Programmable Logic Controllers (PLC):

PLC is the single most widely used industrial controller.

Acc. to the standards, " A Prog. controller is a digitally operated electronic apparatus that uses a programmable memory for the internal storage of instructions that implement specific functions such as logic, sequence, timing, counting and arithmetic to control machines and processes

Relays can easily handle high currents needed to operate actuators and work conveniently on the 230 V ac. However, the relays are

(i) subject to mechanical fatigue
(ii) failure rates in relay systems were higher
(iii) trouble shooting is difficult
(iv) it is most discouraging when we must scrap the entire relay based system at the end of every year to accommodate new models.

PLCs have evolved now into a computer system with a wide assortment of capabilities such as arithmetic operations, D/A converters, data comparisons and equations solving. Two additional functions include communications with the operator and communications with a distributed control system.

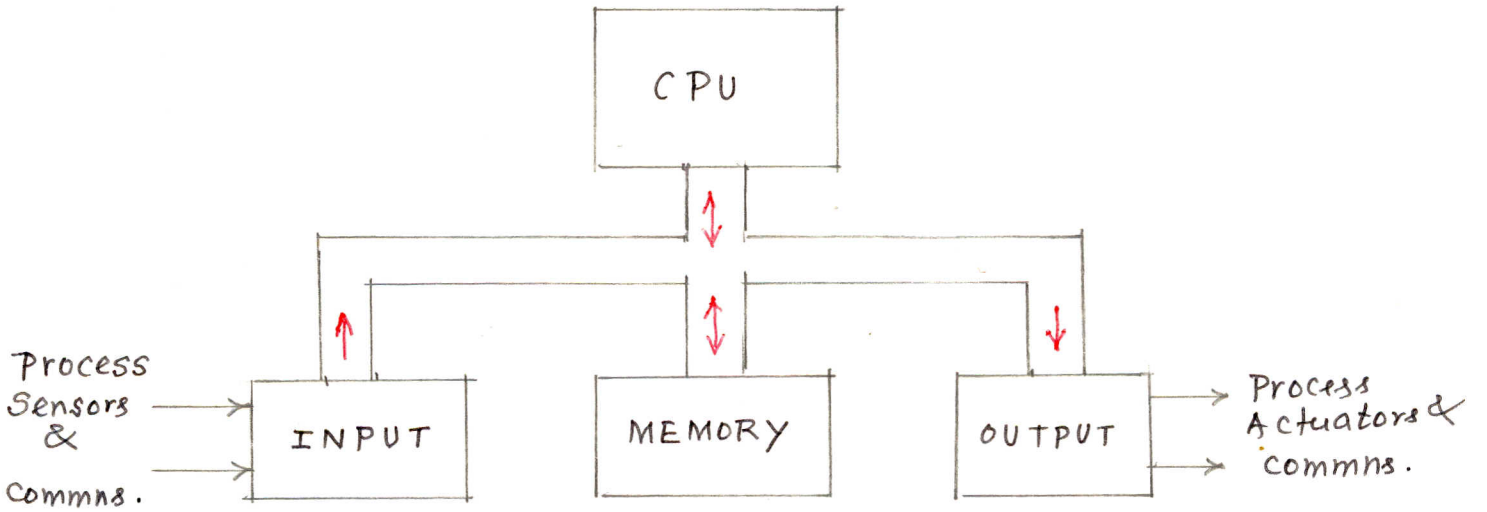
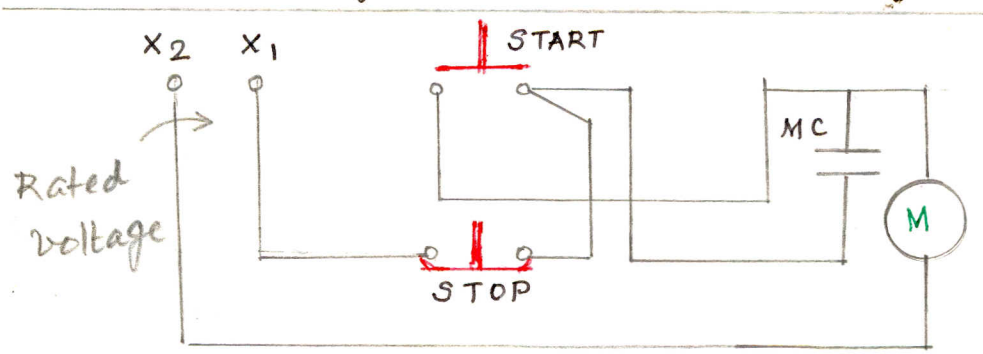
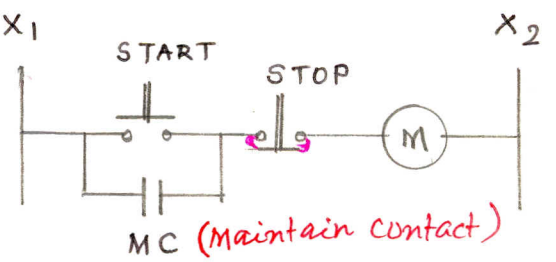


Fig.1 BLOCK DIAGRAM OF PLC



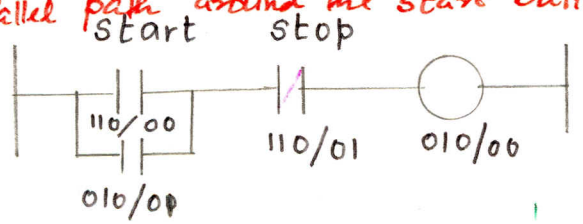
(a) Electrical Schematic

Whenever the power is applied, the MC contacts are closed; this places a closed parallel path around the start button.

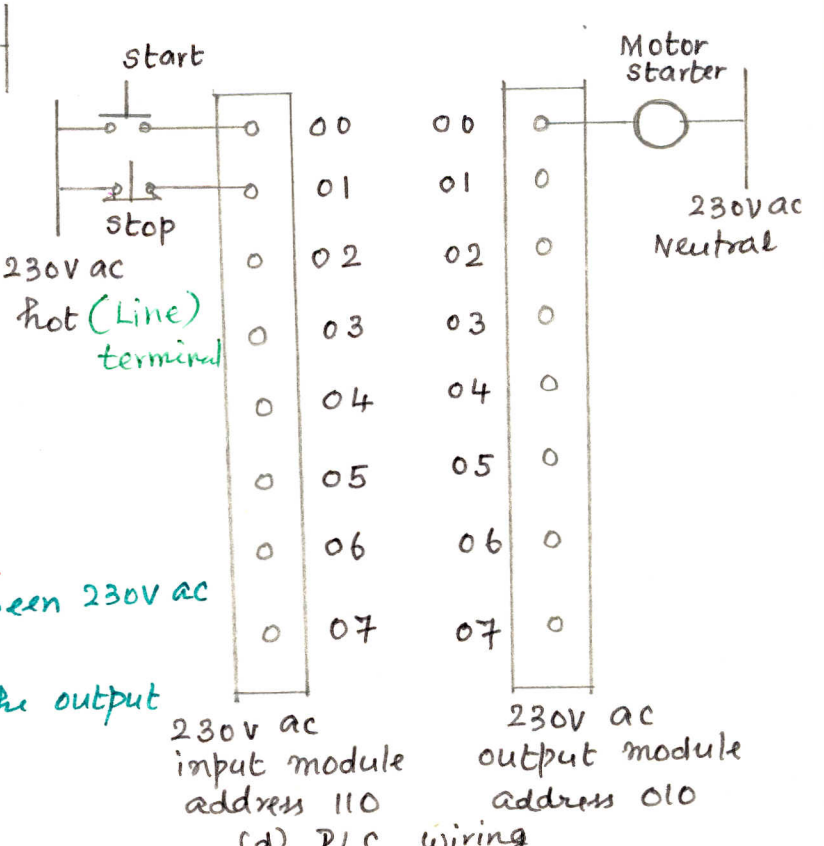


(b) Relay Ladder Logic diagram

Parallel connection: Logic OR
Series connection: Logic AND



(c) PLC Programming



(d) PLC wiring

Fig.2

MOTOR STARTER LOGIC

The contacts are connected between 230V ac hot line and PLC's input module.

Loads are connected between the output module & the 230V ac neutral.

Operational Procedure and Ladder Logic diagram

To program a PLC to accomplish the following task:

A Relay coil is to actuate when two switches are actuated.

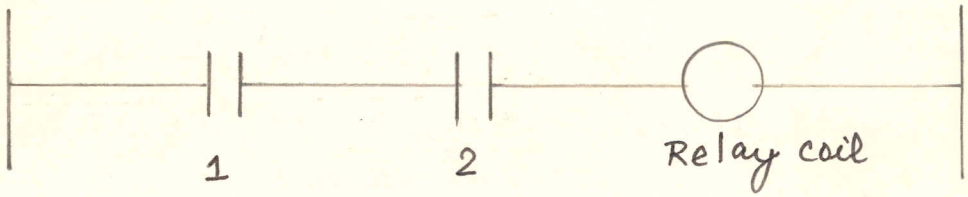
Step 1: Assign PLC identification numbers to the inputs and outputs, as follows:

Switch 1 = IN 01

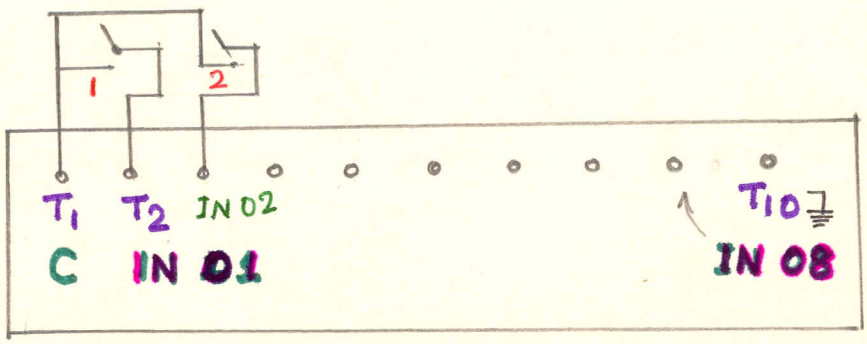
Switch 2 = IN 02

Relay output = O 01

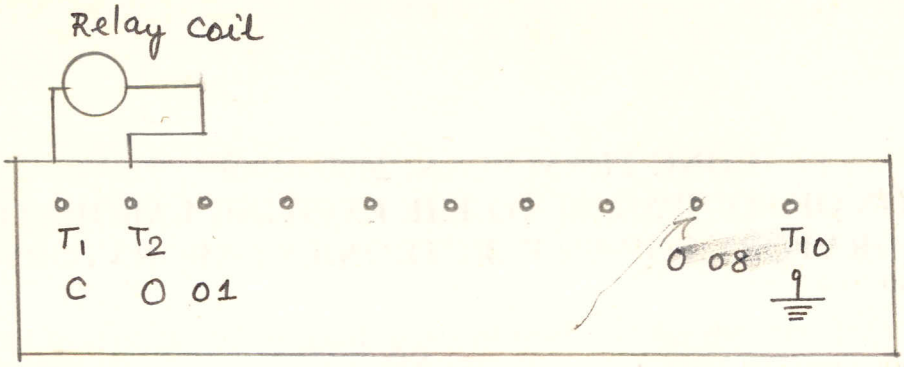
Step 2: Sketch a ladder logic diagram to represent the circuit



Step 3: Make the connections from inputs and outputs. (No external interconnections are made)



Input module



OUTPUT MODULE

Step 4 : Finally the ladder diagram must be entered in the CPU by means of the key board

(i) CLEAR (ii) EDIT MODE (iii) Push the INPUT key

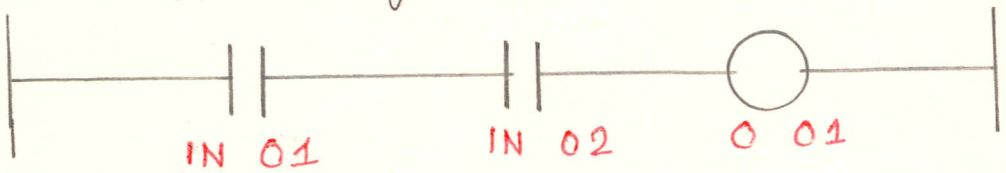
(iv) type 01 (V) ENTER : Now the first Contact will appear in the monitor

(vi) Move the cursor one space to the right

(vii) Push INPUT key (viii) Type 02 (ix) ENTER : Now the second contact will appear on the screen & the resulting PLC diagram is as shown below :

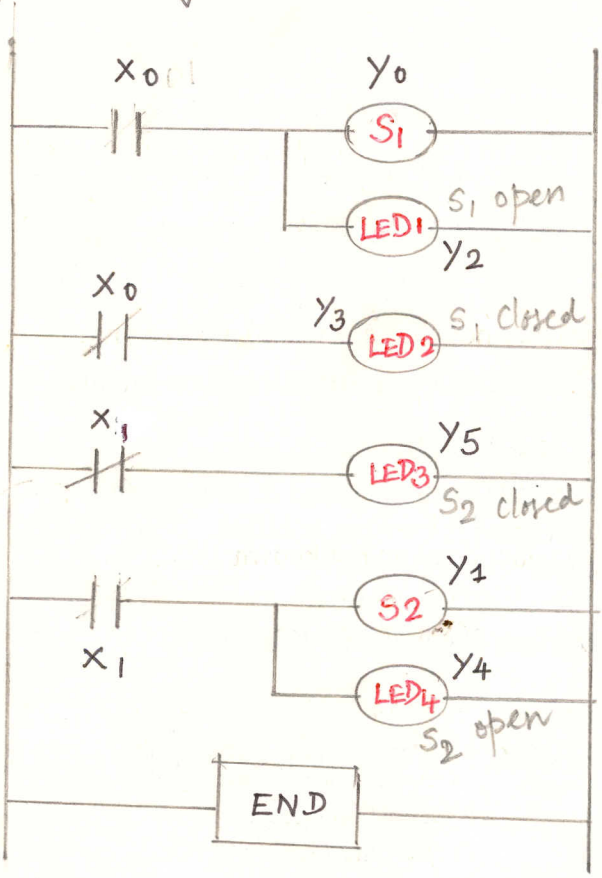
(on the screen)

(ix) one space to right; output key; type 01; ENTER



Step 5 : PLC is set in the RUN Mode.

Ladder Logic diagram :



Battery o/p directly connected to X001
X001 : To sense $V_B > 10V$.

Battery o/p thro' Pot to : X000
X000: To sense $V_B > 14V$

(i) X_0 is connected to the output of Solar panel
∴ when the voltage at X_0 is < 14V; (it gets closed) it closes Y_0
The battery is connected to the output terminal Y_0
Hence when X_0 is High, both Y_0 & Y_2 are closed;
Y_0 connects the battery to Solar panel & Y_2 lights an LED to indicate closure of Y_0 (S_1)
When X_0 is Low (> 14 V), battery should be isolated from the solar panel (thro' S_1) i.e, S_1 is open thro' Y_3

(ii) Illy X_1 is connected to output of the battery & when the battery voltage falls below 10V, X_1 goes High; on sensing this the load which is connected to the output of the battery is disconnected thro' a switch S_2 (which is connected to output port Y_5).

When S_2 is open, it is in

Hardware connections :

(i) The battery voltage is connected directly to input port X001
This is used to check whether the battery voltage has fallen below 10V or not

(ii) The input to channel (port) X000 is given from the battery after passing it thro' the potentiometer.
The pot is set in such a way that when the battery voltage exceeds 14V, the input X000 goes high.

Program :

Position	Mnemonics	device	Remarks
0	LDI (NC)	X000	Signal for activating S_1 (High)
1	OUT	Y000	To open S_1
2	OUT	Y002	To indicate S_1 open (LED)
3	LD (NO)	X000	signal for activating S_1 (Low)
4	OUT	Y003	To close S_1
5	LDI	X001	Signal for activating S_2 (High)
6	OUT	Y005	To open S_2
7	LD	X001	Low Signal for activating S_2
8	OUT	Y001	To close S_2
9	OUT	Y004	To indicate S_2 is closed
10	END		

(iii) When the battery voltage exceeds 10V, X_1 goes High; on sensing this signal, the load is connected to the output of the battery thro' S_2 closing which is done by output port Y_1. The closing of S_2 is indicated by an LED lighted by a signal from Y_4.