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Expt. Name PROGRAMMING AND LOGIC CONTROL (PLC) Date : 22/1/24

Aim :

Introduction / Familiarization PLC trainer and its instruction with PC.

Apparatus Required :

* Lab programmable Logic controller (PLC) kit
* Personal computer

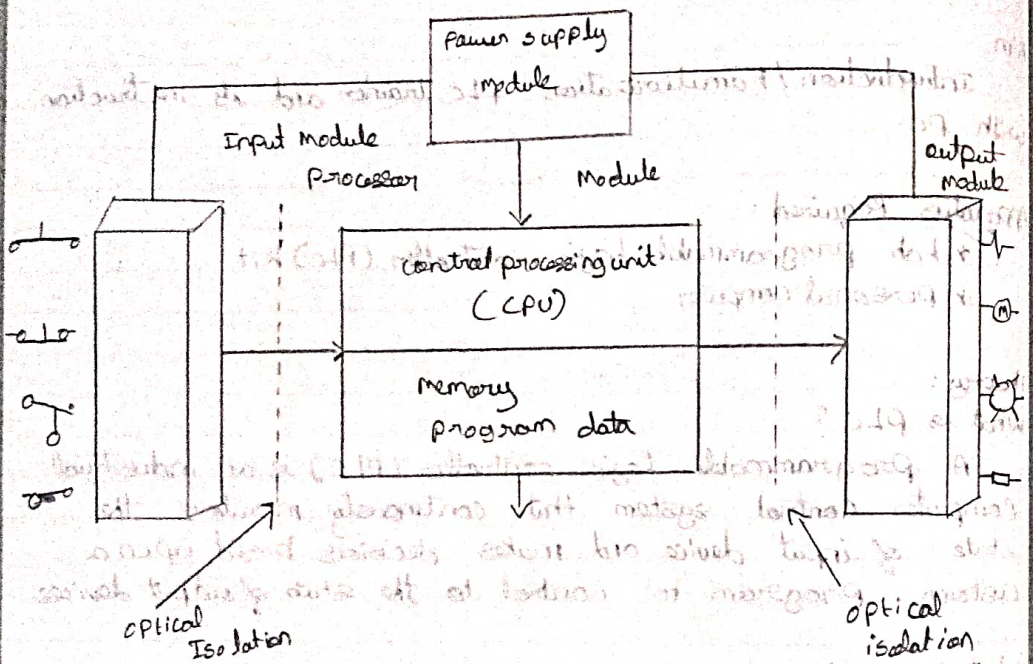
Theory :

What is PLC ?

A programmable Logic controller (PLC) is an industrial computer control system that continously monitors the state of input device and makes decisions based upon a custom program to control to the state of output devices.

What is inside a PLC ?

* The central processing unit, the CPU contains an internal program that tells the PLC how to perform the following functions.
* The CPU combines a microprocessor, an integrated power supply input and output circus, built in PROFINET high speed motion control I/O and on-board analog input in a compact housing to create a powerful controller.
* After you download your program, the CPU contains the logic required to monitor and control the devices in your application.

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* The CPU monitors the input and changes the outputs according to the logic of your user program, which can include Boolean logic, counting, timing, complex math operations and communication with other intelligent devices.

* To communicate with a programming device the CPU can communicate by a built in PROFINET Port.

* With the PROFINET network, the CPU can communicate with HMI panels or another CPU.

* To provide security for your application every S7-1200 CPU provides password protection that allows you to configure access to the CPU functions.

* The CPU supports only a preformatted SIMATIC memory card. To insert a memory card, open the top CPU door and insert the memory card in the slot.

* Use the optional SIMATIC memory card either as a program card or as a transfer card.

* Digital inputs in the controller are 14 and voltage is 24. Digital outputs in the controller are 10 and voltage is 24.

* Back panel is available to connect extra I/O modules and communication modules.

* Analog input in the controller is two.

* Input power supply to the controller is 120/240VAC.

* Three communication modules and eight I/O expansion modules can be used.

* modbus communication board, output board and analog input board can be used.

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PLC Languages:

The function of all programming languages is to allow the user to communicate with the programmable controller via a programmable device. They all convey to the system by means of instructions, a basic control plan.

The most common types of languages encountered in programmable controller system design is;

a) Ladder Diagram (LD)

b) Function Block Diagram (FBD)

Ladder Diagram (LD):

Traditional Ladder logic is graphical programming language. Initially programmed with simple contacts that simulated the opening and closing relay, counters, timers, shift registers etc.

Function Block Diagram (FBD):

Useful for expressing the interconnection of control system algorithms and logic.

Hardware / Software Requirement:

Processor type - Intel pentium i3, 2.5 GHz or similar

RAM - 4 GiB

Available harddisk space - 10 GB on system drive C:\

operating system - windows XP professional SP3, windows 2003 Server R2 SP2, windows 7 SP1, windows 10 pro.

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Graphics card – 32MB RAM 24-bit color depth
Screen resolution – 1024×768
Network – 20m bit/s Ethernet or faster
optical drive – DVD-ROM

Procedure : (PLC SETUP)

* First select TIA Portal 14.0 and double click on it
* Double click on "create new project" then select the "Project name" and select the location path to save project and then click 'create'.
* Double click on "configure a device".
* Click "Add new device". After device is added click "controller" and then click on SIMATIC S7 1200
* click on "CPU" and "CPU 1214 DC/DC/DC", then select the required "MLFB" number and click "Add".
* Now select the signal module AQ 1×12 BIT and Add to the CPU and save project by pressing CTRL+S key.
* The select respective expansion module 3 no's of DI 16/DQ 16×24 VDC, 1 no. of DI 8/DQ8×24 VDC and 1 no. of AI 4×13 BIT/AQ 2×14 BIT from the hardware catalogue.
* Double click on the "RJ45" symbol in the controller now 'properties' of the controller will be open and Ethernet configuration also open if it is not opened just click on the Ethernet address and change IP address and change IP address as required then save the project.

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* Then go to "Downloading the program" setting for click on the "compile" icon and then click on the Download icon.

* Then automatically the "Extended to download device" window open. Select the "PN/IE" into the type of the "PG/PC" interface and also select the "Show all compatible devices". Finally click the "Start Search" option and then click the "Load" button.

* In software synchronization before loading to a device window in opens and then clicks the 'continue without synchronization' option bellow.

* "Stop modules", "Stopall" option and then "Load" option and then load option and also goes to "Load results" window tick the "start all" and click the 'finish' option.

Programming method in PLC:

* Click PLC-1 in the project tree click "program block" and click "main OB1" Now OB1 is created.

* Now select the network and double click on normally open (-| |-)

* Now normally open is added. Now add "output coil (-( )-)" in the network. Then double click on the both NO contact and output coil to enter their address simultaneously.

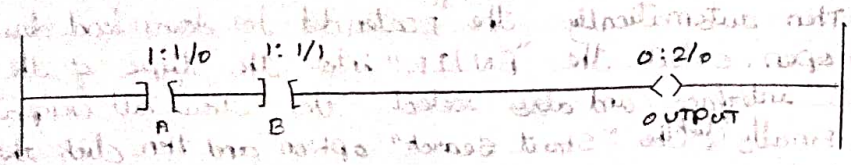
* After it click on the 'compile' icon then download to device' icon.

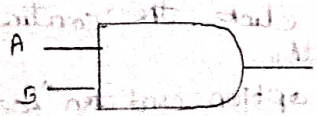
* For more an online process goes to click the "monitoring on/off" icon. Then the window shows the online mode of the PLC.

Result:

We studied introduction of PLC, its installation with PC hardware components, building various blocks and determine no of digital inputs / outputs and analog inputs / outputs.

AND Gate

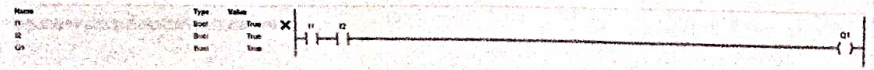



AND Gate Truth Table:

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

0 - Low ; 1 - HIGH



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Expt. Name AND-GATE OPERATION Date : 24/1/24

Aim:

Test the truth table of AND gate using PLC software

Apparatus Required:

* PLC Trainer kit
* personal computer installed with PLC software
* Ethernet cable
* path chords

Theory:

* AND-GATE operation is used to make the multiple operations of 2 inputs. Now using A & B are 2 inputs and c is the output.
* Now generation the following formula to create the AND gate operation is given below.

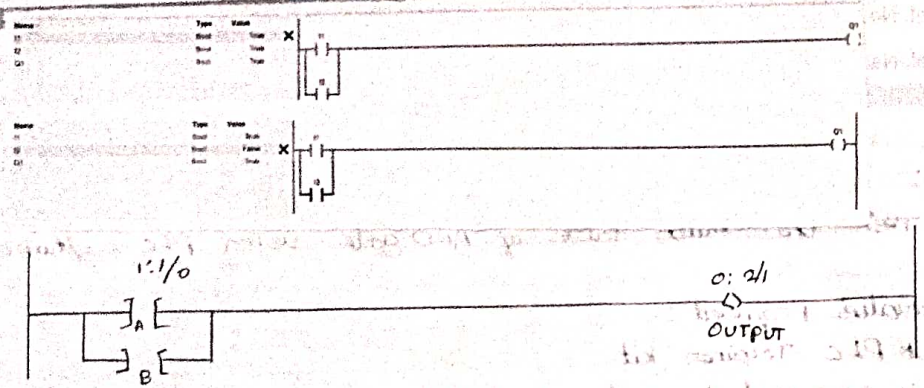
$$A \cdot B = C$$

Procedure:

* click "PLC-1" in the project tree then click "Program block" and click "Main OB1". Now OB1 is created.
* Now write an AND-GATE operation for make 2 inputs A and B. It is created normally using open contacts. A (I0.0) and B (I0.1).
* And the only one output can be used that is C (Q0.0)
* After saving go to online mode and select monitoring on/off icon.
* Finally the two inputs [(I0.0), (I0.1)] are goes to high [Q0.0] high.

Conclusion:

Thus the AND-GATE operation was studied successfully using PLC software.





OR-GATE TRUTH TABLE:

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

0-Low, 1-HIGH

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Expt. Name OR-GATE OPERATION Date: 5/2/24

Aim:

Test the truth table of OR gate using PLC software.

Apparatus Required:

* PLC trainer kit
* personal computer installed with PLC software.
* Ethernet cable, path chords

Theory:

In OR-GATE operation is used to make the addition operation of 2 inputs. Now using A & B are 2 inputs and C is the output.

Now generating the following formula to create the AND Gate.

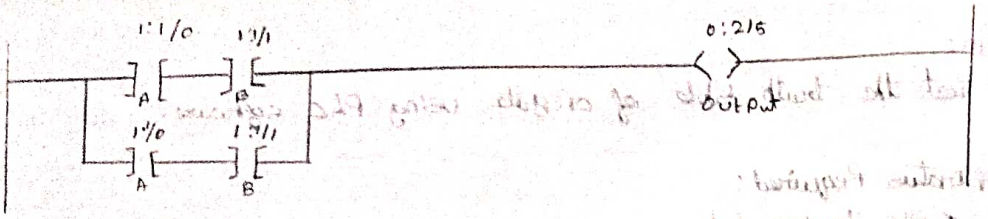
$$A+B=C$$

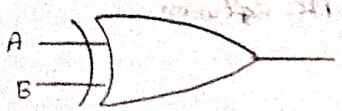
Procedure:

* click PLC-1 then program block then main OB1, OB1 is created.
* write an OR-GATE operation for make a 2 inputs like A and B
* It is created by using two open contacts parallel connection A (I0.0), B (I0.1).
* only one output can be used that is C. (Q0.0).
* Then save the program to press (CTL+S), after saving go to online and select the monitoring ON/OFF icon.
* Finally the inputs [(I0.0), (I0.1)] are goes to HIGH the output [Q0.0] will goes to HIGH. It can be represented in green colour indication.

Conclusion:

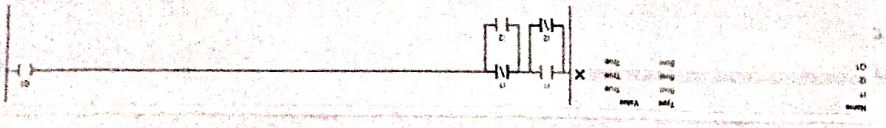
Thus the OR-GATE operation was studied successfully through PLC software.




EX-OR GATE Truth Table :

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |



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Expt. Name EX-OR GATE operation Date : 12/12/24

AIM:

Test the truth table of EX-OR gate using PLC software

Apparatus required:

* PLC Trainer Kit
* PC with PLC software
* Ethernet cable, patch chords

Theory:

In EX-OR gate operation is used to make the operation of inequality functions of inputs. Now using A,B and C is output.

Now generality formula to create EX-OR GATE operation

$$A\bar{B} + \bar{A}B = C$$

procedure:

* click PLC-1, then click program block, then main OB1. OB1 is created.
* write an EX-OR GATE operation for 2 inputs A and B. Then save and download.
* Go to online and monitor all the values of inputs and outputs
* All the inputs are Low at that time the output is Low. The inequality functions of inputs are HIGH the output is HIGH.
* Thus the all input values are HIGH at that time the output is HIGH.

Conclusion:

Thus the EX-OR-Gate operation was studied successfully through PLC software.

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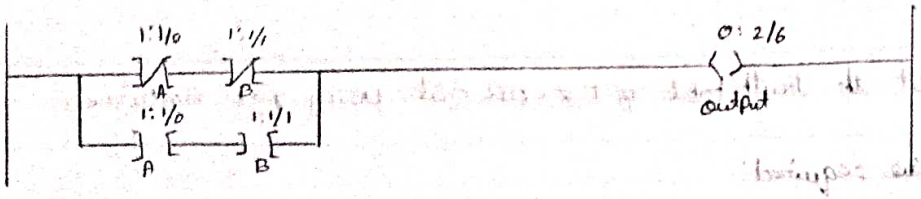
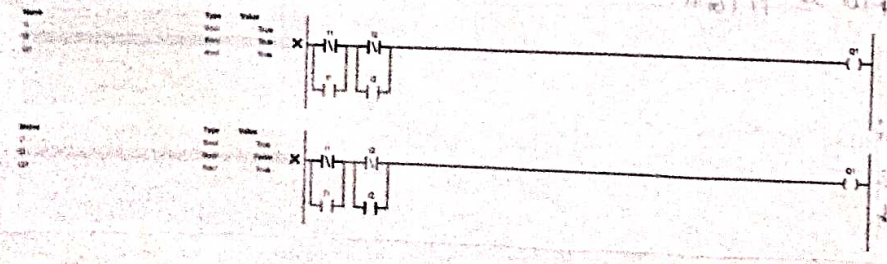




Truth Table for EX-NOR Gate:

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |



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Expt. Name EX-NOR GATE Date : 14/2/24

Aim:

Test the truth tabb EX-OR gate using PLC Software

Apparatus required:

* plc Trainer kit
* PC with plc software
* Ethernet cable, patch chords

Theory:

EX-NOR GATE operation is used to make the inverse operation of the Ex-NOR-GATE value. Now using A, B and C is the output.

Now generating the following formula to create EX-NOR-GATE.

$$A\,B + A \cdot B = C$$

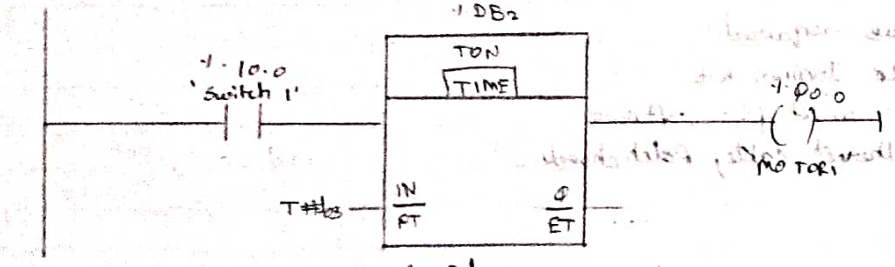
procedure:

* Click PLC-1 then Program block, then main OB1, OB1 is created
* write an EX-NOR-GATE operation for make a 2 input like A and B
* Save the program and download into PLC and o condition.
* Monitor the values of the inputs and outputs.
* All the inputs are LOW at that time the output is HIGH. The inequality function of inputs are HIGH the output is HIGH.
* Thus the all input values are HIGH at that time the output is HIGH.

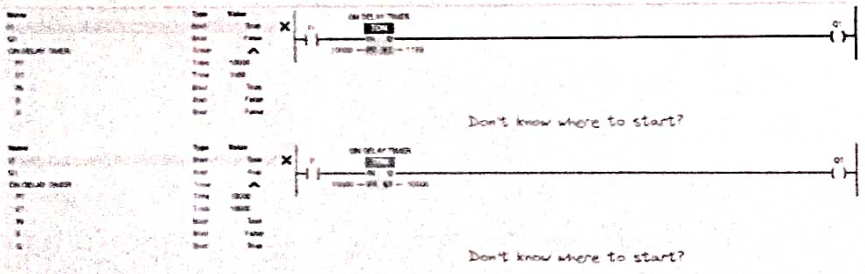
Conclusion:

Thus the EX-NOR-GATE operation was studied successfully through PLC Software.

Ladder Logic Program:




ON Delay Timer

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Expt. Name ON DELAY TIMER Date: 26/2/24

Aim:

To study the on Delay Timer operation using PLC Software.

Apparatus Required:

* PLC Trainer Kit
* PC with PLC software
* Ethernet Cable, Patch chords

Theory:

* ON Delay Timer is used to make the delay operation in processes.
* It can control the inputs an outputs of the field instruments.

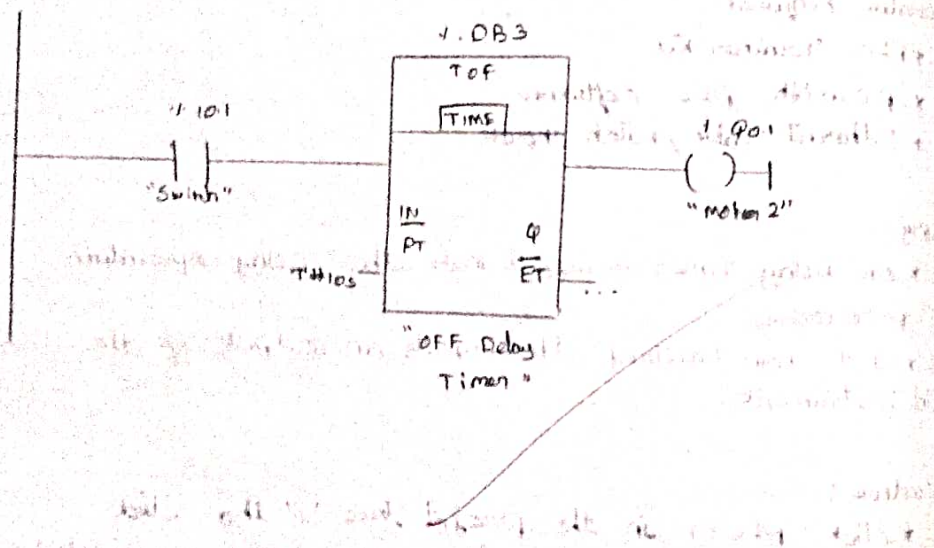
Procedure:

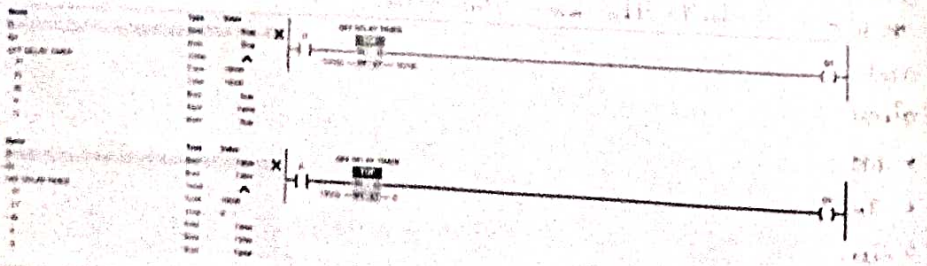
* click PLC-1 in the project tree '1' then click program block '2' and click main OB1 '3' OB1 is created.
* Now select the on Delay Timer goes to instructions tab and click the Basic instructions and select the timer operations tab and double click the TON block.
* Now select timer block the input can be connected with IN of the timer
* Then give the address for the input and output. Save and download.
* Save the program and download give address for input and output.
* Go online and monitor the program.
* when the states of switch 1 (I0.0) changes from 0 to 1 motor (Q0.0) activates.

Result:

Thus the Ladder logic program of ON Timer was written and implemented using PLC Software.

Ladder logic program:



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Expt. Name OFF DELAY TIMER Date : 26/2/24

Aim:

To study the off delay Timer operation using PLC software.

Apparatus required:

* PLC Trainer kit
* PC with PLC software
* Ethernet cable, Patch chords.

Procedure:

* click PLC-1 in the project tree '1' then click program blocks' and click main OB1 '8' .OB1 is created.
* Select OFF Delay Timer and click data block name and ok button.
* click the data block, Timer block is created.
* The input can be connected with IN of the Timer block
* Give the addresses for input and output and write down the values in seconds.
* Then save the program and download after that goes to online mode.
* when the states of switch 2 changes from 0 to 1 it actively motor 2 immediately.
* when the switch 2 change the 0 and the motor 2 will be OFF.

Result:

Thus the OFF - Delay Timer was successfully executed.

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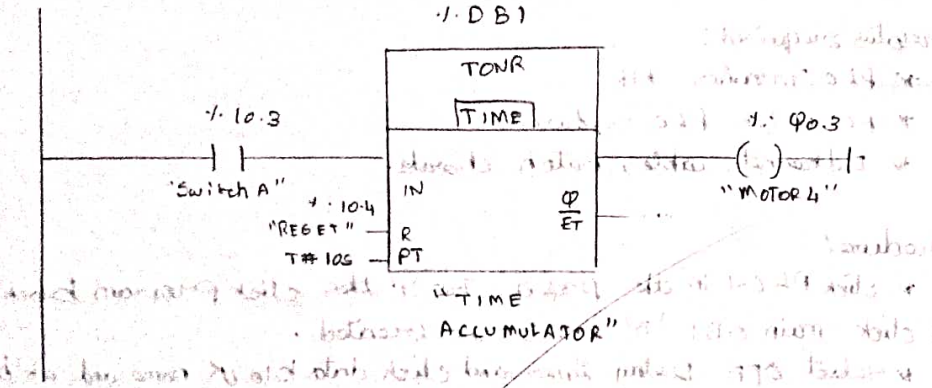
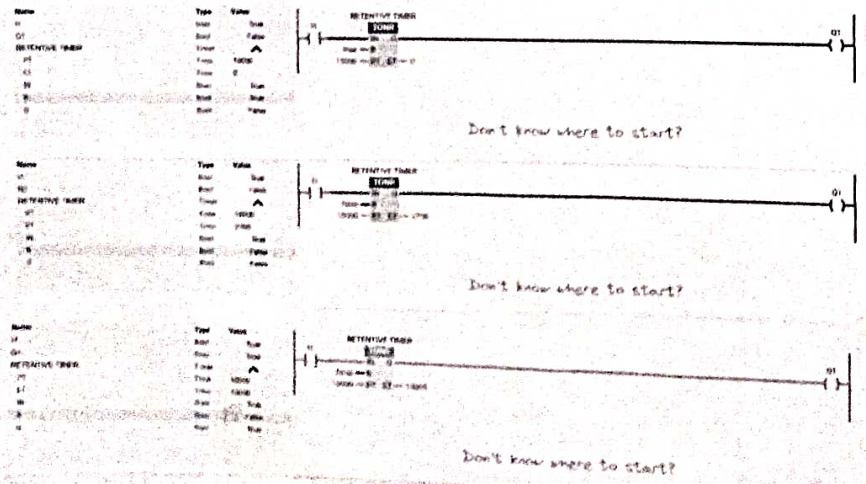
Ladder Logic program:




Expt. No. 8 Page No. 25

Expt. Name RETENTIVE TIMER Date: 26/2/24

Aim:

Write and implement a simple ladder logic diagram using Retentive timer.

Apparatus required:

* PLC Trainer kit
* Personal computer with PLC software
* Ethernet cable, Patch chords

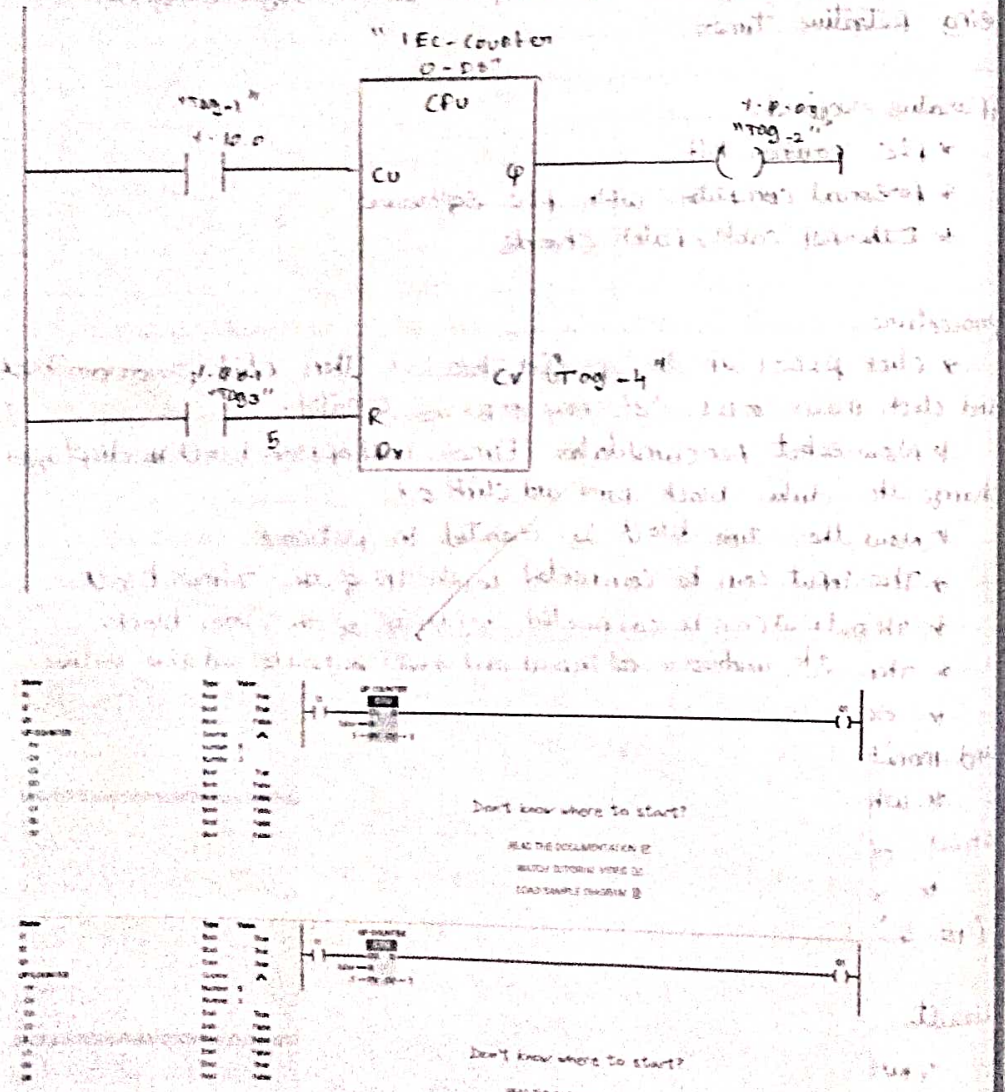
Procedure:

* click PLC-1 in the project tree '1' then click program block '2' and click main OB1 '3'. Now OB1 is created.
* Now select Accumulator timer. call options block is displayed change the data block name and click OK.
* Now the time block is created in Network
* The input can be connected with IN of the Timer block.
* The output can be connected with Q of the Timer block.
* then the addresses of input and and outputs and give values.
* save the program and download and go to online and monitor the program.
* when switch 4 changes from 0 to 1 the motor will start after 10S.
* when the motor 4 will remain ON, till the Reset (I0.4) is necessary to reset the timer.

Result:

Thus the Retentive Timer program is successfully executed.

11/3




Expt. No. 9 Page No. 27

Expt. Name UP COUNTER Date : 4/2/24

Aim :

To study the up counter operation using PLC.

Apparatus Required :

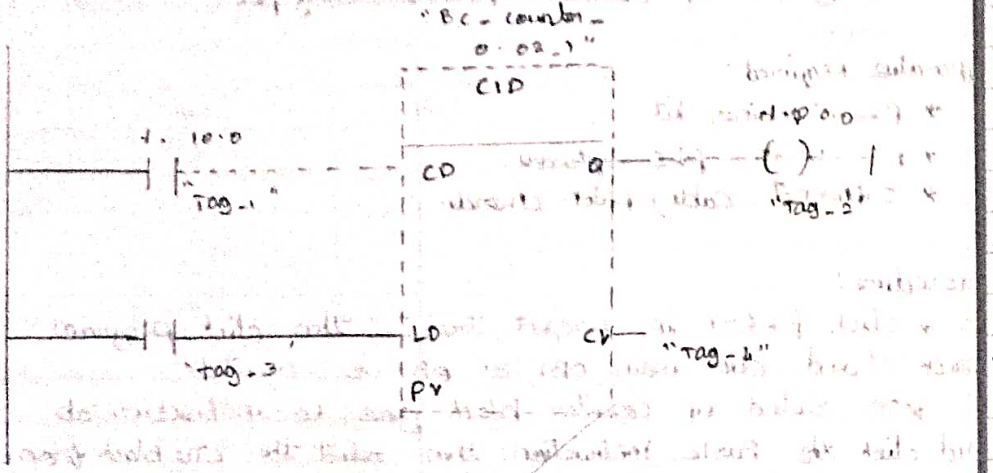
* PLC Trainer kit
* PC with PLC Software.
* Ethernet cable, patch chords.

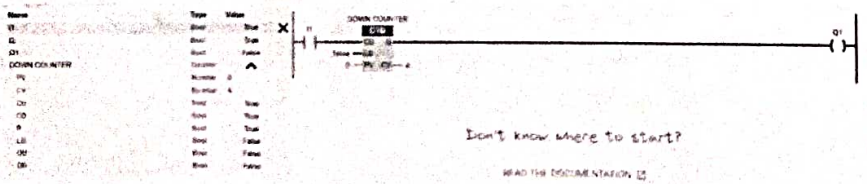
Procedure :

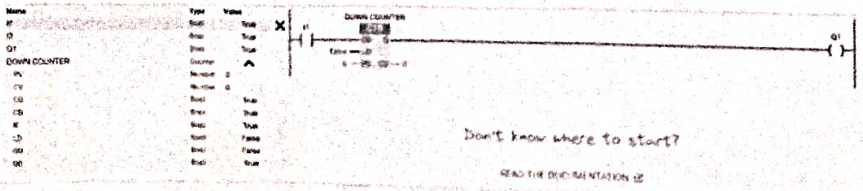
* Click PLC-1 in project tree "1" then click program block '2' and click main OB1 '3'. OB1 is created.
* To Select up counter block goes to instruction tab and click the Basic Instruction then select the CTU block from up.
* Now the up counter call options block can be opened. Then change the data block name in the name block and then click the ok button.
* The following details can be entered into the up counter block.
* Then Save the program and goes to online mode and monitoring the counter values before and after enabling the counter block.

Result :

Thus the up counter operation was successfully performed using PLC Software.




Expt. No. 10 Page No. 24

Expt. Name DOWN COUNTER Date 4/2/24

Aim:

To study about the Down counter operation using PLC.

Apparatus required:

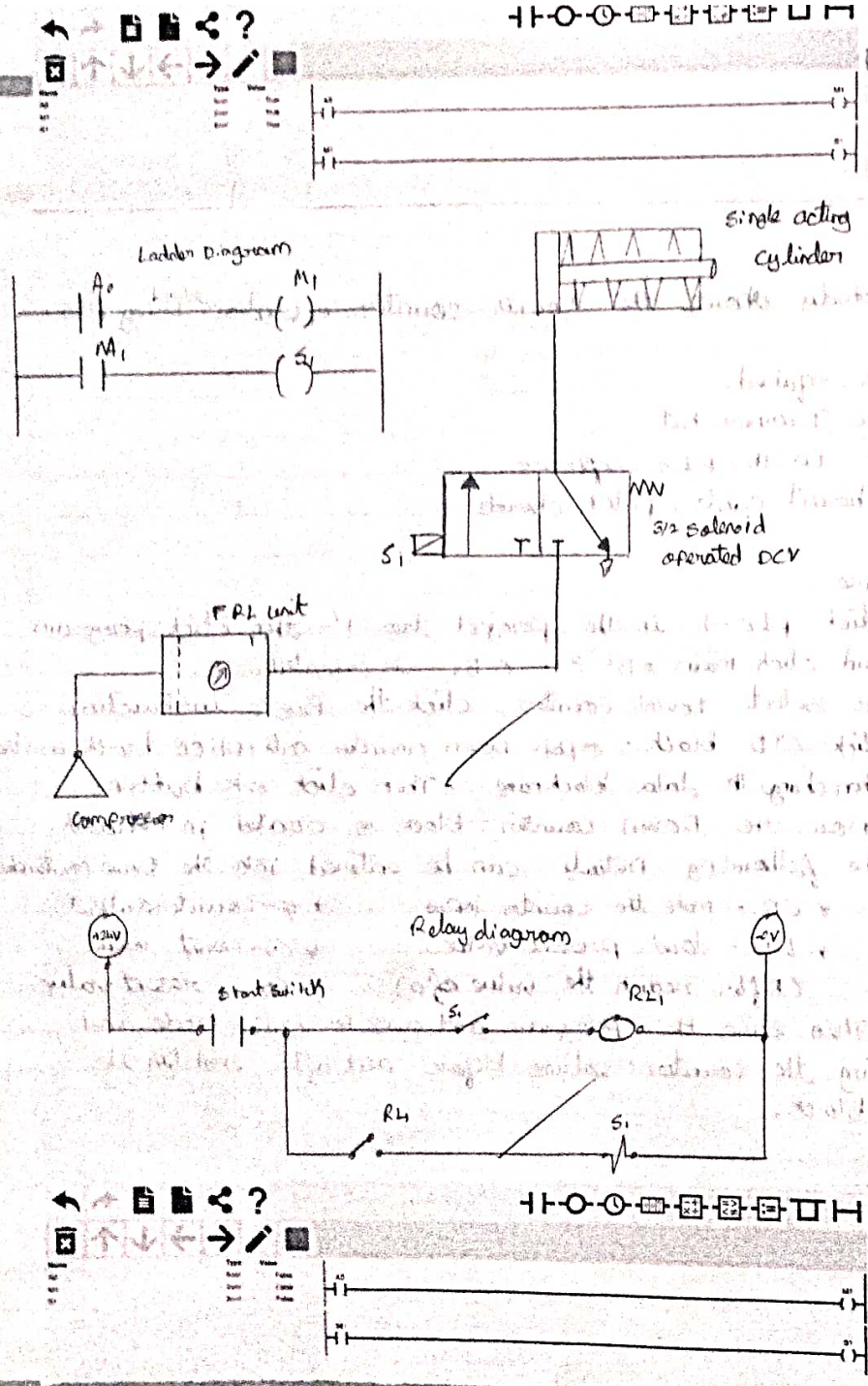
* PLC Trainer kit
* PC with PLC Software
* Ethernet cable, Patch chords

Procedure:

* click PLC-1 in the project tree '1' then click program block '2' and click main OB1 '3'. OB1 is created.
* To select DOWN counter. click the Basic instruction.
* click CTD block. Open Down counter addresses block can be opened. then change the data block name. Then click ok button.
* Now the Down counter block is created in network.
* The following Details can be entered into the Down counter block
  * CD - Make the counter input
  * Q - Counter output
  * LD - load present value
  * CV - Count value
  (After reach the value of 0)
  * PV - present value
* Then save the program and goes to online mode and monitoring the counter values before and after enabling the counter block.

Result:

Thus the DOWN counter operation was performed, successfully using PLC Software.




Expt. No. 11 Page No. 31

Expt. Name IMPLEMENT A LADDER LOGIC PROGRAM FOR Date : 11/3/24

# THE OPERATION OF SINGLE ACTING CYLINDER ACTUATION IN PLC.

**Aim:**

To write and implement a ladder logic program for the operation of single acting cylinder actuation using PLC.

**Apparatus Required:**

* Single acting actuator
* 3/2 Roller operated spring return DCV
* 3/2 Solenoid operated DCV
* Push Button
* FRL unit

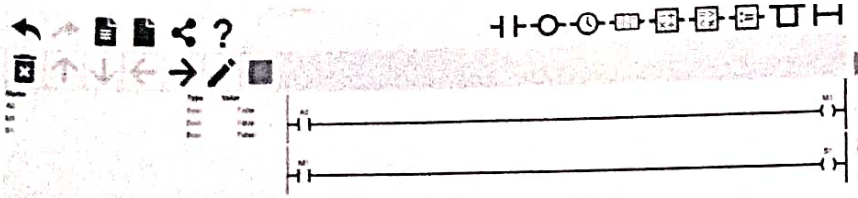
**Procedure:**

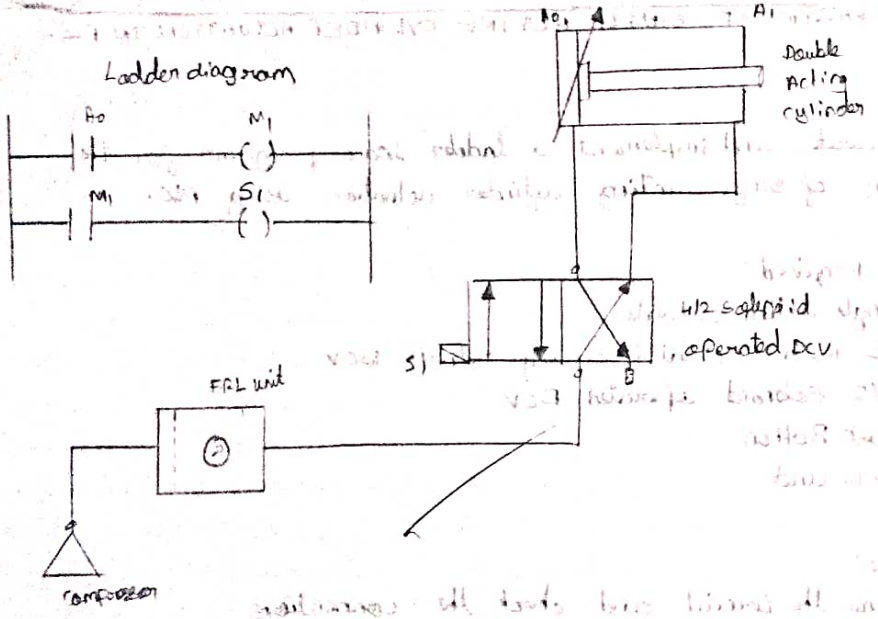
* Draw the circuit and check the connections.
* Connect the FRL unit to the main air supply.
* The various components are connected as per circuit.
* Block the value openings if necessary.
* Check the leakage of air supply and correct it.
* Open the value and operate the Actuator.

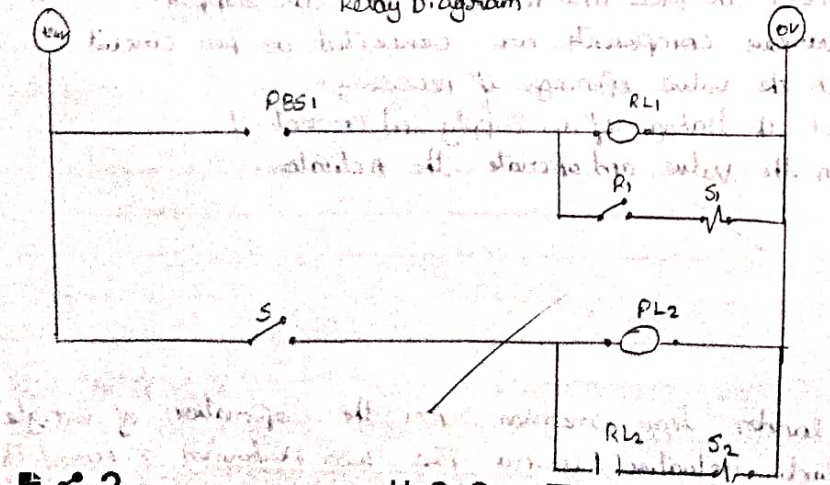
**Result:**

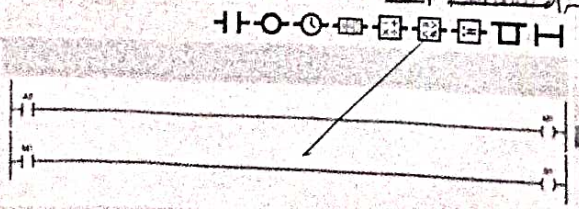
This ladder logic program for the operation of single acting cylinder actuation using PLC was performed successfully.

w/u





Expt. No. 12 Page No. 33

Expt. Name WRITE AND IMPLEMENT LADDER LOGIC PROGRAM FOR THE OPERATION OF DOUBLE ACTING CYLINDER ACTUATION USING PLC Date 11/3/24

## Aim:

To write and implement a ladder logic program for the operation of Double acting cylinder actuation using PLC.

## Apparatus Required:

* Double acting actuator
* 3/2 Roller operated spring return DCV
* 4/2 Solenoid operated DCV.
* Limit Switch
* FRL unit.

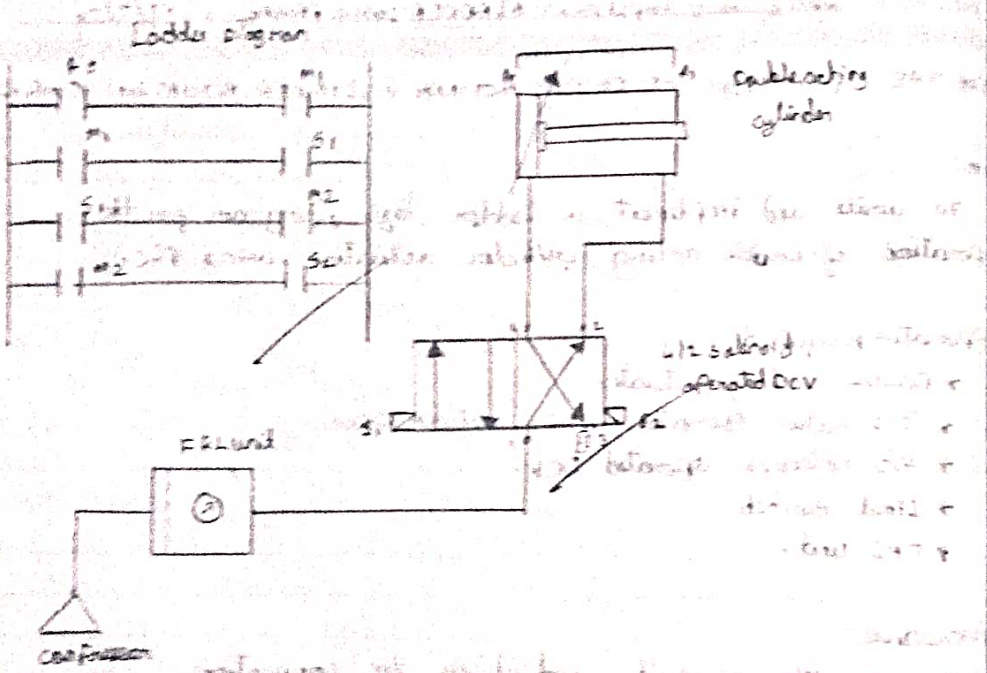
## Procedure:

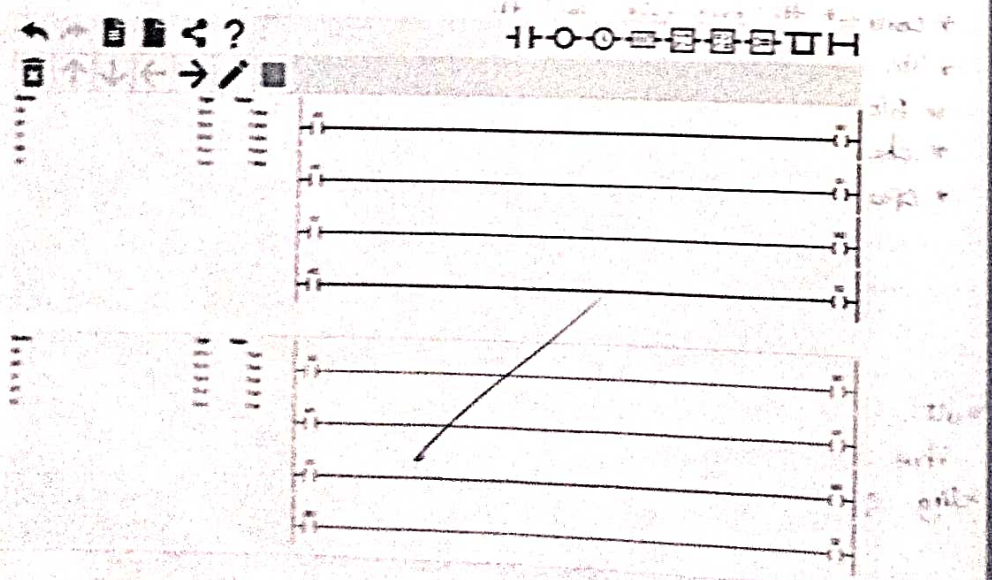
* Draw the circuit and check the connections.
* Connect the FRL unit to the main air supply.
* The various components are connected as per circuit.
* Block the value openings if necessary.
* check the leakage of air supply and correct it.
* Open the value and operate the actuator

## Result:

Thus the ladder logic program for operation of Double acting cylinder actuation using PLC was performed.

W/w



Expt. No. 13 Page No. 86

Expt. Name WRITE AND IMPLEMENT A LADDER LOGIC PROGRAM Date: 15/12/24

FOR THE A+A- operation of CYLINDER ACTUATION USING PLC

Aim:

To write and implement a ladder logic program for the A+A- operation of cylinder actuation using PLC.

Apparatus Required:

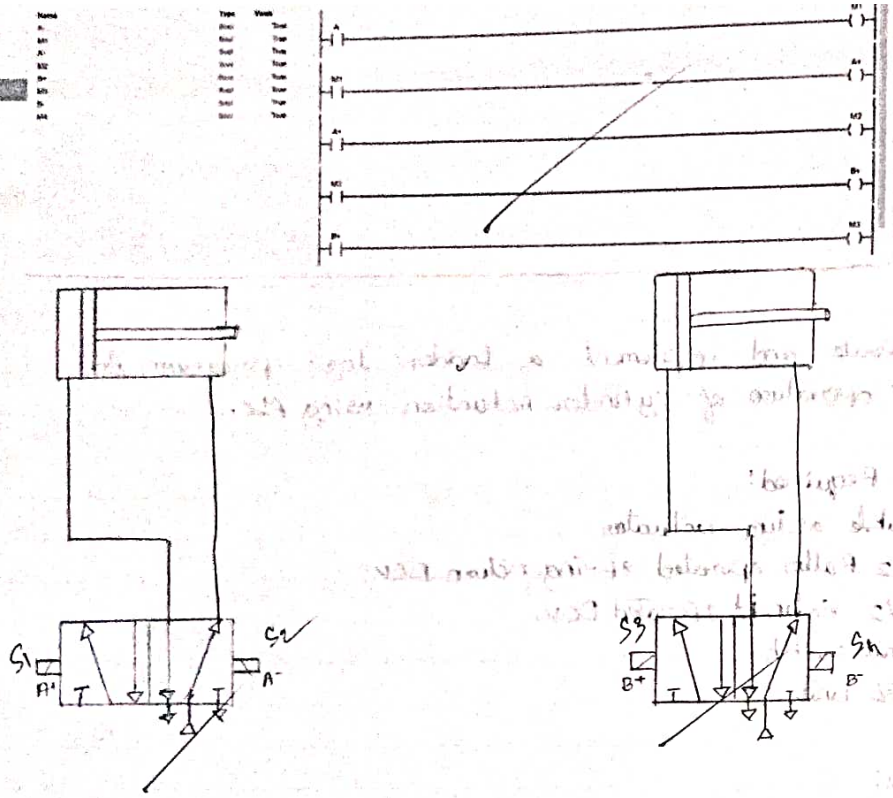
* Double acting actuator
* 3/2 Roller operated spring return DCV
* 5/2 Solenoid operated DCV
* Limit switch
* FRL unit

Procedure:

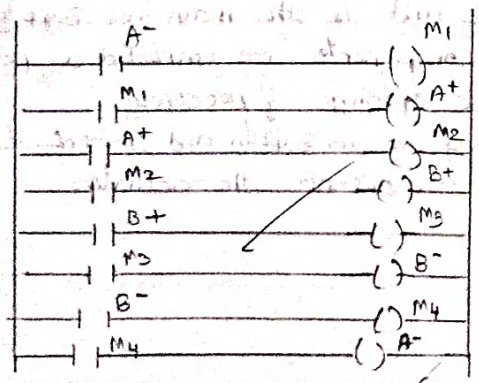
* Draw the circuit and check the connections.
* Connect the FRL unit to the main air supply.
* The various components are connected as per circuit.
* Block the valve openings if necessary.
* Check the leakage of air supply and correct it.
* Open the valve and operate the actuator.

Result:

Thus the ladder logic program for A+A- operation of cylinder actuation using PLC was performed.




Ladder diagram




Expt. No. 14 Page No. 37

Expt. Name $A^+B^+B^-A^-$ Date : 12/3/24

**Aim:**

To write and implement a ladder logic program for the $A^+B^+B^-A^-$ operated of cylinder actuator using PLC.

**Apparatus required:**

* Double acting actuator
* 3/2 Roller operated spring return DCV
* 3/2 push button spring return DCV
* 4/2 solenoid operated DCV.
* Limit switch
* FRL unit

**Procedure:**

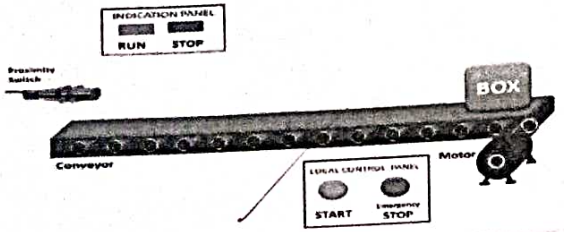
* connect the FRL unit to the main air supply.
* The various components are connected as per the circuit.
* Block the valve openings if necessary.
* check the leakage of air supply and correct it
* open the valve and operate the actuators

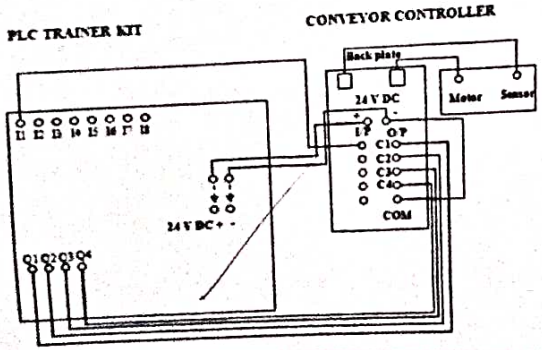
**Result:**

Thus the ladder logic program for the $A^+B^+B^-A^-$ operation of cylinder action is successfully executed.

Expt. No. 15 Page No. 24

Expt. Name CONVEYOR CONTROL SYSTEM Date : 8/4/24




Aim :

To study about control system using PLC.

Apparatus Required:

* VPAT -24 kit
* VPLCT - 03 kit
* PLC software installed PC
* Stepper motor
* Patch chords
* Power chords

procedure:

* open the PLC software and design the ladder diagram.
* Interface the PLC with the system using ethernet cable.
* Make electrical connections as per writing diagram.
* Download the program and run it.
* place an the object on the conveyor. If the sensor senses the object, conveyor stops for 2 seconds and starts again automatically.

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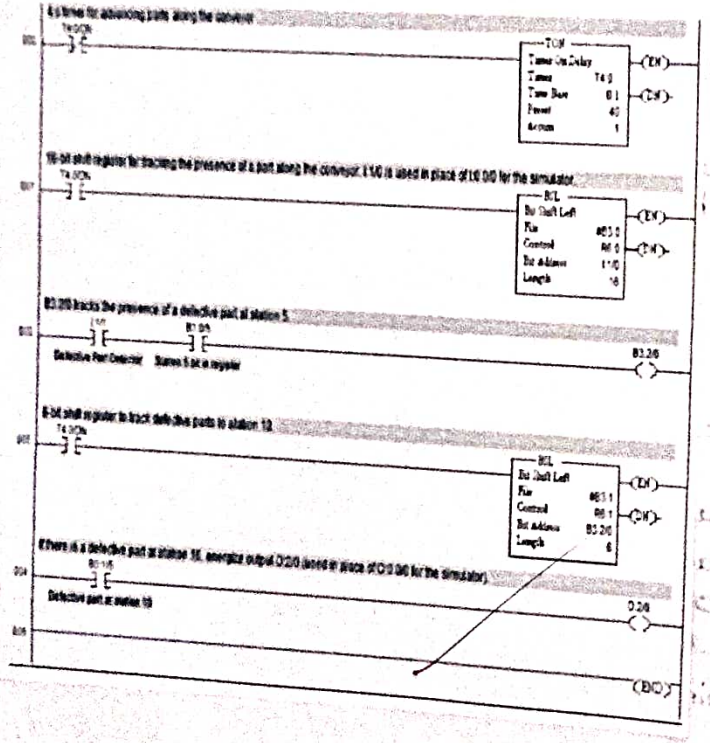
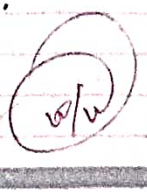
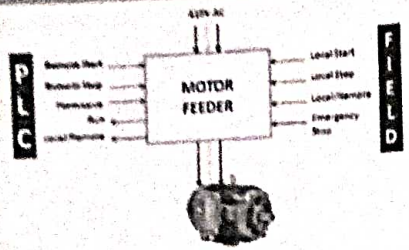
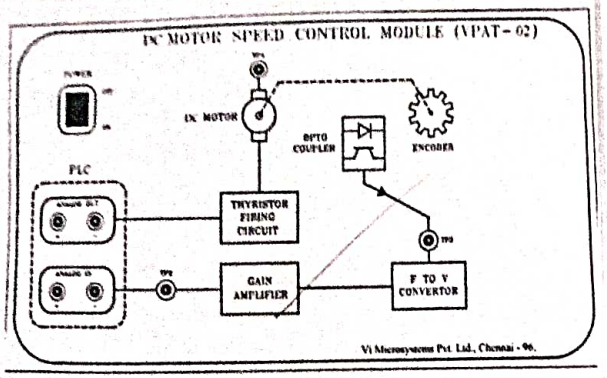


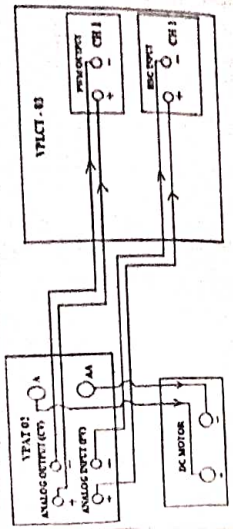

Result:

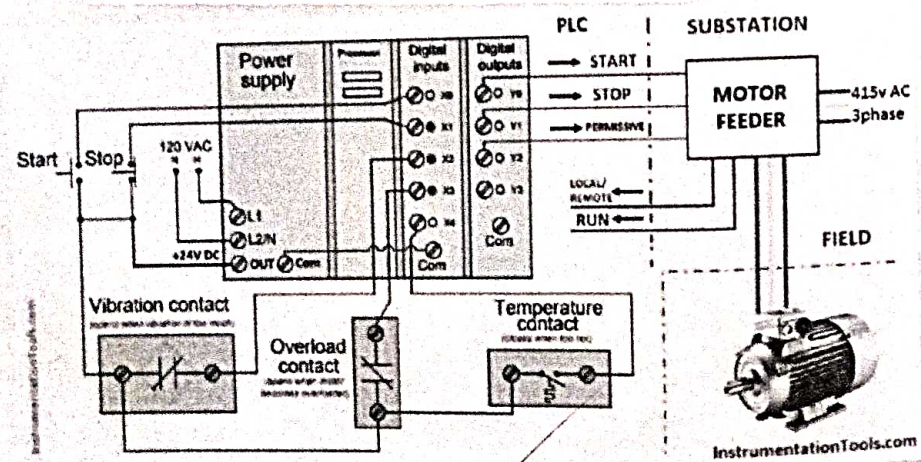
Thus the study of conveyor control system had been studied.

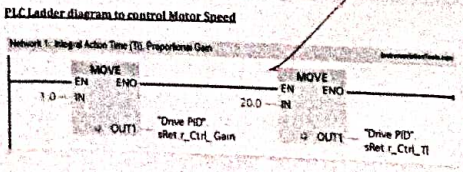




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Expt. Name ON-OFF THE DC MOTOR Date : 8/4/24

Aim:

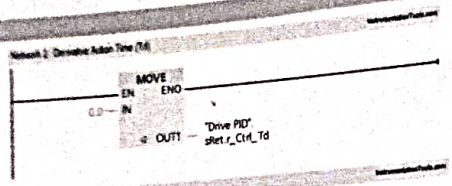
write and implement ladder logic program to on-off the DC motor using PLC.

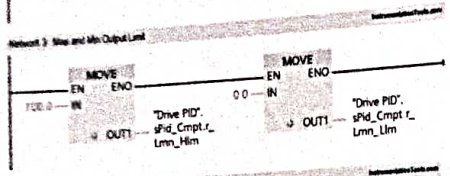
Apparatus Required:

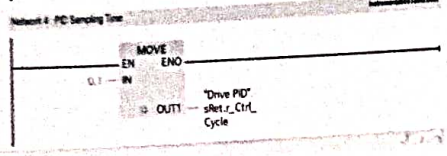
* Speed control module trainer
* PLC trainer kit
* personal computer installed with PLC.
* DC Motor
* patch chords.

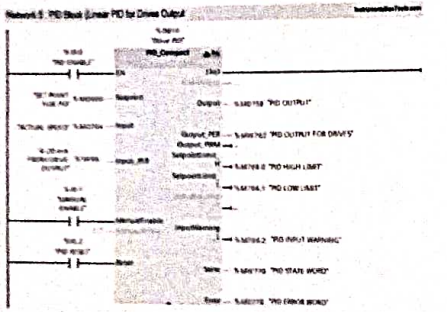
procedure:

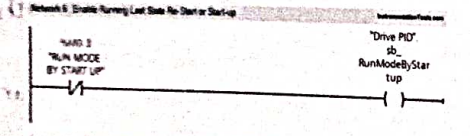
* Make the connections based on wiring diagram.
* switch ON the PLC kit.
* Interface the PC to PLC through Ethernet communication cable.
* For configuration of software, Programming follows.
* switch ON the DC motor speed control kit.
* Download and run the program to PLC.
* set the Setpoint of motor speed (0-1500 RPM).
* Based on set point the PID controller enables the PWM output pulses.
* By this pulse the DC motor starts rotating at some speed.



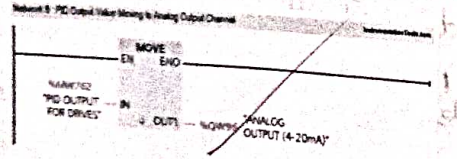








Expected Test Cases:

| Inputs | Outputs | Physical Elements |
|---|---|---|
| I0.5=1 | Q0.0=1 | Drive ON |
| MD700=500RPM | MW762=13836 (approx.) | Drive speed =50RPM |

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* opto coupler sense the feedback of high speed ON.
* The feedback we can read from High speed counter input channel.
* Now the PID controller compares the set point and process.
* By varying the controller output (CV) (PWM) it makes the motor running at set speed.

Result:

Thus the ON-OFF operation of DC motor using PLC was studied successfully.

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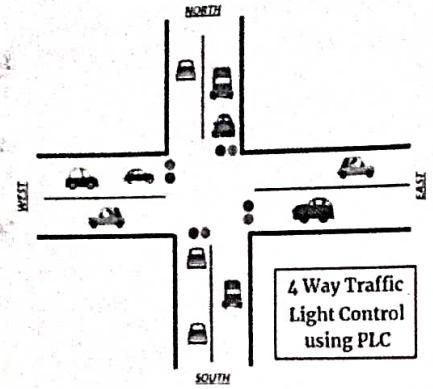
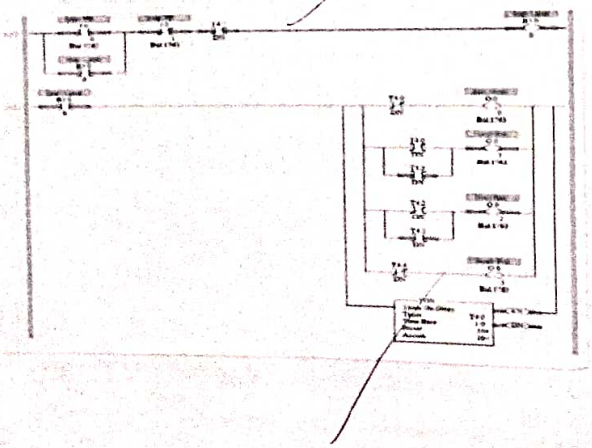
Expt. Name TRAFFIC LIGHT CONTROLLER Date : 5/4/24



Aim:

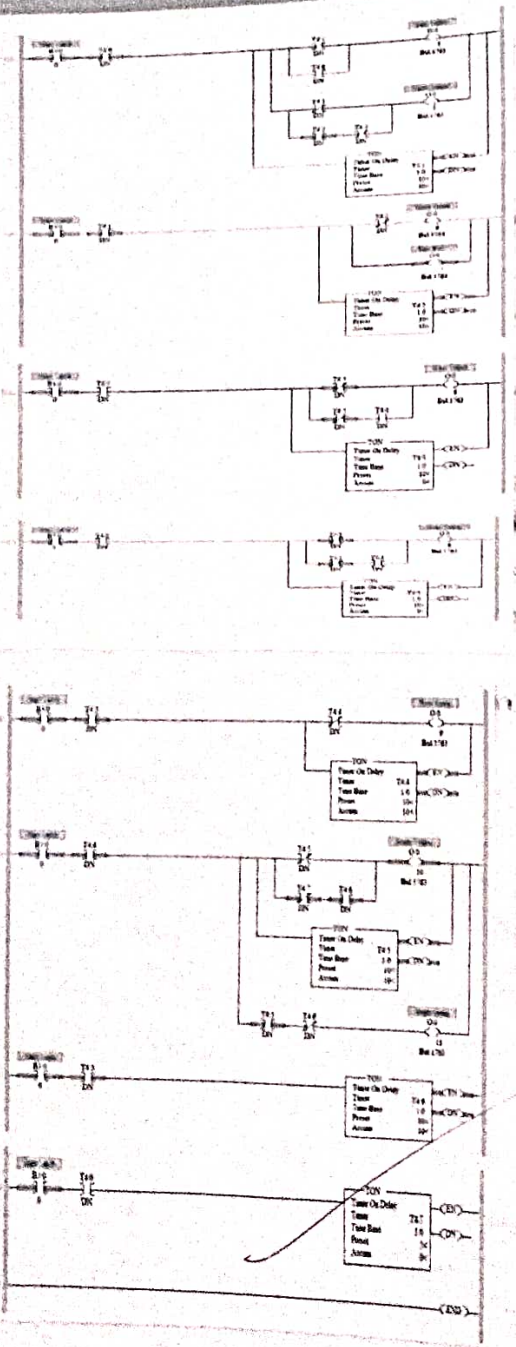
To study the Traffic Light Controller system by using PLC.

Apparatus Required:

* VPAT -03 Kit
* PLC
* PLC Software
* Ethernet cable
* Patch chords
* power chords

List of Inputs and outputs

| Sl no | Address | Name | Input/output |
|---|---|---|---|
| 1 | 1:0/0 | Start | INPUT |
| 2 | 1:0/1 | Step | INPut |
| 3 | B:3/0 | Memory | Memory |
| 4 | 0:0/0 | East green | Output |
| 5 | 0:0/1 | North red | output |
| 6 | 0:0/2 | west Red | output |
| 7 | 0:0/3 | South yellow | output |
| 8 | 0:0/4 | East yellow | output |
| 9 | 0:0/5 | North yellow | output |
| 10 | 0:0/6 | North green | output |



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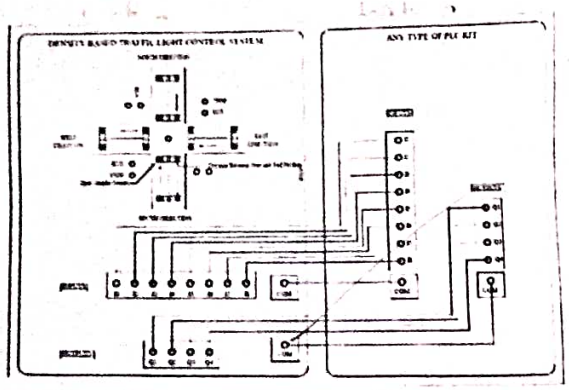
| | | | |
|---|---|---|---|
| 11 | 0:0/7 | East Red | output |
| 12 | 0:0/8 | west green | output |
| 13 | 0:0/9 | west yellow | output |
| 14 | 0:0/10 | South yellow | output |
| 15 | 0:0/11 | South green | output |

Sequence of operation

| S.NO | EAST | WEST | NORTH | SOUTH |
|---|---|---|---|---|
| 1 | G | R | R | R |
| 2 | Y | R | Y | R |
| 3 | R | R | G | R |
| 4 | R | Y | Y | R |
| 5 | R | G | R | R |
| 6 | R | Y | R | Y |
| 7 | R | R | R | G |
| 8 | Y | R | R | Y |

Procedure:

* A Pulse at input 11.0(19) Starts the operation by energizing the open coil M0.0 in network 1.
* The energizes the open coil $Q_{0.0}$ ($Q_1$ coil) in network which also energies an ON delay timer. After a preset type (5 seconds), M0.0 is energized. This de-energizes $Q_{0.0}$ and enables the west direction output $Q_{0.1}$.



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* Q0.1 (Q2 coil) is energized in network, denergized Q0.0 and reseting the timer in network and this process repeats for west direction, North and east direction.

* In the west direction an ON delay timer in network 8 is energized and Q3 coil (Q0.2) is energized.

* In network 10, a latch connection with Q3 coil (Q0.2) is used to keep it energized continously ON Delay timer start due to Q3 contact (Q0.2) energization in run-8, the M0.3 is reset, a4 coil (Q0.3) is energized and Q3 coil (Q0.2) is deenergized.

* In network 13 an Delay timer is starts ON, due to contact [Q0.03] energization, the M0.4 coil will be energized, after completion of time delay reset the timer this time delay depends upon the [M0.4] preset time.

Conclusion:

Thus the study of traffic control system was done by using PLC.

10/10