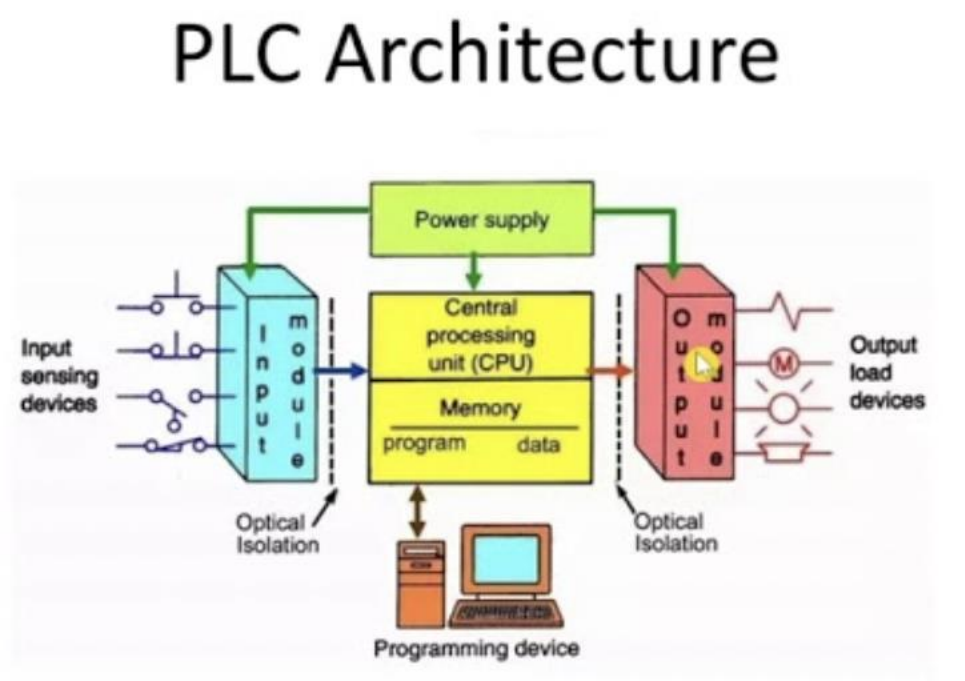
July 2022

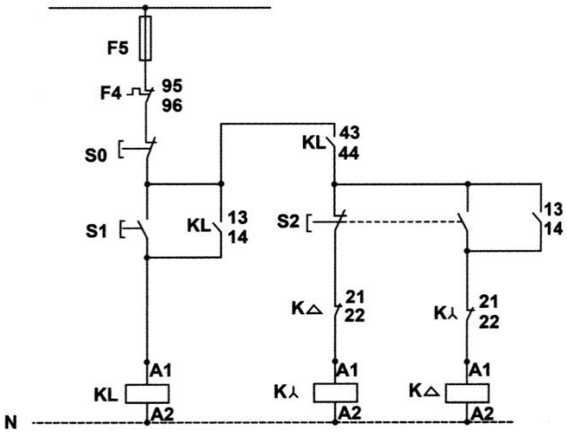
PLC



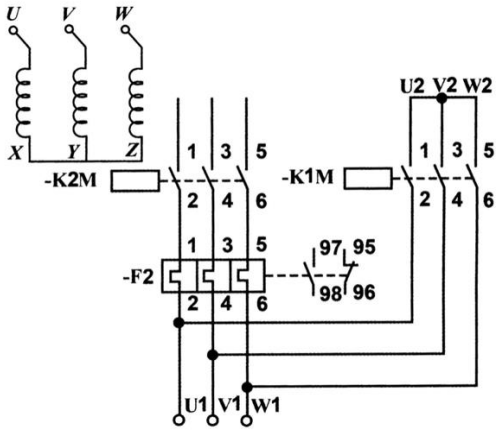
Mahsa Seraji
Dr. Jafar Zarei

In this work report, there are several projects related to Programmable Logic Controllers (PLCs) that have been implemented using STEP7 programming software.

1.Considering the power circuit and the star-delta control scheme, develop its PLC program.

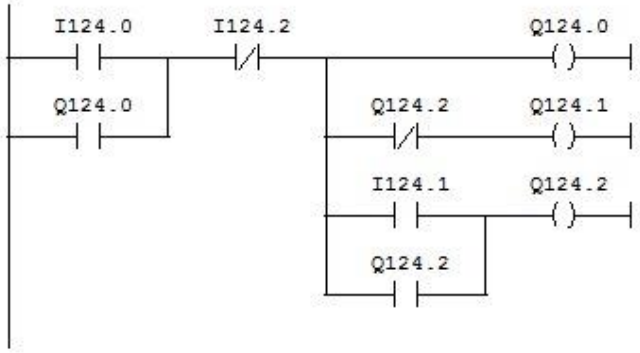


مدار فرمان ستاره مثلث دستی



نحوه اتصال سیم بندی فازهای مختلف موتور به صورت ستاره در مدار قدرت

The program is like this:



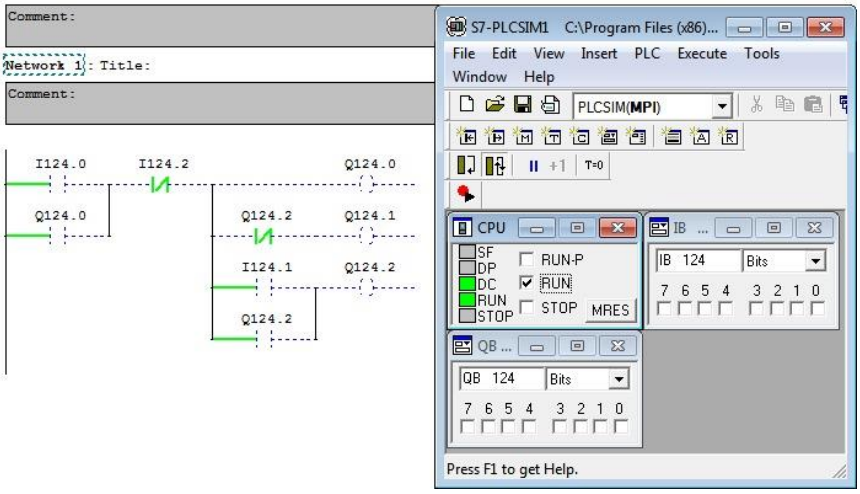
In which we have:

S1	S2	S3	N	Y	Δ
I124.0	I124.1	I124.2	Q124.0	Q124.1	Q124.2

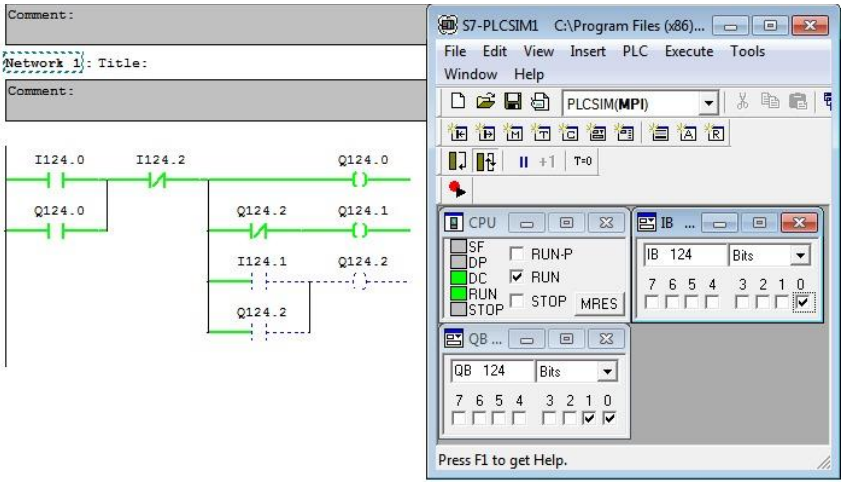
& we have:

		Q124.0	Q124.1	Q124.2
Y	I124.0	ON	ON	OFF
Δ	I124.1	ON	OFF	ON
STOP	I124.2	OFF	OFF	OFF

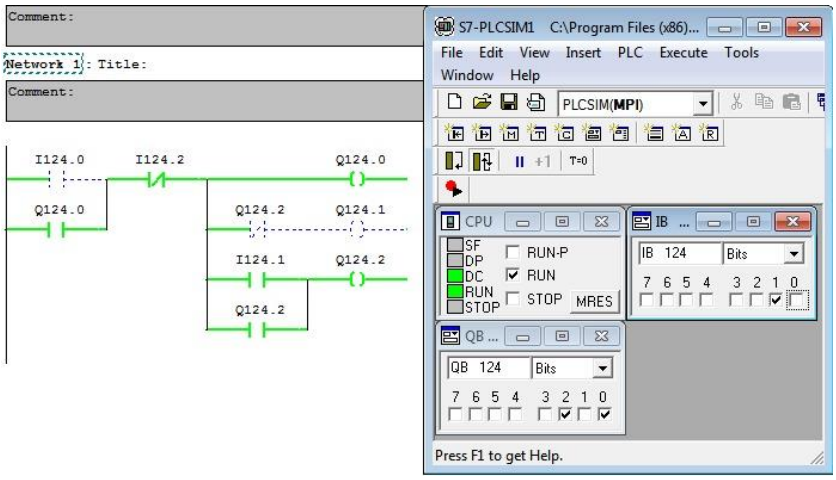
When I124.0 is triggered, Q124.0 and Q124.1 become true, and the motor is started in star connection. Self-holding Q124.0 is closed. Then, if I124.1 is triggered, Q124.2 becomes true, and the normally closed contact Q124.2 opens, Q124.1 becomes false, and the normally open contact Q124.2 closes (self-holding). The motor continues to operate in delta configuration. If I124.2 is pressed, the entire circuit is disconnected.
This is the result of this scenario:



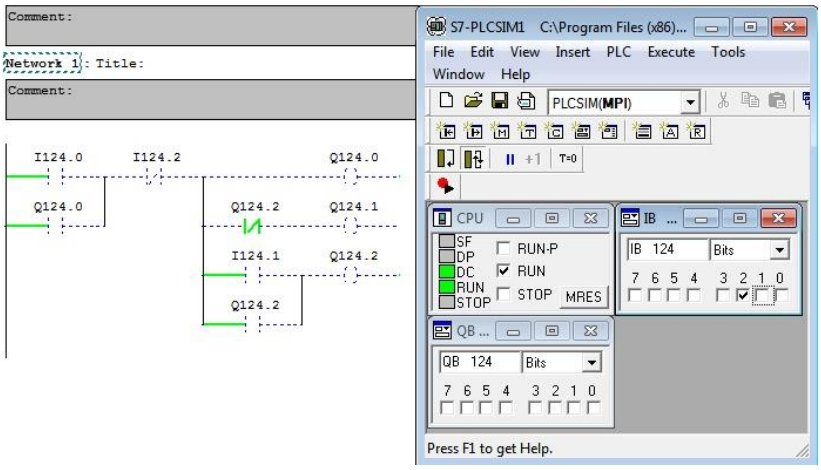
When I124.0 is triggered:



When I124.1 is triggered:



When I124.2 is triggered:



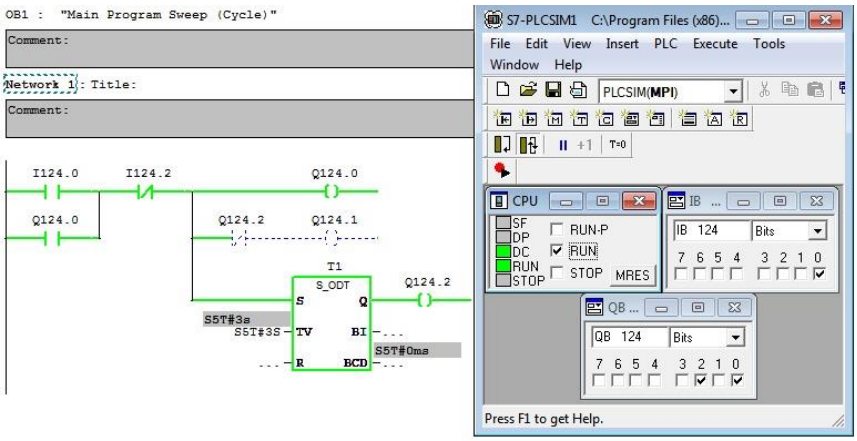
If we automate the star-delta program, it would look like this:

- When I124.0 is triggered:
  - Start the motor in star connection (Q124.0 and Q124.1 become true).
  - Close self-holding contact Q124.0.

- If I124.1 is triggered:
  - Open the normally closed contact Q124.2.
  - Close the normally open contact Q124.2 (self-holding).
  - The motor continues operating in delta configuration.

- If I124.2 is pressed:
  - Disconnect the entire circuit.

- This is the automated implementation of the star-delta control program.



If the circuit automatically switches from star to delta configuration after 3 seconds of starting, it would be like this:

- When I124.0 is triggered:
  - Start the motor in star connection (Q124.0 and Q124.1 become true).
  - Close self-holding contact Q124.0.
  - Start a timer for 3 seconds.

- After 3 seconds (when the timer expires):
  - Open the normally closed contact Q124.2.
  - Close the normally open contact Q124.2 (self-holding).
  - The motor continues operating in delta configuration.

This automated setup ensures that the motor starts in star connection and switches to delta configuration after 3 seconds.

2. Traffic Lights

The PLC program for a traffic signal controls the sequencing of traffic lights. It monitors vehicle presence and other signals, cycles through green, yellow, and red lights in each direction, and manages pedestrian crossings. Additionally, it includes emergency overrides for situations like emergency vehicles. This program operates within a main loop, continually updating the traffic light sequence based on input and timer conditions.

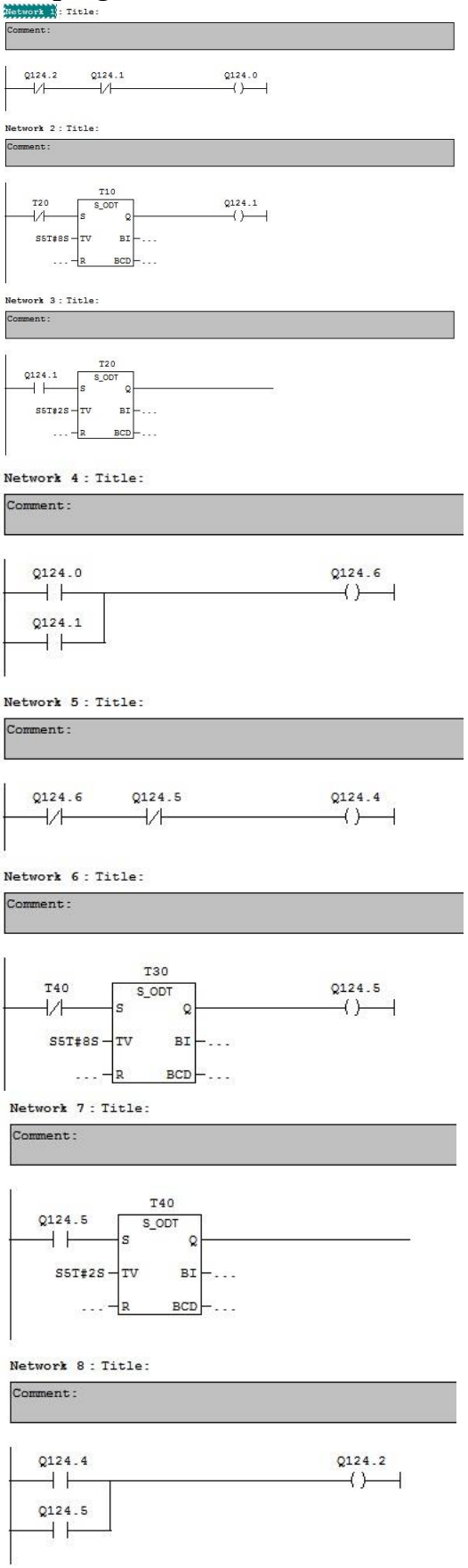
Write a program to display two traffic lights as follows:

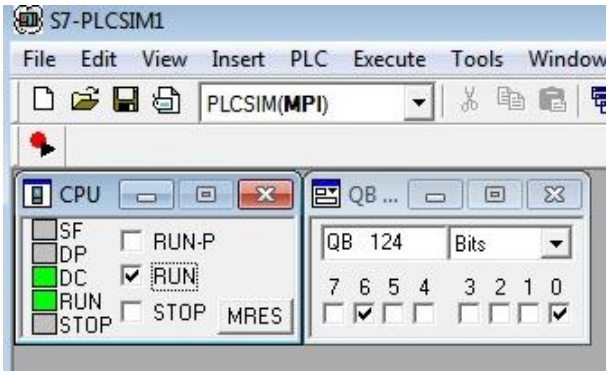
1			2		
name	color	seconds	name	color	seconds
Q124.0	green	8	Q124.4	green	8
Q124.1	yellow	2	Q124.5	yellow	2
Q124.2	red	10	Q124.6	red	10

The program should initially display the first green light for 8 seconds, followed by the first yellow light for 2 seconds, while simultaneously, for these 10 seconds, the second red light is active. Then, the second green light should be displayed for 8 seconds, followed by the second yellow light for 2 seconds, while the first red light is on for 10 seconds during this period.

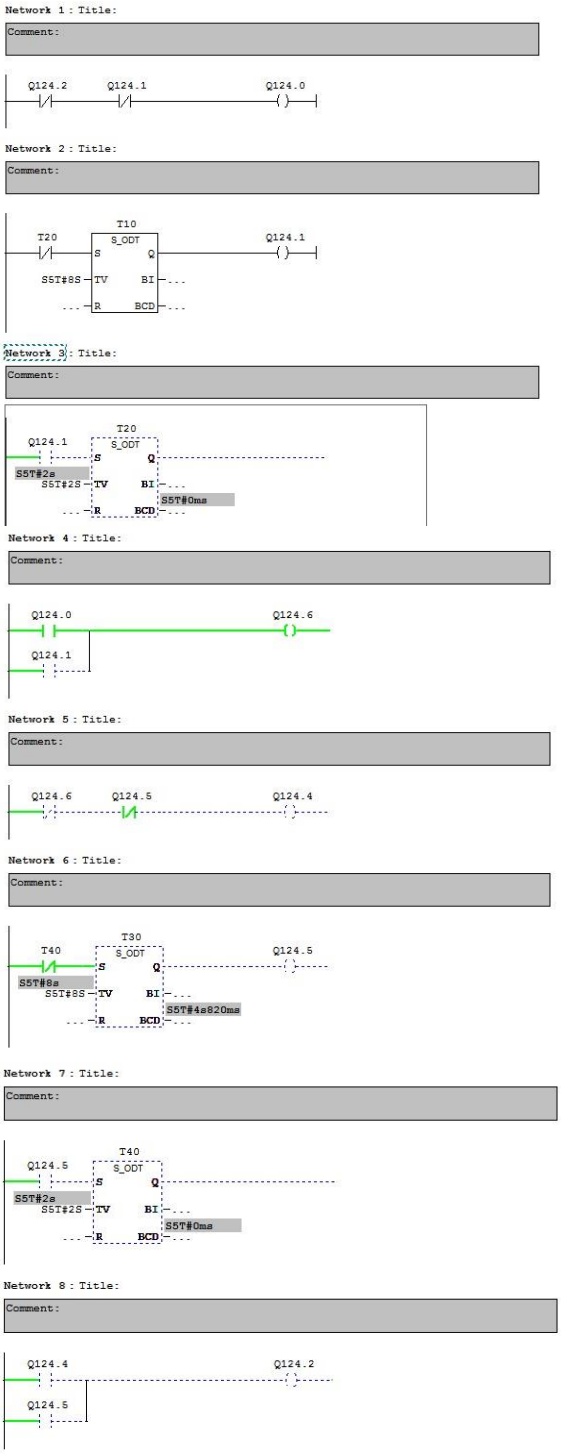
Q124.0	8seconds-green1		
Q124.1	2s-yellow1		
Q124.6	10s-red2		
Q124.4		8s-green2	
Q124.5		2s-yellow2	
Q124.2		10s-red1	

The program will be like:





First, Q124.0 becomes true, and the Q124.0 contact closes. Q124.6 also becomes true, and timer T10 starts counting. After 8 seconds, Q124.1 becomes true, and the Q124.1 contact opens. Then, Q124.1 closes again, and Q124.0 becomes false (green light 1 remains on for 8 seconds). After 2 seconds, Q124.1 becomes false, Q125.0 becomes true, and the Q125.0 contact opens and closes. Q124.4 contact closes, and timer T3 starts recording time. After 8 seconds, green light 2 turns off, and yellow light 2 turns on. Timer T4 starts counting. After 2 seconds, yellow light 2 turns off, and red light 1 turns off after 10 seconds.



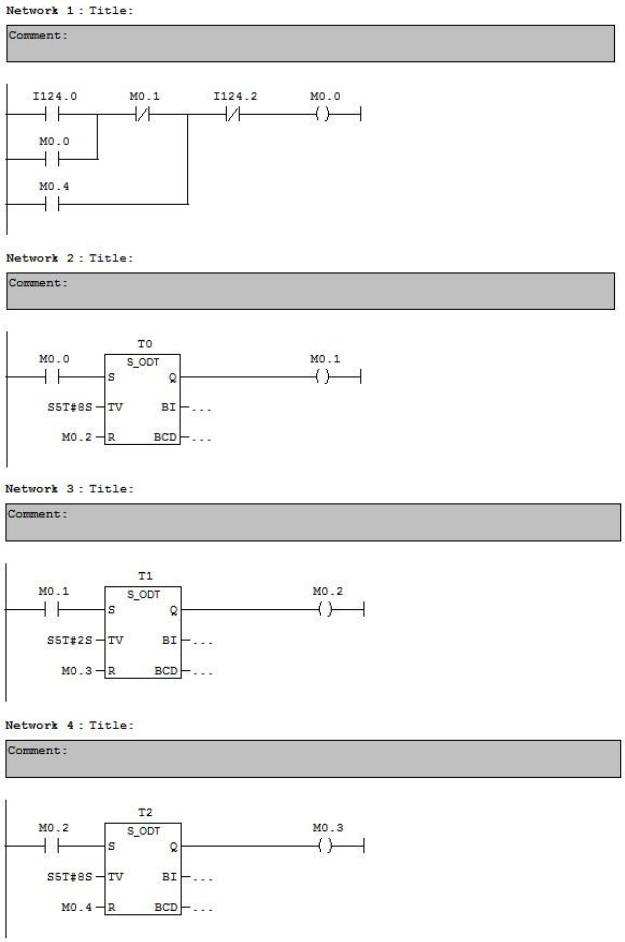
3. Traffic Lights with output QB124

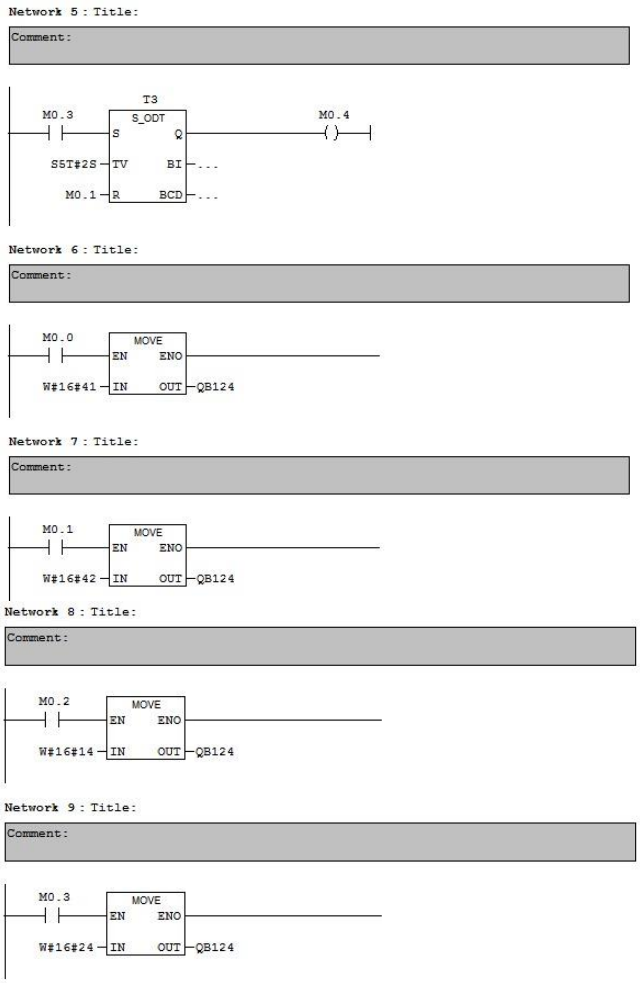
Write a program that can display a similar traffic light as the previous exercise using the move command, with its output being QB124.

		7	6	5	4	3	2	1	0	
			red	yellow	green		red	yellow	green	
1	8s	0	1	0	0	0	0	0	1	W#16#41
	2s	0	1	0	0	0	0	1	0	W#16#42
2	8s	0	0	0	1	0	1	0	0	W#16#14
	2s	0	0	1	0	0	1	0	0	W#16#24

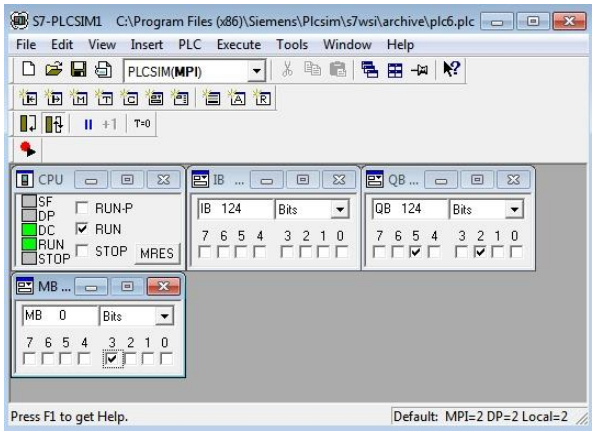
The program can be executed in 2 ways:

1.





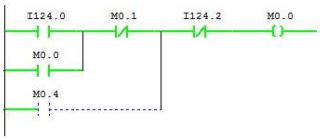
When the key I124.0 is pressed, M0.0 becomes true, and the M0.0 contacts close. The number W#16#41 is transferred to QB124, and timer T0 starts counting. After 8 seconds, M0.1 becomes true, the number W#16#42 is transferred to QB124, and timer T1 starts counting. After 2 seconds, M0.2 becomes true, the M0.2 contacts close, and timer T0 is reset. The number W#16#14 is transferred to QB124, and timer T2 starts counting. After 8 seconds, M0.3 becomes true, the M0.3 contacts close, the number W#16#24 is transferred to QB124, and timer T3 starts counting. Timer T1 is reset, and after 2 seconds, M0.4 becomes true, timer T2 is reset, and the M0.4 contacts close. M0.0 becomes true, and timer T3 is reset when M0.1 becomes true.
We have:



Then:

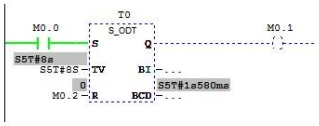
Network 1 : Title:

Comment:



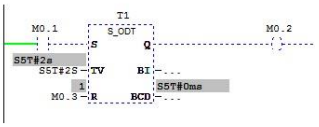
Network 2 : Title:

Comment:



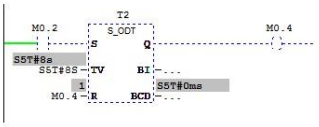
Network 3 : Title:

Comment:



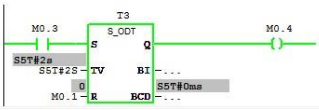
Network 4 : Title:

Comment:



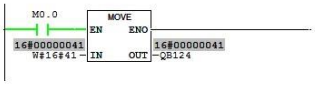
Network 5 : Title:

Comment:



Network 6 : Title:

Comment:



Network 7 : Title:

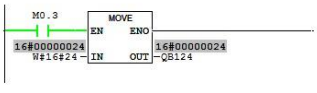
Comment:

Network 8 : Title:

Comment:

Network 9 : Title:

Comment:



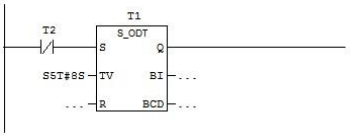
2. SECOND WAY

Network 1 : Title:

Comment:

Network 2 : Title:

Comment:

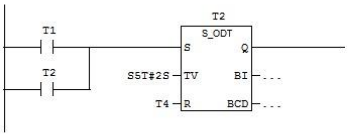


Network 3 : Title:

Comment:

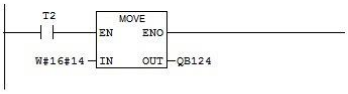
Network 4 : Title:

Comment:



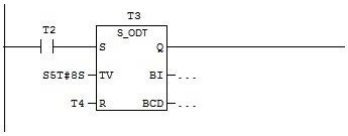
Network 5 : Title:

Comment:



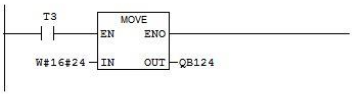
Network 6 : Title:

Comment:



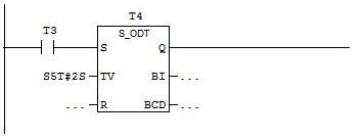
Network 7 : Title:

Comment:

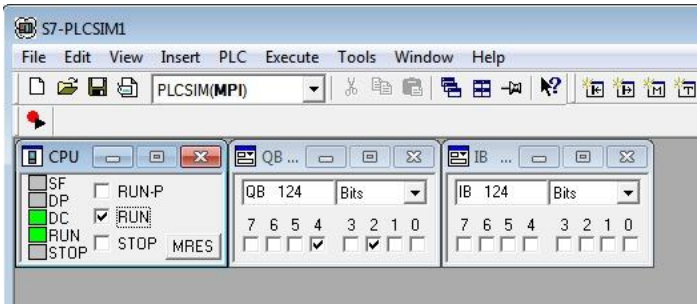


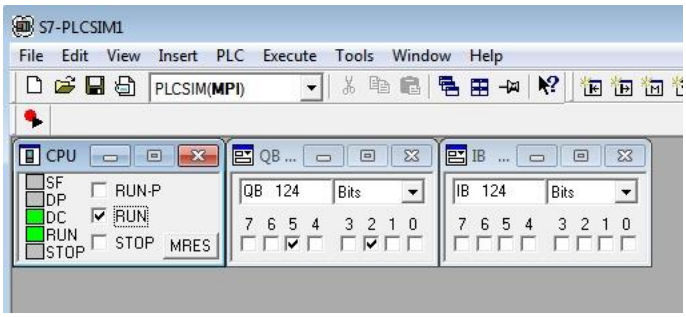
Network 8 : Title:

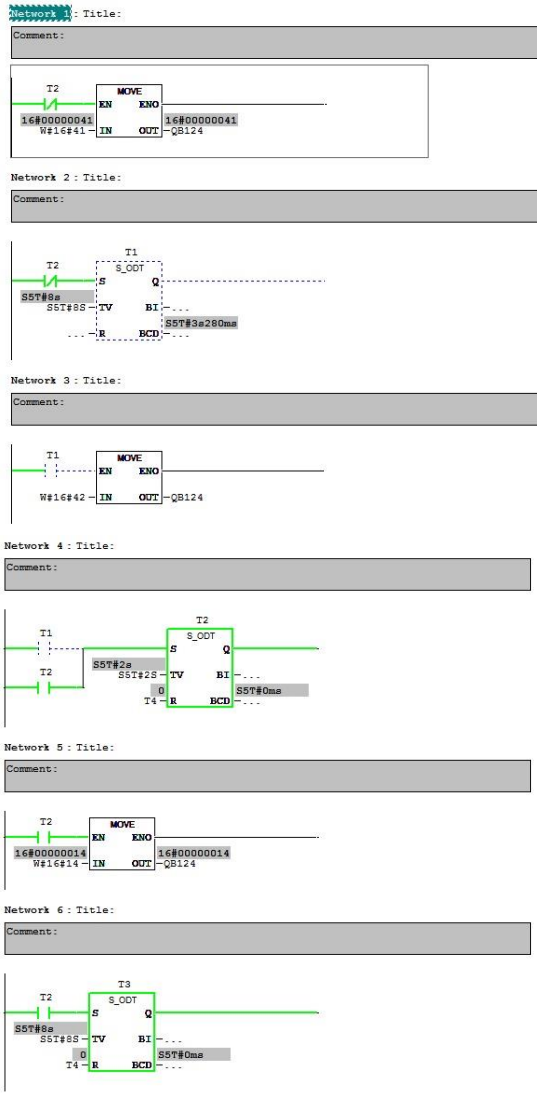
Comment:

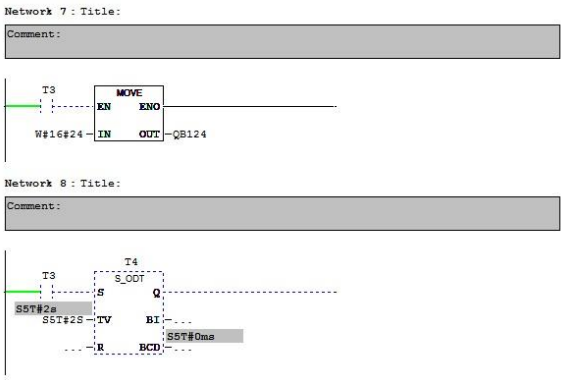


As a result, we have:

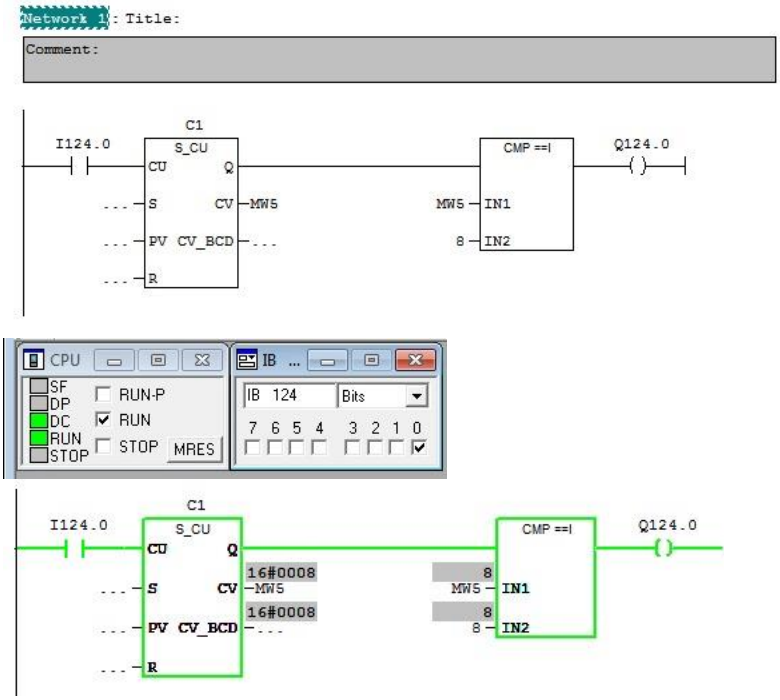






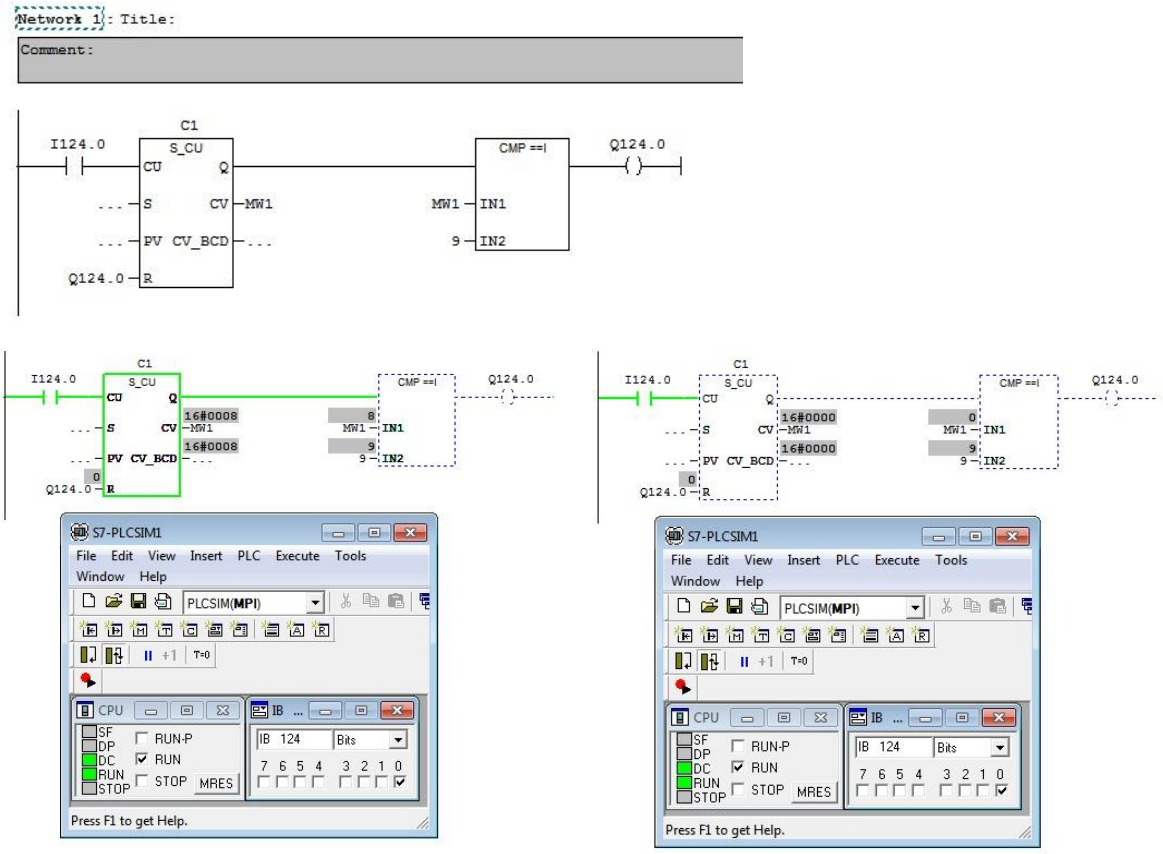


4. Write a program in which each time a photocell at address I124.0 is triggered, one is added to a counter. If the counter reaches 8, a hydraulic jack at address Q124.0 is activated.



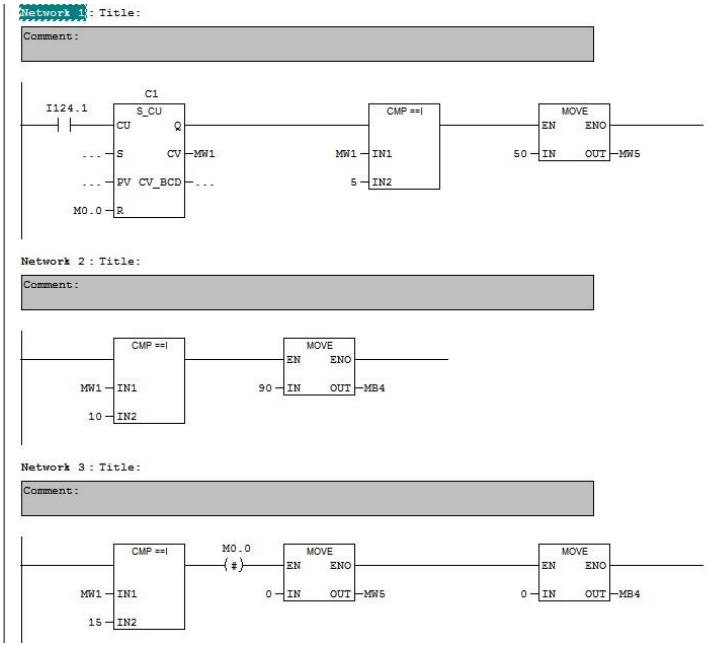
In this program, whenever I124.0 is pressed, counter C increments, and its count is compared to the number 8 by a comparator. When they become equal, the logic Q124.0 becomes true.

5. Write a program where each time a photocell at address I124.0 is triggered, one is added to a counter. If the counter reaches a maximum of 9, it resets automatically and starts counting from zero again.

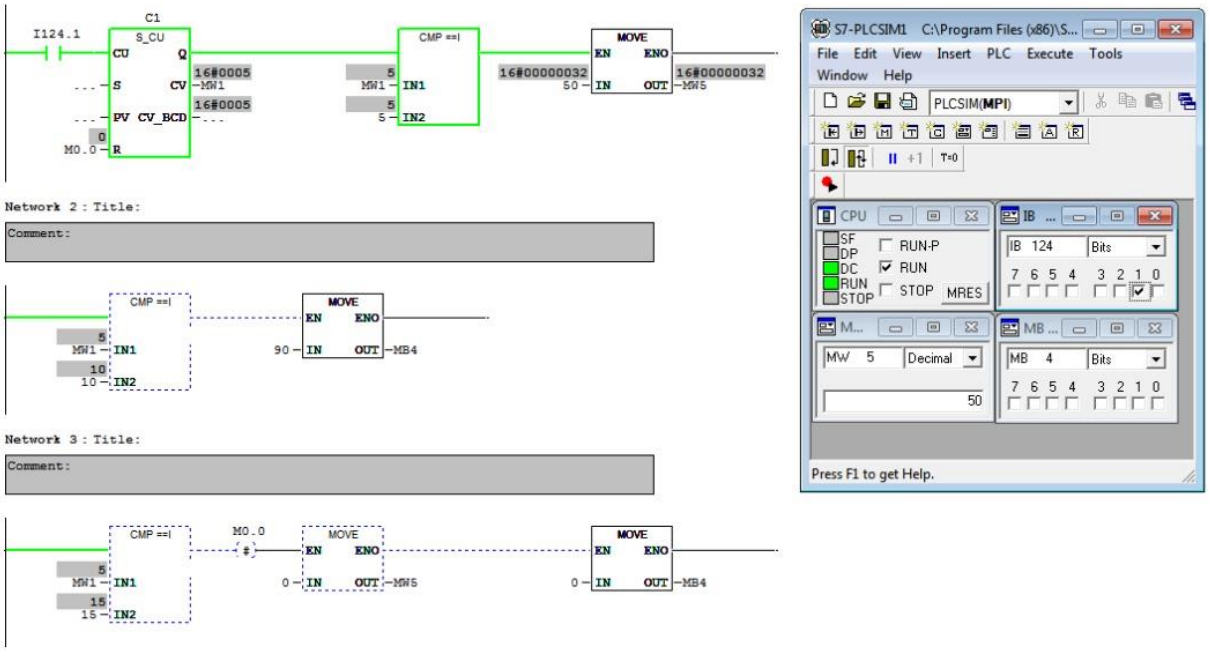


In this program, whenever I124.0 is triggered, counter C1 increments, and its count is compared to the number 9 by a comparator. When they become equal, logic Q124.0 becomes true, and counter C1 is reset, starting counting again from zero.

6. Write a program that, if input I124.1 is pressed 5 times, puts the number 50 in MW5, and if it's pressed 10 times, puts the number 90 in MB4. If it's pressed 15 times, the counter resets and the content of MB4 and MW5 becomes zero.

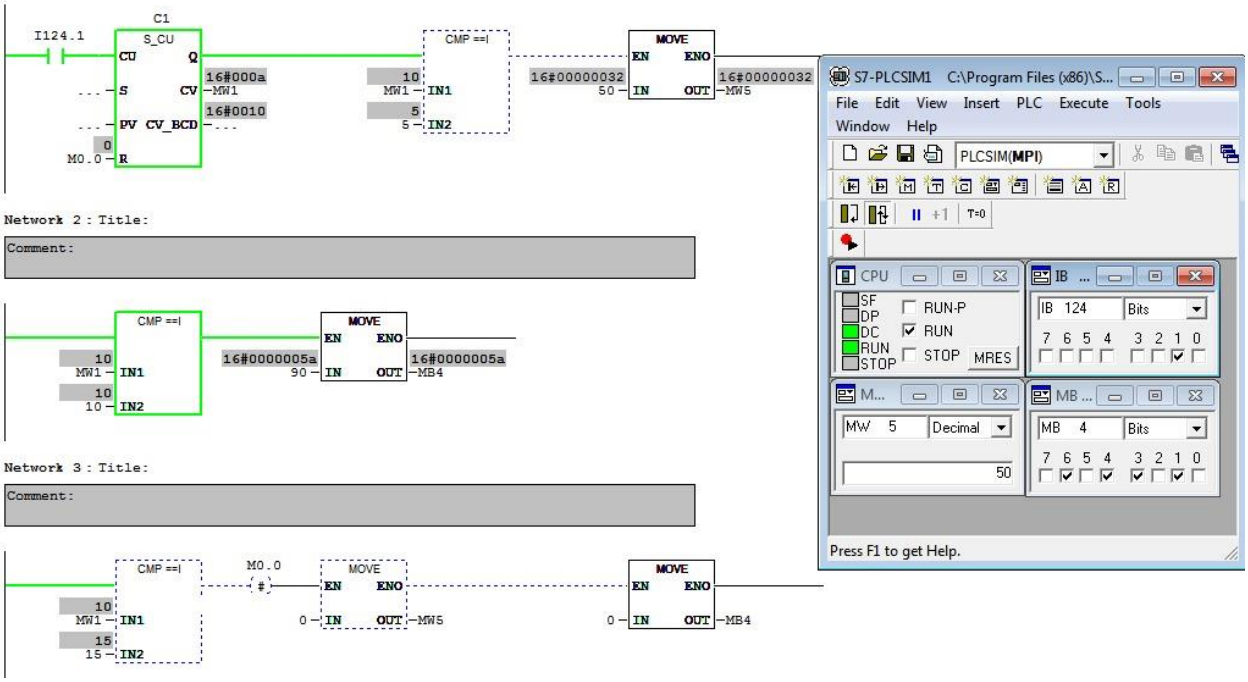


If I124.1 is pressed 5 times,

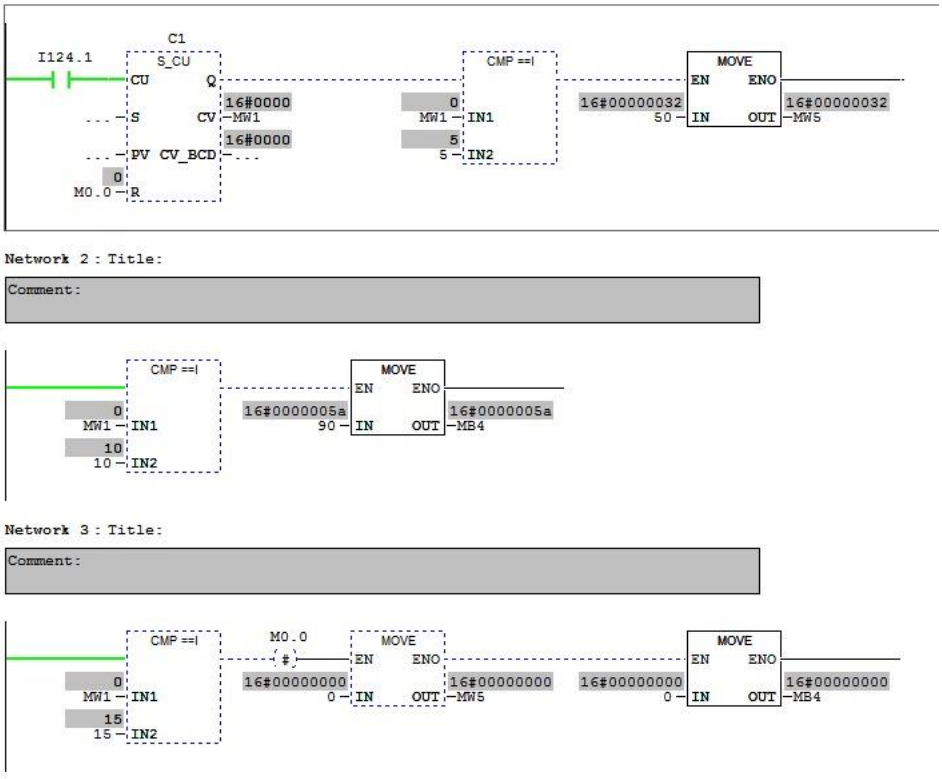


It can be observed that the number 50 has been stored in MW5.

If it's pressed 10 times:

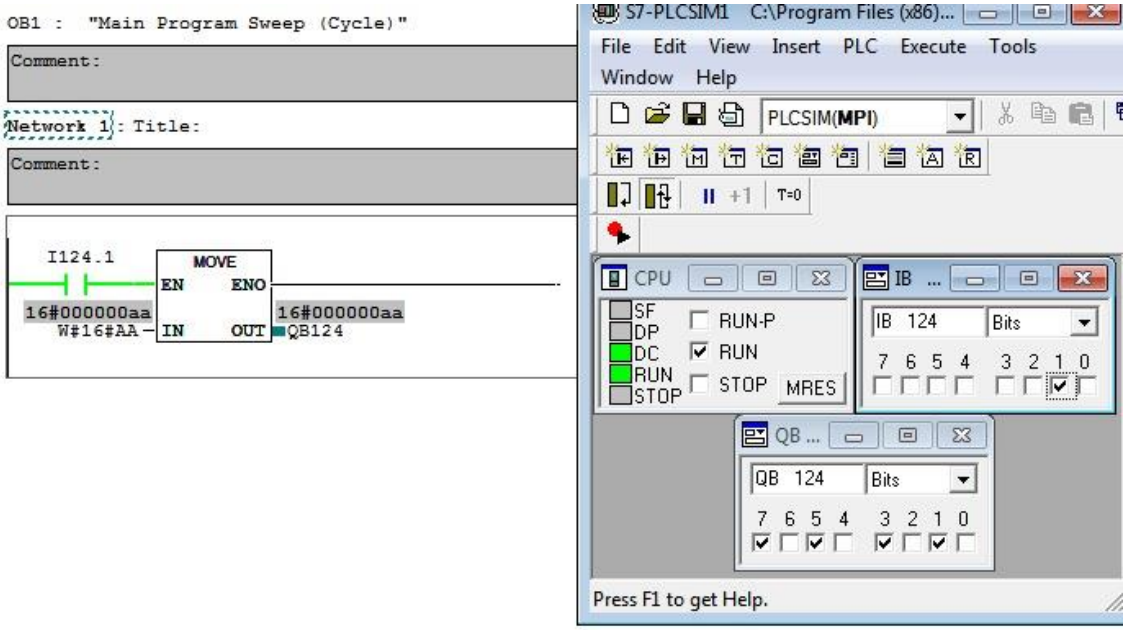


It can be observed that the number 90 has been stored in MB4, and if it's pressed 15 times:

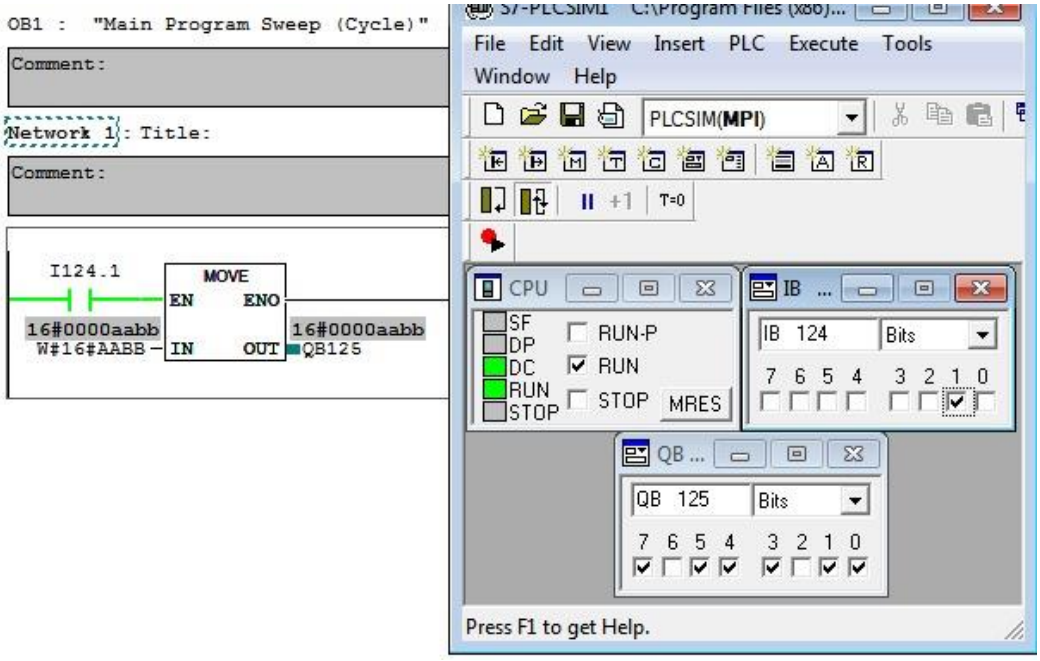


The content of both MW5 and MB4 has been reset to zero.

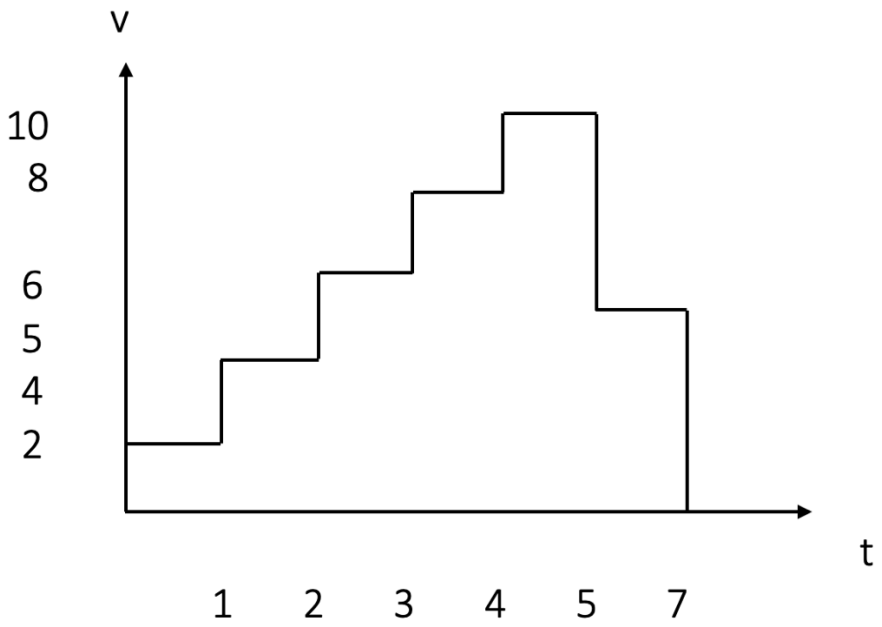
7. The move command for transferring data between different input and output devices.



It can be observed that input W#16#AA can display odd numbers on the output.



8. Write a program to display the following table by pressing the key I124.0, where the voltages are shown on output PQW128:

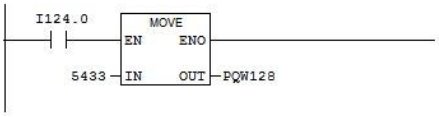


By multiplying the voltages by 27500 and then dividing by 10, we obtain the respective numbers. We have:

number	v
5500	2
11000	4
13750	5
16500	6
22000	8
27500	10

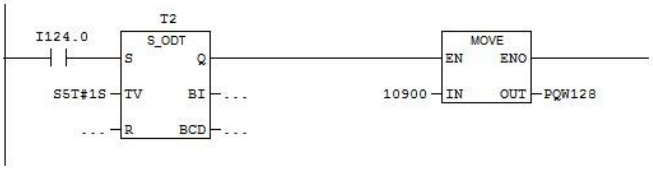
Network 1 : Title:

Comment:



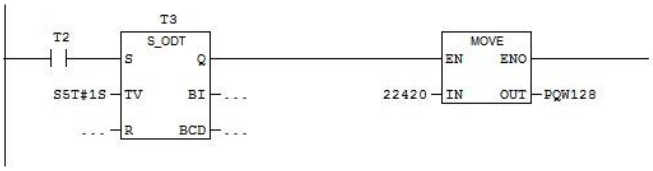
Network 2 : Title:

Comment:



Network 3 : Title:

Comment:



Network 4 : Title:

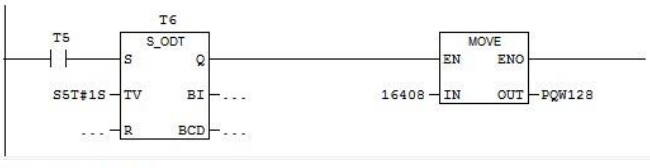
Comment:

Network 5 : Title:

Comment:

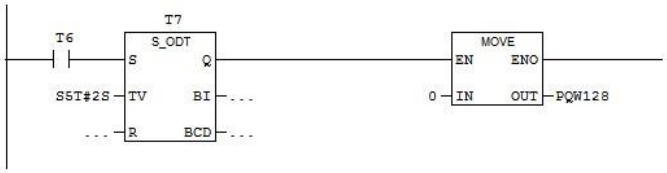
Network 6 : Title:

Comment:



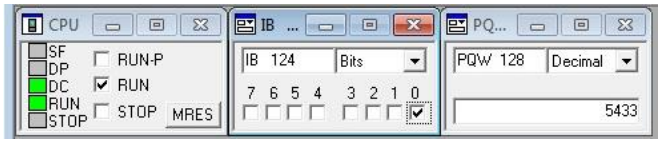
Network 7 : Title:

Comment:

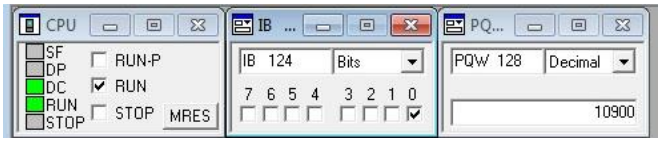


If we press the key I124.0, the number 5433 is displayed on PQW128, and timer T2 starts. After 1 second, the number 10900 is displayed on PQW128. Then, timer T3 is activated, and after 1 second, the number 22420 is displayed on PQW128. Timer T4 is activated, and after 1 second, the number 28000 is displayed on PQW128. Timer T5 is activated, and after 1 second, the number 9500 is displayed on PQW128. Timer T6 is activated, and after 1 second, the number 16408 is displayed on PQW128. Timer T7 is activated, and after 2 seconds, the number 0 is displayed on PQW128. We have:

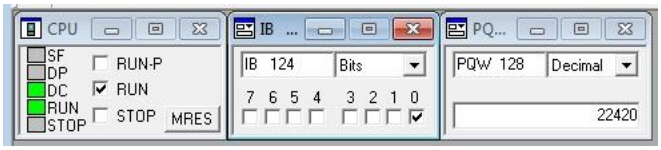
After pressing the key I124.0:



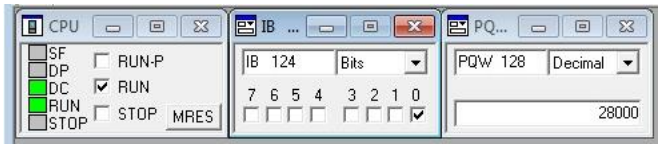
After timer T2 is activated:



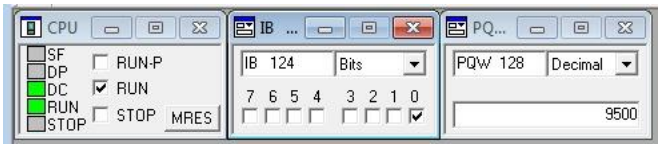
After timer T3 is activated:



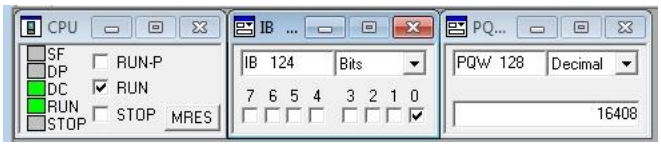
After timer T4 is activated:



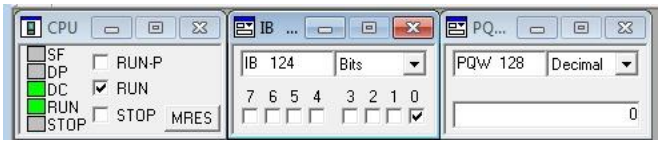
After timer T5 is activated:



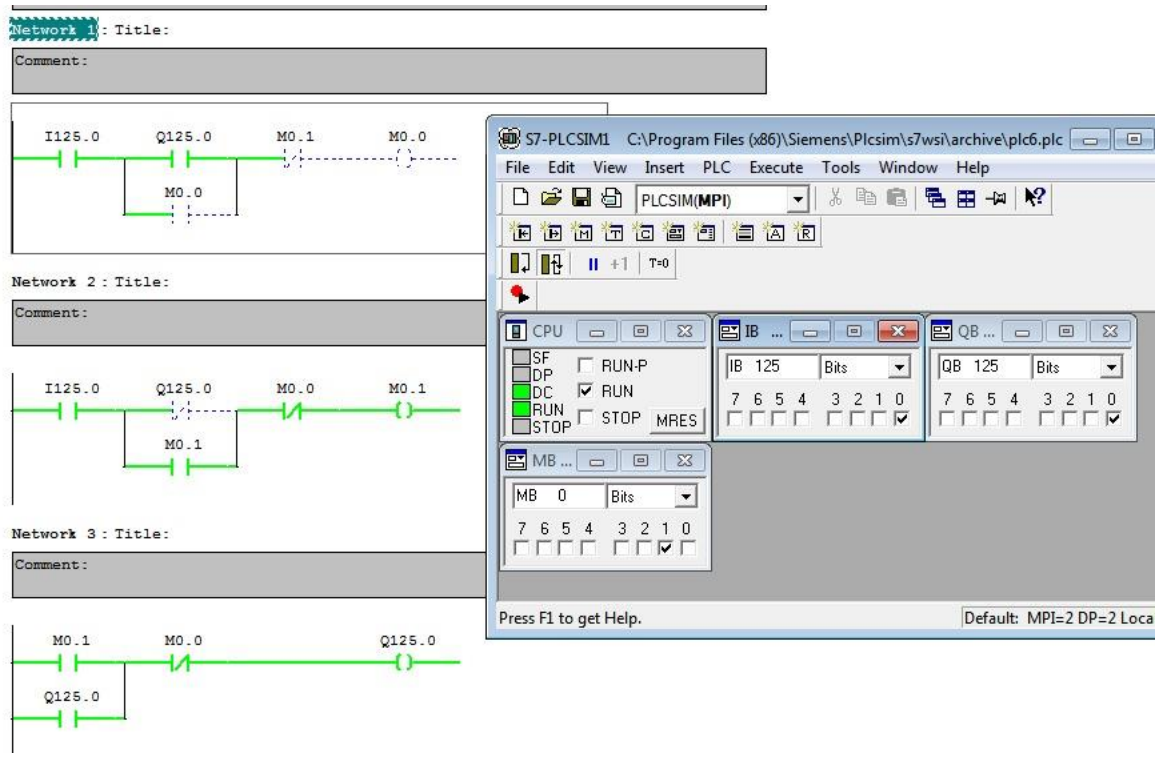
After timer T6 is activated:

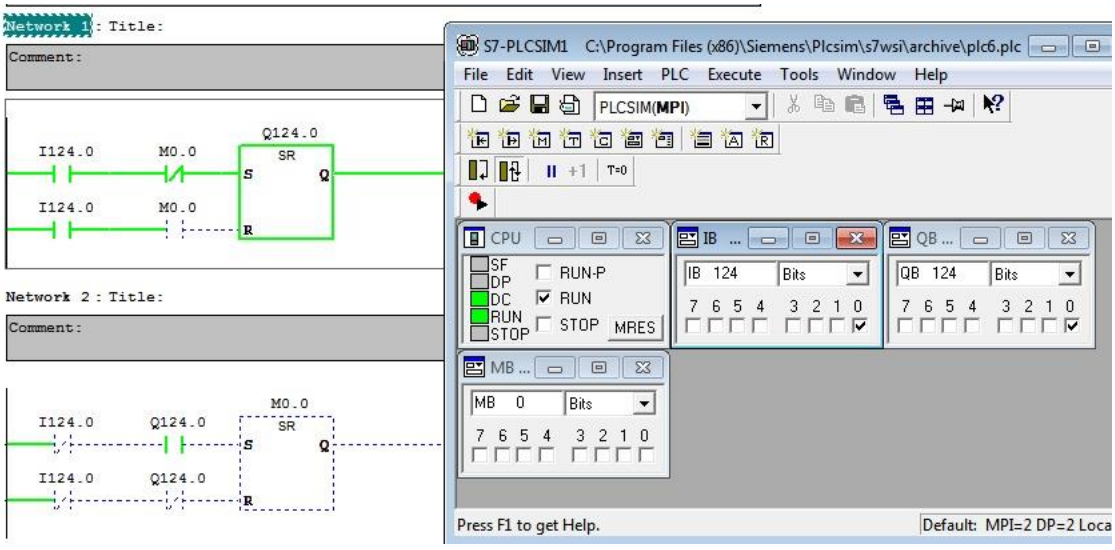


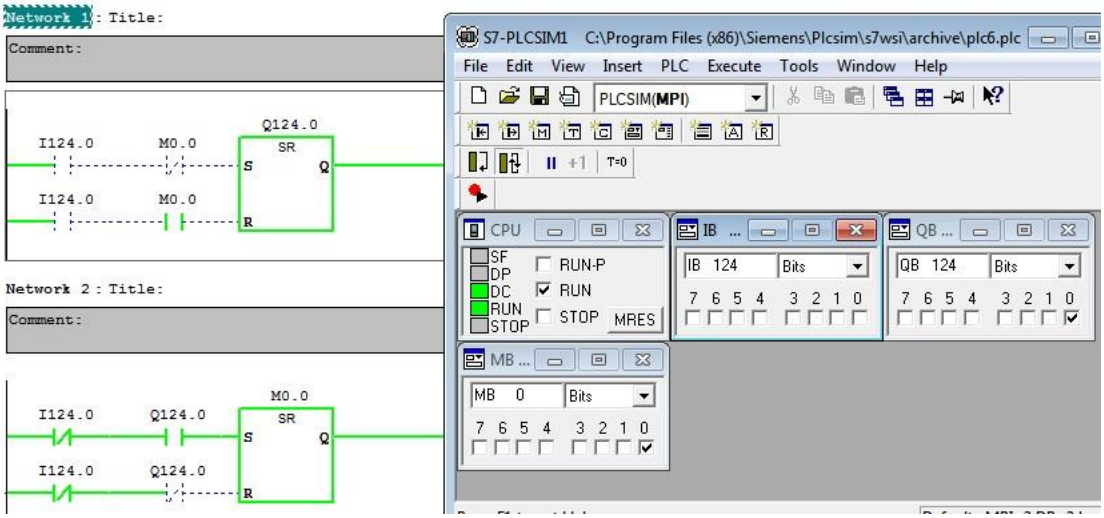
After timer T7 is activated:



Other programs:






Network 1: Title:
Comment:
I124.0
M0.0
Q124.0
SR
S
Q
I124.0
M0.0
R
Network 2: Title:
Comment:
I124.0
Q124.0
M0.0
SR
S
Q
I124.0
Q124.0
R
S7-PLCSIM1 C:\Program Files (x86)\Siemens\Plcsim\s7wsi\archive\plc6.plc
File Edit View Insert PLC Execute Tools Window Help
PLCSIM(MPI)
CPU
SF
DP
DC
RUN
STOP
RUN-P
RUN
STOP
MRES
IB ...
IB 124
Bits
7 6 5 4 3 2 1 0
QB ...
QB 124
Bits
7 6 5 4 3 2 1 0
MB ...
MB 0
Bits
7 6 5 4 3 2 1 0