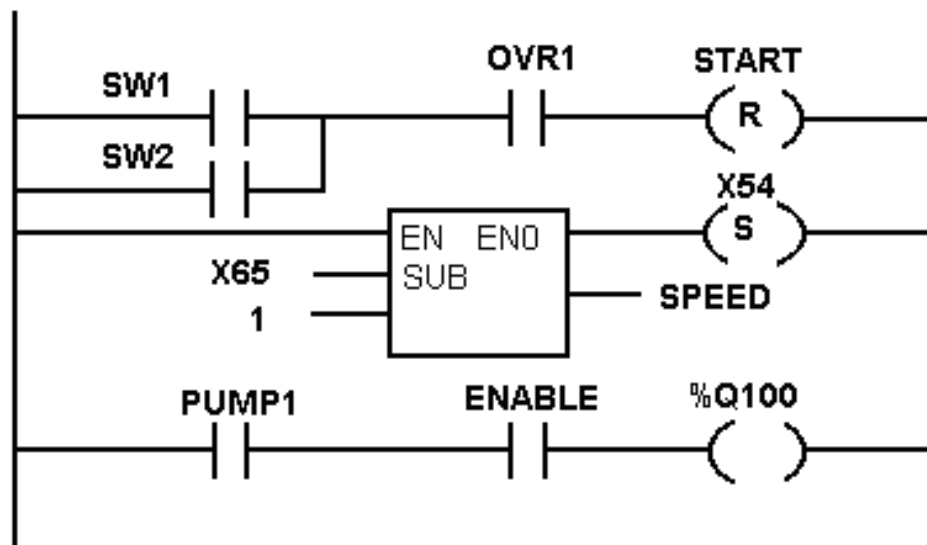
Four Steps In The PLC Operations :

- 1.) **Input Scan** : Detects the state of all input devices that are connected to the PLC.
- 2.) **Program Scan** : Executes the user created program logic.
- 3.) **Output Scan** : Energizes or de-energize all output devices that are connected to the PLC.
- 4.) **Housekeeping** : This step includes communications with programming terminals, internal diagnostics, etc...

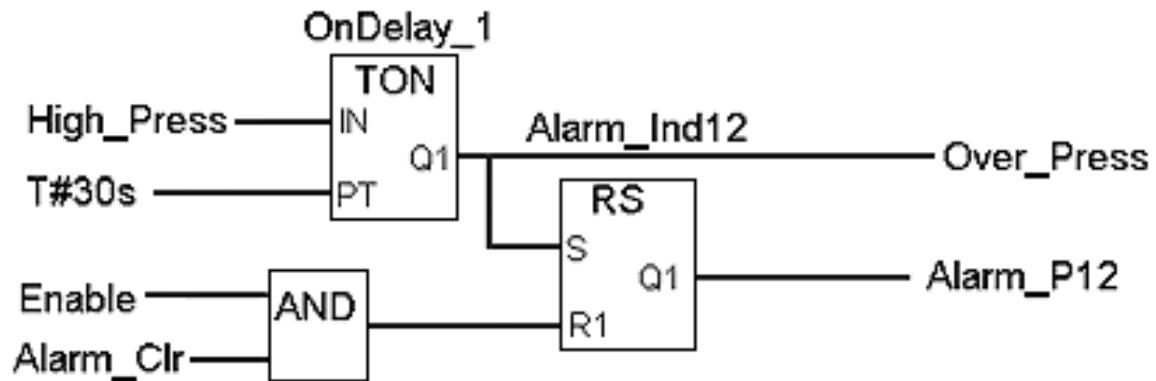
## What Programming Language Is Used To Program A PLC?

While Ladder Logic is the most commonly used PLC programming language, but it is not the only one. The following table lists of some of languages that are used to program a PLC.

**Ladder Diagram (LD)** : Traditional ladder logic is graphical programming language. Initially programmed with simple contacts that simulated the opening and closing of relays, Ladder Logic programming has been expanded to include such functions as counters, timers, shift registers, and math operations.



**Function Block Diagram (FBD) :** A graphical language for depicting signal and data flows through re-usable function blocks. FBD is very useful for expressing the interconnection of control system algorithms and logic.



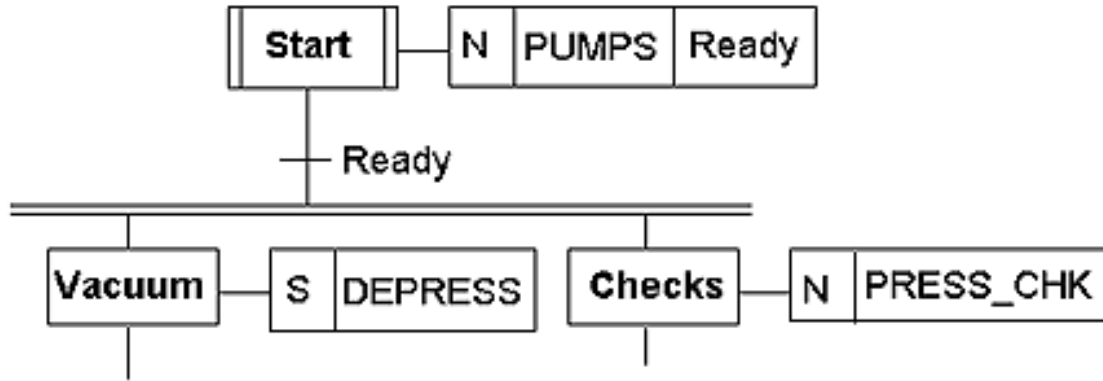
**Structured Text (ST) :** A high level text language that encourages structured programming. It has a language structure (syntax) that strongly resembles PASCAL and supports a wide range of standard functions and operators. For example;

```
    If Speed1 > 100.0 then
        Flow_Rate: = 50.0 + Offset_A1;
    Else
        Flow_Rate: = 100.0; Steam: = ON
    End_If;
```

**Instruction List (IL) :** A low level “assembler like” language that is based on similar instructions list languages found in a wide range of today’s PLCs.

```
LD R1
MPC RESET
LD PRESS_1
ST MAX_PRESS
RESET: LD 0
ST A_X43
```

**Sequential Function Chart (SFC)** : A method of programming complex control systems at a more highly structured level. A SFC program is an overview of the control system, in which the basic building blocks are entire program files. Each program file is created using one of the other types of programming languages. The SFC approach coordinates large, complicated programming tasks into smaller, more manageable tasks.



## What Are Input / Output Devices?

### INPUTS

- Switches and Pushbuttons
- Sensing Devices
- Limit Switches
- Photoelectric Sensors
- Proximity Sensors



- Condition Sensors
- Encoders
- Pressure Switches
- Level Switches
- Temperature Switches
- Vacuum Switches
- Float Switches



### OUTPUTS

- Valves
- Motor Starters
- Solenoids
- Actuators



- Horns and Alarms
- Stack lights
- Control Relays
- Counter/Totalizer
- Pumps
- Printers
- Fan



# LOGO! 8 Types PLC

We are using LOGO! 8 PLC on our project, so here we will have some discussion on it.

## Overview

- The space-saving basic variants
- Interface for the connection of expansion modules, up to 24 digital inputs, 20 digital outputs, 8 analog inputs and 8 analog outputs can be addressed
- All basic units with integrated web server
- Enclosure width 72 mm (4 MW)
- All basic units with Ethernet interface for communication with LOGO! 8, LOGO! TDE, SIMATIC Controllers, SIMATIC Panels and PCs
- Use of standard micro SD cards

## Design

- Ethernet port
- Relay outputs with max. 10 A output current
- Integrated display field with parameterizable backlight (6 x 16 characters, 3 background colors).
- Integrated operator control panel.
- Integrated EEPROM memory for control program and set point values.
- Optional standard micro CF cards
- Integral real-time clock with automatic summer/winter time switchover.
- Backup of the integrated real-time clock for 20 days.
- 8 digital inputs, 4 digital outputs.
- 4 inputs as analog inputs in 12/24 V DC variants (0 to 10 V); inputs can also be used digitally.
- 4 inputs can be used for high-speed counting up to 5 kHz (DC versions only).
- Interface for the connection of expansion modules, up to 24 digital inputs, 20 digital outputs, 8 analog inputs and 8 analog outputs can be addressed.
- Connection of the LOGO! TDE text display via Ethernet.

## Function

- Integrated basic and special functions:
  - ✓ Basic logic functions:
    - AND, OR, NOT, NAND, NOR, XOR, positive/negative pulse edge evaluation.
  - ✓ Special functions:
    - ON delay, latching ON delay, OFF delay, impulse relay, locking relay, counter (forward/backward), time switch, interval time-delay relay, operating hours counter, trigger, asynchronous pulse generator, year time switch, comfort light switch function, random generator, staircase light switch function as per DIN 18015-2, edge-triggered interval time-delay relay, combined ON/OFF delay, analog comparator, analog trigger, analog delta trigger, analog watchdog, analog amplifier, text and variable display, shift register, soft key function,

PI controller, ramp function, analog multiplexer, PWM function, analog arithmetic function, function for detecting errors in the analog arithmetic function.

- 400 function blocks can be interlinked
- Up to 64 bit memories  
(Including restart bit memory, bit memory for controlling the backlight of the integral display and the LOGO! TDE text display, bit memory for switching between 2 parameterizable character sets in the message text).
- Integrated retentivity.
- Password protection.
- Additional know-how protection with the optional micro CF card.
- Data logging to internal memory or micro CF card (up to 20 000 records)
- Macros (user-defined functions) for LOGO! Soft Comfort
- 64 open terminals
- 4 8-bit shift registers
- Extended diagnostic functions

## Technical specifications of LOGO! 8 series PLC

Article number	6ED1052-1CC08-0BA1	6ED1052-1MD08-0BA1	6ED1052-1HB08-0BA1	6ED1052-1FB08-0BA1
	LOGO! 24CE, 8DI(4AI)/4DO, 400 Blocks	LOGO!12/24RCE, 8DI(4AI)/4DO, 400 Blocks	LOGO! 24RCE, 8DI/4DO, 400 Blocks	LOGO!230RCE, 8DI/4DO, 400 Blocks
<b>Display</b>				
with display	Yes	Yes	Yes	Yes
<b>Installation type/mounting</b>				
Mounting	on 35 mm DIN rail, 4 spacing units wide	on 35 mm DIN rail, 4 spacing units wide	on 35 mm DIN rail, 4 spacing units wide	on 35 mm DIN rail, 4 spacing units wide
<b>Supply voltage</b>				
Rated value (DC)				
• 12 V DC		Yes		
• 24 V DC	Yes	Yes	Yes	
• 115 V DC				Yes
• 230 V DC				Yes; 240 V DC
permissible range, lower limit (DC)	20.4 V	10.8 V	20.4 V	100 V
permissible range, upper limit (DC)	28.8 V	28.8 V	28.8 V	253 V
Rated value (AC)				
• 24 V AC			Yes	
• 115 V AC				Yes
• 230 V AC				Yes; 240 V AC

Article number	6ED1052-1CC08-0BA1	6ED1052-1MD08-0BA1	6ED1052-1HB08-0BA1	6ED1052-1FB08-0BA1
	LOGO! 24CE, 8DI(4AI)/4DO, 400 Blocks	LOGO!12/24RCE, 8DI(4AI)/4DO, 400 Blocks	LOGO! 24RCE, 8DI/4DO, 400 Blocks	LOGO!230RCE, 8DI/4DO, 400 Blocks
<b>Line frequency</b>				
• permissible range, lower limit			47 Hz	47 Hz
• permissible range, upper limit			63 Hz	63 Hz
<b>Time of day</b>				
<b>Time switching clocks</b>				
• Number	400; Max. 400, function-specific	400; Max. 400, function-specific	400; Max. 400, function-specific	400; Max. 400, function-specific
• Power reserve	480 h	480 h	480 h	480 h
<b>Digital inputs</b>				
Number of digital inputs	8; Of which 4 can be used in analog mode (0 to 10 V)	8; Of which 4 can be used in analog mode (0 to 10 V)	8	8
<b>Digital outputs</b>				
Number of digital outputs	4; Transistor	4; Relays	4; Relays	4; Relays
Short-circuit protection	Yes; electrical (1 A)	No; external fusing necessary	No; external fusing necessary	No; external fusing necessary
<b>Output current</b>				
• for signal "1" permissible range for 0 to 55 °C, max.	0.3 A	10 A		
<b>Relay outputs</b>				
<b>Switching capacity of contacts</b>				
— with inductive load, max.		3 A	3 A	3 A
— with resistive load, max.		10 A	10 A	10 A
<b>EMC</b>				
<b>Emission of radio interference acc. to EN 55 011</b>				
• Limit class B, for use in residential areas	Yes; Radio interference suppression according to EN55011, Limit Value Class B	Yes; Radio interference suppression according to EN55011, Limit Value Class B	Yes; Radio interference suppression according to EN55011, Limit Value Class B	Yes; Radio interference suppression according to EN55011, Limit Value Class B
<b>Standards, approvals, certificates</b>				
CE mark	Yes	Yes	Yes	Yes
CSA approval	Yes	Yes	Yes	Yes
UL approval	Yes	Yes	Yes	Yes

Article number	6ED1052-1CC08-0BA1	6ED1052-1MD08-0BA1	6ED1052-1HB08-0BA1	6ED1052-1FB08-0BA1
	LOGO! 24CE, 8DI(4AI)/4DO, 400 Blocks	LOGO!12/24RCE, 8DI(4AI)/4DO, 400 Blocks	LOGO! 24RCE, 8DI/4DO, 400 Blocks	LOGO!230RCE, 8DI/4DO, 400 Blocks
FM approval	Yes	Yes	Yes	Yes
developed in accordance with IEC 61131	Yes	Yes	Yes	Yes
according to VDE 0631	Yes	Yes	Yes	Yes
Marine approval	Yes	Yes	Yes	Yes
<b>Ambient conditions</b>				
<b>Ambient temperature during operation</b>				
• min.	-20 °C; No condensation	-20 °C; No condensation	-20 °C; No condensation	-20 °C; No condensation
• max.	55 °C	55 °C	55 °C	55 °C
<b>Ambient temperature during storage/transportation</b>				
• min.	-40 °C	-40 °C	-40 °C	-40 °C
• max.	70 °C	70 °C	70 °C	70 °C
<b>Altitude during operation relating to sea level</b>				
• Ambient air temperature-barometric pressure-altitude	Tmin ... Tmax at 1 080 hPa ... 795 hPa (-1 000 m ... +2 000 m)	Tmin ... Tmax at 1 080 hPa ... 795 hPa (-1 000 m ... +2 000 m)	Tmin ... Tmax at 1 080 hPa ... 795 hPa (-1 000 m ... +2 000 m)	Tmin ... Tmax at 1 080 hPa ... 795 hPa (-1 000 m ... +2 000 m)
<b>Dimensions</b>				
Width	71.5 mm	71.5 mm	71.5 mm	71.5 mm
Height	90 mm	90 mm	90 mm	90 mm
Depth	60 mm	60 mm	60 mm	60 mm

LOGO! 230RCE, logic module, display  
 PS/I/O: 115V/230V/relay, 8 DI/4 DQ,  
 memory 400 blocks, modular expandable,  
 Ethernet, integrated web server, data log,  
 user-defined web pages, standard microSD  
 card for LOGO! Soft Comfort V8.3 or higher,  
 older projects executable cloud connection in  
 all LOGO! 8.3 basic units



<b>Display</b>	
with display	Yes
<b>Installation type/mounting</b>	
Mounting	on 35 mm DIN rail, 4 spacing units wide
<b>Supply voltage</b>	
Rated value (DC)	
• 115 V DC	Yes
• 230 V DC	Yes; 240 V DC
permissible range, lower limit (DC)	100 V
permissible range, upper limit (DC)	253 V
Rated value (AC)	
• 115 V AC	Yes
• 230 V AC	Yes; 240 V AC
<b>Line frequency</b>	
• permissible range, lower limit	47 Hz
• permissible range, upper limit	63 Hz
<b>Time of day</b>	
Time switching clocks	
• Number	400; Max. 400, function-specific
• Power reserve	480 h
<b>Digital inputs</b>	
Number of digital inputs	8
<b>Digital outputs</b>	
Number of digital outputs	4; Relays
Short-circuit protection	No; external fusing necessary
<b>Relay outputs</b>	
Switching capacity of contacts	
— with inductive load, max.	3 A
— with resistive load, max.	10 A
<b>EMC</b>	
Emission of radio interference acc. to EN 55 011	
• Limit class B, for use in residential areas	Yes; Radio interference suppression according to EN55011, Limit Value Class B
<b>Standards, approvals, certificates</b>	
CE mark	Yes
CSA approval	Yes
UL approval	Yes
FM approval	Yes



# What is a Magnetic Contactor?

A magnetic contactor is a device that is powered by magnetism. Used to open and close the contacts in the motor control circuit, may also be called a magnetic switch or a contactor.

A magnetic contactor is a device that is very often used in industry. Commercial, large industries are very much dependent on this device. Through it, we can easily control heavy loads such as high-capacity motors.

## Magnetic Contactor Working Principle

When an electric current flows to the magnetic field coil located in the center leg of the coil core. This will create a magnetic field in which the magnetic field forces overcome the spring force to cause the steel core to move down in this state (ON).

Two sets of contactors will change the operating condition,

- The normally closed (NC) contactor will open the contact point circuit and
- The normally open contactor (NO) will open the contact circuit, connect the circuit of the contact point when there is no current flowing to the coil, all contactor magnetic fields.

## The Major Structure of the Magnetic Contactor

The basic elements of magnetic contactors are as follows.

### 1. Iron Core

The iron core is divided into two parts:

### 2. Fixed Core

It becomes an electromagnet when the coil is energized.

### 3. Moving Core

When the coil gets energized, a magnetic contactor is closed and it makes the moving core slide into the fixed core.

### 4. Coil

The coil is powered to pull the main contacts close, auxiliary contacts use the power of that coil to operate.

### 5. Contact

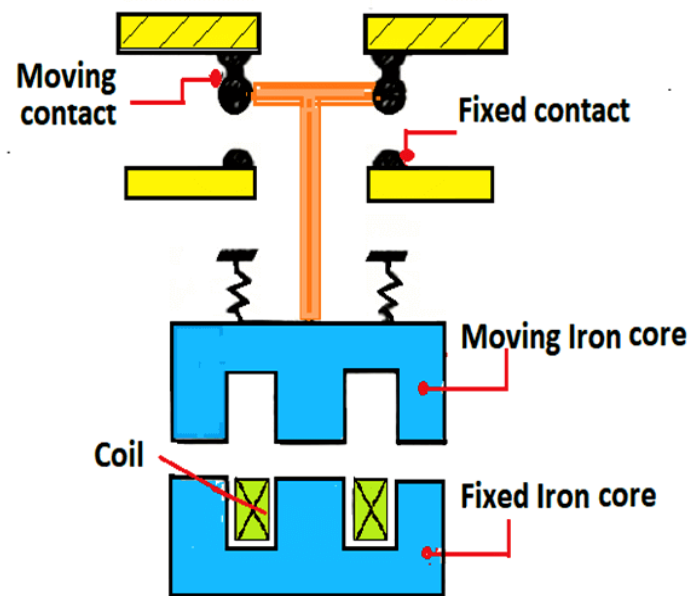
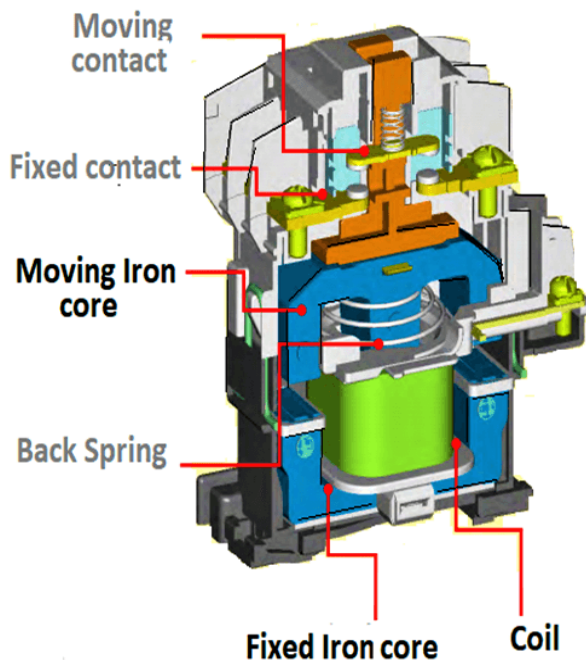
There are mainly two types available.

## Main Contact

The main contact is also known as “the main Contact”, is used in the power circuit to connect the electrical system to the load. The main contacts are designed for hundreds or more ampacity and auxiliary contacts are for tens or less.

## Auxiliary Contact

Auxiliary Contact is used with the “auxiliary contact control circuit” as a secondary switching. The contacts may be normally open (NO) or normally close (NC). Normally open are open when the contactor is de-energized, whereas normally closed are opposite. The auxiliary contacts are allowed to pass small currents, used to show the status of the main contacts. In other words, it provides an interface to the control system.



## Types of Magnetic Contactors :

Magnetic contactors are divided mainly into two categories

- AC contactor.
- DC contactor.

## AC Contactor

Contactors that are used with AC power are divided into 4 types according to the nature of the load.

## **DC Contactor**

Contactors that are used with DC power are divided into 5 types according to the nature of the load.

## **Advantages of Magnetic Contactors**

Advantages of using relays and magnetic contactors when compared with other switches

1. Provides high safety for operators
2. Provide ease of control
3. Economical compared to manual controls
4. Controllable with an automatic device or a remote-control operation is possible.

## **Applications of Magnetic Contactors**

The following are some of the applications of magnetic contactors.

### **Magnetic Motor Starter**

It is an electrically operated switch (contactor) that comprises motor overload protection. Magnetic motor starters are similar to contactors, additionally, they have an overload attached to them. Overloads have heaters or electronic overloads, which sense excessive current flow to the motor. The magnetic motor starter is a magnetic contactor plus overload relay.

### **Lighting Control Contactor**

It is being used for remote or local switching of relatively large mercury, fluorescent, or tungsten, or even in LED lighting load centralized ON/OFF control.

# Sensor

We live in a World of Sensors. You can find different types of Sensors in our homes, offices, cars etc. working to make our lives easier by turning on the lights by detecting our presence, adjusting the room temperature, detect smoke or fire, make us delicious coffee, open garage doors as soon as our car is near the door and many other tasks.

All these and many other automation tasks are possible because of Sensors. Before going in to the details of What is a Sensor, What are the Different Types of Sensors and Applications of these different types of Sensors, we will first take a look at a simple example of an automated system, which is possible because of Sensors (and many other components as well).

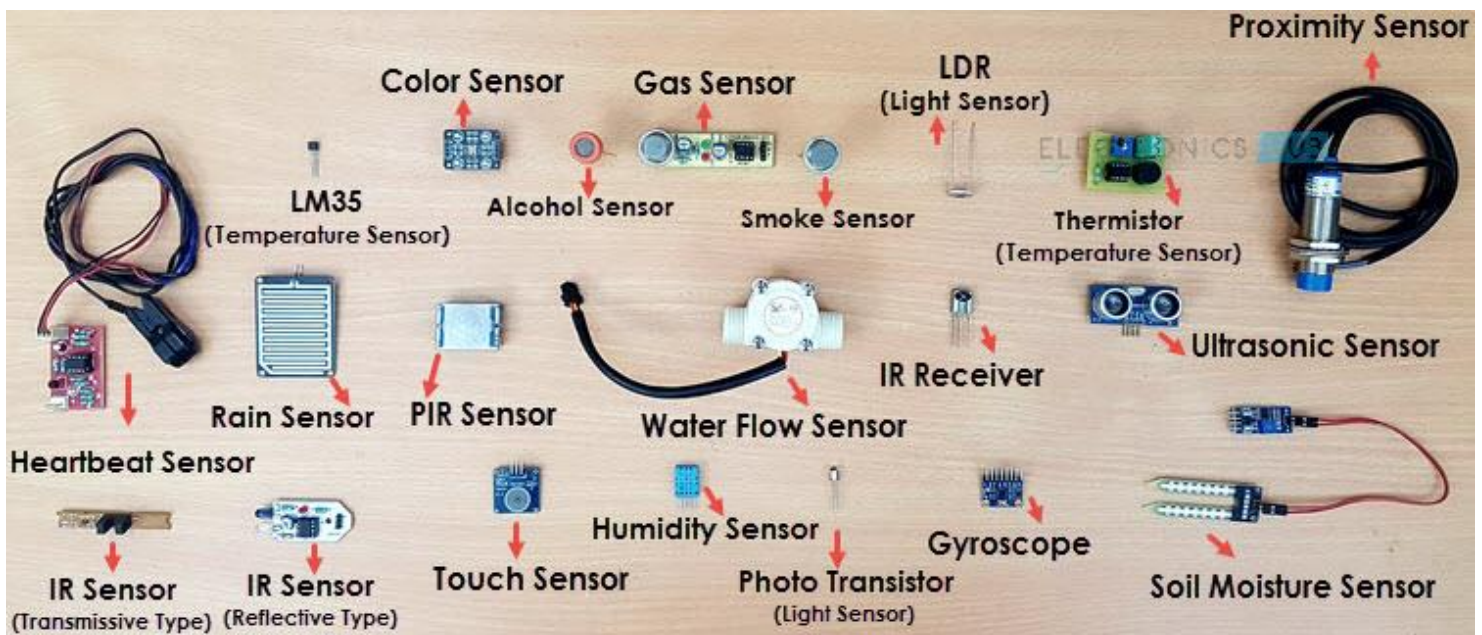
## What is a Sensor?

There are numerous definitions as to what a sensor is but we would like to define a Sensor as an input device which provides an output (signal) with respect to a specific physical quantity (input). The term “input device” in the definition of a Sensor means that it is part of a bigger system which provides input to a main control system (like a Processor or a Microcontroller).

Another unique definition of a Sensor is as follows: It is a device that converts signals from one energy domain to electrical domain. The definition of the Sensor can be better understood if we take an example in to consideration.

The simplest example of a sensor is an LDR or a Light Dependent Resistor. It is a device, whose resistance varies according to intensity of light it is subjected to. When the light falling on an LDR is more, its resistance becomes very less and when the light is less, well, the resistance of the LDR becomes very high.

We can connect this LDR in a voltage divider (along with other resistor) and check the voltage drop across the LDR. This voltage can be calibrated to the amount of light falling on the LDR. Hence, a Light Sensor.



# Classification of Sensors

We have seen what a sensor is, we will proceed further with the classification of Sensors. There are several classifications of sensors made by different authors and experts. Some are very simple and some are very complex. The following classification of sensors may already be used by an expert in the subject but this is a very simple classification of sensors. In the first classification of the sensors, they are divided into Active and Passive.

- Active Sensors are those which require an external excitation signal or a power signal. Passive Sensors, on the other hand, do not require any external power signal and directly generate output response.
- The other type of classification is based on the means of detection used in the sensor. Some of the means of detection are Electric, Biological, and Chemical, Radioactive etc.
- The next classification is based on conversion phenomenon i.e., the input and the output. Some of the common conversion phenomena are Photoelectric, Thermoelectric, Electrochemical, Electromagnetic, Thermo-optic, etc.
- The final classification of the sensors are Analog and Digital Sensors. Analog Sensors produce an analog output i.e., a continuous output signal (usually voltage but sometimes other quantities like Resistance etc.) with respect to the quantity being measured.

Digital Sensors, in contrast to Analog Sensors, work with discrete or digital data. The data in digital sensors, which is used for conversion and transmission, is digital in nature.

## Different Types of Sensors

The following is a list of different types of sensors that are commonly used in various applications. All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

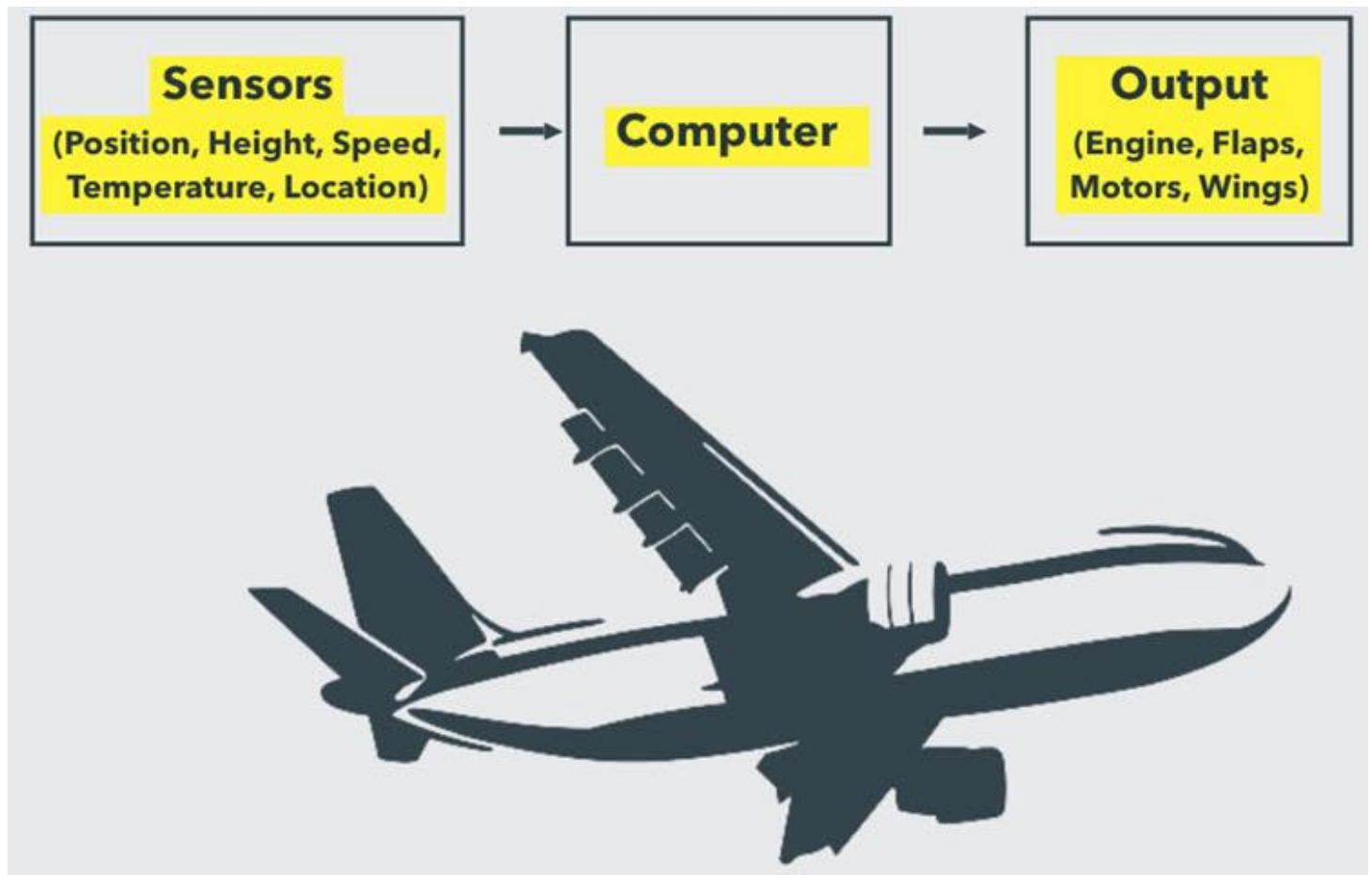
- |                                 |  |
|---------------------------------|--|
| ✓ Temperature Sensor            | ✓ Humidity Sensor                      |
| ✓ Proximity Sensor              | ✓ Position Sensor                      |
| ✓ Accelerometer                 | ✓ Magnetic Sensor (Hall Effect Sensor) |
| ✓ IR Sensor (Infrared Sensor)   | ✓ Microphone (Sound Sensor)            |
| ✓ Pressure Sensor               | ✓ Tilt Sensor                          |
| ✓ Light Sensor                  | ✓ Flow and Level Sensor                |
| ✓ Ultrasonic Sensor             | ✓ PIR Sensor                           |
| ✓ Smoke, Gas and Alcohol Sensor | ✓ Touch Sensor                         |
| ✓ Touch Sensor                  | ✓ Strain and Weight Sensor             |
| ✓ Color Sensor                  |  |

❖ We'll see about few of the above-mentioned sensors in brief, those have been used on our project.



## ❖ Real Time Application of Sensors

The example we are talking about here is the Autopilot System in aircrafts. Almost all civilian and military aircrafts have the feature of Automatic Flight Control system or sometimes called as Autopilot.



An Automatic Flight Control System consists of several sensors for various tasks like speed control, height monitoring, position tracking, status of doors, obstacle detection, fuel level, maneuvering and many more. A Computer takes data from all these sensors and processes them by comparing them with pre-designed values.

The computer then provides control signals to different parts like engines, flaps, rudders, motors etc. that help in a smooth flight. The combination of Sensors, Computers and Mechanics makes it possible to run the plane in Autopilot Mode.

All the parameters i.e., the Sensors (which give inputs to the Computers), the Computers (the brains of the system) and the mechanics (the outputs of the system like engines and motors) are equally important in building a successful automated system.

This is an extremely simplified version of Flight Control System. In fact, there are hundreds of individual control systems which perform unique tasks for a safe and smooth journey.

# What is Relay?

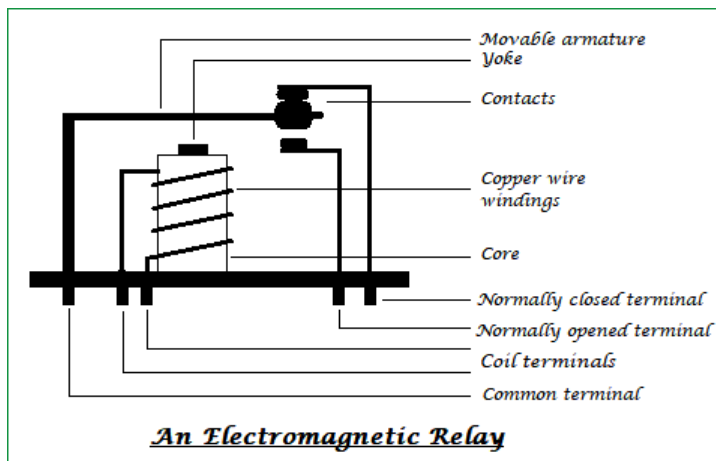
A Relay is an electromechanical device that can be used to make or break an electrical connection. It consists of a flexible moving mechanical part which can be controlled electronically through an electromagnet, basically, a relay is just like a mechanical switch but you can control it with an electronic signal instead of manually turning it on or off. Again this working principle of relay fits only for the electromechanical relay.

There are many types of relay and each relay has its own application, a standard, and generally used relay is made up of electromagnets which in general used as a switch. Dictionary says that relay means the act of passing something from one thing to another, the same meaning can be applied to this device because the signal received from one side of the device controls the switching operation on the other side. So relay is a switch which controls (open and close) circuits electromechanically. The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF. It is mainly used to control a high powered circuit using a low power signal. Generally, a DC signal is used to control the circuit which is driven by high voltage like controlling AC home appliances with DC signals from microcontrollers.

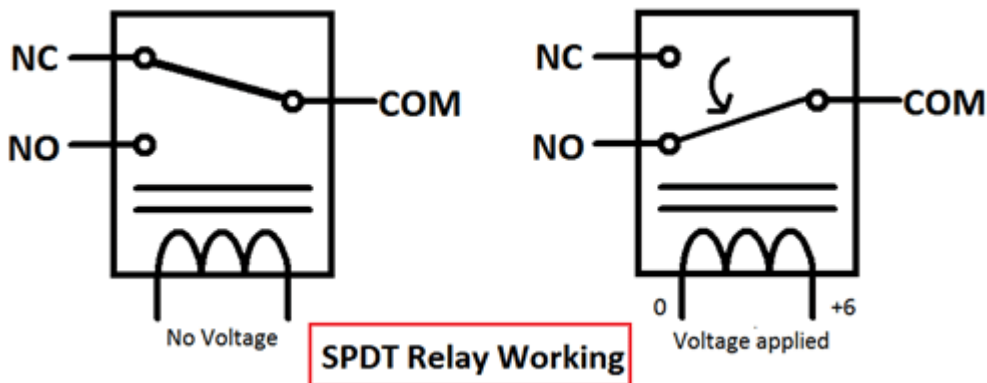
## Construction of Relay and its operation :

The following figure shows how a Relay looks internally and how it can be constructed, on a

casing, a core with copper windings (forms a coil) wound on it is placed. A movable armature consists of a spring support or stand like structure connected to one end, and a metal contact connected to another side, all these arrangements are placed over the core such that, when the coil is energized, it attracts the armature. The movable armature is generally considered as a common terminal which is to be connected to the external circuitry. The relay also has two pins namely



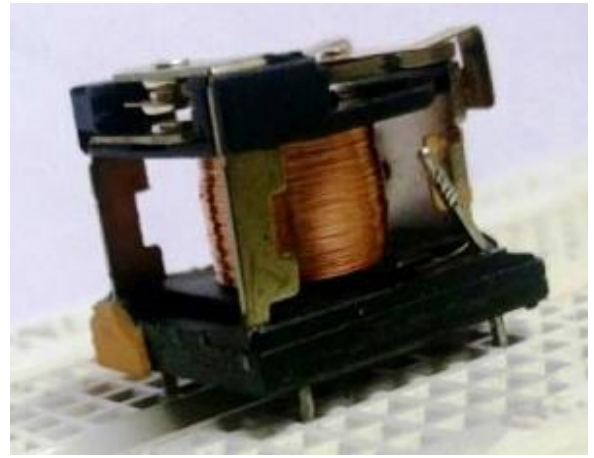
normally closed and normally opened (NC and NO), the normally closed pin is connected to the armature or the common terminal whereas the normally opened pin is left free (when the coil is not energized). When the coil is energized the armature moves and is get connected to the normally opened contact till there exists flow of current through the coil. When it is de-energized it goes to its initial position. The general circuit representation of the relay is as shown in the figure below





## What is inside a Relay - Teardown?

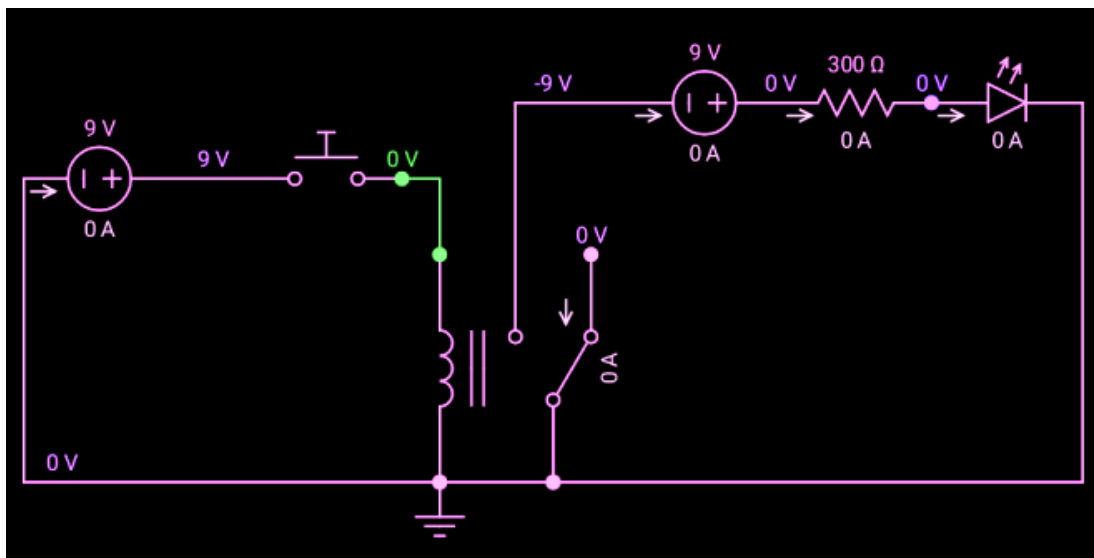
An electromechanical relay is basically designed using few mechanical parts like Electromagnet, a movable armature, contacts, yoke, and a spring/frame/stand, these parts are showing in the internal pictures of Relay below. All these are arranged logically to form into a relay. Here we have explained the internal mechanical parts of a Relay:



- **Electromagnet:** An Electromagnet plays a major role in the working of a relay. It is a metal which doesn't have magnetic property but it can be converted into a magnet with the help of an electrical signal. We know that when current passes through the conductor it acquires the properties of a magnet. So, when a metal wound with a copper wire and driven by the sufficient power supply, that metal can act as a magnet and can attract the metals within its range.
- **Movable Armature:** A movable armature is a simple metal piece which is balanced on a pivot or a stand. It helps in making or breaking the connection with the contacts connected to it.
- **Contacts:** These are the conductors that exist within the device and are connected to the terminals.
- **Yoke:** It is a small metal piece fixed on a core in order to attract and hold the armature when the coil is energized.
- **Spring (optional):** Few relays don't need any spring but if it is used, it is connected to one end of the armature to ensure its easy and free movement. Instead of a spring, a metal stand like structure can be used.

## Relay Working Principle

Now let's understand how a relay works in a normally closed condition and normally open condition.

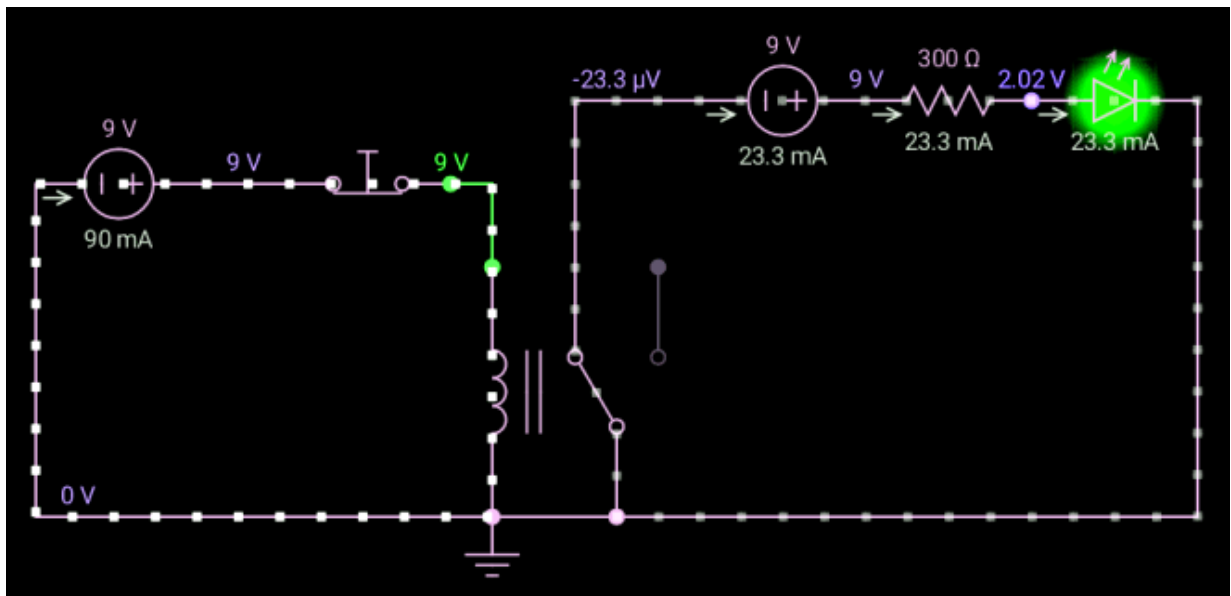


## Relay in NORMALLY CLOSED condition

When no voltage is applied to the core, it cannot generate any magnetic field and it doesn't act as a magnet. Therefore, it cannot attract the movable armature. Thus, the initial position itself is the armature connected in normally closed position (NC).

## Relay in NORMALLY OPENED condition:

When sufficient voltage is applied to the core it starts to create a magnetic field around it and acts as a magnet. Since the movable armature is placed within its range, it gets attracted to that magnetic field created by the core, thus the position of the armature is being altered. It is now connected to the normally opened pin of the relay and external circuit connected to it function in a different manner.



Note: The functionality of the external circuit depends upon the connection made to the relay pins.

So finally, we can say that when a coil is energized the armature is attracted and the switching action can be seen, if the coil is de-energized it loses its magnetic property and the armature goes back to its initial position.

## Different Types of Relay:

Other than the Electromagnetic relay there are many other types of relays that work on different principles. Its classification is as follows

Types of Relay Based on the principle of operation

- **Electrothermal Relay** : When two different materials are joined together it forms into a bimetallic strip. When this strip is energized it tends to bend, this property is used in such a way that the bending nature makes a connection with the contacts.
- **Electromechanical Relay** : With the help of few mechanical parts and based on the property of an electromagnet a connection is made with the contacts.

- **Solid State Relay** : Instead of using mechanical parts as in electrothermal and electromechanical relays, it uses semiconductor devices. So, the switching speed of the device can be made easier and faster. The main advantages of this relay are its more life span and faster switching operation compared to other relays.
- **Hybrid Relay** : It is the combination of both electromechanical and solid-state relays.

## Types of Relay Based on the polarity:

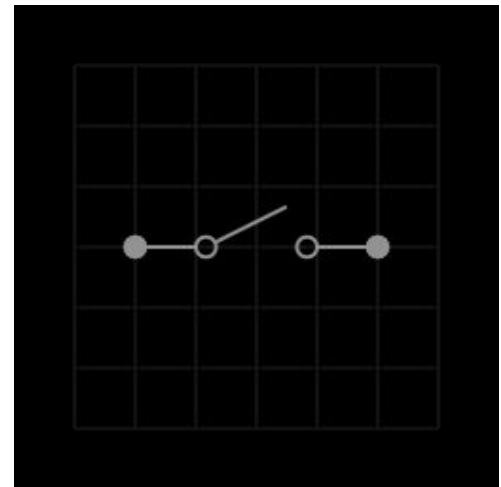
**Polarized relay:** These are similar to the electromechanical relays but there exists both permanent magnet and electromagnet in it, the movement of the armature depends on the polarity of the input signal applied to the coil. Used in telegraphy applications.

**Non-polarized relay:** The coil in these relays doesn't have any polarities and its operation remains unchanged even if the polarity of the input signal is altered.

## Pole and Throw combinations:

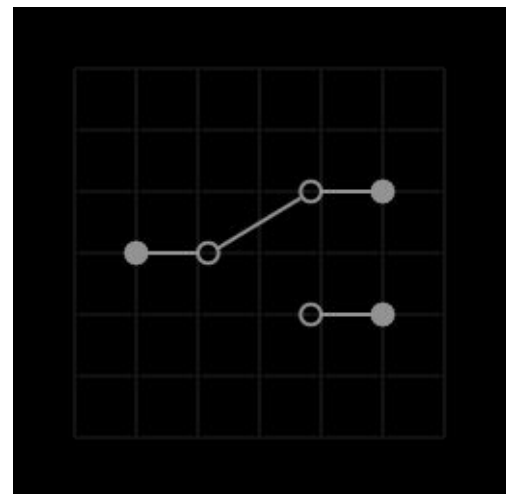
Switches can also be classified based on the number of pole and throw combinations. A pole can be considered as an input terminal and a movable part connected to it, whereas a throw can be considered as an output terminal. Its classification is as follows

**Single pole, single-throw Relay (SPST)** : It consists of only one pole and one throw. Generally, the path is either closed or opened (remains untouched to any terminal). A push button is the best example of this type. When we push the button, the contact is in the closed position and when released the contact is in the open position, which can be understood from the below image.

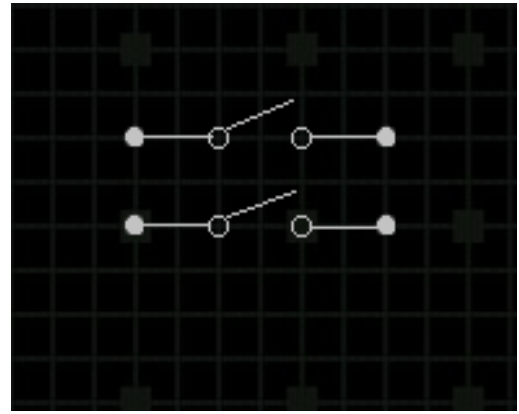


## Single pole, double throw Relay (SPDT) :

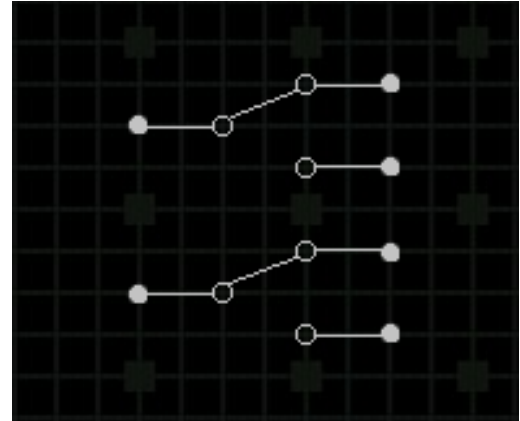
This type of switches consists of only one pole but has two throws. So, the contact is always made to either of the terminals. A slide switch can be considered as its example. The slider is always connected to either of the contacts i.e., a closed path always exists all the time if both the terminals are connected to a circuit.



**Double pole, single throw Relay (DPST):**It has two poles and a throw. The contacts of it are either opened or closed which is done simultaneously. Toggle switch works on this property. When the switch is toggled from one position to another, both the contacts are moved simultaneously.



**Double pole, double throw Relay (DPDT):**This type of switches has two poles but the individual pole has two throws. So, it is named as double throw and the switching action is done similarly and simultaneously for both the poles. A switch on a standard trimmer is of DPDT because while we are charging the trimmer and when the switch on the trimmer is in the ON state, it automatically stops charging means the switches are internally opened in the charging circuit.



## Applications of Relay:

The applications of the relay are limitless, its main function is to control the high voltage circuit (230V circuit AC) with the low voltage power supply (a DC voltage).

- Relays are not only used in the large electrical circuits but also used in computer circuits in order to perform the arithmetic and mathematical operations in it.
- Used to control the electric motor switches. To turn ON an electric motor we need 230V AC supply but in few cases/applications, there may be a situation to switch ON the motor with a DC supply voltage. In those cases, a relay can be used.
- Automatic stabilizers are one of its applications where a relay is used. When the supply voltage is other than the rated voltage, set of relays sense the voltage variations and controls the load circuit with the help of circuit breakers.
- Used for the circuit selection if there exists more than one circuit in a system.
- Used in Televisions. An old picture tube television's internal circuitry works with the DC voltage but the picture tube needs a very high AC voltage, in order to turn on the picture tube with a DC supply we can use a relay.
- Used in the traffic signal controllers, temperature controllers.

## What is a Power Supply Unit (PSU)?

A Power Supply Unit (PSU) is an internal IT hardware component. Despite the name, Power Supply Units (PSU) do not supply systems with power - instead they convert it. Specifically, a power supply converts the alternating high voltage current (AC) into direct current (DC), and they also regulate the DC output voltage to the fine tolerances required for modern computing components. Most power supplies are switched-mode (SMPS), which has both efficiency advantages and makes designing for multiple voltage inputs easier. This means that most PSUs can operate in different countries where the power input might change. In the UK, the voltage is 240V 50Hz, whereas in the USA the voltage is 120V 60Hz, and in Australia it is 230V 50Hz.

## When do we need a PSU?

The power supply unit is a crucial part of any server. Without it, your IT infrastructure would not work. It's no surprise, then, that most systems include a power supply upon purchase. However, there is an alternative to the PSU that can be used in some instances. By choosing Power over Ethernet (POE), electrical power can be carried within network cables without being tethered to an electrical outlet. This is ideal for systems that need more flexibility; PoE can provide wireless access points to wherever is most convenient, and less space is taken up by wiring.

## 12V Power Supplies

12V power supplies (or 12VDC power supplies) are one of the most common power supplies in use today. In general, a 12VDC output is obtained from a 120VAC or 240VAC input using a combination of transformers, diodes and transistors. 12V power supplies can be of two types: 12V regulated power supplies, and 12V unregulated power supplies. 12V regulated power supplies come in three styles: Switching regulated AC to DC, Linear regulated AC to DC, and Switching regulated DC to DC.

Switching regulated 12VDC power supplies, sometimes referred to as SMPS power supplies, switchers, or switched mode power supplies, regulate the 12VDC output voltage using a complex high frequency switching technique that employs pulse width modulation and feedback. Acopian switching regulated power supplies also employ extensive EMI filtering and shielding to attenuate both common and differential mode noise conducted to the line and load. Galvanic isolation is standard in our 12VDC switchers, affording our users input to output and output to ground isolation for maximum versatility. Acopian switching regulated power supplies are highly efficient, small and lightweight, and are available in both AC-DC single and wide-adjust output and DC-DC configurations. Our Low Profile wide adjust output switchers can be voltage or current regulated and are externally programmable.

Linear regulated 12VDC power supplies regulate the output using a dissipative regulating circuit. They are extremely stable, have very low ripple, and have no switching frequencies to produce EMI. Galvanic isolation is standard in our 12VDC linears, affording our users input to output and output to ground isolation for maximum versatility. Acopian linear regulated power supplies are available AC to DC single and wide adjust outputs.

Unregulated 12VDC power supplies are basic power supplies with an AC input and an unregulated 12VDC output. The output voltage changes with the input voltage and load. These power supplies are inexpensive and extremely reliable.

Model number: S-60-12



## Description Model number and parameters

Model number	S-60-5	S-60-12	S-60-15	S-60-24
DC output voltage	5V	12V	15V	24V
Output voltage error (Note: 2)	±2%	±1%	±1%	±1%
Rated output current	12A	5A	4A	2.5A
Output current rage	0-12A	0-5A	0-4A	0-2.5A
Wave and noise (Note: 3)	100mVp-p	75mVp-p	75mVp-p	75mVp-p
Inlets tability (Note: 4)	±0.5%	±0.5%	±0.5%	±0.5%
Load stability (Note: 5)	±1%	±0.5%	±0.5%	±0.5%
DC output power	60W	60W	60W	60W
Efficiency	73%	78%	78%	82%
Adjustable range for DC voltage	+10,-5%	+10%	+10%	+10%

## General

Model number	S-60 series
AC input voltage range	85-132VAC/170-264VAC, selected by switch, 47-63Hz; 240-370VDC
Input current	2A/115V, 1A/230V
AC inrush current	Cold-start current: 30A/115V, 60A/230V
Leakage current	3.5mA/240VAC max
Overload protection	105%-150% Type:Foldback current limiting Rest:auto-recovery
Temperature coefficient	±0.03%/°C (0-50°C)
Setup rise hold up time	800ms,50ms,10ms/150v,300ms,50ms,80ms/230v

<b>Vibration</b>	10-500HZ,2G 10min/1cycle, Period for 60min, Each axes
<b>Dielectric strength</b>	1.5KVac, 50/60 Hz for 1 min between input and output 1.5KVac, 50/60 Hz for 1 min between input and enclosure 0.5KVac, 50/60 Hz for 1 min between output and enclosure
<b>Isolation resistance</b>	100MΩ min. at 500 VDC
<b>Working temperature humidity</b>	-10°C-60°C (Refer to output characteristic figure), 20%-90%RH
<b>Store temperature humidity</b>	-20°C-85°C, 10%-95%RH
<b>External dimension</b>	157x97x38 mm
<b>Weight</b>	0.55kg
<b>Safety standards</b>	UL1012 TUV refer to 6050 (IEC,UL1950) verification
<b>EMC standards</b>	CISPR22(refer to 55022), IEC801-2,3,4IEC555-2 verification
<b>Note</b>	<ol style="list-style-type: none"> <li>1. The testing condition for the above parameter is: 230VAC input, rated load, 25°C, Humidity 70%RH.</li> <li>2. Error, include the setting error, line stability and load stability. (Note:5)</li> <li>3. Wave test: adopting A12 double wire for 20MHZ,and 0.1uF-47uF capacitor short-circuit for interrupting.</li> <li>4. Inlet voltage stability test: when is over load,the lowest voltage of enter is representative to the highest voltage</li> <li>5. Load stability test: The load is from 0% to 100%.</li> </ol>

## Typical applications for 12 VDC power supplies:

- Computer Peripherals and Networking Applications
- Telecommunications and Fiber optic Network
- Voice, Data and Analog Communications
- Universities and Educational Facilities
- Instrumentation and Electronics
- Utility and Power Industries
- Data Acquisition
- Medical
- Military
- Motor control

## What is a 24V Power Supply?

A 24V Power supply can change AC to DC. In addition to converting the AC power to DC power, the voltage level can be adjusted at the same time. Some devices need DC but only have access to the AC coming from the wall. The 24V power supply can make this adjustment quite easily. In areas where AC power is not convenient, a DC power supply is an inexpensive and effective solution.

Model number: S-250-24



## Model number and parameters

Model number	S-250-5	S-250-7.5	S-250-12	S-250-13.5	S-250-15	S-250-24	S-250-27	S-250-48
DC output voltage	5V	7.5V	12V	13.5V	15V	24V	27V	48V
Output voltage error (Note: 2)	±2%	±2%	±1%	±1%	±1%	±1%	±1%	±1%
Rated output current	45A	33A	20A	18A	16.5A	10A	9A	5A
Output current range	0-45A	0-33A	0-20A	0-18A	0-16.5A	0-10A	0-9A	0-5A
Wave and noise (Note: 3)	75mVp-p	75mVp-p	75mVp-p	75mVp-p	75mVp-p	75mVp-p	100mVp-p	100mVp-p
Inlets stability (Note: 4)	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
Load stability (Note: 5)	±1%	±1%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
DC output power	225W	240W	240W	240W	240W	240W	240W	240W
Efficiency	74%	79%	83%	83%	84%	85%	85%	86%
Adjustable range for DC voltage	4.5-5.6V	6-9V	10-13.2V	12-15V	13.5-18V	20-26.4V	26-32V	41-56V

## General

Model number	S-250 series
AC input voltage range	90-132VAC/180-264VAC, selected by switch, 47-63Hz; 254-370VDC
Input current	3.6A/115V, 1.8A/230V
AC inrush current	Cold-start current: 25A/115V, 50A/230V
Leakage current	3.5mA/240VAC max
Overload protection	105%-150% Type:Foldback current limiting Rest:auto-recovery
Over-voltage protection	115%-135% Type:hiccup mode Rest:auto-recovery
Temperature coefficient	±0.03%/°C (0-50°C)
Setup rise hold up time	200ms, 100ms, 20ms



<b>Vibration</b>	10-500HZ,2G 10min/1cycle, Periodfor 60min, Each axes
<b>Dielectric strength</b>	1.5KVac, 50/60 Hz for 1 min between input and output 1.5KVac, 50/60 Hz for 1 min between input and enclosure 0.5KVac, 50/60 Hz for 1 min between output and enclosure
<b>Isolation resistance</b>	100MΩ min. at 500 VDC
<b>Working temperature humidity</b>	-10°C-60°C (Refer to output characteristic figure), 20%-90%RH
<b>Store temperature humidity</b>	-20°C-85°C, 10%-95%RH
<b>External dimension</b>	199x110x50 mm
<b>Weight</b>	0.9kg
<b>Safety standards</b>	UL1950
<b>EMC standards</b>	FCC part 15J condition level A
<b>Note</b>	<ol style="list-style-type: none"> <li>1. The testing condition for the above paramenter is: 230VAC input, rated load, 25°C, Humidity 70%RH.</li> <li>2. Error, include the setting error, line stability and load stability. (Note:5)</li> <li>3. Wave test: adopting A12 double wire for 20MHZ,and 0.1uF-47uF capacitor short-circuit for interrupting.</li> <li>4. Inlet voltage stability test: when is over load,the lowest voltage of enter is representative to the highest voltage</li> <li>5. Load stability test: The load is from 0% to 100%.</li> </ol>

## What is a 24V Power Supply used for?

A 24V power supply can be used in a variety of situations. Anytime an object needs a source of power, the 24V supply could be a valuable solution. Although we often think about a 24V Power Supply being used on a construction site or workplace, there are other applications for the 24V power supply as well. Many times audio and lighting situations are going to need a 24V power supply.

## What is Digital Timer?

A digital timer is a battery-operated small electronic device. The main function of this device is to count down minutes for precise timing. As compared to a traditional clock, these timers are much portable. Digital timers mainly range from simple type to complex which is portable, & includes complete operating systems. The manufacturing of digital timers can be done by different manufacturing companies. So Countronics is one of the best companies to make efficient timers with accurate measuring time. These timers are used everywhere because a lot of tasks can be made easily. Some timers include clocks as well as alarm clocks.

The working principle of a digital timer is, once you set the fixed time, the timer will generate a beep sound or vibrate at the drop of the specified time period. Also, it can be set to restart immediately to countdown & repeat the function of the alarm at normal intervals. The digital timer construction can be done by using different electronic components along with the power source for a time like Secs, Mins & Hrs. Here the power source used for this timer may be a power cable or a battery. At last, the time is displayed on the LCD screen.

## Different Types

Digital timer device suppliers provide timer meters, one-shot, delay-on/off, interval delay & recycle timers.

- Timer meters are employed in applications for displaying elapsed procedure time otherwise to track running time for factory equipment.
- Delay-on timers use a fixed time period to pass once the timer gets its input signal and output is activated.
- At the time the delay end, the contacts will release or shut. If the contact is NO (normally open), the load will strengthen at the time delay end. If the contact is NC (normally closed), the load will de-energize after the delay of time. Detaching power will reset the output & time delay. So this capacity is also called on-delay, delay-on operates, delay-on energization, delay on make, pre-purge delay, operate delay, etc.
- Delay-off timers will begin their timing functions once the power supply is interrupted. When the power is supplied initially, then the contacts of the output relay will respond instantly.
- Once the power supply is detached, then output relay contact will stay in the activated position & the time period starts. Once the time has passed, the output relay contacts will release which is called delay on release, break, post-purge delay, release delay & de-energization delay.
- The designing of one-shot timers can be done in such a way that whenever the power supply is given to this timer, then instantly contacts will alter the position & remain altered for the fixed time period after the timer gets power. Once the fixed time period has exceeded, then contacts will come back to their regular position. So these are also known as pulse formers.
- Interval delay timers are reverse for delay-on devices, where the relay is immediately strengthened on the application of the supply or end of the input switch and turns off at the phase of the end. Sometimes, Interval delay is known as delay pulse.
- Once Recycle timers operate, the control switch the closing will begin the cycling function. The load will continue to switch ON & OFF at normal time intervals if the control switch is stopped. The function of cycling will stop once the control switch is released. Sometimes, this function is known as a pulse generator or flasher.

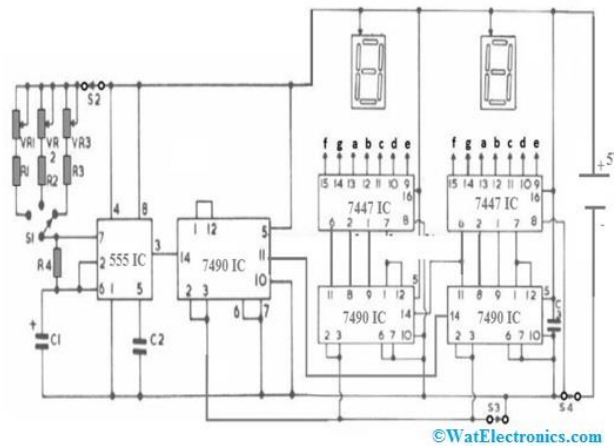
The functions of digital timers are an indication of position, delay cycles, arithmetic functions, preset counters, controllers & combinations of timer & counter.

## Features

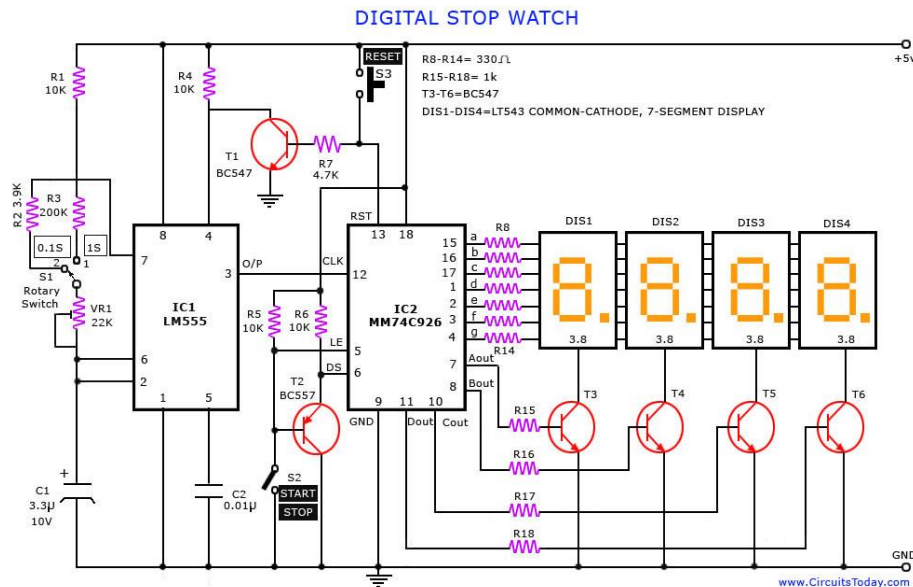
There are some features that need to consider while purchasing a digital timer.

- Some models of digital timers include a clock whereas some others type simply show countdown time. In addition, the highest countdown time mainly specifies how long an alarm can be set the countdown time in advance. Some models of timers include the highest 100 hours or above countdown time.
- One more feature is, we can set a number of separate alarms at a time. If you need only one alarm setting or above then you can use some settings in some models.

- For instance, a timer might be going off in 20 minutes, another alarm in 25 minutes, one in 10 hours through a single-channel based digital timer by setting every alarm physically in series, however by using the number of channels timers, then all the alarms can be put immediately.



## Digital Timer Circuit Diagram



## Applications

The applications of digital timers include the following.

- Digital timers are used in the applications of large industries and common consumer applications.
- These timers are mainly used in equipment for process control to help in process regulation.
- These are used in industries to record the equipment's age and use & they are used like consumer electronics for recreational & household use.
- Digital timers are broadly used in a variety of industrial processes for controlling devices' timing and also to check the life cycles of equipment.

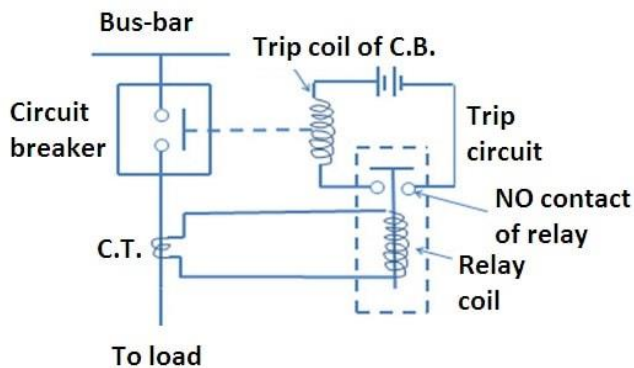
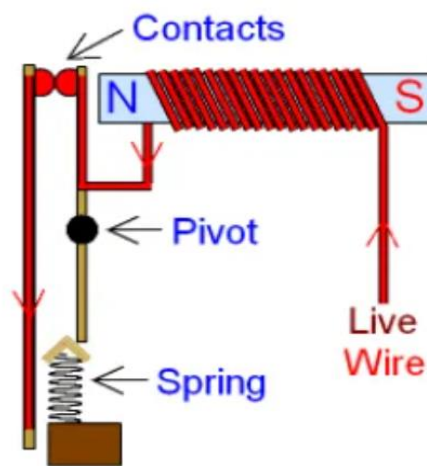
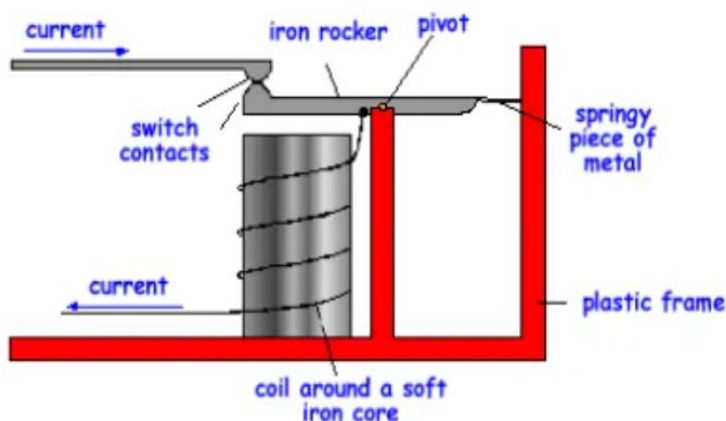
# Advantages

The advantages of a digital timer include the following.

- Portable
- Battery Operated
- Less Cost
- Highly Effective
- Less Weight
- Provides Exact Measurement

# Circuit Breaker

A circuit breaker is a switching device that interrupts the abnormal or fault current. It is a mechanical device that disturbs the flow of high magnitude (fault) current and in additions performs the function of a switch. The circuit breaker is mainly designed for closing or opening of an electrical circuit, thus protects the electrical system from damage.



# Circuit breaker components

Although low and medium voltage circuit breakers have unique designs that are specific to amperage, voltage and application, there are five main components that are universal across the different types of circuit breakers.

Five universal circuit breaker components. The five universal circuit breaker components are:

- ✓ Frame – Protects internal parts of the circuit breaker from outside materials
- ✓ Operating mechanism – Provides a means of opening and closing the circuit breaker
- ✓ Contacts – Allows the current to flow through the circuit breaker when closed.
- ✓ Arc extinguisher – Extinguishes an arc when the circuit breaker interrupts a fault.
- ✓ Trip unit – Opens the operating mechanism in the event of a prolonged overload or short circuit.

## Working Principle of Circuit Breaker

Circuit breaker essentially consists of fixed and moving contacts. These contacts are touching each other and carrying the current under normal conditions when the circuit is closed. When the circuit breaker is closed, the current carrying contacts, called the electrodes, engaged each other under the pressure of a spring.

During the normal operating condition, the arms of the circuit breaker can be opened or closed for a switching and maintenance of the system. To open the circuit breaker, only a pressure is required to be applied to a trigger.

Whenever a fault occurs on any part of the system, the trip coil of the breaker gets energized and the moving contacts are getting apart from each other by some mechanism, thus opening the circuit.

## Types of Circuit Breaker

Circuit breakers are mainly classified on the basis of rated voltages. Circuit breakers below rated voltage of 1000V are known as the low voltage circuit breakers and above 1000V are called the high voltage circuit breakers. The most general way of the classification of the circuit breaker is on the basis of the medium of arc extinction. Such types of circuit breakers are as follows :

According different criteria there are different types of circuit breaker.

➤ According to their arc quenching media the circuit breaker can be categorized as:

1. Oil circuit breaker.
2. Air circuit breaker.
3. SF6 circuit breaker.
4. Vacuum circuit breaker.

➤ According to their services the circuit breaker can be categorized as:

1. Outdoor circuit breaker.
2. Indoor breaker.

➤ According to the operating mechanism of circuit breaker they can be categorized as:

1. Spring operated circuit breaker.
2. Pneumatic circuit breaker.
3. Hydraulic circuit breaker.

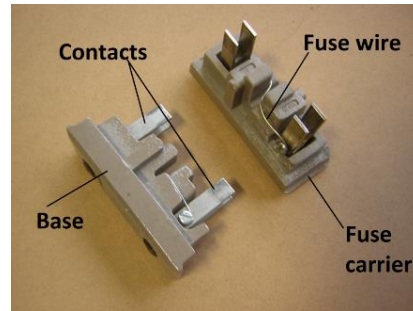
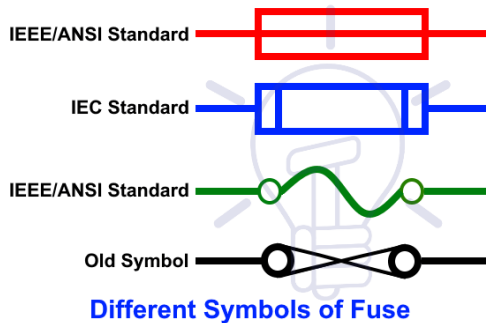
➤ According to the voltage level of installation types of circuit breaker are referred as-

1. High voltage circuit breaker.
2. Medium voltage circuit breaker.
3. Low voltage circuit breaker.

All high-voltage circuit breakers may be classified under two main categories i.e oil circuit breakers and oil-less circuit breaker.

## What is a Fuse?

A fuse is an electric / electronic or mechanical device, which is used to protect circuits from over current, overload and make sure the protection of the circuit. Electric fuse was invented by Thomas Alva Edison in 1890. There are many types of fuses, but the function of all these fuses is the same. In this article, we will discuss the different types of fuses, its construction, working and operation and their application in various electronics and electrical systems.



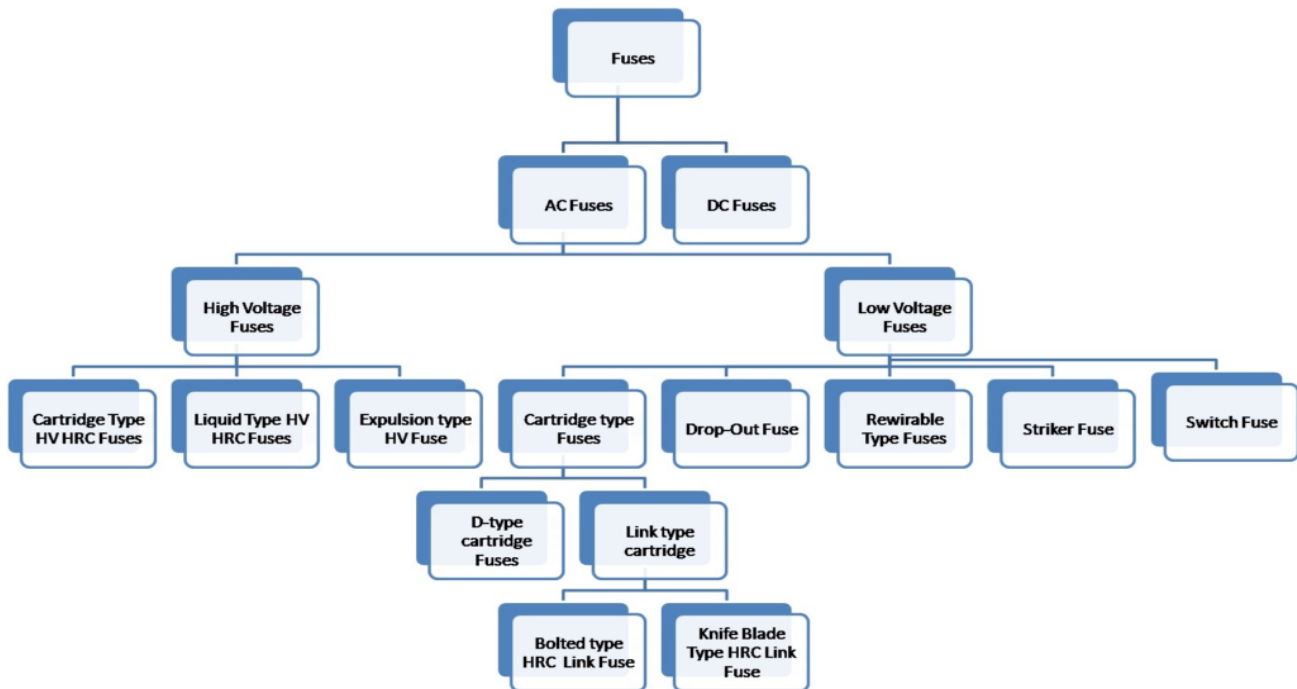
**Different Types of Fuses**

## Construction & Working of a Fuse

A general Fuse consists of a low resistance metallic wire enclosed in a non combustible material. It is used to connect and install in series with a circuit and device which needs to be protected from short circuit and over current, otherwise, electrical appliance may be damaged in case of absence of the fuse and circuit breaker as they are unable to handle the excessive current according to their rating limits. The working principle of a fuse is based on the “Heating effect of Current” i.e. Whenever a short circuit, over current or mismatched load connection occurs, then the thin wire inside the fuse melts because of the heat generated by the heavy current flowing through it. Therefore, it disconnects the power supply from the connected system. In normal operation of the circuit, fuse wire is just a very low resistance component and does not affect the normal operation of the system connected to the power supply.

# Different Types of Fuses

The fuses are classified into different types based on the application namely AC type fuse and DC type fuse. Again these fuses are classified into several types. The following diagram shows the electrical fuse types chart based on the AC fuse and DC fuse.



## Advantages

- ✓ Stable time/current characteristics.
- ✓ Reliable for discrimination.
- ✓ No chances of smoke or fire.
- ✓ Deterioration is negligible.
- ✓ Cartridges are so sized that only connect value fuse can be filled.
- ✓ Used for very high faults levels.
- ✓ Having high speed operation.
- ✓ Require no maintenance.
- ✓ Cheaper.

## Disadvantages

- After each operation, they have to be changed.
- Heat produced by the arc may affect the other switches.
- Environment hazard.
- Arcing when this type of fuse melts is buried in the powder fusion of which in path provides quenching and helps to extinguish it.

## What is a push button switch?

A Push Button switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off.

Depending on model they could operate with momentary or latching action function. The button itself is usually constructed of a strong durable material such as metal or plastic. Push Button Switches come in a range of shapes and sizes. We have a selection of push button switches here at here. Push button switches are used throughout industrial and medical applications and are also recognizable in everyday life.

For uses within the Industrial sector, push buttons are often part of a bigger system and are connected through a mechanical linkage. This means that when a button is pressed it can cause another button to release.



## Working principle

The working principle of the push button switch is shown in the figure below: There is an electromagnet adsorption device inside the button. When the button is pressed down, the electromagnet is energized to generate magnetism, and the circuit is connected or disconnected by the adsorption device to realize functions such as remote control circuit.

## What is an Indicator Lamp?

An indicator lamp is a warning device used to alert drivers of potential problems with their vehicles. Functions such as oil pressure, water temperature and the voltage are all typically wired into dashboard indicator lamps. When there is a potential problem or a dangerous reading from an engine sensor, the indicator lamp will illuminate. Many vehicles have both full-functioning gauges that show the reading of the function as well as an indicator lamp. Typically, lower-optioned and base-packaged vehicles will possess only the indicator lamp system.

Indicator Light is a widely used in the ship, machine tools, machine equipment, switch cabinet, power distribution cabinet. Indicator lamp, also name pilot lamp, who to indicate whether power is on or a equipment device is for showing the operating condition of some system.





## Lamp holder

Lamp holder or ‘socket’ means a device which holds the lamp in position, usually by having the cap inserted in it, in which case it also provides the means of connecting the lamp to the electric supply.

Porcelain Lamp Socket E27



## What is a Digital temperature Controller?

A temperature controller is an instrument used to control temperature calculating the difference between a set point and a measured temperature. The controller takes an input from a temperature sensor and has an output that is connected to a control element such as a heater or fan.

To accurately control process temperature without extensive operator involvement, a temperature control system relies upon a controller, which accepts a temperature sensor such as a thermocouple or RTD as input. It compares the actual temperature to the desired control temperature, or set point, and provides an output to a control element. The temperature controller or thermostat is one part of the entire control system, and the whole system should be analyzed in selecting the proper equipment.

# RKC REX-C700 PID/On-Off Temperature Controller



## General

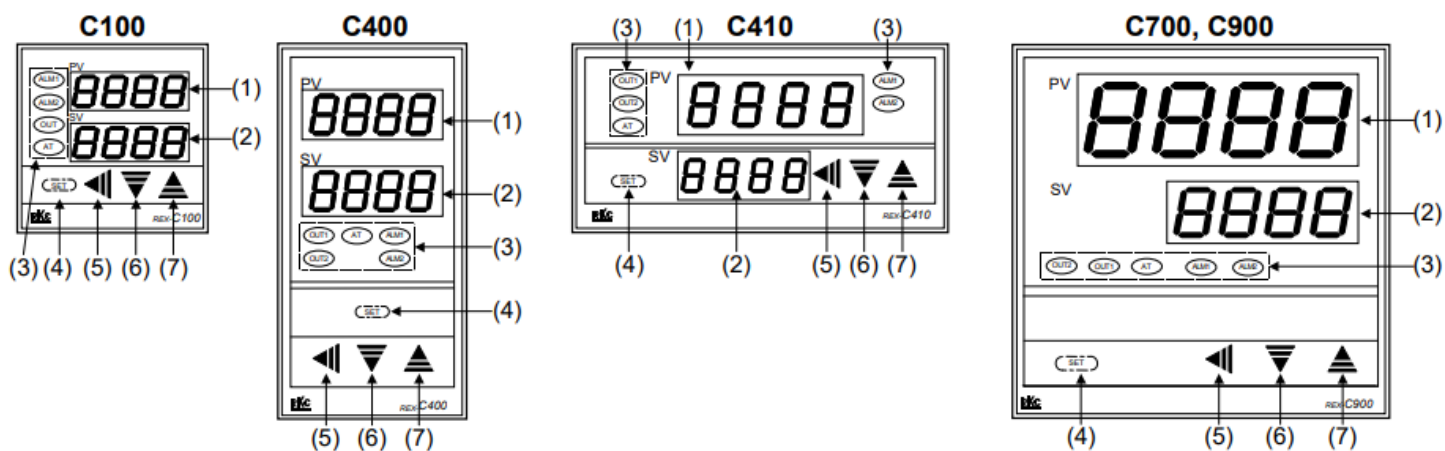
<b>Model number</b>	REX-C series
<b>Accuracy</b>	±0.5%F.S±1°C
<b>Supply voltage</b>	220VAC, 50/60 Hz
<b>Input type</b>	Thermocouple: K, J, R, S, B, E, N, T RTD: Pt100, Cu50 Voltage: 0-5V, 1-5V (Need to be customized, default don't have) Current: 0-20mA, 4-20mA (Need to be customized, default don't have) REX-C100 has two types: only K input, Thermocouple and RTD input. Others are Thermocouple and RTD input. If only K input type, the max temperature is 999°C, and don't have self-turning, LCK function
<b>Output type</b>	Electromagnetic relay, SSR, current, SCR (not in one product, need to select)
<b>Power consumption</b>	Less than 5VA
<b>Control method</b>	PID, or ON/OFF
<b>Setting method</b>	Touch switch
<b>Indication method</b>	8-segment 4-digital display and LED indication
<b>Alarms</b>	1. Alarm quantity: REX-C100: 1pcs, others: default is 1pcs, if 2pcs, need to be customized 2. Alarm form: N: No alarm A: Deviation low B: Deviation high C: Deviation high/low D: Band E: Deviation high with hold action F: Deviation low with hold action G: Deviation high/low with hold action H: Process high J: Process low K: Process high with hold action L: Process low with hold action Note: rex-c100 only K input just has Deviation high alarm.
<b>Operating temperature</b>	0 to 50 °C (32 to 122 °F)
<b>Operating humidity</b>	30-85% RH max, non-condensing
<b>Alias name</b>	REX-C pid temperature controller, intelligent temperature controller

## Output type and description

Electromagnetic relay	Contact rating: 3A at 250Vac
Solid state relay	Contact rating can be selected, order separately ( <a href="#">Single phase 40A</a> , <a href="#">Three phase 40A</a> )
Current	4-20mA
SCR	Zero crossing pulse

## Input type and measuring range

K	0-1372 °C ( <a href="#">Bolt</a> , <a href="#">Press spring</a> , <a href="#">Ring</a> , <a href="#">M12 probe</a> , <a href="#">M8 probe</a> , <a href="#">Flexible probe</a> , <a href="#">Armor high temperature resistant</a> , <a href="#">Customized thread probe</a> )
R	-50-1769 °C
S	0-1769 °C ( <a href="#">Probe</a> , <a href="#">Armor</a> )
B	-50-1769 °C
E	0-1000 °C ( <a href="#">Bolt</a> , <a href="#">Press spring</a> , <a href="#">Ring</a> , <a href="#">Probe</a> , <a href="#">Customized thread probe</a> )
N	0-1300 °C
T	-200-400 °C
Pt100	-199.9-649.0 °C ( <a href="#">Bolt</a> , <a href="#">Press spring</a> , <a href="#">Ring</a> , <a href="#">Probe</a> , <a href="#">Polish rod</a> , <a href="#">Polish rod waterproof</a> , <a href="#">Polish rod waterproof anticorrosive</a> , <a href="#">Flexible probe</a> , <a href="#">Customized thread probe</a> )
Cu50	-50.0-150.0 °C ( <a href="#">Probe</a> , <a href="#">Polish rod waterproof</a> )
Voltage 0-5V, 1-5V	0.0-100.0 °C
Current 0-20mA, 4-20mA	0.0-100.0 °C



(1) Measured value (PV) display [Green]  
Displays PV or various parameter symbols.

(2) Set value (SV) display [Orange]  
Displays SV or various parameter set values (or CT input value).

(3) Indication lamps  
Alarm output lamps (ALM1, ALM2) [Red]  
ALM1: Lights when alarm 1 output is turned on.  
ALM2: Lights when alarm 2 output is turned on.

Autotuning (AT) lamp [Green]  
Flashes when autotuning is activated.  
(After autotuning is completed: AT lamp will go out)

Control output lamps  
(OUT1 [Yellow], OUT2 [Green])  
OUT1: Lights when control output is turned on.\*  
OUT2: Lights when cool-side control output is turned on.

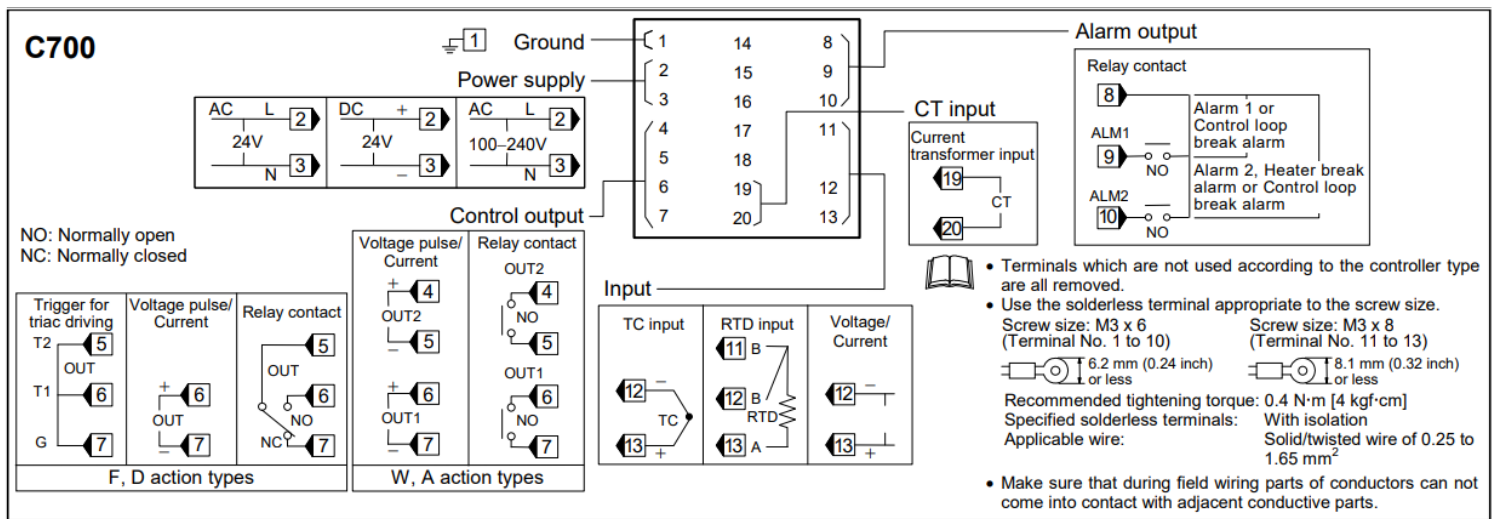
(4) (SET) (Set key)  
Used for parameter calling up and set value registration.

(5) (Shift key)  
Shift digits when settings are changed.

(6) (DOWN key)  
Decrease numerals.

(7) (UP key)  
Increase numerals.

To avoid damage to the instrument, never use a sharp object to press keys.



## Water Pump

A solar water pump system is essentially an electrical pump system in which the electricity is provided by one or several Photo Voltaic (PV) panels. A typical solar powered pumping system consists of a solar panel array that powers an electric motor, which in turn powers a bore or surface pump. The water is often pumped from the ground or stream into a storage tank that provides a gravity feed, so energy storage is not needed for these systems.

Solar water pumps can supply water to locations which are beyond the reach of power lines. Commonly, such places rely on human or animal power or on diesel engines for their water supply (Omer, 2001). Solar water pumps can replace the current pump systems and result in both socio-economic benefits as well as climate related benefits. The water supplied by the solar water pump can be used to irrigate crops, water livestock or provide potable drinking water.

On this project we are using Aishang 12v DC Solar Water Pump.



## DC Cooling Fans

Cooling fans are a cost-effective way to lower the temperature in our home or working area with zero effort and a smaller investment than an AC unit. Basically, they make high temperatures much more bearable. DC fans also known as DC Brushless Fans are basically cooling fans engineered to meet requirements such as higher air flows at high static pressures. A cooling fan is a vital component in a cooling system that helps takes away all heat absorbed from the area using coolant. All its work is done through the radiator by pushing or pulling air through the radiator.



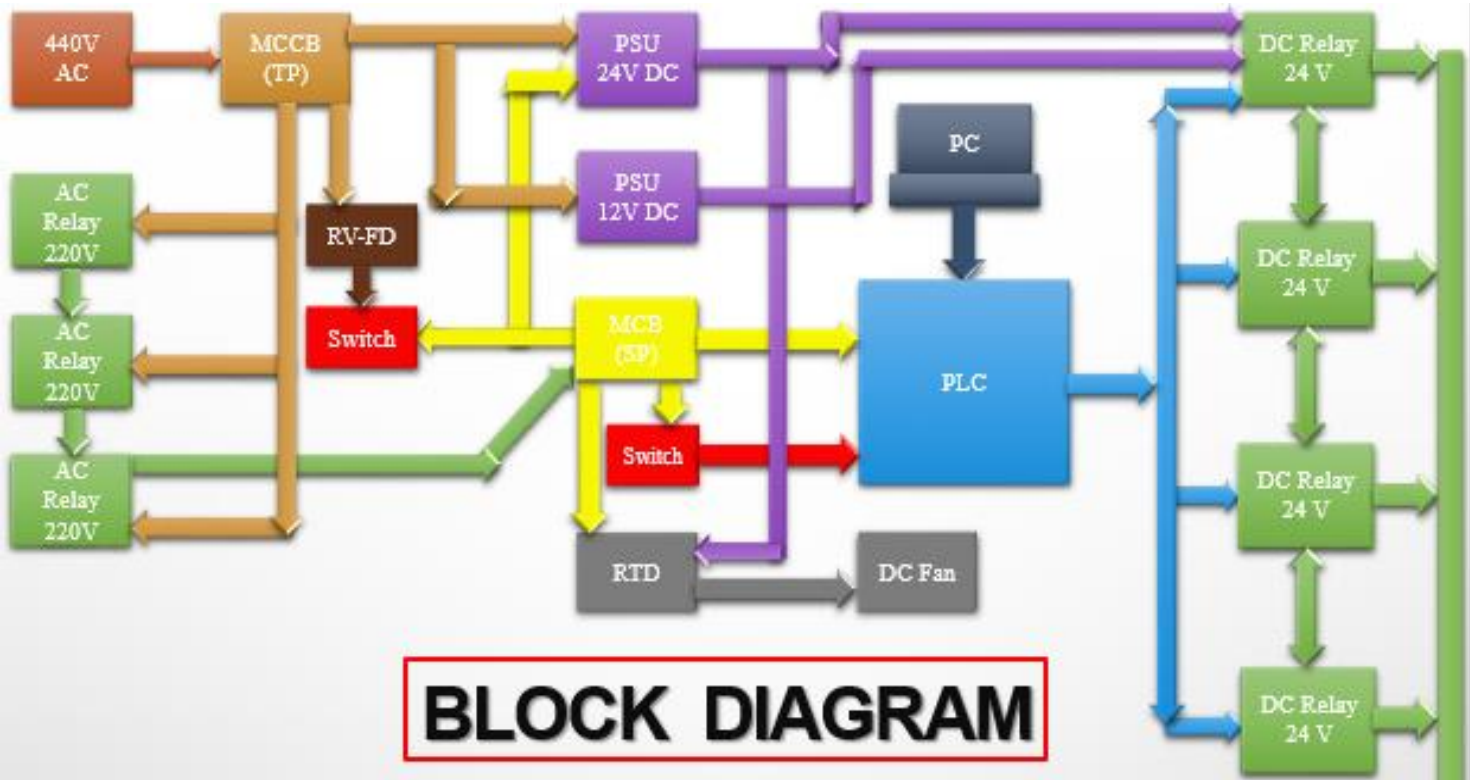
## Electrical Connector

An electrical connector is an electromechanical device used to join electrical conductors and create an electrical circuit. Most electrical connectors have a gender – i.e. the male component, called a plug, connects to the female component, or socket. The connection may be removable (as for portable equipment), require a tool for assembly and removal, or serve as a permanent electrical joint between two points. An adapter can be used to join dissimilar connectors.

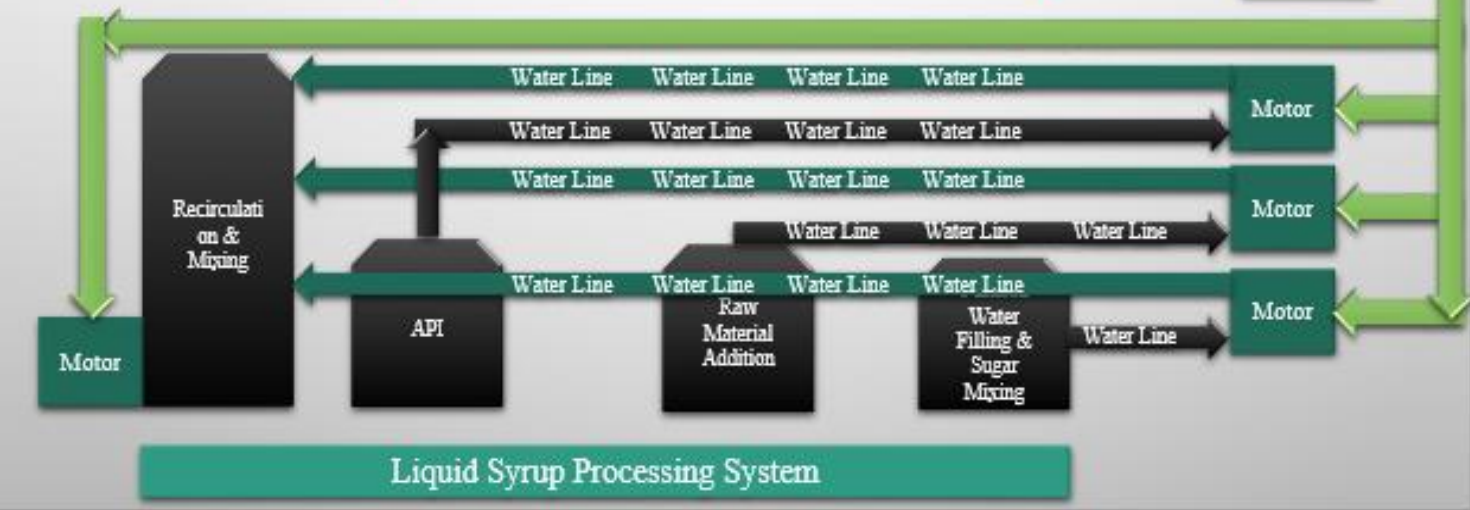


# CHAPTER II : Project Layout Design and Fabrication

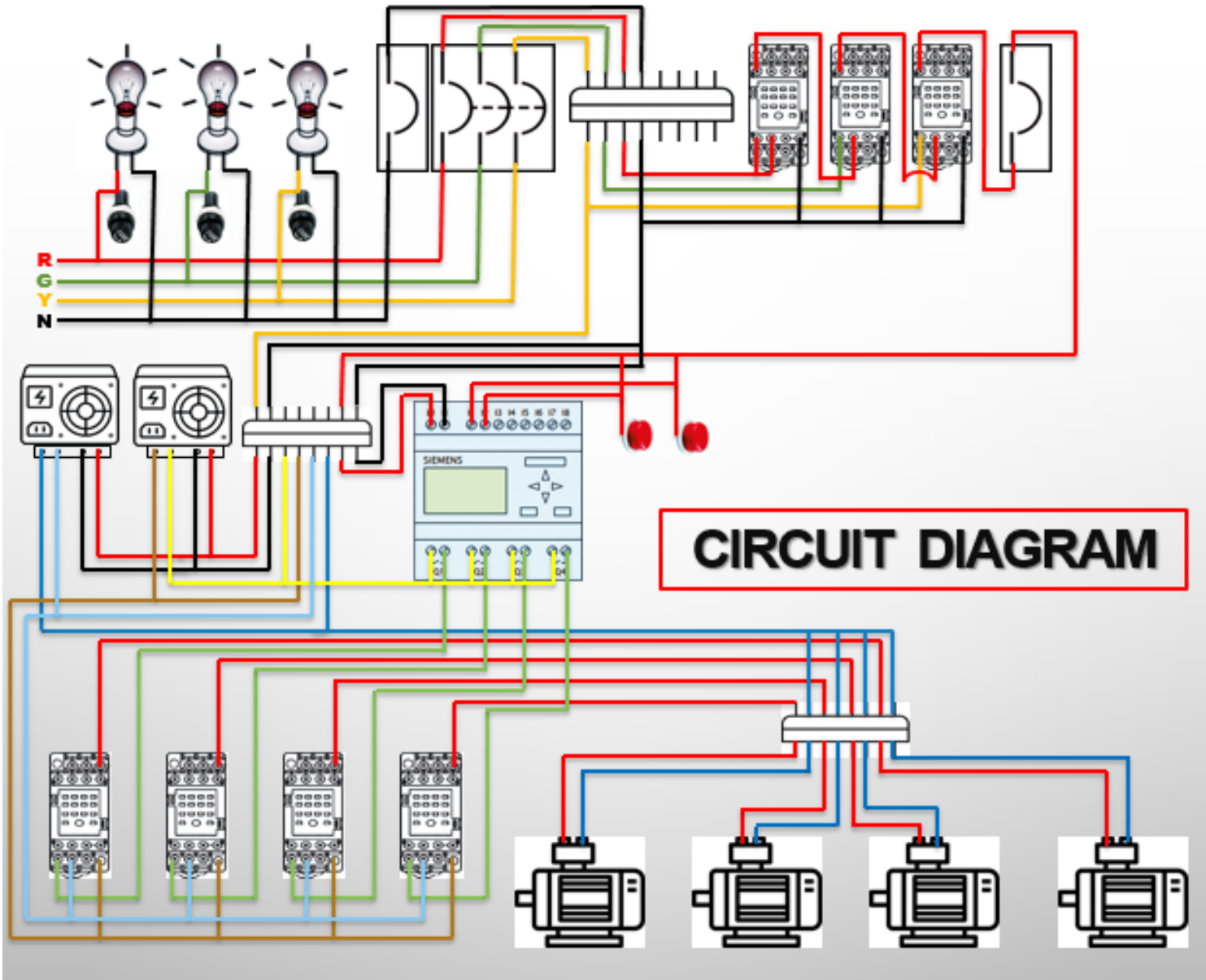
## BLOCK DIAGRAM



## BLOCK DIAGRAM

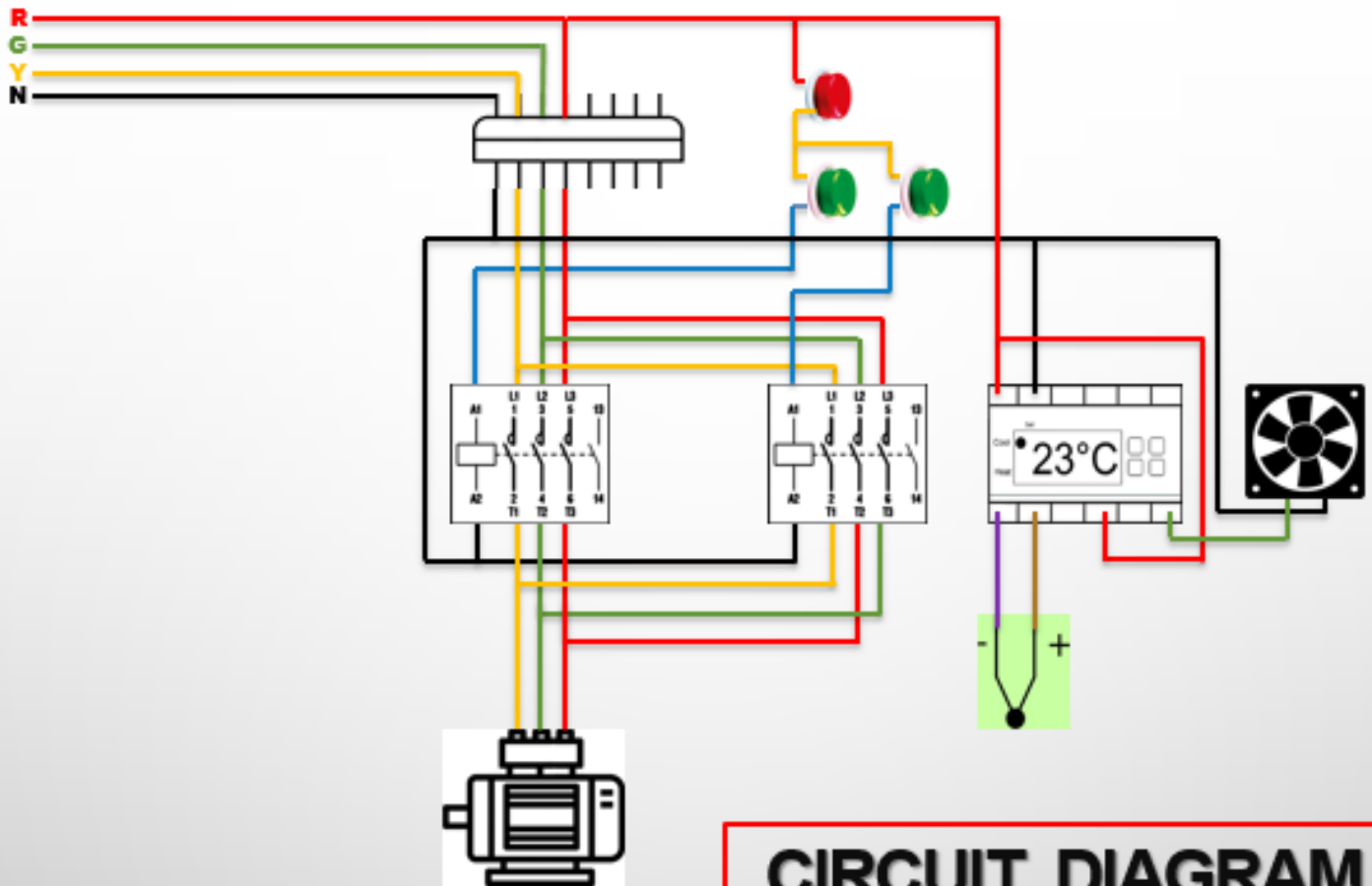


# CIRCUIT DIAGRAM



# CIRCUIT DIAGRAM

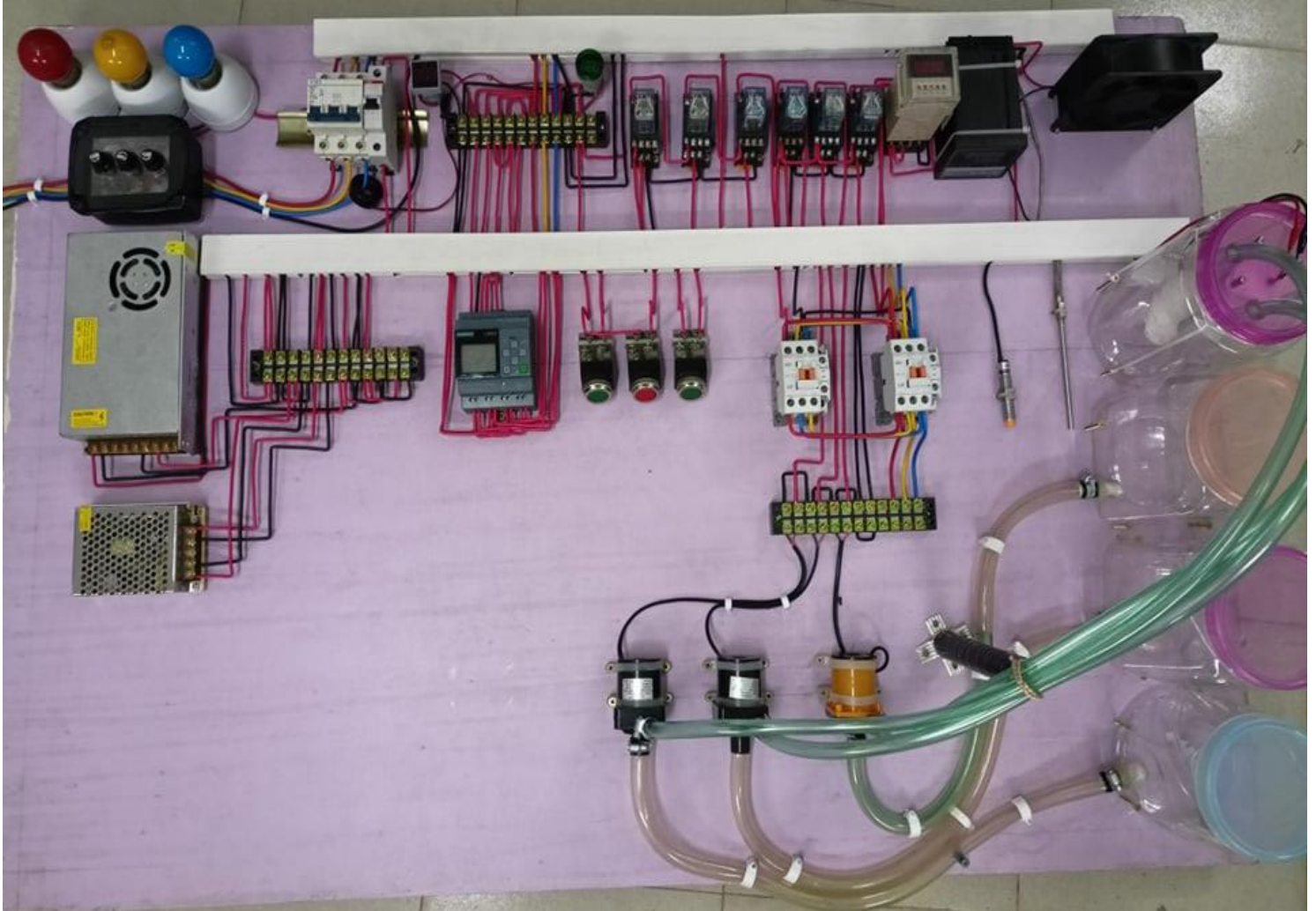
# CIRCUIT DIAGRAM



CIRCUIT DIAGRAM



# PROJECT PICTURE



# WORKING PRINCIPLE

At first, to run this project the electrical power supply must be turned on, and power must be transmitted between all devices.

- A PLC program has to be created according to the type of production and the program has to be uploaded to PLC through computer.
- Now press the "ON SWITCH" button, firstly the first motor will start and then turn off after 5 seconds. Then after 10 seconds the second motor will start and after 8 seconds it will turn off. Again after 10 seconds the third motor will start and after 6 seconds it will turn off. Again after 10 seconds the fourth motor will start and after 5 seconds it will turn off.
- It is mentioned here that the first, second and third motors will work to transport various chemicals and raw materials to the main tank and the fourth motor will work to mix the substances in the main tank properly.
- It can be operated in two ways:
  1. Manually : Once started, after a certain amount of work or time it will be turned off and will have to be restarted.
  2. Automatically : Once started it will not stop, will continue in phases and the production process will continue till it is turned off manually

## **ADVANTAGES OF THE PROJECT**

- ✓ Easy cleaning & dismantling.
- ✓ Easy Operating System.
- ✓ Equipments Easily Replaceable.
- ✓ Fully Automatically Controlled.
- ✓ Reduces the man power & total cost of mixing system.
- ✓ Can be achieved maximum bulk density .
- ✓ Faults can be identified very quickly.

## LIMITATION OF THE PROJECT

- ✓ No more than 4 outputs can be found from our used PLC. Someone needs to use external PLC module to get more output.
- ✓ Any kind of small project can be made by it, but to make a big project some more parts need to be added.
- ✓ The programming of the project is done with “Ladder Diagram language”, which is relatively simple but with “Function Block Diagram” or “UDF Diagram” this program will become much more complicated.
- ✓ It is not possible to provide DC voltage in PLC input.

**THANK**

**YOU**