Modeling and Automation of Industrial Processes

Modelação e Automação de Processos Industriais / MAPI

Introduction to MAPI laboratory

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Prof. José Gaspar

IST / DEEC / MAPI

Shift 1: Mon 09:30-11:00
Thu 10:00-11:30

Número	Grupo Nº	Nome
66325	1	Tomás Marques Videira Fonseca
96139	1	Afonso Miguel De Almeida Santos Klier
96329	1	Tiago Filipe Espadinha Simões
93143	2	Miguel Henrique Dos Santos Vicente Alves Nabais
96134	2	Afonso Bispo Certo
96945	3	Sebastião Barroso Dias Gonçalves Chaves
97381	3	João Mendes das Neves Martins
106903	4	Afonso Folgado Soares Amorim de Figueiredo
96297	4	Pedro Afonso Botelho Pires Lopes Dias

Shift 2: Wed 12:30-14:00
Thu 11:30-13:00

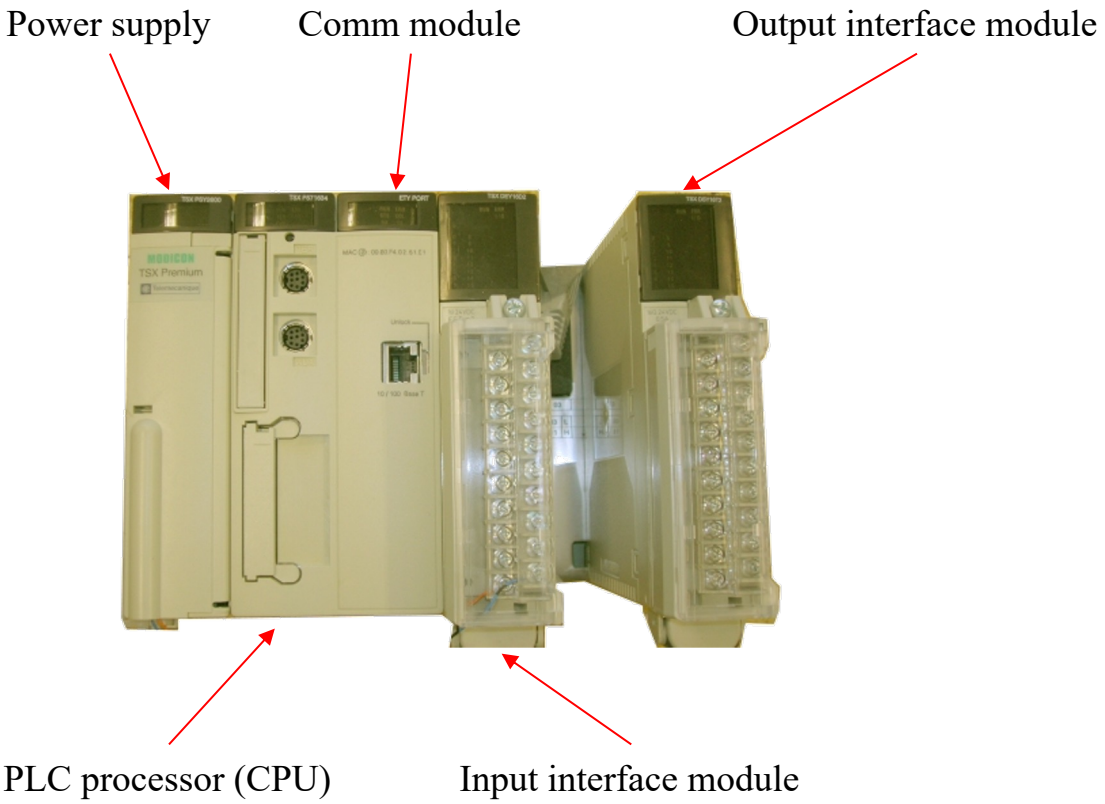
Número	Grupo Nº	Nome
86680	1	Ricardo Beja Belchior dos Santos
105737	1	João Lourenço Mestre Vitorino de Almeida e Paiva
104688	1	Rodrigues de Fátima Jacinto
90058	2	Duarte Mata da Silva Honrado
81595	2	António Martim Carneiro Portugal e Vasconcelos
93150	2	Paulo Luís Santos Cruz
107842	3	Arianna Esposito
105065	3	Carla Juan Cazalla
107886	3	Eirik Berg Wang
93197	4	Tomás Pericão Moreira Roque Pires
93777	4	João Afonso Pacheco de Sousa

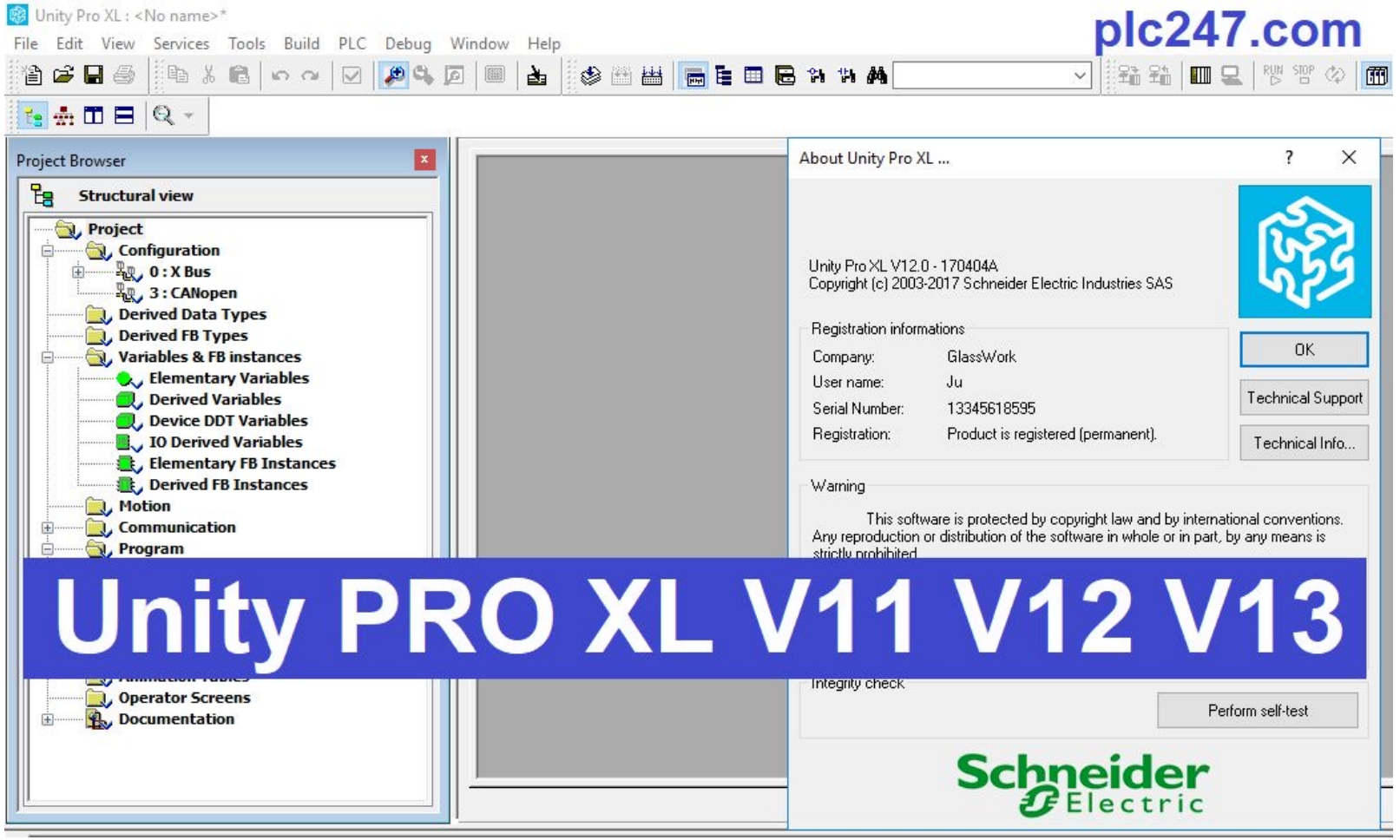
Training Laboratory Work

Part A - Introduction to PLC Programming

Part B - Data Logging using the PLC Memory

PLC TSX Premium P57 1634M




Unity Pro XL : <No name>*
File Edit View Services Tools Build PLC Debug Window Help
plc247.com
Project Browser
Structural view
Project
Configuration
0 : X Bus
3 : CANopen
Derived Data Types
Derived FB Types
Variables & FB instances
Elementary Variables
Derived Variables
Device DDT Variables
IO Derived Variables
Elementary FB Instances
Derived FB Instances
Motion
Communication
Program
Operator Screens
Documentation
About Unity Pro XL ...
Unity Pro XL V12.0 - 170404A
Copyright (c) 2003-2017 Schneider Electric Industries SAS
Registration informations
Company: GlassWork
User name: Ju
Serial Number: 13345618595
Registration: Product is registered (permanent).
OK
Technical Support
Technical Info...
Warning
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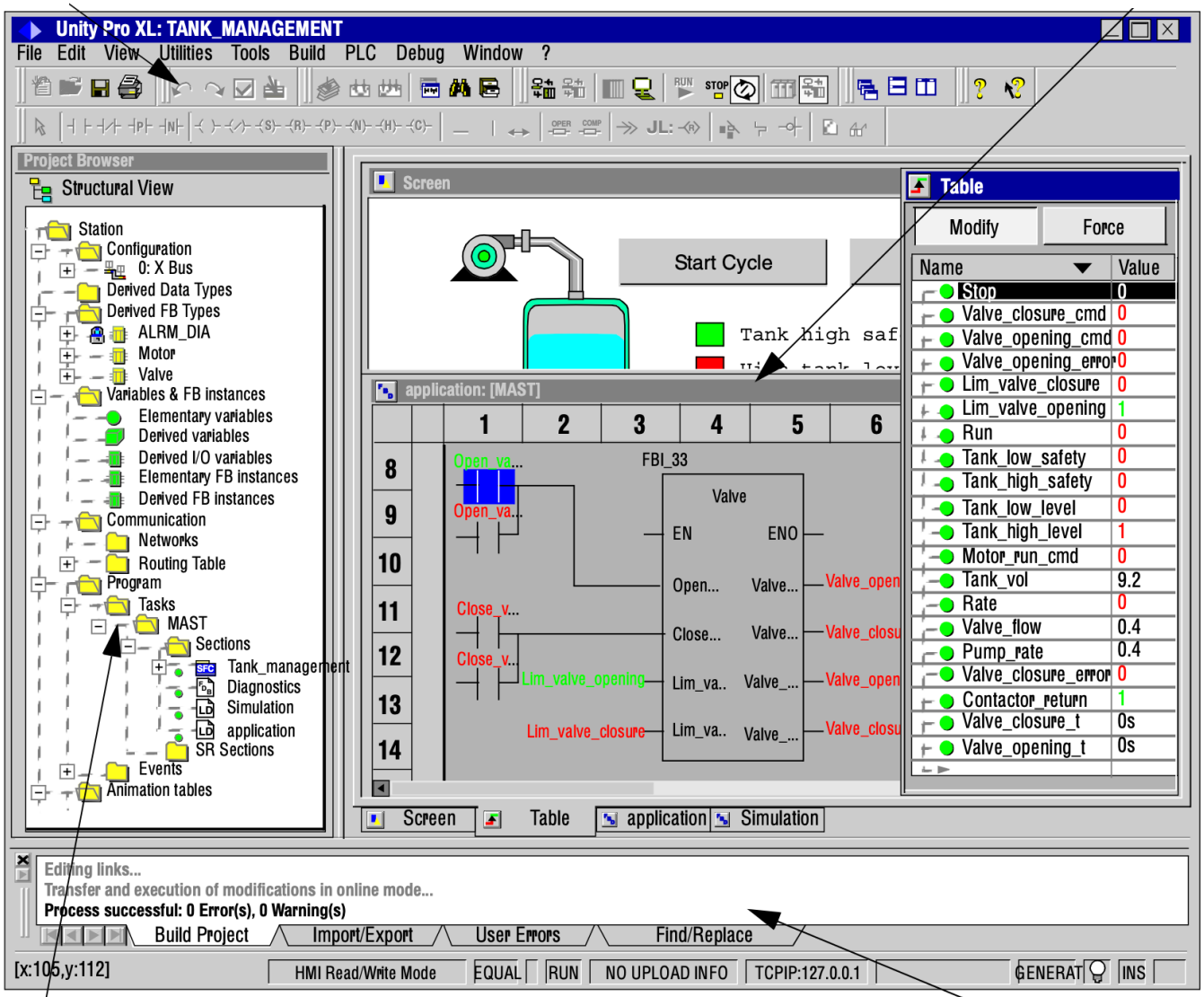
strictly prohibited
Integrity check
Perform self-test
Schneider Electric
Unity PRO XL V11 V12 V13

toolbar

Editor window



Project browser

Information window

Group folder creation:

☞ Start MatLab 2022

☞ Run

>> login_mapi <group_number>

If you don't know your group number, just run

>> login_mapi

Find your group number in the list and enter it

This command creates your group folder with the following path (write it down):

C:\users2\mapi\<group_number>

Save all your files and projects in your group folder

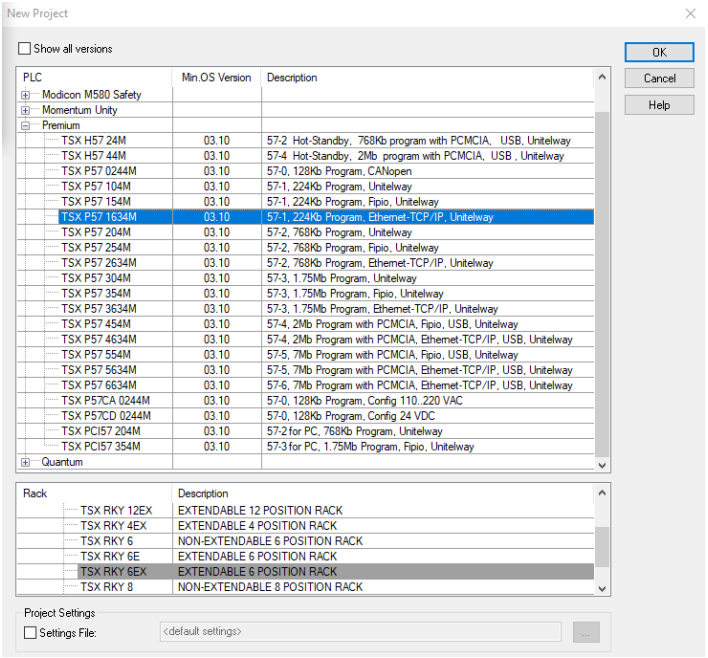
Configuration:

In the Lab there are PLCs with two different processors: 1634 or 2634

In the Unity software be sure that the right processor is selected (**version 2.00** for both)

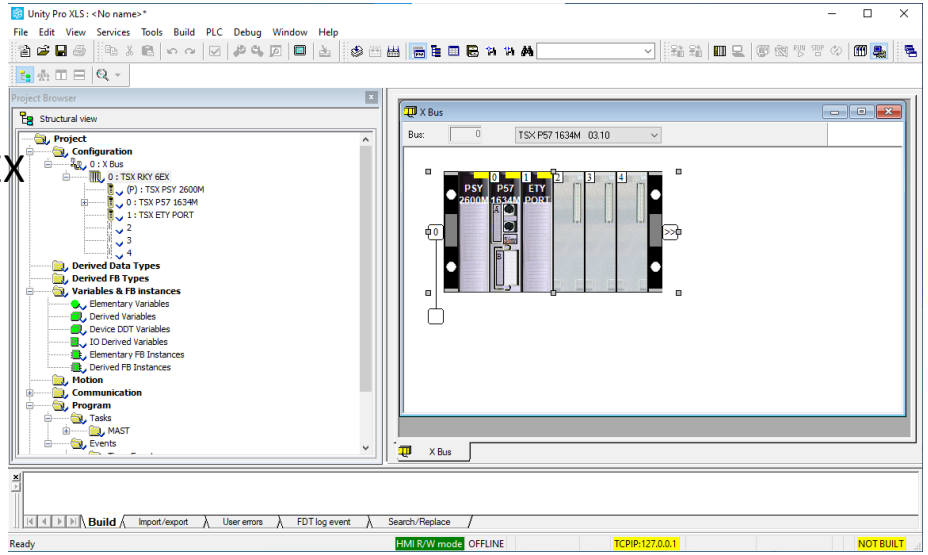
☞ File → New

Premium TSX P57 1634M (or 2634)



☞ (Project browser) click + 0:X Bus

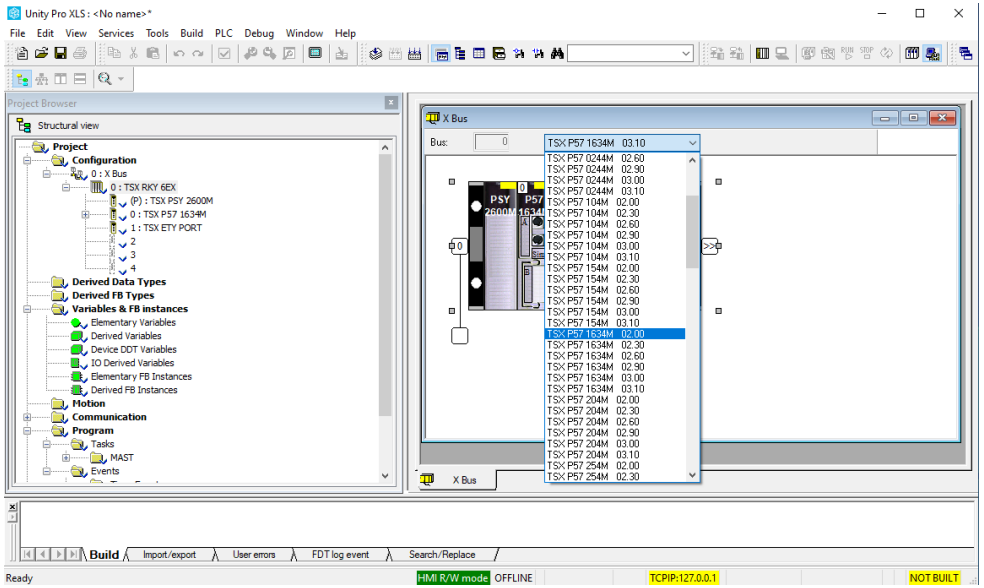
doubleclick 0:TSX RKy 6EX

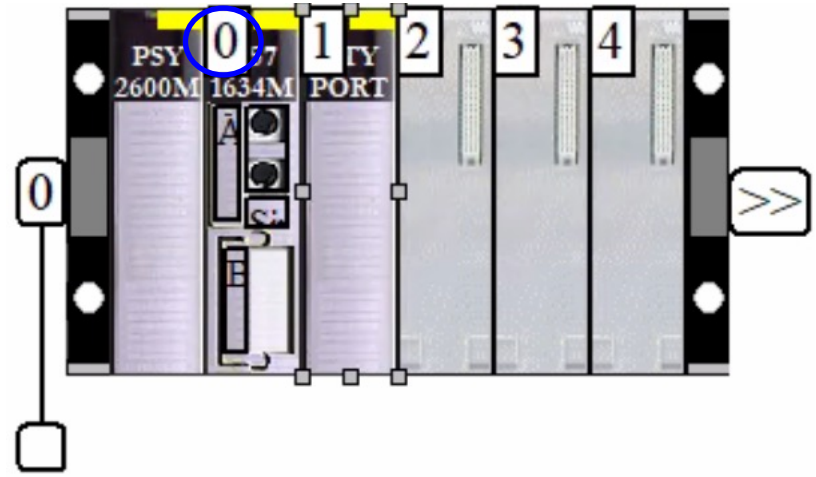


downgrade to version 2.00:

TSX P57 1634M 02.00

or 2634M 02.00





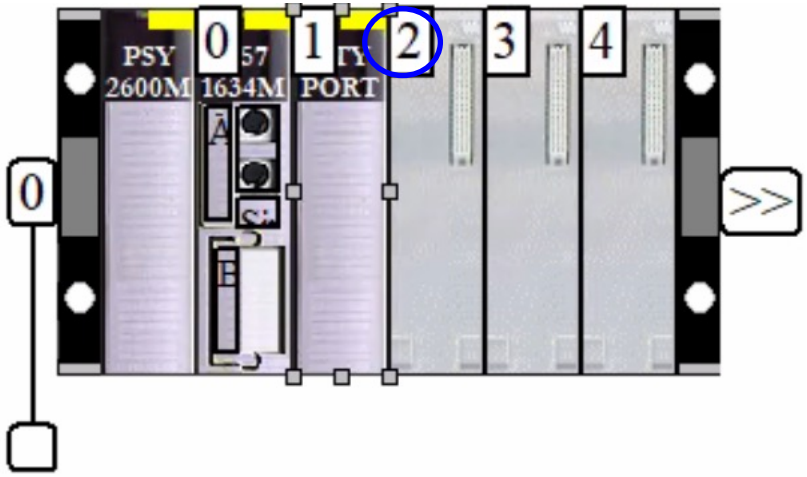
☞ doubleclick module (0)

select tab I/O objects

[select Implicits %I and %Q]

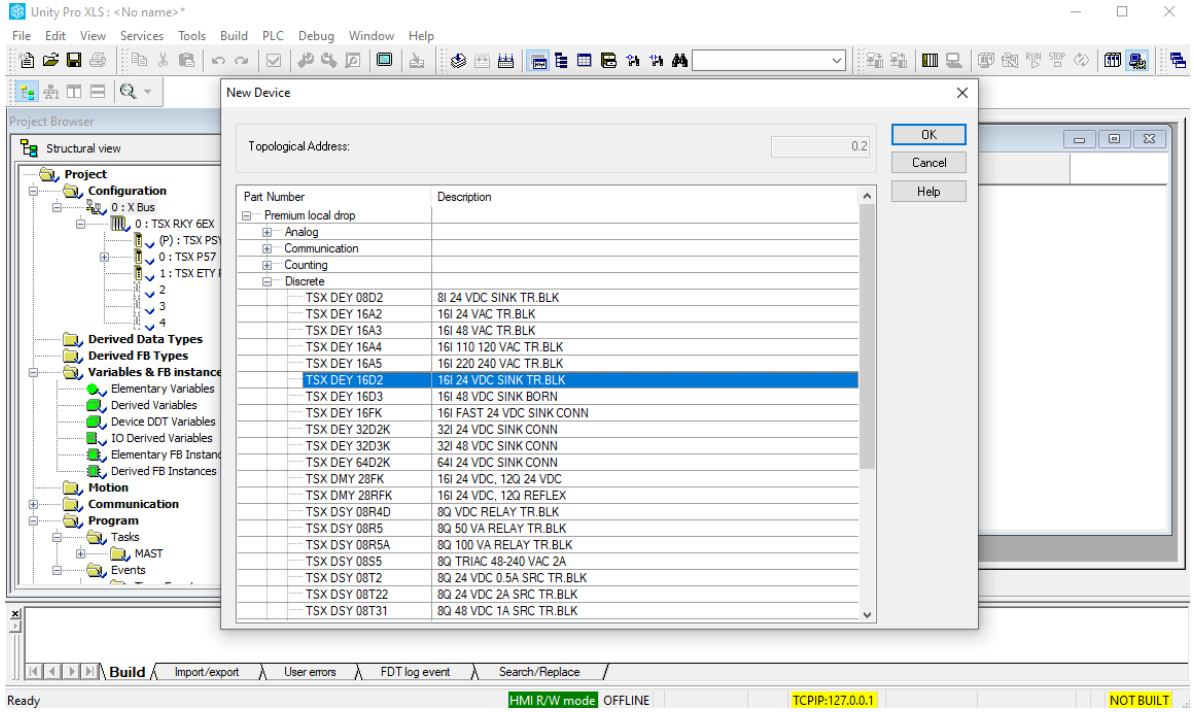
[update grid with]

Configuration:

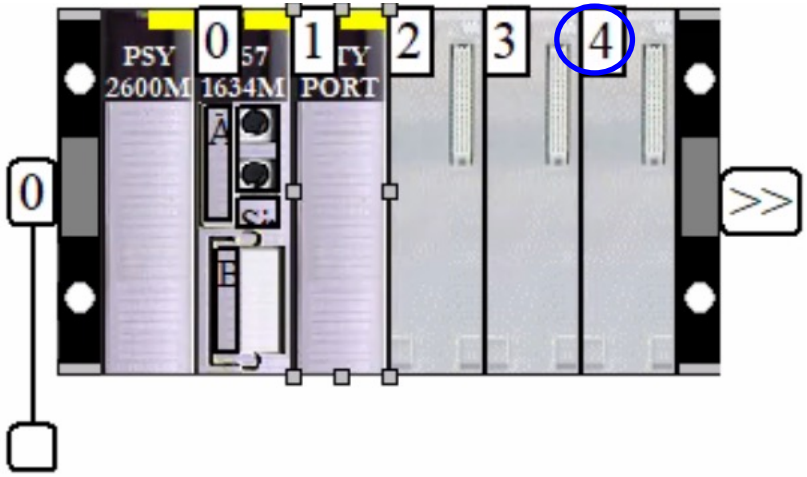


☞ doubleclick (2)

select DEY 16D2 (discrete) or DMY 28FK (module 3)

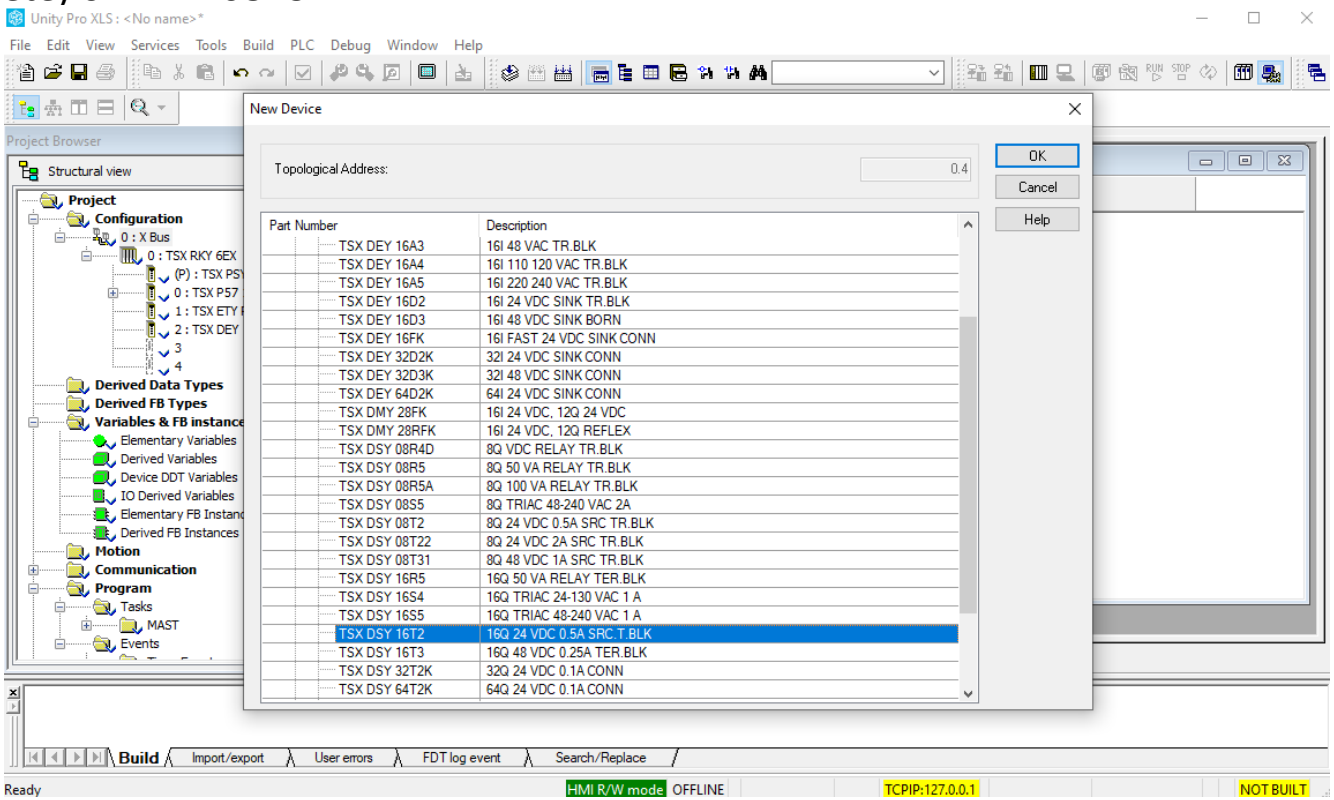


Configuration:

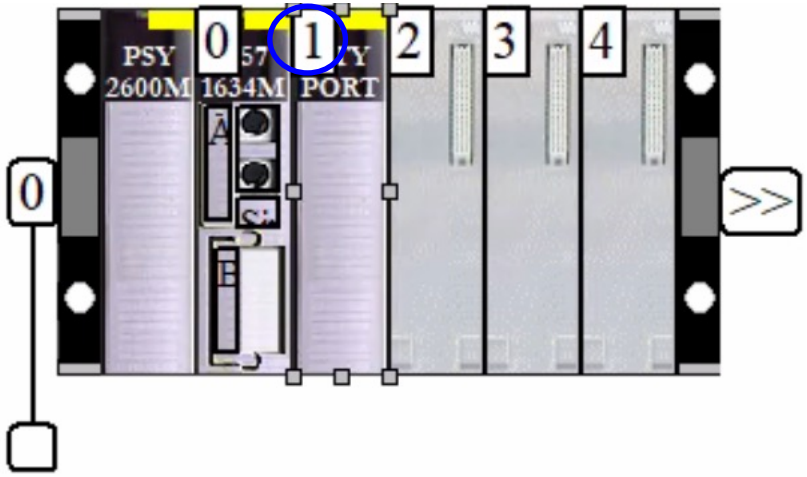


☞ doubleclick (4)

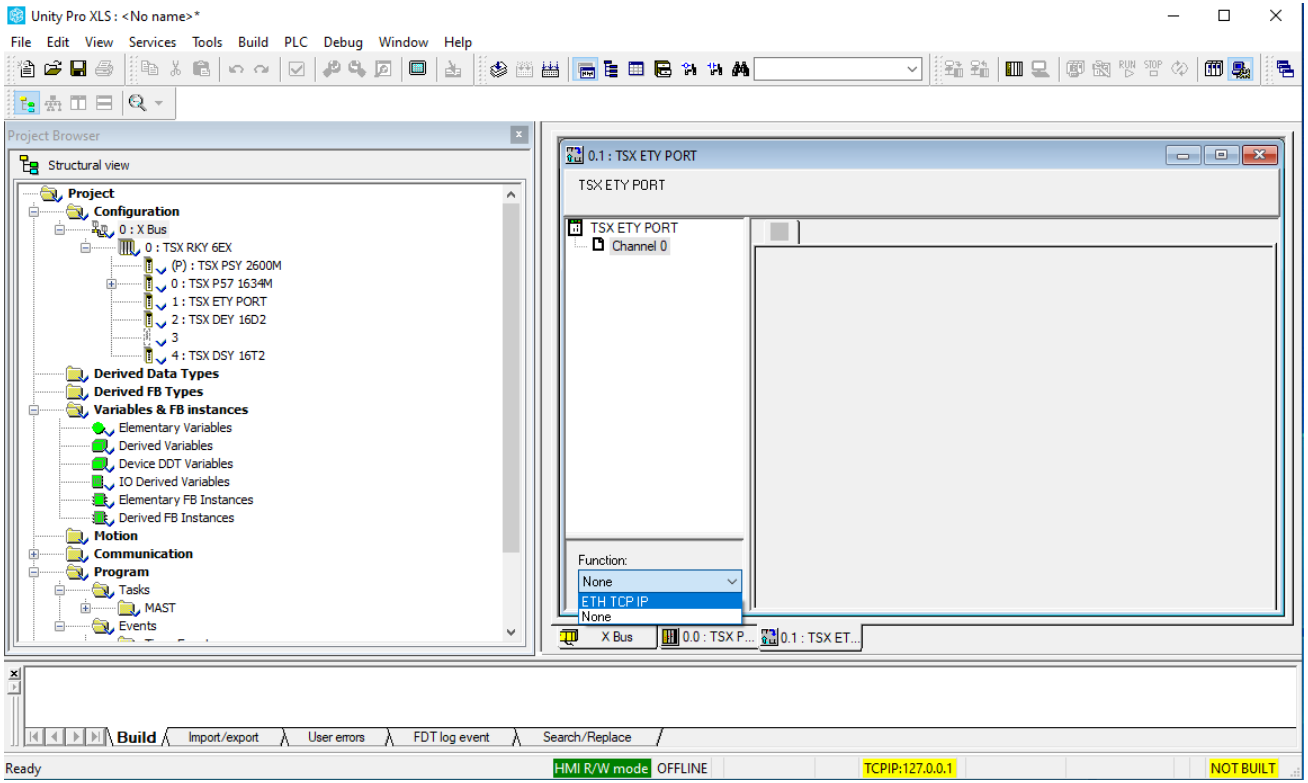
select DSY 16T2 (discrete) ~~or DMY 08R5~~



Configuration:



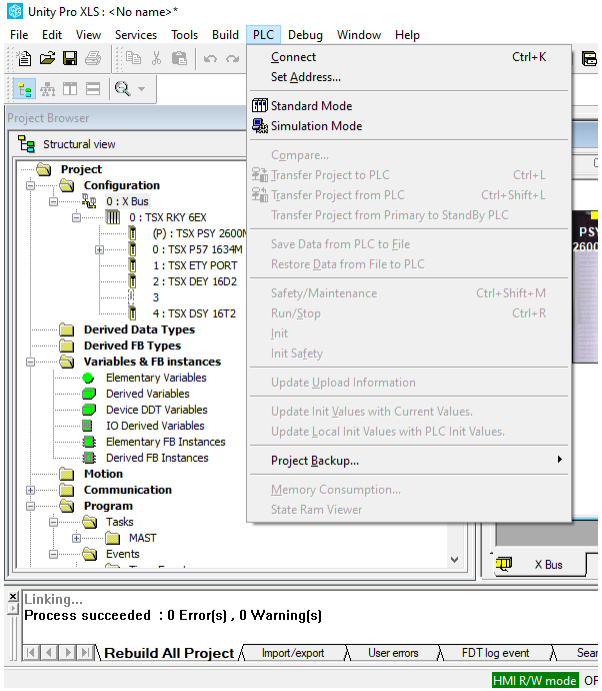
doubleclick (1) ETY Port & Channel 0: Function “ETH TCP IP” (close the window)



Run:

☞ File → Save [be sure to save in your folder c:\users2\mapi\<group number>]

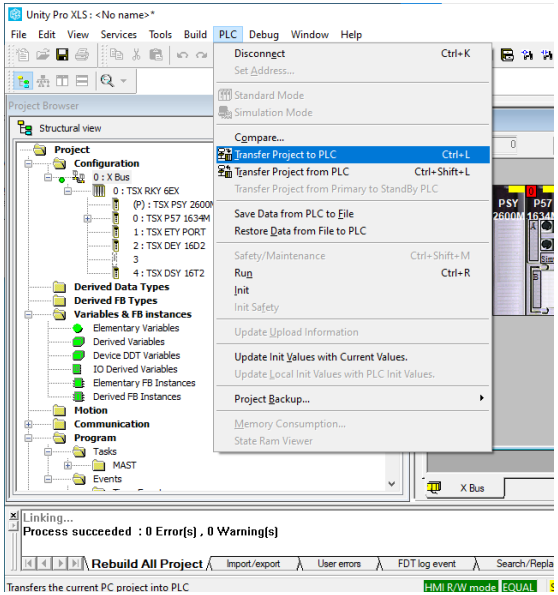
☞ PLC menu select Simulation Mode



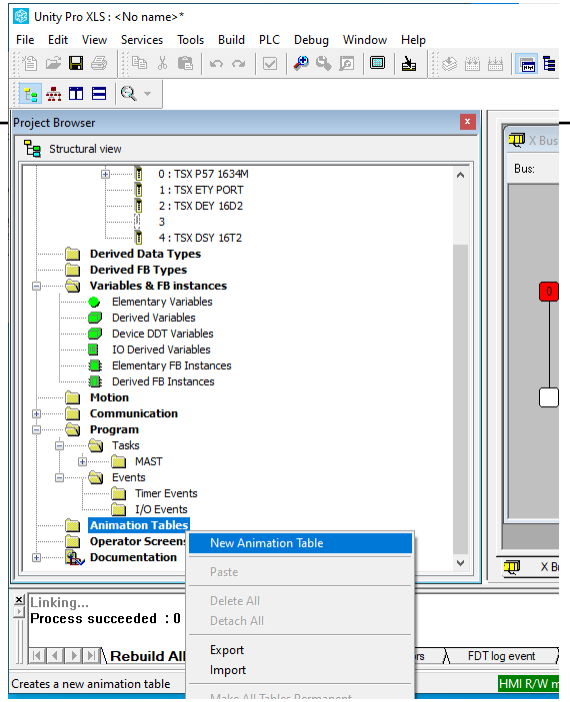
☞ PLC → Connect

☞ PLC → Transfer project to PLC (accept “Rebuild”)

☞ PLC → Run



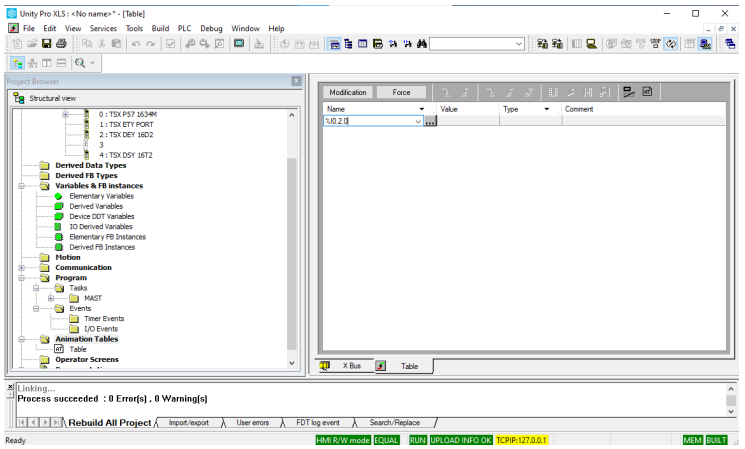
Animation table:



☞ (Project browser) Animation Tables → New

☞ Name (insert)

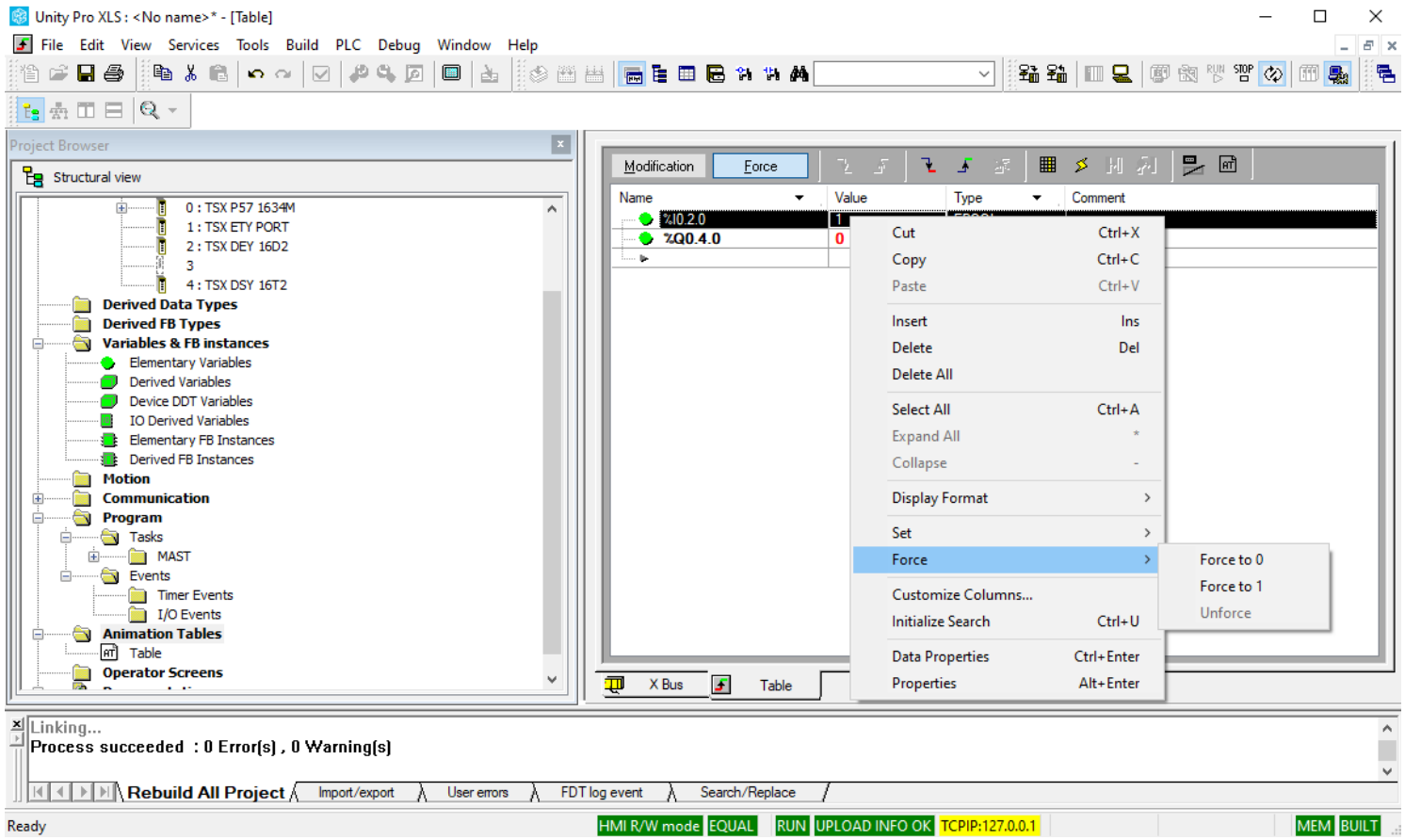
	DMY 28FK
%I0.2.0	%i0.3.0
%I0.2.1	%i0.3.1
%Q0.4.0	%q0.3.16
%Q0.4.1	%q0.3.17



Animation table:

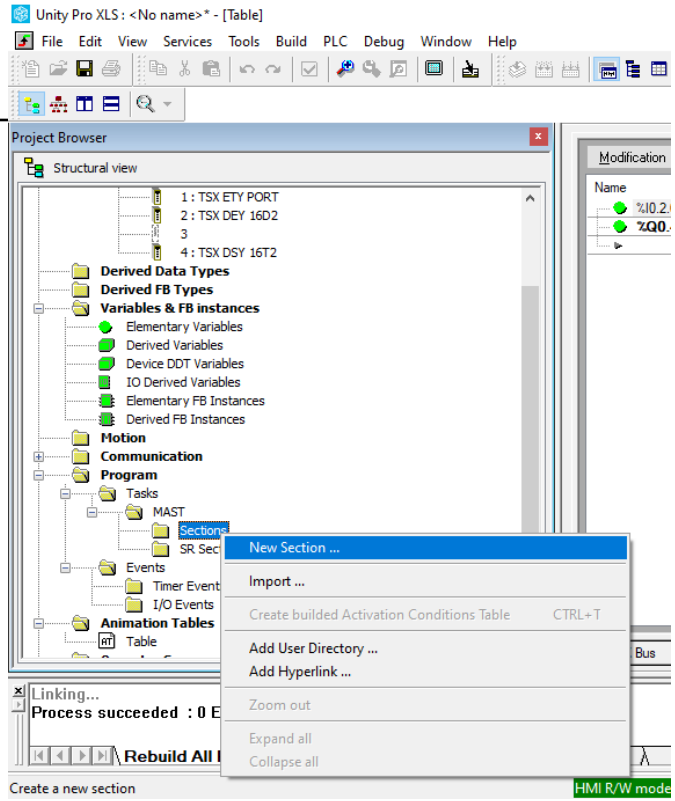
☞ click Force

☞ right click variable, option Force, Values: F0 F1 unforce

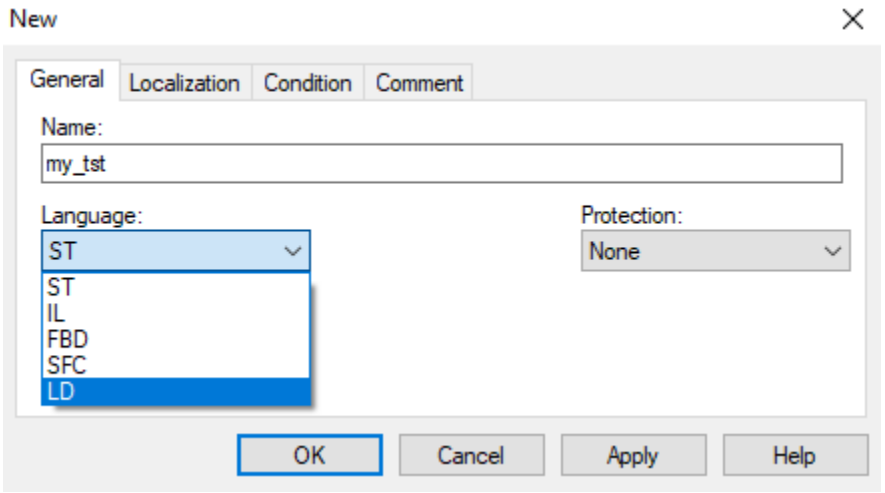


First Ladder program:

☞ Program → Tasks → MAST → Sections (right click)

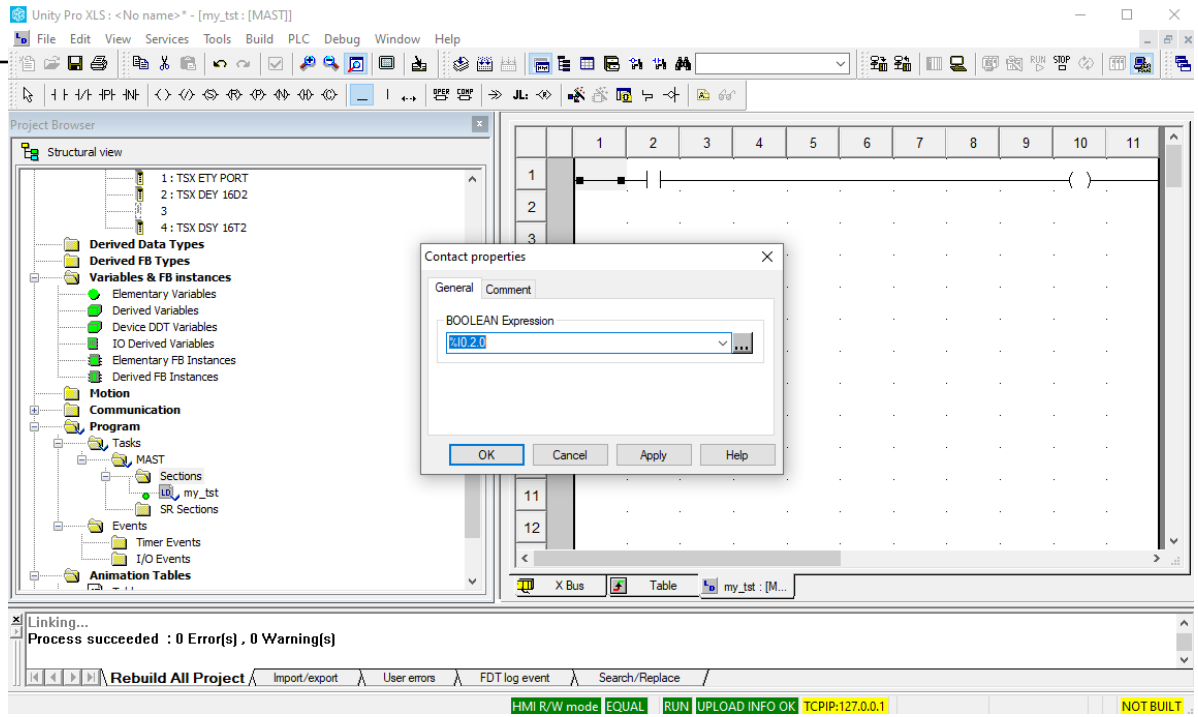


“New section” name: my_tst language: LD



First Ladder program:

☞ (Editor window) enter



(add to the animation table %i0.2.3 and %q0.4.3)

☞ PLC → Connect (if not connected)

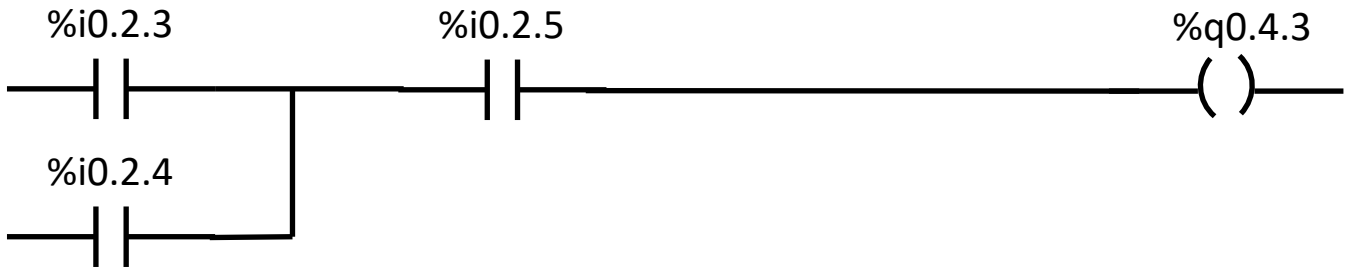
☞ PLC → Transfer project to PLC

☞ PLC → Run

☞ Animation table - (right click) %i02.3 Force to 1

new Ladder program:

☞ (Editor window) enter

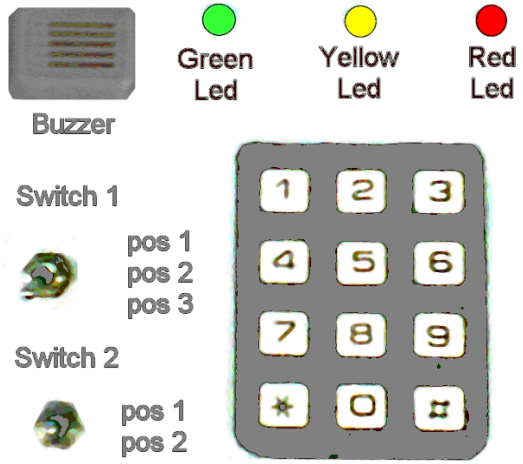


(test it) What is the logic table?

Lab hardware:

- PLC TSX Premium P57 in two different configurations: 1634 and 2634
- PC
- connection between PLC and PC uses a RS485 cable linked to the PC serial port
- Lab Panel with:
  - a 2-position switch (On/Off): On → bit 2 = 1
  - a 3-position switch (left/middle/right): left → bit 0 = 1, right → bit 1 = 1
  - a 12-key 4x3 keyboard (see more next)

  - a buzzer (output bit 0 = 1)
  - a red led (output bit 1 = 1)
  - a yellow led (output bit 2 = 1)
  - a green led (output bit 3 = 1)



- Power supply for the I/O modules

Setup with one input and one output modules

PLC testing:

☞ connect PLC (standard mode)

☞ connect power supply for the I/O modules

☞ change the program to

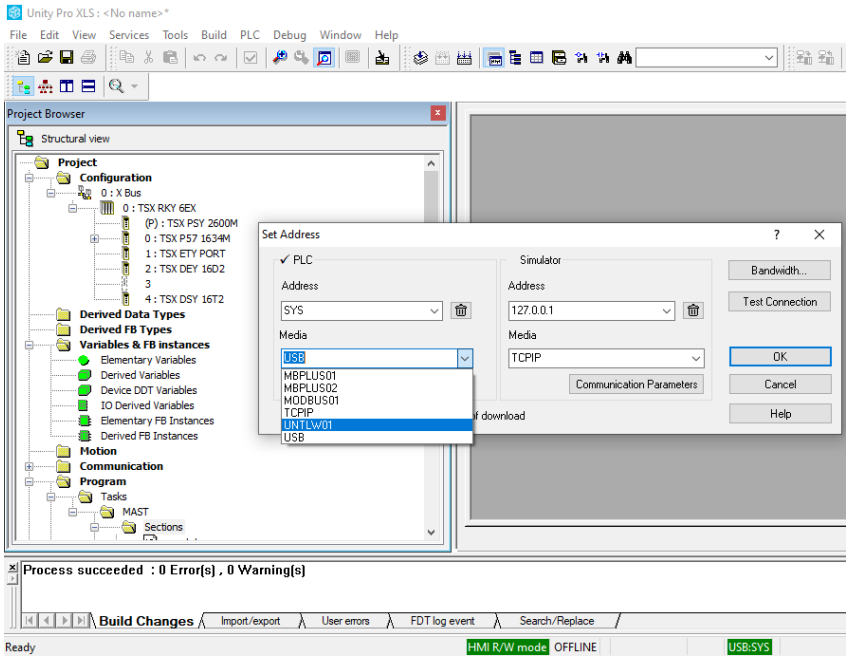
☞ PLC menu select Standard Mode

☞ PLC → Set address: Media → UNTLW01
Address → SYS

☞ PLC → Connect

☞ PLC → Transfer project to PLC

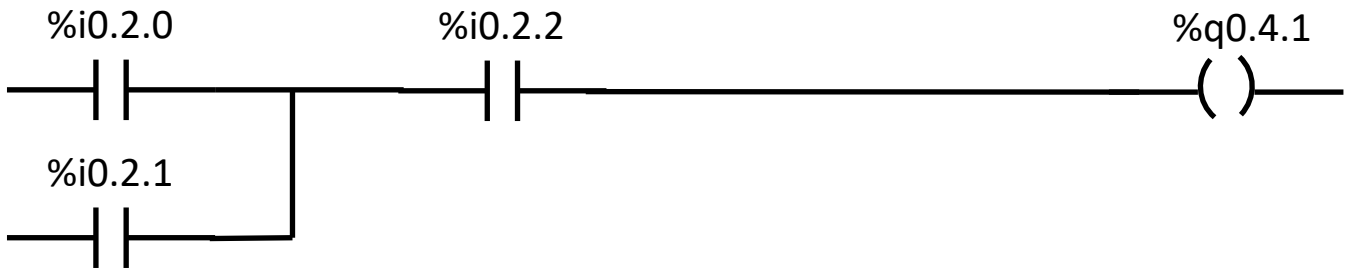
☞ PLC → Run



(guess what this program does)

PLC testing:

☞ change the program to

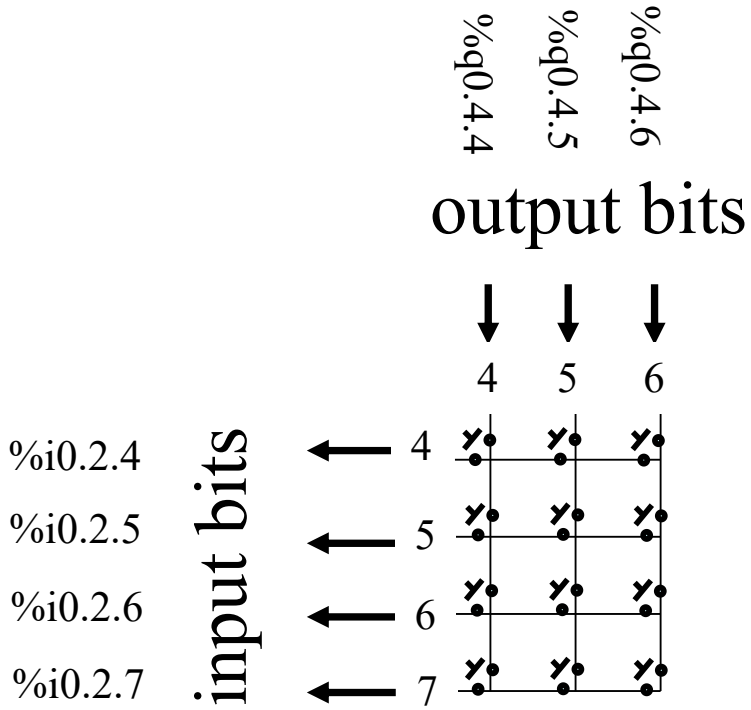


☞ PLC → Transfer project to PLC

☞ PLC → Run

(guess what this program does)

Lab keyboard:



In order to identify that a key has been pressed, first we have to energize each one of the keyboard columns through the output bits 4 to 6, and then read the input bits 4 to 7

For instance, if %q0.4.4 is set to 1 (and both %q0.4.5 and %q0.4.6 are zero) and %i0.2.6 is 1, then key “7” is pressed

Data Logger

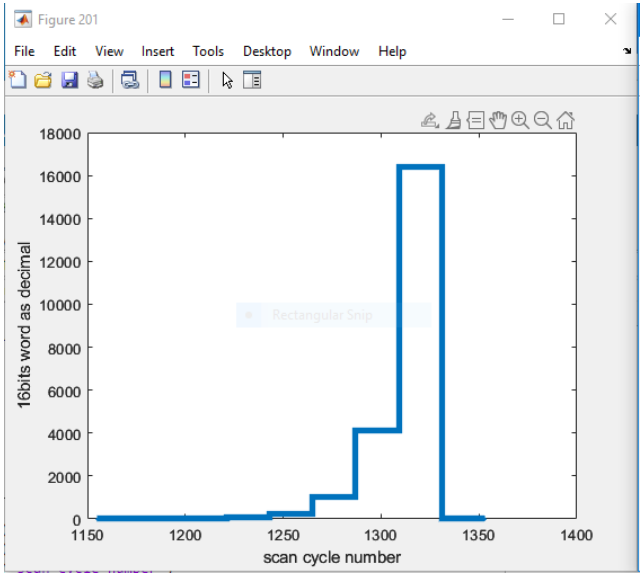
Procedure to test the program:

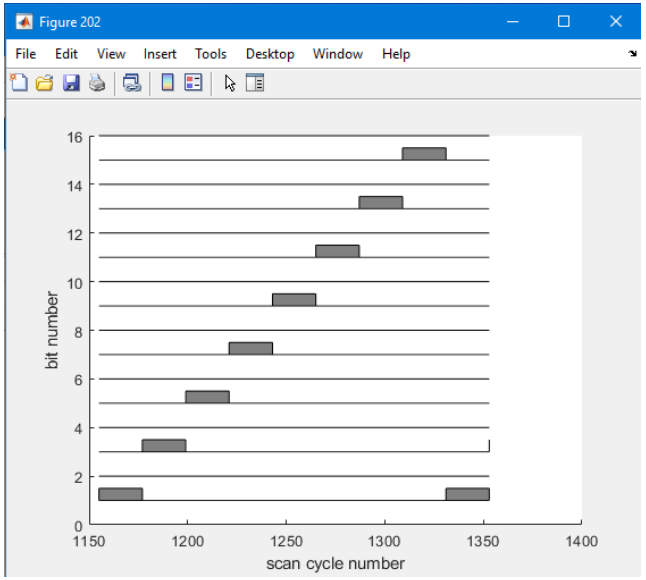
- download the zip file data_log_up13.zip by running *>> get_files logger* using Matlab
  (also available at http://users.isr.ist.utl.pt/~jag/course_utils/plc_log/data_log_up13.zip)

- Decompress the downloaded zip file to your group folder (extract, not double click)

- the zip file contains already one log file "**data_log2_tmp.dtx**"

- Using Matlab change dir to your group folder and run: *>> mem_dump_load_tst* and observe the produced plots





Data Logger (cont)

Procedure to test the program:

- Using Unity Pro, open the file **data_log2.stu**, transfer the code to the PLC simulator, and run it.
- Double-click on section 'tst_data_log' and try to interpret the code

```
if %m93 then
  (* log changes on inputs %i0.2.0 .. %i0.2.15 *)
  mem_log_inputs();
end_if;


if %m92 then
  (* log changes on memories %m100 .. %m115 *)
  mem_log_mem();
end_if;


(* test buffer full and place this info in %m91 *)
if %mw96 >= 2*MOD(%MW99,1000) then
  %m91 := 1;
else
  %m91 := 0;
end_if;


(* delete logged data *)
if %m90 then
  %mw97 := 0;
  (* reset will be done in the next call to mem_log_mem() *)
  %m90 := 0;
end_if;
```

- Set variable %m92 to 1 to start the log process
- Check value of variable %mw96
- Wait until %mw96 = 20
- using Unity Pro, export the memory to a file, **PLC -> "Save data from PLC to file"**. Save data into the file "**data_log2_tmp.dtx**" (overwrite it) in your group folder.

Data Logger (cont)

Procedure to test the program:

- Within Matlab run again: >> **mem_dump_load_tst** and observe the new plots
- Reset the log memory by setting the adequate variable
- Start a new log process and observe the changes in the produced plots

Data Logger (cont)

Procedure to test the program:

- Double-click on section ‘square_wave’ and try to interpret the code

- Set variable %m97 to 1

- Reset the log memory

- Start a new log process and observe the changes in the produced plots

```
(* Use one timer for all square waves *)
TON_0 (IN := NOT(%M99) (*BOOL*),
       PT := t#0.5s (*TIME*),
       Q => %M99 (*BOOL*) );

(* Update the output whenever TON_0 shows a timeout *)
IF %M99 THEN

  (* output a 1Hz square wave to %q0.4.1 *)
  %q0.4.1 :=NOT(%q0.4.1);


  (* %m97=0 make square waves, %m97=1 pulse even bits *)
  (* if you want, output all zeros by setting %m98 *)
  if %m98 then
    %mw90 := 0;
  end_if;
  WORD_TO_BIT( int_to_word(%mw90),
    %m100, %m101, %m102, %m103,
    %m104, %m105, %m106, %m107,
    %m108, %m109, %m110, %m111,
    %m112, %m113, %m114, %m115 );
  if NOT(%m97) then
    (* udate counter to make square waves in memory %m100..%m115 *)
    %mw90 := %mw90 +1;
  else
    (* pulse even bits in memory %m100..%m115 *)
    if %mw90=0 then %mw90:=1;
    else %mw90:= ROL(%mw90,2);
    end_if;
  end_if;

END_IF;
```

Data Logger (cont)

- Solve item B3 using the PLC

Use the two switches in Lab panel to make a sequence of states 00, 01, 11, 10, 00, 01, 11, 10, 00, each one taking about a couple of seconds. Make a data log (plot) showing each state of the sequence.