Experiment #1
Programmable logic controller
(PLC)

➢ **Object:**

To introduce the basic concepts in using Programmable logic controller (PLC's) in industrial automation.

➢ **Equipment:**

PLC, Mitsubishi F1-40 PLC and accessories.

➢ **Introduction:**

PLCs are used as alternative to relay circuits in industrial automation. As simple computer a plc has input components, output components and processing unit the plc changes its output state depending on the signals applied to the inputs according to a program stored in the memory. While the CPU of the PLC executes instructions written in a list language as well the ladder program is translated into the list language of the PLC before execution. The instruction to the plc use addresses for operands. These addresses are divided into input elements (with addresses starting with an X), output elements (with addresses starting with a Y), internal relays (with addresses starting with an M), timers (with addresses starting with a T), counters (with addresses starting with a C), and conditional jump relays (with addresses starting with a JC), the appendix to the experiment and manual of the PLC must be consulted to get a more detailed picture of the working of the PLC. You need also to get your self-familiar with the process of data entry to the PLC from the pendant keypad.

➢ **Procedure:**

In this experiment we use the various PLC elements in the control of tasks of different complexities.

➤ Part A: <u>Common connections:</u>

To supply power to the switches and light on the training panel (this will be called the common connections):

1. Make sure that the panel ON/OFF switch is OFF.
2. Take three jumper wires and connect them –24v to light common, switch common to input common and output common to +24v and check the connection.

➤ <u>Part B: Testing The PLC:</u>

1. Make the common connections as explained above.
2. Plug the pendant into the PLC.
3. Set RUN/STOP switch on the panel to STOP.
4. Plug in the trainer and turn on the main power switch. Note what appears on the   display screen.
5. Use the down arrow to move to CLEAR PGP PROGRAM and press GO to clear the memory of the PLC from any programs. SELECT MODE appears at the bottom of the screen.
6. Enter the ladder-programming (and write) mode by pressing LDR WR.
7. Enter the program shown in Figure (1.1). (Ladder Programming) at the end enter CNV GO to convert the program into the list language.
8. Press PC WRITE to store the program into the PLC memory and when the beep comes turn the RUN/STOP switch into RUN. Press switch A and watch the output of the output devices
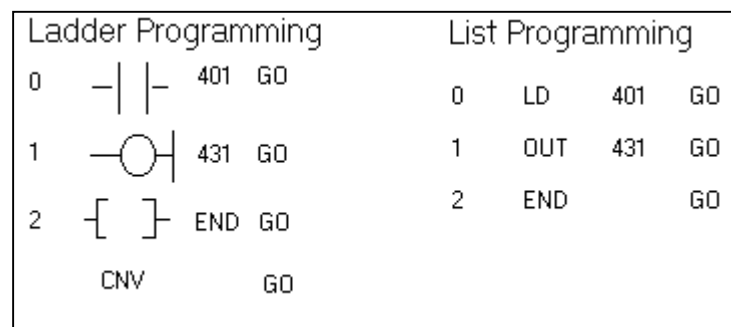

Figure (1.1)

9. Connect the input X401 with switch "A".
10. To return to the program mode put the STOP/RUN switch into STOP mode.
11. Repeat steps 7-11 and change the input to its reverse. Watch the results.

NOTE: to remove any component , press DEL then press on the symbol type and point on the element by the cursor then press GO ”Green”, after that you should press WR to turn back to the writing mode.

NOTE: To delete the output you have to repeat the previous steps but when you choose the type press on the normally open symbol.

NOTE: if you want to delete the whole ladder program , you should pres DEL and choose the output symbol then press "GO"

➢ **Part C: AND/OR operation:**

More complicated functions can be programmed by applying combinations of input elements in series (AND operations) and parallel (OR operations).

1. Enter the ladder program given in Figure (1.2),
2. Connect the inputs X401 to switch "E", inputs X402 to switch "A", inputs X403 to switch "F", inputs X404 to switch "B" and inputs X405 to switch "G pushed down".
3. repeat steps 1-2 for the circuit of figure (1.3).
4. Connect the inputs X401 to switch "A", inputs X402 to switch "B".
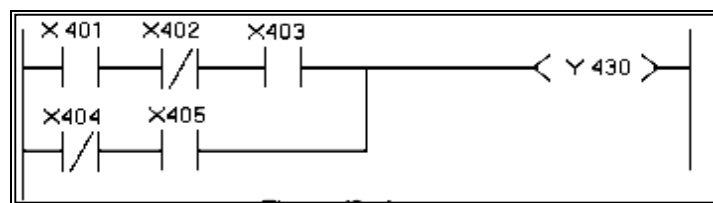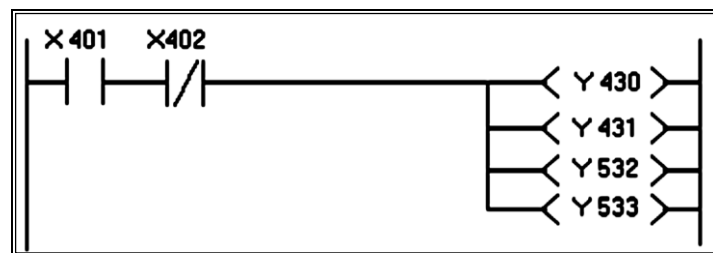

Figure (1.2) Multiple Input in AND / OR Operations.

Figure (1.3) Branched Outputs

➢ **Part D: PLC internal relays:**

The PLC has a set of internal relays that can be used to control other processes in stead of the input switches and timers that can be used to activate certain circuits at preset times.

1. Enter the programs of Figure (3.3) and observe how a single relay can be used to control multiple outputs and break an exciting circuit.
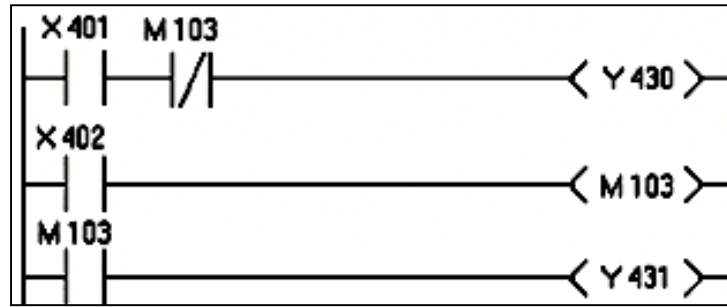
Figure (3.3) Relay Used to Break an Existing Circuit

5. Connect the inputs X401 to switch "A", inputs X402 to switch "E".

➤ **Part E: PLC timed operation:**

In this part we want to use the internal timers of the PLC to program three lights on the panel of the PLC to simulate a **traffic light**. You can use the example of Figure (1.4) to test the operation of timers. Use one input to control the start of the work of the lights and another to stop them. Make sure that the time intervals between the different color lights are realistic.
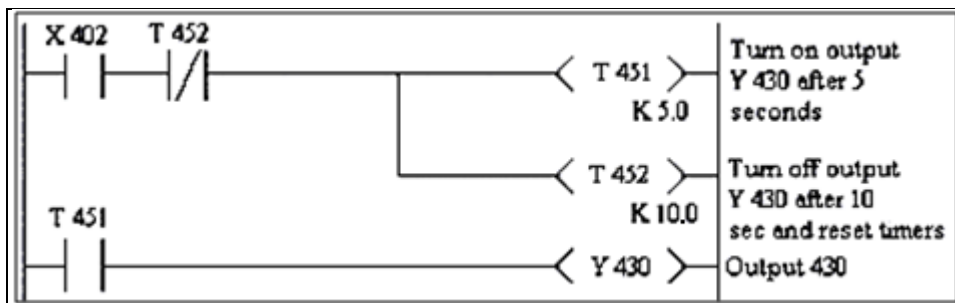

Figure (1.4) Switch and Timer program

☑**Note:**

To enter the timer ⟨ T 451 ⟩ write the following
--O--| 451   go
--[ ]--   k 5.0   go
 Note: connect the input X402 to switch "E".

--[ ]--   this means shift.

➤ **Part F: Counter operation:**

The PLC has a set of counters that can be used to manipulate asynchronous events. Enter the program given in Figure (1.5) and test its operation to see how the output depends on the number of times the input button is activated. Record the results. Try to change the k parameter of the counter and observe the results.
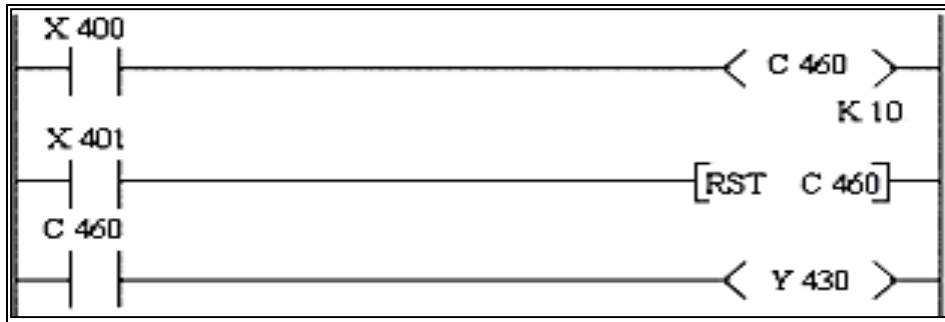
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Figure (1.5) Simple counter Progra

☑**Note:**

To enter the Rest   --[RST C460]-- write the following :

--[   ]--   RST 460   go

Note: connect the input X400 to switch "A" and the input X401 to switch "B".

➢ **Part J: jump instructions:**

As in usual programming jump instructions are used to bypass sets of instructions depending on the values of certain input signals. In this part we want to test the use of jump instructions of the PLC. Enter the program given in Figure (1.6) and test its operation. Make sure that you understand how to use the jump instructions in more complicated tasks.
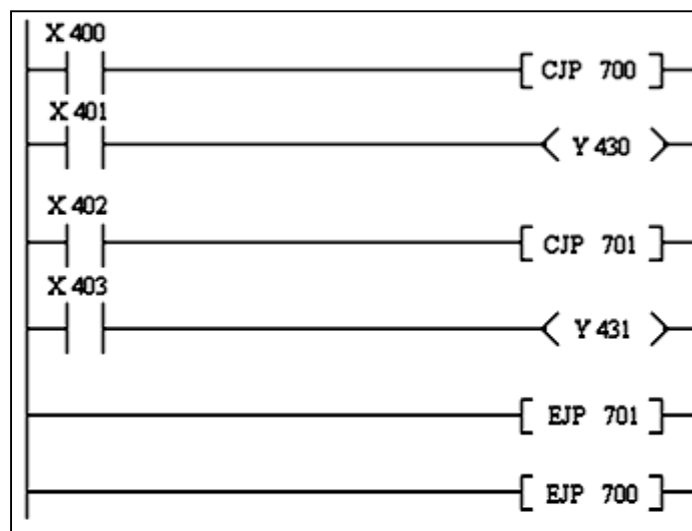

Figure (1.6) Multiple Jump Instruction

☑**Note:**

To enter the   --[CJB 700]-- write the following :

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--[ ]--   CJP 700   go

Note: connect the input X400 to switch "A" , the input X401 to switch "B", the input X402 to switch "E", the input X403 to switch "F".