

# Suport curricular

Instruirea și certificarea utilizatorilor în domeniul ingineriei fabricației pentru Industria 4.0 – Ianuarie 2025



# Modulul 2 – Sisteme integrate de conducere (UTM-I40-002)

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# Agenda – Modulul 2

- ~~Structuri moderne de automate programabile - PLC (Siemens, Allen Bradley, Beckhoff, Phoenix Contact, Bosch Rexroth)~~
- ~~Dezvoltarea aplicațiilor PLC pentru managementul unei celule robotice (standard IEC 61131-3)~~
- Interfețe HMI (Human Machine Interface) pentru monitorizarea și conducerea proceselor industriale
- Aspecte de integrare și comunicații industriale în vederea gestionării unei celule robotice
- Studiu de caz:
  - Modelarea unei aplicații de automatizare cu ajutorul diagramelor de stare
  - Implementarea unui program de conducere automat cu tehnologii Siemens



# Recapitulare



# Unde găsim PLC-uri?



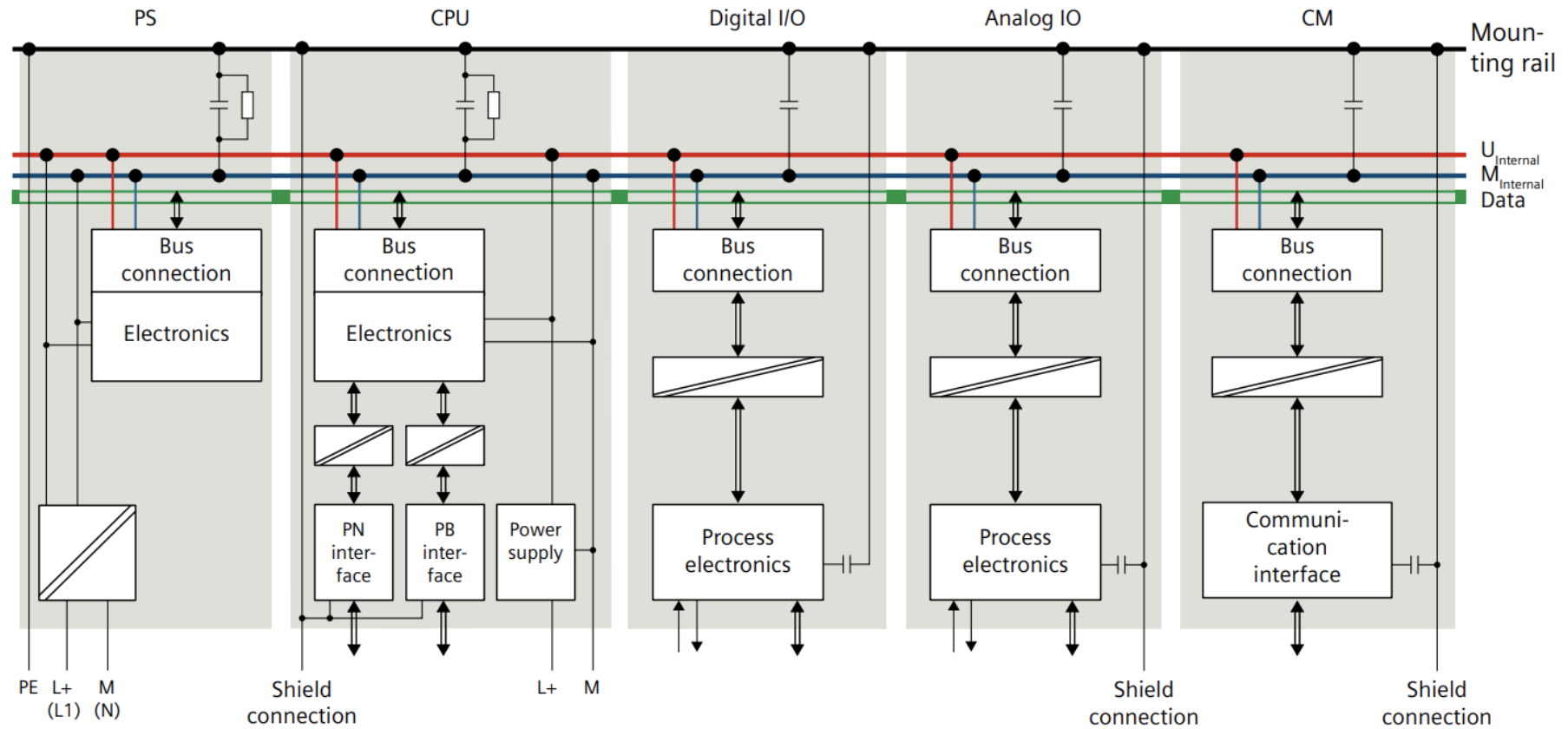
Automatizări Industriale



Laboratorul Industry 4.0

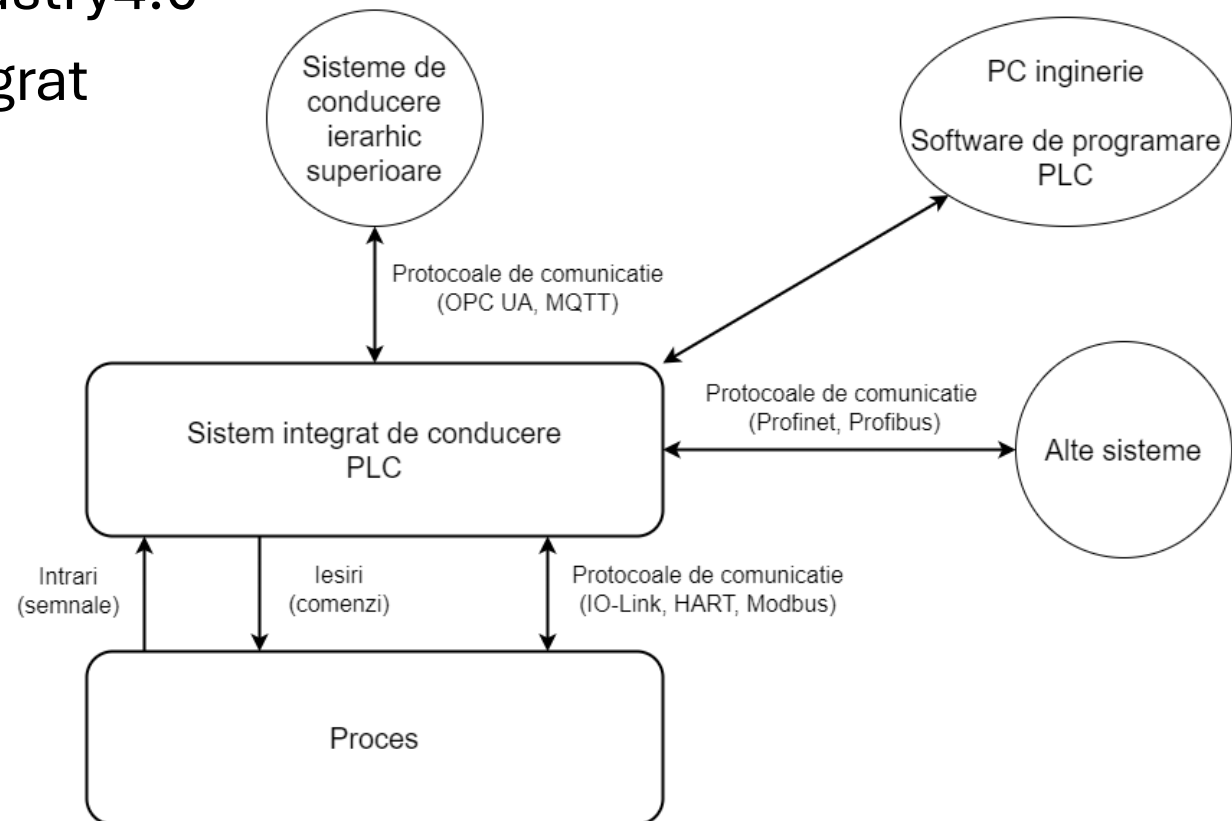


# PLC: Structură

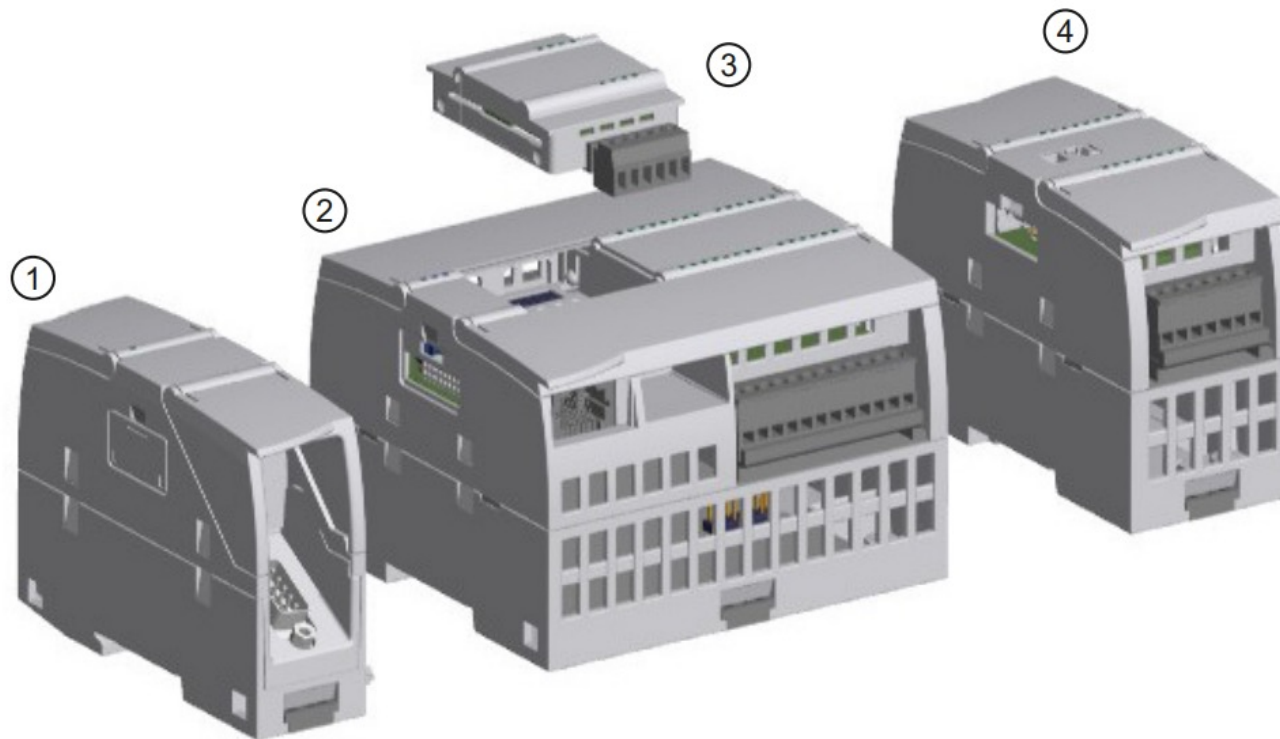


# PLC: Recapitulare

- Componenta cheie in Industry4.0
- Sistem de conducere integrat hardware si software
- Structura modulara
- Comunicatii industriale
- IEC61131-3
- Program / Function / Function Block
- LD / FBD / ST / IL / SFC

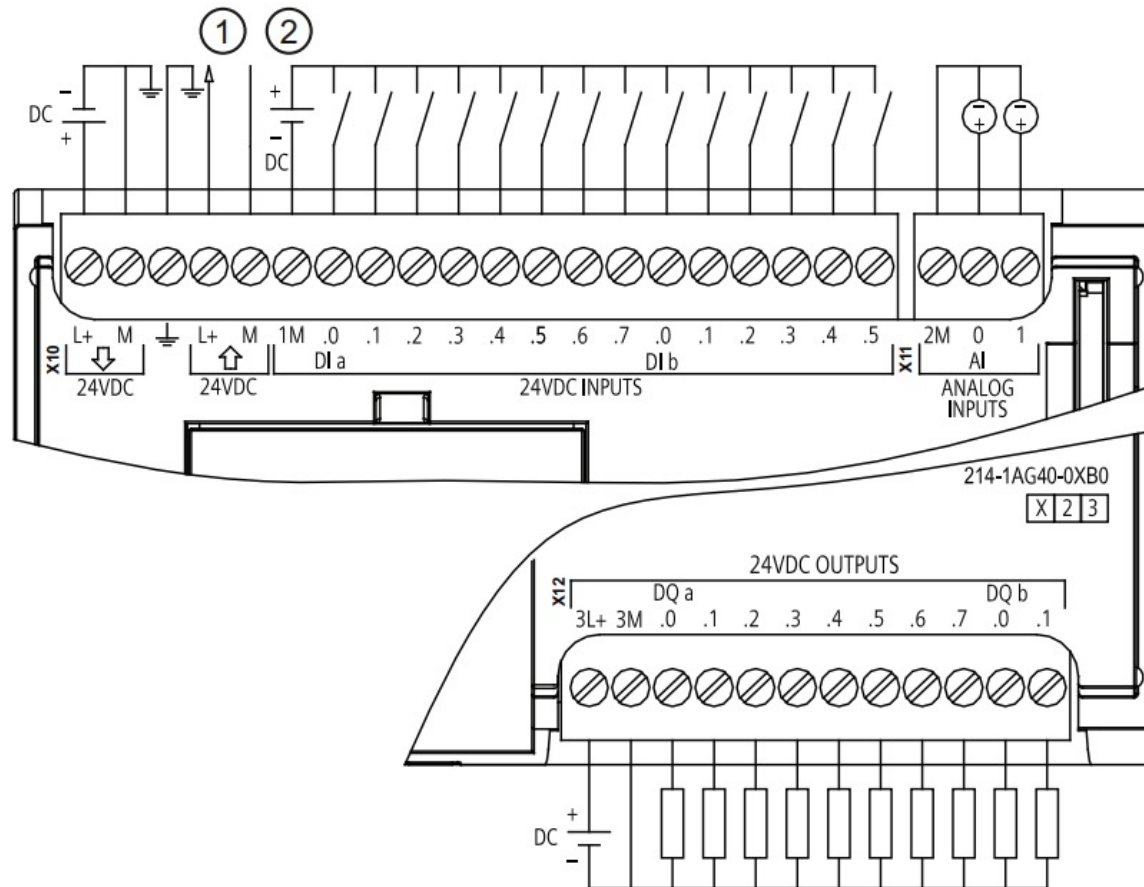


# PLC: S7-1200C





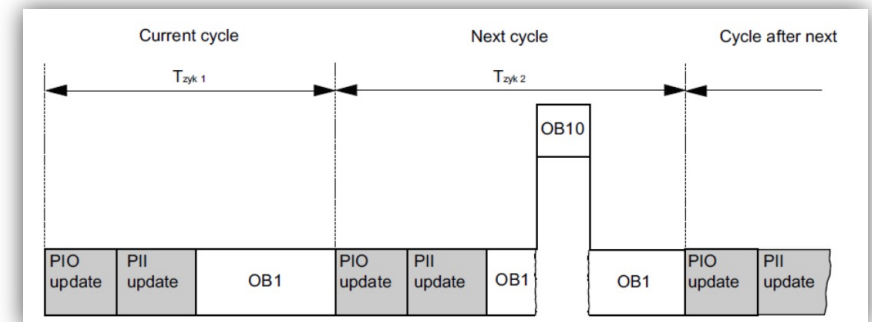
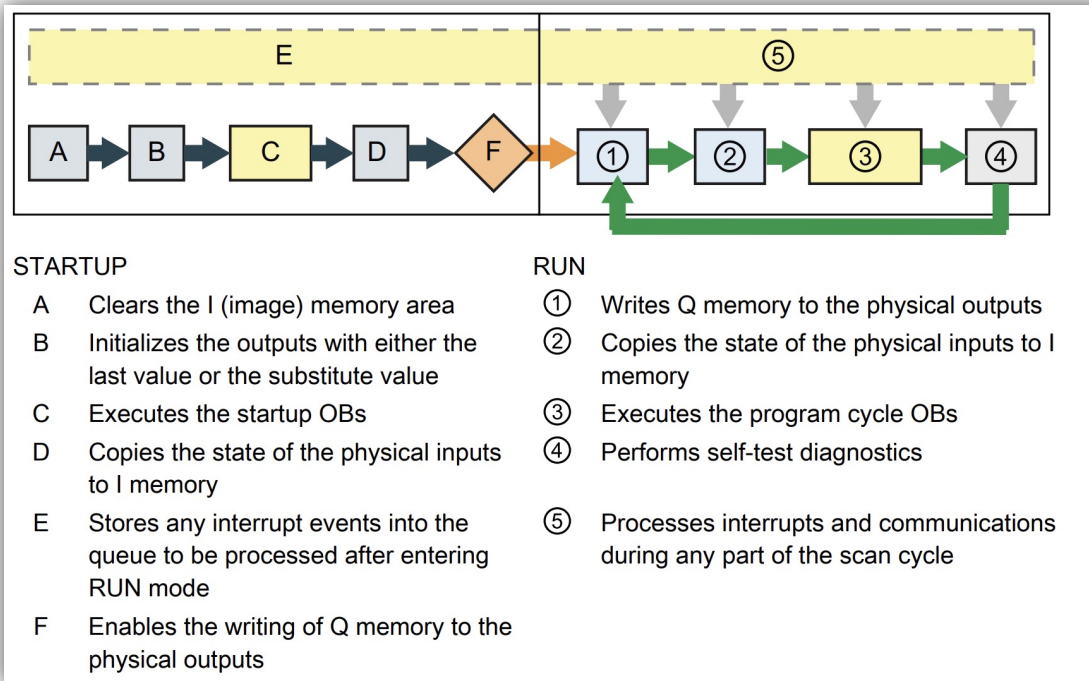
# PLC: S7-1200C: Cablare



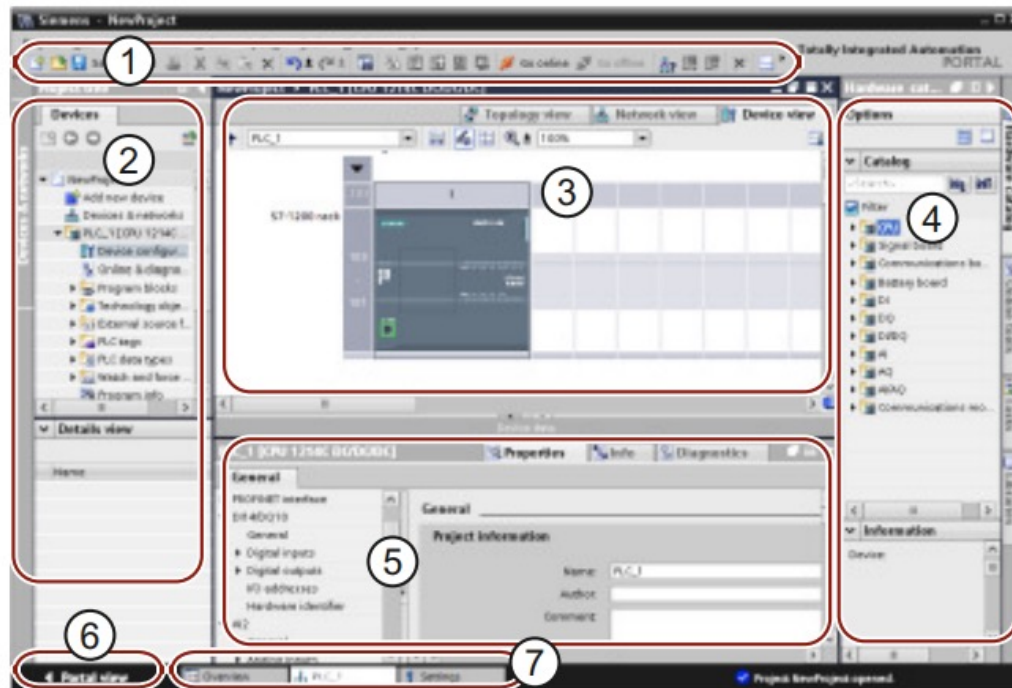
- |   |  |
|---|--|
| ① | <p>24 V DC Sensor Power Out</p> <p>For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.</p> |
| ② | <p>For sinking inputs, connect "-" to "M" (shown).</p> <p>For sourcing inputs, connect "+" to "M".</p>                               |



# PLC: S7-1200C: Ciclu automat



# TIA Portal: Project view

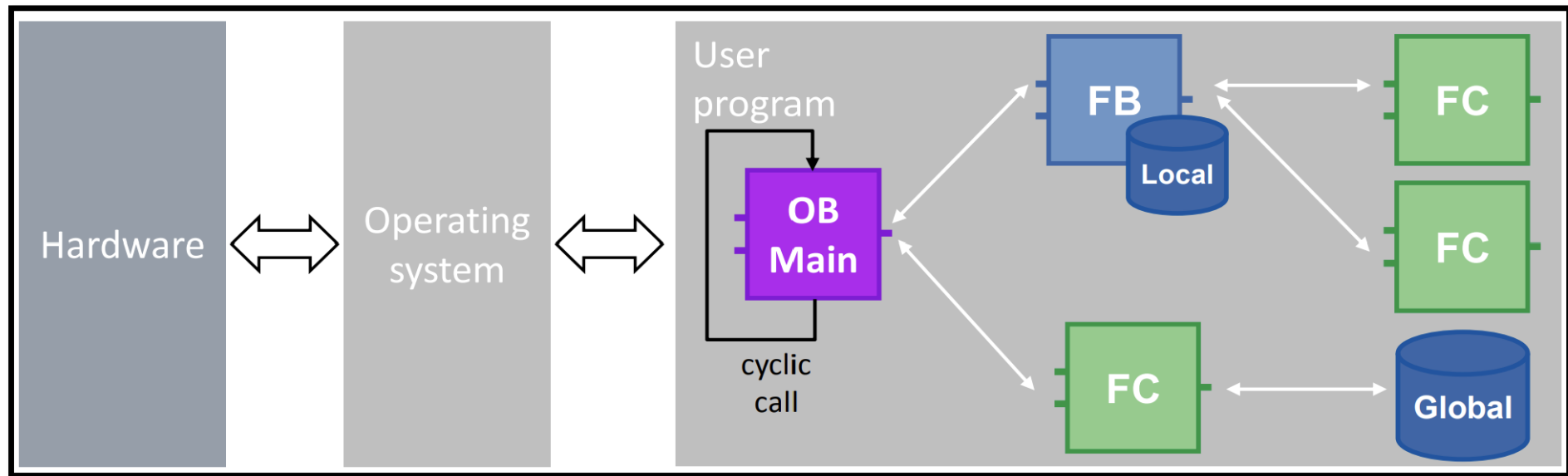


## Project view

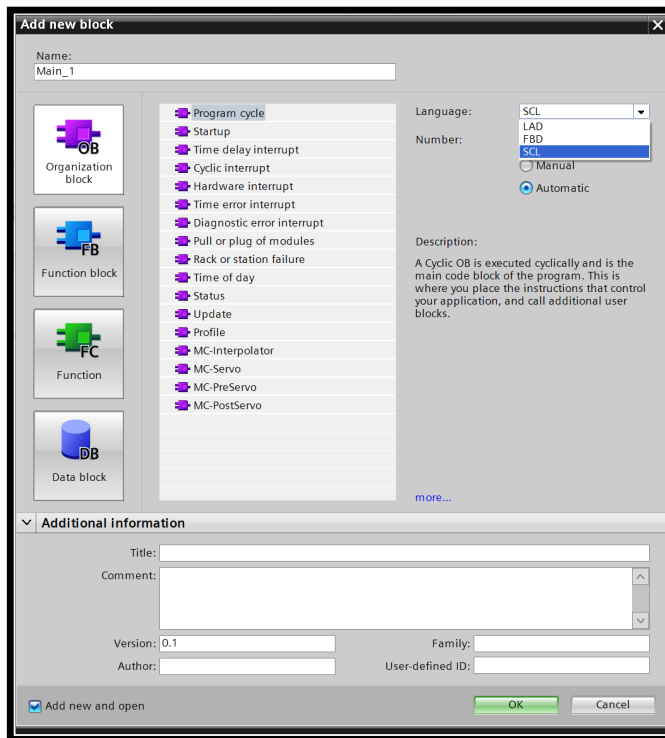
- ① Menus and toolbar
- ② Project navigator
- ③ Work area
- ④ Task cards
- ⑤ Inspector window
- ⑥ Changes to the Portal view
- ⑦ Editor bar



# PLC: S7-1200C: Organizare soft

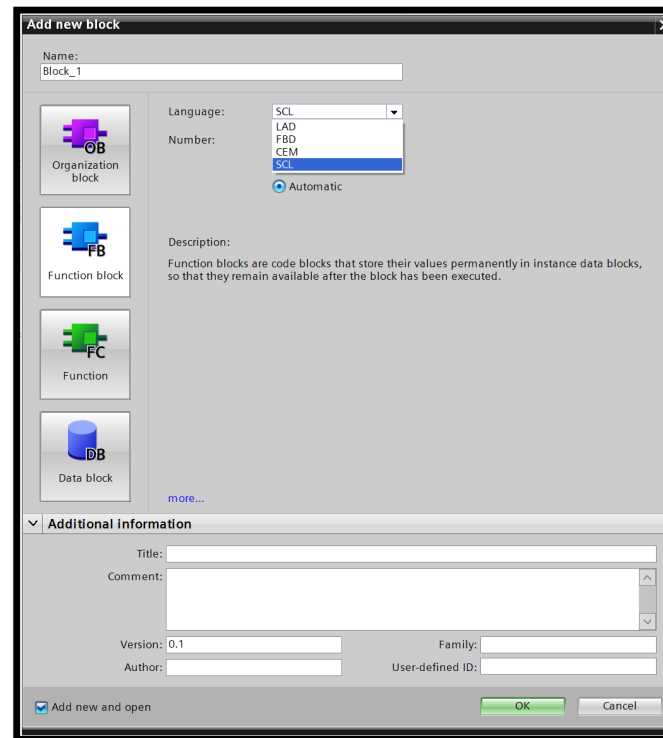


# Organizare program (OB, FB, FC)



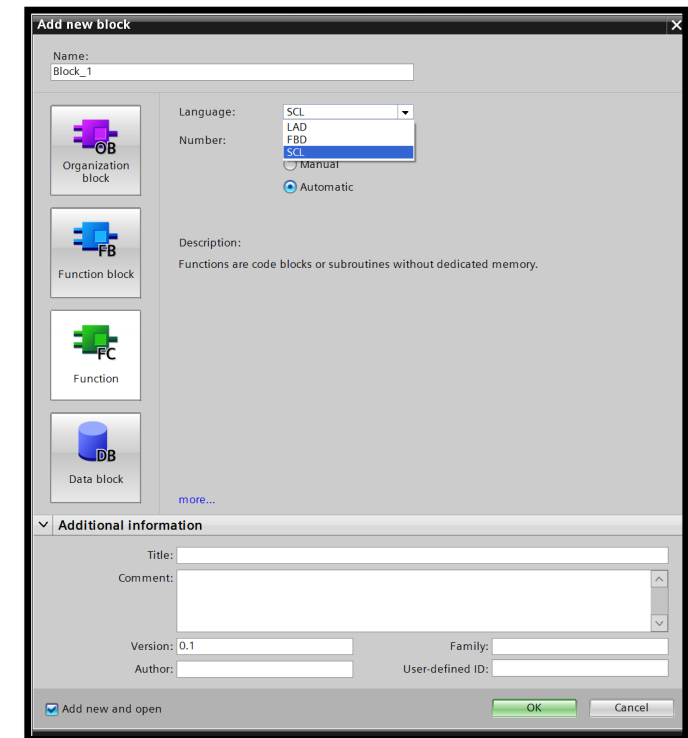
The screenshot shows the 'Add new block' dialog for an Organization Block (OB). The 'Name' field contains 'Main\_1'. The 'Language' dropdown is set to 'SCL'. The 'Number' dropdown is also set to 'SCL'. The 'Automatic' radio button is selected. The 'Description' field contains the text: 'A Cyclic OB is executed cyclically and is the main code block of the program. This is where you place the instructions that control your application, and call additional user blocks.' The 'Additional information' section at the bottom includes fields for Title, Comment, Version (0.1), Family, Author, and User-defined ID. The 'Add new and open' checkbox is checked, and the 'OK' button is highlighted.

OB – Organization Block



The screenshot shows the 'Add new block' dialog for a Function Block (FB). The 'Name' field contains 'Block\_1'. The 'Language' dropdown is set to 'SCL'. The 'Number' dropdown is also set to 'SCL'. The 'Automatic' radio button is selected. The 'Description' field contains the text: 'Function blocks are code blocks that store their values permanently in instance data blocks, so that they remain available after the block has been executed.' The 'Additional information' section at the bottom includes fields for Title, Comment, Version (0.1), Family, Author, and User-defined ID. The 'Add new and open' checkbox is checked, and the 'OK' button is highlighted.

FB – Function Block

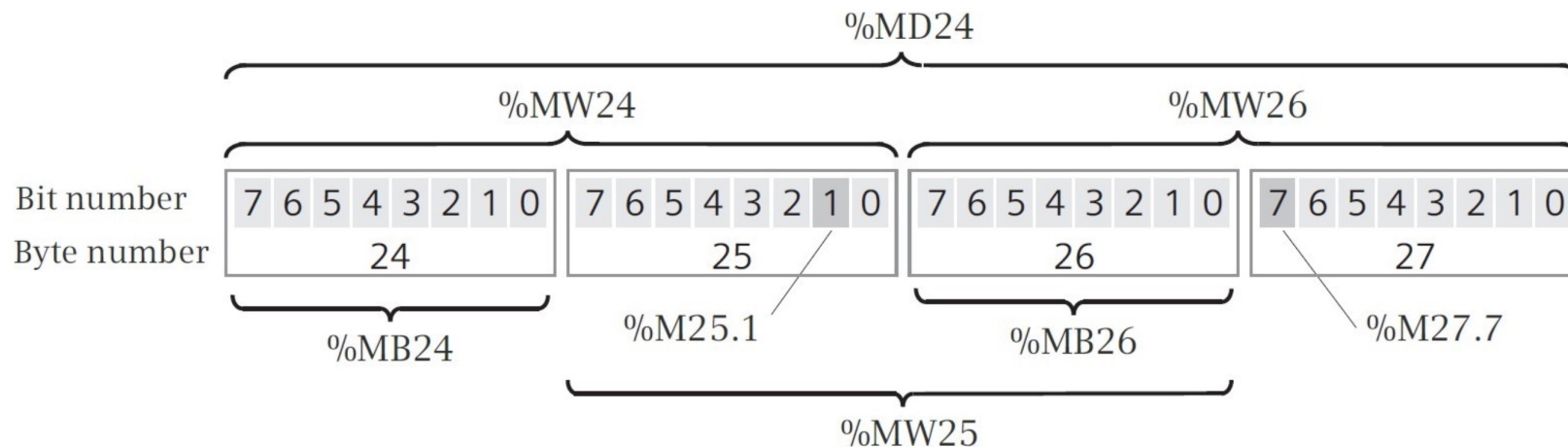
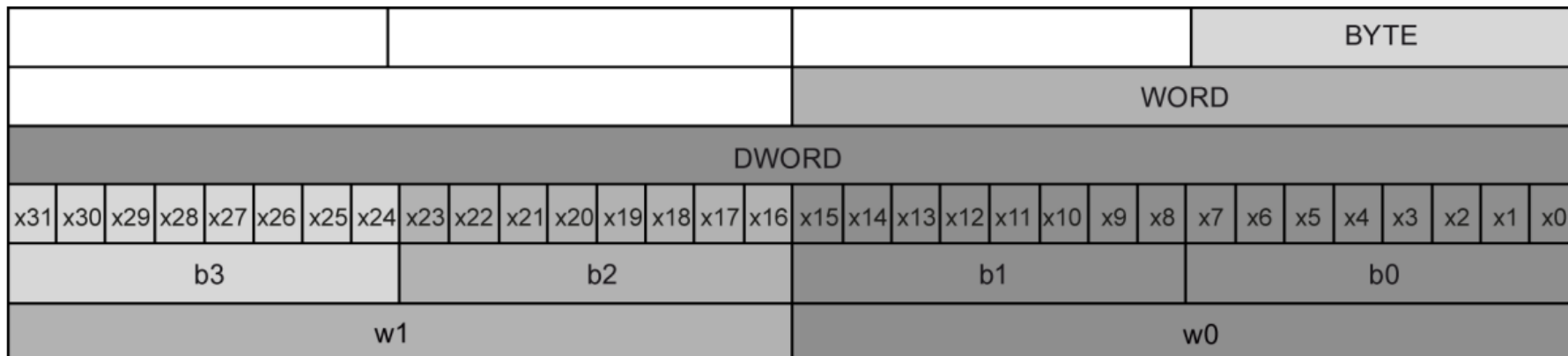


The screenshot shows the 'Add new block' dialog for a Function (FC). The 'Name' field contains 'Block\_1'. The 'Language' dropdown is set to 'SCL'. The 'Number' dropdown is also set to 'SCL'. The 'Automatic' radio button is selected. The 'Description' field contains the text: 'Functions are code blocks or subroutines without dedicated memory.' The 'Additional information' section at the bottom includes fields for Title, Comment, Version (0.1), Family, Author, and User-defined ID. The 'Add new and open' checkbox is checked, and the 'OK' button is highlighted.

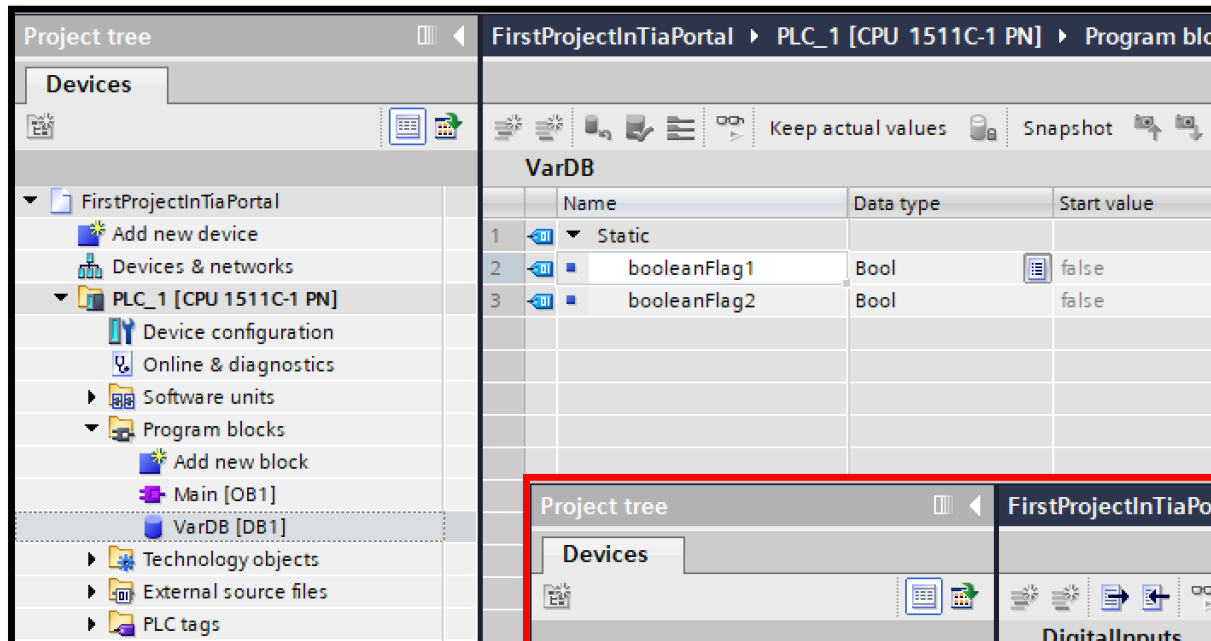
FC – Function



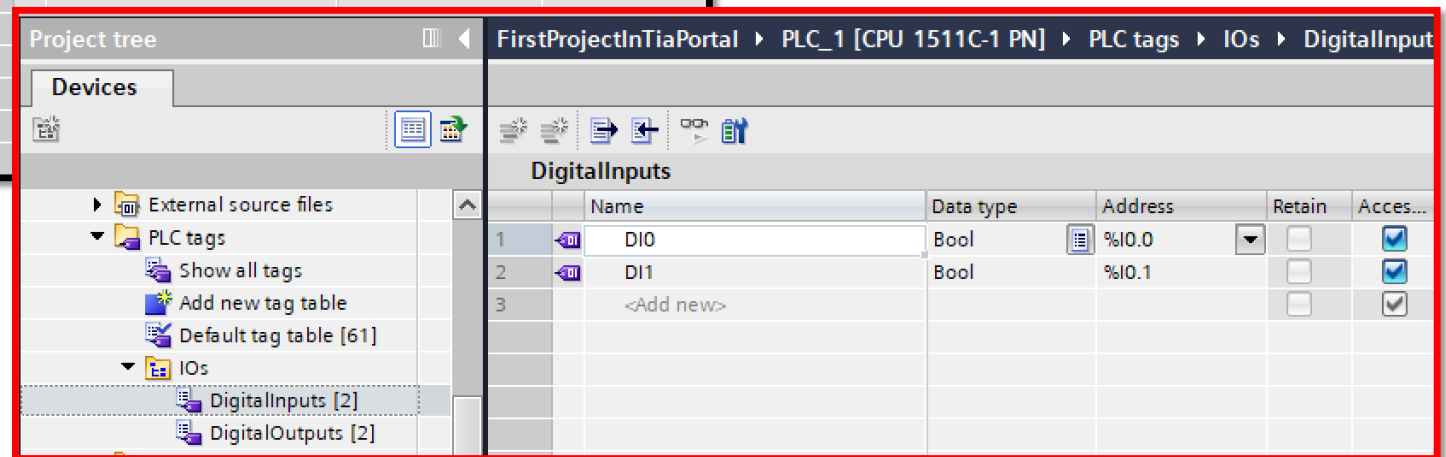
# PLC: S7-1200C: Memorie



# PLC: S7-1200C: Variabile



	Name	Data type	Start value
1	Static		
2	booleanFlag1	Bool	false
3	booleanFlag2	Bool	false



	Name	Data type	Address	Retain	Access...
1	DIO	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	DI1	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	<Add new>			<input type="checkbox"/>	<input checked="" type="checkbox"/>



# PLC: S7-1200C: Tipuri de date uzuale



BOOL	1 bit	1-bit binary value	0, 1, FALSE, TRUE
BYTE	8 bits	8-bit binary value	B#16#00 to B#16#FF
WORD	16 bits	16-bit binary value	W#16#0000 to W#16#FFFF
DWORD	32 bits	32-bit binary value	DW#16#0000 0000 to DW#16#FFFF FFFF
CHAR	8 bits	A character in ASCII code	'a', 'A', '1', ...





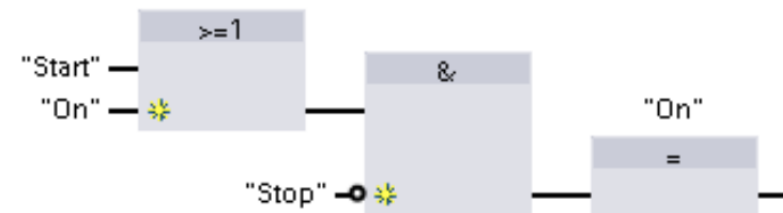
# PLC: S7-1200C: Tipuri de date uzuale

USINT	8 bits	Unsigned 8-bit fixed-point number	0 to 255
UINT	16 bits	Unsigned 16-bit fixed-point number	0 to 65 535
UDINT	32 bits	Unsigned 32-bit fixed-point number	0 to 4 294 967 296
SINT	8 bits	8-bit fixed-point number	-128 to +127
INT	16 bits	16-bit fixed-point number	-32 768 to +32 767
DINT	32 bits	32-bit fixed-point number	-2 147 483 648 to +2 147 483 647
REAL	32 bits	32-bit floating-point number	approx. $\pm 1.18 \times 10^{-38}$ to $\pm 3.40 \times 10^{38}$
LREAL	64 bits	64-bit floating-point number	approx. $\pm 2.23 \times 10^{-308}$ to $\pm 1.80 \times 10^{308}$
TIME	32 bits	Duration in IEC format (number of milliseconds)	T#-24d20h31m23s648ms to T#+24d20h31m23s647ms



# PLC: S7-1200C: Programare

- LAD – ladder logic
- FBD – function block diagram
- SCL – structured control text



```
1 IF condition THEN
2   // Statement section IF
3   ;
4 END_IF;
```






# PLC: S7-1200C: Instrucțiuni de baza



	LAD	SCL
Contact NO	<p>"IN" — —</p>	<pre>IF in THEN     Statement; ELSE     Statement; END_IF;</pre>
Contact NC	<p>"IN" — /—</p>	<pre>IF NOT (in) THEN     Statement; ELSE     Statement; END_IF;</pre>



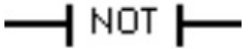


# PLC: S7-1200C: Instrucțiuni de baza

	FBD	SCL <sup>1</sup>
AND		<pre>out := in1 AND in2;</pre>
OR		<pre>out := in1 OR in2;</pre>
XOR		<pre>out := in1 XOR in2;</pre>



# PLC: S7-1200C: Instrucțiuni de baza




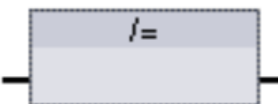
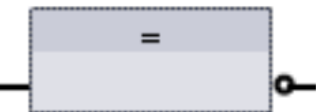
NOT  
(negatia)

LAD	FBD	SCL
		<b>NOT</b>
		



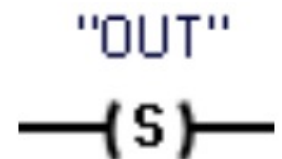
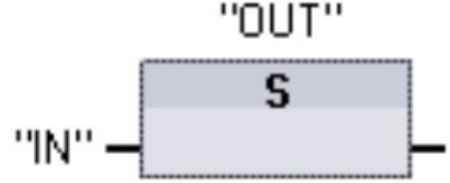
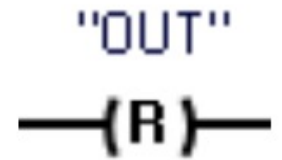
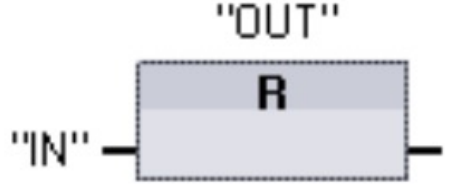
# PLC: S7-1200C: Instrucțiuni de baza

## Atribuirea

LAD	FBD	SCL
<p>"OUT"</p> 	<p>"OUT"</p> 	<pre>out := &lt;Boolean expression&gt;;</pre>
<p>"OUT"</p> 	<p>"OUT"</p> 	<pre>out := NOT &lt;Boolean expression&gt;;</pre>
	<p>"OUT"</p> 	



# PLC: S7-1200C: Instrucțiuni de baza

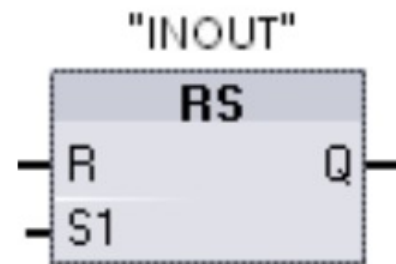
	LAD	FBD
Setare		
Resetare		



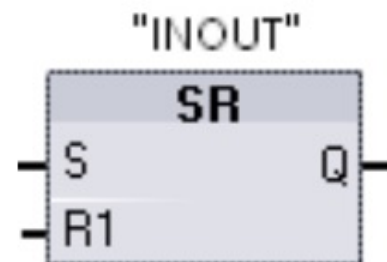
# PLC: S7-1200C: Instrucțiuni de baza

## LAD / FBD

Bistabil RS



Bistabil SR



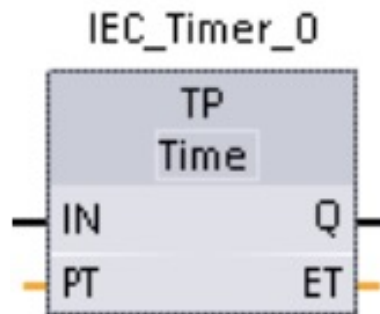
Instruction	S1	R	"INOUT" bit
RS	0	0	Previous state
	0	1	0
	1	0	1
	1	1	1
SR	<b>S</b>	<b>R1</b>	
	0	0	Previous state
	0	1	0
	1	0	1
	1	1	0



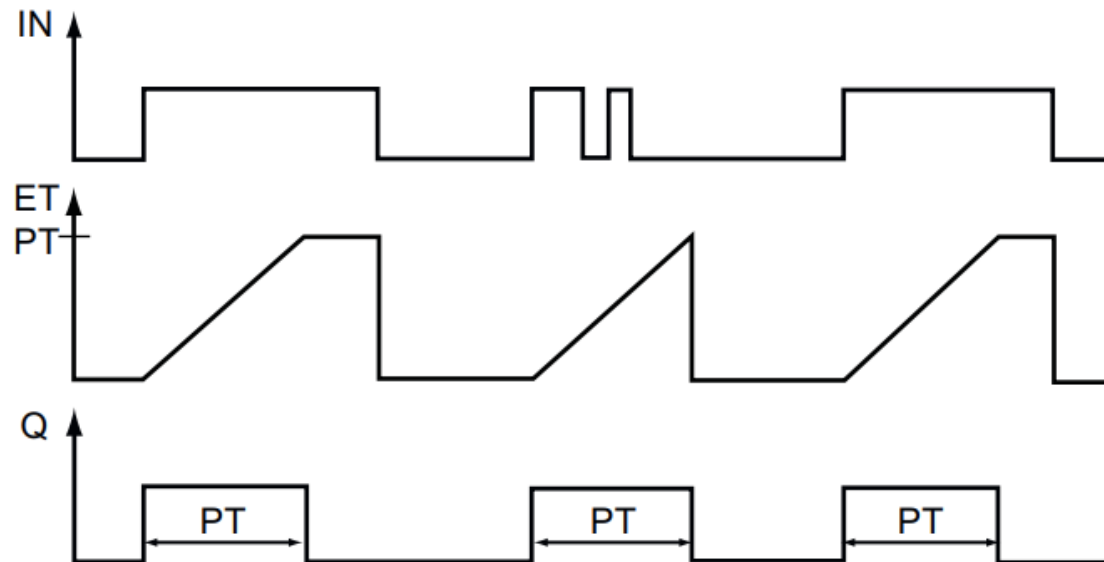


# PLC: S7-1200C: Instrucțiuni de baza

TP generează un puls de lungime PT

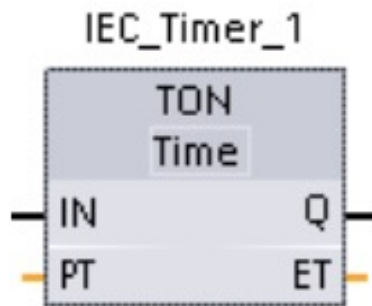


```
"IEC_Timer_0_DB".TP(  
  IN:=_bool_in_,  
  PT:=_time_in_,  
  Q=>_bool_out_,  
  ET=>_time_out_);
```

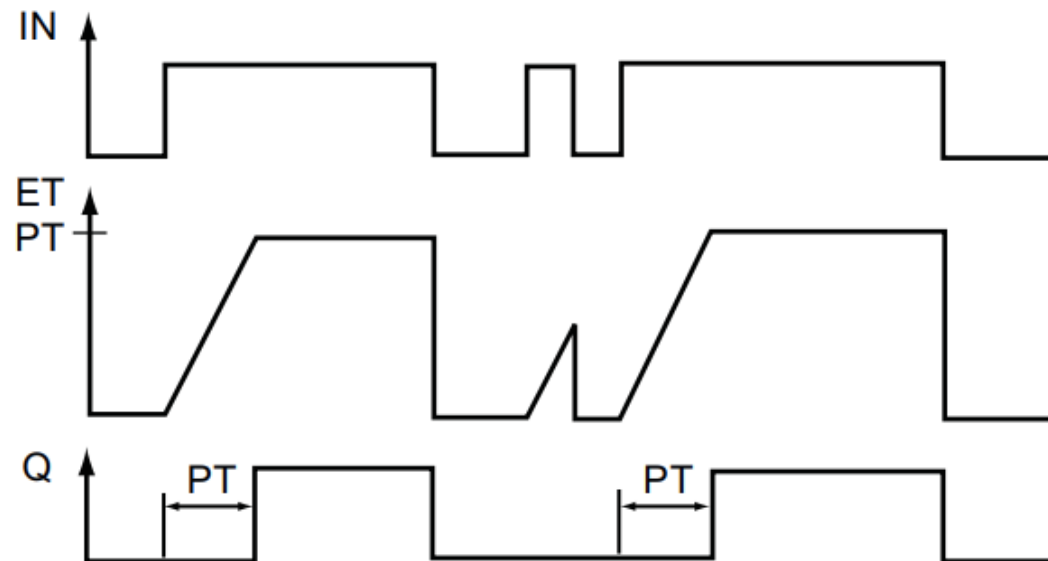


# PLC: S7-1200C: Instrucțiuni de baza

TON intarzie aclansarea lui Q cu o perioada presetata PT

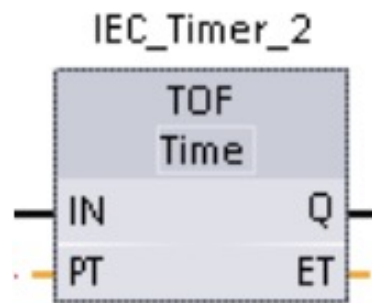


```
"IEC_Timer_0_DB".TON (  
  IN:=_bool_in_,  
  PT:=_time_in_,  
  Q=>_bool_out_,  
  ET=>_time_out_);
```

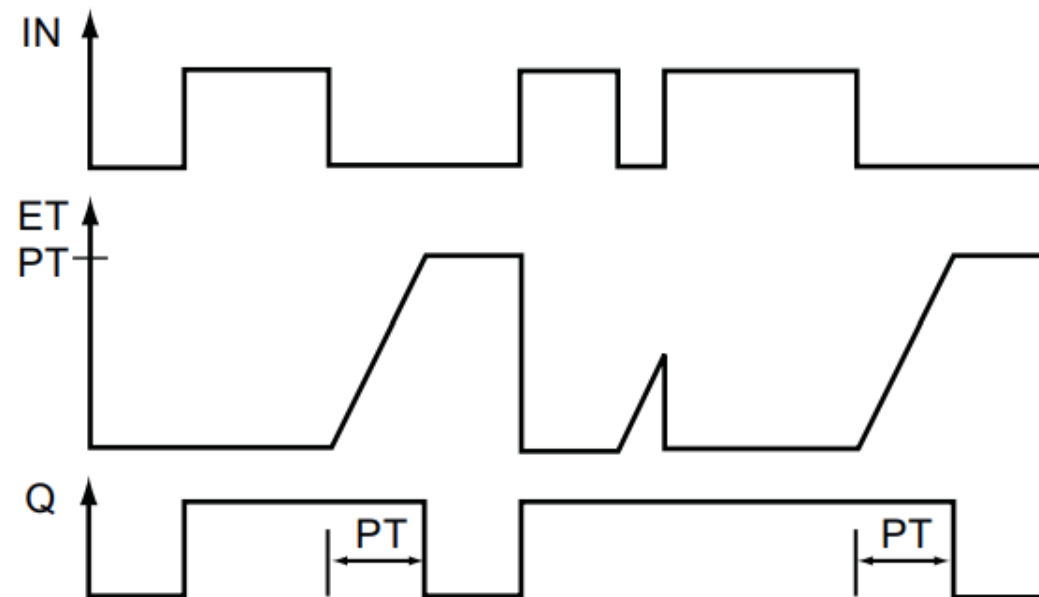


# PLC: S7-1200C: Instrucțiuni de baza

TOF intarzie declansarea lui Q cu o perioada presetata PT

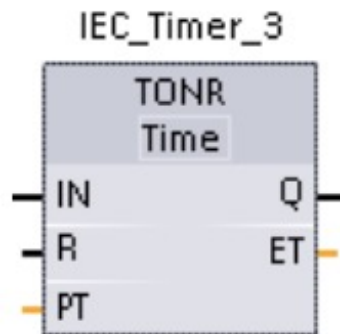


```
"IEC_Timer_0_DB".TOF (  
  IN:=_bool_in_,  
  PT:=_time_in_,  
  Q=>_bool_out_,  
  ET=>_time_out_);
```

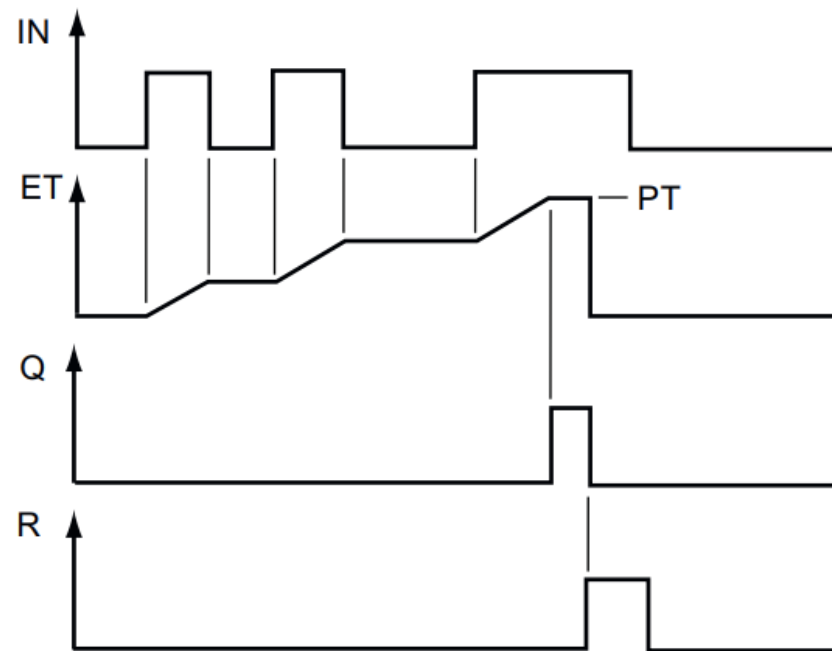


# PLC: S7-1200C: Instrucțiuni de baza

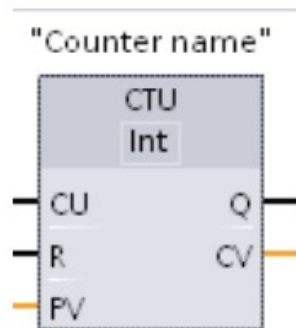
TONR intarzie aclansarea lui Q cu o perioada presetata PT (cu acumulator)



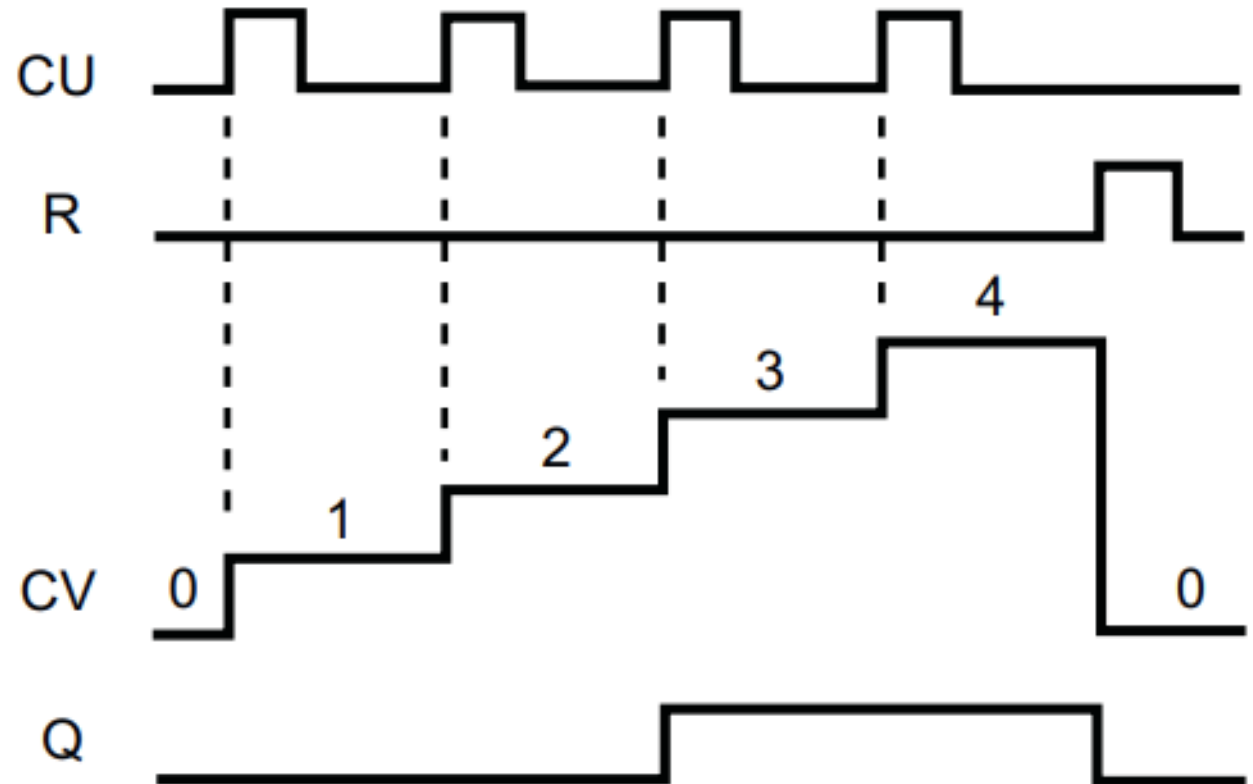
```
"IEC_Timer_0_DB".TONR (  
  IN:=_bool_in_,  
  R:=_bool_in_,  
  PT:=_time_in_,  
  Q=>_bool_out_,  
  ET=>_time_out_);
```



# PLC: S7-1200C: Instrucțiuni de baza

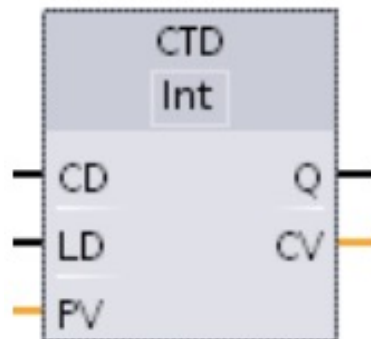


```
"IEC_Counter_0_DB".CTU  
U(  
  CU:=_bool_in,  
  R:=_bool_in,  
  PV:=_in,  
  Q=>_bool_out,  
  CV=>_out);
```

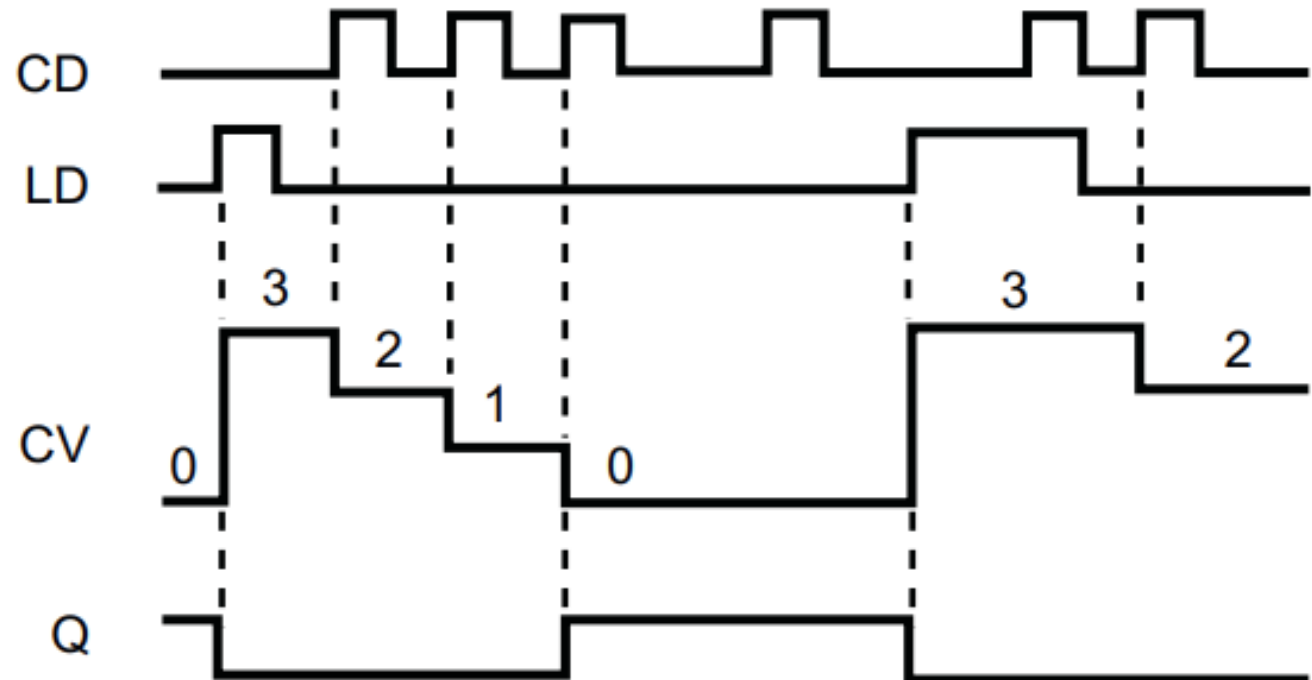


# PLC: S7-1200C: Instrucțiuni de baza

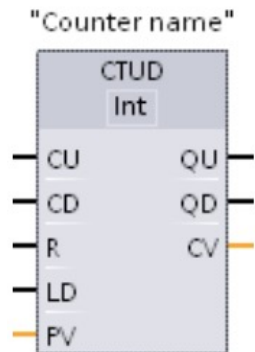
"Counter name"



```
"IEC_Counter_0_DB".CTD  
D(  
  CD:=_bool_in,  
  LD:=_bool_in,  
  PV:=_in,  
  Q=>_bool_out,  
  CV=>_out);
```



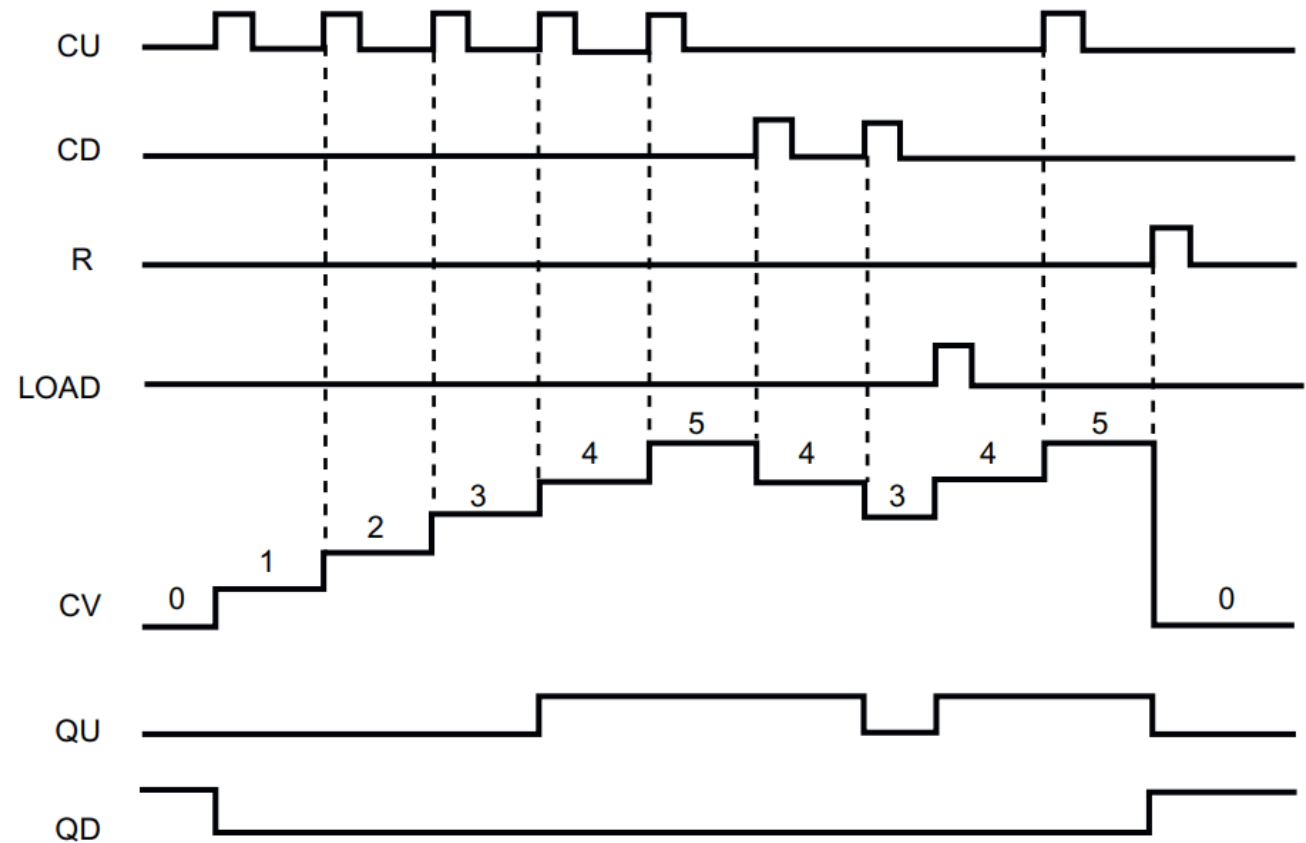
# PLC: S7-1200C: Instrucțiuni de baza



"IEC\_Counter\_0\_DB".CTU


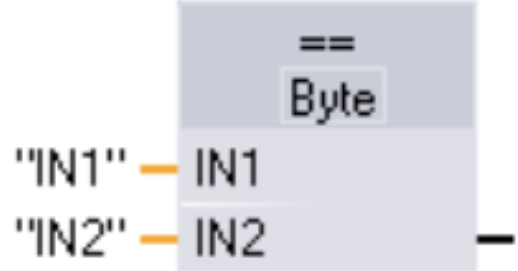
```

D(
  CU:=_bool_in,
  CD:=_bool_in,
  R:=_bool_in,
  LD:=_bool_in,
  PV:=_in_,
  QU=>_bool_out,
  QD=>_bool_out,
  CV=>_out_);
  
```



# PLC: S7-1200C: Instrucțiuni de baza

## Comparatie

LAD	FBD	SCL
		<pre>out := in1 = in2;  or IF in1 = in2   THEN out := 1;   ELSE out := 0; END IF;</pre>

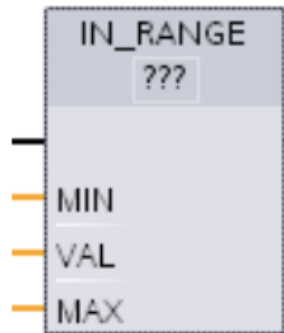




# PLC: S7-1200C: Instrucțiuni de baza

In domeniu

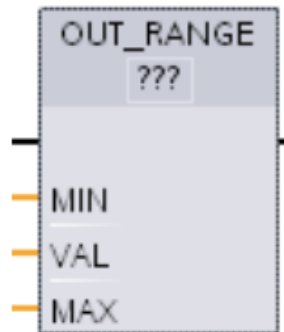
LAD / FBD



SCL

```
out := IN_RANGE (min,  
val, max);
```

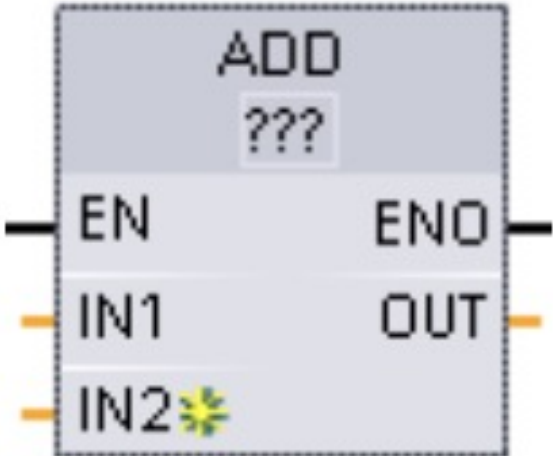
In afara domeniului



```
out := OUT_RANGE (min,  
val, max);
```


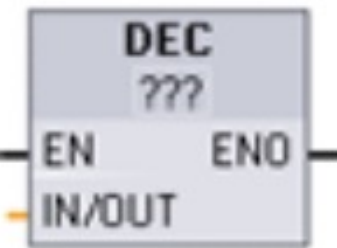


# S7-1200C: Instrucțiuni matematice

LAD / FBD	SCL
	<pre>out := in1 + in2; out := in1 - in2; out := in1 * in2; out := in1 / in2;</pre>



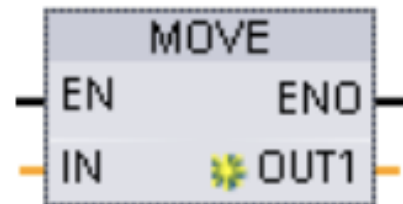
# S7-1200C: Instrucțiuni matematice

LAD / FBD	SCL
	<pre>in_out := in_out + 1;</pre>
	<pre>in_out := in_out - 1;</pre>



# S7-1200C: MOVE

LAD / FBD



SCL

```
out1 := in;
```



# Primul program PLC



# Primul program PLC – Cerinte



Prima iesire digitala este activa daca avem cel putin o conditie de mai jos adevarata:

- Prima intrare este activa si a doua intrare nu este activa
- A treia intrare nu este activa
- Trec 5 secunde de la activarea intrarii digitale 4



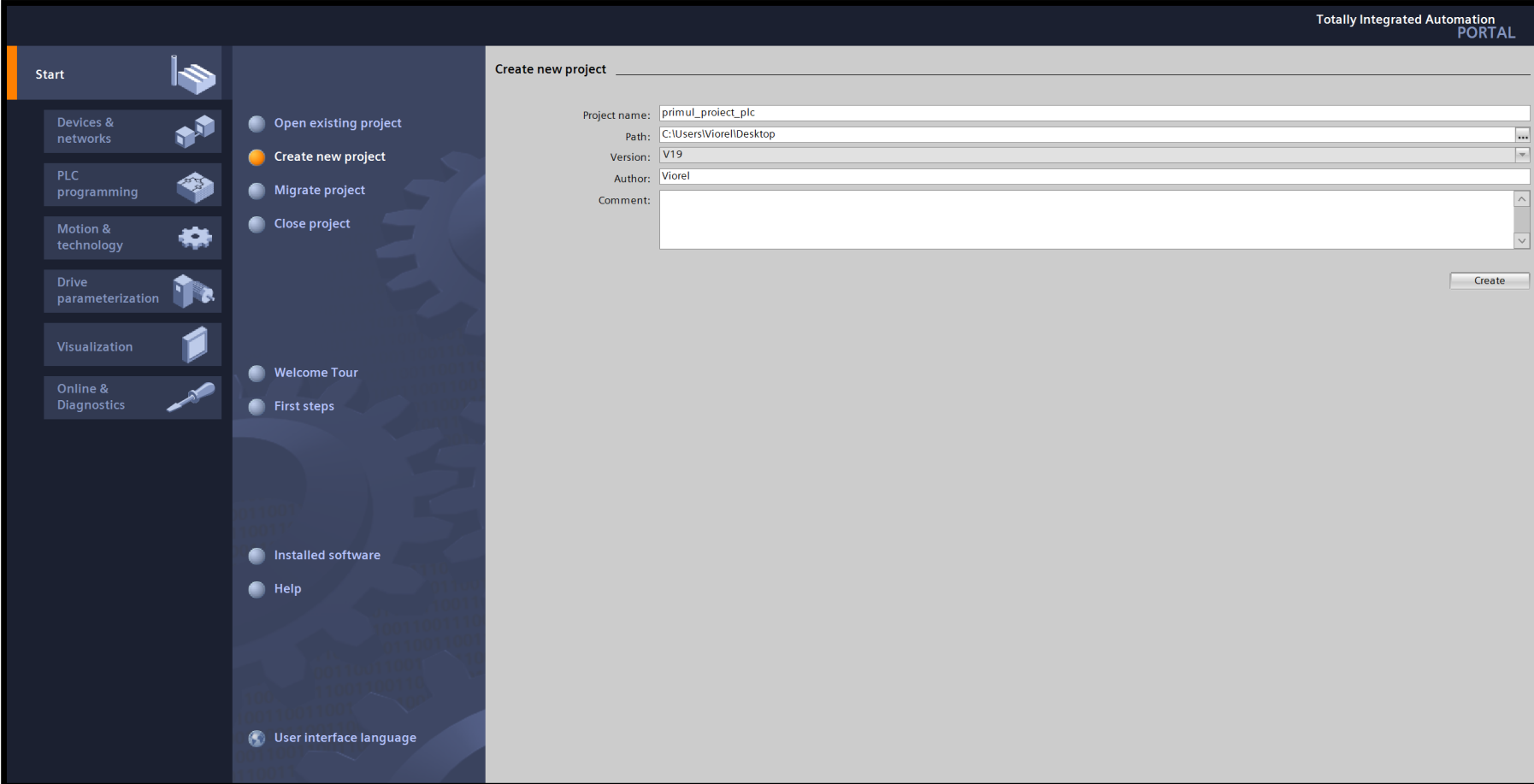
# Primul program PLC – TIA Portal



- TIA Portal (Totally Integrated Automation)
- Selectare PLC
- Setări de securitate (Industry 4.0)
- Configurare hardware
- Definire intrări / ieșiri (Tag Table)
- Organizare soft (OB, FB, FC, DB)
- Simulare program (online view)
- Programare Ladder Diagram (LAD) in OB1
- Programare Function Block Diagram (FBD) in bloc FC
- Programare Structured Control Language (SCL) in bloc FB



# TIA Portal – proiect nou



Totally Integrated Automation  
PORTAL

Create new project

Project name: primul\_proiect\_plc

Path: C:\Users\Viorel\Desktop

Version: V19

Author: Viorel

Comment:

Create

Start

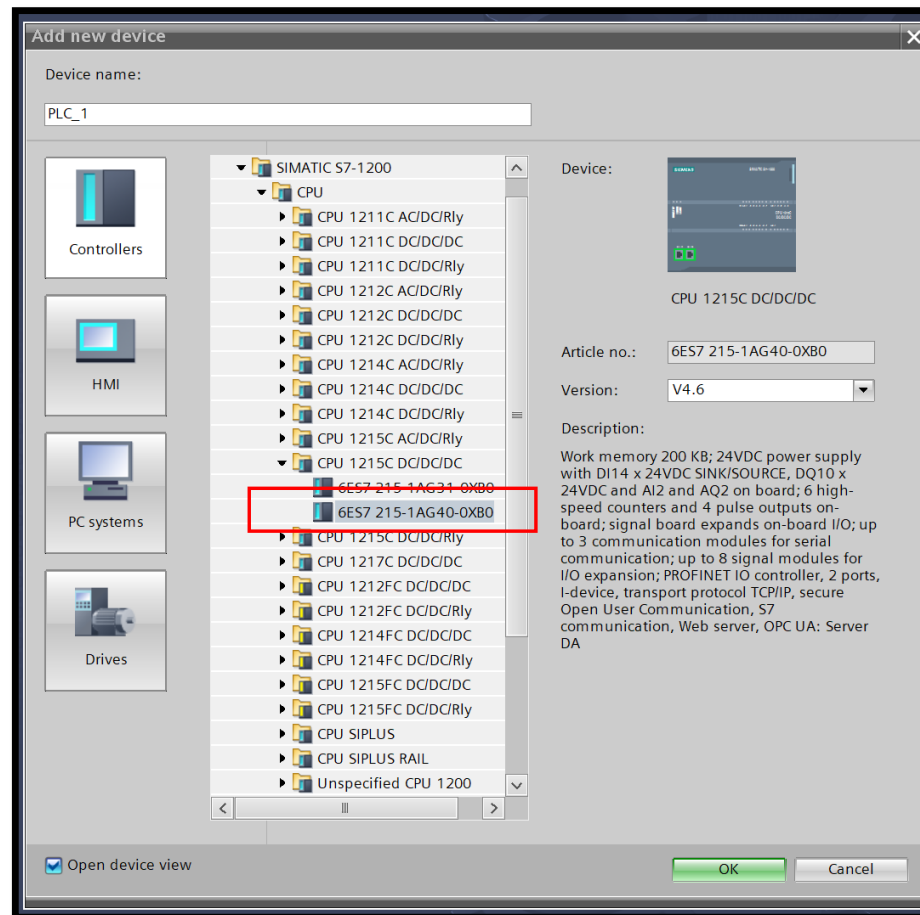
- Devices & networks
- PLC programming
- Motion & technology
- Drive parameterization
- Visualization
- Online & Diagnostics

- Open existing project
- Create new project
- Migrate project
- Close project
- Welcome Tour
- First steps
- Installed software
- Help
- User interface language

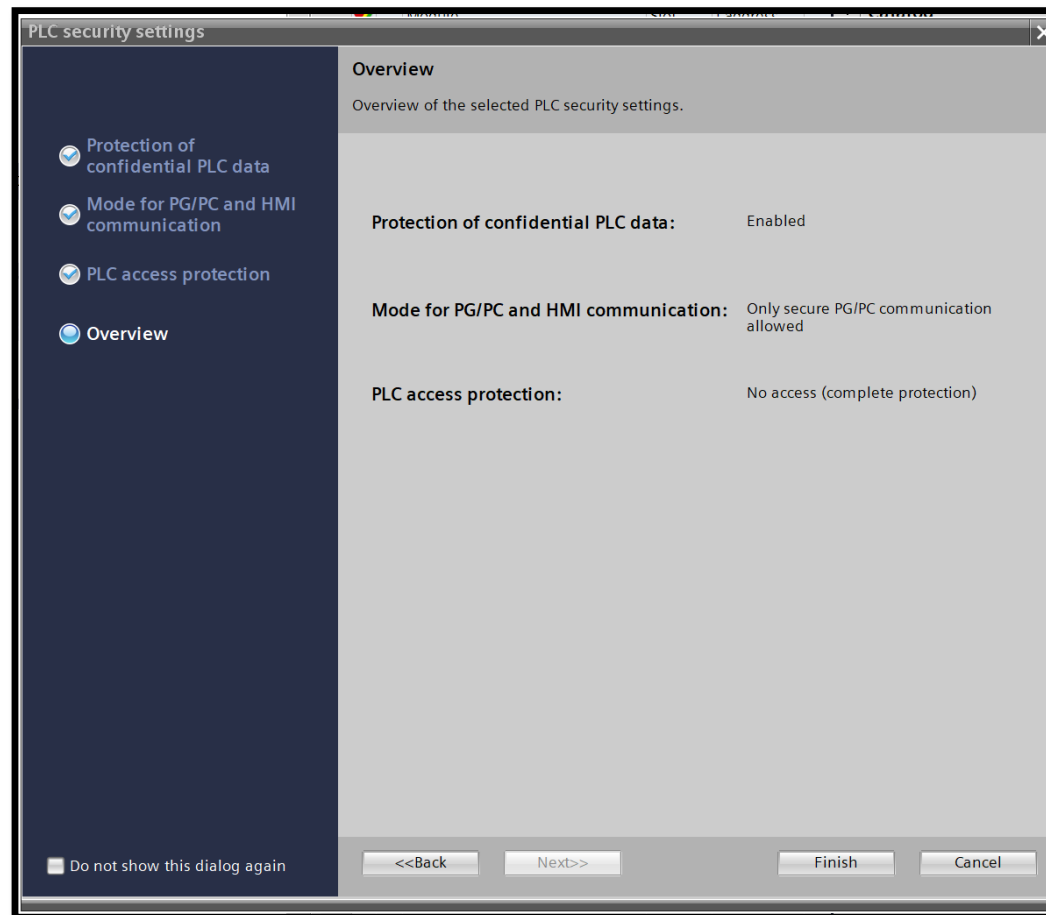




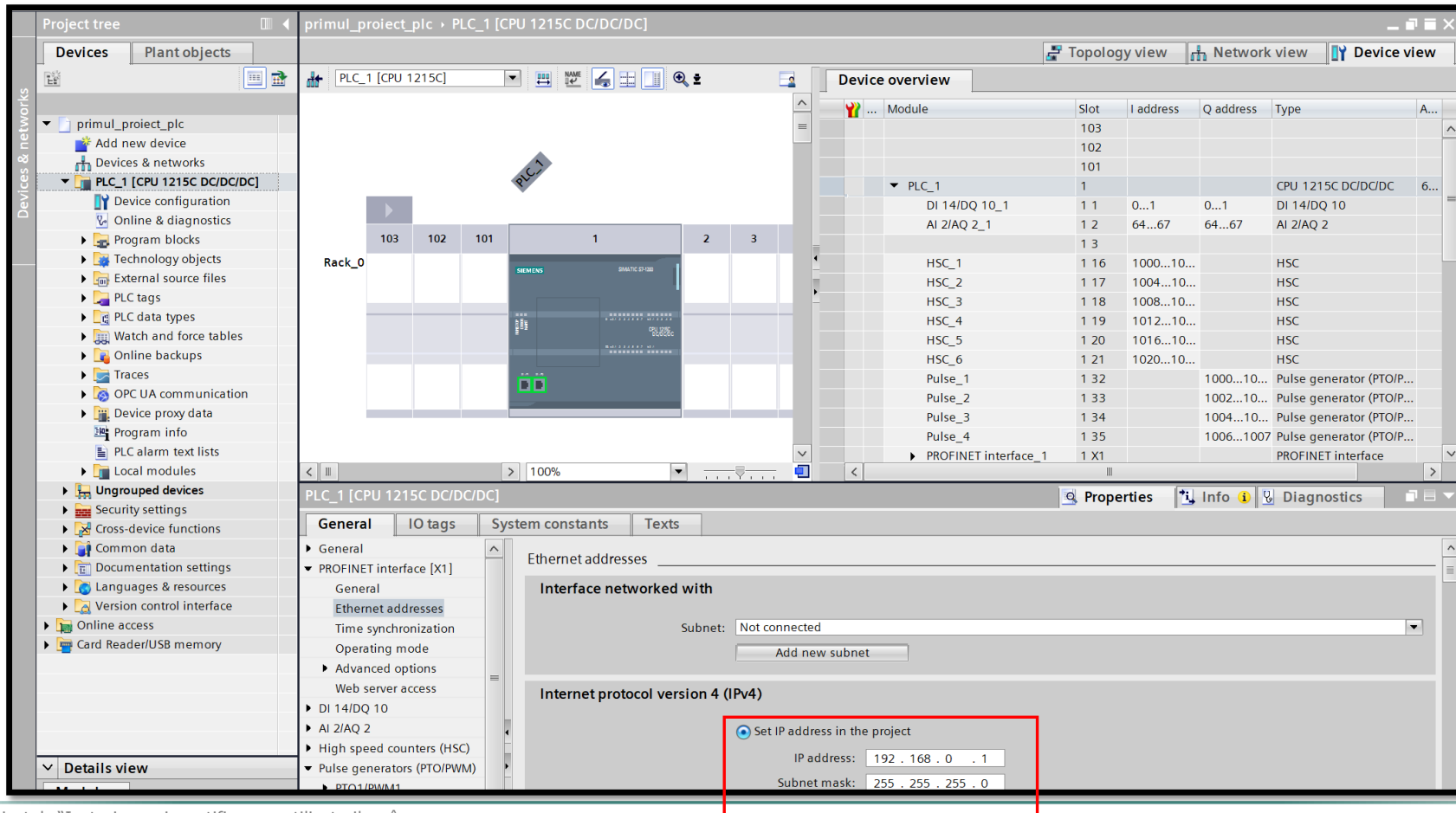
# Selectare PLC



# Setari de securitate



# Configurare hardware



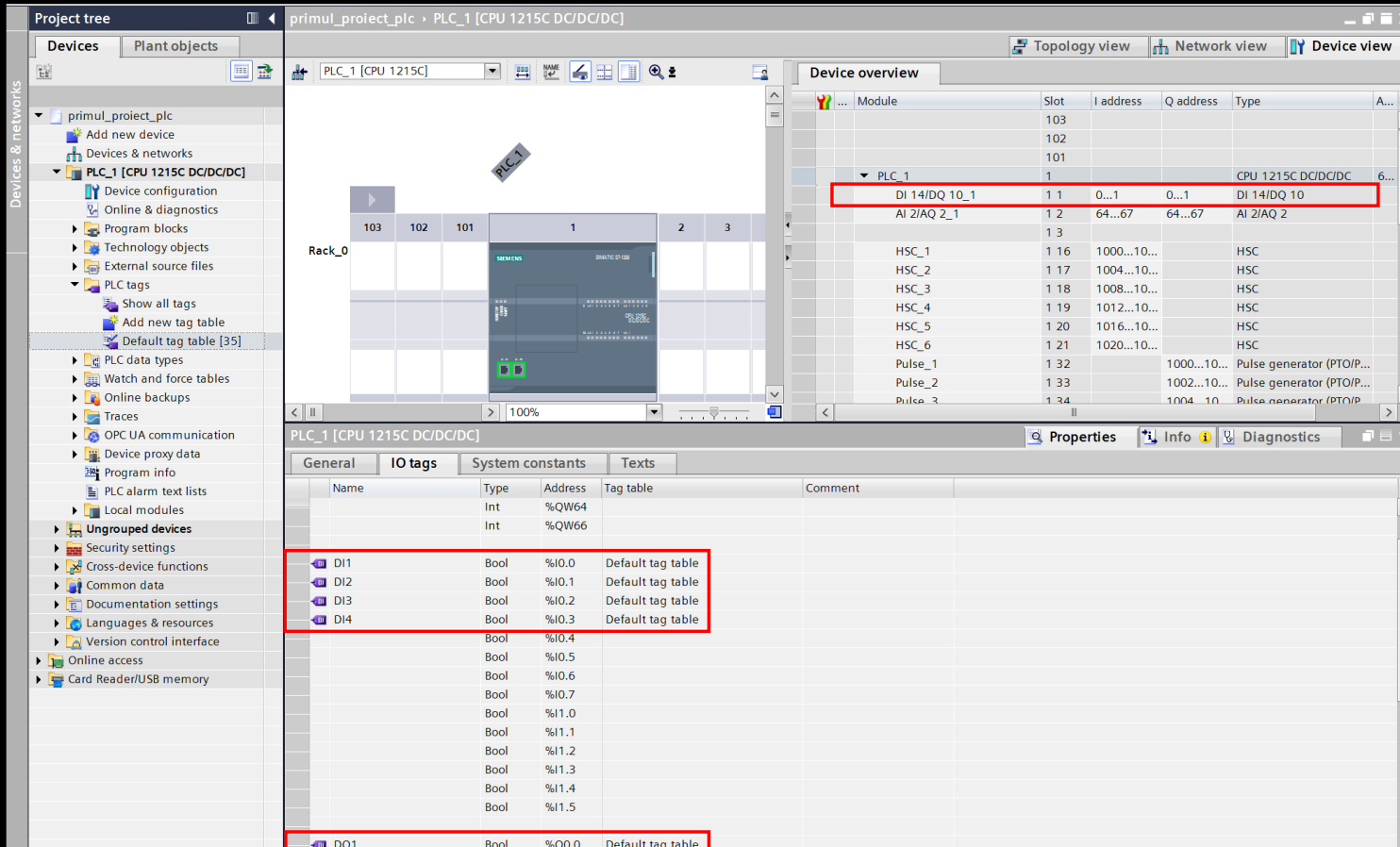
The screenshot displays the Siemens SIMATIC Manager hardware configuration interface. The left pane shows the project tree for 'primul\_proiect\_plc' with 'PLC\_1 [CPU 1215C DC/DC/DC]' selected. The center pane shows a rack diagram with slots 103, 102, 101, 1, 2, and 3. The right pane shows the 'Device overview' table:

Module	Slot	I address	Q address	Type	A...
PLC_1	1			CPU 1215C DC/DC/DC	6...
DI 14/DQ 10_1	1 1	0...1	0...1	DI 14/DQ 10	
AI 2/AQ 2_1	1 2	64...67	64...67	AI 2/AQ 2	
	1 3				
HSC_1	1 16	1000...10...		HSC	
HSC_2	1 17	1004...10...		HSC	
HSC_3	1 18	1008...10...		HSC	
HSC_4	1 19	1012...10...		HSC	
HSC_5	1 20	1016...10...		HSC	
HSC_6	1 21	1020...10...		HSC	
Pulse_1	1 32		1000...10...	Pulse generator (PTO/P...	
Pulse_2	1 33		1002...10...	Pulse generator (PTO/P...	
Pulse_3	1 34		1004...10...	Pulse generator (PTO/P...	
Pulse_4	1 35		1006...1007	Pulse generator (PTO/P...	
PROFINET interface_1	1 X1			PROFINET interface	

The bottom pane shows the 'Properties' window for 'PLC\_1 [CPU 1215C DC/DC/DC]' with the 'Ethernet addresses' section expanded. The 'Internet protocol version 4 (IPv4)' option is selected, and the IP address is set to 192.168.0.1.



# Definire intrari / iesiri



**Device overview**

Module	Slot	I address	Q address	Type	A...
PLC_1	1			CPU 1215C DC/DC/DC	6...
DI 14/DQ 10_1	1.1	0...1	0...1	DI 14/DQ 10	
AI 2/AQ 2_1	1.2	64...67	64...67	AI 2/AQ 2	
HSC_1	1.16	1000...10...		HSC	
HSC_2	1.17	1004...10...		HSC	
HSC_3	1.18	1008...10...		HSC	
HSC_4	1.19	1012...10...		HSC	
HSC_5	1.20	1016...10...		HSC	
HSC_6	1.21	1020...10...		HSC	
Pulse_1	1.32		1000...10...	Pulse generator (PTO/P...	
Pulse_2	1.33		1002...10...	Pulse generator (PTO/P...	
Pulse_3	1.34		1004...10...	Pulse generator (PTO/P...	

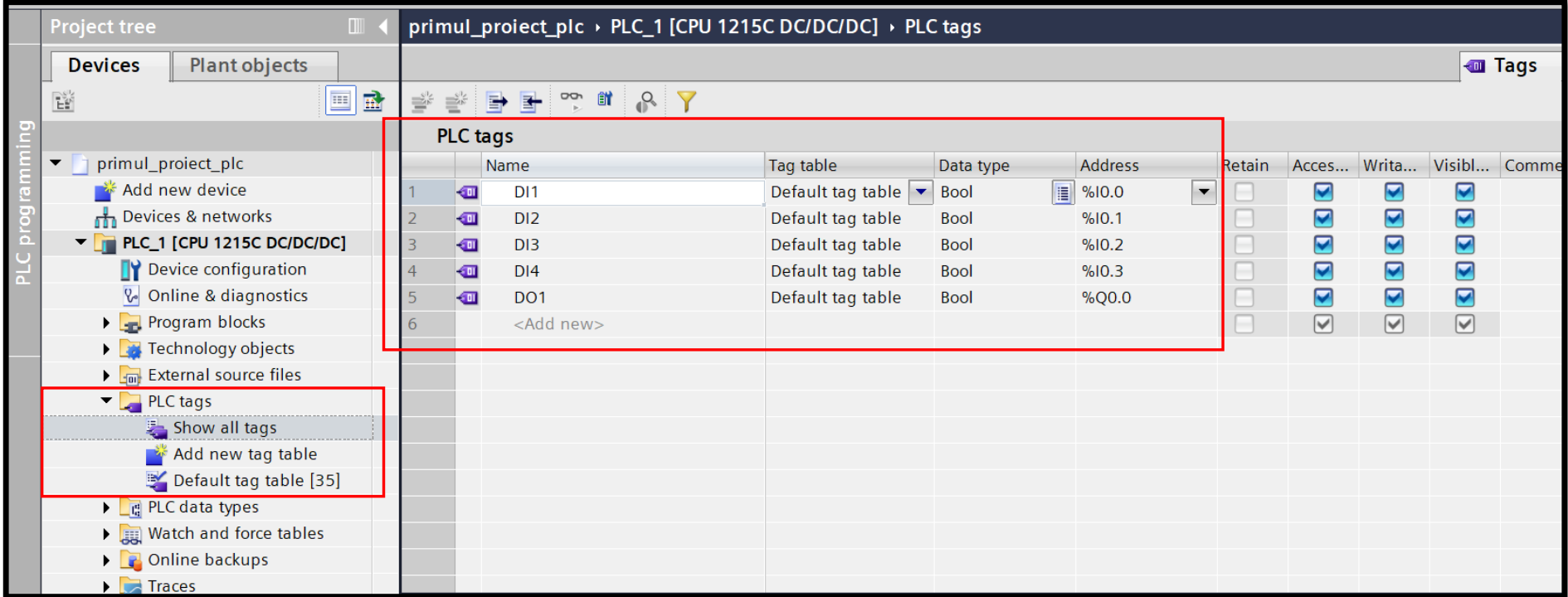
  

**IO tags**

Name	Type	Address	Tag table	Comment
DI1	Bool	%I0.0	Default tag table	
DI2	Bool	%I0.1	Default tag table	
DI3	Bool	%I0.2	Default tag table	
DI4	Bool	%I0.3	Default tag table	
	Bool	%I0.4		
	Bool	%I0.5		
	Bool	%I0.6		
	Bool	%I0.7		
	Bool	%I1.0		
	Bool	%I1.1		
	Bool	%I1.2		
	Bool	%I1.3		
	Bool	%I1.4		
	Bool	%I1.5		
DO1	Bool	%Q0.0	Default tag table	



# Definire intrari / iesiri



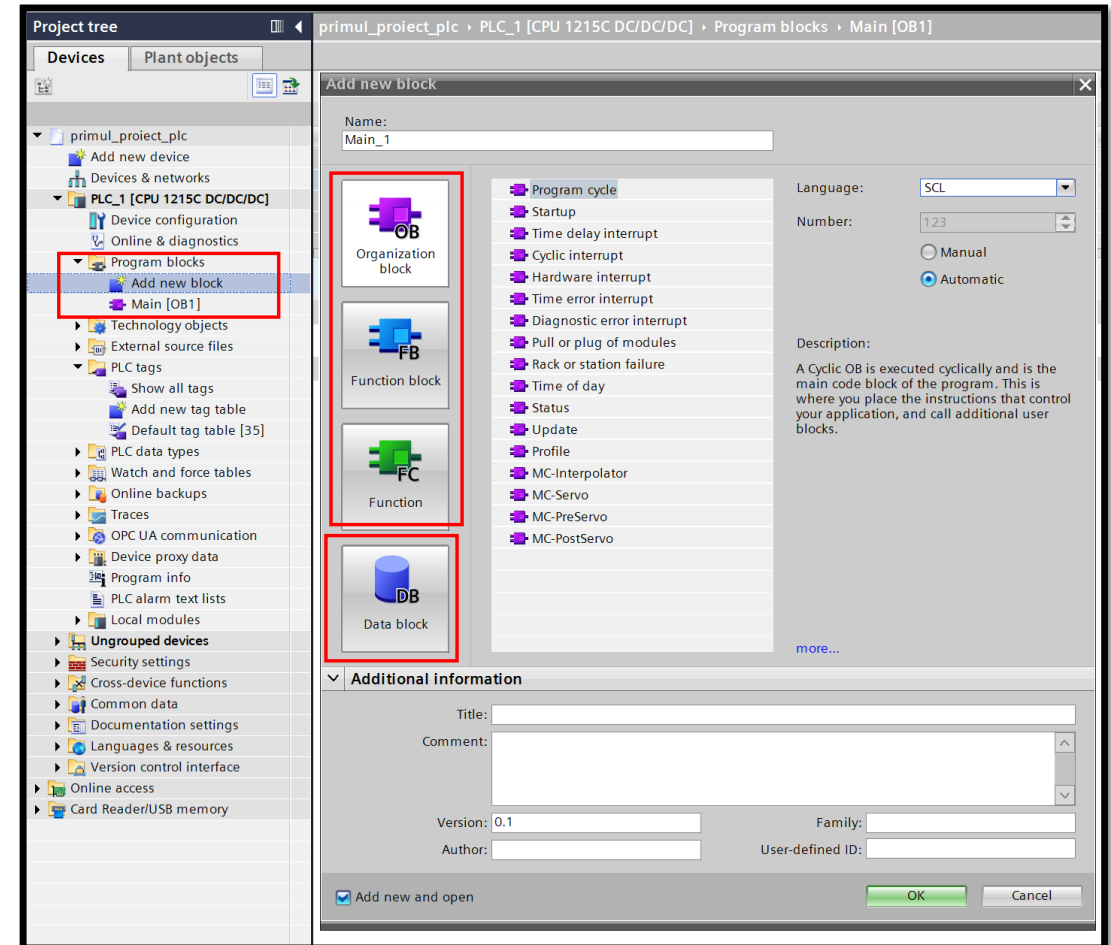
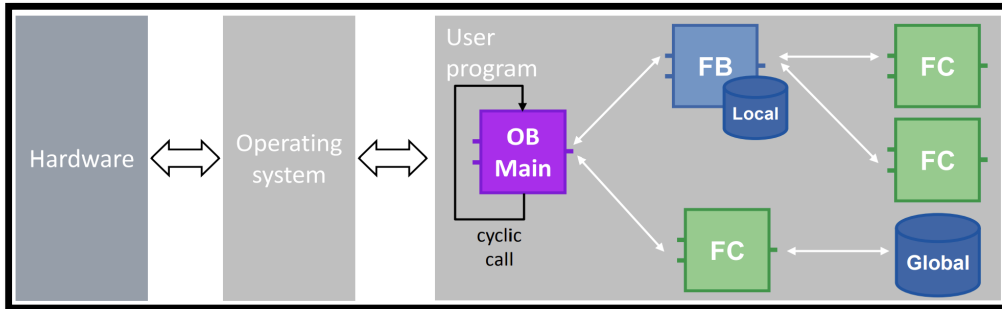
Project tree: primul\_proiect\_plc > PLC\_1 [CPU 1215C DC/DC/DC] > PLC tags

PLC tags table:

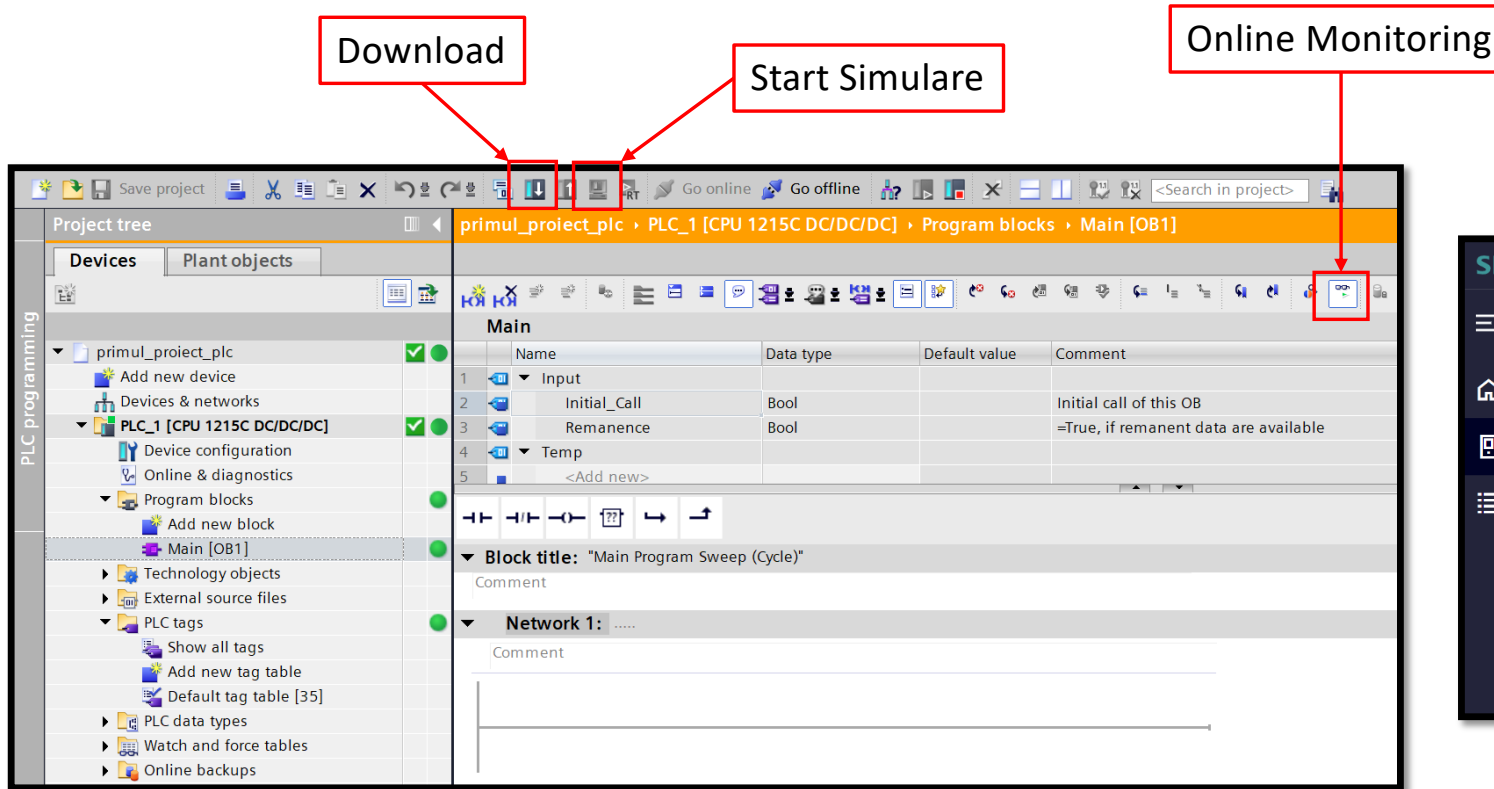
	Name	Tag table	Data type	Address	Retain	Acces...	Writa...	Visibl...	Comme
1	DI1	Default tag table	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
2	DI2	Default tag table	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3	DI3	Default tag table	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4	DI4	Default tag table	Bool	%I0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5	DO1	Default tag table	Bool	%Q0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6	<Add new>				<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	



# Organizare soft (OB, FB, FC, DB)



# Simulare program (online view)



Download

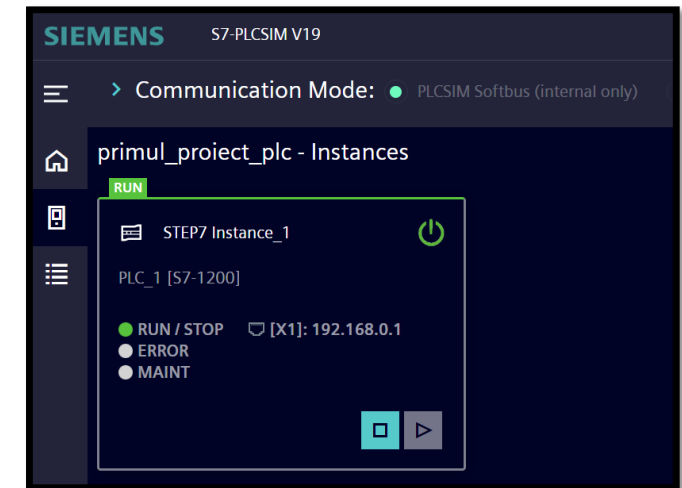
Start Simulare

Online Monitoring

Name	Data type	Default value	Comment
1	Input		
2	Initial_Call	Bool	Initial call of this OB
3	Remanence	Bool	=True, if remanent data are available
4	Temp		
5	<Add new>		

Block title: "Main Program Sweep (Cycle)"

Network 1: .....



SIEMENS S7-PLCSIM V19

Communication Mode: ● PLCSIM Softbus (internal only)

primul\_proiect\_plc - Instances

RUN

STEP7 Instance\_1

PLC\_1 [S7-1200]

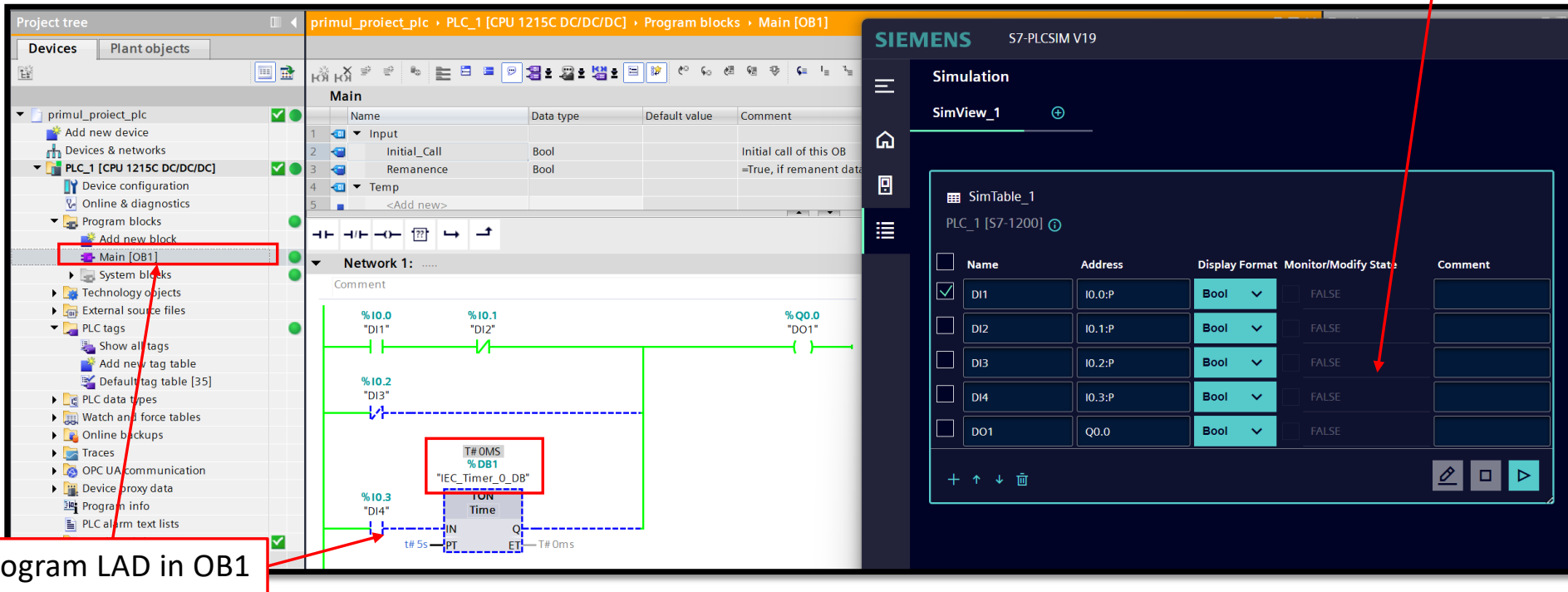
● RUN / STOP [X1]: 192.168.0.1

● ERROR

● MAINT



# Programare LAD in OB1



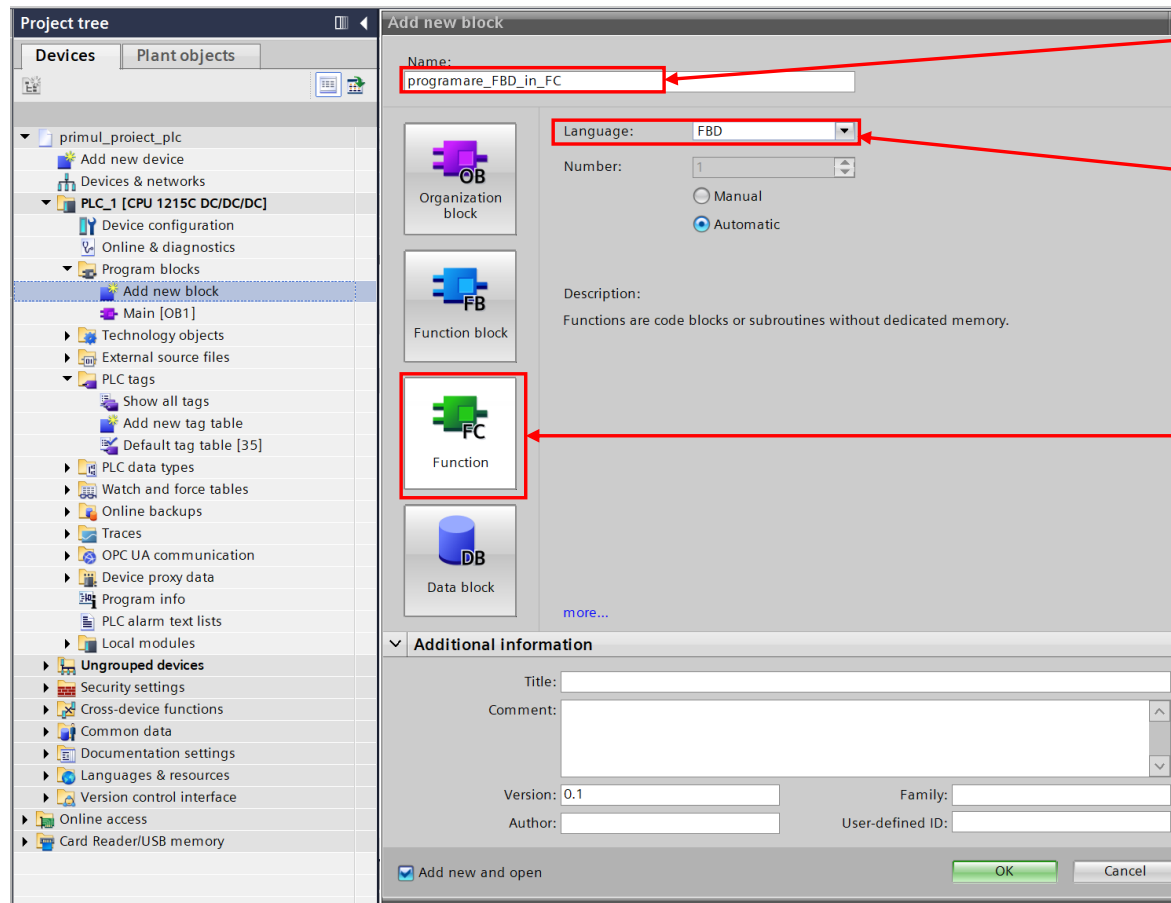
The screenshot displays the Siemens SIMATIC Manager interface. On the left, the Project tree shows the hierarchy: primul\_proiect\_plc > PLC\_1 [CPU 1215C DC/DC/DC] > Program blocks > Main [OB1]. The main window shows the Ladder Logic (LAD) program for Network 1, featuring inputs %I0.0, %I0.1, %I0.2, and %I0.3, and output %Q0.0. A timer T#0MS is also present. A red box highlights the 'Main [OB1]' entry in the Project tree, with a label 'Program LAD in OB1'. Another red box highlights the 'Simulare I/O' label, which points to the 'Simulation' window on the right. The simulation window shows a table for 'SimTable\_1' with the following data:

Name	Address	Display Format	Monitor/Modify State	Comment	
<input checked="" type="checkbox"/>	D11	IO.0:P	Bool	FALSE	
<input type="checkbox"/>	D12	IO.1:P	Bool	FALSE	
<input type="checkbox"/>	D13	IO.2:P	Bool	FALSE	
<input type="checkbox"/>	D14	IO.3:P	Bool	FALSE	
<input type="checkbox"/>	DO1	Q0.0	Bool	FALSE	





# Programare FBD in bloc FC



Denumire FC

Limbaj de programare

Tip bloc (FC)



# Programare FBD in bloc FC

The image displays the Siemens SIMATIC Manager interface for programming and simulating a function block (FC).

**Top Left:** Project tree showing the structure: Main [OB1], programare\_FBD\_in\_FC [FC1], System blocks, Technology objects, External source files, PLC tags, and PLC data types.

**Top Center:** Block title: "Main Program Sweep (Cycle)". Network 1 shows a call to the function block: `%FC1 "programare_FBD_in_FC"`. EN and ENO terminals are visible.

**Top Right:** "Apelare FC in OB1" (Call FC in OB1) label pointing to the function block call.

**Bottom Left:** "Program FBD in FC" label pointing to the function block definition in the project tree.

**Bottom Center:** Network 1 of the function block definition. It features an AND gate with inputs `%I0.0 "DI1"` (TRUE) and `%I0.1 "DI2"` (FALSE). The output of the AND gate is connected to a timer block `T#0ms "IEC_Timer_1_DB"` (Instant DB). The timer's output is connected to an OR gate with input `%I0.2 "DI3"` (TRUE). The output of the OR gate is connected to an output coil `%Q0.0 "DO1"`.

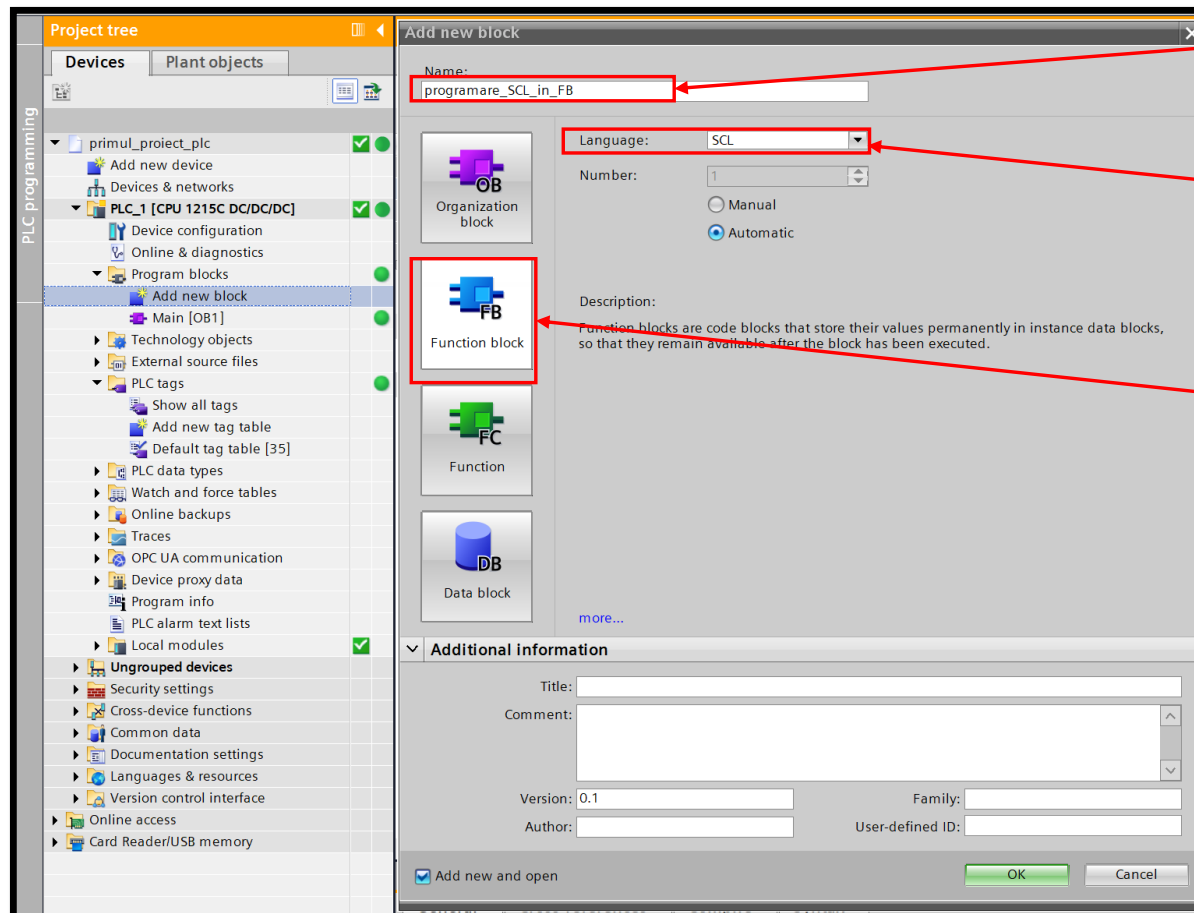
**Bottom Right:** "Simulare I/O" (Simulate I/O) label pointing to the simulation monitoring table.

**Simulation Monitoring Table:**

Name	Address	Display Format	Monitor/Modify State	Comment	
<input checked="" type="checkbox"/>	DI1	IO.0:P	Bool	<input checked="" type="checkbox"/> TRUE	
<input type="checkbox"/>	DI2	IO.1:P	Bool	<input type="checkbox"/> FALSE	
<input type="checkbox"/>	DI3	IO.2:P	Bool	<input checked="" type="checkbox"/> TRUE	
<input type="checkbox"/>	DI4	IO.3:P	Bool	<input type="checkbox"/> FALSE	
<input type="checkbox"/>	DO1	Q0.0	Bool	<input checked="" type="checkbox"/> TRUE	



# Programare SCL in bloc FB



Denumire FC

Limbaj de programare

Tip bloc (FB)



# Programare SCL in bloc FB

The screenshot displays the Siemens SIMATIC Manager interface. On the left, the 'Program blocks' tree shows a function block 'programare\_SCL\_in\_FB [FB1]' and its data block 'programare\_SCL\_in\_FB\_DB [DB1]'. The main editor shows the SCL code for the function block, including a call to 'programare\_SCL\_in\_FB' and a timer instance '#IEC\_Timer\_0\_Instance'. A simulation window on the right shows the 'Monitoring' table for 'SimTable\_1'.

**Annotations:**

- Apelare FB in OB1:** Points to the function block call in the SCL code.
- Simulare I/O:** Points to the monitoring table in the simulation window.
- Program SCL in FB:** Points to the SCL code editor.
- Instanta FB:** Points to the function block in the project tree.
- Instanta locala:** Points to the local timer instance in the SCL code.

Name	Address	Display Format	Monitor/Modify State	Comment
DI1	I0.0:P	Bool	<input type="checkbox"/> FALSE	
DI2	I0.1:P	Bool	<input type="checkbox"/> FALSE	
DI3	I0.2:P	Bool	<input checked="" type="checkbox"/> TRUE	
DI4	I0.3:P	Bool	<input type="checkbox"/> FALSE	
DO1	Q0.0	Bool	<input type="checkbox"/> FALSE	



# Primul program HMI



# Primul program HMI – Cerinte



Prima iesire digitala este activa daca avem cel putin o conditie de mai jos este adevarata:

- Prima intrare este activa si a doua intrare nu este activa
- A treia intrare nu este activa
- Trec 5 secunde de la activarea intrarii 4



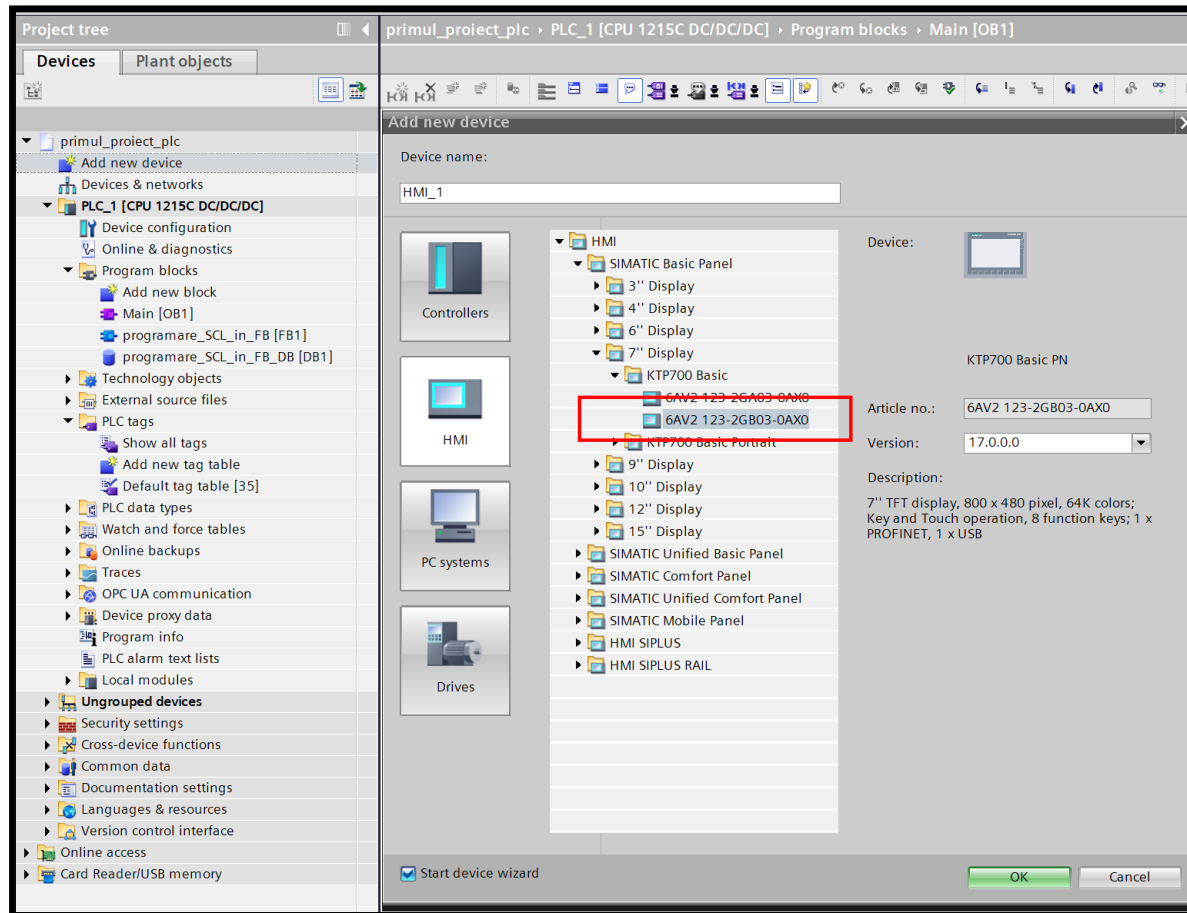
# Primul program HMI – TIA Portal



- TIA Portal (Totally Integrated Automation)
- Selectare HMI
- Configurare hardware
- Simulare HMI
- Pregatire variabile PLC
- Controlul unei variabile digitale
- Afisarea unei variabile digitale
- Controlul unei variabile analogice
- Afisarea unei variabile analogice

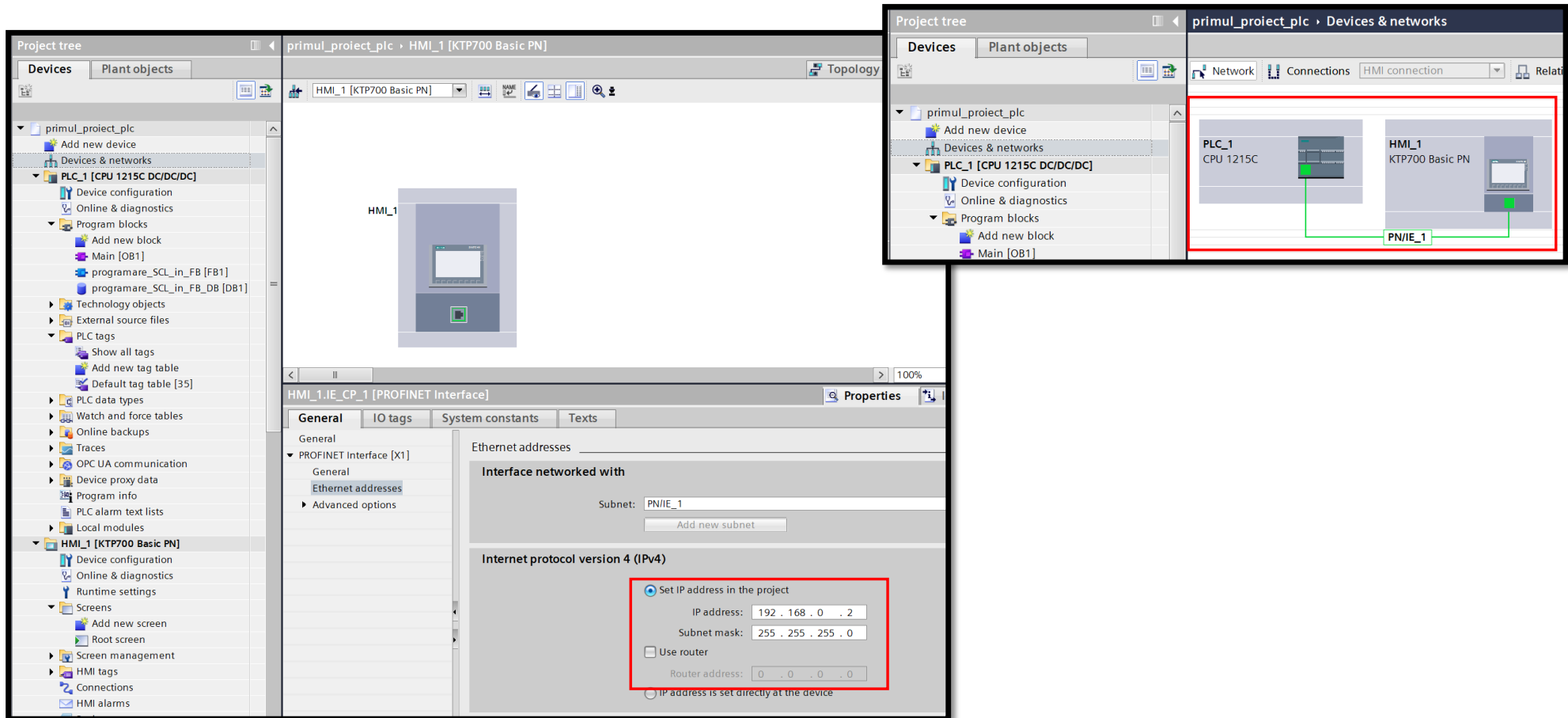


# Selectare HMI





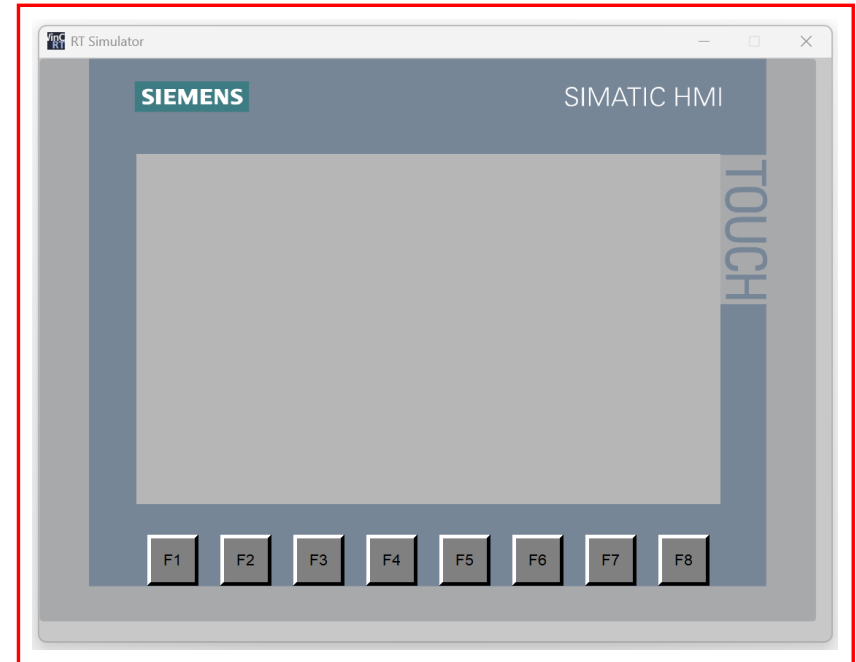
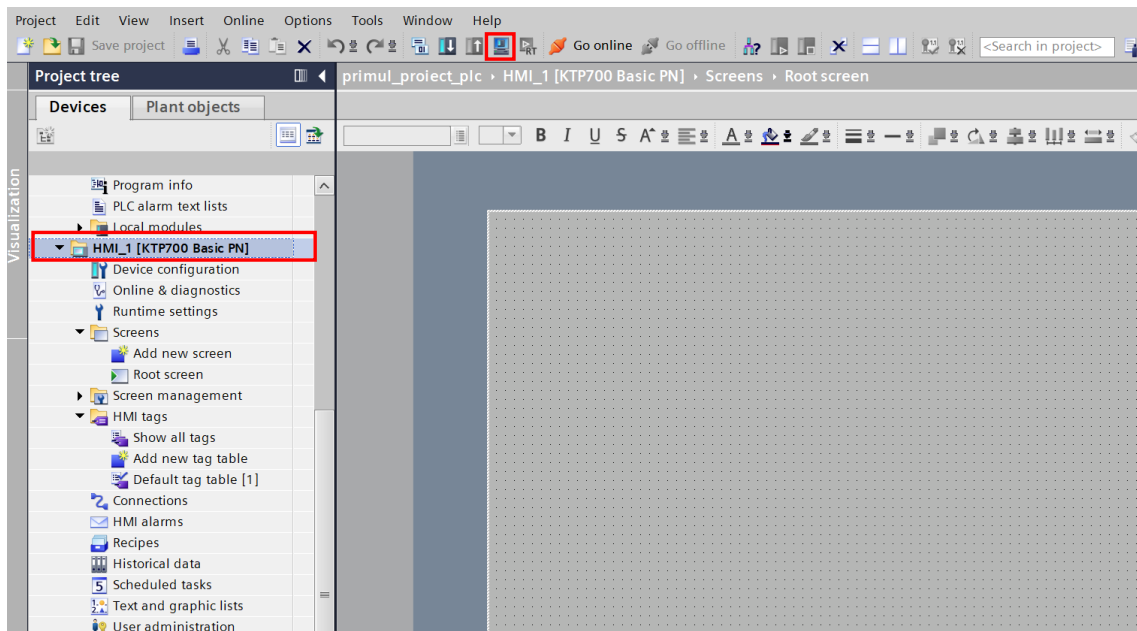
# Configurare hardware



The screenshot displays the Siemens SIMATIC Manager interface for configuring hardware. The main window shows the HMI\_1 device. The Project tree on the left lists the project structure, including PLC\_1 [CPU 1215C DC/DC/DC] and HMI\_1 [KTP700 Basic PN]. The Properties window for HMI\_1.IE\_CP\_1 [PROFINET Interface] is open, showing the 'Ethernet addresses' tab. The 'Interface networked with' section shows 'Subnet: PN/IE\_1'. The 'Internet protocol version 4 (IPv4)' section has 'Set IP address in the project' selected, with IP address '192.168.0.2' and Subnet mask '255.255.255.0'. A network diagram in the top right shows PLC\_1 (CPU 1215C) and HMI\_1 (KTP700 Basic PN) connected via a green line labeled PN/IE\_1.

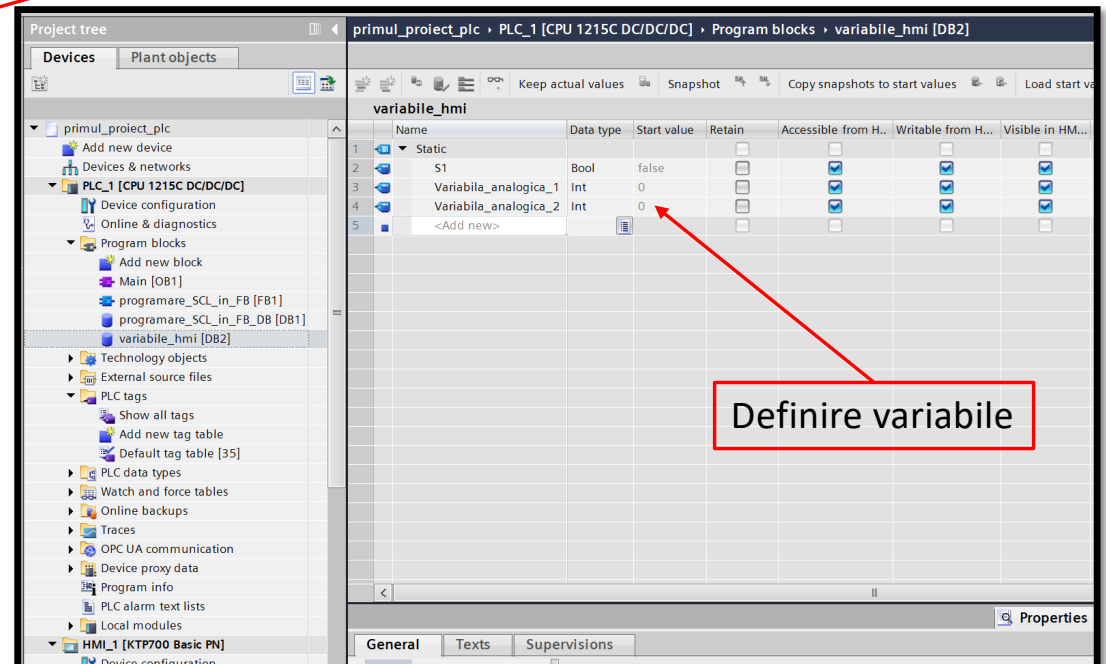
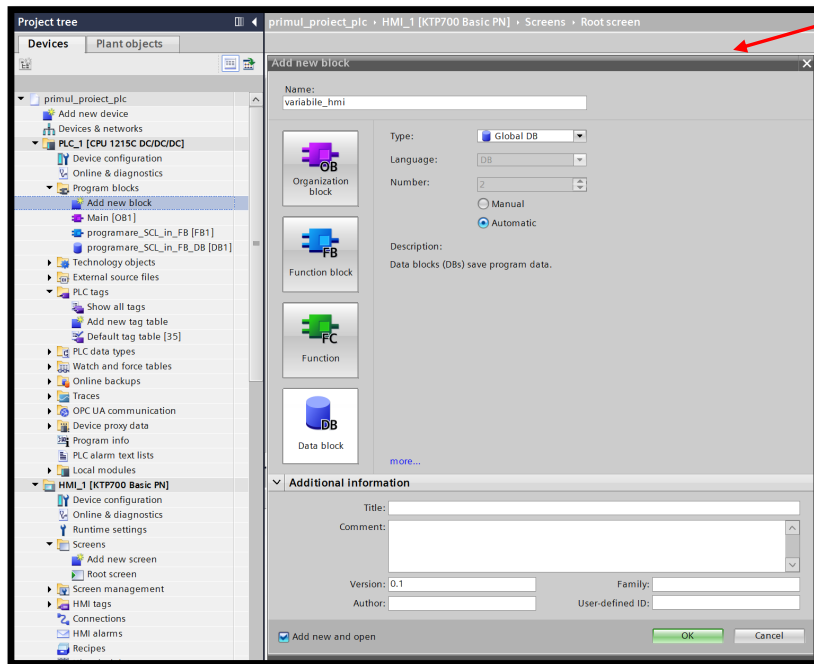


# Simulare HMI



# Pregatire variabile PLC

Adaugare DB

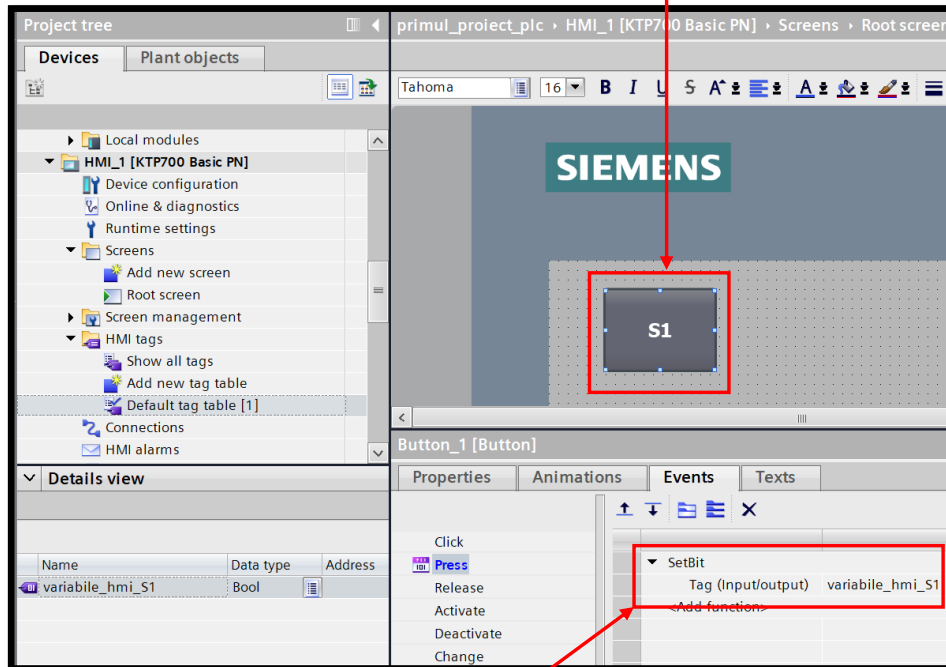


Definire variabile



# Controlul unei variabile digitale

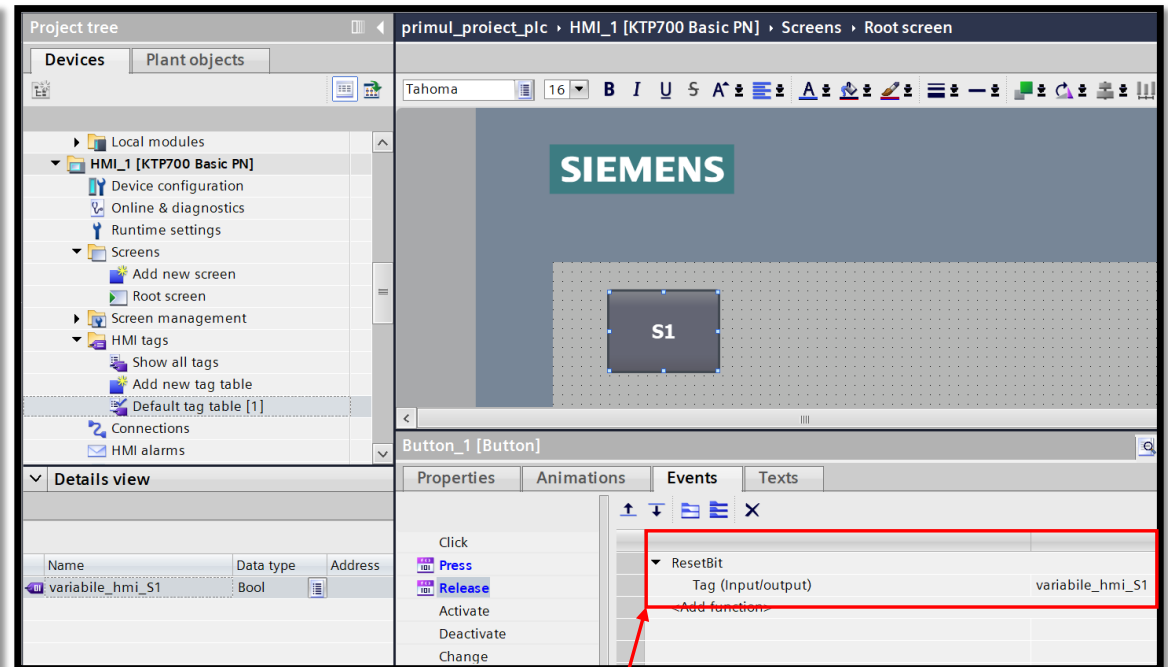
Buton cu revenire



The screenshot shows the SIMATIC Manager interface. The main window displays a button labeled 'S1' on a 'SIEMENS' background. The 'Details view' at the bottom is open to the 'Events' tab. A red box highlights the 'Press' event, which is configured with the 'SetBit' function. The 'Tag (Input/output)' is set to 'variabile\_hmi\_S1'. A red arrow points from the 'Buton cu revenire' label to the 'S1' button.

Name	Data type	Address
variabile_hmi_S1	Bool	

Event	Function	Tag (Input/output)
Press	SetBit	variabile_hmi_S1



The screenshot shows the SIMATIC Manager interface. The main window displays a button labeled 'S1' on a 'SIEMENS' background. The 'Details view' at the bottom is open to the 'Events' tab. A red box highlights the 'Press' event, which is configured with the 'ResetBit' function. The 'Tag (Input/output)' is set to 'variabile\_hmi\_S1'. A red arrow points from the 'Buton cu revenire' label to the 'S1' button.

Name	Data type	Address
variabile_hmi_S1	Bool	

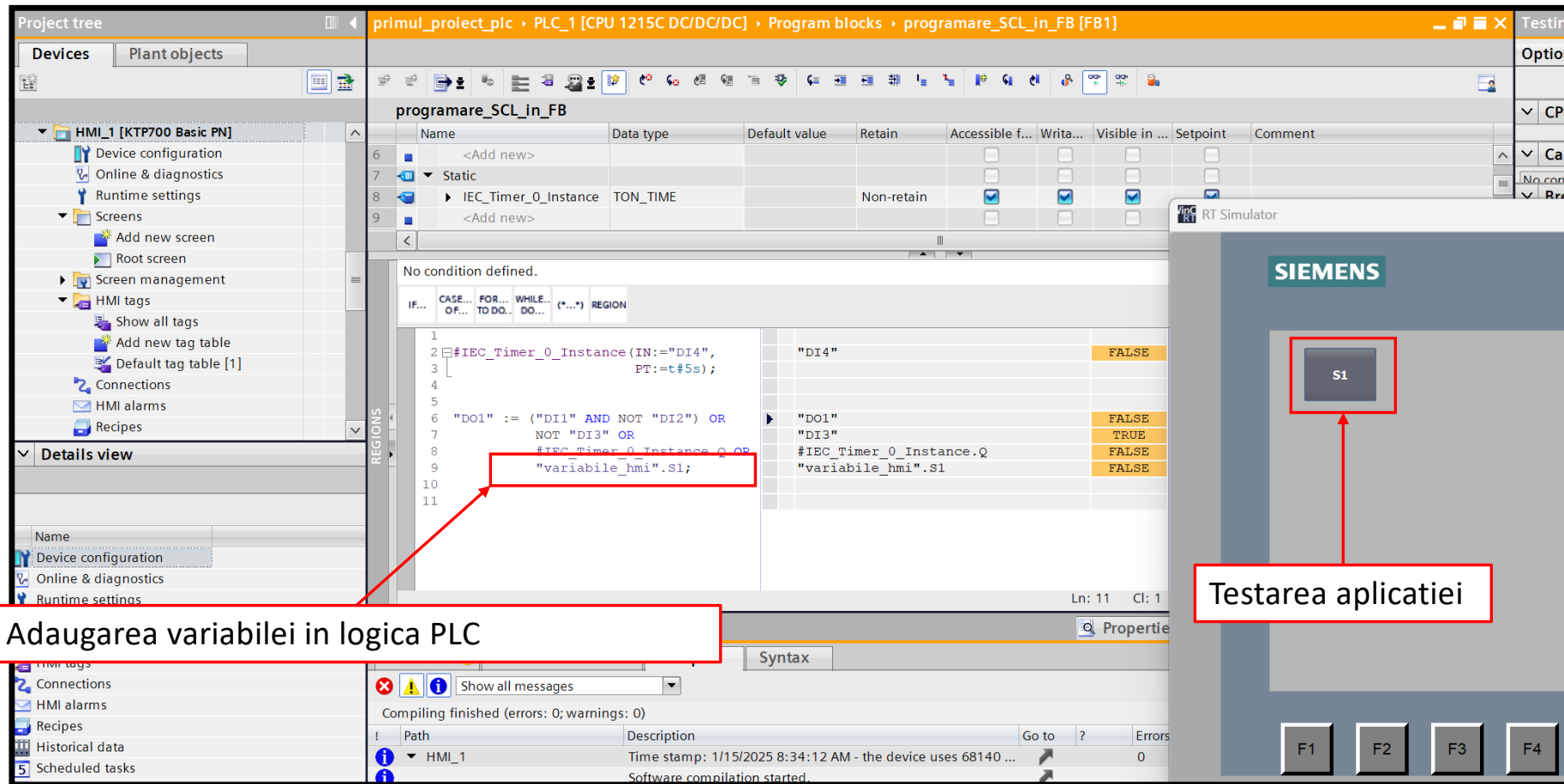
Event	Function	Tag (Input/output)
Press	ResetBit	variabile_hmi_S1

Eveniment "Press" pentru setarea variabilei bool

Eveniment "Press" pentru resetarea variabilei bool



# Controlul unei variabile digitale



The screenshot displays the Siemens SIMATIC Manager interface. On the left, the 'Project tree' shows the project structure, including 'HMI\_1 [KTP700 Basic PN]'. The main window shows the 'programare\_SCL\_in\_FB' block with a ladder logic diagram. A red box highlights the variable 'variabile\_hmi'.s1 in the logic. Below the logic, a truth table is visible, showing the state of various variables. On the right, the 'RT Simulator' window shows a graphical HMI interface with a 'SIEMENS' logo and a button labeled 'S1', which is highlighted with a red box and labeled 'Testarea aplicatiei'. The status bar at the bottom indicates 'Compiling finished (errors: 0; warnings: 0)'.

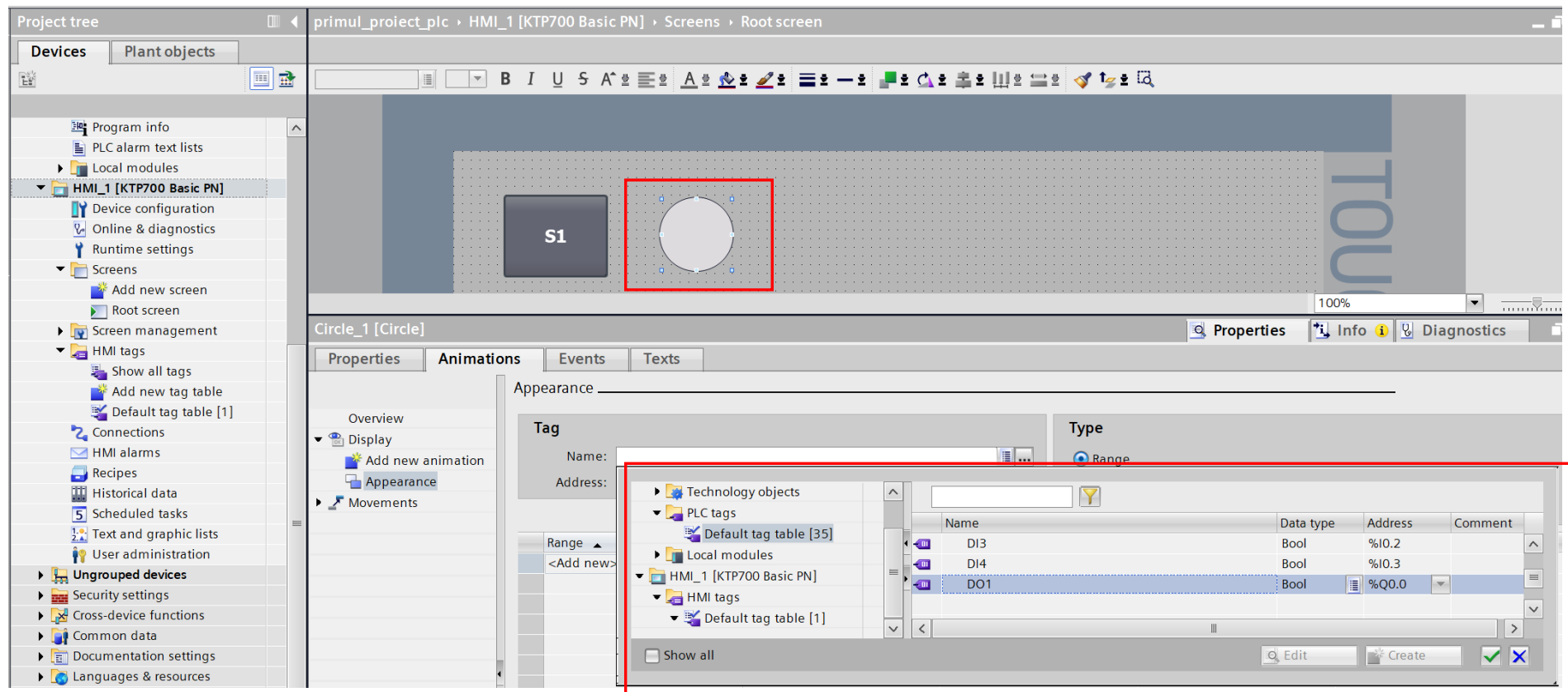
IF...	CASE... OF...	FOR... TO DO...	WHILE... DO...	(*...*)	REGION		
						"DI4"	FALSE
						"DO1" := ("DI1" AND NOT "DI2") OR NOT "DI3" OR #IEC_Timer_0_Instance.Q	FALSE
						"variabile_hmi".s1;	FALSE

Adaugarea variabilei in logica PLC

Testarea aplicatiei



# Afisarea unei variabile digitale



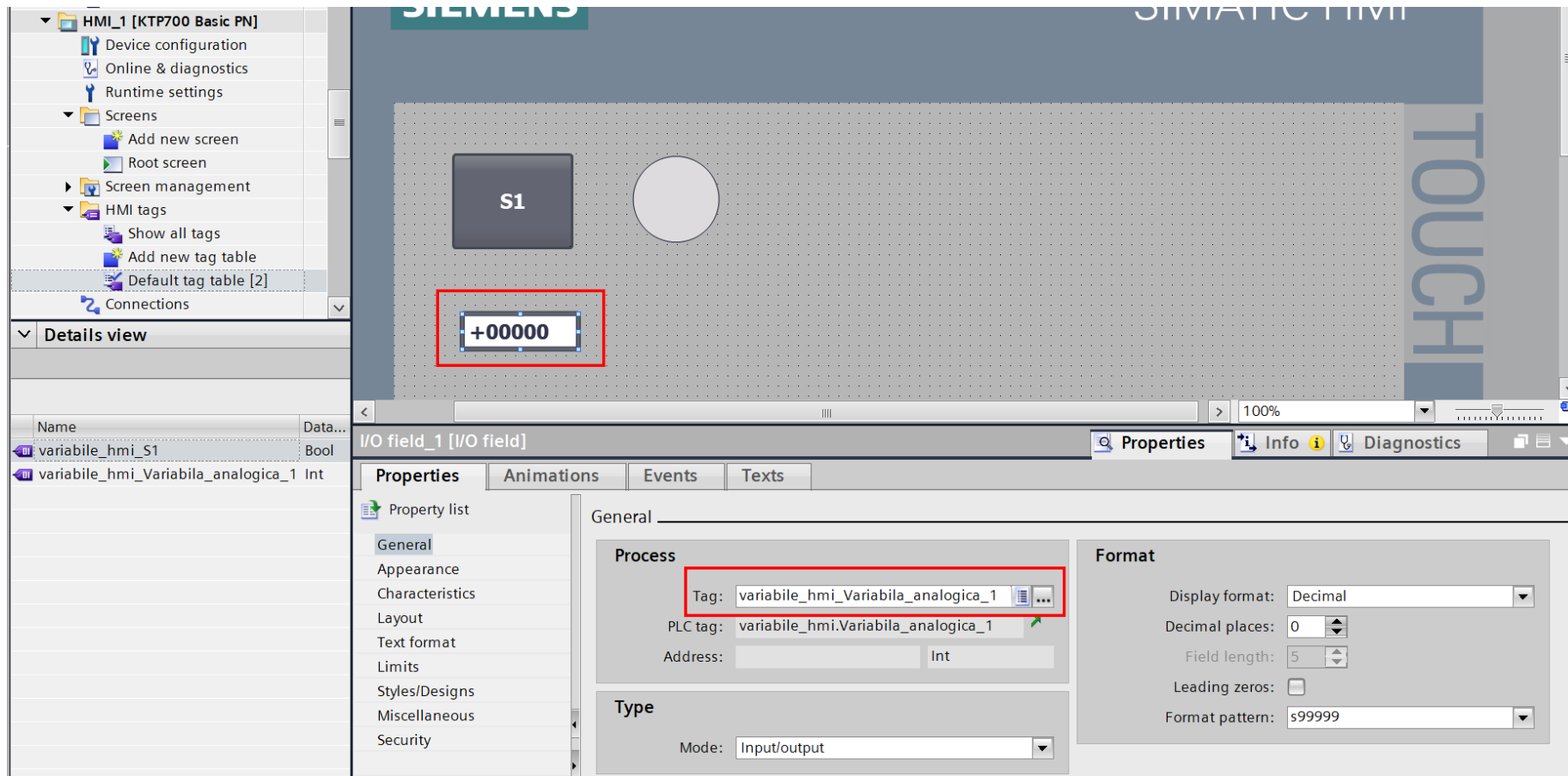
The screenshot displays the ASTI HMI software interface. The main workspace shows a screen design with a button labeled 'S1' and a circular graphic element highlighted with a red box. Below the workspace, the 'Properties' panel is open, showing the 'Tag' configuration for the selected object. The 'Tag' configuration includes a tree view on the left and a table on the right.

**Tag Configuration Table:**

Name	Data type	Address	Comment
DI3	Bool	%I0.2	
DI4	Bool	%I0.3	
DO1	Bool	%Q0.0	



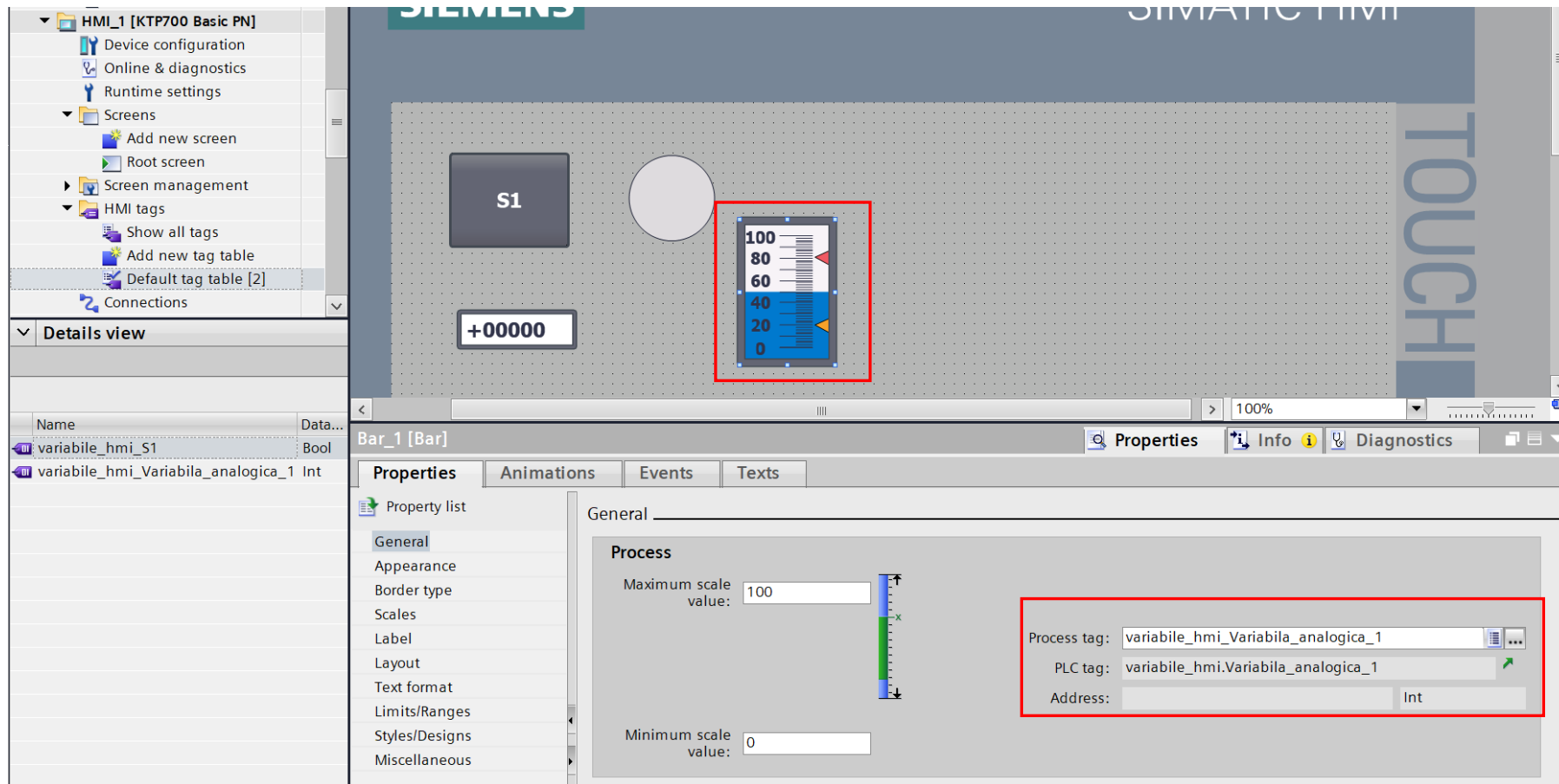
# Controlul unei variabile analogice



The screenshot displays the SIMATIC Manager interface for configuring an HMI screen. On the left, a project tree shows the structure of the HMI\_1 project. The main workspace shows a screen layout with a button labeled 'S1' and a numeric display field containing '+00000'. The numeric display field is highlighted with a red box. Below the workspace, the 'Properties' window is open, showing the configuration for the selected 'I/O field\_1 [I/O field]'. The 'Process' section is highlighted, and the 'Tag' field is set to 'variabile\_hmi\_Variabila\_analogica\_1', which is also highlighted with a red box. The 'Format' section shows the display format set to 'Decimal', with 0 decimal places and a field length of 5. The 'Type' section shows the mode set to 'Input/output'.



# Afisarea unei variabile analogice



The screenshot displays the SIMATIC Manager interface for configuring an HMI screen. On the left, a project tree shows the structure of the HMI\_1 project. The main workspace shows a simulated HMI screen with a scale indicator for an analog variable. The scale is labeled 'Bar\_1 [Bar]' and has a range from 0 to 100. The current value is displayed as '+00000'. The scale indicator is highlighted with a red box. Below the workspace, the 'Properties' window is open, showing the configuration for the selected scale indicator. The 'Process' section is highlighted, and the 'Process tag' field is set to 'variabile\_hmi\_Variabila\_analogica\_1'. The 'PLC tag' field is set to 'variabile\_hmi.Variabila\_analogica\_1'. The 'Address' field is set to 'Int'. The 'Maximum scale value' is set to 100 and the 'Minimum scale value' is set to 0.





# Primul program: Extindere



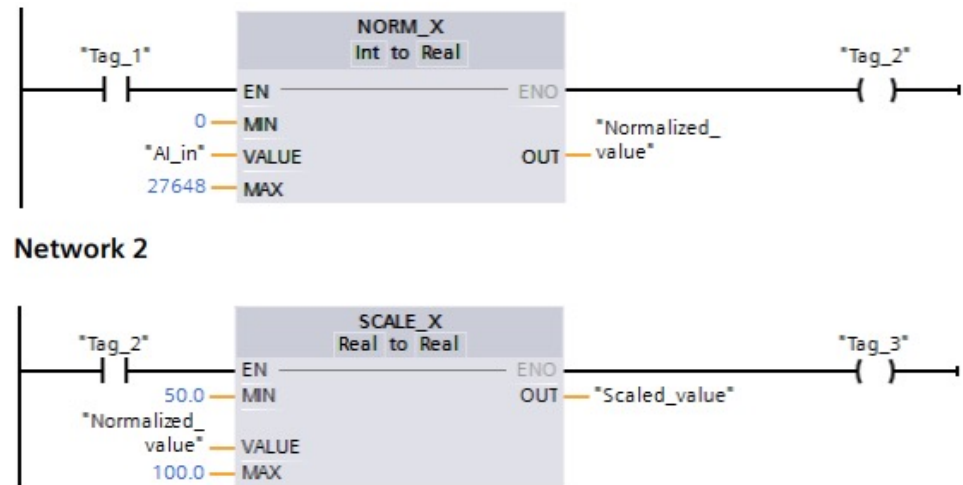
- Gestionarea ecranelor HMI folosind butoanele fizice
- Adaugarea unei alarme digitale generata de intrarea digitala 5
- Limitarea valorii de input pentru “variabila\_analogica\_1”
- Animatia schimbarea vizibilitatii unui obiect
- Deplasarea unui obiect grafic pe ecranul HMI



# Primul program: Extindere

- Gestionarea unei intrari analogice (0-27548)

Analog input value	Engineering units
0	50 °C
6192	62.5 °C
12384	75 °C
18576	87.5 °C
27648	100 °C



# Studiu de caz

Modelarea unei aplicații de automatizare cu ajutorul diagramelor de stare

Implementarea unui program de conducere automat cu tehnologii Siemens

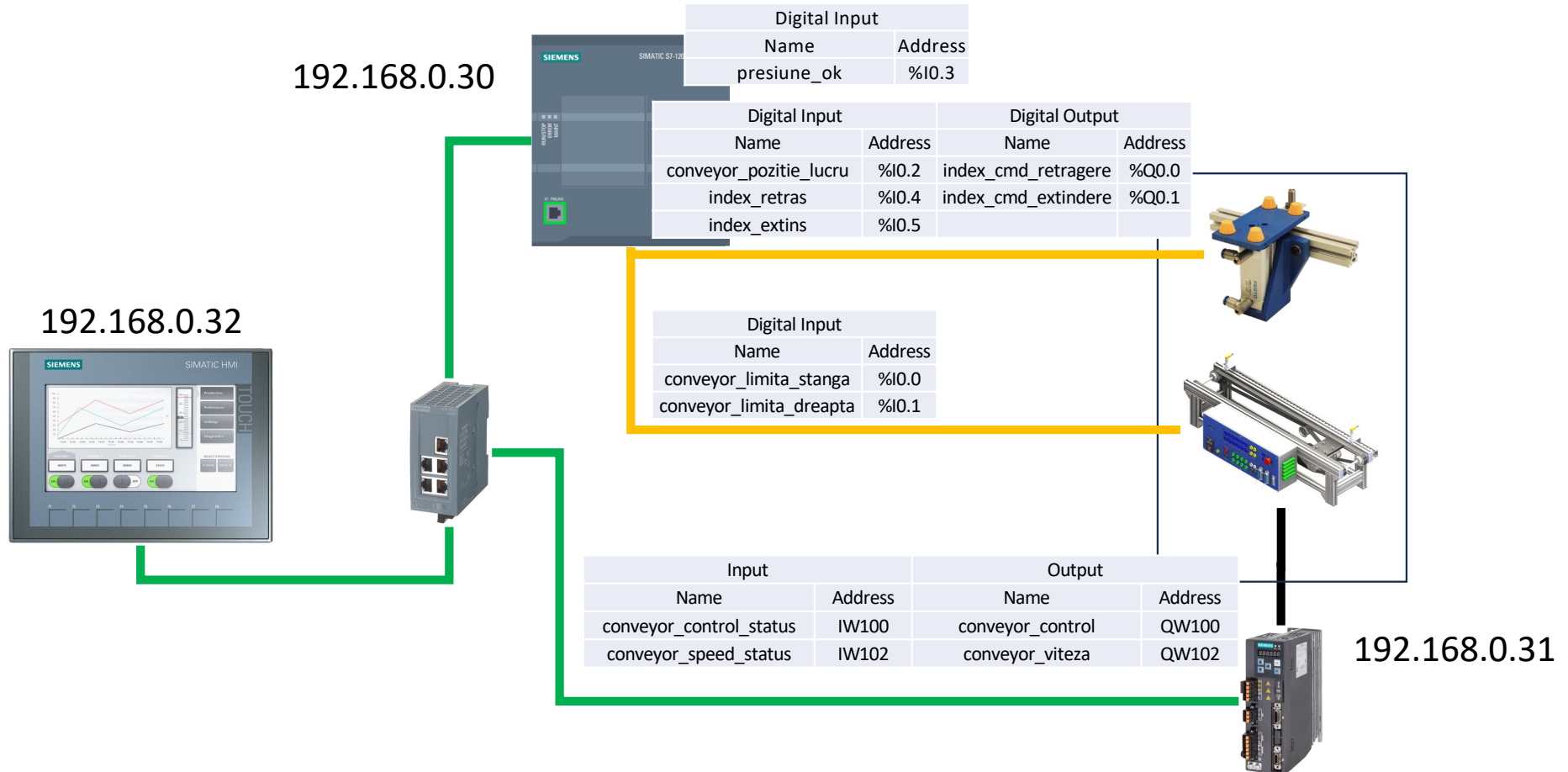


# Materiale utilizate:

- PLC Siemens S7-1214C DC/DC/DC
- HMI Siemens KTP700
- Servodrive V90 cu servomotor 1FK6
- Cilindru pneumatic FESTO cu dublă acțiune
- Distribuitor pneumatic 5/2 bistabil pentru comanda cilindrului
- Senzori inductivi IFM pentru detecția poziției paletelor pe conveyor
- Senzori de poziție pentru cilindrul pneumatic
- Piesă de lucru
- TIA Portal



# Materialle utilizate:



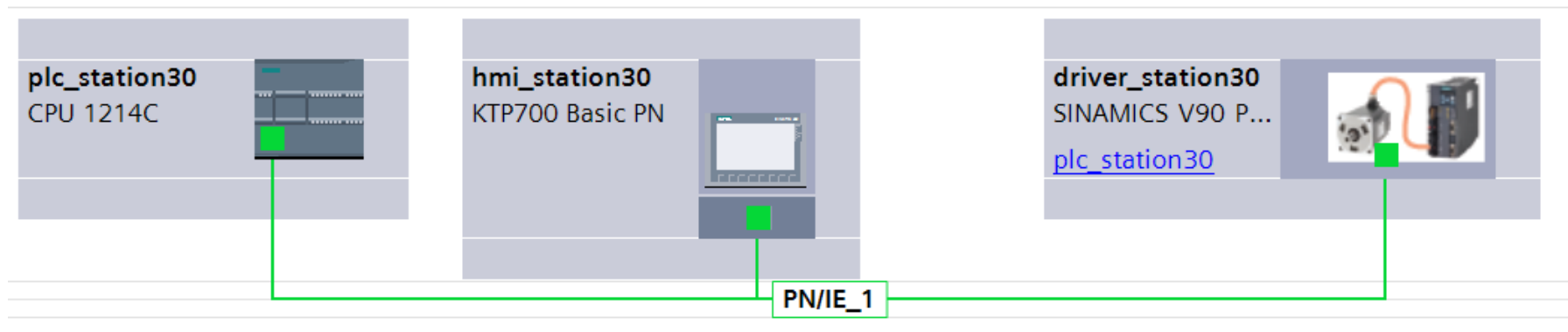
# Descriere aplicație



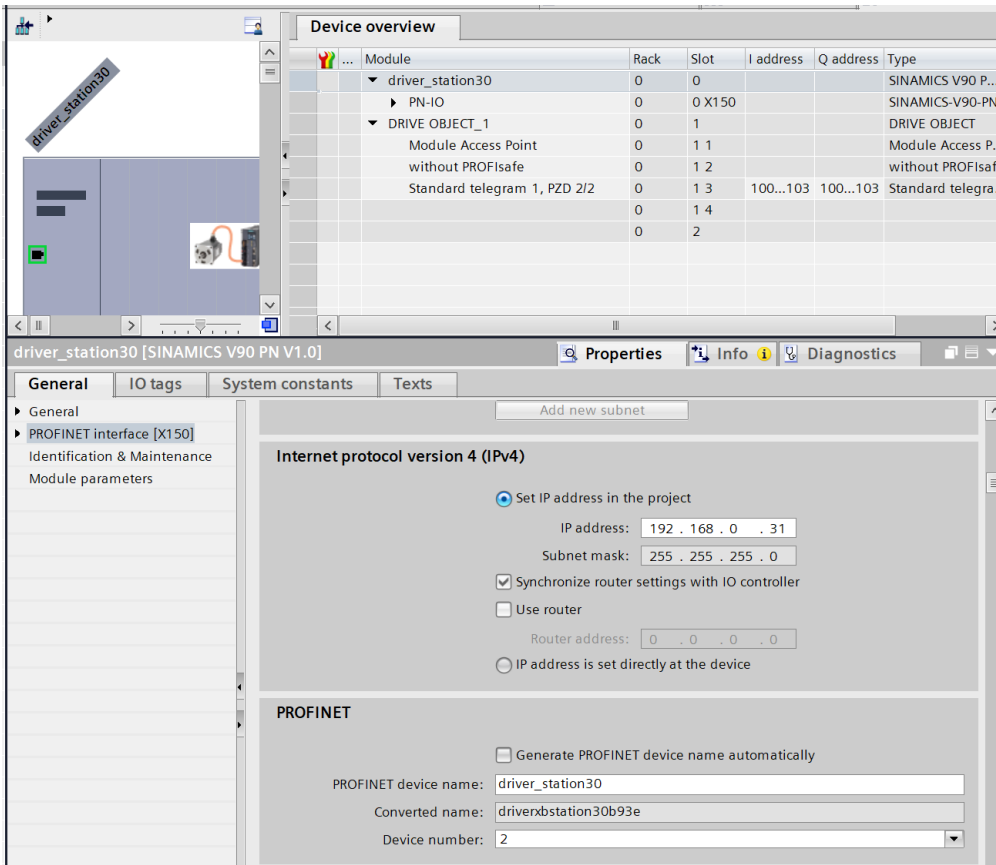
- La apăsarea butonului “Start” de pe HMI piesa trebuie deplasata spre limita din stânga a conveyor-ului
- Atunci când piesa a ajuns la limita din stânga, conveyor-ului se oprește și sta oprit pentru 2 secunde
- După 2 secunde piesa pornește spre poziția de lucru
- Atunci când piesa a ajuns la poziția de lucru, conveyor-ul se oprește și index-ul ridică piesa. Piesa sta ridicata 5 secunde
- După 5 secunde indexul se retrage
- Atunci când indexul este retras complet piesa este transportata spre limita din dreapta a conveyor-ului
- In orice stare a sistemului, la apăsarea butonului “Stop” conveyor-ul se oprește și indexul se retrage



# Configuratie hardware



# Configuratie driver



Module	Rack	Slot	I address	Q address	Type
driver_station30	0	0			SINAMICS V90 P...
PN-IO	0	0 X150			SINAMICS-V90-PN
DRIVE OBJECT_1	0	1			DRIVE OBJECT
Module Access Point	0	1 1			Module Access P...
without PROFIsafe	0	1 2			without PROFIsafe
Standard telegram 1, PZD 2/2	0	1 3	100...103	100...103	Standard telegra..
	0	1 4			
	0	2			

**Internet protocol version 4 (IPv4)**

Set IP address in the project

IP address: 192 . 168 . 0 . 31

Subnet mask: 255 . 255 . 255 . 0

Synchronize router settings with IO controller

Use router

Router address: 0 . 0 . 0 . 0

IP address is set directly at the device





**PROFINET**

Generate PROFINET device name automatically

PROFINET device name: driver\_station30

Converted name: driverxbstation30b93e

Device number: 2

PLC tags				
	Name	Tag table	Data type	Address
1	 conveyor_control	Default tag table	Word	%QW100
2	 conveyor_speed	Default tag table	Word	%QW102
3	 conveyor_control_status	Default tag table	Word	%IW100
4	 conveyor_speed_status	Default tag table	Word	%IW102





# Driver: Telegrama 1

Control Word																
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
					PLC Control			Ack	Enable setpoint	Continue	Op condition	Enable	OFF3	OFF2	OFF1	
0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	0	<b>16#047E</b>
0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	<b>16#047F</b>

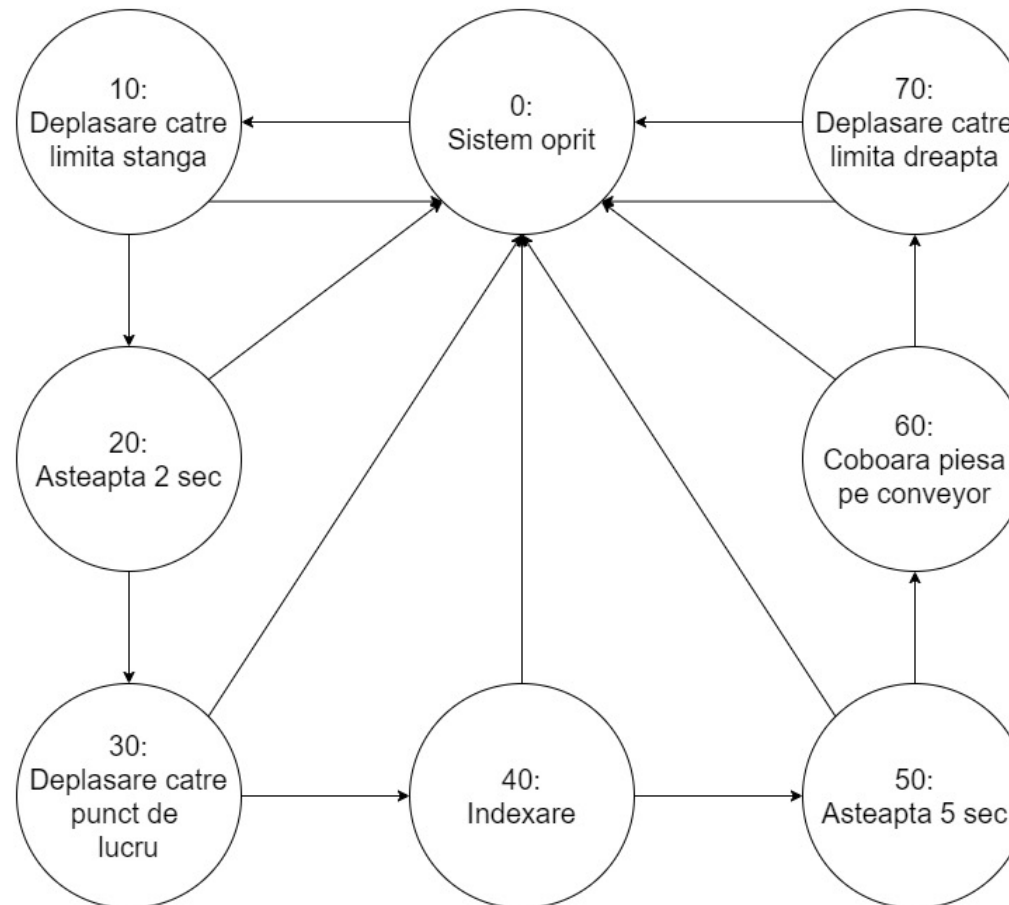
Speed SetPoint Word																
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
- 16384 ... 16384 (-100 % ... 100 %)																

Feedback Word																
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
No Alarm	Dir	Overtemp	Brake	Lim reached	f/n	Control requested	Run	Alarm	Sw ON Inhibited	OFF3 act	OFF2 act	Fault	Op enabled	Ready	Servo On	
1 = No alarm, thermal overload, power unit	1 = Motor rotates forwards	1 = No motor overtemperature alarm	1 = Open the holding brake	0 = I, M, or P limit reached	1 = target position reached	1 = Control requested	1 = Following error in range	1 = Alarm present	1 = Switching on inhibited active	1 = No fast stop active (OFF3 inactive)	1 = No coast down active (OFF2 inactive)	1 = Fault present	1 = Operation enabled	1 = Ready for operation	1 = Ready for power up	

Actual Speed Word																
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
- 16384 .. 16384 (-100 % ... 100 %)																



# Modelare aplicație



# Bibliografie

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- [S7-1500/ET 200MP Automation system](#)
- [S7-1500/ET 200MP Digital input module DI 16x24VDC BA](#)
- [S7-1500/ET 200MP Digital input module DI 64x24VDC SNK/SRC BA](#)
- [S7-1200 Programmable controller](#)



# Vă mulțumim!

