Solve the tasks in FBD language.

Task 1

Create a function block that works as a generator (Fig.1).

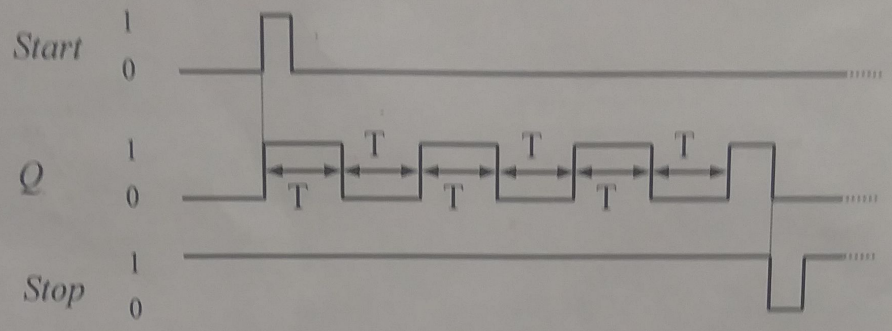


Fig.1 Time sequence of the generator

Tab. 1 The function block interface

Function Block interface for point a				
Parameter name	Parameter sort	Parameter type	Range	Description
Start	input	bool		Input that starts the generator. Reacts on **rising edge**.
Stop	input	bool		Input that stops the generator. Reacts on the **level** 0 of the signal.
Timer1	input	timer		The timer used to implement the generator. It measures the time the output is ON.
Timer2	input	timer		The timer used to implement the generator. It measures the time the output is OFF.
T	input	S5Time	10ms-2h46m30s	Half of the generator period
Q	output	bool		Output of the generator

To solve the task **use only local variables** in function block (FB) !

Remark
The function block being the solution of the task 1 should be then used to solve the task 2.

Task 2

Assume that system under consideration consists of feeder with bolt (latch) and three belt-conveyors (Fig.1). Control panel consists of three pushbuttons:

1. *Start* (NO),
2. *Stop* (NC) and
3. *Emergency_Stop* (NC),

and one switch *Shift* (NO).

There are five outputs in the system: signal to open/close the bolt (latch) of the feeder, signals to switch on/off three belt conveyors and a lamp to signal the mode of operation.

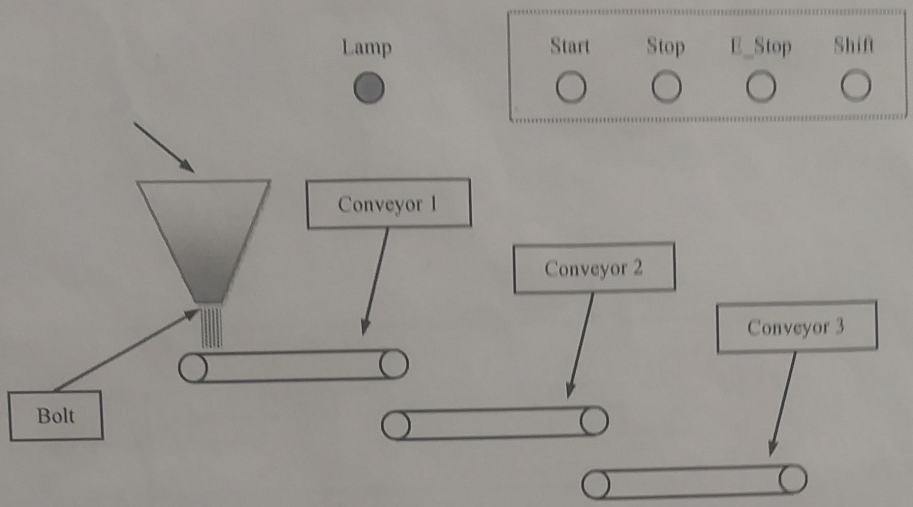
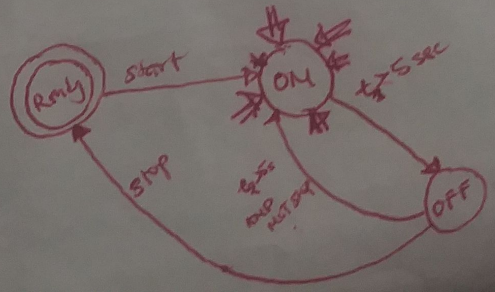


Fig.2 Diagram of the system

Conditions of operation:

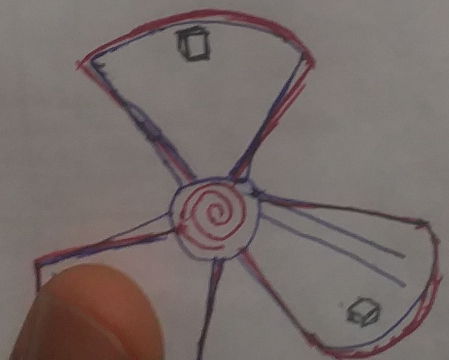
1. Pressing *Start* pushbutton causes to open the bolt (latch) of the feeder and start the first conveyor, then after 3s the second one and finally after next 4s the third one start,
2. Pressing *Stop* pushbutton causes to close the bolt (latch) of the feeder, then after 3s switch off the first conveyor, then after 4s the second conveyor, and finally after next 3s the third one switch off,
3. Pressing *Emergency_Stop* pushbutton causes to close the bolt and switch off all conveyors at once (without any delays),
4. Pressing *Start* pushbutton after pressing *Emergency_Stop* causes to open the bolt and switch on all conveyors at once (without any delays).
5. After two complete cycles (*Start/Stop/Start/Stop*) the system is blocked (does not react on pressing *Start*) until the operator presses the *Emergency_Stop* pushbutton once. In that case to indicate this fact the *Lamp* is blinking (with the period 300ms).
6. If the object is stopped by pressing *Stop* pushbutton the *Lamp* is turn on. If the object is stopped by pressing *Emergency_Stop* pushbutton the *Lamp* is blinking (with the period 600ms).
7. Operators work in shifts. If the switch *Shitf*=0, the day-shift is working. If the switch *Shitf*=1, the night-shift is working. In the memory word MW20 program should store the number of full cycles performed by currently working shift. In the memory words MW30 and MW40 program should store the number of full cycles performed by the previous day-shift and night-shift, respectively. In the memory word MW50 program should store the number of full cycles performed by the previous day-shift and night-shift. The values in MW20, MW30, MW40 and MW50 change with the change of switch *Shitf* state (0→1 or 1→0).

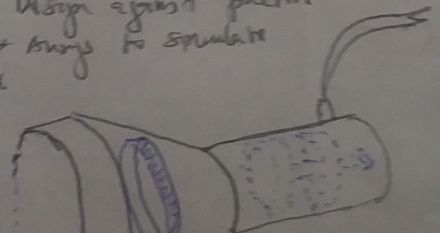


Inputs	Contact	Address
Start	Normally open	I 124.0
Stop	Normally closed	I 124.1
Emergency_Stop	Normally closed	I 124.2
Shift	Switch	I 124.3
Outputs		**Address**
Bolt		Q 124.0
Conveyor 1		Q 124.1
Conveyor 2		Q 124.2
Conveyor 3		Q 124.3
Lamp		Q 124.4

Memory words	Meaning
MW20	the number of full cycles performed by currently working shift
MW30	the number of full cycles performed by the previous day-shift
MW40	the number of full cycles performed by the previous night-shift
MW50	the number of full cycles performed by the previous day-shift and night-shift. The sum of < *MW30*> and < *MW40*>.

Remark.
Term *full cycle* means that the following sequence took place: the *Start* pushbutton was pressed, all the outputs were activated, the *Stop* pushbutton was pressed and all the outputs were deactivated with appropriate delays.





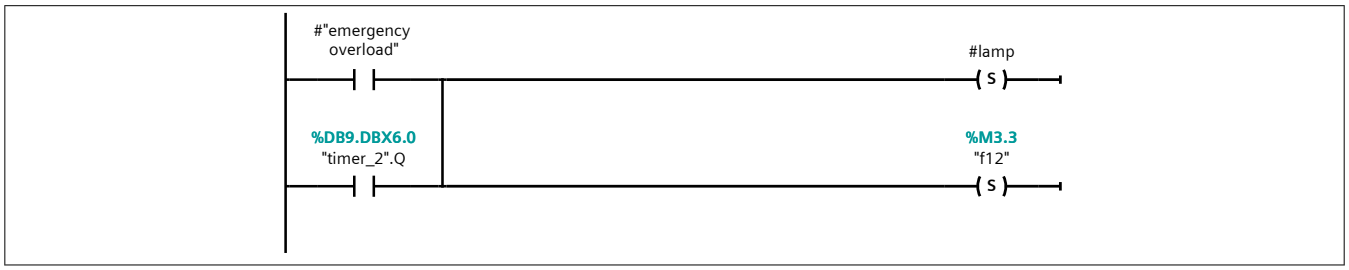
laboratory2 / PLC_1 [CPU 314C-2 DP] / Program blocks

Lamp_Emergency [FC1]

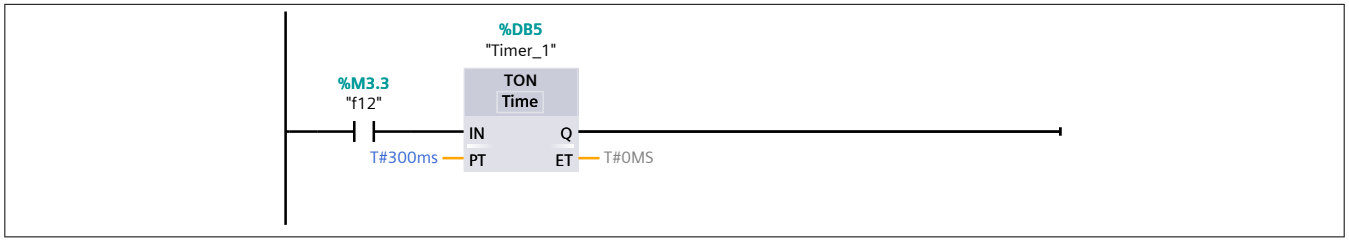
Lamp_Emergency Properties					
General					
Name	Lamp_Emergency	**Number**	1	**Type**	FC
Language	LAD	**Numbering**	Automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Lamp_Emergency				
Name	**Data type**	**Offset**	**Default value**	**Comment**
▼ Input				
emergency overload	Bool			
start	Bool			
▼ Output				
lamp	Bool			
InOut				
Temp				
Constant				
▼ Return				
Lamp_Emergency	Void			

Network 1:

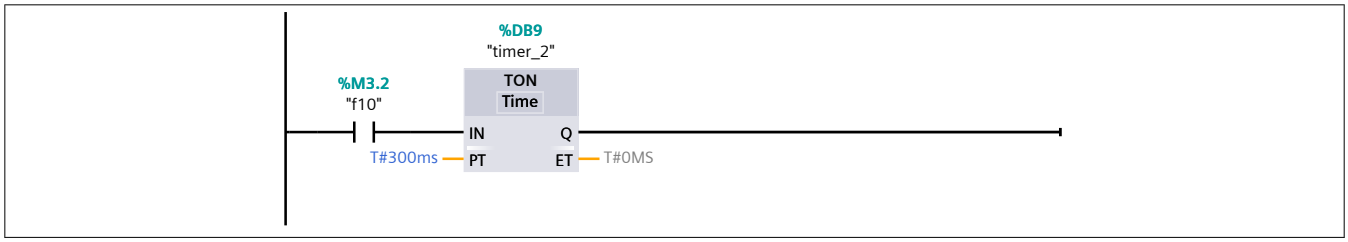


Network 2:

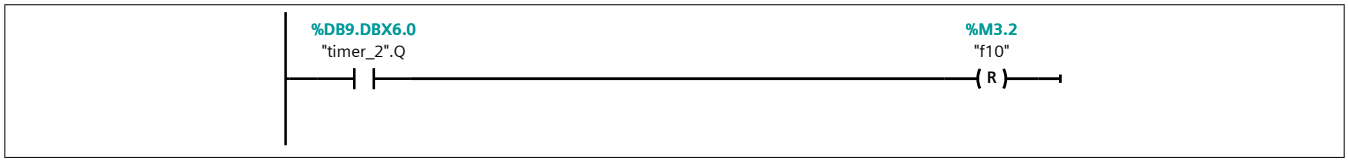


Network 3:

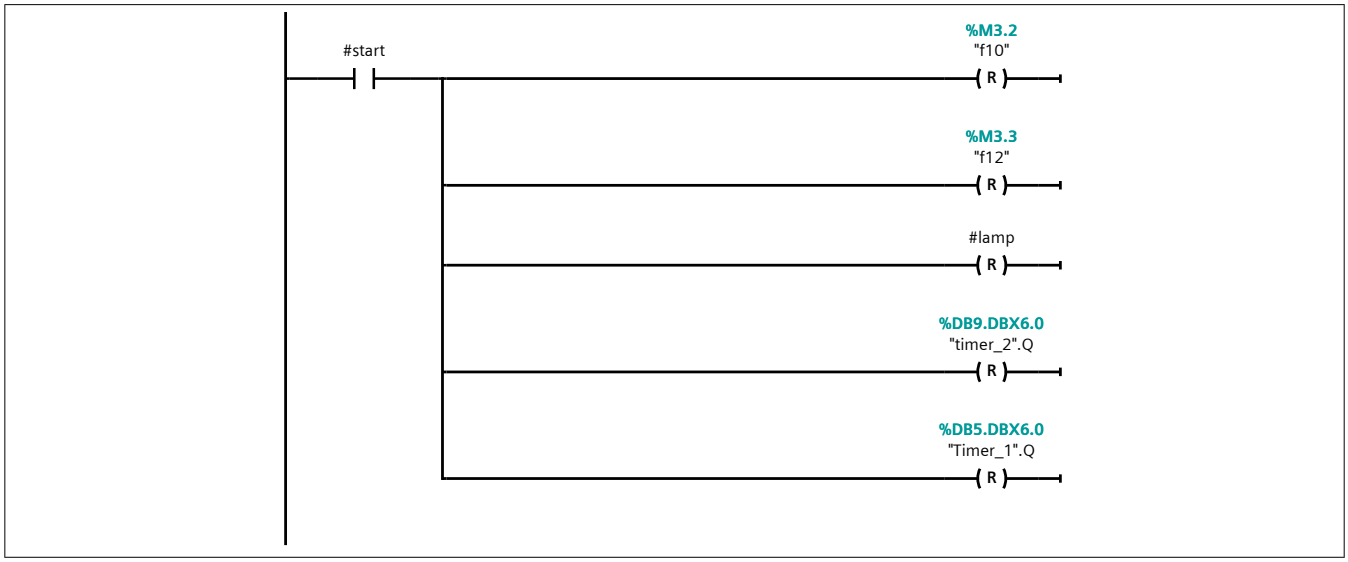
Network 4:



Network 5:



Network 6:



laboratory2 / PLC_1 [CPU 314C-2 DP] / Program blocks

Main [OB1]

Main Properties					
General					
Name	Main	**Number**	1	**Type**	OB
Language	FBD	**Numbering**	Manual		
Information					
Title	"Main Program Sweep (Cycle)"	**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Main

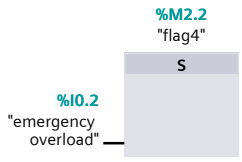
Name	Data type	Offset	Default value	Comment
▼ Temp				
OB1_EV_CLASS	Byte	0.0		Bits 0-3 = 1 (Coming event), Bits 4-7 = 1 (Event class 1)
OB1_SCAN_1	Byte	1.0		1 (Cold restart scan 1 of OB 1), 3 (Scan 2-n of OB 1)
OB1_PRIORITY	Byte	2.0		Priority of OB Execution
OB1_OB_NUMBR	Byte	3.0		1 (Organization block 1, OB1)
OB1_RESERVED_1	Byte	4.0		Reserved for system
OB1_RESERVED_2	Byte	5.0		Reserved for system
OB1_PREV_CYCLE	Int	6.0		Cycle time of previous OB1 scan (millisec-onds)
OB1_MIN_CYCLE	Int	8.0		Minimum cycle time of OB1 (milliseconds)
OB1_MAX_CYCLE	Int	10.0		Maximum cycle time of OB1 (milliseconds)
OB1_DATE_TIME	Date_And_Time	12.0		Date and time OB1 started
Constant				

Network 1:

Involcation of Master control relay

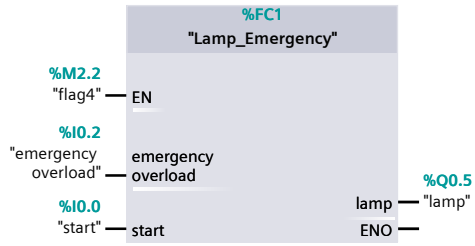
Network 2:

Set flag 4 when emergency_overload push botton is pressed

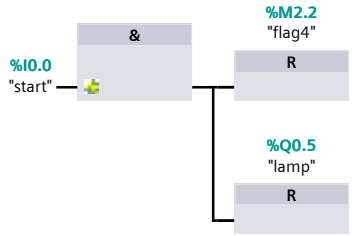


Network 3: Call Emergency lamp function

Blink Lamp when emergency_overload push button is pressed

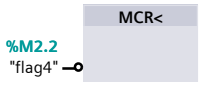


Network 4:

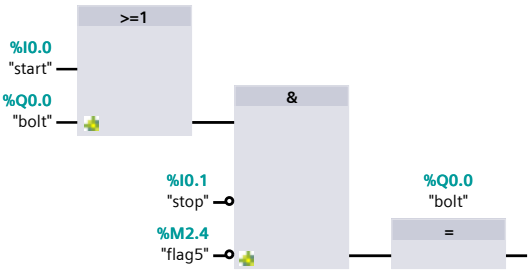


Network 5: Activation of Master control relay

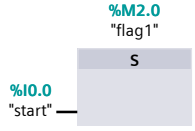
If flag4 receives a high signal, Master control relay is activated and power is cut off.



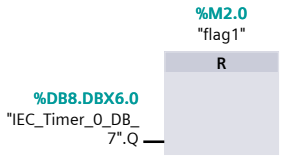
Network 6: OPEN FEED BOLT



Network 7:

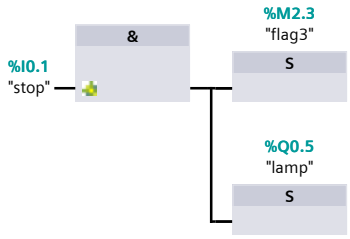


Network 8:

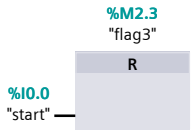


Network 9:

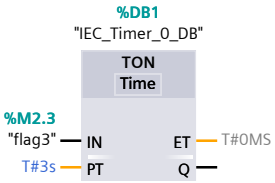
the stop button is used to set flag 3



Network 10:

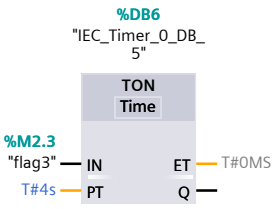


Network 11:



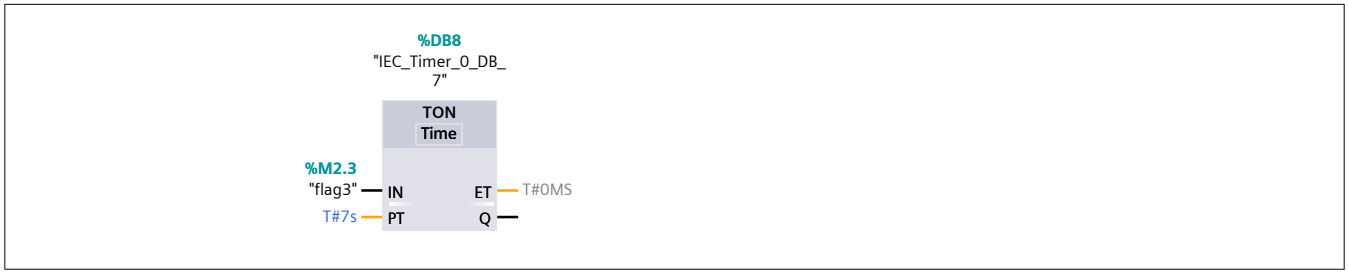
Network 12: timer output used to reset conveyor2

I used the output of this timer to stop conveyor 2 after 4 seconds

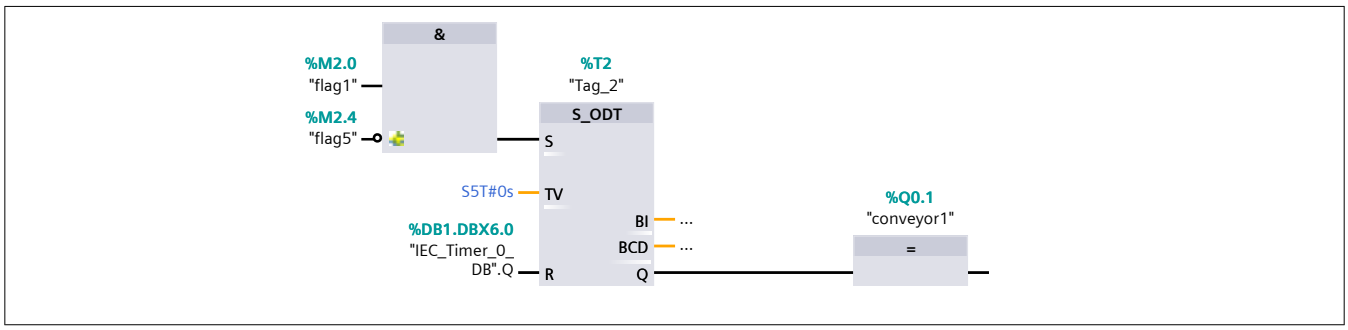


Network 13: timer output to reset conveyor 3

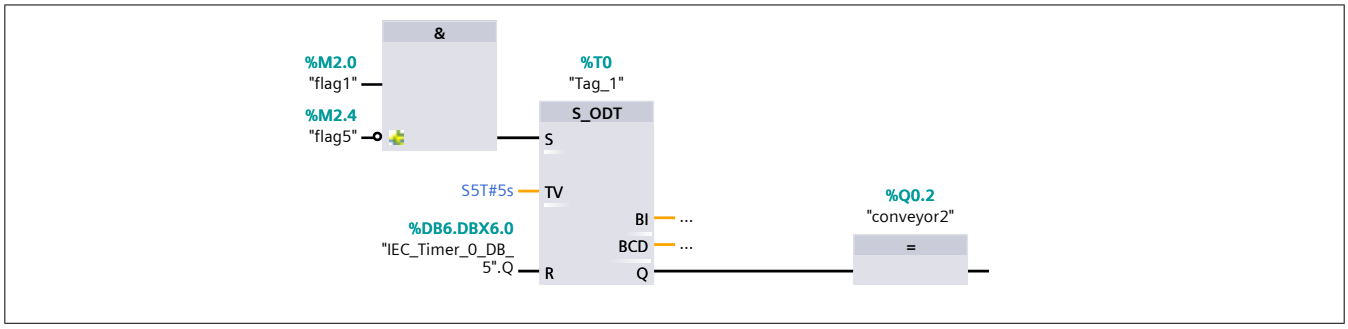
I used the output of this timer to stop conveyor 3 after 7 seconds



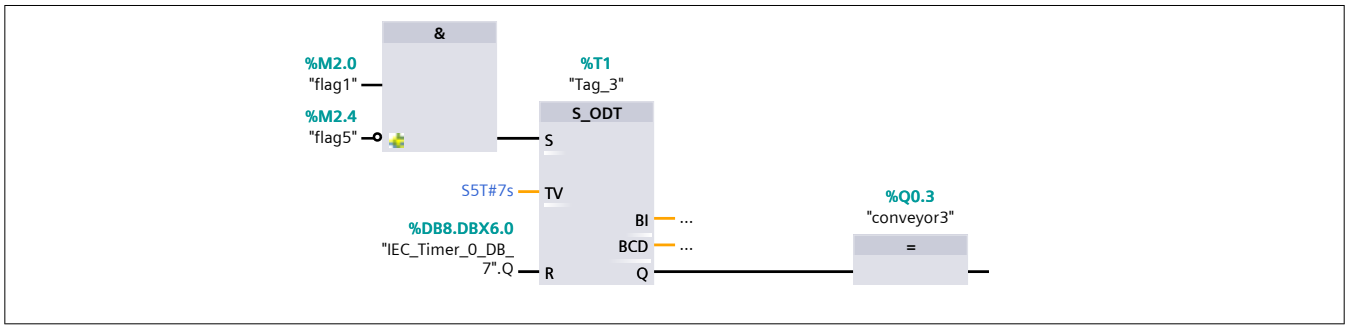
Network 14:



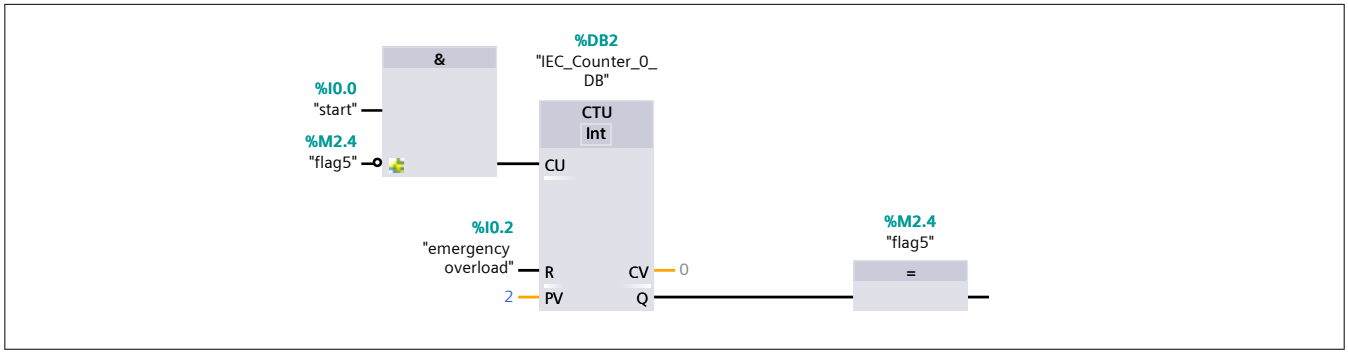
Network 15:



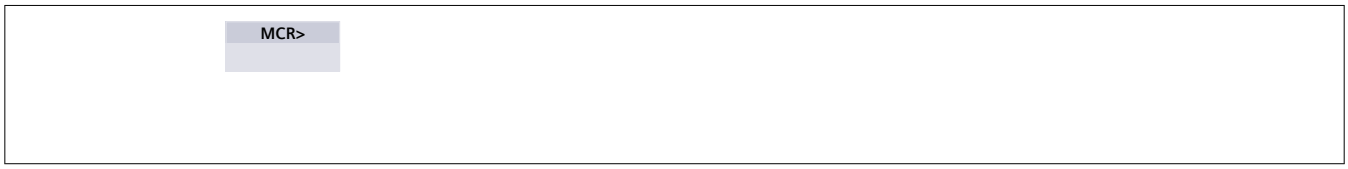
Network 16:



Network 17:



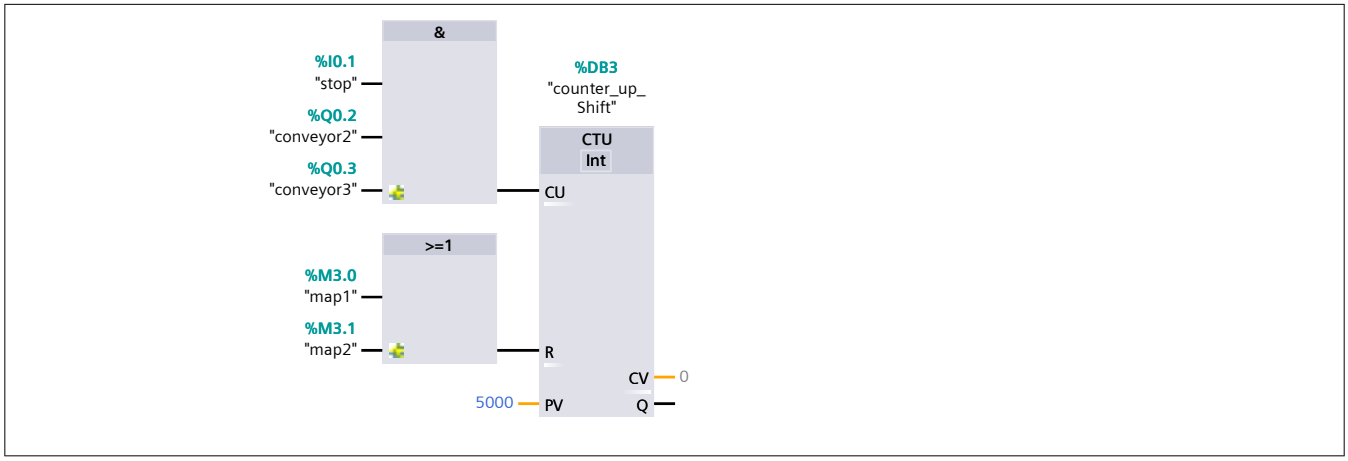
Network 18:



Network 19: OPERATORS WORK IN SHIFT

Network 20:

Network 21:

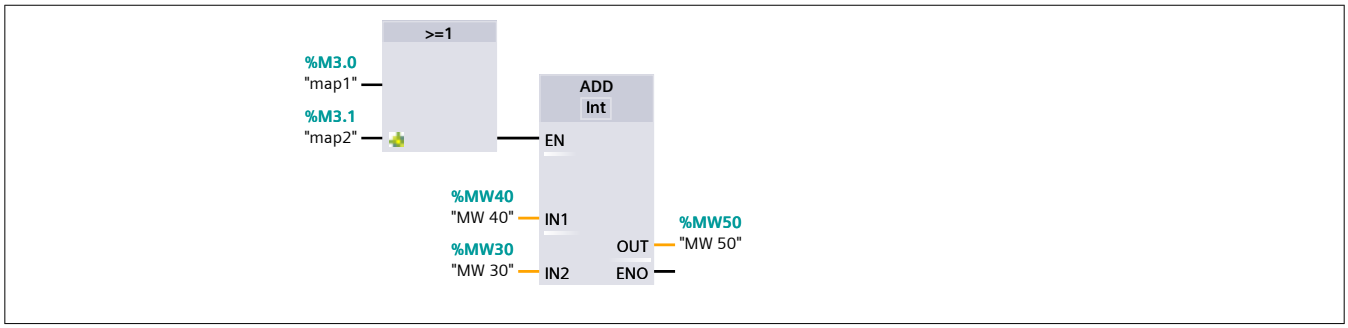


Network 22:

Network 23:

Network 24:

Network 25:



Network 26: