

Freeway Exercise

Solutions for OEMs, FreeStudio
Thermostat exercise



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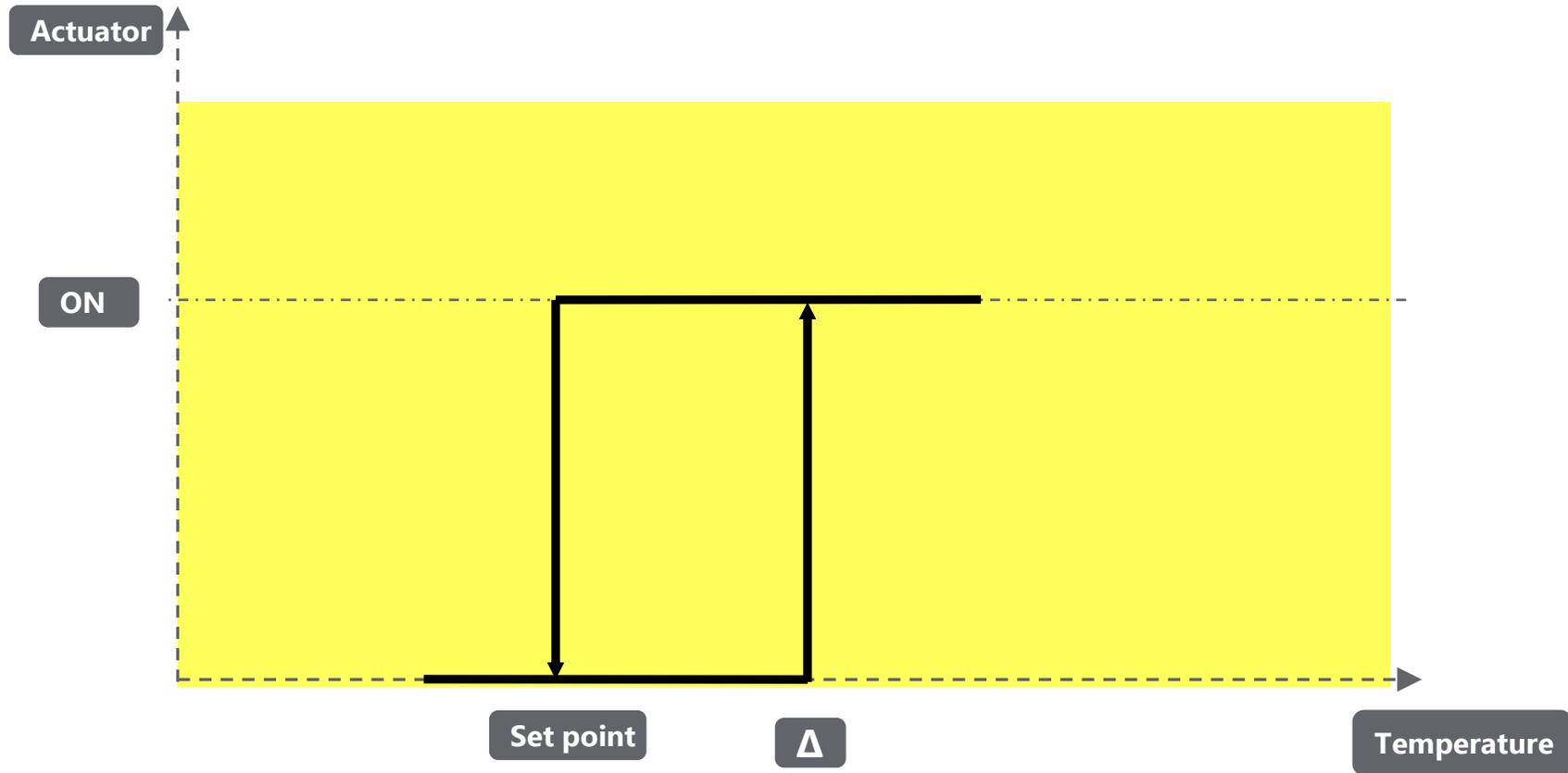
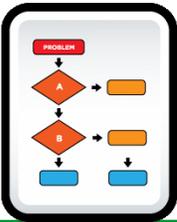
Chapter 1

Function Description

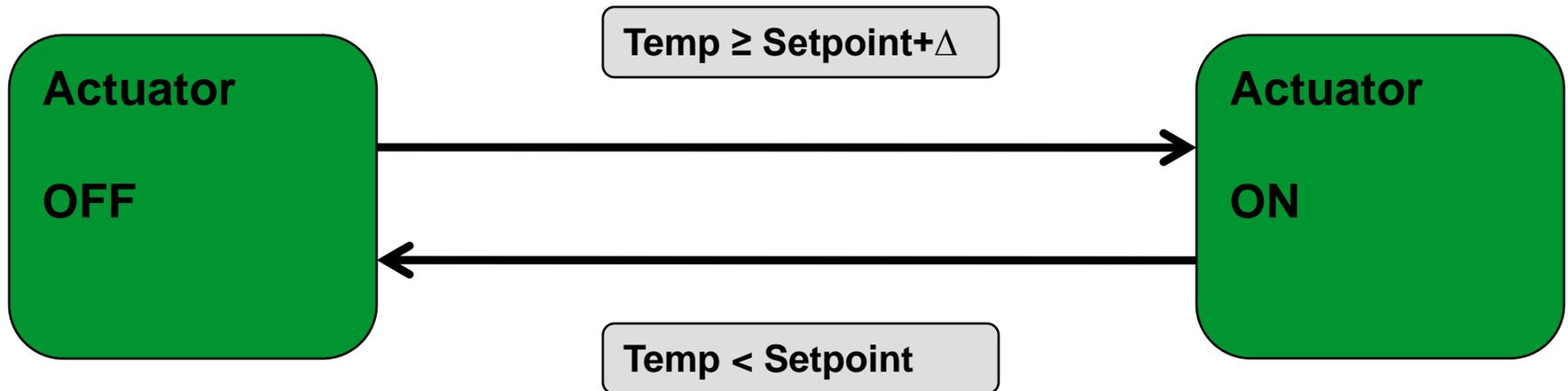
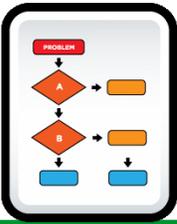
Goal:

Describe thermostat flow chart

Thermostat cycle



Thermostat states (function description)



Chapter 2

Programming

Goal:

- Familiarizing with programming environment
- Creating Thermostat Function Block



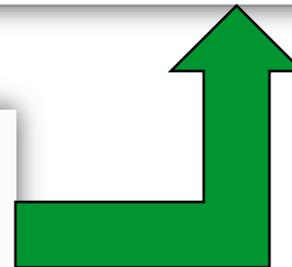
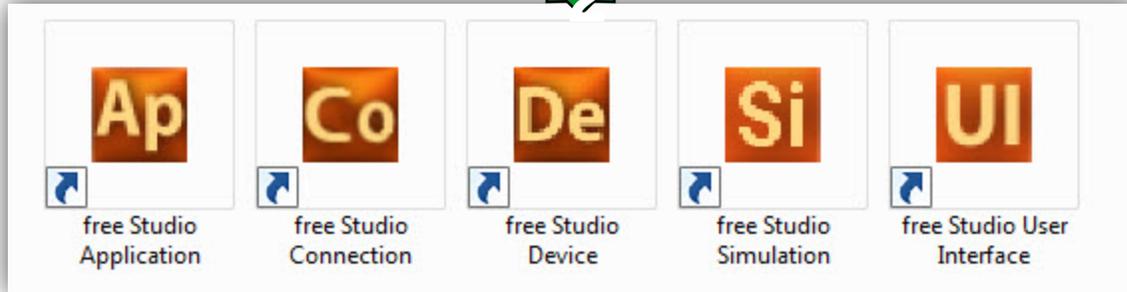
Creating New project



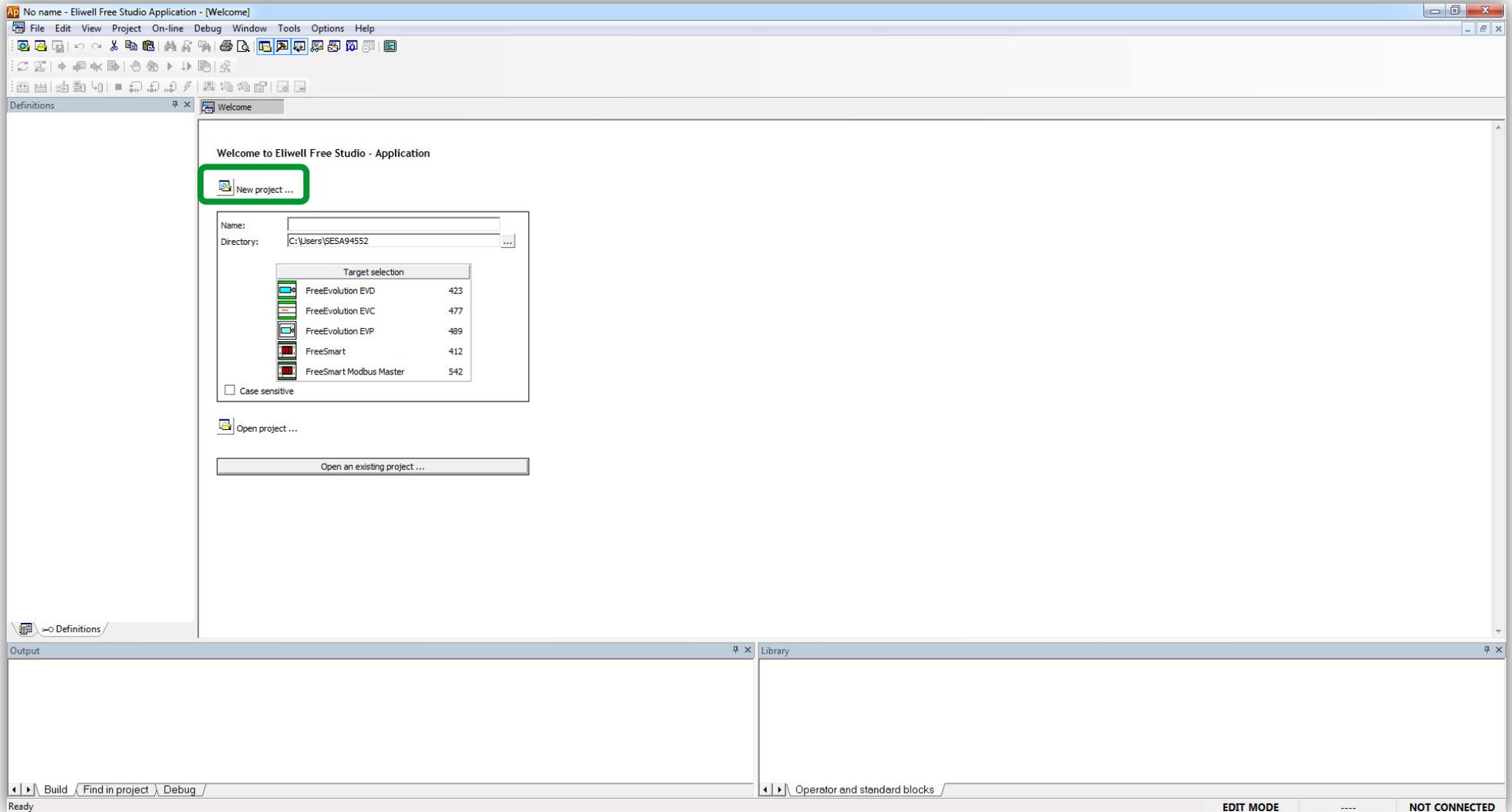
2*click



2*click



Creating New project



Creating New project



The screenshot displays the Elwell Free Studio Application interface. The main window is titled "FreeSmart Configuration" and contains several sections:

- Display:** A dropdown menu for "Fundamental state display" is set to "None".
- Execution time:** A checkbox for "Set execution time" is unchecked, and the "Execution time (ms)" is set to 100.
- Data export:** A field for "Select XSLT export filter" is empty, with "Browse" and "Export" buttons.

In the center of the configuration window is a photograph of the physical thermostat device. The device is white with a central display and several buttons labeled F1, F2, F3, and F4. The "free" logo is visible at the top of the device.

The bottom of the interface shows the "Output" window with the following text:

```
Preprocessing module TARGET completed.
Preprocessing module MAIN completed.
Preprocessing basic completed.

0 warnings, 0 errors.
```

The bottom status bar indicates "Ready" and "NOT CONNECTED".

Programming environment



The screenshot displays the Esiwell Free Studio programming environment. The interface is divided into several key sections:

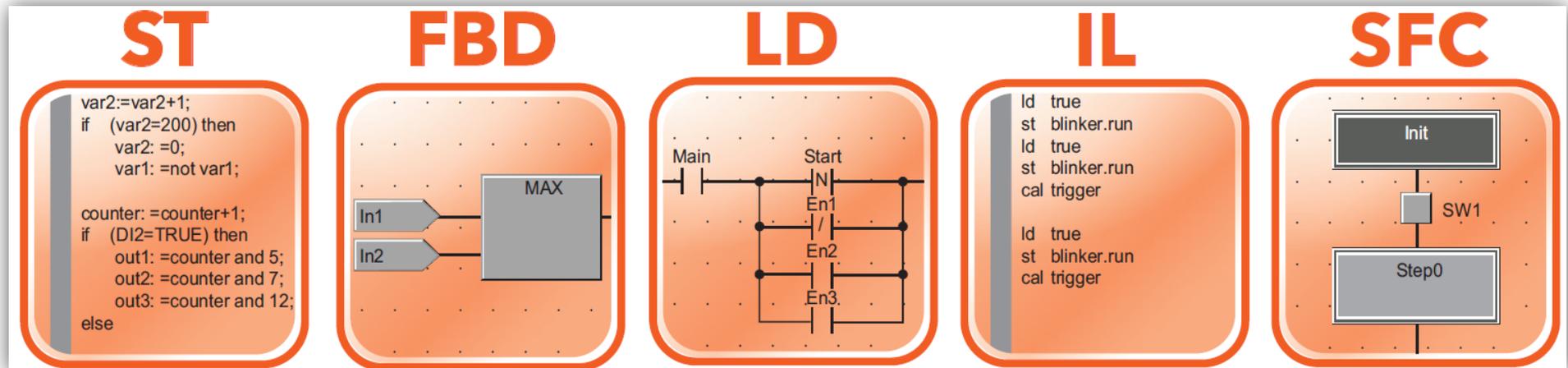
- Project Explorer (Left):** Shows a hierarchical tree of project components. A green box highlights the 'Thermostat New Project' folder, which contains sub-folders for Programs, Function blocks, Functions, Global variables (Automatic, Mapped, Constants, Retain), Global shared, Alarms, Mappings, Parameters, Variables, and Tasks (Timed, Background, Boot, Init). A green star with the number 5 is placed at the bottom right of this section.
- Resources Explorer (Bottom Left):** Shows configuration files and modules like FreeSmart, Modbus objects, EEPROM Parameters, Status variables, Enums, BIOS Parameters, Menu Prg, Cfg, Menu set, Setting Menu, I/O Mapping, Local, Extended, Remote, Alarms, and Help. A green star with the number 5 is placed at the bottom right of this section.
- Code Editor (Center):** Displays the 'main' program with a table of local variables. A green star with the number 6 is placed over the table area.
- Output Window (Bottom):** Shows the compilation output: 'Preprocessing module TARGET completed.', 'Preprocessing module MAIN completed.', and 'Preprocessing basic completed.' followed by '0 warnings, 0 errors.' A green star with the number 1 is placed over this text.
- Library (Bottom Right):** A grid of mathematical and logical operators and functions such as ABS, ACOS, ADD, AND, ASIN, ATAN, COS, DIV, EQ, EXP, GE, GT, JMP, LE, LIMIT, LN, LOG, LT, MAX, MIN, MOD, MOVE, MUL, NE, NOT, OR, R, RET, ROL, ROR, SEL, SHL, SHR, SIN, SIZEOF, Sqrt, SUB, TAN, TO_BOOL, TO_DINT, TO_INT, TO_REAL, TO_SINT, TO_UDINT, TO_USINT, and XOR. A green star with the number 4 is placed over this grid.
- Watch Window (Top Right):** A table for monitoring variable values. A green star with the number 3 is placed over it.
- Oscilloscope (Bottom Right):** A graphical tool for viewing signal waveforms. A green star with the number 7 is placed over it.

At the bottom of the interface, the status bar shows 'Ready', 'Build', 'Find in project', 'Debug', 'Resources', 'Operator and standard blocks', 'Target variables', 'Target blocks', 'basic', 'EDIT MODE', and 'NOT CONNECTED'. A green star with the number 2 is placed at the bottom right corner of the entire window.

Programming Languages



The **FREE STUDIO** platform is compatible with all 5 standard programming languages (IEC 61131-3).



5 programming languages, 2 text-based and 3 graphics-based:

- **ST, Structured Text, language text**
- **FBD, Functional Block Diagram language graphical**
- **LD, Ladder language graphical**
- **IL, Instruction List language text**
- **SFC, Sequential Function Chart language graphical**

Thermostat program



1. Right click on the programs
 2. New program
 3. Select language
 4. Name it
 5. Assign it to the background or timer task
- Note: The main (default) program can be deleted if not used (Rename is possible, Editing language is not possible).

The screenshot shows the 'Eliwell Free Studio Application' interface. On the left, a project tree for 'Lesson01 Project' is visible, with the 'Programs' folder highlighted. A green star with the number '1' is placed over the 'Programs' folder. The 'New program' dialog is open in the center, with a green star with the number '2' over the 'Language' section. The 'Language' section has radio buttons for 'IL', 'FBD', 'LD', 'ST', and 'SFC', with 'FBD' selected. A green star with the number '3' is over the 'FBD' radio button. The 'Name' field contains 'Thermostat', with a green star with the number '4' over it. The 'Task' section has a dropdown menu set to 'Background', with a green star with the number '5' over it. A green box with the text 'See the next slide for Task detail' is overlaid on the bottom of the dialog. To the right, a 'Delete the selected PLC Object?' dialog is open, with a green star with an asterisk over it. The dialog shows 'Type - Program' and 'Name - main' and has 'Yes' and 'No' buttons.

Associating a program to a task

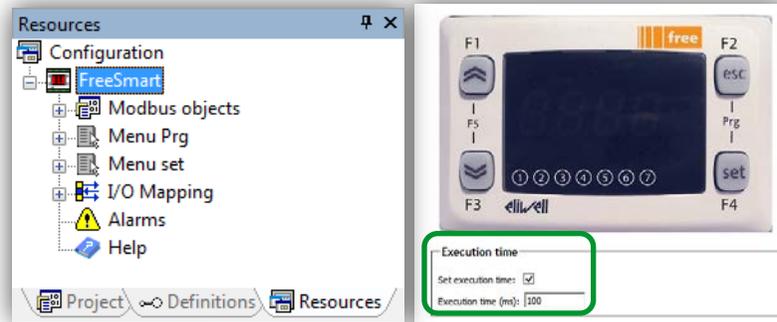


For a program to run, it must be associated to a task.

There are various types of tasks:

- **BOOT Task** runs once only at system start-up.
- **Init. Task** runs each time the application is downloaded and after **BOOT**.
- **Timed. Task** runs at regular intervals which can be set by the developer.

The default setting is 100ms.



- **Background. Task** runs with low priority after the Timed tasks (between the end of one Timed task and the start of the next), it can be interrupted in case of long execution or executed more than 1time in case short execution.

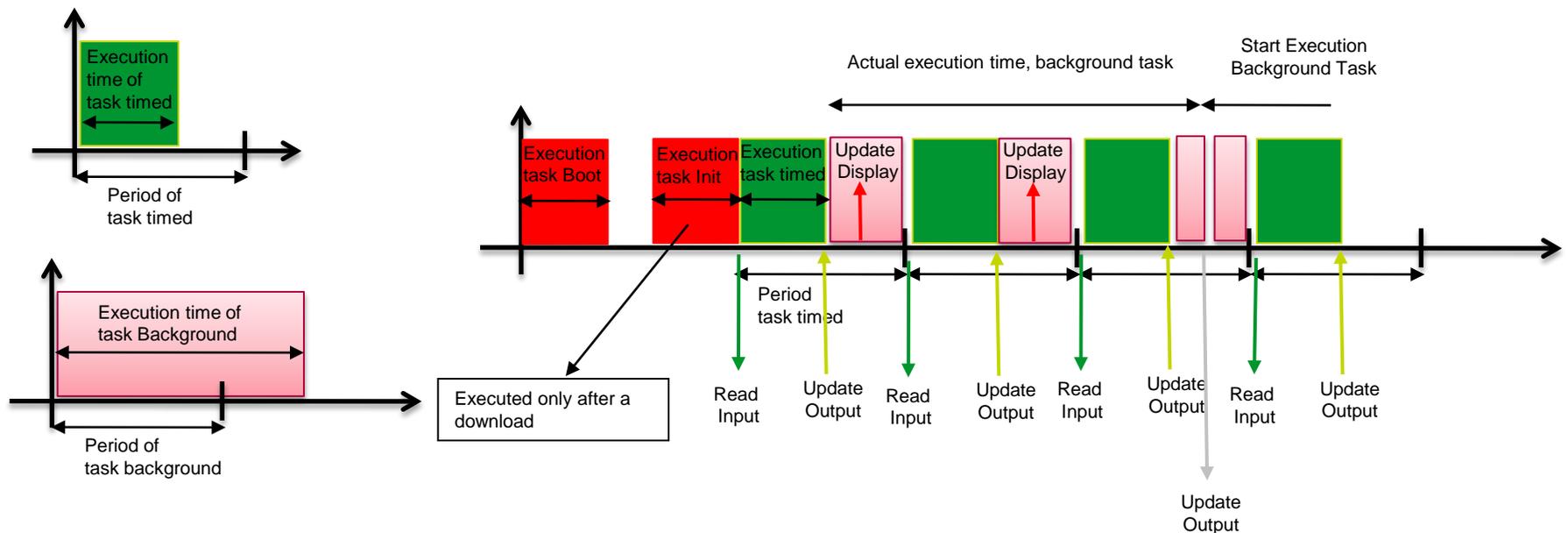
Note Each new project has the main program associated to the background task (the main program can still be eliminated and/or associated to other tasks).

To activate a task, go to the task you want, right-click and select Add program

Tasks



- **BOOT Task** runs once only at system start-up.
- **Init. Task** runs each time the application is downloaded and after **BOOT**.
- **Timed. Task** runs at regular intervals which can be set by the developer. The default setting is 100ms.
- **Background. Task** runs with low priority after the Timed tasks (between the end of one Timed task and the start of the next).



Assigning program to the task



Tasks > Background > right click > add program

Output
Preprocessing module TARGET completed.
Preprocessing module MAIN completed.
Preprocessing basic completed.

0 warnings, 0 errors.

ABS	DIV	LN	MUX	S	TAN
ACOS	EQ	LOG	NE	SEL	TO_BOOL
ADD	EXP	LT	NOT	SHL	TO_DINT
ADR	GE	MAX	OR	SHR	TO_INT
AND	GT	MIN	R	SIN	TO_REAL
ASIN	JMP	MOD	RET	SIZEOF	TO_SINT
ATAN	LE	MOVE	ROL	SORT	TO_UDINT
COS	LIMIT	MUL	ROR	SUB	TO_UINT

View FBD toolbar



The screenshot shows the 'View' menu with the following options checked:

- ✓ Main toolbar
- ✓ Status Bar
- ✓ Debug bar Ctrl+B
- ✓ FBD bar Ctrl+D
- LD bar Ctrl+A
- SFC bar Ctrl+Q
- ✓ Project bar Ctrl+J
- Network Ctrl+N
- ✓ Document bar Ctrl+M

The FBD toolbar contains icons for: mouse, search, zoom, AND gate, OR gate, NOT gate, timer, reset, set, and EN/ENO.

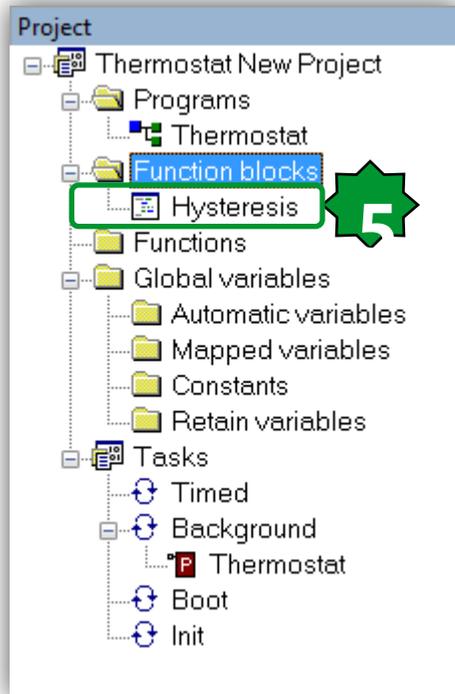
Callout box instructions:

1. View
2. Toolbars > FBD bar

The 'View' menu is also shown in a second instance with the SFC bar option highlighted:

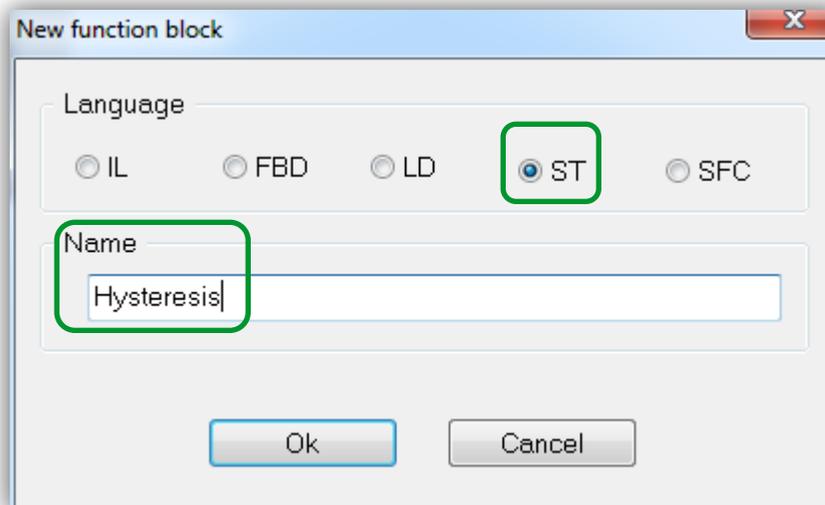
- ✓ Main toolbar
- ✓ Status Bar
- ✓ Debug bar Ctrl+B
- ✓ FBD bar Ctrl+D
- ✓ LD bar Ctrl+A
- ✓ SFC bar Ctrl+Q
- ✓ Project bar Ctrl+J
- Network Ctrl+N
- ✓ Document bar Ctrl+M

New function block creation



1. Right Click
2. New function block
3. Select the language
4. Assign a name
5. Double click on the Hysteresis to open the editor related to the selected language.

Note: Try to create function if the block does not require static RAM, it will optimize the RAM usage



Insert record



1

2

3

4

5

6

5 & 6. Optional

Class	Pin	Name	Type	Array	Init value	Attribute	Description
VAR		Temperature	INT	No			Analogue Input 1

Object browser

Objects filter

- Programs
- Function Blocks
- Functions
- Variables
- User types
- Operators
- Standard functions
- Local variables
- Basic types

Check all Check none

Other filters

Name * OK

Location All

Library All

Vars type All

Cancel OK

Name

- BOOL
- BYTE
- DINT
- DWORD
- INT
- REAL
- SINT
- STRING
- UDINT
- UINT
- USINT
- WORD

4

Inside Hysteresis FBD



Local variables								
	Class	Pin	Name	Type	Array	Init value	Attribute	Description
1	VAR_INPUT	0	Temperature	INT	No		..	Analogue Input 1
2	VAR_INPUT	1	Setpoint	INT	No		..	Set point
3	VAR_INPUT	2	Differentiation	INT	No		..	Δ
4	VAR_OUTPUT	0	Alarm	BOOL	No		..	Probe Alarm
5	VAR_OUTPUT	1	Output	BOOL	No		..	Actuator

```
0001 (* Hysteresis FBD *)
0002
0003 if Temperature >= Setpoint + Differentiation then
0004     Output := TRUE;
0005 end_if;
0006
0007 if Temperature < Setpoint then
0008     Output := FALSE;
0009 end_if;
0010
0011 (* Probe disconnection detector *)
0012
0013 if Temperature = -32768 then
0014     Alarm := TRUE;
0015 else Alarm := FALSE;
0016 end_if;
0017
0018
```

Compile result is valid as soon as FBD used in the program

Output		
Free code space:	2F1E0h	(188 KByte)
Data space:	8C0h	(2 KByte)
Free data space:	8ABh	(2 KByte)

0 warnings, 0 errors.

Build Find in project Debug Resources

FBD in Background



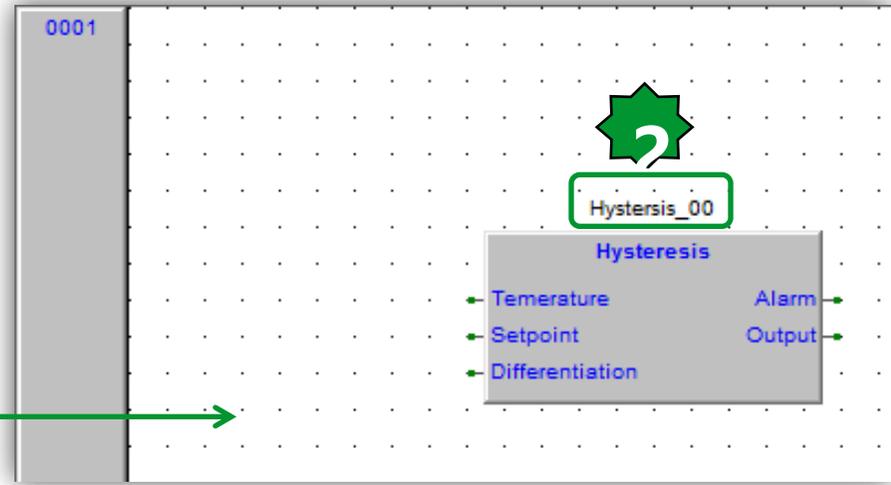
1. Double click on the Thermostat program to open the editor that is related to the program
2. drag & drop
3. Name it
4. Add new network

Project

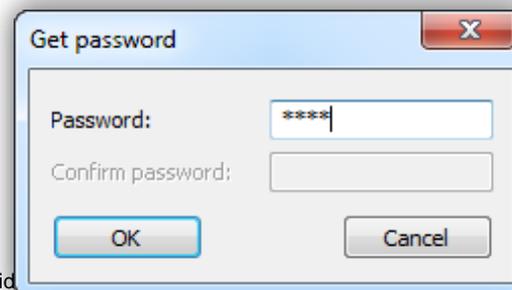
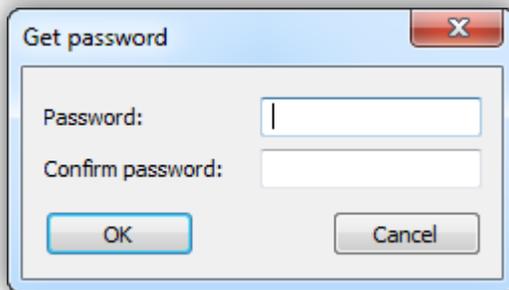
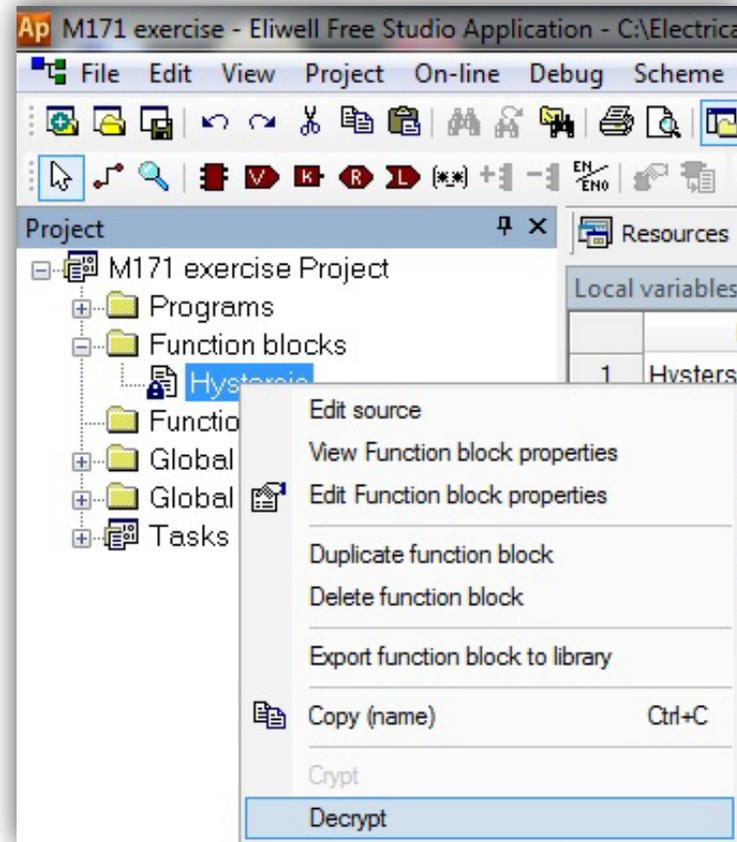
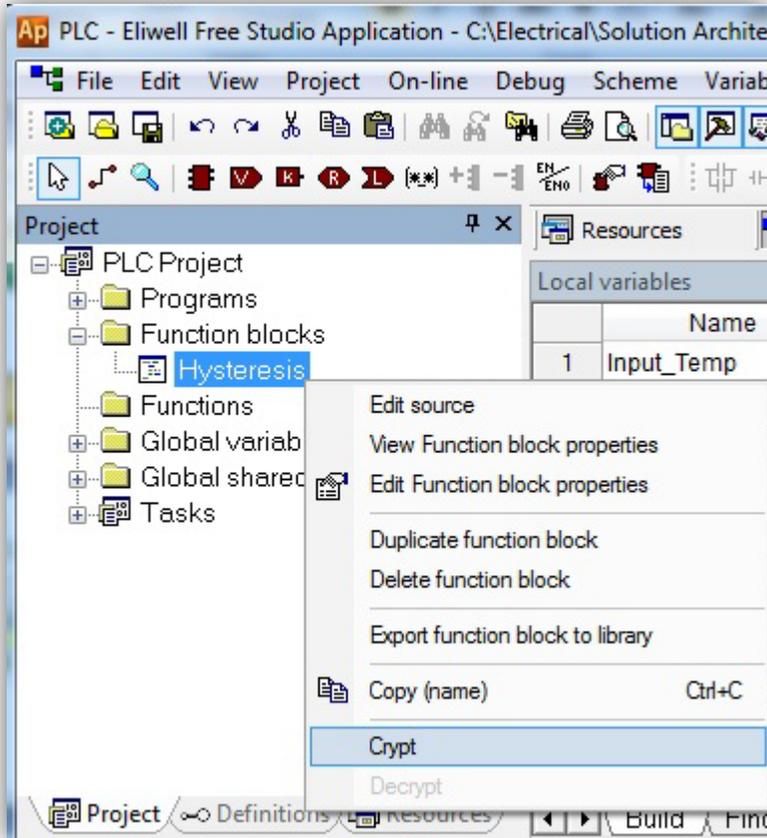
- Thermostat New Project
 - Programs
 - Thermostat
 - Function blocks
 - Hysteresis
 - Input variables
 - Differentiation
 - Setpoint
 - Temperature
 - Output variables
 - Alarm
 - Output
 - Functions
 - Global variables
 - Automatic variables
 - Mapped variables
 - Constants
 - Retain variables
 - Tasks
 - Timed
 - Background
 - Thermostat
 - Boot
 - Init

Local variables							
	Name	Type	Address	Array	Init value	Attribute	Description
1	Hystersis_00	Hysteresis	Auto	No		..	

1
Drag & Drop

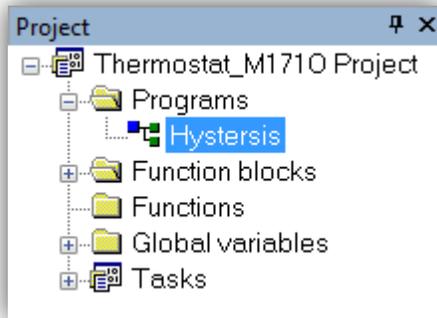


Set password for written FB



You can prevent access to your written codes inside of FBD by cript.

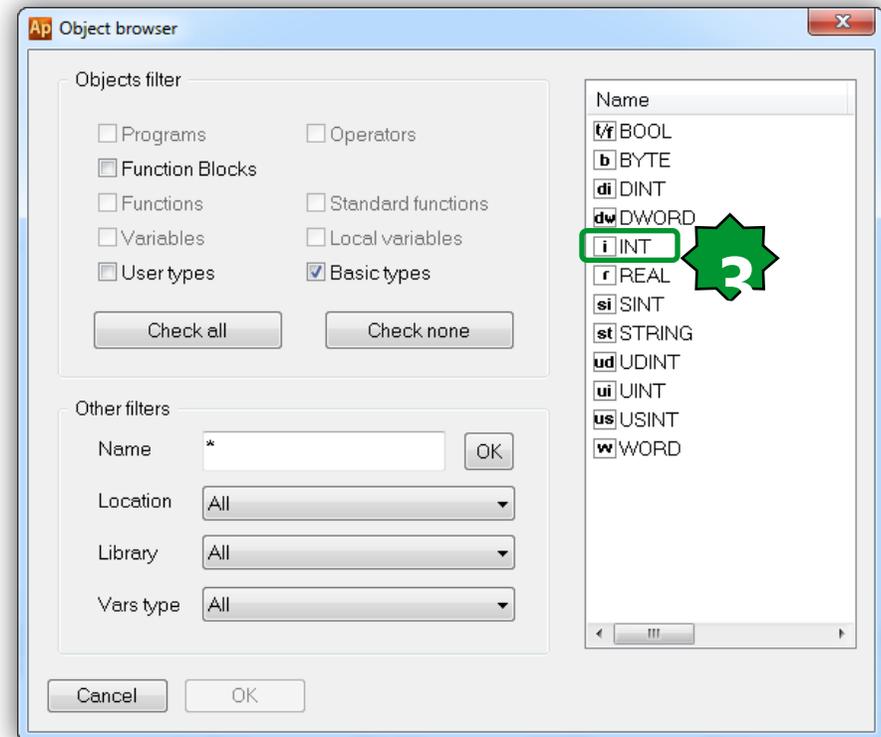
Assigning local variable to the FBD



	Name	Type	Address	Array	Init value	Attribute	Description
1	Hysteresis_00	Hysteresis	Auto	No		..	
2	Input_Temp	INT	Auto	No		..	



1. Add new record
2. Name it
3. Define the type from object browser



Connecting Variables to the FBD



Local variables							
	Name	Type	Address	Array	Init value	Attribute	Description
1	Input_Temp	INT	Auto	No		..	
2	Input_Setpoint	INT	Auto	No		..	
3	Input_Differentiation	INT	Auto	No		..	
4	Output_Alarm	BOOL	Auto	No		..	
5	Output_Output	BOOL	Auto	No		..	
6	Hysteresis_00	Hysteresis	Auto	No			

Drag & Drop

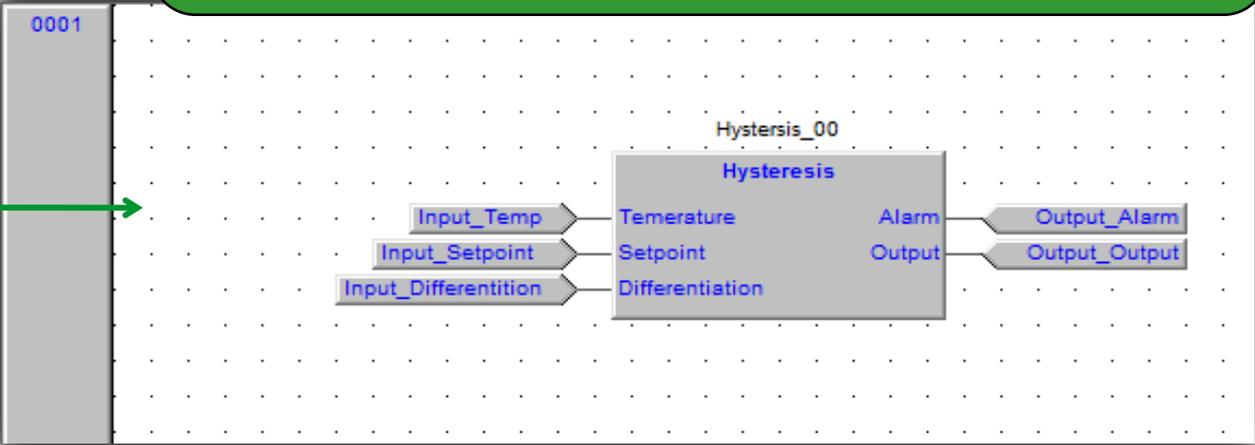
Shortcuts:
Space: Connecting Mode ◀ ▶ Insert/Move Mode
Ctrl+Left Mouse Button: Multiple Selection
Ctrl+Shift+F: Find in project

Var type

Input Output

OK Cancel

Select Input/output

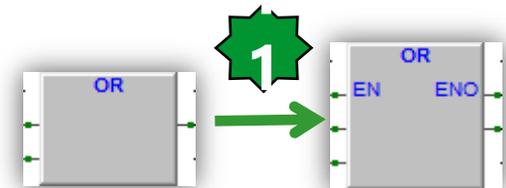


FBD toolbar...



1. Connection
2. Watch
3. New block
4. Variable
5. Constant
6. Return
7. Jump
8. Comment
9. Increase number of pins
10. Decrease number of pins
11. Display enable I/O pins
12. FBD properties
13. View source

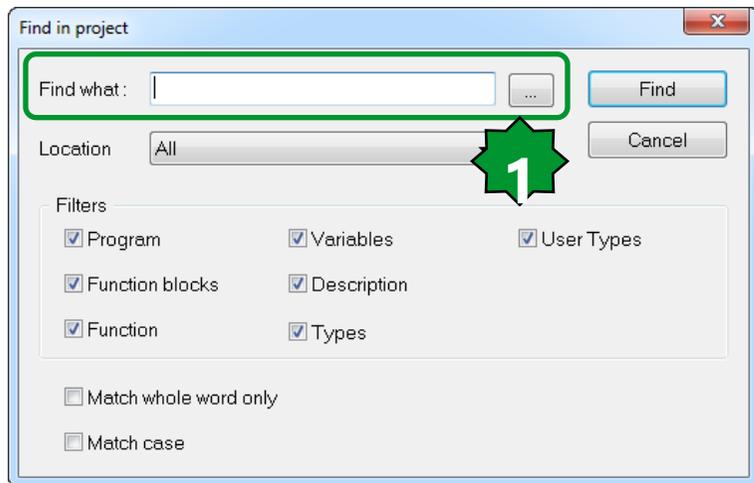
11. The output will not update if En=False



Cross Reference



1. Find in project (cross reference)



Compile/Build



Compile



```
Output
Preparing for PLC application download .. done.
Downloading file C:\Users\SESA94552\Thermostat New\Thermostat New.cod .. completed.
Booting PLC application .. done.
0 warnings, 0 errors.
```

```
Output
Generating program THERMOSTAT
Generating program DISPLAYALARMLED
Generating program APPLICATIONMENU
Generating unresolved
aborted.
THERMOSTAT(1$FB:HYSTERSIS_00) - error G0008: ST => Invalid access to variable
0 warnings, 1 errors.
```

Double click on the error to refer to the error source

Chapter 3

Simulation/Debugging – Part 1

Goal:

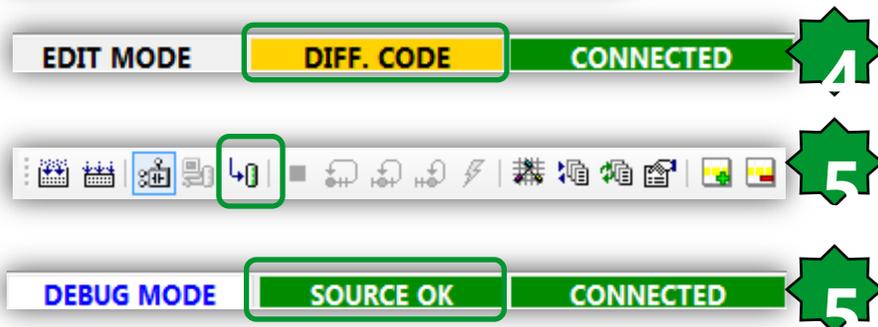
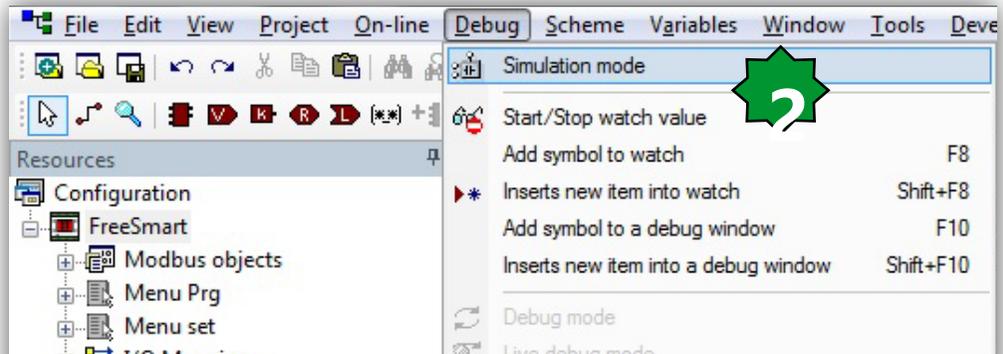
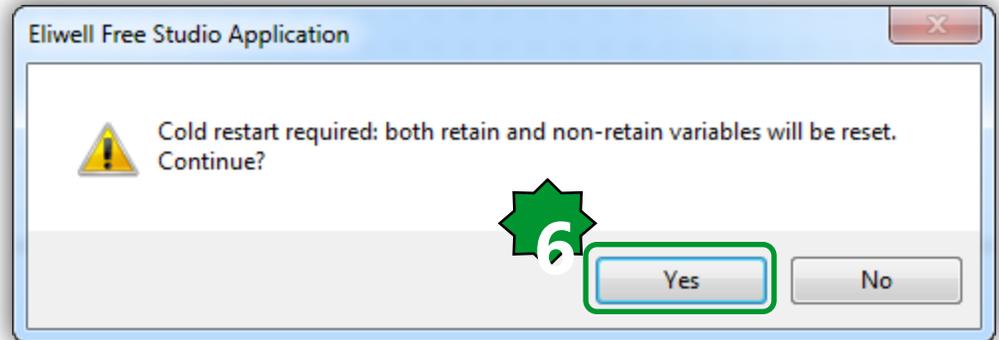
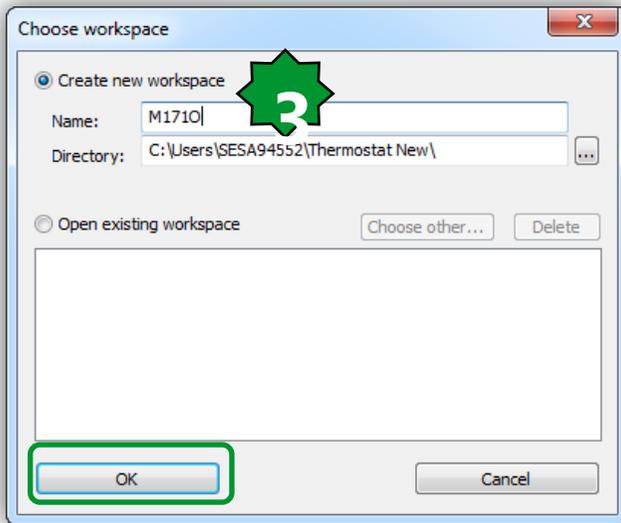
Debugging created FB by different off-line simulation tools such as Watch or Oscilloscope



Off line simulation mode



1 **2**
Debug ► Simulation mode ►



1. Debug
2. Simulation mode
3. Name it ► OK
4. If differs or no code
5. Download the code, OK
6. Reset Variables

On-Line Status / Application Status



The state of communication is shown in a small box next to the right border of the **Status bar**.

If you have not yet attempted to connect to the target, the state of communication is set to **Not connected**.

A horizontal rectangular bar with a light beige background and a thin black border. The text 'NOT CONNECTED' is written in a black, monospaced, all-caps font.

NOT CONNECTED

When you try to connect to the target device, the state of communication becomes one of the following:

-Error: the communication cannot be established. You should check both the physical link and the communication settings.

A horizontal rectangular bar with a solid red background. The text 'ERROR' is written in a yellow, monospaced, all-caps font.

ERROR

-Connected: the communication has been established

A horizontal rectangular bar with a solid green background. The text 'CONNECTED' is written in a white, monospaced, all-caps font.

CONNECTED

On-Line Status / Application Status



Next to the communication status there is another small box which gives information about the status of the application currently executing on the target device.

When the connection status is Connected, the application status takes on one of the following values.

-No code: no application is executing on the target device.

NO CODE

--Diff. code: the application currently executing on the target device is not the same as the one currently open in the IDE; moreover, no debug information consistent with the running application is available: thus, the values shown in the watch window or in the oscilloscope are not reliable and the debug mode cannot be activated.

DIFF. CODE

On-Line Status / Application Status



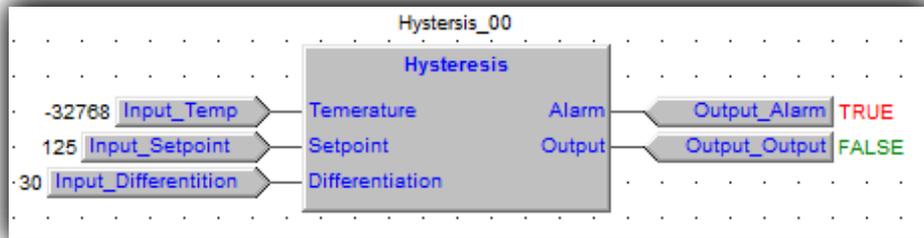
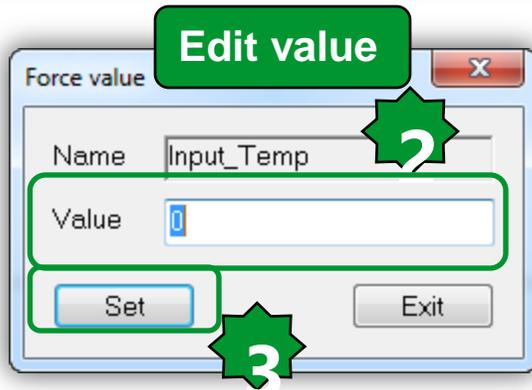
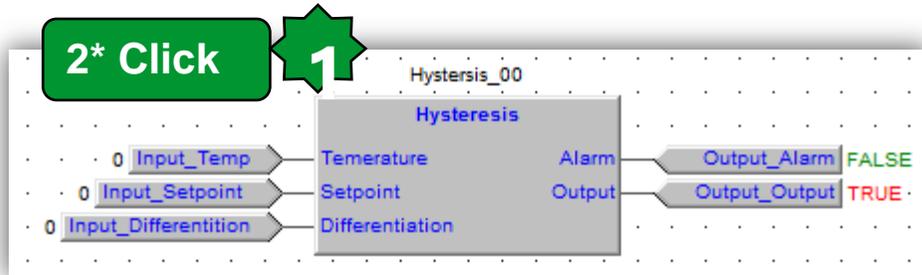
--Diff. code, Symbols OK: the application currently executing on the target device is not the same as the one currently open in the IDE; however, some debug information consistent with the running application is available (for example, because that application has been previously downloaded to the target device from the same PC): the values shown in the watch window or in the oscilloscope are reliable, but the debug mode still cannot be activated.

DIFF. CODE (SYM)

-Source OK: the application currently executing on the target device is the same as the one currently open in the IDE: the debug mode can be activated.

SOURCE OK

Debug mode/Changing values



1. 2*click on required variable
2. Edit the value
3. Set the values
4. Check the Output status
5. Check the Alarm status
In probe disconnection, short circuited or broken the value= - 32768
6. Debug mode (optional)
7. Live (continuous) debug mode (optional)

Watch configuration



Local variables							
	Name	Type	Address	Array	Init value	Attribute	Description
1	Hystersis_00	Hysteresis	Auto	No	..		
2	Input_Temp	INT	Auto	No	..		
3	Input_Setpoint	INT	Auto	No	..		
4	Input_Differentition	INT	Auto	No	..		
5	Output_Alarm	BOOL	Auto	No	..		
6	Output_Output	BOOL	Auto	No	..		

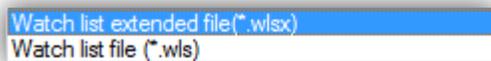
Watch list is independant from live debug mode

Drag & Drop

Watch			
Symbol	Value	Type	Location
— INPUT_TEMP	179	INT	@BACKGROUND:THERMOSTAT
— INPUT_SETPOINT	125	INT	@BACKGROUND:THERMOSTAT
— INPUT_DI...	30	INT	@BACKGROUND:THERMOSTAT
■ OUTPUT_ALARM	FALSE	BOOL	@BACKGROUND:THERMOSTAT
■ OUTPUT_OUTPUT	TRUE	BOOL	@BACKGROUND:THERMOSTAT



Save watch list



Watch list formats

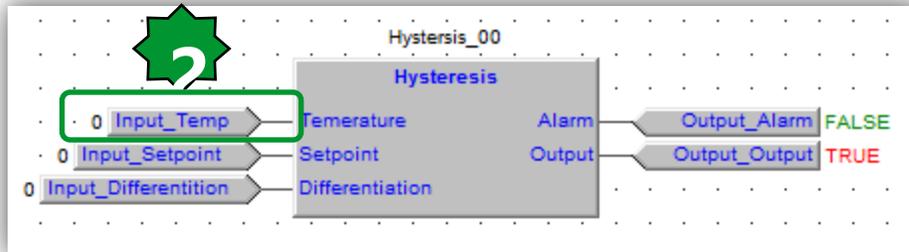
Watch/ drag & drop



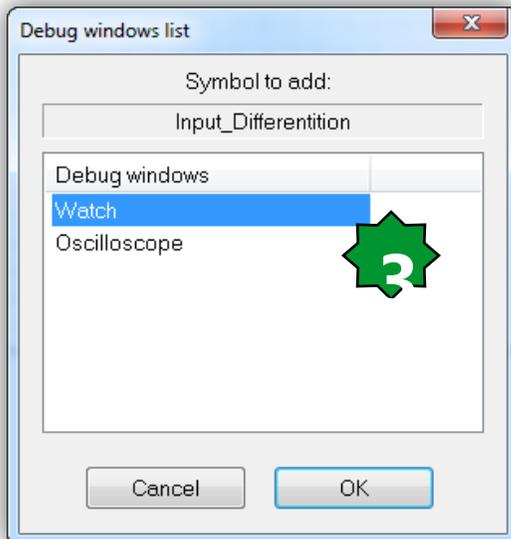
1



2



1. Select watch icon
2. Select the variable
3. Select the watch
4. ► OK
5. It adds to watch list



4

Symbol	Value	Type	Location
— INPUT_TEMP	0	INT	@BACKGROUND:THERMOSTAT

Watch Configuration/ST language



```
0001 (* Hystersis FBD *)
0002
0003 if Temperature >= Setpoint + Differentiation then
0004     Output := TRUE;
0005 end_if;
0006
0007 if Temperature < Setpoint then
0008     Output := FALSE;
0009 end_if;
0010
0011 (* Probe disconnection detector *)
0012
0013 if Temperature = -32768 then
0014     Alarm := TRUE;
0015     else Alarm := FALSE;
0016 end_if;
0017
0018
```



1. Select the variable
2. Double click
3. Drag & drop it directly to the watch properties

```
0001 (* Hystersis FBD *)
0002
0003 if Temperature >= Setpoint + Differentiation then
0004     Output := TRUE;
0005 end_if;
0006
0007 if Temperature < Setpoint then
0008     Output := FALSE;
0009 end_if;
0010
0011 if Temperature = -32768 then
0012     Alarm := TRUE;
0013     else Alarm := FALSE;
0014 end_if;
0015
```



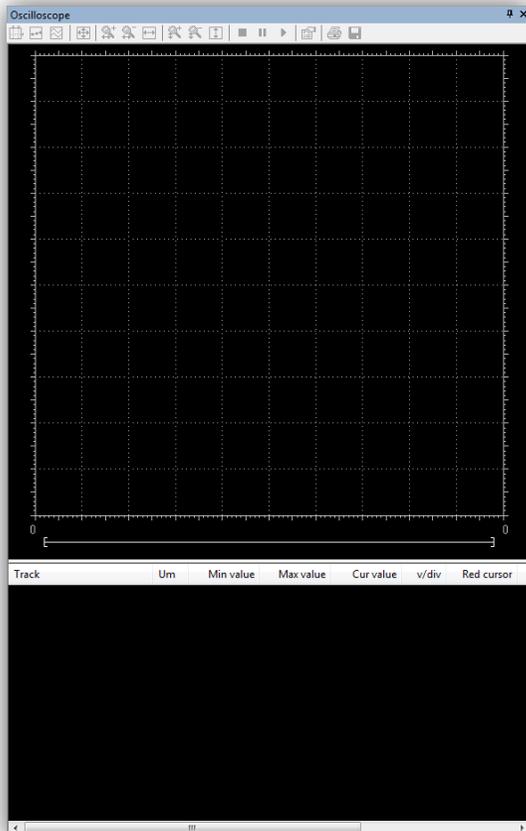
Symbol	Value	Type	Location
— HYSTERESIS_00.TEMPERATURE	0	INT	@BACKGROUND:THERMOSTAT



Oscilloscope



View ► Tool windows ► Async graphic windows ►



Assigning variable to the oscilloscope



Local variables

	Name	Type	Address	Array	Init value	Attribute	Description
1	Hysteresis_00	Hysteresis	Auto	No			
2	Input Temp	INT	Auto	No			
3	Input_Setpoint	INT	Auto	No			
4	Input_Differentiation	INT	Auto	No			

Oscilloscope

ms/div: 5000.00

629616 679616

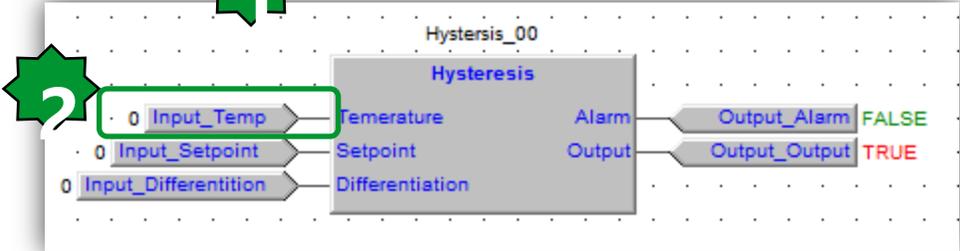
Track	Um	Min value	Max value	Cur value	v/div	Red cursor	Blue cursor	Horz cursor	Note
@BACKGROUND:THERMOSTAT.INPUT_SETPOINT		0.000	125.000	125.000	1	...	...	...	@BACKGROUND:THERMOSTAT
@BACKGROUND:THERMOSTAT.INPUT_DIFFERENTIATION		0.000	25.000	25.000	1	...	...	...	@BACKGROUND:THERMOSTAT
@BACKGROUND:THERMOSTAT.OUTPUT_ALARM		0.000	1.000	0.000	1	...	...	...	@BACKGROUND:THERMOSTAT
@BACKGROUND:THERMOSTAT.OUTPUT_OUTPUT		0.000	1.000	0.000	1	...	...	...	@BACKGROUND:THERMOSTAT
@BACKGROUND:THERMOSTAT.INPUT_TEMP		-32768.000	150.000	110.000	1	...	...	...	@BACKGROUND:THERMOSTAT

Drag & Drop

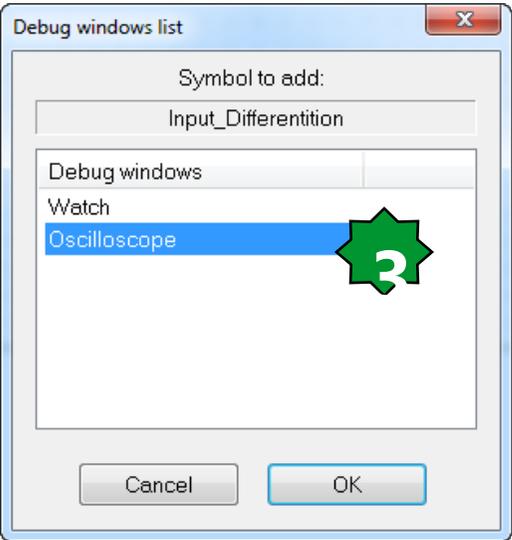
Up to 8 channels could be traced simultaneously



Assigning variable to the oscilloscope



- 1. Select watch icon
- 2. Select the variable
- 3. Select the Oscilloscope
- 4. It adds to oscilloscope list



Oscilloscope tools/starting & stopping data acquisition



When you add a variable to the Oscilloscope, data acquisition begins immediately.

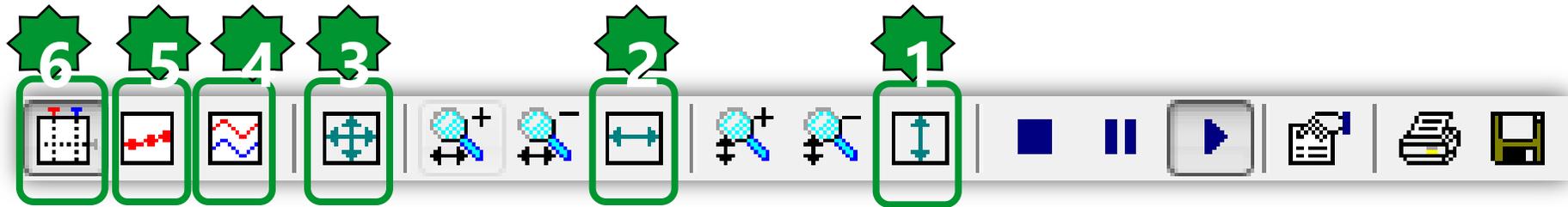
However, you can suspend the acquisition by clicking on **Pause acquisition**.

The curve freezes (while the process of data acquisition is still running in background), until you click on **Restart acquisition**.

In order to stop the acquisition you may click on **Stop acquisition**.

In this case, when you click on **Restart acquisition**, the evolution of the value of the variable is plotted from scratch.

Oscilloscope tools/ Vertical split



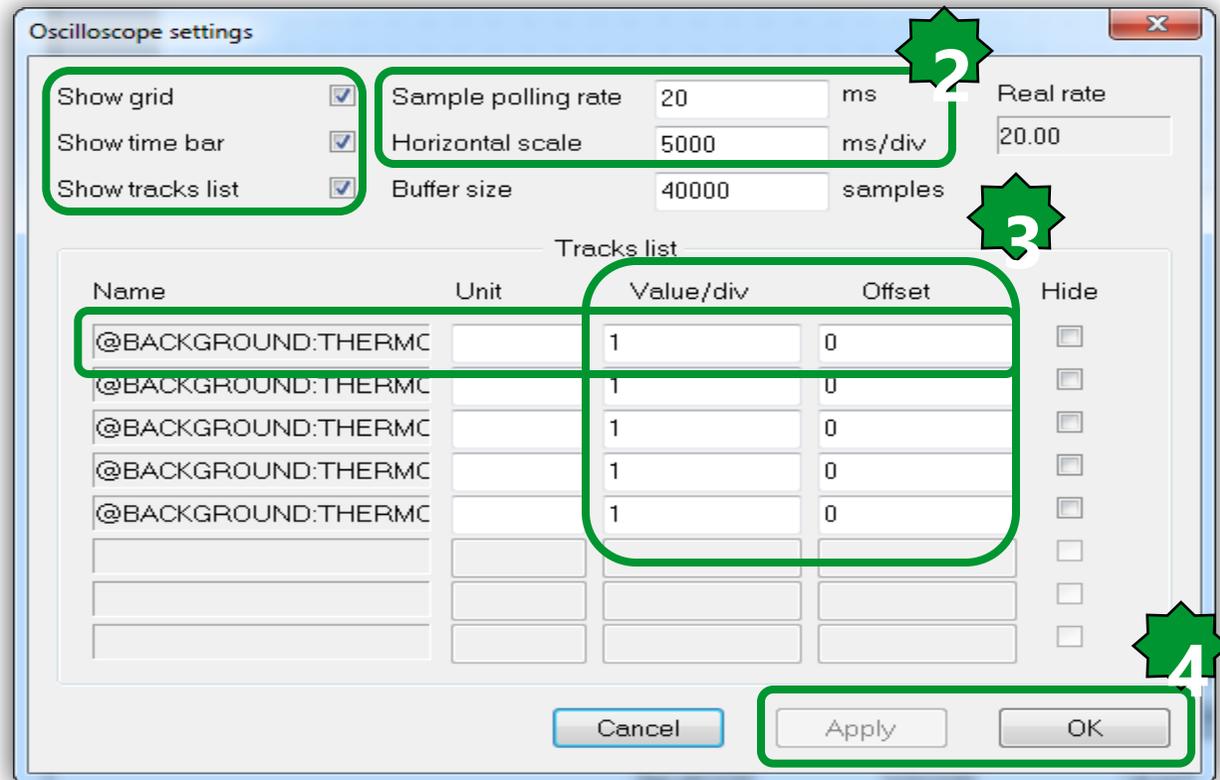
1. Selected track's vertical show all
2. Horizontal show all
3. Show all values
4. When you are watching the evolution of two or more variables, you may want to split the respective tracks.
5. The tool highlights the single values detected during data acquisition. You can click on the same item again, in order to go back to the default view mode.
6. The Oscilloscope includes two measure bars, which can be exploited to take some measures on the chart.

Oscilloscope tools/ Setting the scale of the axes

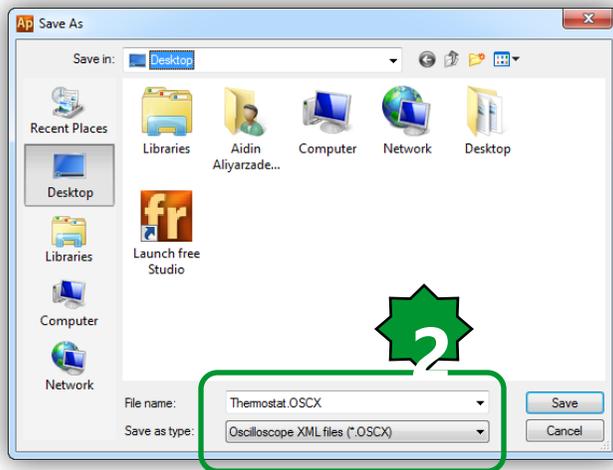


When you open the Oscilloscope, Application applies a default scale to the axes. However, if you want to set a different scale, you may follow this procedure:

- 1) Open the graph properties
- 2) Set the scale of the horizontal axis & sampling polling rate
- 3) Specify a distinct scale for the vertical axis.
- 4) Confirm your settings.



Oscilloscope/export



Available formats

- Oscilloscope XML files (*.OSCX)
- Oscilloscope files (*.OSC)
- All files (*.*)

1. Save icon
2. Name & format defining
 - OSC: simple plain-text file, containing time and value of each sample
 - OSCX: XML file, that includes more complete information
3. Open it via Excel (OSCX)

	A	B	C	D	E	F	G	H	I	J
1	hscale	triggerpos	name	um	vscale	offset	color	note	sample	time
2	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870186
3	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870205.9
4	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870226.2
5	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870246.1
6	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870266.2
7	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870286.2
8	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870306.1
9	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870326
10	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870346.1
11	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870366
12	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870386.2
13	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870406.1
14	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870426.2
15	55536.85563	1.79769313486232E+308	@BACKGROUND:THERMOSTAT.NTC_PROBE		25323.57143	111271.0714	65535	@BACKGROUND:THERMOSTAT	0	232870445.9

Chapter 4

Resources

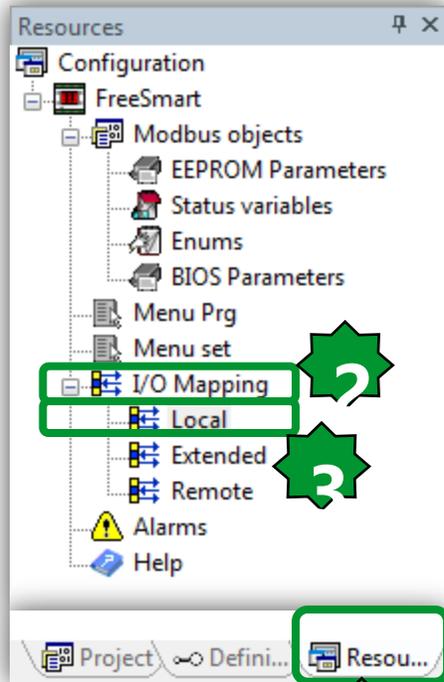
Goal:

Defining the resources:

- Assigning physical Input/output
- EEPROM parameters
- Status variables
- Menu definition and navigation



Physical I/O Mapping (Base Unit)...



FreeSmart Local I/O Mapping

#	Name	Variable	Type	Description
1	AIL1	NTC_Probe	INT	AIL1 analogue input
2	AIL2		INT	AIL2 analogue input
3	AIL3		INT	AIL3 analogue input
4	AIL4		INT	AIL4 analogue input
5	AIL5		INT	AIL5 analogue input
6	DIL1		BOOL	DIL1 digital input
7	DIL2		BOOL	DIL2 digital input
8	DIL3		BOOL	DIL3 digital input
9	DIL4		BOOL	DIL4 digital input
10	DIL5		BOOL	DIL5 digital input
11	DIL6		BOOL	DIL6 digital input
12	DOL1	Output_Cooling	BOOL	DOL1 digital output
13	DOL2	Alarm	BOOL	DOL2 digital output
14	DOL3		BOOL	DOL3 digital output
15	DOL4		BOOL	DOL4 digital output
16	DOL5		BOOL	DOL5 digital output
17	DOL6		BOOL	DOL6 digital output
18	AOL1		INT	AOL1 analogue output
19	AOL2		INT	AOL2 analogue output
20	AOL3		INT	AOL3 analogue output
21	AOL4		INT	AOL4 analogue output
22	AOL5		INT	AOL5 analogue output
23	TCL1		INT	TCL1 analogue output

2. I/O Mapping definition:

Local: Base I/O
Extend: Expansion
Remote: Keyboard

1. Resources
2. I/O mapping
3. Local
4. Name variables

...Physical I/O Mapping (Base Unit)...



Thermostat Exercise rev.1 - Eliwell Free Studio Application - C:\Electrical\Solution Architect\Eliwell\Exercise\Thermostat Exercise\Restore\Thermostat Exercise

File Edit View Project On-line Debug Window Tools Developer Help

Project: Thermostat Exercise rev.1 Project

- Programs
- Function blocks
- Functions
- Global variables
- Global shared
- Alarms
 - Mappings
 - Ambient_temperature
 - Output_Cooling**
 - Alarm
- Parameters
- Variables
- Tasks

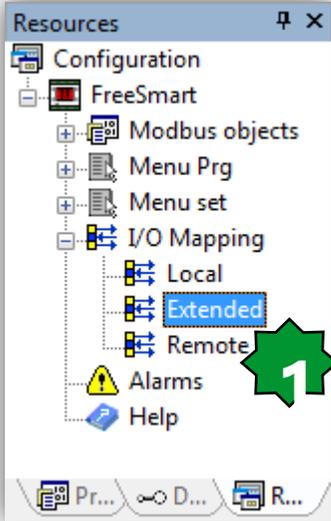
Resources: Thermostat, Global variables

FreeSmart Local I/O Mapping

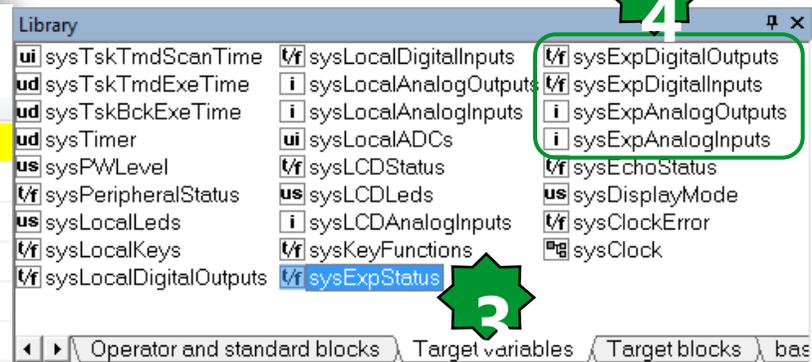
#	Name	Variable	Type	Description
1	AIL1	Ambient_temperature	INT	AIL1 analogue input
2	AIL2		INT	AIL2 analogue input
3	AIL3		INT	AIL3 analogue input
4	AIL4		INT	AIL4 analogue input
5	AIL5		INT	AIL5 analogue input
6	DIL1		BOOL	DIL1 digital input
7	DIL2		BOOL	DIL2 digital input
8	DIL3		BOOL	DIL3 digital input
9	DIL4		BOOL	DIL4 digital input
10	DIL5		BOOL	DIL5 digital input
11	DIL6		BOOL	DIL6 digital input
12	DOL1	Output_Cooling	BOOL	DOL1 digital output
13	DOL2	Alarm	BOOL	DOL2 digital output
14	DOL3		BOOL	DOL3 digital output
15	DOL4		BOOL	DOL4 digital output
16	DOL5		BOOL	DOL5 digital output
17	DOL6		BOOL	DOL6 digital output
18	AOL1		INT	AOL1 analogue output
19	AOL2		INT	AOL2 analogue output
20	AOL3		INT	AOL3 analogue output
21	AOL4		INT	AOL4 analogue output
22	AOL5		INT	AOL5 analogue output
23	TCL1		INT	TCL1 analogue output

After saving the project, all the defined resources will be available under Global shared folder; Mappings in case of I/O

...Physical I/O Mapping (Expansion)



#	Na...	Variable	Type	Description
1	AIE1	AIE1	INT	AIE1 analogue input
2	AIE2		INT	AIE2 analogue input
3	AIE3		INT	AIE3 analogue input
4	AIE4		INT	AIE4 analogue input
5	AIE5		INT	AIE5 analogue input
6	DIE1		BOOL	DIE1 digital input
7	DIE2		BOOL	DIE2 digital input
8	DIE3		BOOL	DIE3 digital input
9	DIE4		BOOL	DIE4 digital input
10	DIE5		BOOL	DIE5 digital input
11	DIE6		BOOL	DIE6 digital input
12	DOE1		BOOL	DOE1 digital output
13	DOE2		BOOL	DOE2 digital output
14	DOE3		BOOL	DOE3 digital output
15	DOE4		BOOL	DOE4 digital output
16	DOE5		BOOL	DOE5 digital output
17	DOE6		BOOL	DOE6 digital output
18	AOE1		INT	AOE1 analogue output
19	AOE2		INT	AOE2 analogue output
20	AOE3		INT	AOE3 analogue output
21	AOE4		INT	AOE4 analogue output
22	AOE5		INT	AOE5 analogue output
23	TCE1		INT	TCE1 analogue output



Note.

In case of losing communication between Base & expansion:

All DO's = 0

All DI's = False

All Probes = -32768

3. It can use as communication alarm variable

4. They can only use in watch

How to configure I/O types, range?

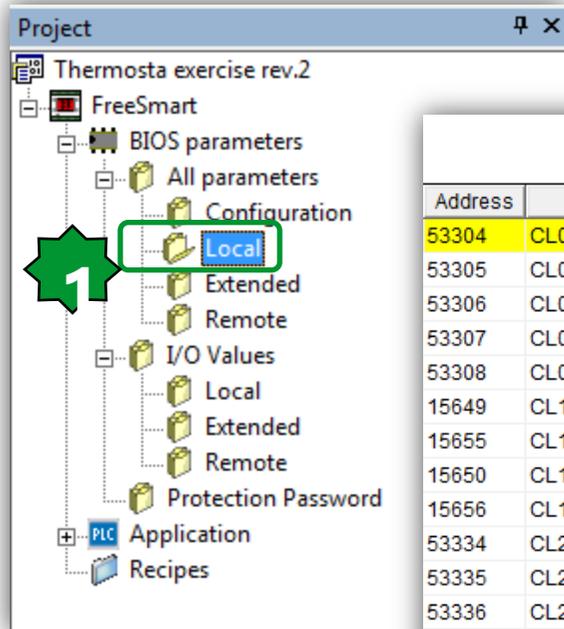


The screenshot displays the Schneider Electric FreeSmart Configuration software. The 'Developer' menu is open, and the 'Open with Free Studio Device' option is highlighted with a green box and a green arrow. The main configuration window shows the 'FreeSmart Configuration' section. Under 'Display', the 'Fundamental state display' is set to 'Ambient_Temporator'. Under 'Execution time', there is a checkbox for 'Set execution time' and a text field for 'Execution time (ms)' set to '100'. Under 'Data export', there is a text field for 'Select XSLT export filter' with 'Browse' and 'Export' buttons. Below the software interface, a physical FreeSmart device is shown, featuring a central display and several function keys (F1-F5, F3-F4, set, eSC, Prg).

1. Menu Developer ► Open with free studio device

Note: BIOS parameters are also available on the installation manual

Check FS Device parameters description...



Local								
Address	Name	Value	Um	Default	Min	Max	Description	
53304	CL00	2=NTC	num	2=NTC	0	8	AIL1 analogue input type	
53305	CL01	2=NTC	num	2=NTC	0	8	AIL2 analogue input type	
53306	CL02	2=NTC	num	2=NTC	0	7	AIL3 analogue input type	
53307	CL03	2=NTC	num	2=NTC	0	7	AIL4 analogue input type	
53308	CL04	2=NTC	num	2=NTC	0	8	AIL5 analogue input type	
15649	CL10	500	°C/Bar	500	-9999	9999	AIL3 analogue input full scale value	
15655	CL11	0	°C/Bar	0	-9999	9999	AIL3 analogue input start of scale value	
15650	CL12	500	°C/Bar	500	-9999	9999	AIL4 analogue input full scale value	
15656	CL13	0	°C/Bar	0	-9999	9999	AIL4 analogue input start of scale value	
53334	CL20	0	°C	0	-120	120	AIL1 analogue input differential	
53335	CL21	0	°C	0	-120	120	AIL2 analogue input differential	
53336	CL22	0	°C/Bar	0	-120	120	AIL3 analogue input differential	
53337	CL23	0	°C/Bar	0	-120	120	AIL4 analogue input differential	
53338	CL24	0	°C	0	-120	120	AIL5 analogue input differential	
53344	CL60	0=0-20mA	num	0=0-20mA	0	2	AOL5 analogue output type	
53346	CL70	0=Disable	num	0=Disable	0	2	Enable TCL1 analogue output	
53347	CL71	0=Disable	num	0=Disable	0	2	Enable AOL1 analogue output	
53348	CL72	1=Enable	num	1=Enable	0	2	Enable AOL2 analogue output	
53349	CL73	27	Deg	27	0	90	Phase shift TCL1 analogue output	
53350	CL74	27	Deg	27	0	90	Phase shift AOL1 analogue output	
53351	CL75	27	Deg	27	0	90	Phase shift AOL2 analogue output	
53352	CL76	10	69 µsec	10	5	40	TCL1 analogue output pulse length	
53353	CL77	10	69 µsec	10	5	40	AOL1 analogue output pulse length	
53354	CL78	10	69 µsec	10	5	40	AOL2 analogue output pulse length	

...and define the Application BIOS Default

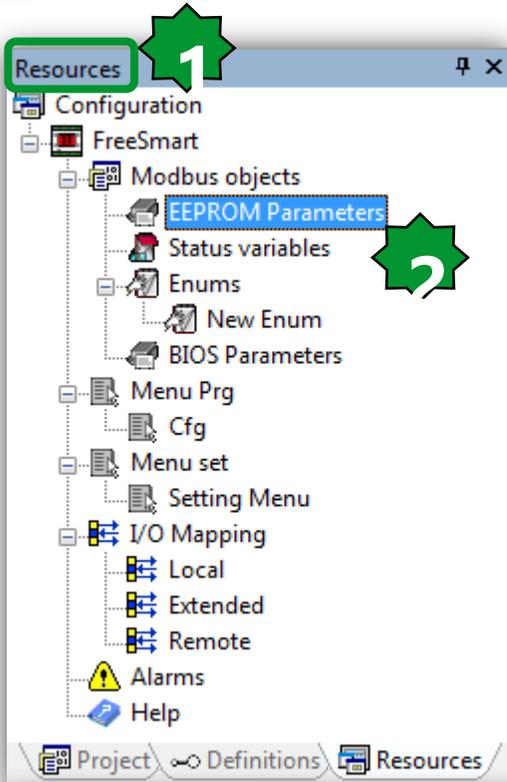


FreeSmart BIOS Parameters

#	Name	Default value	Description
1	CL00	2=NTC	AIL1 analogue input type

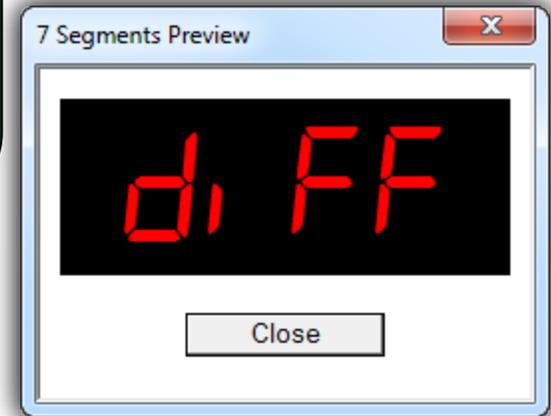
1. BIOS parameters
2. Add
3. Select the name
4. Select the type

EEPROM parameters



1. Resources
 2. EEPROM parameters
 3. Add
 4. Define required „retain“ data
 5. 1% resolution
- Format XXX.Y
- Note: Default values are written to the target only by Free Studio Device

App. Type : IEC variable type
 Device Type : FS Device / Display type
 App. Type = Scale x Device Type + Offset



FreeSmart EEPROM Parameters

Add
 Remove
 Recalc

#	Address	Name	Display label	Device type	Application type	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Description	Note
1	16384	Setpoint	SetP	Signed 16-bit	INT	180	150	300	1	0	°C	XXX.Y	Always visible		
2	16385	Differentiation	Diff	Signed 16-bit	INT	20	5	50	1	0	°C	XXX.Y	Always visible		

EEPROM Properties



FreeSmart EEPROM Parameters

Add Remove Recalc



#	Address	Name	Display label	Device type	Application type	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Description
1	16384	Setpoint	SetP	Signed 16-bit	INT	180	150	300	1	0	°C	XXX.Y	Always visible	
2	16385	Differentiation	Diff	Signed 16-bit	INT	20	5	50	1	0	°C	XXX.Y	Always visible	



Message from webpage

Invalid address value! Must be in 16384..16895 range

OK



°C
bar
%R.H.



XXX.Y
XX.YY
%04x
HH:MM



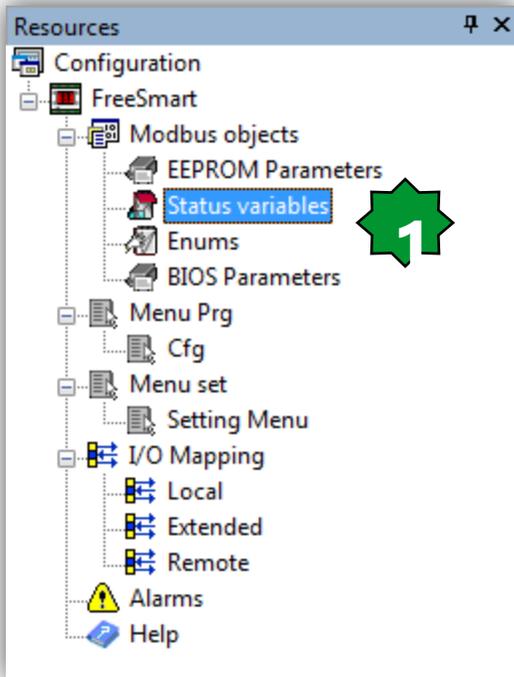
Never visible
Level 1
Level 2
Always visible

EEPROM Parameters:

App. Type : IEC variable type
 Device Type : FS Device / Display type
 App. Type = Scale x Device Type + Offset

Note.
 Dynamic setpoint by the other parameters
 Min/Maxis possible.

Status Variables



1. Resources ► Status variable
2. Add new record
3. Define required RAM data
4. Valid range

Note: Same properties as EEPROM + read only



App. Type : IEC variable type
Device Type : FS Device / Display type
App. Type = Scale x Device Type + Offset

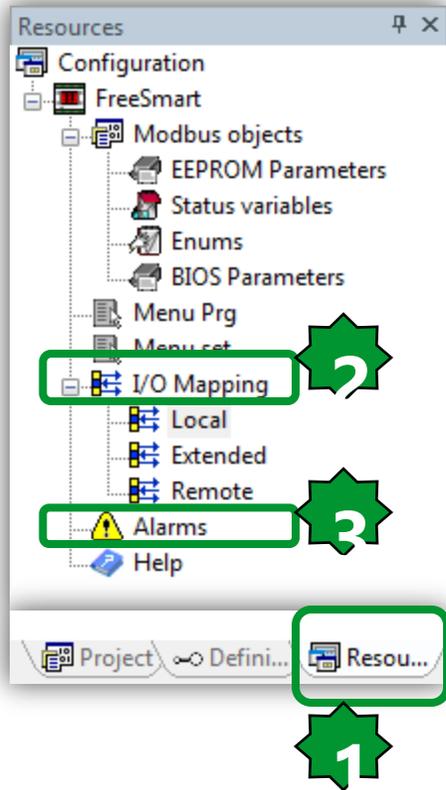
FreeSmart Status Variables

Add Remove Recalc

#	Address	Name	Display label	Device type	Application type	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Read only
1	8960	Ambient_Temperature	ATMP	Signed 16-bit	INT				1	0	°C	XXX.Y	Always visible	True

False
True

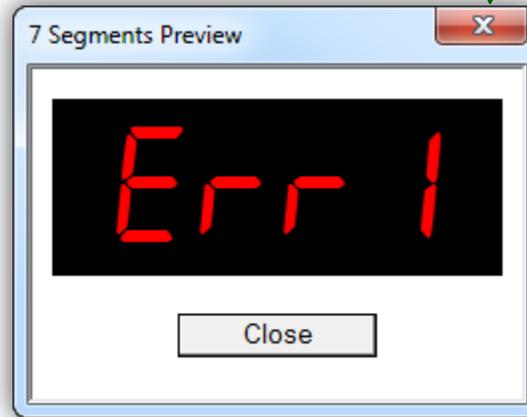
Alarms



FreeSmart Alarms

Add Remove

#	Name	Short name	Description
1	Temperature_Probe_Error	Err1	



1. Resources
2. I/O mapping
3. Alarm
4. Add

4.1 Name

4.2 without short name

4.3 7 segments preview

4.4 with short name

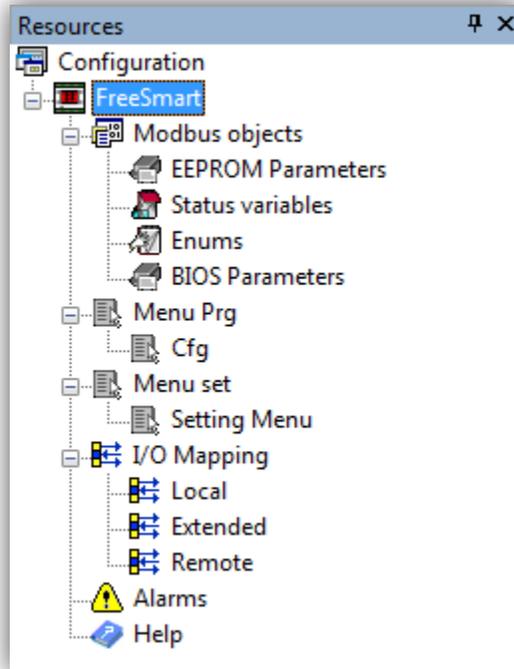
4.5 7 segments preview

- It is automatic folder which display the Alarms, if value is 0, no display In AL folder if alarm value is 1, displays the short name.

blinks if value > than 1.

- In case of any alarms, the red triangle icon in the display is on.

Fundamental state display configuration



FreeSmart Configuration

Execution time: _____
Set execution time:
Execution time (ms):

Data export: _____
Select XSLT export filter: _____

Display

Rst E2

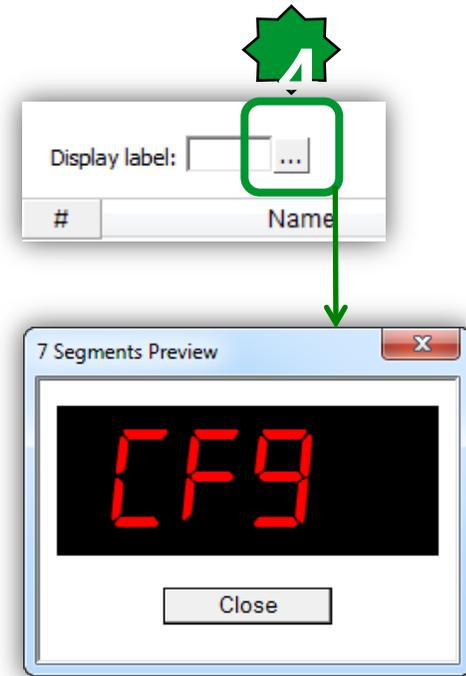
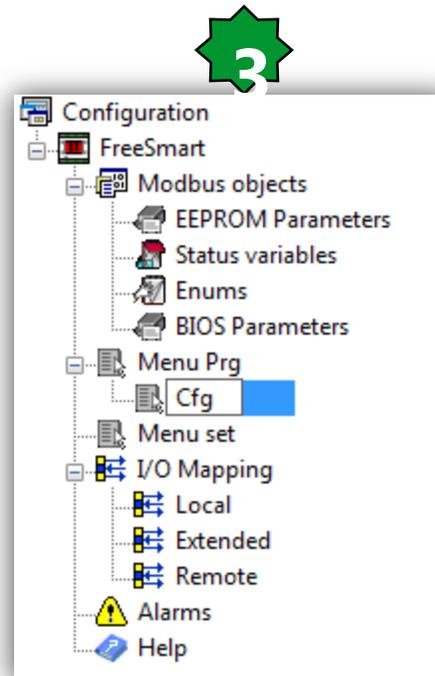
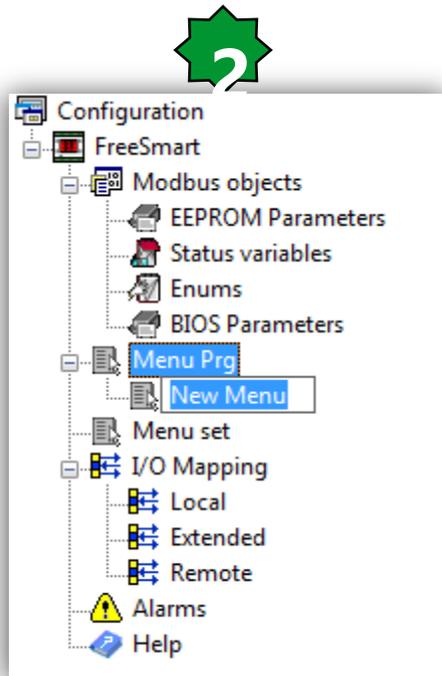
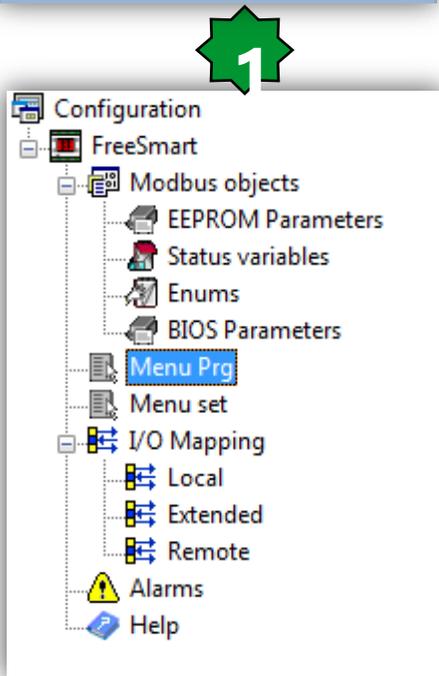
- Display
- Fundamental state display
- Desired variable in the display



Menu Program – Add Folder



Resources

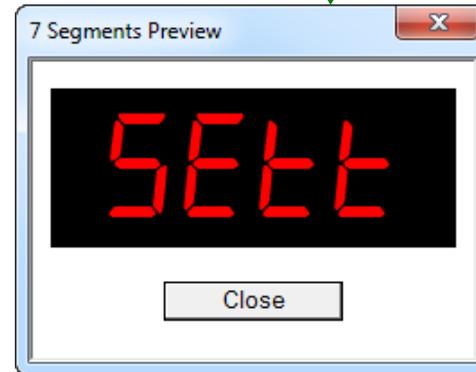
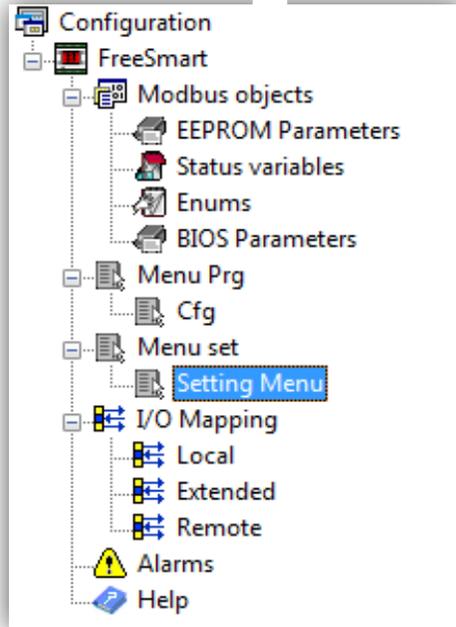
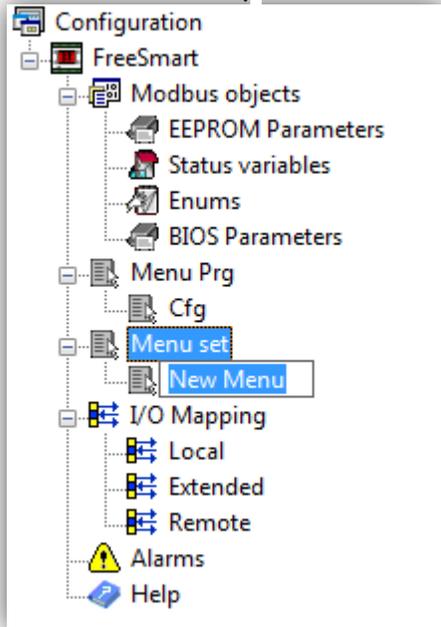


1. Menu Prg.
2. Add Menu
3. New Menu, name it (Cfg)
4. 7 segment preview

Menu Set – Add Folder



Resources



1. Menu Set, Right Click Add Menu
2. New Menu, name it (Setting Menu)
3. 7 segments preview

Add/Remove elements to folder



FreeSmart 'Cfg' Menu

Display label: ...

#	Name	Description
1	Setpoint	

1

2

3

4

Setpoint
Differentiation

CF01
CF20
CF21
CF30
CF31
CF32
CF60
CF61
CL00
CL01
CL02
CL03
CL04
CL10
CL11
CL12
CL13
CL20
CL21
CL22
CL23
CL24
CL60
CL70
CL71
CL72
CL73
CL74
CL75
CL76

- 1. Add
- Open the list sorted by names
- 2. Select the parameter
- 3. Add again
- 4. Select the other parameter

FreeSmart 'Cfg' Menu

Display label: ...

#	Name	Description
1	Setpoint	
2	Differentiation	



Add/Remove elements by drag & drop



Resources

- Configuration
 - FreeSmart
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - BIOS Parameters
 - Menu Prg
 - Cfg
 - Menu set
 - Setting Menu
 - I/O Mapping
 - Alarms
 - Help

Drag & Drop

FreeSmart 'Cfg' Menu

Display label: ... Add Remove Up Down

#	Name	Description
1	Setpoint	
2	Differentiation	

FreeSmart 'Setting Menu' Menu

Display label: ... Add Remove Up Down

#	Name	Description
1	Setpoint	
2	Differentiation	
3	Ambient_Temperator	

FreeSmart EEPROM Parameters

Add Remove Recalc

#	Address	Name	Display label	Device type	Application type	Default value	Min	Max	Scale	Offset	Format	AccessLevel
1	16384	Setpoint	SetP	Signed 16-bit	INT	180	150	300	1	0	XXX.Y	Always visible
2	16385	Differentiation	Diff	Signed 16-bit	INT	20	5	50	1	0	XXX.Y	Always visible

Menu Program – How to Access



The diagram illustrates the process of accessing the menu program on a Schneider Electric device. It is divided into three main parts:

- Step 1:** A hand icon points to the 'Prg' button on the device's keypad. A green starburst with the number '1' is next to it.
- Step 2:** A hand icon points to the 'esc' and 'set' buttons on the device's keypad. A green starburst with the number '2' is next to it.
- Step 3:** A screenshot of the simulation software interface. The 'Resources' tree on the left shows the 'Menu Prg' folder selected. A table on the right shows the contents of the 'Menu Prg' folder:

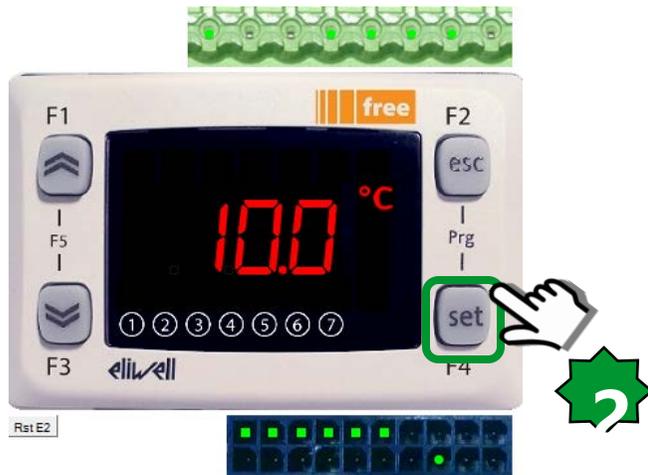
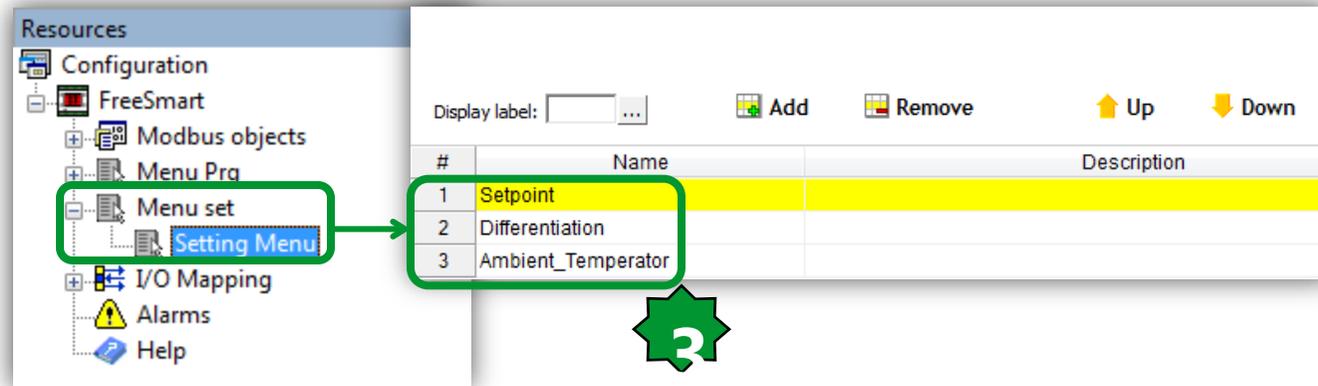
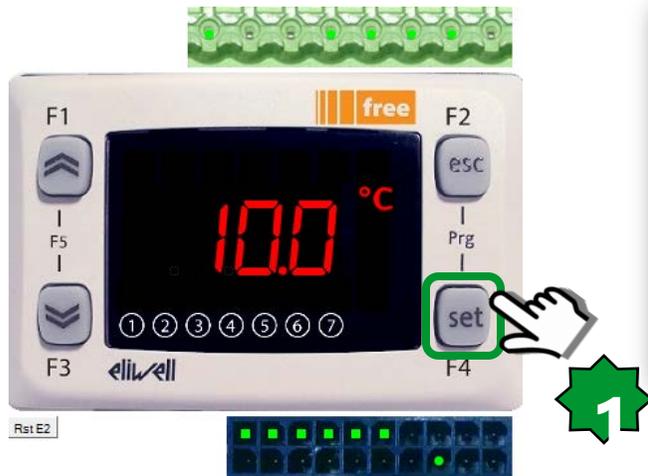
#	Name	Description
1	Setpoint	
2	Differentiation	

The table has a yellow highlight on the first two rows. A green starburst with the number '3' is next to the table.

To form & define the program button function:

1. Menu Prg, access by pressing Prg button in simulation
2. Menu Prg, access by pressing esc.& set buttons simultaneously on the product
3. Scroll up or down into the defined variables ▲ ▼

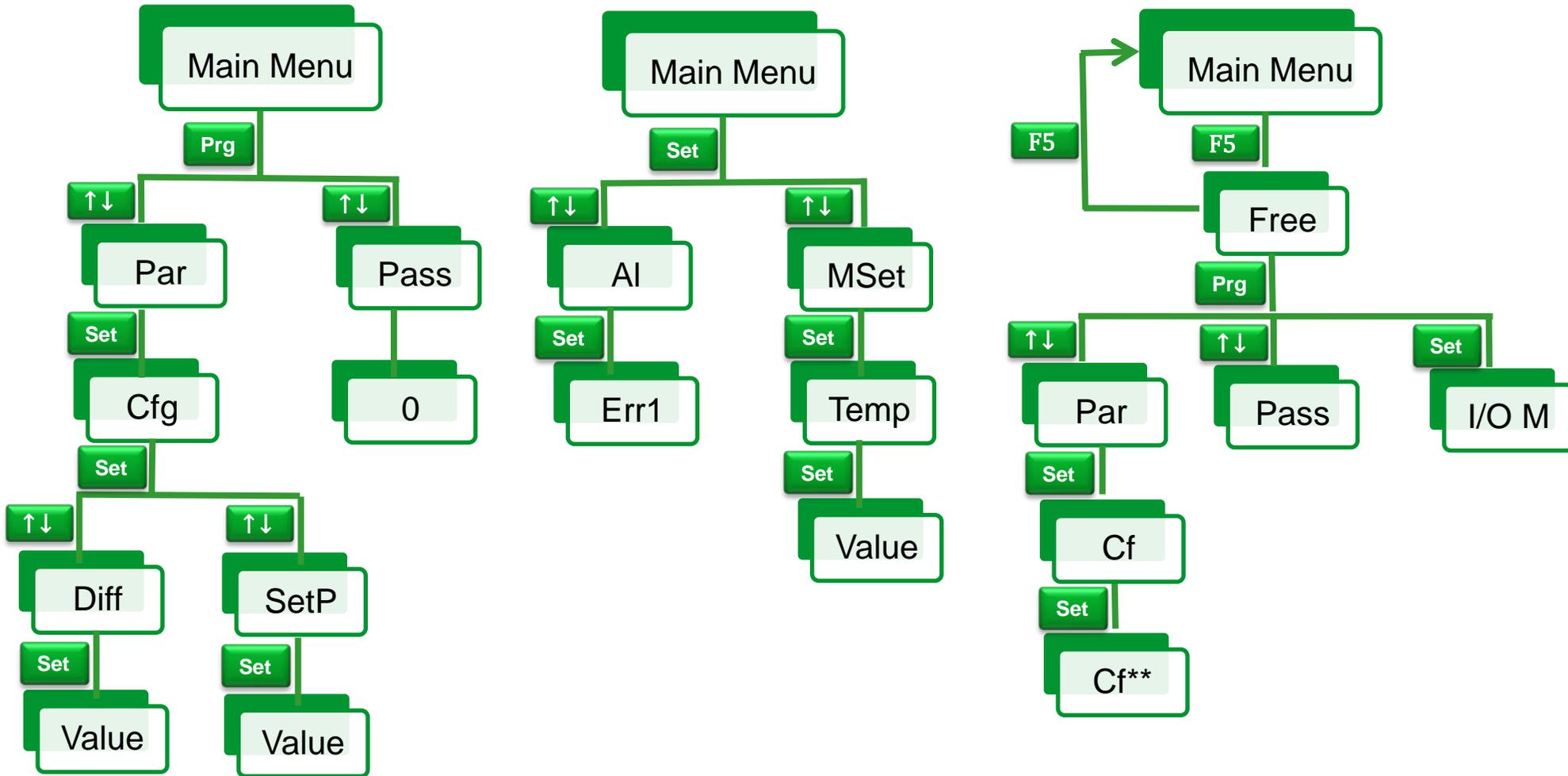
Menu Set – How to Access



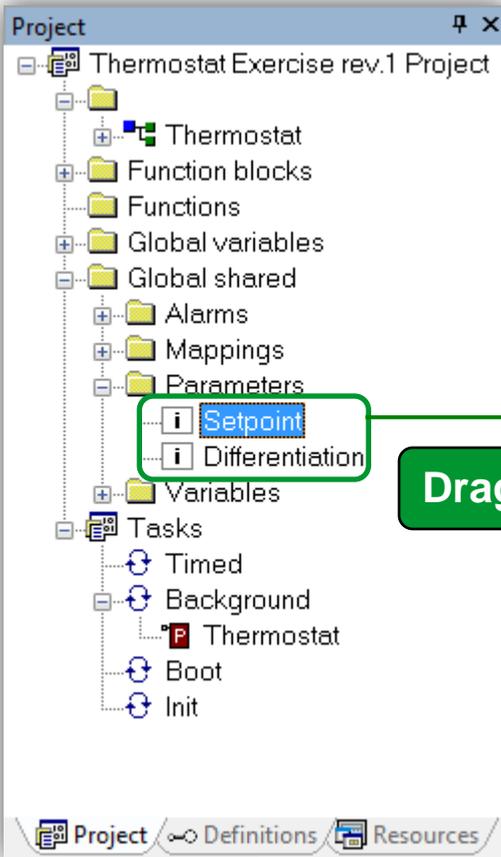
To form & define the set button function:

1. Access to the set menu by pressing set in simulation
2. Access to the set menu by pressing set on the product
3. Scroll up or down into the defined variables ▼ ▲

Menu architecture

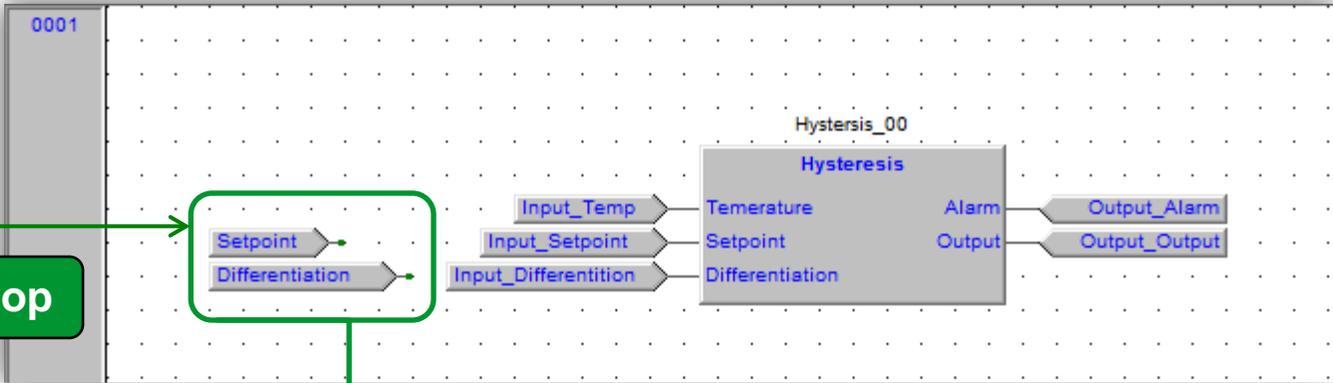


Project / Global Shared



All the resources are available in the project tab under Global Shared folder (after saving or compiling the project)

Drag & Drop

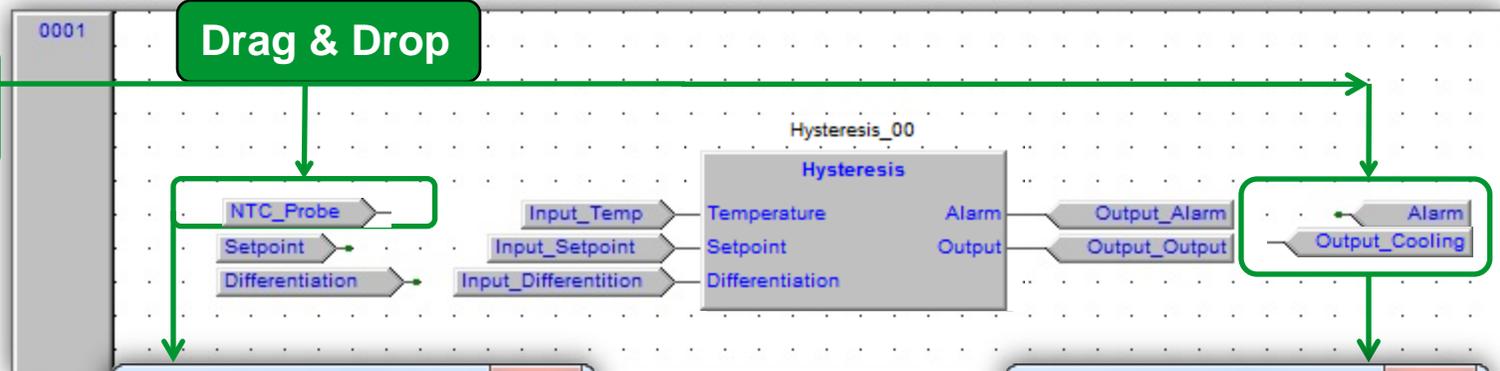
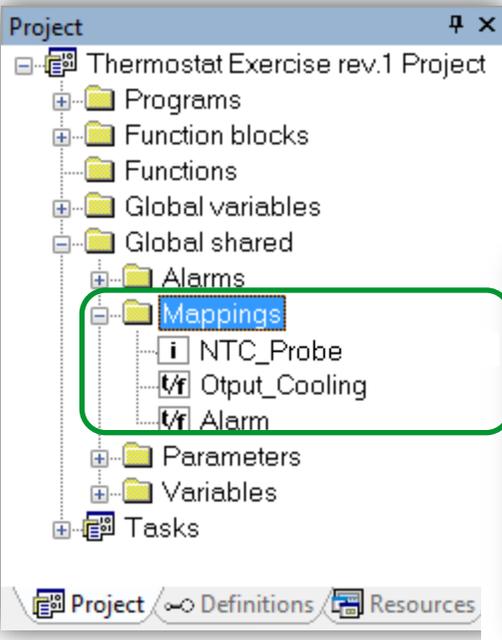


Var type

Input Output

OK Cancel

Using physical I/O



Var type

Input Output

OK Cancel

Var type

Input Output

OK Cancel

System LED setting



Resources

- Configuration
 - FreeSmart
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - BIOS Parameters
 - Menu Prg
 - Cfg
 - Menu set
 - Setting Menu
 - I/O Mapping
 - Local
 - Extended
 - Remote
 - Alarms
 - Help



Library

- System timers
- System clock
- System Tasks Execution Time
- Peripheral
- Password Level
- Leds status
- Keys
- Key Functions
- DisplayMode
- Digital Outputs
- Digital Inputs
- Analog Outputs
- Analog Inputs

Operator and standard blocks | Target variables



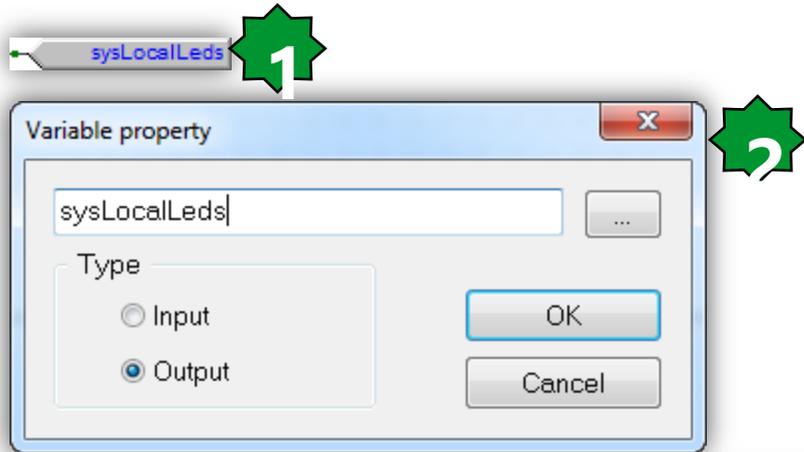
LED reference for the developer

The IEC developer can turn on (either steady or blinking) and off the whole range of local display LEDs, by properly setting the array SYSLED.

LED number	Symbol or icon	Description	Off	On (steady)	On (blinking)
0	:	Colon	SYSLED[0]=0	SYSLED[0]=1	SYSLED[0]=2
1	%R.H.	%RH	SYSLED[1]=0	SYSLED[1]=1	SYSLED[1]=2
2		Defrost	SYSLED[2]=0	SYSLED[2]=1	SYSLED[2]=2
3	Bar	Bar	SYSLED[3]=0	SYSLED[3]=1	SYSLED[3]=2
4		Stand-by	SYSLED[4]=0	SYSLED[4]=1	SYSLED[4]=2
5	°C	°C	SYSLED[5]=0	SYSLED[5]=1	SYSLED[5]=2
6		Cooling	SYSLED[6]=0	SYSLED[6]=1	SYSLED[6]=2
7		Clock (RTC)	SYSLED[7]=0	SYSLED[7]=1	SYSLED[7]=2
8		Heating	SYSLED[8]=0	SYSLED[8]=1	SYSLED[8]=2
9		User-defined 1	SYSLED[9]=0	SYSLED[9]=1	SYSLED[9]=2
10		User-defined 2	SYSLED[10]=0	SYSLED[10]=1	SYSLED[10]=2
11		User-defined 3	SYSLED[11]=0	SYSLED[11]=1	SYSLED[11]=2
12		User-defined 4	SYSLED[12]=0	SYSLED[12]=1	SYSLED[12]=2
13		User-defined 5	SYSLED[13]=0	SYSLED[13]=1	SYSLED[13]=2
14		User-defined 6	SYSLED[14]=0	SYSLED[14]=1	SYSLED[14]=2
15		User-defined 7	SYSLED[15]=0	SYSLED[15]=1	SYSLED[15]=2
16		Alarm	SYSLED[16]=0	SYSLED[16]=1	SYSLED[16]=2
17		Menu	SYSLED[17]=0	SYSLED[17]=1	SYSLED[17]=2
18		Economy	SYSLED[18]=0	SYSLED[18]=1	SYSLED[18]=2

Some of the LEDs - for example, LED number 0, 1, 3, 5, and 7 (in green) - cannot be used by the IEC developer when BIOS menu is active.

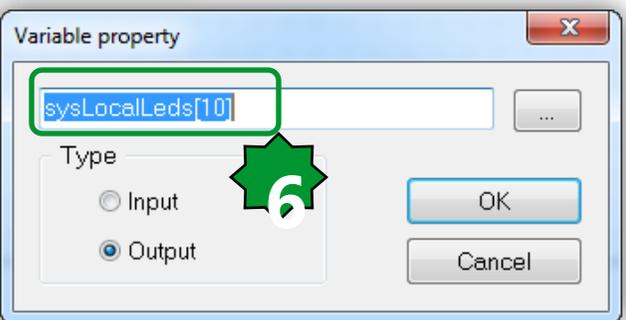
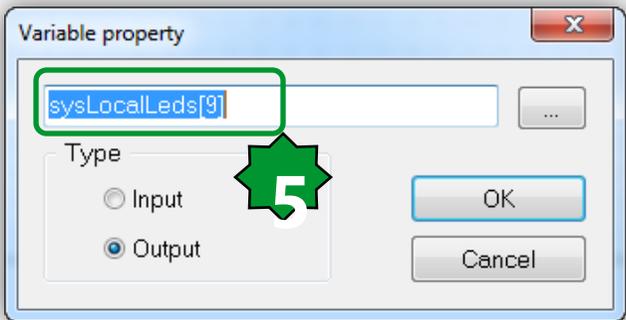
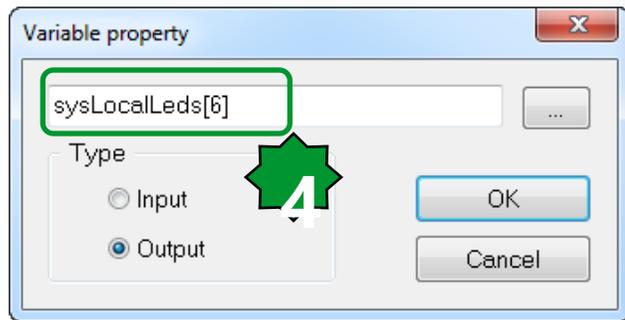
System local LED assigning



1. 2*click
2. Variable property
3. Dedicate required LED
4. Type [6] ▶ Output ▶ OK
5. Type [9] ▶ Output ▶ OK
6. Type[10] ▶ Output ▶ OK
7. Dedicated LED's



LED number	Symbol or icon	Description	Off	On (steady)	On (blinking)
6		Cooling	SYSLED[6]=0	SYSLED[6]=1	SYSLED[6]=2
9		User-defined 1	SYSLED[9]=0	SYSLED[9]=1	SYSLED[9]=2
10		User-defined 2	SYSLED[10]=0	SYSLED[10]=1	SYSLED[10]=2



Connecting dedicated LED's to the FBD



1

2

3

4

LED number	Symbol or icon	Description	Off	On (steady)	On (blinking)
6		Cooling	SYSLED[6]=0	SYSLED[6]=1	SYSLED[6]=2
9		User-defined 1	SYSLED[9]=0	SYSLED[9]=1	SYSLED[9]=2
10		User-defined 2	SYSLED[10]=0	SYSLED[10]=1	SYSLED[10]=2

5

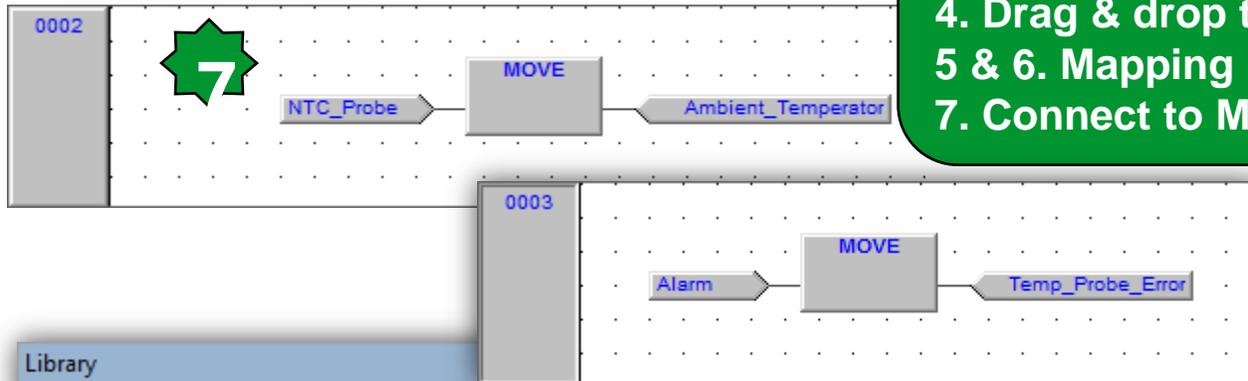
Digital output map

Digital Input map

Valorize Fundamental State Display



1. Insert bottom (new network)
2. Adding new network
3. Select Move block
4. Drag & drop to new network
- 5 & 6. Mapping ◀▶ Variables
7. Connect to Move block



Library

|x| ABS	÷ DIV	ln LN	x ^y POW	sizeof SIZEOF
∠ ACOS	= EQ	log LOG	R	√ SQRT
+ ADD	e ^x EXP	< LT	REPLACE	- SUB
? ADR	ABC FIND	M MAX	RET	/ TAN
& AND	FLOOR	ABC MID	RIGHT	tnh TANH
∠ ASIN	GE	m MIN	ROL	TO_BOOL
∠ ATAN	> GT	% MOD	ROR	TO_DINT
∠ ATAN2	ABC INSERT	MOVE	S	TO_INT
→ CEIL	→ JMP	X MUL	SEL	TO_REAL
ABC CONCAT	≤ LE	MUX	SHL	TO_SINT
√ COS	ABC LEFT	≠ NE	SHR	TO_UDINT
csh COSH	ABC LEN	∠ NOT	SIN	TO_UINT
ABC DELETE	X LIMIT	I OR	snh SINH	TO_USINT

Operator and standard blocks | Target variables | Target blocks | basic

Project

- Thermostat New Project
 - Programs
 - Function blocks
 - Functions
 - Global variables
 - Automatic variables
 - Mapped variables
 - Constants
 - Retain variables
 - Global shared
 - Alarms
 - Mappings
 - NTC_Probe
 - Output_Heating
 - Alarm
 - Parameters
 - Variables
 - Ambient_Temperator
 - Tasks
 - Timed
 - Background
 - Thermostat
 - Boot
 - Init

* Move command is mandatory to connect two variables.

Compile/Build



Compile

```
Output
Preparing for PLC application download .. done.
Downloading file C:\Users\SESA94552\Thermostat New\Thermostat New.cod .. completed.
Booting PLC application .. done.
0 warnings, 0 errors.
```

```
Output
Generating program THERMOSTAT
Generating program DISPLAYALARMLED
Generating program APPLICATIONMENU
Generating unresolved
aborted.
THERMOSTAT(1$FB:HYSTERSIS_00) - error G0008: ST => Invalid access to variable
0 warnings, 1 errors.
```

**Double click on
the error to refer to
the error source**

Chapter 5

Simulation and Debugging – Part 2

Goal:

On-Line simulation mode, testing of:

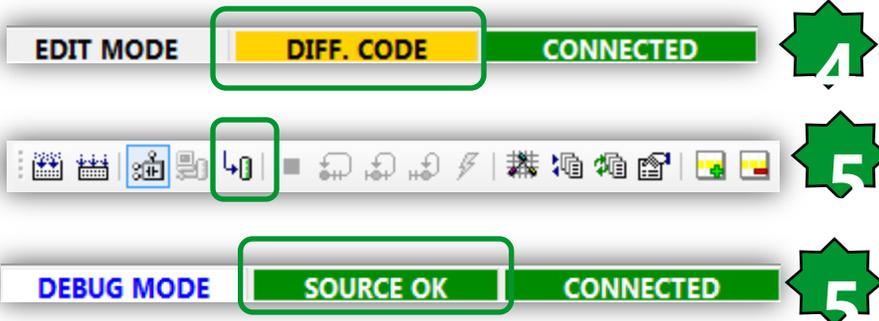
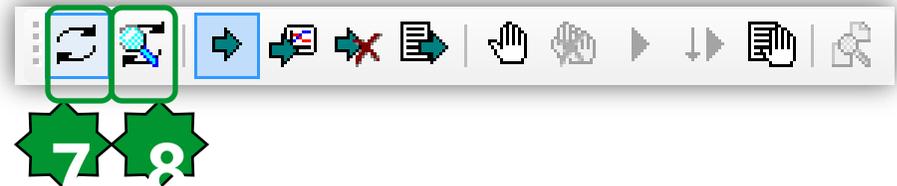
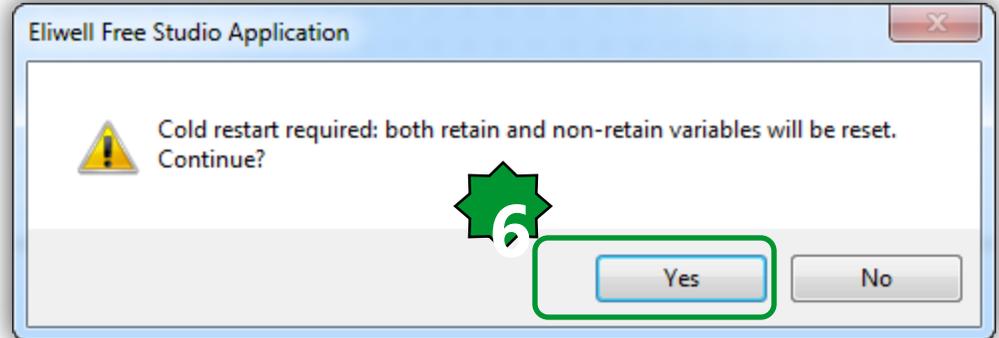
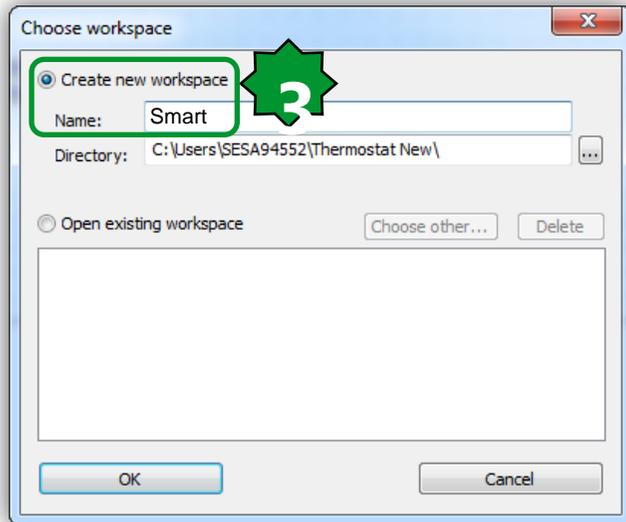
- Physical I/O
- 7 segment display



Off line simulation mode

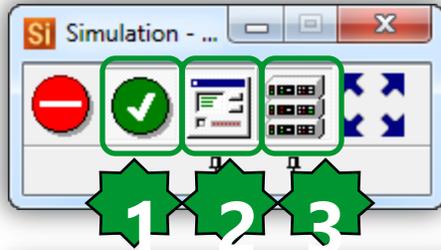


Debug ► Simulation mode ►



1. Debug
2. Simulation mode
3. Name it ► OK
4. If differs or no code
5. Download code, OK
6. Reset Variables
7. Debug mode (optional)
8. Live debug (Continuous) mode (optional)

Simulation tools



1. Active code execution
2. Show I/O panels
3. Show HMI window

Digital Inputs	
DIL1	<input checked="" type="checkbox"/>
DIL2	<input checked="" type="checkbox"/>
DIL3	<input checked="" type="checkbox"/>
DIL4	<input checked="" type="checkbox"/>
DIL5	<input checked="" type="checkbox"/>
DIL6	<input checked="" type="checkbox"/>

Analogue Inputs	
AIL1	<input type="checkbox"/>
AIL2	<input type="checkbox"/>
AIL3	<input type="checkbox"/>
AIL4	<input type="checkbox"/>
AIL5	<input type="checkbox"/>

Digital Outputs	
DOL1	<input checked="" type="checkbox"/>
DOL2	<input checked="" type="checkbox"/>
DOL3	<input checked="" type="checkbox"/>
DOL4	<input checked="" type="checkbox"/>
DOL5	<input checked="" type="checkbox"/>
DOL6	<input checked="" type="checkbox"/>

Analogue Outputs	
AOL1	<input checked="" type="checkbox"/>
AOL2	<input checked="" type="checkbox"/>
AOL3	<input checked="" type="checkbox"/>
AOL4	<input checked="" type="checkbox"/>
AOL5	<input checked="" type="checkbox"/>
TCL1	<input checked="" type="checkbox"/>



Open Free Studio Device from Application



The screenshot displays the Schneider Electric FreeStudio software interface. The 'Developer' menu is open, and the 'Open with Free Studio Device' option is highlighted with a green box and a green arrow. The main window shows the 'FreeSmart Configuration' dialog, which includes sections for 'Display' (with a dropdown menu set to 'Ambient_Temperature'), 'Execution time' (with a checkbox for 'Set execution time' and a text field for 'Execution time (ms)' set to 100), and 'Data export' (with a text field for 'Select XSLT export filter' and 'Browse' and 'Export' buttons). A physical FreeSmart device is shown at the bottom left of the interface.

1. Developer ► Open with Free Studio Device

Free Studio Device (Simulation Target)



FreeSmart 412 Configuration

General
Name: FreeSmart
File version: 412.15

Communication
Protocol: GDB [Settings]
Address: 127.0.0.1
Port: TCP/IP:5000
Baud rate: []
 Disable communication

Information
Status: NOT CONNECTED
Firmware version: []

Firmware management
BIOS download
Create firmware file

Catalog

Device name	Version	Max versi...	Description
FreeSmart			Not connected

Connection Status

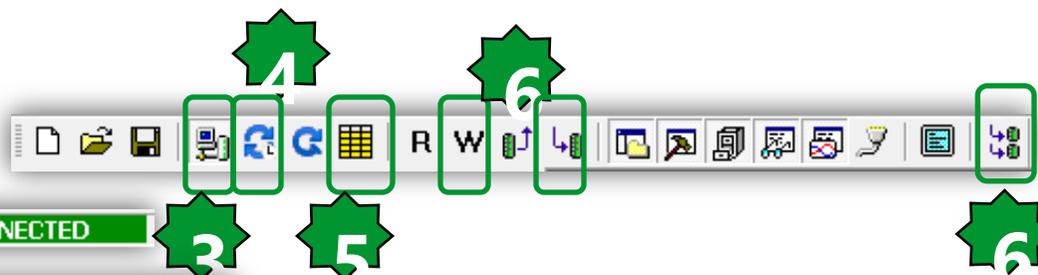
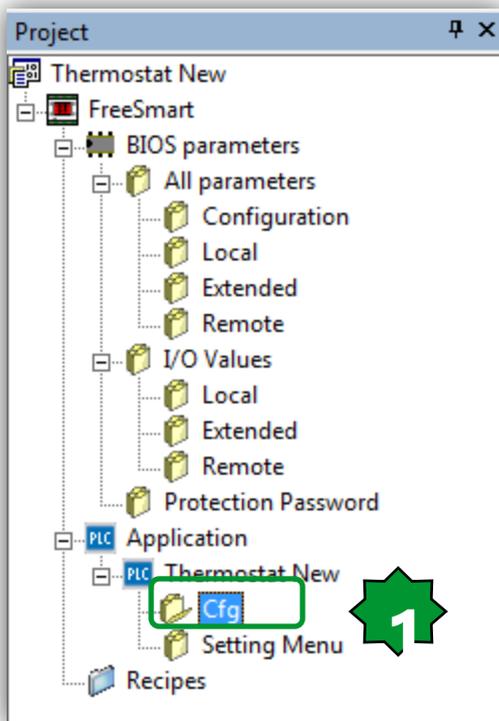
Device name	Description
FreeSmart	Not connected

CONNECTED

Connect to the target ► Connected feedback

Note: Free Studio Device does not download the code in Simulation, it is used only for setting EEPROM parameters and check Status

Read / Write Values



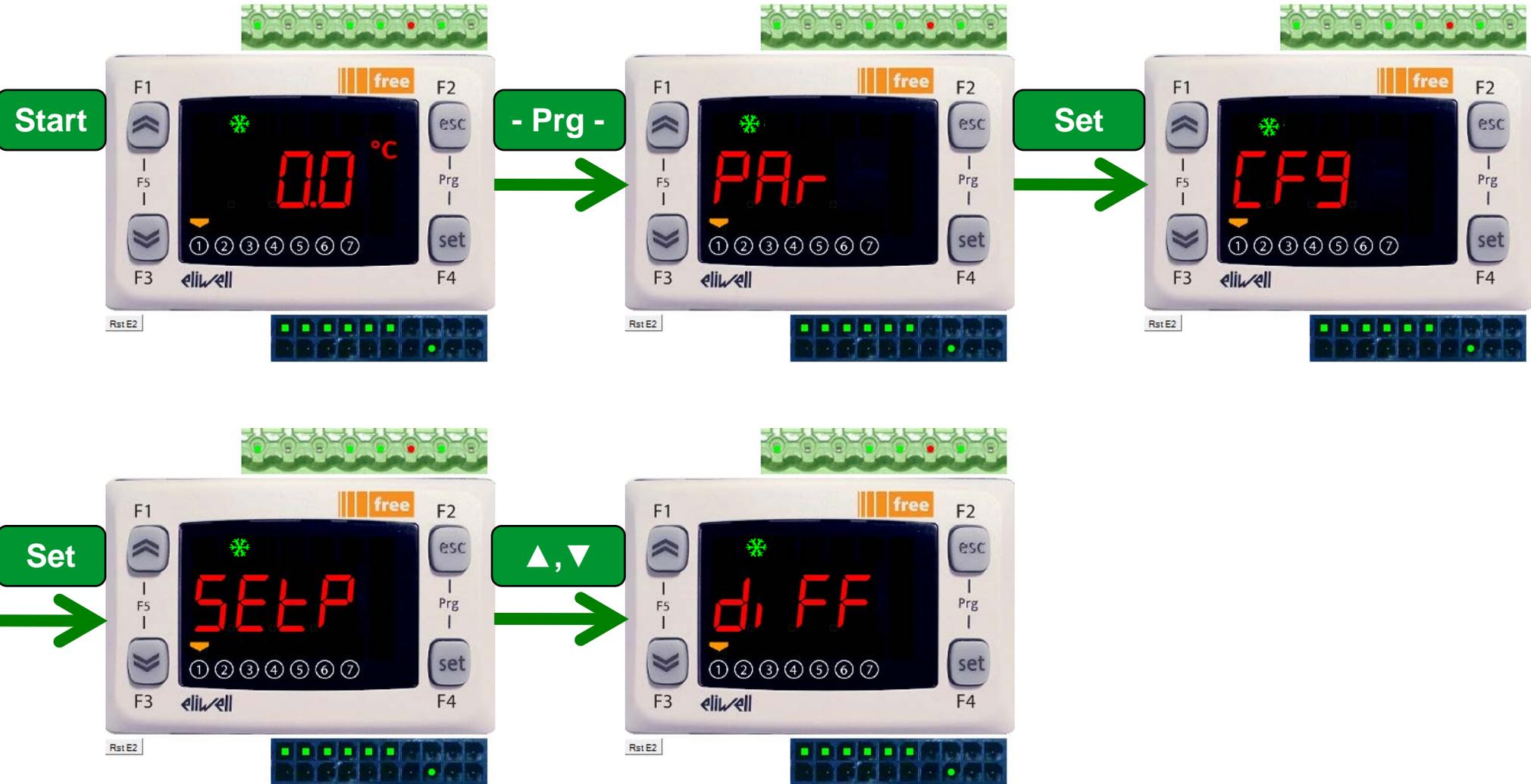
CONNECTED

Connection Status	
Device name	Description
FreeSmart	Connected

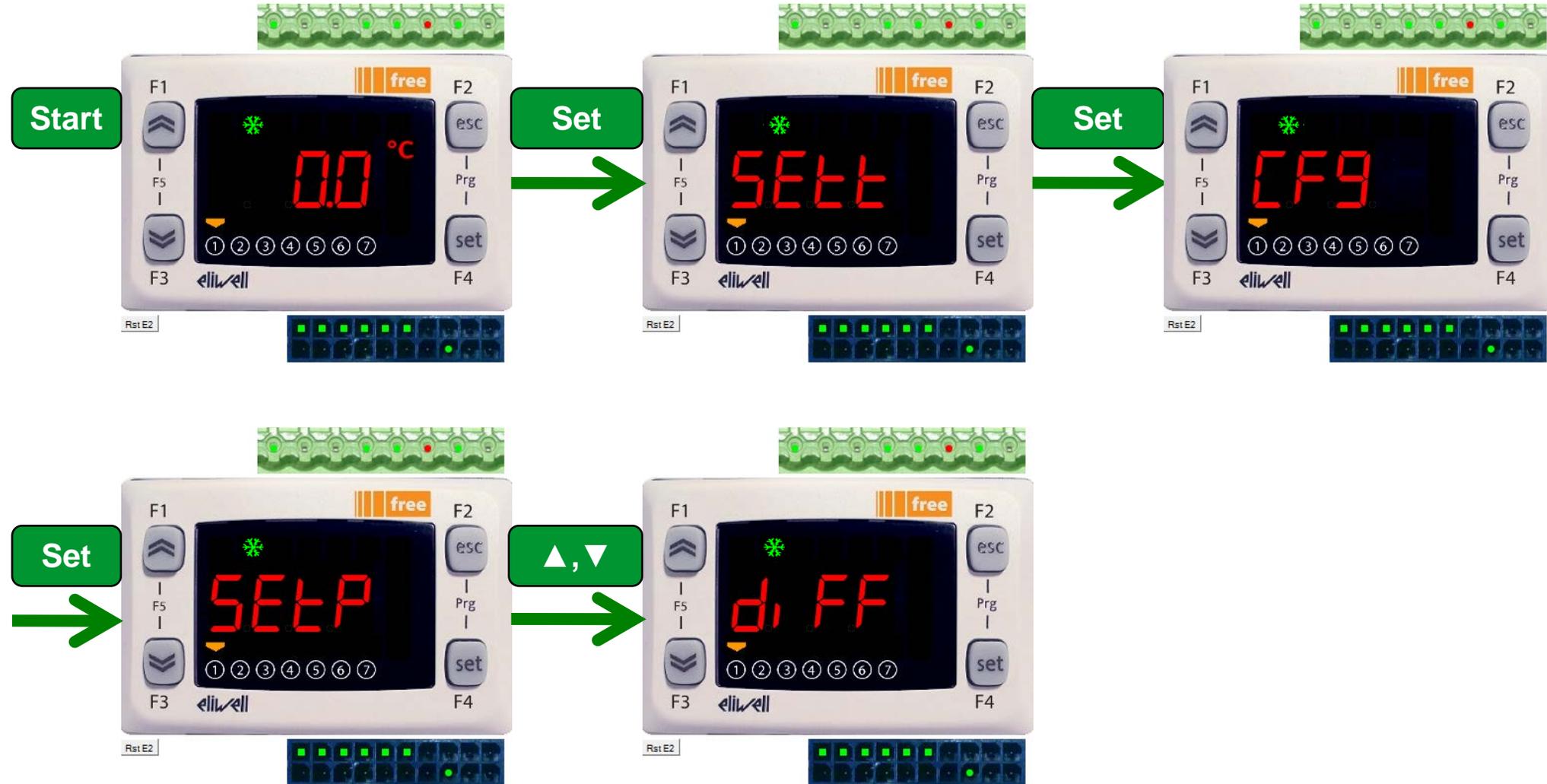
1. Connect to the target ▶ Connected feedback
2. Application ▶ Project ▶ Cfg
3. Cfg menu ▶ non aligned value with target (Red)
4. Auto refresh mode (optional)
5. Select all parameters (or selective)
6. Write parameter (all or selective)+ download all
7. Aligned values with the target (black)

Cfg							
Address	Name	Value	Um	Default	Min	Max	Description
16384	Setpoint	180.0	°C	180.0	150.0	300.0	
16385	Differentiation	20.0	°C	20.0	5.0	50.0	

Menu Navigation



Menu Navigation



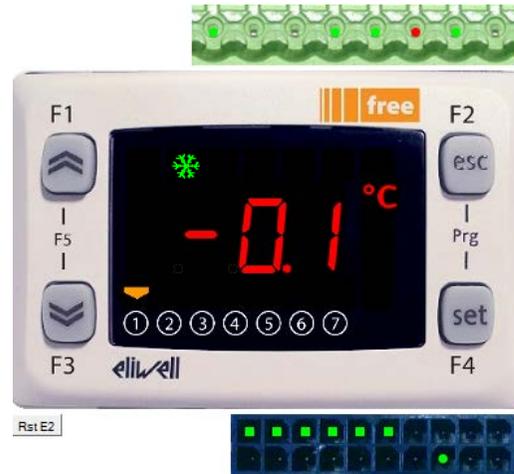
Setting the setpoint



Setting the differentiation



Message



Out of range message
Only can display:
- 99.9.....999.9

Free Studio Device does
not write default values

Testing program/applying values

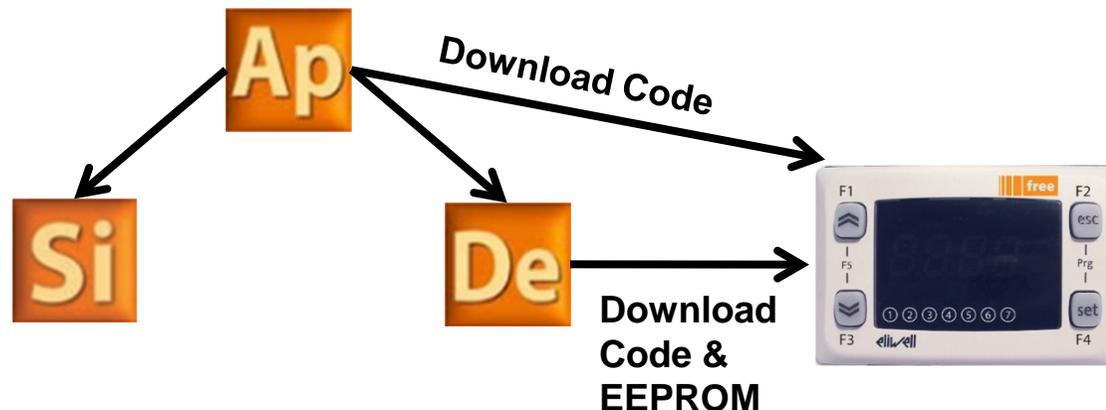


- **Setpoint=26.0, Differentiation=10.0 & Ambient_Temperature =37.0**
⇒ **DOL1= ON & ☀ = ON**
- **Setpoint=26.0, Differentiation=10.0 & Ambient_Temperature =25.0**
⇒ **DOL1= OFF & ☀ = OFF**
- **Setpoint=26.0, Differentiation=10.0 & 26.0<Ambient_Temperature<36.0**
⇒ **DOL1= ON & ☀ = ON**
- **Ambient_Temperature =-32768**
⇒ **DOL1= OFF , ☀ = OFF & DOL2= ON (probe disconnection alarm= ON)**

Smart Project Architecture



- Application is the programming starting point.
- Device is used to download the overall compiled project and it is the only tool able to write EEPROM parameters.
- From Application it will always be possible to open Device directly without having to launch the program using the FREE Studio icon.



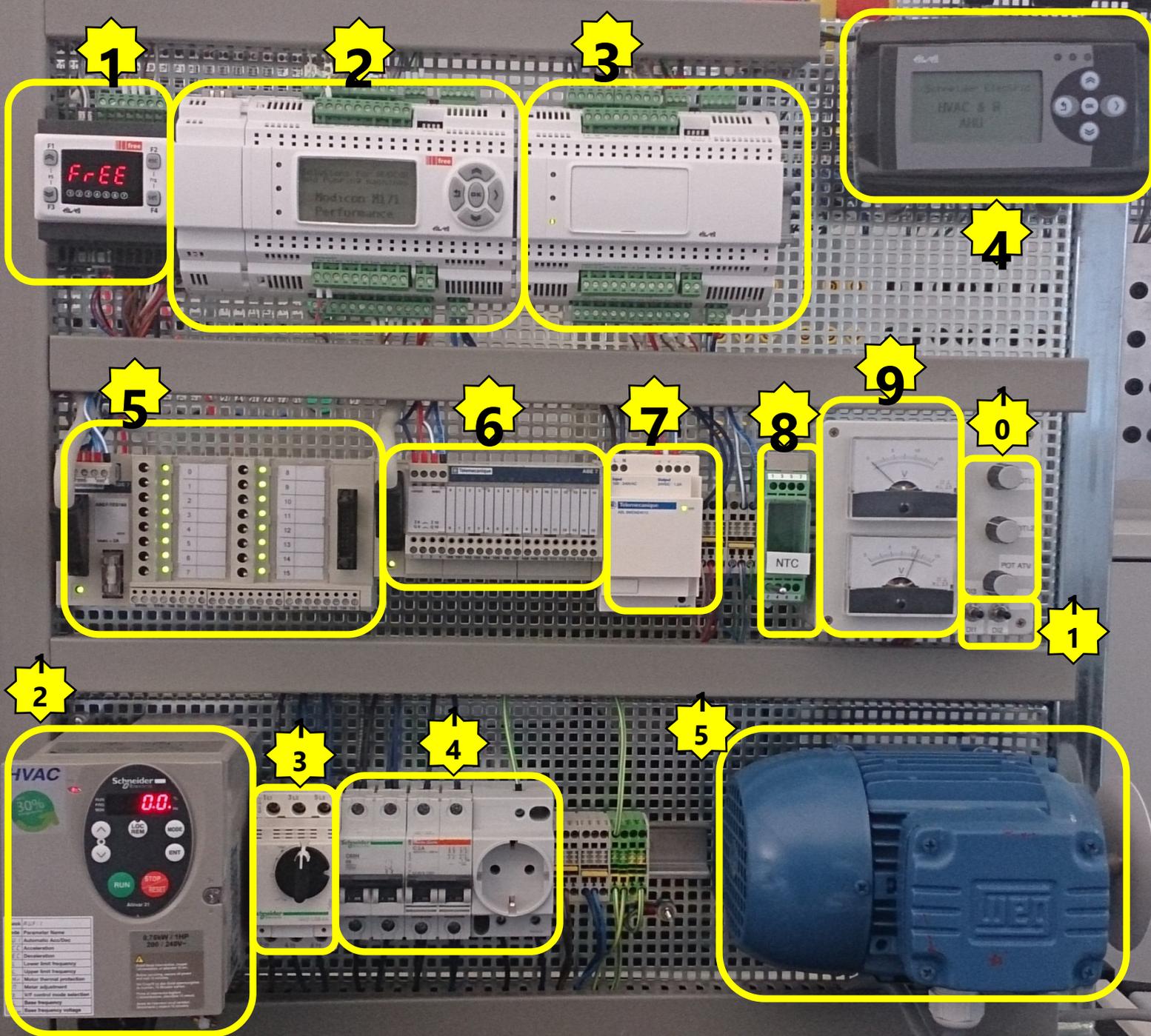
Chapter 6

Hardware

Goal:

Introduction of products that are used in training stand and target pin-out





1. M1710/SMART
2. M171P/EVOLUTION
3. EVE*
4. EVK1000
5. Digital input
I0-I7 ▶ M171P
I8-I15 ▶ EVE*
6. Digital Output
Q0-Q3 ▶ M1710
Q4-Q9 ▶ M171P
Q10-Q15 ▶ EVE*
7. 24VDC power supply
8. NTC probes (AI1*)
9. Analogue Output
AO1 ▶ M1710
AO2 ▶ M171P
10. Analogue Input
AI1 ▶ M1710
AI2 ▶ M171P
AI3 ▶ ATV21
11. Digital input
I0 & I1(level) ▶ M1710
I2 & I3 (edge) ▶ M1710
12. Variable Speed Drive
ATV21 (1 to 3 phases)
13. Short circuit
protection (GV3P)
14. LV distribution &
protection
15. Asynchronous
motor

Training Stand I/O wiring diagram



M1710	Description	Label
DI1	Switch DI 1 (level)	DI0-O
DI2	Switch DI 2 (Level)	DI1-O
DI3	Switch DI 3 (Pulse)	DI2-O
DI4		
DI5		
DI6		
AI 1	NTC 1	AI1-O
AI 2		
AI 3	Potentiometer 1	AI3-O
AI 4		
AI 5		
DO 1	Telefast DO 0	DO0-O
DO 2	Telefast DO 1	DO1-O
DO 3	Telefast DO 2	DO2-O
DO 4		
DO 5		
DO 6		
AO 1		
AO 2		
AO 3	Meter 1	AO1-O
AO 4		
AO 5		

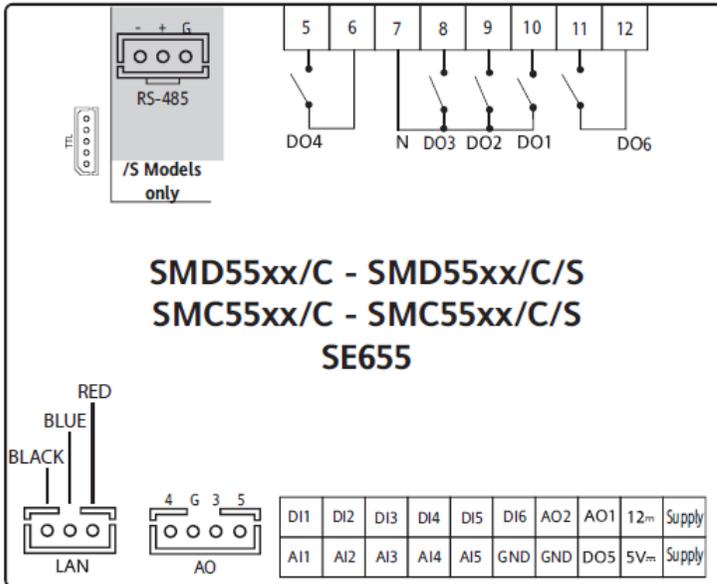
M171P	Description	Label
DI 1	Telefast DI 0	DI1-P
DI 2	Telefast DI 1	DI2-P
DI 3	Telefast DI 2	DI3-P
DI 4	Telefast DI 3	DI4-P
DI 5	Telefast DI 4	DI5-P
DI 6	Telefast DI 5	DI6-P
DI 7	Telefast DI 6	DI7-P
DI 8	Telefast DI 7	DI8-P
AI 1	NTC 2	AI1-P
AI 2		
AI 3	Potentiometer 2	AI3-P
AI 4		
AI 5		
AI 6		
DO 1		
DO 2		
DO 3	Telefast DO3	DO3-P
DO 4	Telefast DO4	DO4-P
DO 5	Telefast DO5	DO5-P
DO 6	Telefast DO6	DO6-P
DO 7	Telefast DO7	DO7-P
AO 1	Meter 2	AO1-P
AO 2		
AO 3		
AO 4		
AO 5		

M171E	Description	Label
DI 1	Telefast DI 8	DI1-E
DI 2	Telefast DI 9	DI2-E
DI 3	Telefast DI 10	DI3-E
DI 4	Telefast DI 11	DI4-E
DI 5	Telefast DI 12	DI5-E
DI 6	Telefast DI 13	DI6-E
DI 7	Telefast DI 14	DI7-E
DI 8	Telefast DI 15	DI8-E
AI 1	NTC 3	AI1-E
AI 2		
AI 3		
AI 4		
AI 5		
AI 6		
DO 1	Telefast DO9	DO1-E
DO 2	Telefast DO10	DO2-E
DO 3	Telefast DO11	DO3-E
DO 4	Telefast DO12	DO4-E
DO 5	Telefast DO13	DO5-E
DO 6	Telefast DO14	DO6-E
DO 7	Telefast DO15	DO7-E
AO 1		
AO 2		
AO 3		
AO 4		
AO 5		

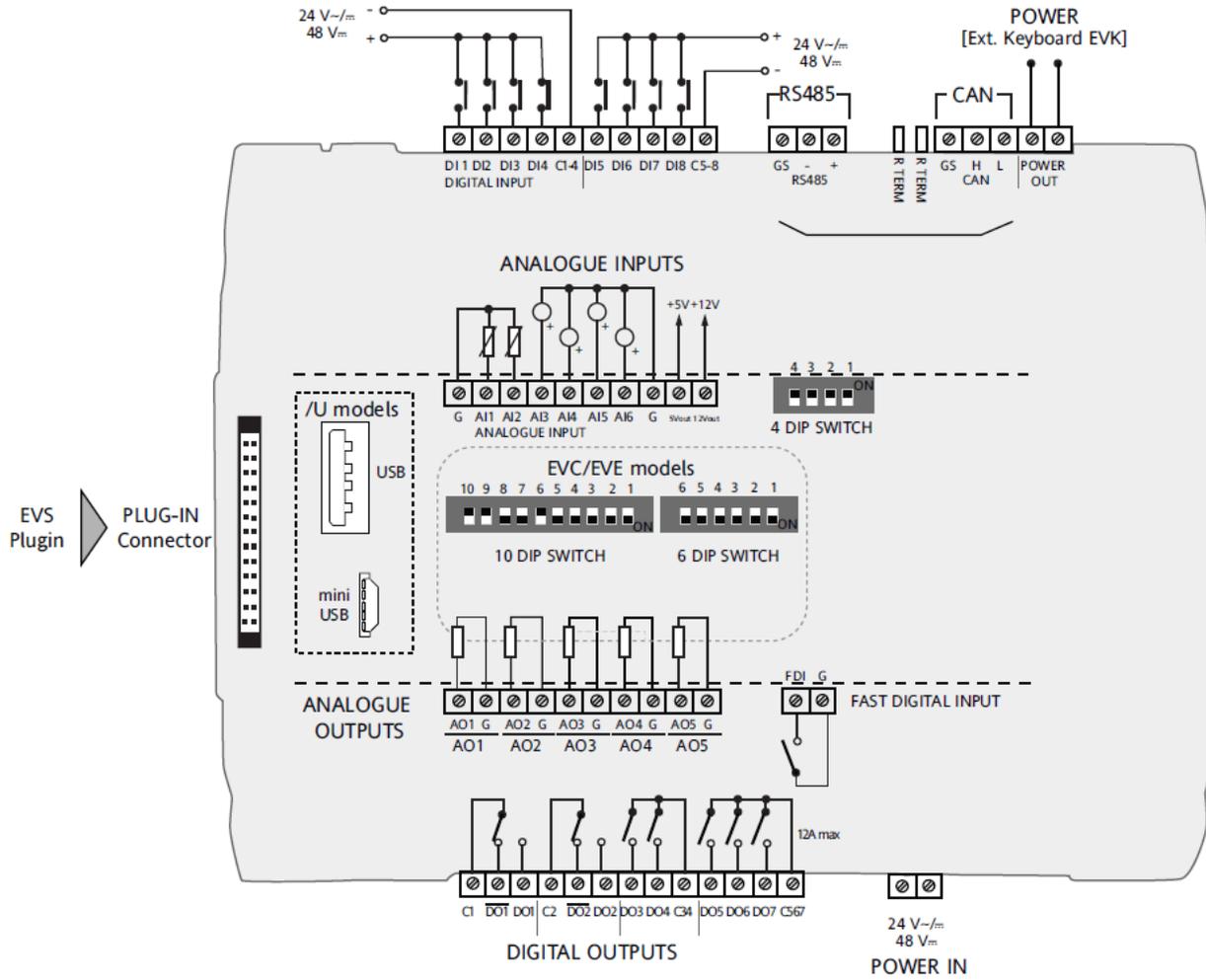
Wiring Diagram



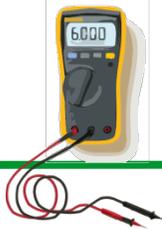
M171O
SMD5500/C/S



M171P
EVD7500/C/U



NTC probe, Type: 103AT/NTCNK103

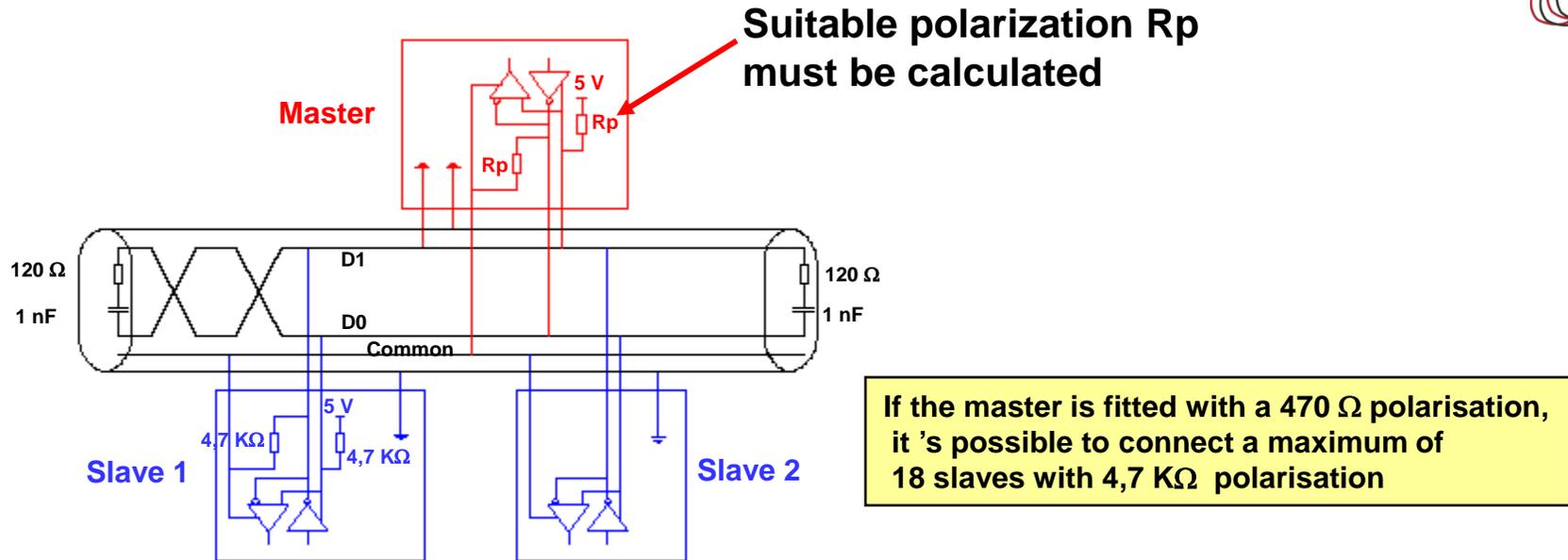


Temperature probes (*) 	SN691150	NTC 103AT probe, 1.5m (plastic cap, 2-wire cable)
	SN8DED11502C0	NTC103AT 5X20 1.5mt TPE IP68
	SN8DED13002C0	NTC103AT 5X20 3mt TPE IP68
	SN8DAD11502C0	NTC103AT 6X20 1.5mt TPE IP68
	SN8DAD13002C0	NTC103AT 6X20 3mt TPE IP68

	NTC* -50...+100°C	0/4...20 mA	0-10V	0-5V	0-1V	DI
Resolution	0.1°C	0.1	0.1	0.1	0.1	
Accuracy	1%	1% e.o.s. 1% f.s.	1% e.o.s. 1% f.s.	1% e.o.s. 1% f.s.	2% e.o.s. 2% f.s.	
Impedence		100Ohm	21KOhm	110KOhm	110KOhm	

	NTC* -50...+100°C	0/4...20 mA	0-10V	0-5V	0-1V	DI
AI1	✓	-	-	-	-	✓
AI2	✓	-	-	-	-	✓
AI3	✓	✓	✓	✓	✓	✓
AI4	✓	✓	✓	✓	✓	✓
AI5	✓	-	-	-	-	✓

Modbus RS485 standard schematic



Maximum length of bus	1000 m at 19200 bps
Maximum number of stations (without repeater)	At most 32 stations (depending on R_p and the number of 4,7 K Ω)
Maximum length of tap links	20 m for one tap link 40 m divided by the number of tap links
Bus polarisation	R_p should be validated by calculating the equivalent polarisation R_e according to the polarisation of the master and slave stations. R_e must be between 162 Ω and 650 Ω
Line terminator	120 Ω - 0,25Wm in series with 1nF 10V
Common polarity	Yes (Common) connected to the PG

Chapter 7

Connection to Smart

Goal:

DMI interface driver installation and connect to the target

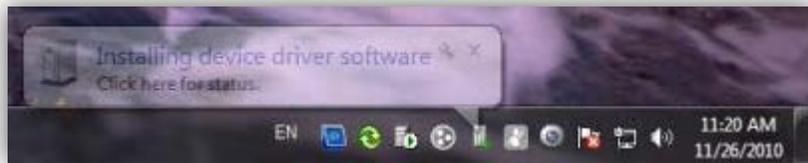


DMI interface setup WIN 7



- As soon as the DM interface is connected, the Windows 7 operating system recognizes the newly connected hardware. The steps to be followed are described below.

1. Once the hardware is connected, the message shown in the figure will appear:

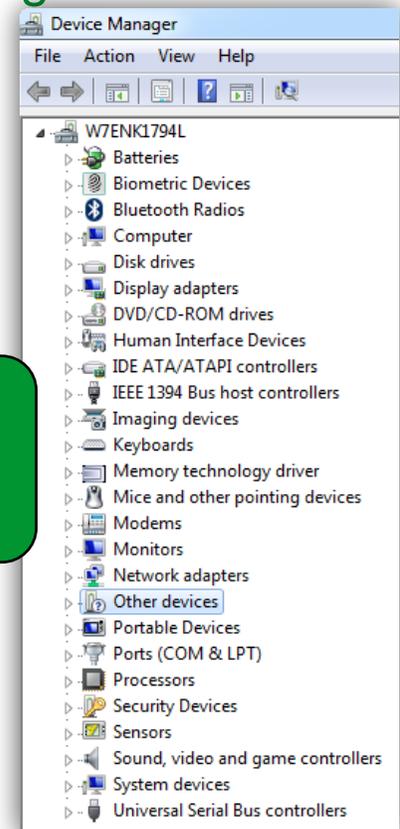


Click on the message to start the Guided installation procedure
Or you can manually find it at:

**Note: Connection procedure:
Connection: first USB then TTL
Disconnection: first TTL then USB**

Control Panel ► All Control Panel Items ► System

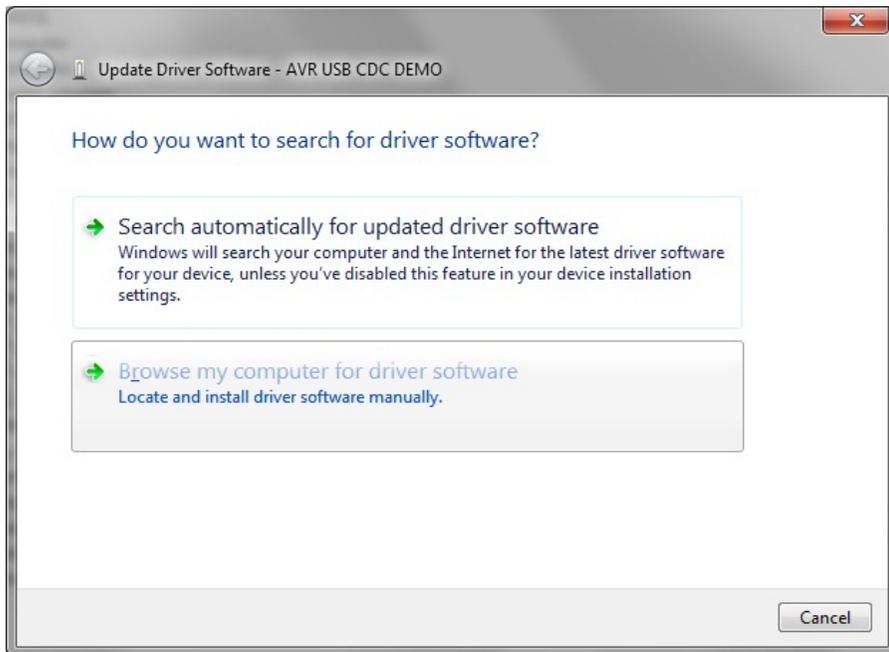
Device manager ► other devices ►



Update driver software



2. The screen shown below will appear: select the second option to identify the driver

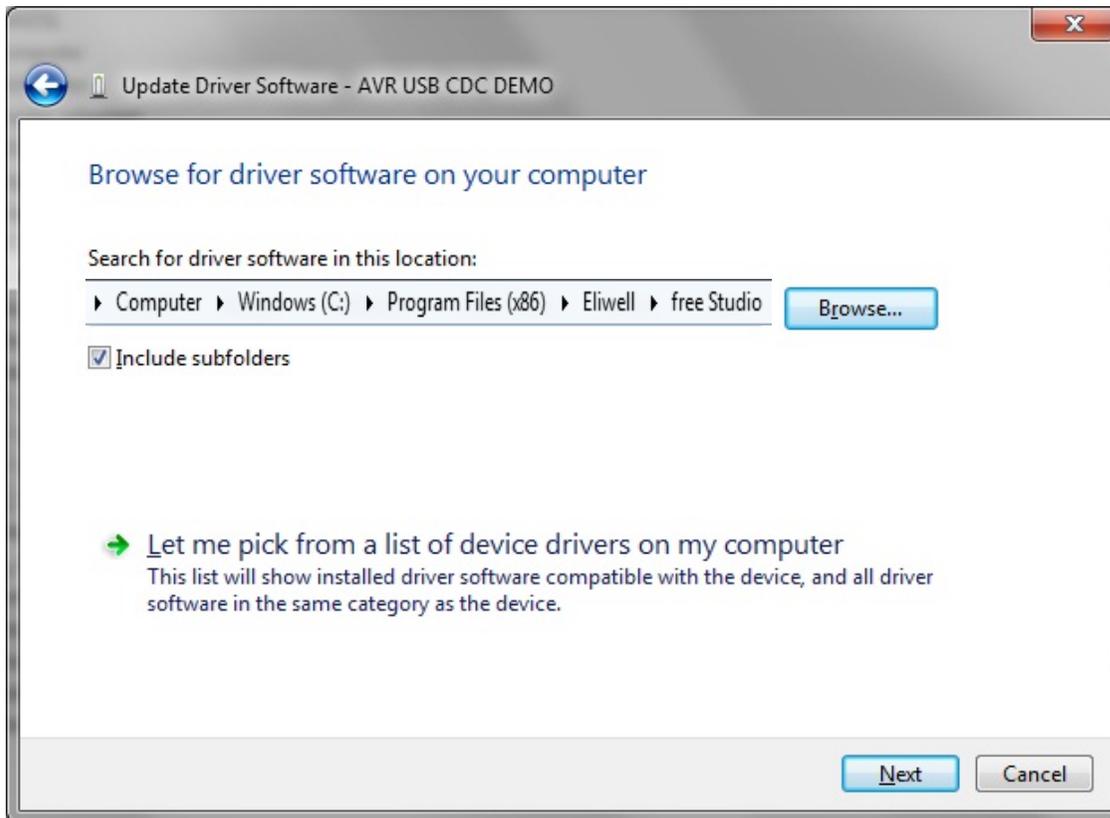


3. In the next screen, select the installation path for the FREE Studio program. Unless changed during installation, the path will be as shown in the next figure.

Update driver software



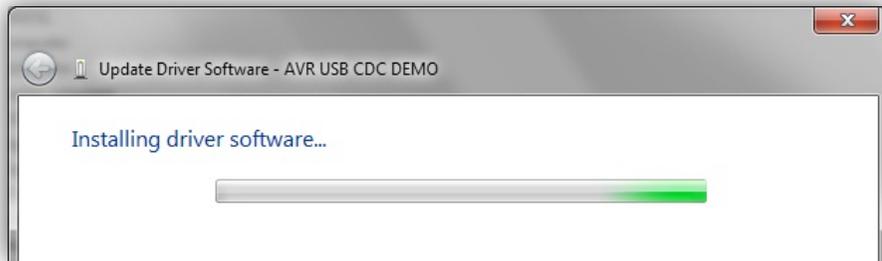
4. Once you have selected the correct path, the screen shown below will appear: select **Install this driver software anyway**



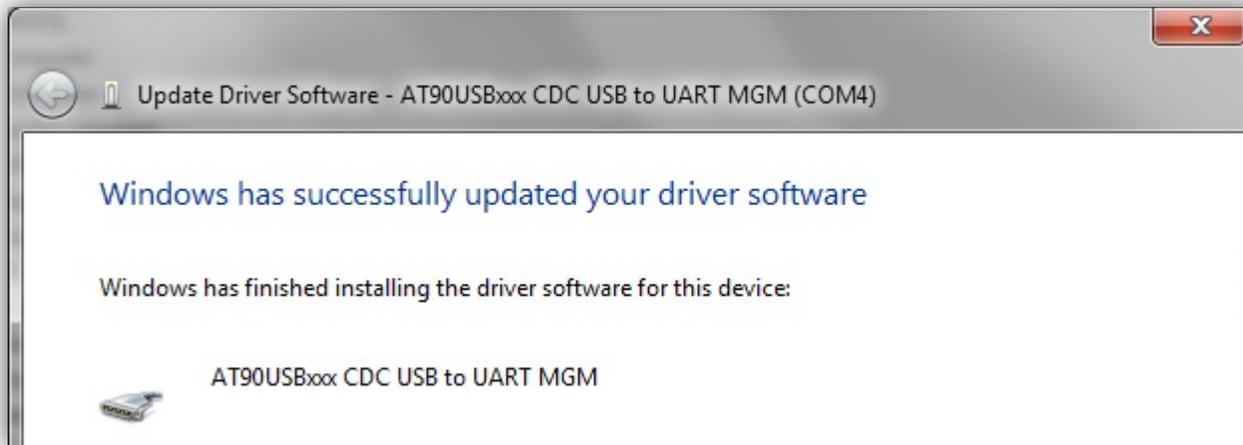
Update driver software



5. The screen shown below will appear, indicating that the action has been performed.



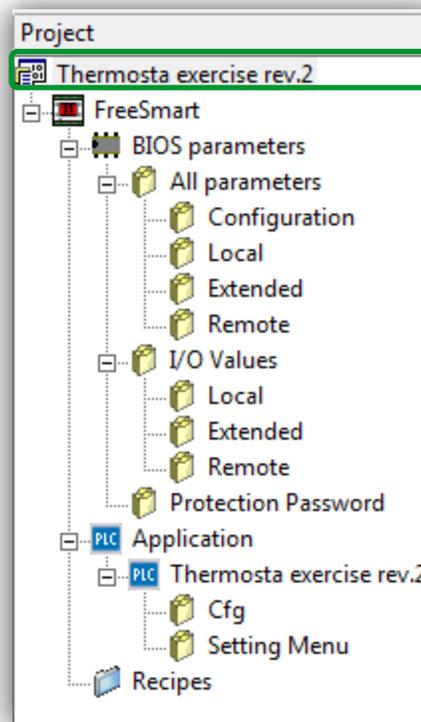
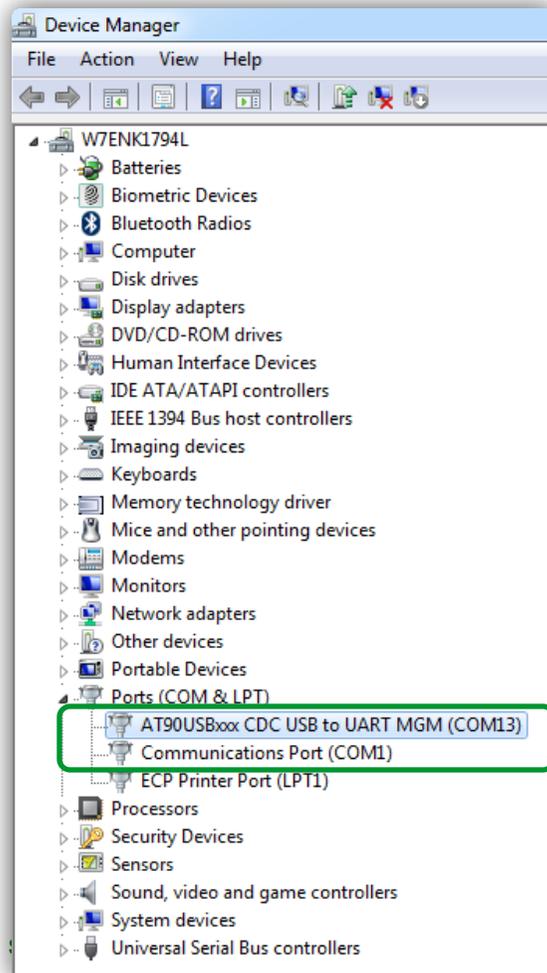
6. On completion of the process, the screen shown below will appear, then close.



DMI Test via FS Device



To check correct installation of the driver and the port to which the hardware has been allocated, check the Windows screens shown below:



Project Thermosta exercise rev.2.CFN

Most recent projects

- C:\Electrical\Solution Architect\Eliwell\Exercise\Thermostat Exercise\rev.2\Thermosta exercise rev.2.CFN
- C:\Users\SESA94552\Thermostat New\Thermostat New.CFN
- C:\Users\SESA94552\Thermostat\Thermostat.CFN

Add new device to project		
	FreeEvolution EVD	423
	FreeEvolution EVC	477
	Keyboard EVK	476
	FreeEvolution EVP	489
	Expansion EVE	460
	FreeSmart	412
	FreeSmart Modbus Master	542

Default Address range is between 1 to 5

Network scan

Advanced <<

Protocol: EwDMI
Modbus
EwDMI
ModbusTCP
CANopen

Port: COM 13

Baud range: 9600 57600

Address range: 1 1

Line conf: E,8,1

Start Scan Stop Scan

Device	Version	Application	Version	Address	Baud rate
--------	---------	-------------	---------	---------	-----------

Connection to Smart



Smart

Preliminary operations

In order to download the application correctly:

1. connect the DMI hardware interface to the PC.
2. Make sure that the driver is installed

Press Settings

The COM port must previously have been read/set in “Peripherals Management” (see Reading the DMI interface COM port) to be recognized. If there are errors, refer to the paragraph “**DMI interface connection error**”.

* the COM settings must be set on all of the workspaces: Application, Device and User Interface

General

Name: FreeSmart
File version: 412.15

Communication

Protocol: EwDMI
Address: 1
Port: COM:5
Baud rate: 38400

Disable communication

Settings

Device Link Manager Config v10.0.28.0

Current selected protocol : EwDMI

Protocols	Active
CanOpen	
EwDMI	Active
GDB	
Modbus	
ModbusTCP	

Properties Activate

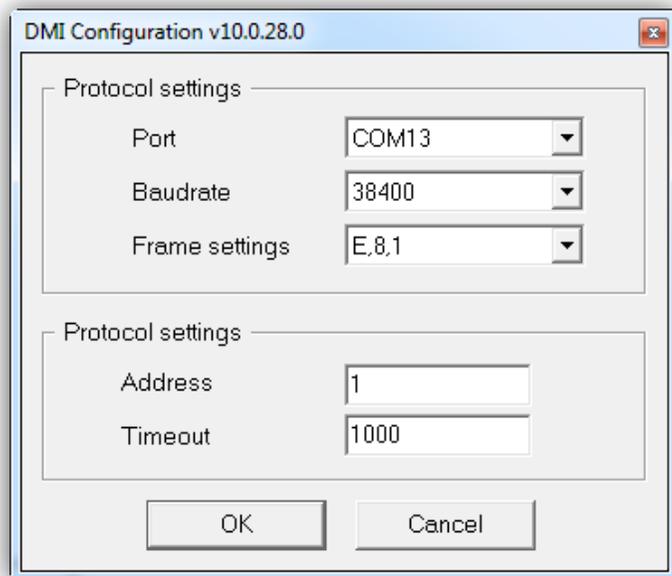
Description
Eliwell DMI

OK Cancel

Protocol Configuration



- For **Smart select EWDMI or Modbus***. If the protocol is not activated **press the Activate button**
- The value selected for the COM port will be saved and will reappear each time the program is accessed, until it is changed.
- The properties are visible and can be edited from the panel **Communication > Settings > Properties****



- * in the case of Modbus for /S models only with maximum speed 19200 baud. TTL not for use. **NOT POSSIBLE TO UPDATE the BIOS.**
- ** obviously, the protocol must be activated beforehand

Factory default configuration:

Address:1, Baud rate: 9600
E,8,1 (CF30=1, CF31=3, CF32=1)



De Connect to the target

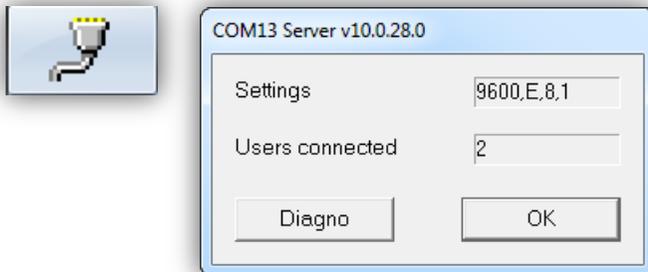
DMI interface connection error



Error opening serial port

If the “Error opening serial port” message appears, proceed as follows:

1. Check that the COM port setting in the program is the same as one read in the COM port reading by the DMI interface.
2. Check if Com Server is opened when you try to connect to Evolution. If not disconnect TTL cable, USB port and reconnect first USB and then TTL.



3. Repeat the DMI Detection function.

Target and Free Studio



Parameters needed for correct connection between the **Smart target and Free Studio.**

parameter	description	values	default	visibility	notes
CF30	Modbus protocol controller address	1...255	1	3	Check that the set values correspond to those defined by the panel Communication > Settings > Properties
CF31**	Modbus protocol baud rate	0,1, 2 = not used 3 = 9600 baud 4 = 19200 baud 5 = 38400 baud 6 = 57600 baud 7 = 115200 baud	3	3	
CF32	Modbus protocol controller parity	1 = EVEN 2 = NONE 3 = ODD	1	3	
*COM1 = TTL / RS485 (/S models only): cannot be used simultaneously					
**CF31			5=38400 baud (RS485: not supported) 6=57600 baud (RS485: non supported) 7=115200 baud (RS485: non supported)		

Customize Smart Baud Rate



Smart parameters in the CF folder manages the connection between the target and Studio
If the target is “empty”, i.e. there is no IEC application on the device, Smart will display the message FrEE, otherwise fundamental state is displayed (Press F5 to switch to FrEE menu)



To view the parameter menu, press the Esc and Set keys at the same time. This will open the PAr menu.



The parameters menu PAr contains all controller folders. Press the set key to view folders.



The first folder shown is the CF configuration folder. Press the set key to view the folder parameters.



The first parameter shown is CF30. To view the value of the parameter press the set key.

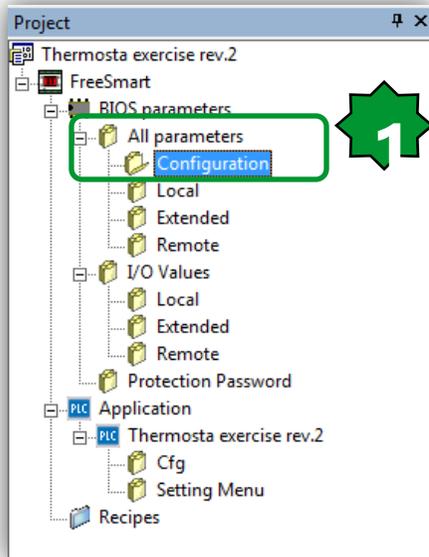


Use the UP and DOWN keys to change the value if necessary. To confirm the value press the set key. To exit press Esc



Use the UP and DOWN keys to scroll the other parameters and repeat the procedure to view the values and - if necessary - edit them.

Customize Smart Baud Rate by FS Device



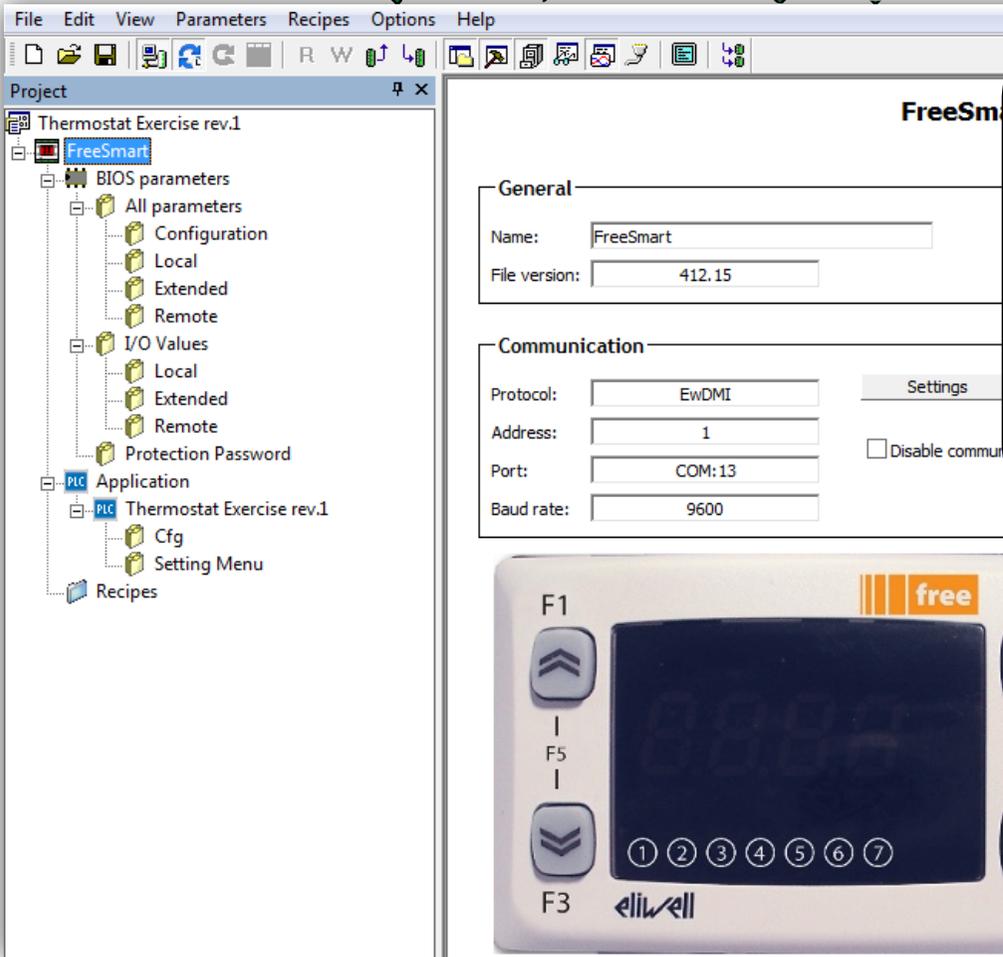
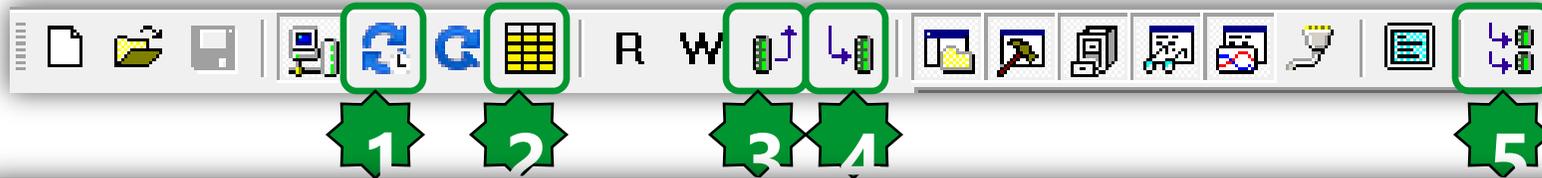
Only After Connection has been established:

1. Project ► BIOS parameters ► All parameters ► Configuration
2. CF31 editing ► 38400 bits/Sec.

Protocol parameters are loaded at power up, remember to switch off controller after changing them.

Configuration							
Address	Name	Value	Um	Default	Min	Max	Description
53265	CF01	1	num	1	0	1	Select COM1 protocol
53272	CF20	0	num	0	0	14	Eliwell protocol controller address
53273	CF21	0	num	0	0	14	Eliwell protocol controller family
53274	CF30	1	num	1	1	255	Modbus protocol controller address
53275	CF31	5=38400	num	3=9600	0	7	Modbus baud rate protocol
53276	CF32	1=2400 2=4800	num	1=Even	1	3	Modbus parity protocol
15639	CF60	3=9600	num	0	0	999	Customer code 1
15640	CF61	4=19200	num	0	0	999	Customer code 2
53456	CF50	5=38400	num	1=Present	0	1	RTC present
15715	Ui26	6=57600 7=115200	4ms	350	0	999	Key hold time to enable function
15744	Ui27	1	num	1	0	255	Installation engineer password
15745	Ui28	2	num	2	0	255	Manufacturer password
15636	Par_POLI	1026	num	0	0	65535	Polycarbonate code

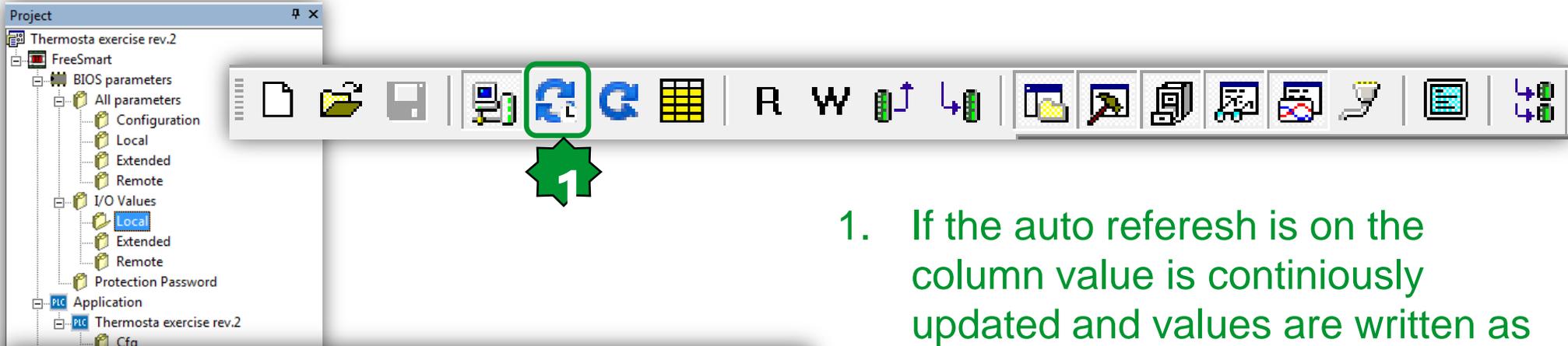
Free Studio Device - Main icons



1. Continuous read/write by toggle auto refresh mode. As soon as value changes, it will automatically aligne with the target.
2. Select all variables
3. Read all device parameters
4. Write all device parameter
5. Download all (PLC & parameter)
6. It is possible to check the firmware version via information.



Free Studio Device - Colors



Local							
Address	Name	Value	Um	Default	Min	Max	
8336	AIL1	0.0		0.0			AIL1 analogue input
8337	AIL2	0.0		0.0			AIL2 analogue input
8338	AIL3	0.0		0.0			AIL3 analogue input
8339	AIL4	0.0		0.0			AIL4 analogue input
8340	AIL5	0.0		0.0			AIL5 analogue input
8192	DIL1	False		False			DIL1 digital input
8193	DIL2	False		False			DIL2 digital input
8194	DIL3	False		False			DIL3 digital input
8195	DIL4	False		False			DIL4 digital input
8196	DIL5	False		False			DIL5 digital input
8197	DIL6	False		False			DIL6 digital input
8528	DOL1	False		False			DOL1 digital output
8529	DOL2	False		False			DOL2 digital output
8530	DOL3	False		False			DOL3 digital output
8531	DOL4	False		False			DOL4 digital output
8532	DOL5	False		False			DOL5 digital output
8533	DOL6	False		False			DOL6 digital output
8448	AOL1	0.0		0.0			AOL1 analogue output
8449	AOL2	0.0		0.0			AOL2 analogue output
8450	AOL3	0.0		0.0			AOL3 analogue output
8451	AOL4	0.0		0.0			AOL4 analogue output
8452	AOL5	0.0		0.0			AOL5 analogue output
8453	TCL1	0.0		0.0			TCL1 analogue output

1. If the auto refresh is on the column value is continuously updated and values are written as soon as you change them.

Color meanings:

Red: not aligned with the target

Grey: read only data

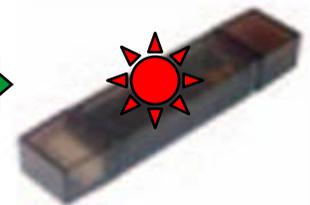
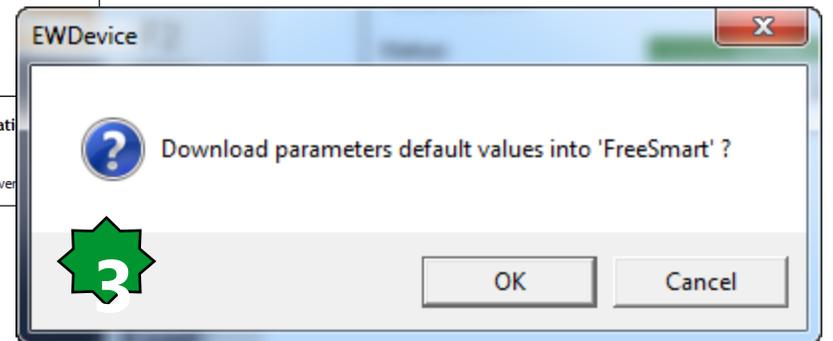
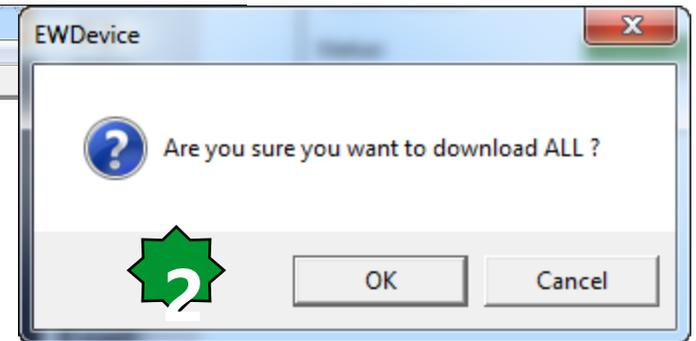
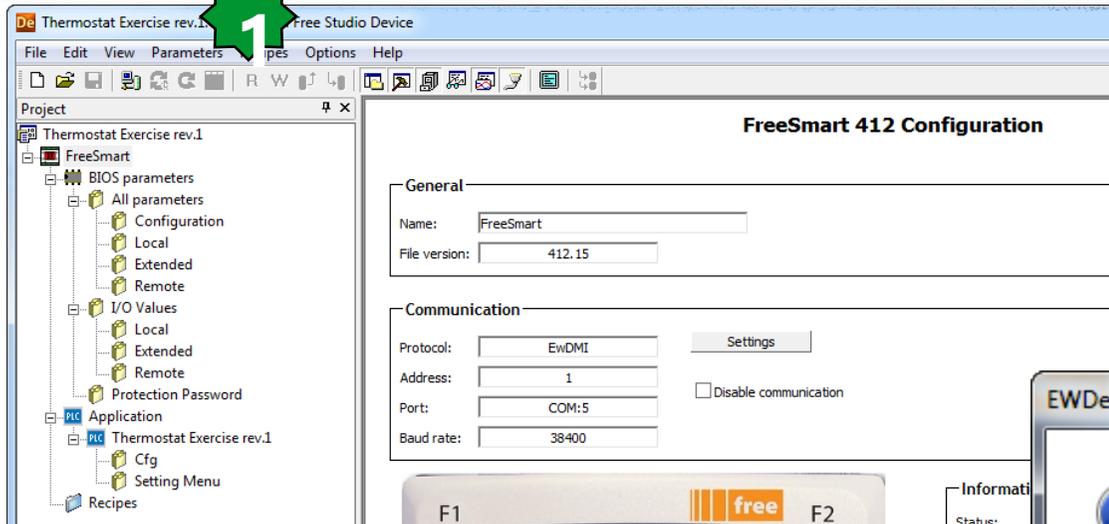
Blue: value is different from default

Green: data is not visible in the target

Black: aligned with the target

(if auto refresh is enabled) 

Connect to the target and Download All



- 1. Connect
- 2. Download All
- 3. Write the default parameter values
- 4. DMI Blink: Communicating

Editing value



1. Be sure to be Connected
2. Set or change the value (Red, not applied)
3. Write the parameter (Black, applied)



CONNECTED



Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	21.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	22.9	°C			

Setting Menu



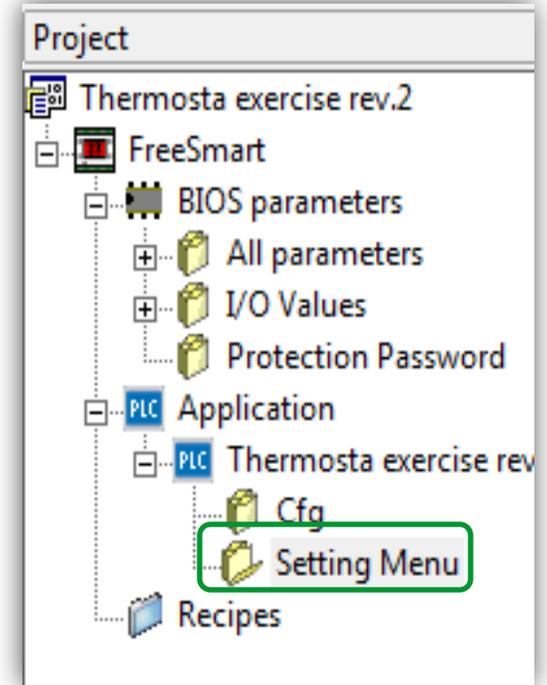
Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	23.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	22.9	°C			

Setting Menu



Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	23.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	26.3	°C			

Setting Menu

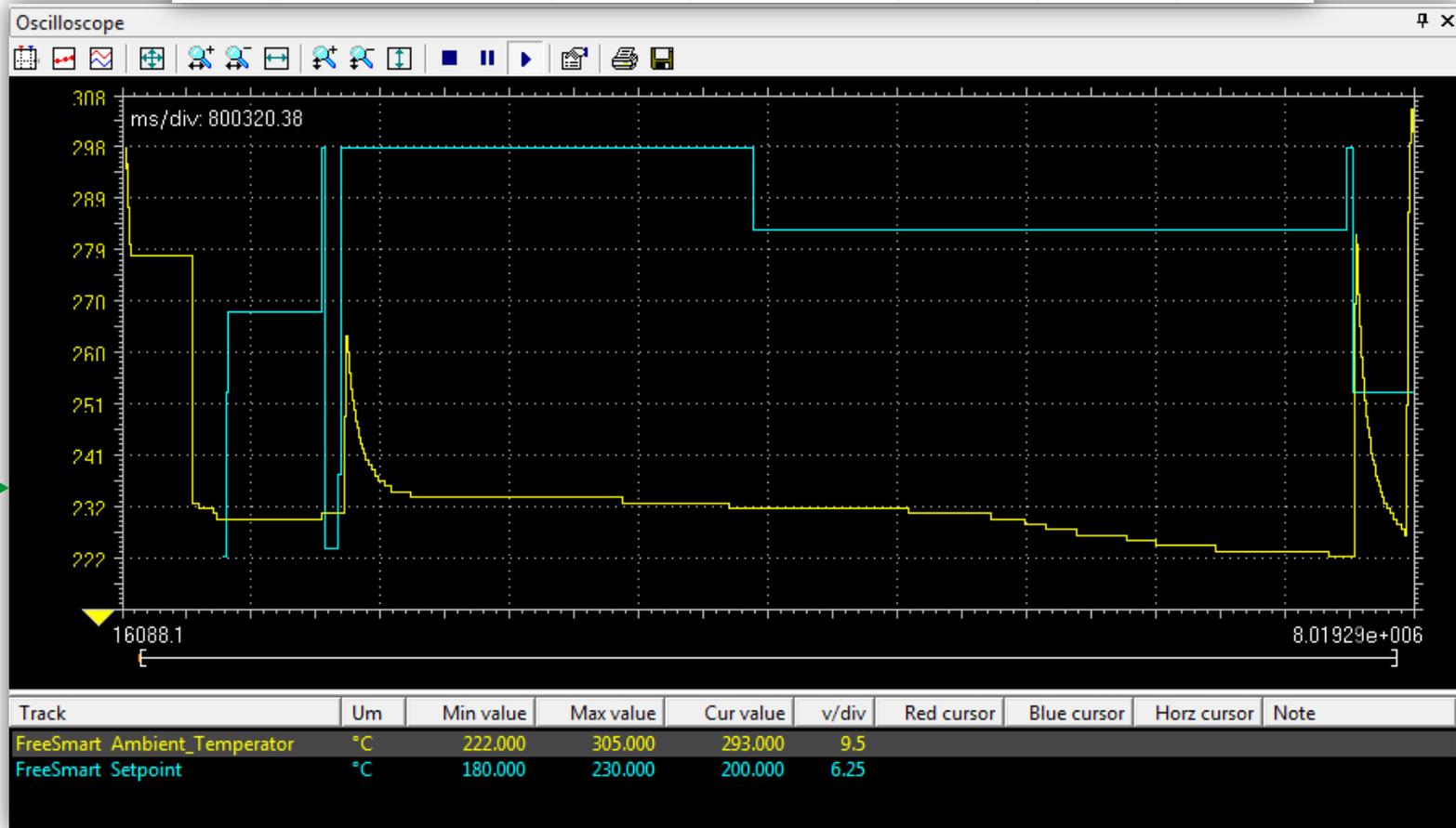


Oscilloscope

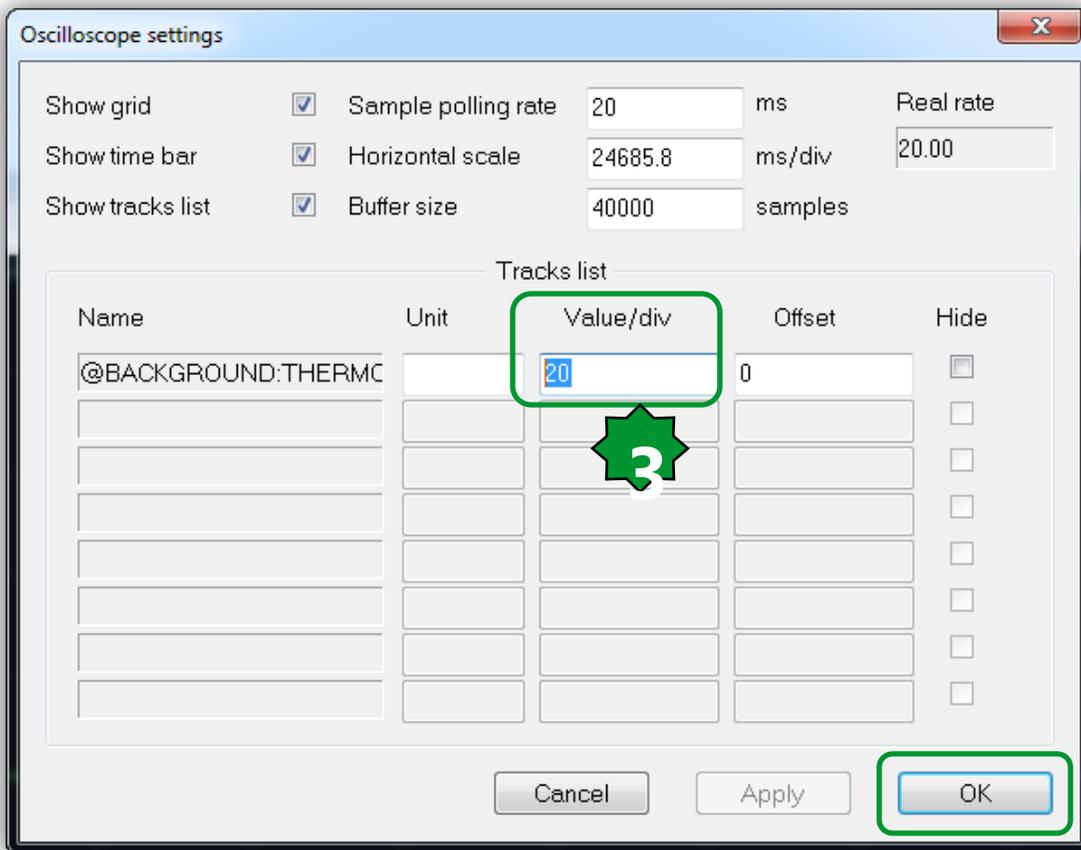


Drag & Drop

Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	20.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	23.1	°C			



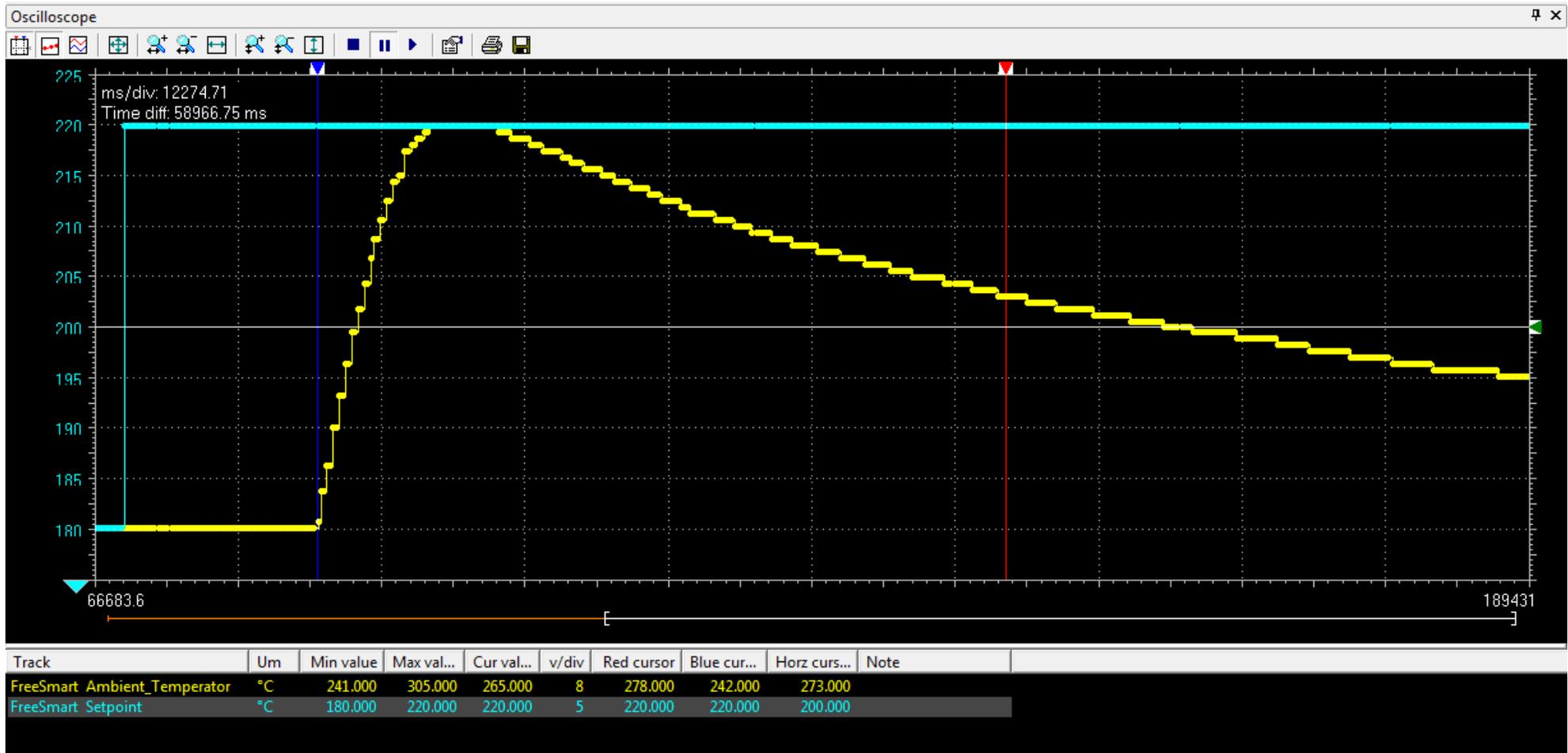
Oscilloscope



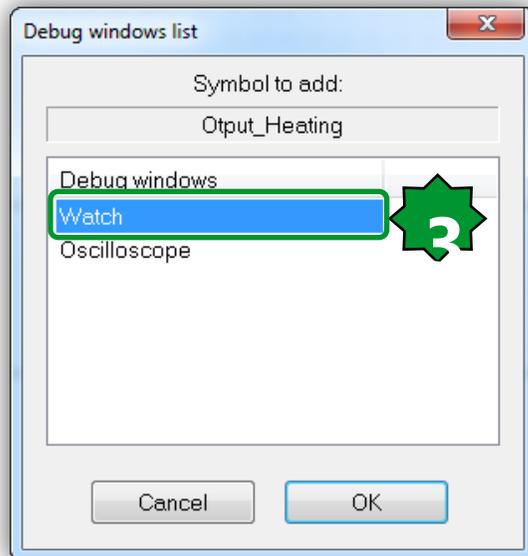
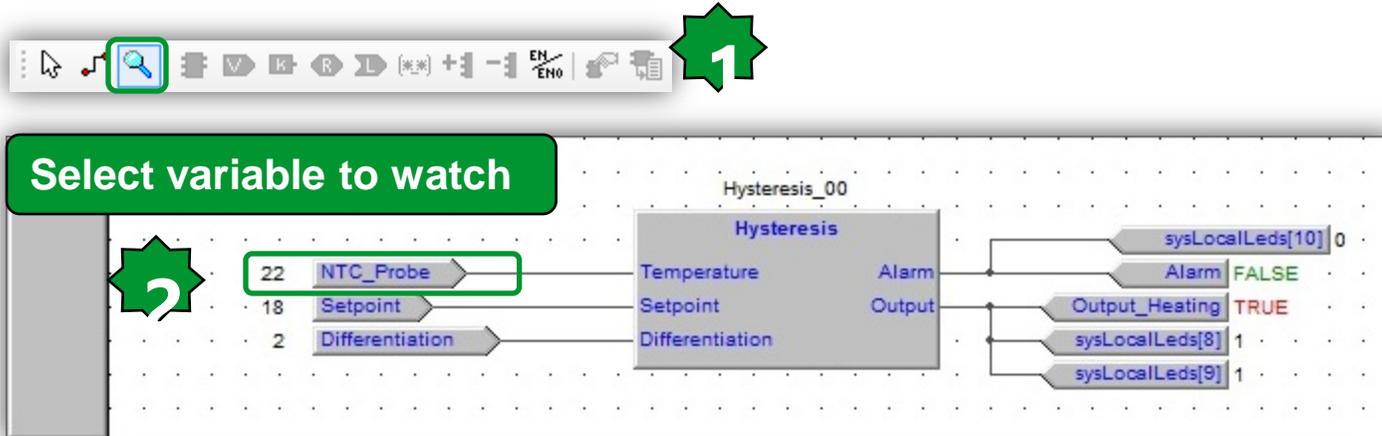
1. Show all values
2. Graph properties
3. Value/div=20 ► OK
4. Vertical split



Oscilloscope



Debug on-line/Watch



Symbol	Value	Type	Location
NTC_PROBE	22	INT	global
OUTPUT_HEATING	TRUE	BOOL	global
ALARM	FALSE	BOOL	global
SETPOINT	18	INT	@BACKGROUND:THERMOSTAT
DIFFERENTIATION	2	INT	@BACKGROUND:THERMOSTAT

Chapter 8

Target conversion and code import

Goal:

Reuse of existing code and libraries



Converted project from Smart to Evolution



FreeEvolution Configuration

Execution time

Set execution time:

Execution time (ms):

Data export

Select XSLT export filter:

Output

```
Preprocessing module TARGET completed.
Preprocessing module MAIN completed.
Preprocessing Global shared completed.
Preprocessing Menu completed.
Preprocessing basic completed.

0 warnings, 0 errors.
```

Library

<input checked="" type="checkbox"/> ABS	<input checked="" type="checkbox"/> COSH	<input checked="" type="checkbox"/> LN	<input checked="" type="checkbox"/> NOT	<input checked="" type="checkbox"/> SHR
<input checked="" type="checkbox"/> ACOS	<input checked="" type="checkbox"/> DIV	<input checked="" type="checkbox"/> LOG	<input checked="" type="checkbox"/> OR	<input checked="" type="checkbox"/> SIN
<input checked="" type="checkbox"/> ADD	<input checked="" type="checkbox"/> EQ	<input checked="" type="checkbox"/> LT	<input checked="" type="checkbox"/> POW	<input checked="" type="checkbox"/> SINH
<input checked="" type="checkbox"/> AND	<input checked="" type="checkbox"/> EXP	<input checked="" type="checkbox"/> MAX	<input checked="" type="checkbox"/> R	<input checked="" type="checkbox"/> SIZEC
<input checked="" type="checkbox"/> ASIN	<input checked="" type="checkbox"/> FLOOR	<input checked="" type="checkbox"/> MIN	<input checked="" type="checkbox"/> RET	<input checked="" type="checkbox"/> SQRT
<input checked="" type="checkbox"/> ATAN	<input checked="" type="checkbox"/> GE	<input checked="" type="checkbox"/> MOD	<input checked="" type="checkbox"/> ROL	<input checked="" type="checkbox"/> SUB
<input checked="" type="checkbox"/> ATAN2	<input checked="" type="checkbox"/> GT	<input checked="" type="checkbox"/> MOVE	<input checked="" type="checkbox"/> ROR	<input checked="" type="checkbox"/> TAN
<input checked="" type="checkbox"/> CEIL	<input checked="" type="checkbox"/> JMP	<input checked="" type="checkbox"/> MUL	<input checked="" type="checkbox"/> S	<input checked="" type="checkbox"/> TANH
<input checked="" type="checkbox"/> COS	<input checked="" type="checkbox"/> LE	<input checked="" type="checkbox"/> MUX	<input checked="" type="checkbox"/> SEL	<input checked="" type="checkbox"/> TO_BI
	<input checked="" type="checkbox"/> LIMIT	<input checked="" type="checkbox"/> NE	<input checked="" type="checkbox"/> SHL	<input checked="" type="checkbox"/> TO_D

Oscilloscope

Track

Um	Min value	Max value	Cur value	v/div	Red cursor
----	-----------	-----------	-----------	-------	------------

Ready

EDIT MODE

NOT CONNECTED

Import Objects from library (or Project)

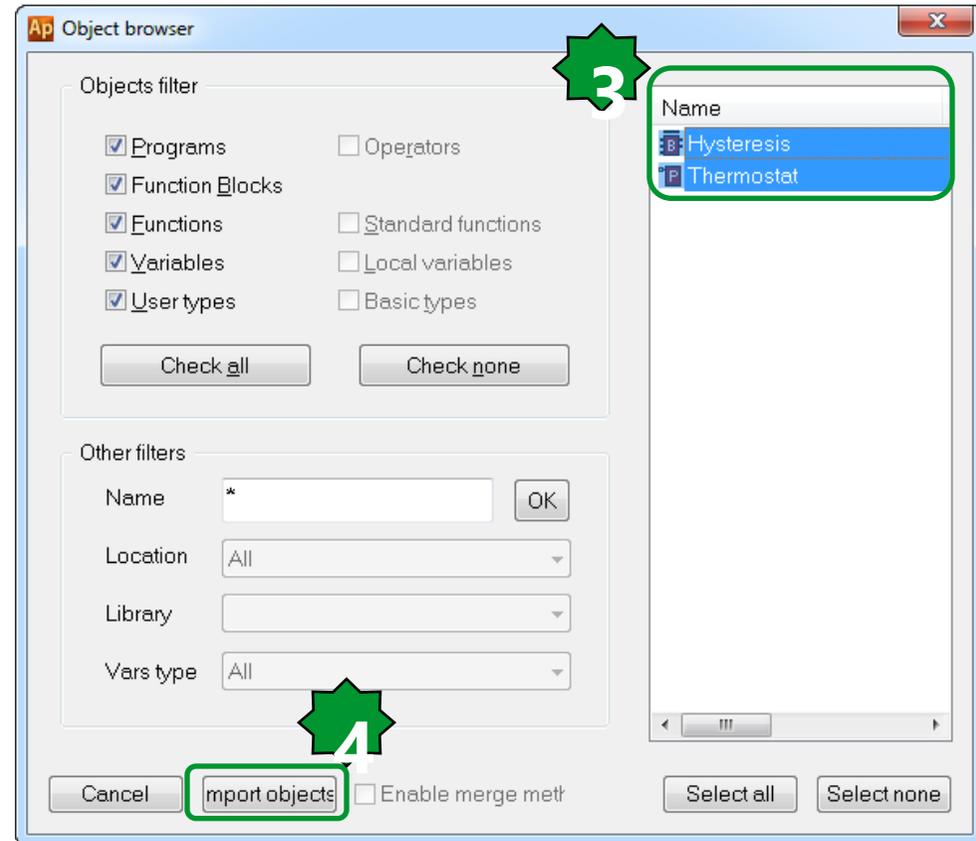
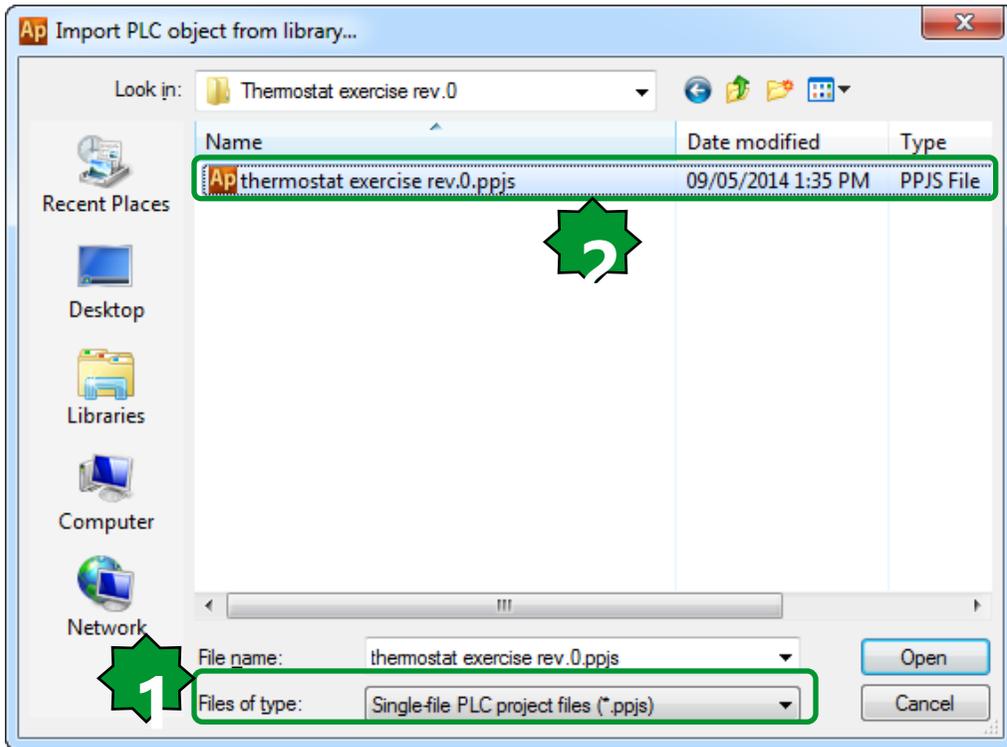


The screenshot displays the Schneider Electric software interface. The 'Project' menu is open, showing options such as 'New object', 'Copy Object', 'Paste object', 'Duplicate object', 'Delete object', 'PLC Object properties', 'Object Browser', 'Compile', 'Recompile all', 'Generate redistributable source module', 'Import object from library' (highlighted), 'Export object to library', 'Library manager', 'Refresh all libraries', 'Macros', 'Select target...', 'Refresh current target', and 'Options...'. The background shows a PLC device with a screen displaying 'free' and a 'FreeEvolution Configuration' panel with 'Execution time' and 'Data export' settings.

Both directions, upgrade & downgrade are possible, from:
Smart ► Evolution
Evolution ► Smart

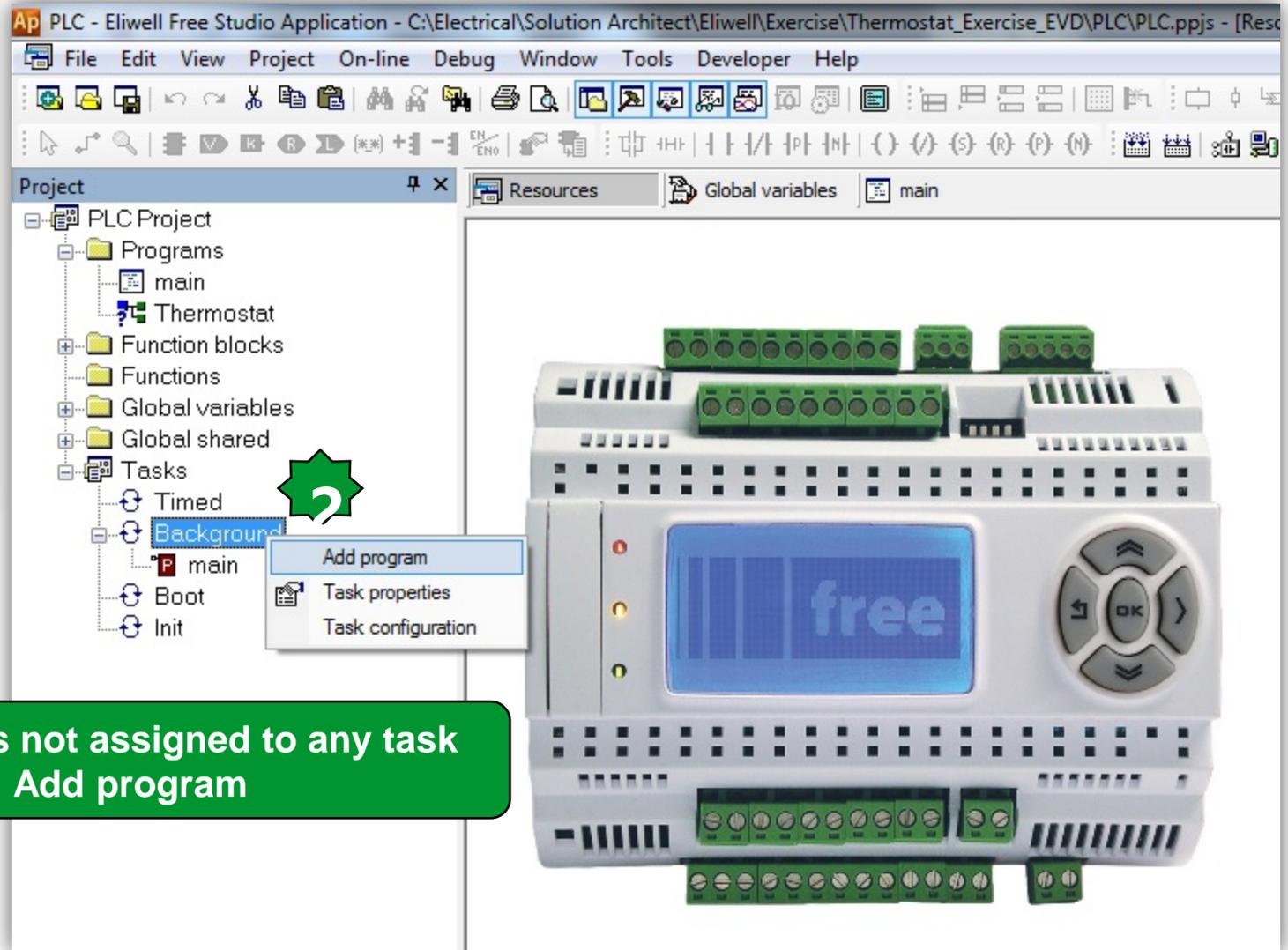
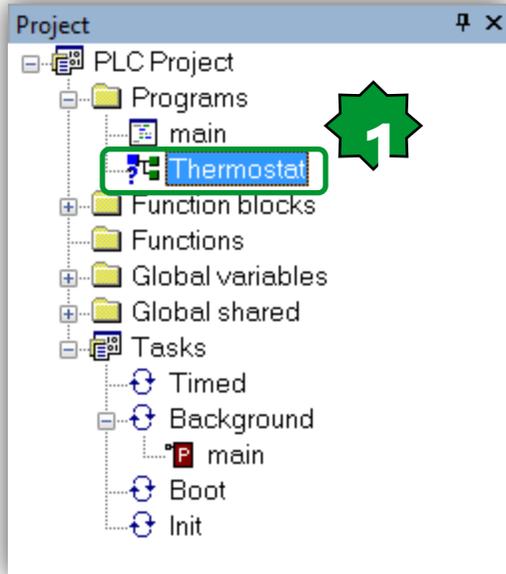
It allows also to import programs, FB, functions from other projects regardless the related target.

Import Objects from Project...



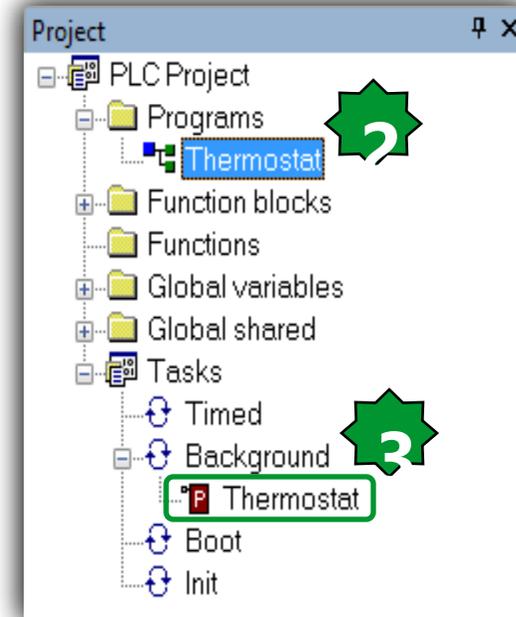
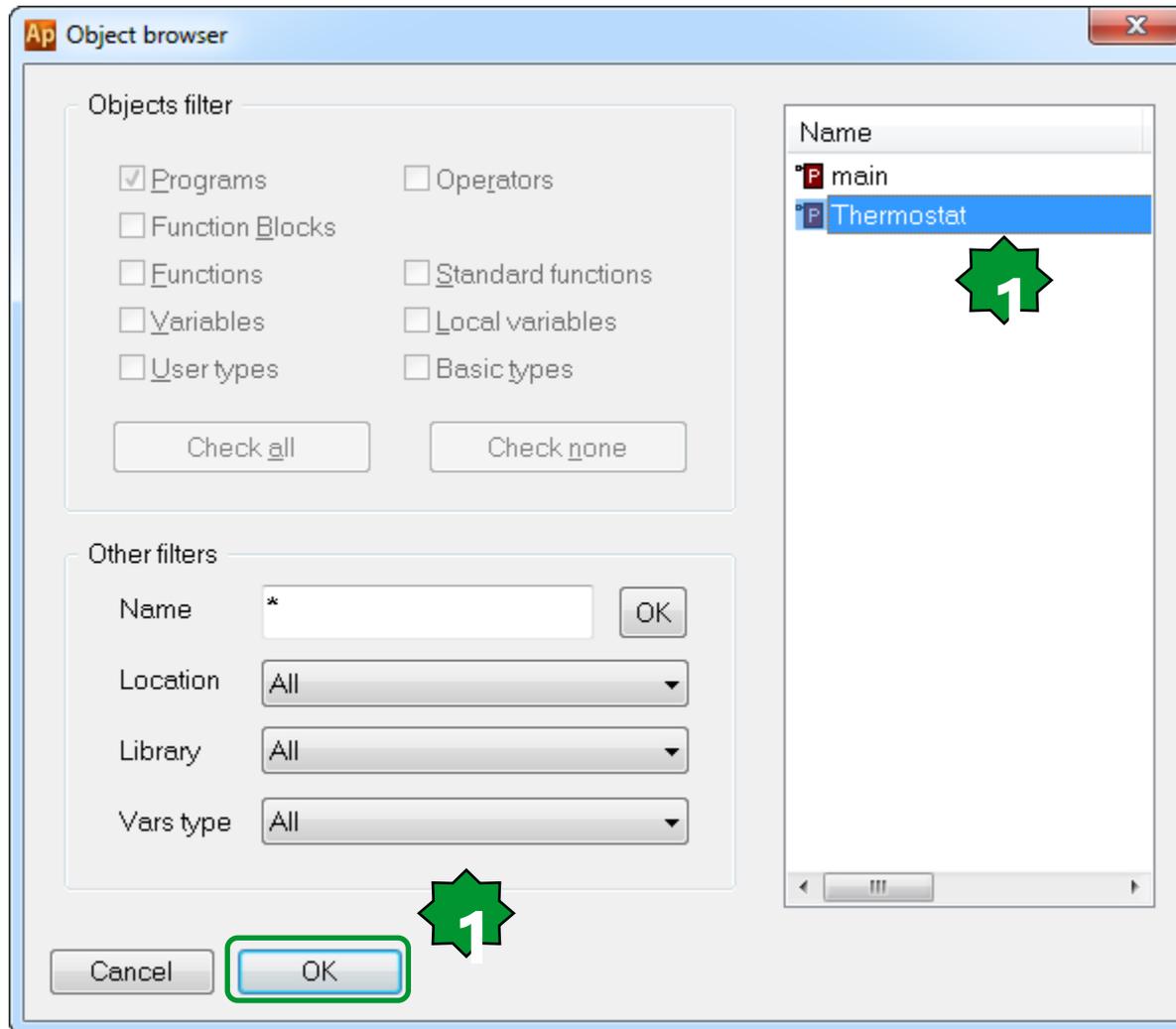
1. Select *.ppjs file type
2. Select desired project (Smart)
3. Select desired program & FBD
4. Import Objects

...Assign to Task (in case of program)



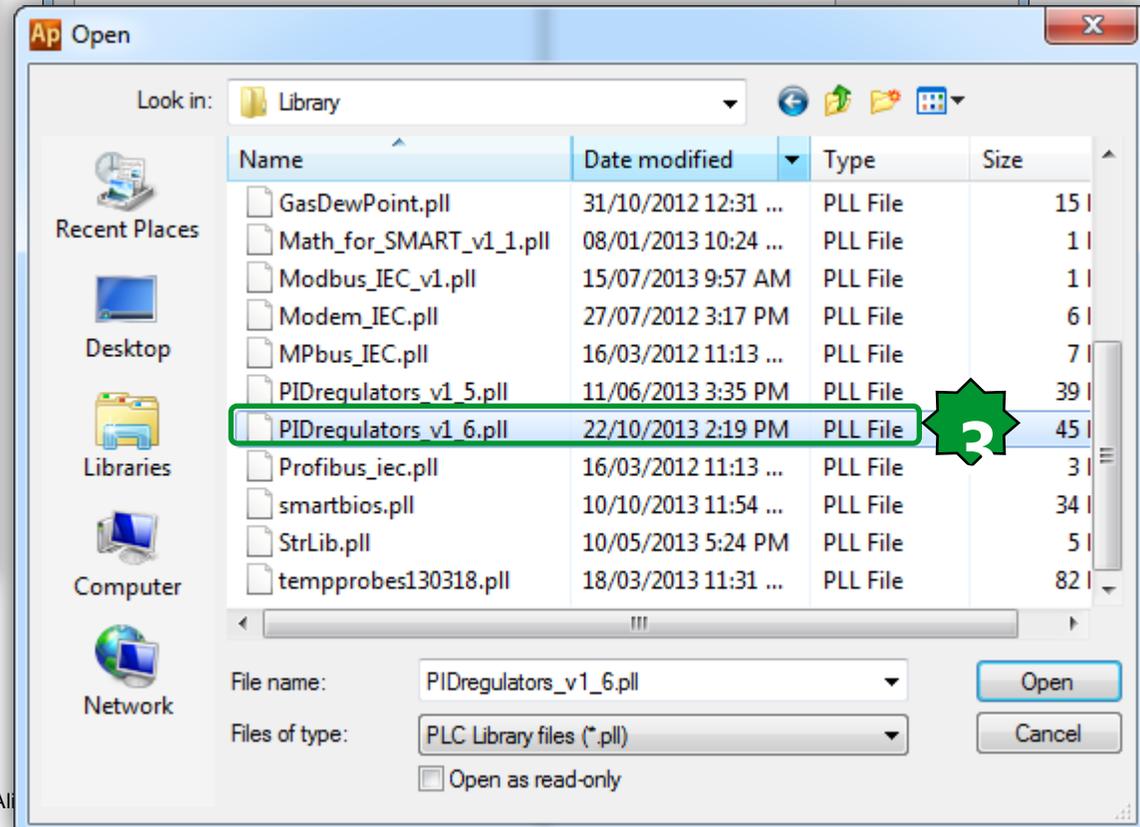
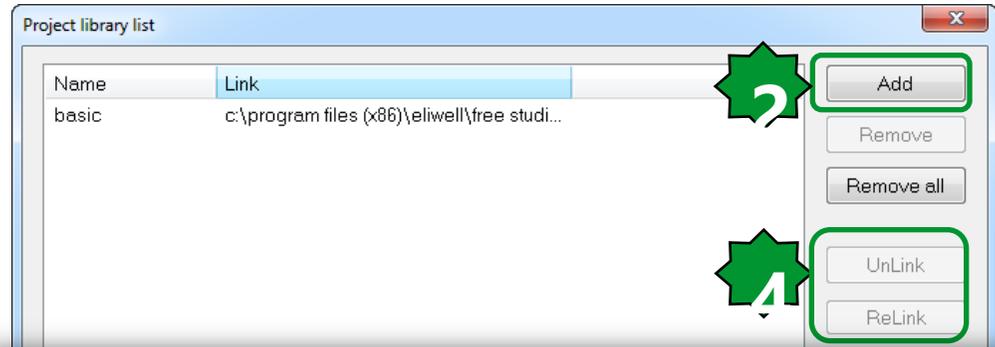
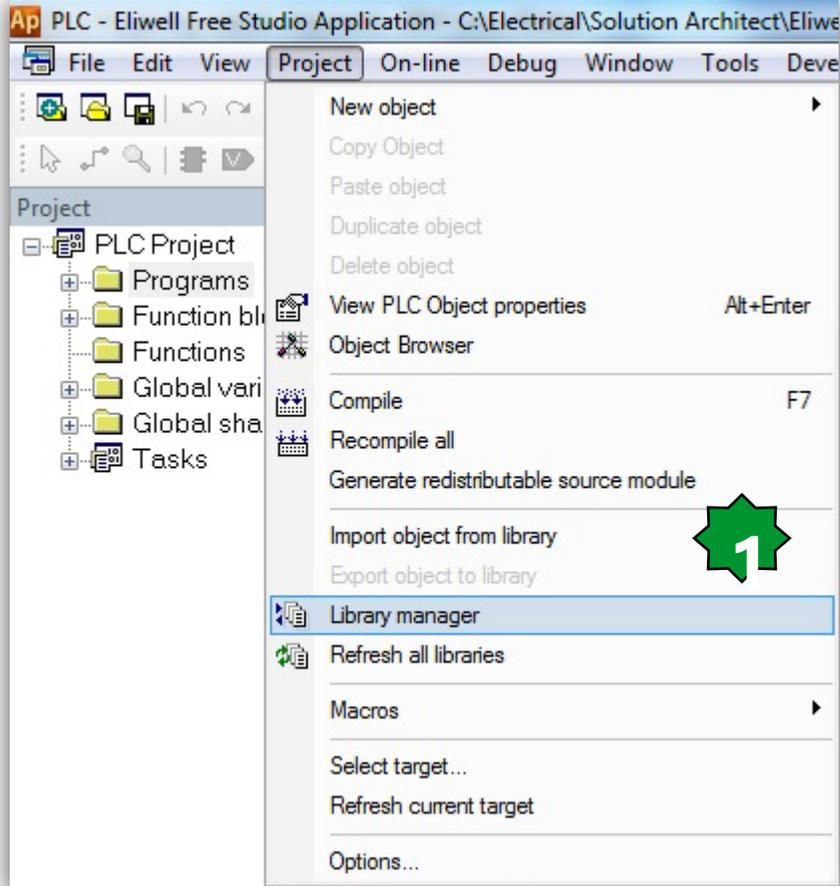
- 1. ? Means that program is not assigned to any task
- 2. Tasks ► Background ► Add program

Assigning imported program to the task



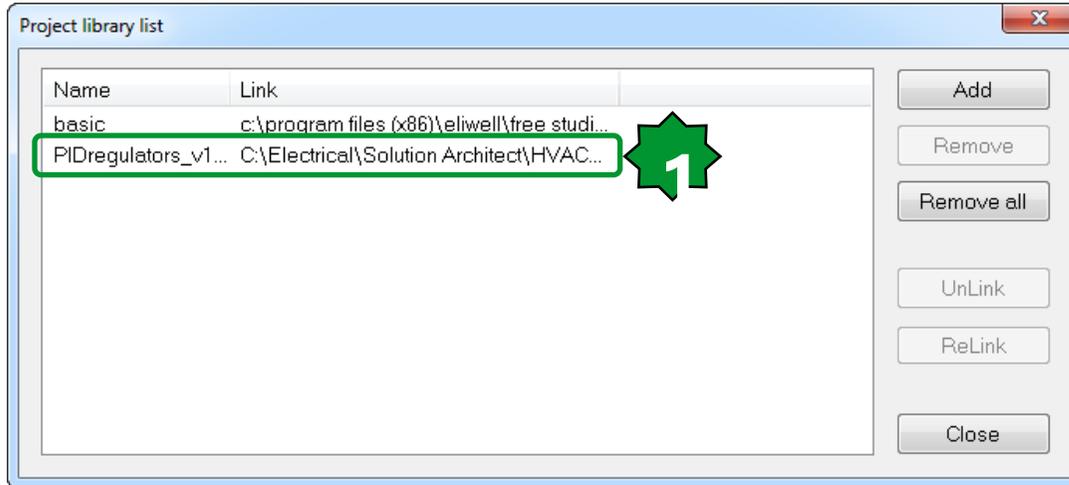
1. Select the desired program name ► OK
2. The ? Disapeares in prgrams
3. It will assign to to desired task (delete non-required programmes)

Link libraries...



1. Project ► Library Manager
2. Project Library list
3. add/remove
4. Unlink/Relink

...Link Libraries

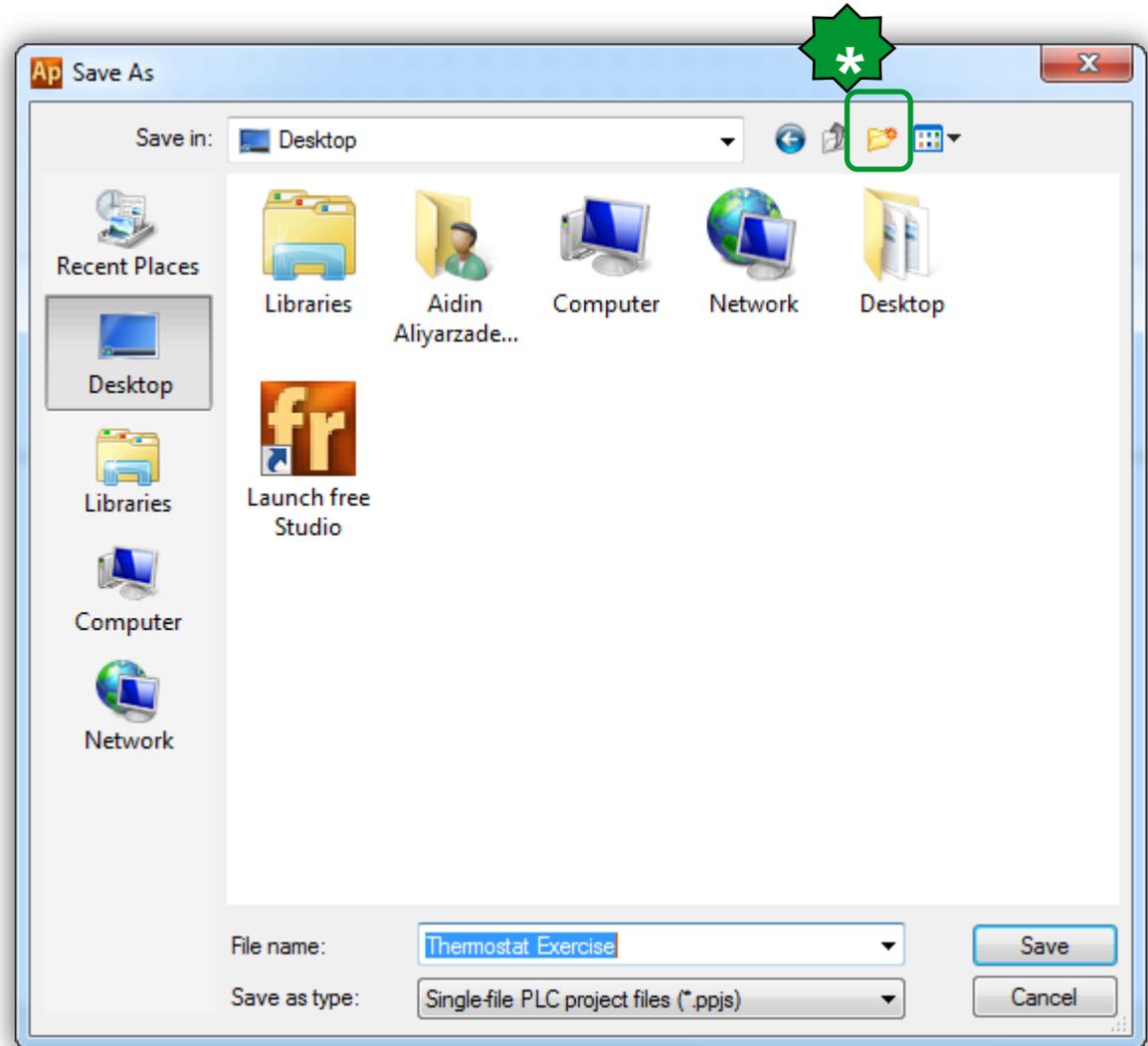


Save a project as:



File ► save a project as :

* Create a folder for the project before saving



Chapter 9

Methodology:

Goal:

Navigation between the SW, application, device, connection & familiarizing with their abilities



Free studio/unique programming software



In Unique software suite for Smart and Evolution



The screenshot displays the Free Studio software interface. On the left, there is a project tree and a table of parameters. The central area shows a graphical ladder logic diagram. On the right, there is a 'FreeEvolution 423 Configuration' dialog box with various settings. In the center, there is a logo with the letters 'fr' and a blue arrow pointing to the text 'Launch free Studio'.



Smart



Evolution



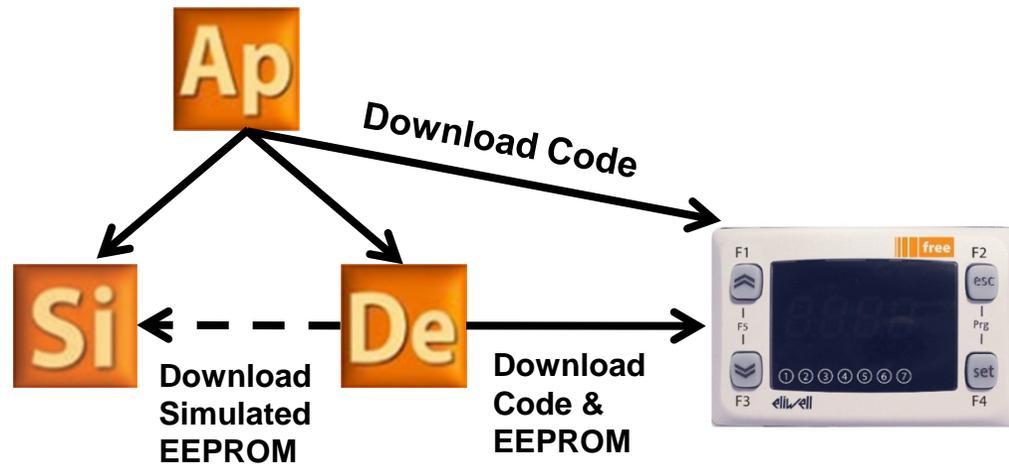
Software suite presentation

M171P + M171O		M171P	
icon (link)	description	icon (link)	description
	Application development tool for Smart & Evolution		Connection development tool for Evolution
	Device development tool for Smart & Evolution		User Interface development tool for Evolution
	Simulation development tool for Smart & Evolution		

Smart Project Architecture



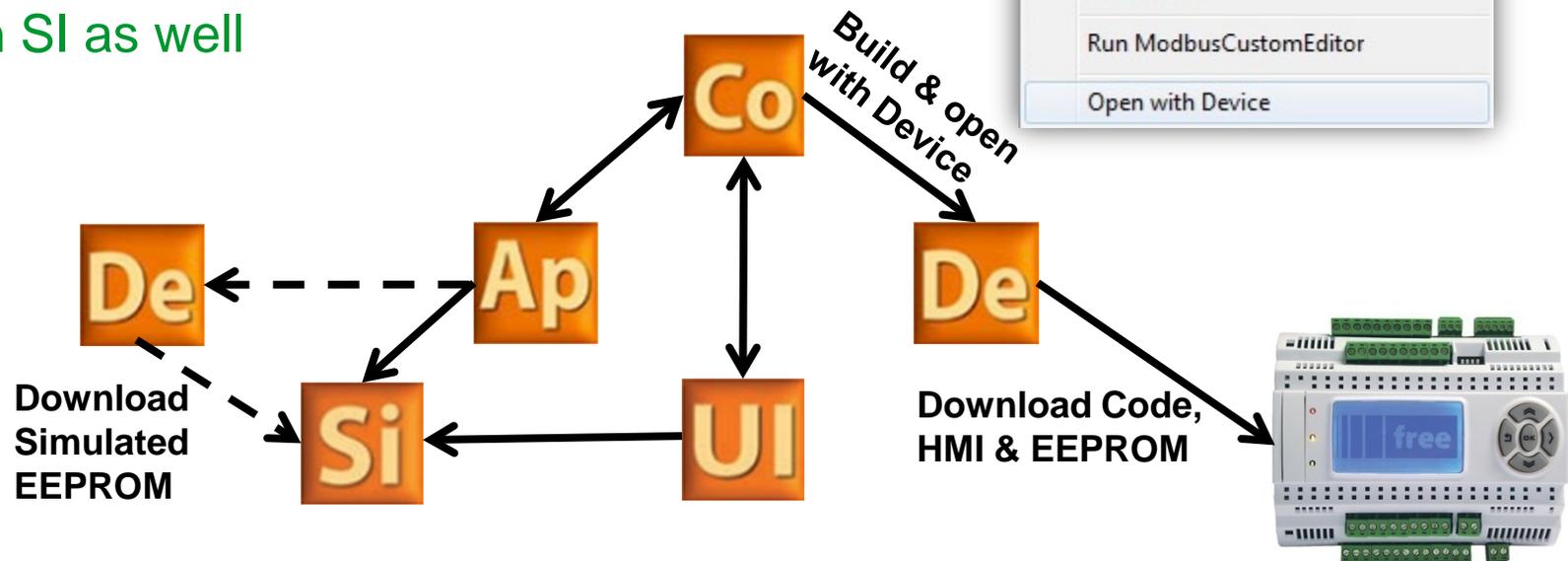
- Application is the programming starting point.
- Device is used to download the overall compiled project and it is the only tool able to write EEPROM parameters.
- From Application it will always be possible to open Device directly without having to launch the program using the FREE Studio icon.



Evolution Project Architecture



- Connection is the entry point for all development activities.
- Device is used to download the overall compiled project and it is the only tool able to write EEPROM parameters and the master connectivity configuration
- Application can download only the algorithm and the EEPROM parameters and Status Variable definition.
- UI can download only the HMI to EVD
- UI can open SI as well



Chapter 10

Fan Management

Goal:

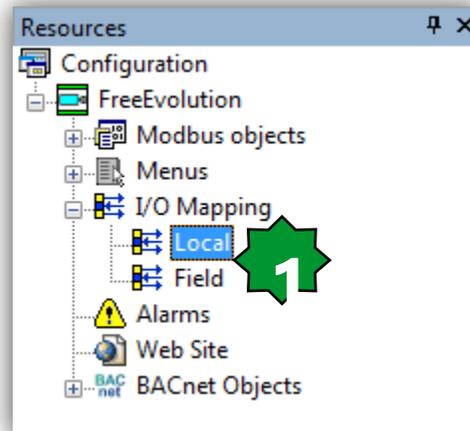
Manage 3 fans base on analogue input configuration



Physical I/O assignment

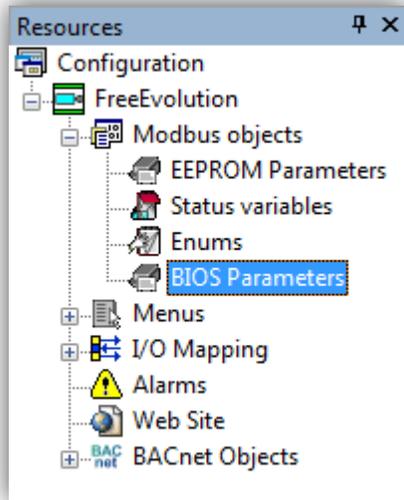


Fan Management Function Description:
 Fan Management enable by DIL1=True
 If AI3P > 3.3 V => Fan1=ON
 If 3.3 V < AI3P < 6.6 V => Fan1 & 2 = ON
 If AI3P > 6.6 V => Fan1,2 & 3 =ON
 If AI3P = - 32768 => Alarm=ON & Fans=False
 Monitoring AI3P by the gauge that is connected to the AO1P (0-10 V).



#	Name	Variable	Type	
1	AIL1	NTC_Probe	INT	AIL1 analogue input
2	AIL2		INT	AIL2 analogue input
3	AIL3	Potentiometer_AI3P	INT	AIL3 analogue input
4	AIL4		INT	AIL4 analogue input
5	AIL5		INT	AIL5 analogue input
6	AIL6		INT	AIL6 analogue input
7	DIL1	Fan_Start_Stop	BOOL	DIL1 digital input
8	DIL2		BOOL	DIL2 digital input
9	DIL3		BOOL	DIL3 digital input
10	DIL4		BOOL	DIL4 digital input
11	DIL5		BOOL	DIL5 digital input
12	DIL6		BOOL	DIL6 digital input
13	DIL7		BOOL	DIL7 digital input
14	DIL8		BOOL	DIL8 digital input
15	DOL1		BOOL	DOL1 digital output
16	DOL2		BOOL	DOL2 digital output
17	DOL3	Output_Cooling	BOOL	DOL3 digital output
18	DOL4	Alarm	BOOL	DOL4 digital output
19	DOL5	Fan1	BOOL	DOL5 digital output
20	DOL6	Fan2	BOOL	DOL6 digital output
21	DOL7	Fan3	BOOL	DOL7 digital output
22	AOL1	Guage_AO1P	INT	AOL1 analogue output
23	AOL2		INT	AOL2 analogue output
24	AOL3		INT	AOL3 analogue output
25	AOL4		INT	AOL4 analogue output
26	AOL5		INT	AOL5 analogue output
27	FDI_counter		UDINT	FDI Input counter
28	FDI_frequency		UDINT	FDI Input frequency
29	FDI_value		BOOL	FDI Input value
30	FDI_reset_counter		BOOL	FDI reset input counter value

BIOS Parameters/AI* Configuration

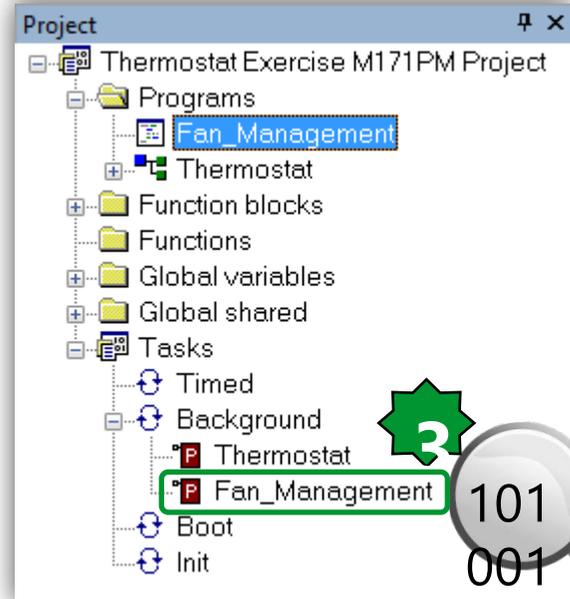
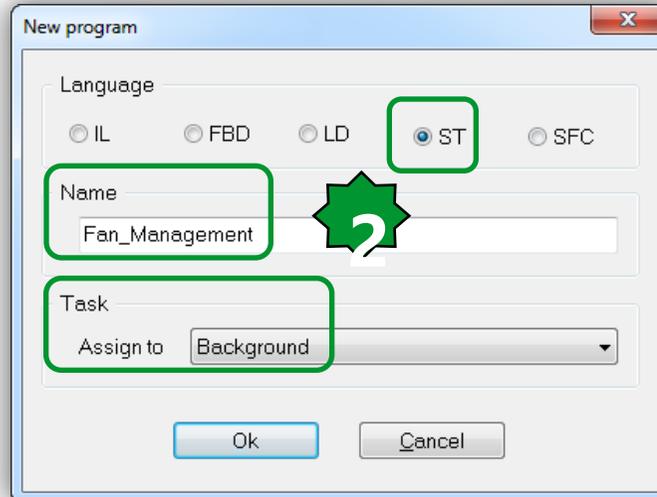
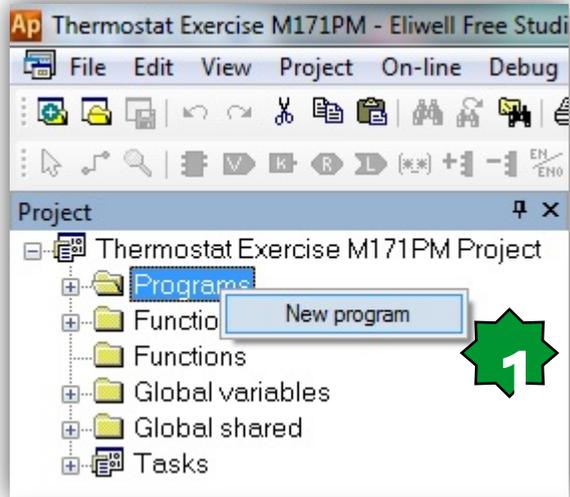


FreeEvolution BIOS Parameters

Add Remove

#	Name	Default value	Description
1	Cfg_AI3	4=0÷10V	Type of analogue input AI3
2	FullScaleMin_AI3	0	First value analogue input AI3 scale
3	FullScaleMax_AI3	10000	Last value analogue input AI3 scale
4	Cfg_AI1	2=NTC(103AT)	Type of analogue input AI1
5	Cfg_AO1_AO5	2=Voltage modulation	Type of analogue output AO1/AO5

New program creation

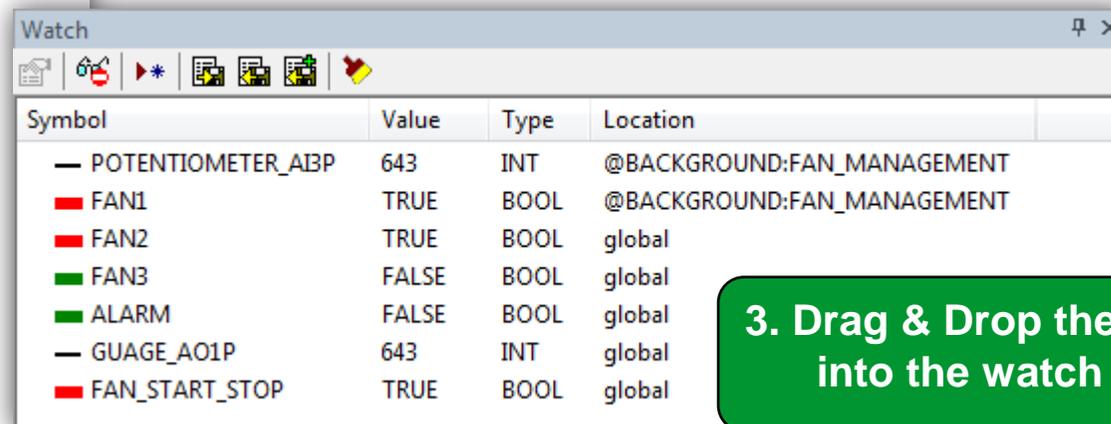
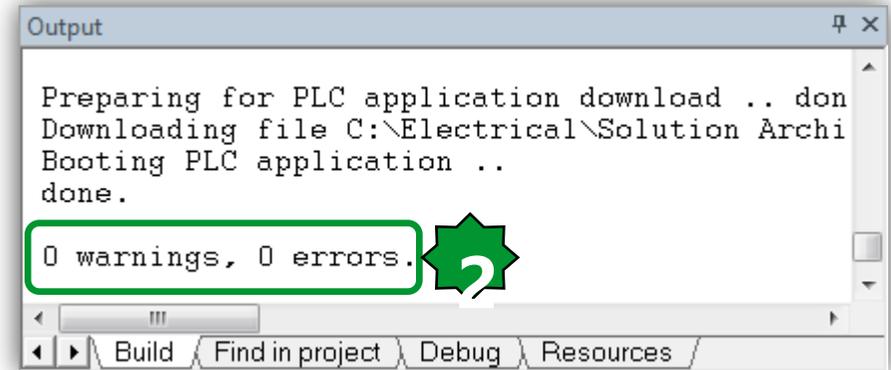
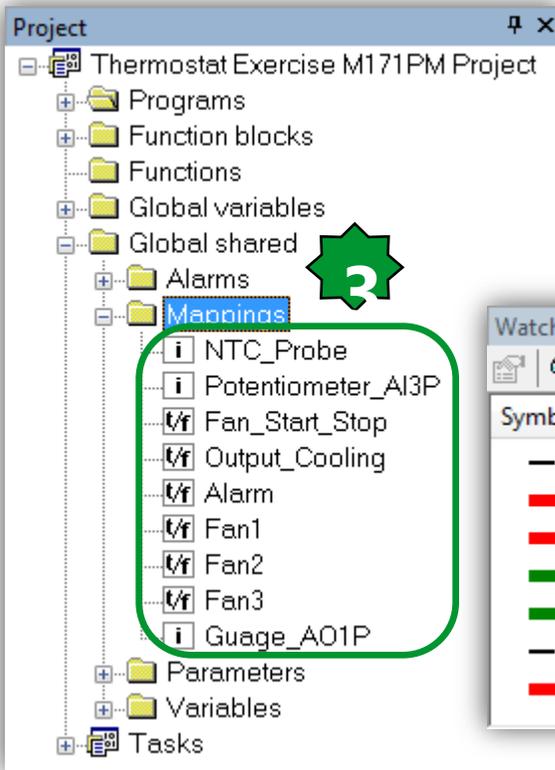


Click on the magnifying-glass to write the codes.

```
0001 (* Enable/Disable of Fan management by Start/Stop the digital Input (DIL1) *)
0002 If Fan_Start_Stop = False then
0003     Fan3:= FALSE;
0004     Fan2:= FALSE;
0005     Fan1:= FALSE;
0006 end_if;
0007
0008
0009 (* If the AI3P value is less than 3.33 volts, then Fan1=ON *)
0010
0011 if Potentiometer_AI3P <= 333 and Fan_Start_Stop = True then
0012     Fan1:= True;
0013     else Fan1 := FALSE;
0014 End_If;
0015
0016 (* If the AI3P value is less or equal than 6.66 volts or greater than 3.33 Volts, then Fan1=ON & Fan2=ON*)
0017
0018 if Potentiometer_AI3P <= 666 and Potentiometer_AI3P > 333 and Fan_Start_Stop = True then;
0019     Fan2:= True;
0020     Fan1:= True;
0021     else Fan2 := FALSE;
0022 End_If;
0023
0024 (* If the AI3P value is grater than 6.66 volts, then Fan1=ON & Fan2=ON & Fan3=ON*)
0025
0026 if Potentiometer_AI3P >666 and Fan_Start_Stop = True then;
0027     Fan3:= True;
0028     Fan2:= True;
0029     Fan1:= True;
0030     else Fan3 := FALSE;
0031 End_If;
0032
0033 (* AI3P disconnection detector *)
0034
0035 if Potentiometer_AI3P = -32768 then
0036     Alarm:= TRUE;
0037     Fan3:= FALSE;
0038     Fan2:= FALSE;
0039     Fan1:= FALSE;
0040     else Alarm := FALSE;
0041 end_if;
0042
0043 (* Monitoring AI3P by AO1P via the 0-10 Volts gauge *)
0044
0045 Guage_AO1P := Potentiometer_AI3P;
```

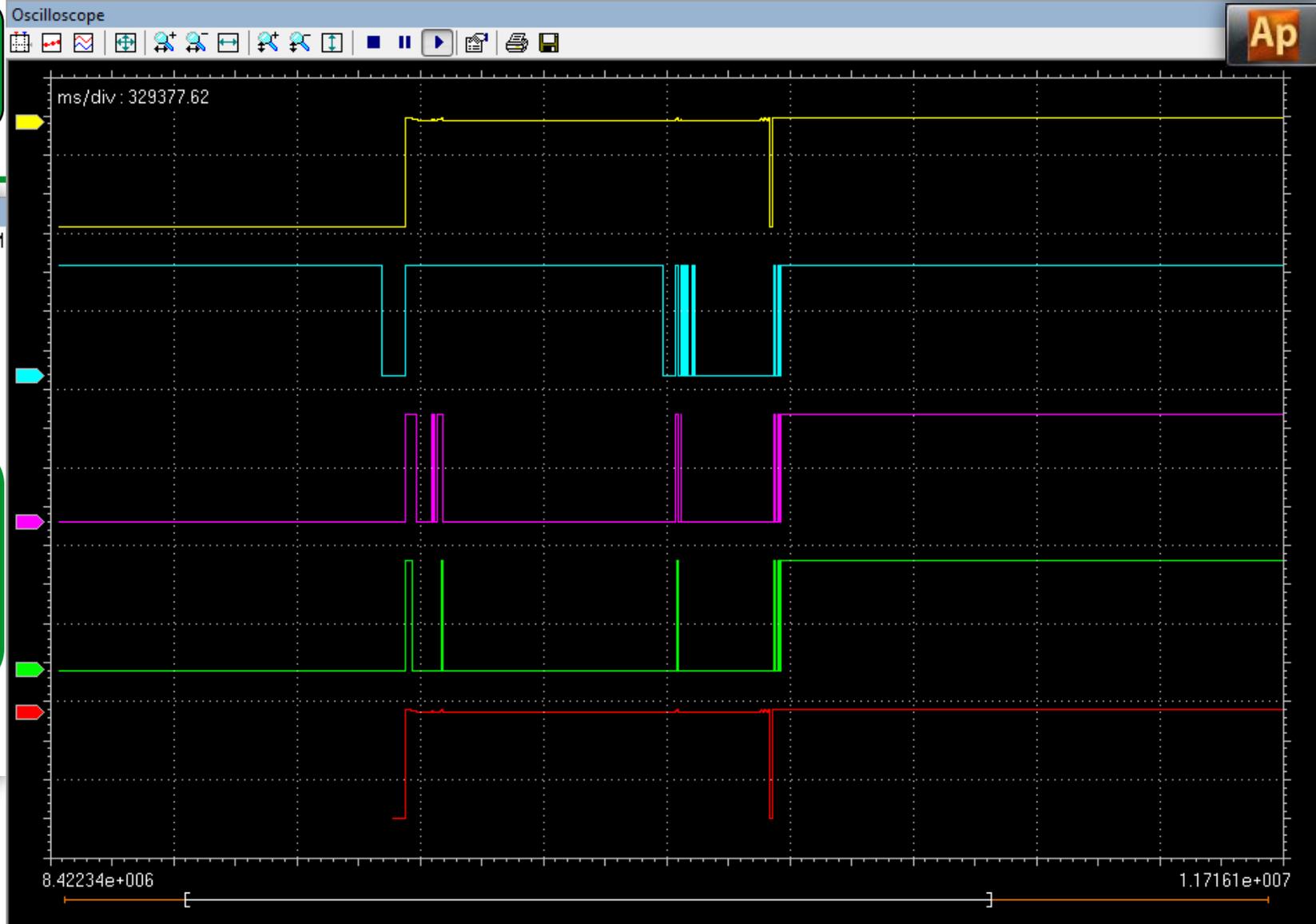
**Fan Management,
Enable/Disable Outputs,
AI monitoring by AO (0-10 V),
AI disconnection detection codes.**

Debugging/Watch



3. Drag & Drop the mappings into the watch window.

Debugging /Oscilloscope:



- Project
- Thermostat Exercise M171PM
 - Programs
 - Function blocks
 - Functions
 - Global variables
 - Global shared
 - Alarms
 - Mappings
 - NTC_Probe
 - Potentiometer_AI3P
 - Fan_Start_Stop
 - Output_Cooling
 - Alarm
 - Fan1
 - Fan2
 - Fan3
 - Guage_AO1P
 - Parameters
 - Variables
 - Tasks

Track	Um	Min value	Max value	Cur value	v/div	Red ...	Blue...	Horz cursor	Note
@BACKGROUND:FAN_MANAGEMENT.POTENTIOMETER_ABP		-32768.000	1048.000	643.000	2415...	...	...	...	@BACKGROUND:...
@BACKGROUND:FAN_MANAGEMENT.FAN1		0.000	1.000	1.000	0.714...	...	...	...	@BACKGROUND:...
@BACKGROUND:FAN_MANAGEMENT.FAN2		0.000	1.000	1.000	0.714...	...	...	...	@BACKGROUND:...
@BACKGROUND:FAN_MANAGEMENT.FAN3		0.000	1.000	0.000	0.714...	...	...	...	@BACKGROUND:...
@BACKGROUND:FAN_MANAGEMENT.GUAGE_AO1P		-32768.000	1022.000	643.000	2413...	...	...	...	@BACKGROUND:...

Analogue Input Configuration



Project: Thermostat Exercise M171PM

- FreeEvolution
 - BIOS parameters
 - All parameters
 - Acknowledgement
 - Calibration AI
 - Calibration AO
 - Analogue Inputs** (1)
 - Analogue Outputs V/I
 - RS485 On Board
 - CAN On Board
 - RS485 Plugin Passive
 - CAN Plugin Passive
 - RS232 Plugin Passive
 - Ethernet Plugin Passive
 - Modem
 - Display
 - BACnet
 - I/O Values
 - Dip Switch Values
 - Led & Backlight Values
 - System CLock Values
 - Protection Password
 - PLC Application
 - HMI
 - HMI Remote
 - Cfg files
 - Recipes

Analogue Inputs							
Address	Name	Value	Um	Default	Min	Max	Description
15725	Temp_UM	0=°C	num	0=°C	0	1	Unit of temperature measurement
15726	Cfg_AI1	2=NTC(103AT)	num	2=NTC(103AT)	0	2	Type of analogue input AI1
15727	Cfg_AI2	2=NTC(103AT)	num	2=NTC(103AT)	0	2	Type of analogue input AI2
15728	Cfg_AI3	4=0÷10V	num	3=4÷20mA	0	8	Type of analogue input AI3
15729	Cfg_AI4	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI4
15730	Cfg_AI5	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI5
15731	Cfg_AI6	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI6
15736	FullScaleMin_AI3	0	digit	0	-9999	9999	First value analogue input AI3 scale
15737	FullScaleMax_AI3	1000	digit	1000	-9999	9999	Last value analogue input AI3 scale
15738	FullScaleMin_AI4	0	digit	0	-9999	9999	First value analogue input AI4 scale
15739	FullScaleMax_AI4	1000	digit	1000	-9999	9999	Last value analogue input AI4 scale
15740	FullScaleMin_AI5	0	digit	0	-9999	9999	First value analogue input AI5 scale
15741	FullScaleMax_AI5	1000	digit	1000	-9999	9999	Last value analogue input AI5 scale
15742	FullScaleMin_AI6	0	digit	0	-9999	9999	First value analogue input AI6 scale
15743	FullScaleMax_AI6	1000	digit	1000	-9999	9999	Last value analogue input AI6 scale
15748	Calibration_AI1	0	°C/10,°F/10	0	-180	180	Analogue input AI1 differential
15749	Calibration_AI2	0	°C/10,°F/10	0	-180	180	Analogue input AI2 differential
15750	Calibration_AI3	0	digit	0	-1000	1000	Analogue input AI3 differential
15751	Calibration_AI4	0	digit	0	-1000	1000	Analogue input AI4 differential
15752	Calibration_AI5	0	digit	0	-1000	1000	Analogue input AI5 differential
15753	Calibration_AI6	0	digit	0	-1000	1000	Analogue input AI6 differential

Analogue Output Configuration



Project

- Thermostat Exercise M171PM
 - FreeEvolution
 - BIOS parameters
 - All parameters
 - Acknowledgement
 - Calibration AI
 - Calibration AO
 - Analogue Inputs
 - Analogue Outputs V/I**
 - RS485 On Board
 - CAN On Board
 - RS485 Plugin Passive
 - CAN Plugin Passive
 - RS232 Plugin Passive
 - Ethernet Plugin Passive
 - Modem
 - Display
 - BACnet
 - I/O Values
 - Dip Switch Values
 - Led & Backlight Values
 - System CLock Values
 - Protection Password
 - PLC Application
 - HMI
 - HMI Remote
 - Cfg files
 - Recipes

Address	Name	Value	Um	Default	Min	Max	Description
15758	Cfg_AO1_AO5	2=Voltage modulat	num	0=Current modulation	0	2	Type of analogue output AO1/AO5
15759	Cfg_AO2	0=Current modulation	num	0=Current modulation	0	2	Type of analogue output AO2
15760	Cfg_AO3	0=Current modulation	num	0=Current modulation	0	2	Type of analogue output AO3
15761	Cfg_AO4	0=Current modulation	num	0=Current modulation	0	2	Type of analogue output AO4
15762	SubCfg_AO5	0	num	0	0	1	Subtype of analogue output AO5



Chapter 11

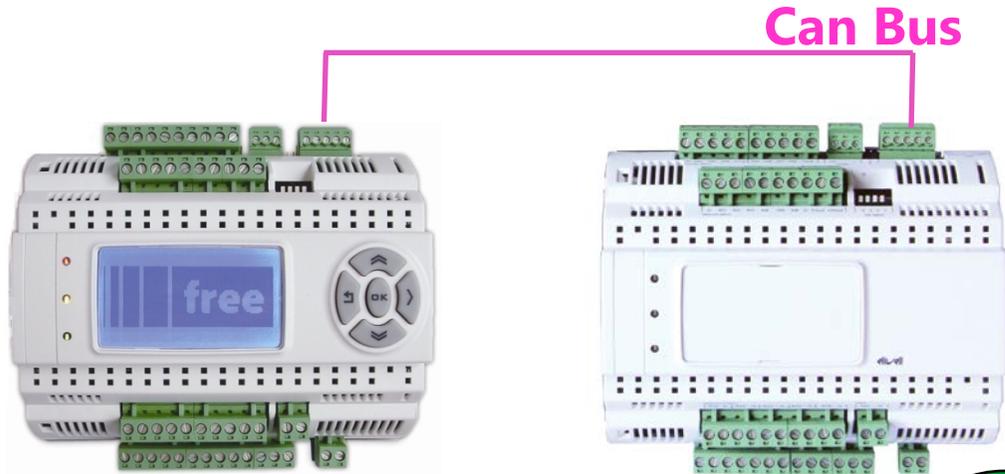
Network

Goal:

Expansion connection to the base unit via CAN BUS



Evolution Networking Exercise



EVD1

EVE1

Address 2
→
Dip Switch 1 = ON

Goals:

- Connect an expansion EVE1 to Can Bus,
- Configure the AI3 of the EVD as 0-10V input
- Read AI3 and DI1 of the EVD.
- Write AO1 and DO5, 6 & 7 of the EVD.

Note: Connect GS,H,L of EVD to GS,H,L of EVE respectively

DO NOT CONNECT together POWER OUT, POWER OUT is just for powering the remote EVK1000 display.

NOTE: Leave the CanOpen end resistor jumpers only to the endline Devices, in this case EVD1 and EVE1

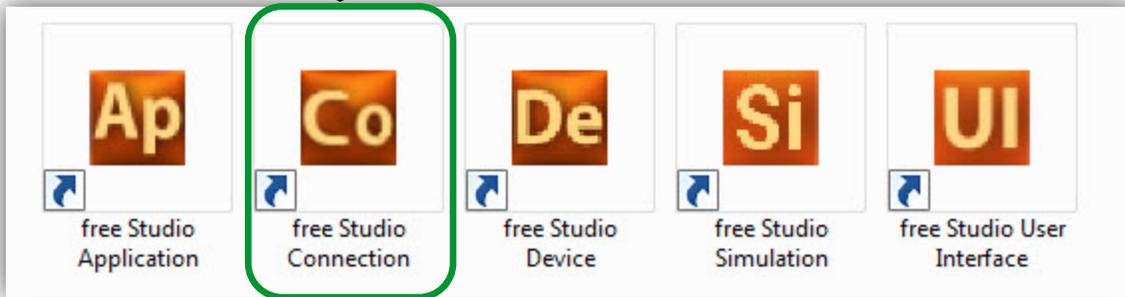
Creating New project's connection



2*click



2*click



Define the Project Architecture



The screenshot displays the 'Project' configuration window in the Eliwell Free Studio Connection software. The window title is 'Untitled - Eliwell Free Studio Connection'. The menu bar includes 'File', 'Edit', 'View', 'Tools', 'Options', and 'Help'. The toolbar contains icons for file operations and help. The 'Project' tree on the left shows a project named 'Untitled' containing a sub-project 'FreeEvolution EVD_1' with components: PLC, HMI, HMI Remote, CANopen, RS485, and Plugins. The main area is titled 'Project Untitled' and has two tabs: 'General' (selected) and 'Networks list'. Under the 'General' tab, there is a 'Most recent projects' section with an empty list box. Below that is a table titled 'Add new device to project'.

Add new device to project		
	FreeEvolution EVD	423
	FreeEvolution EVC	477
	Keyboard EVK	476
	FreeEvolution EVP	489



FreeEvolution EVD configuration



Untitled - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Untitled
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CANopen
 - RS485
 - Plugins

FreeEvolution EVD Configuration

General

Name: FreeEvolution EVD_1

Version: 423.18



Dip-switch setting: 0



ON 1 2 3 4

Save new Connection project

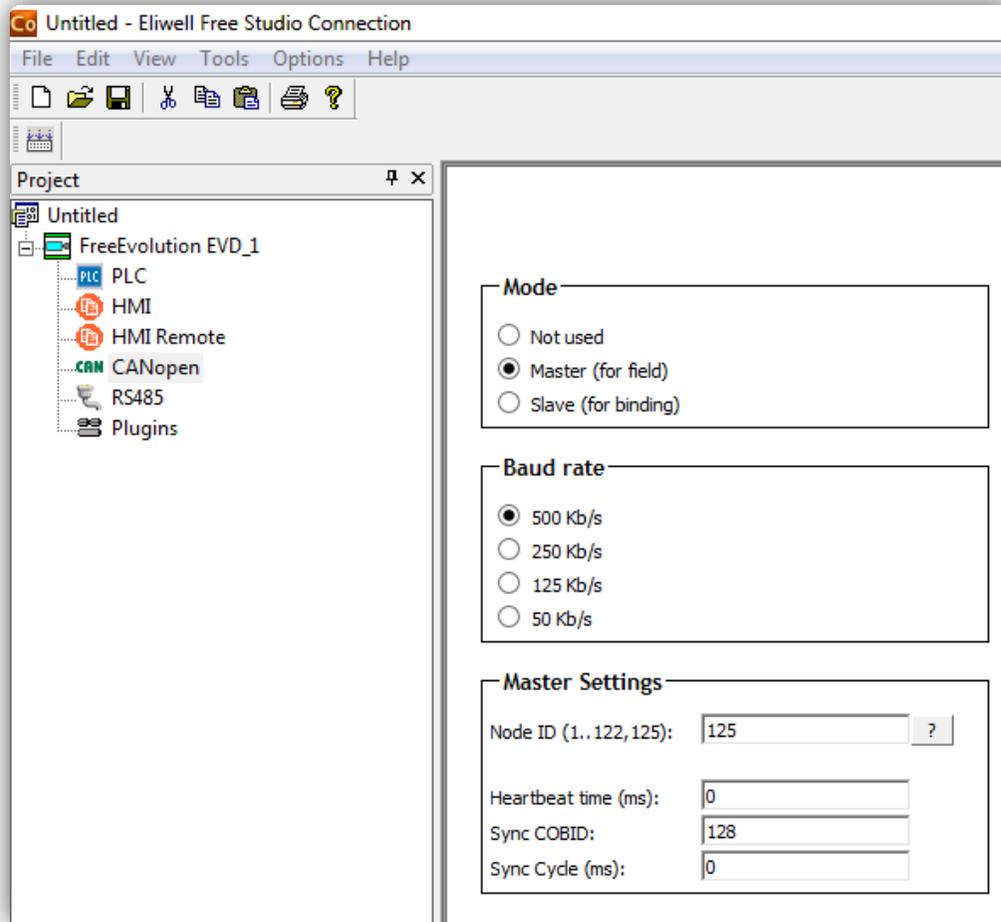
Project

Name: Thermostat Exercise

Directory: C:\Electrical\Solution Architect\Eliwell\Exercise

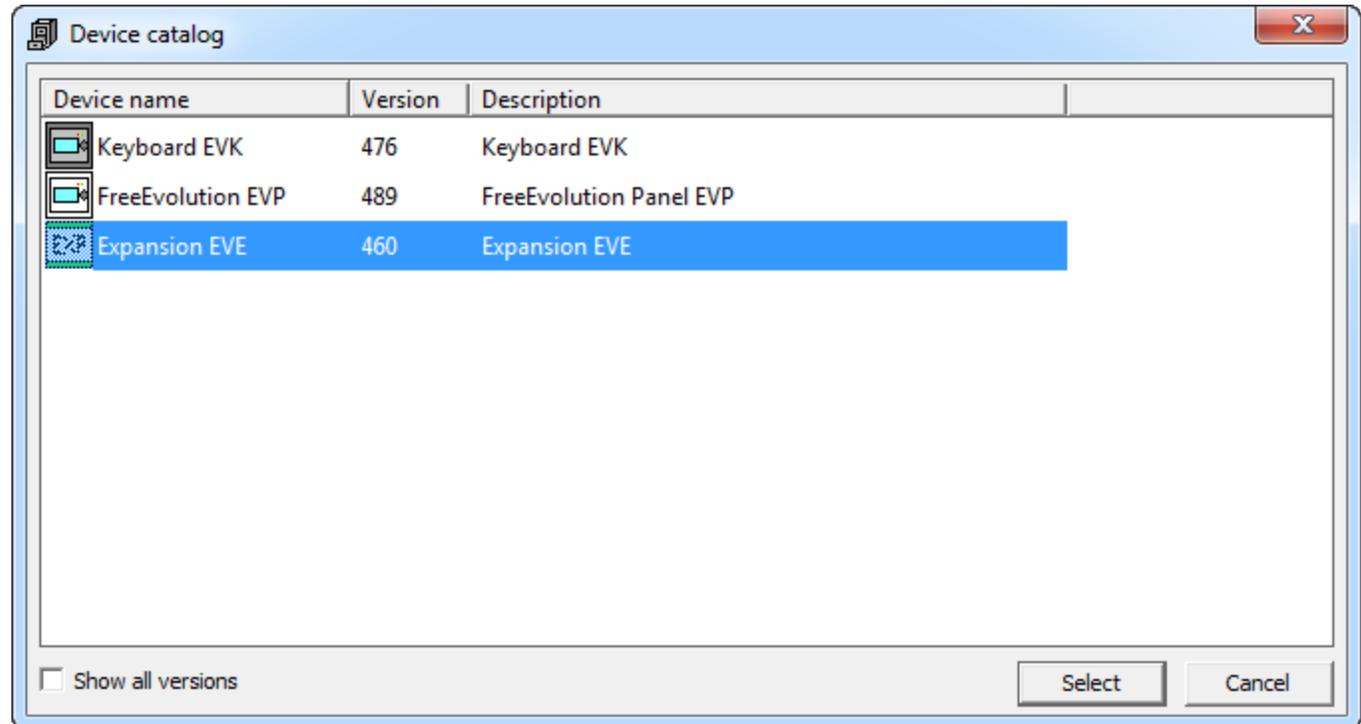
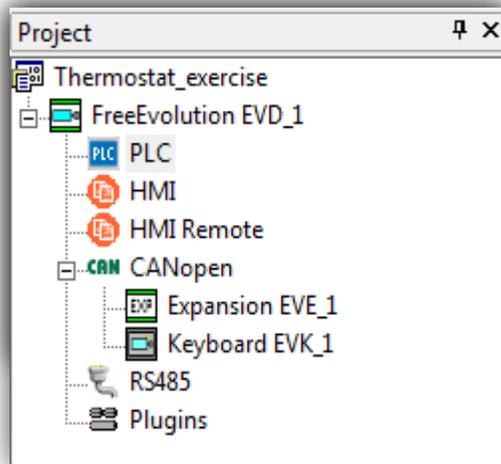
OK Cancel

CANopen configuration



- The CanOpen address of EVD is 125, it will be written in the CONNEC.PAR file, CAN On Board parameters are not valid if the Evolution is Master on CAN.
- EVE must be set at the speed defined here (if changed the devices must be restarted, Factory default is 500Kb/s)

Add an expansion



Drag & drop from device catalogue to the CANopen
Or
CANopen ► Add ► Device catalogue ► Select the target



Expansion EVE configuration



Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CAN CANopen
 - Expansion EVE_1**
 - Keyboard EVK_1
 - RS485
 - Plugins

Expansion EVE Configuration

General

SDO Set

PDO Tx - Input

PDO Rx - Output

Network settings

Node number (1.. 122)	<input type="text" value="1"/>
Node Guard Period (ms)	<input type="text" value="200"/>
Life time Factor	<input type="text" value="3"/>
Boot time elapsed (ms)	<input type="text" value="2000"/>
Node heartbeat producer time (ms)	<input type="text" value="0"/>
Node heartbeat consumer time (ms)	<input type="text" value="0"/>
Master heartbeat consumer time (ms)	<input type="text" value="0"/>
Identity object check	<input type="checkbox"/>

PDO Tx communication settings

USER DEFINED Mode

SYNC Mode

EVENT Mode

CYCLIC Mode ms

PDO Rx communication settings

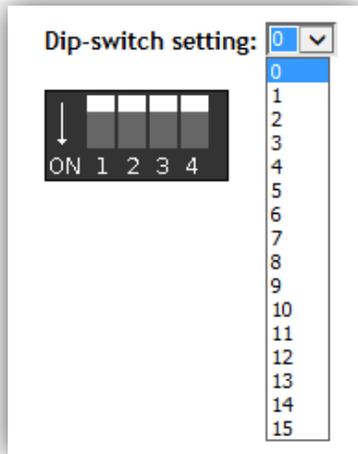
USER DEFINED Mode

SYNC Mode

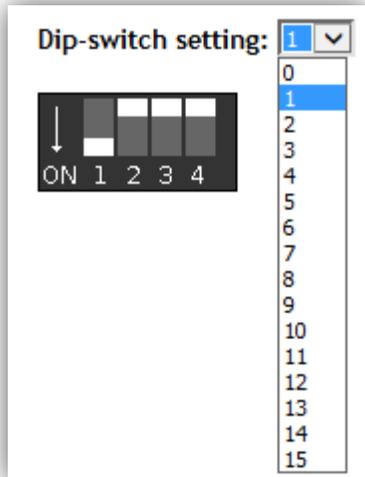
EVENT Mode

- Node Number is the address to be set on **EVE** via **Dip Switch**.

Dip switch setting ► EVE Address defining



Address=Dip switch +1
1=0+1



Address=Dip switch +1
2=1+1

It is possible to connect up to 12 expansion+2 keyboard

Expansion EVE configuration



- Pressing Add you can eventually define the I/O configuration of EVE that EVD will send at powerup
- For example: EVE1 AI3 is set as 0-10V.

Expansion EVE Configuration

 **General** | SDO Set | PDO Tx - Input | PDO Rx - Output

 Add |  Remove

#	Label	Index	SubIndex	Type	Value	Timeout
1	COB-ID	1404	1	UDINT	\$NODEID+0x40000500	1000
2	COB-ID	1804	1	UDINT	\$NODEID+0x40000480	1000
3	Transmission Type	1800	2	USINT	255	100
4	Event Timer	1800	5	UINT	0	100
5	Transmission Type	1801	2	USINT	255	100
6	Event Timer	1801	5	UINT	0	100
7	Transmission Type	1802	2	USINT	255	100
8	Event Timer	1802	5	UINT	0	100
9	Transmission Type	1804	2	USINT	255	100
10	Event Timer	1804	5	UINT	0	100
11	Transmission Type	1400	2	USINT	255	100
12	Transmission Type	1401	2	USINT	255	100
13	Transmission Type	1402	2	USINT	255	100
14	Transmission Type	1404	2	USINT	255	100
15	Cfg_AI3	3d70	0	UINT	4	100
16	FullScaleMin_AI3	3d78	0	INT	0	100
17	FullScaleMax_AI3	3d79	0	INT	1000	100

Variables List

Filter: AI3

- 3d70.0 Cfg_AI3 (UINT)
- 3d78.0 FullScaleMin_AI3 (INT)
- 3d79.0 FullScaleMax_AI3 (INT)
- 3d86.0 Calibration_AI3 (INT)

OK Cancel

Check FS Device for parameter enumeration



File Edit View Parameters Recipes Options Help

Project: Untitled

- Expansion EVE_1
 - BIOS parameters
 - All parameters
 - Acknowledgement
 - Calibration AI
 - Calibration AO
 - Analogue Inputs
 - Analogue Outputs V/I
 - I/O Values
 - Dip Switch Values
 - Led Values

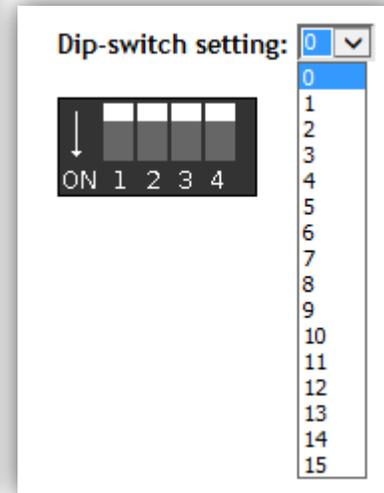
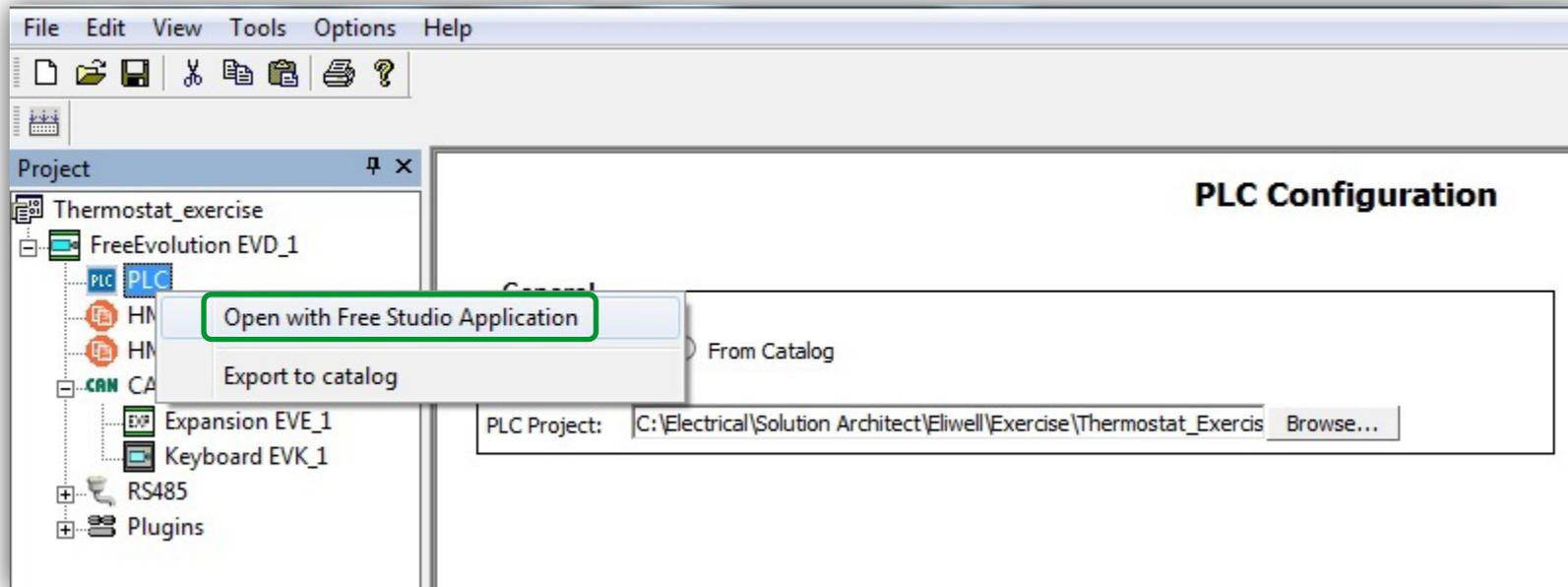
Analogue Inputs

Address	Name	Value	Um	Default	Min	Max	Description
15725	Temp_UM	0=*C	num	0=*C	0	1	Unit of temperature measurement
15726	Cfg_AI1	2=NTC(103AT	num	2=NTC(103AT	0	2	Type of analogue inputAI1
15727	Cfg_AI2	2=NTC(103AT	num	2=NTC(103AT	0	2	Type of analogue inputAI2
15728	Cfg_AI3	3=4+20mA	num	3=4+20mA	0	8	Type of analogue inputAI3
15729	Cfg_AI4	2=NTC(10	num	3=4+20mA	0	8	Type of analogue inputAI4
15730	Cfg_AI5	3=4+20mA	num	3=4+20mA	0	8	Type of analogue inputAI5
15731	Cfg_AI6	4=0+10V	num	3=4+20mA	0	8	Type of analogue inputAI6
15736	FullScaleMin_AI3	5=0+5V	digit	0	-9999	9999	First value analogue inputAI3 scale
15737	FullScaleMax_AI3	6=PT1000	digit	1000	-9999	9999	Last value analogue inputAI3 scale
15738	FullScaleMin_AI4	7=hO(NTC	digit	0	-9999	9999	First value analogue inputAI4 scale
15739	FullScaleMax_AI4	8=daO(PT	digit	1000	-9999	9999	Last value analogue inputAI4 scale
15740	FullScaleMin_AI5	1000	digit	0	-9999	9999	First value analogue inputAI5 scale
15741	FullScaleMax_AI5	0	digit	1000	-9999	9999	Last value analogue inputAI5 scale
15742	FullScaleMin_AI6	1000	digit	0	-9999	9999	First value analogue inputAI6 scale
15743	FullScaleMax_AI6	0	digit	1000	-9999	9999	Last value analogue inputAI6 scale
15748	Calibration_AI1	0	*C/10,*F/10	0	-180	180	Analogue inputAI1 differential
15749	Calibration_AI2	0	*C/10,*F/10	0	-180	180	Analogue inputAI2 differential
15750	Calibration_AI3	0	digit	0	-1000	1000	Analogue inputAI3 differential
15751	Calibration_AI4	0	digit	0	-1000	1000	Analogue inputAI4 differential
15752	Calibration_AI5	0	digit	0	-1000	1000	Analogue inputAI5 differential
15753	Calibration_AI6	0	digit	0	-1000	1000	Analogue inputAI6 differential

PLC project linking/creation



- Already existing PLC/HMI project can be linked through the related project field.

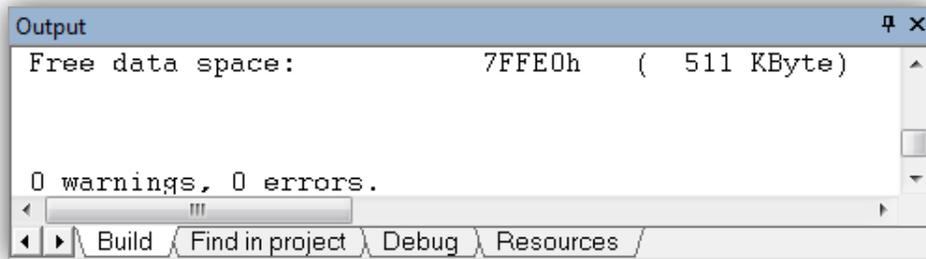


- If it is empty, a new project will be created and saved in a folder placed where the connection project is saved

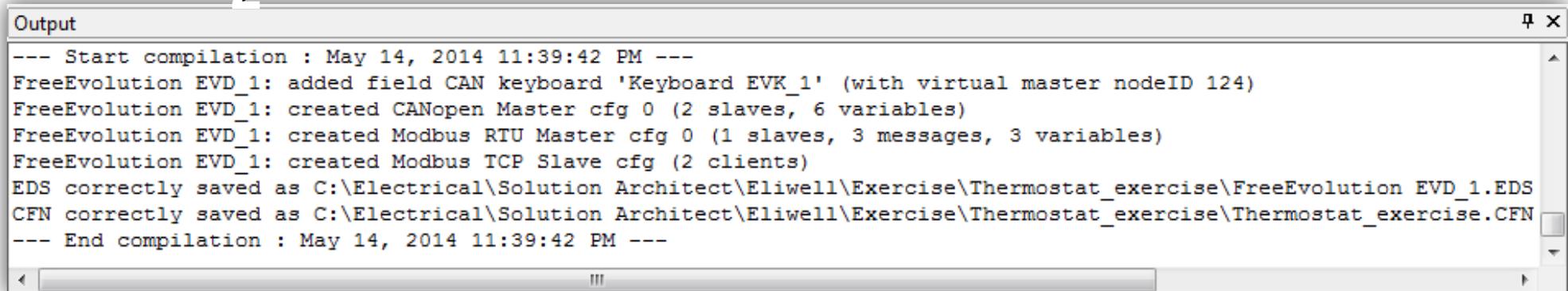
Dictionary Organization:

When a project is created & saved from CO a directory will be create; then if AP created by new from CO; a directory of the project is created inside the CO directory

Build the connection



Note:
To apply the changes to the network, free studio asks you to reboot.



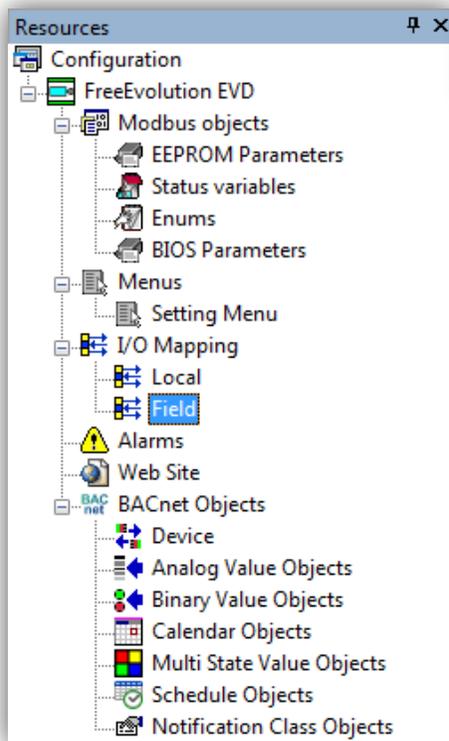
Define Application Variables to be linked to Physical I/O of EVE



The set of PLC objects you can read or write is made of:

- Status variables, created with FREE Studio Application (not BIOS).
- Field variables, created with FREE Studio Application.

1. Add
2. Name it
3. Define the type
4. Define the In/Out



FreeEvolution Field I/O Mapping

1

Add Remove Up Down

#	Name	Type	In/Out	Description
1	AI1_E	INT	Input	NTC Probe
2	AI3_E	INT	Input	
3	AO1_E	INT	Output	
4	DI1_E	BOOL	Input	
5	DI2_E	BOOL	Input	
6	DO3_E	BOOL	Output	
7	DO4_E	BOOL	Output	

2 3 4

- NOTE: If the Status Variables is defined in order to be linked to an EVE input

it must be set as not READ ONLY

EVE Expansion configuration



Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CAN CANopen
 - Expansion EVE_1**
 - Keyboard EVK_1
 - RS485
 - Plugins

Expansion EVE Configuration

General
SDO Set
PDO Tx - Input
PDO Rx - Output

Assign
UnAssign

#	Idx	Sub	PDO	Bit	COBID	Object Name	Type	Size	Label	DataBlock
1	6000	1	1	0	181	Read Input 1h to 8h	BOOL	1		
2	6000	1	1	1	181	Read Input 1h to 8h	BOOL	1		
3	6000	1	1	2	181	Read Input 1h to 8h	BOOL	1		
4	6000	1	1	3	181	Read Input 1h to 8h	BOOL	1		
5	6000	1	1	4	181	Read Input 1h to 8h	BOOL	1		
6	6000	1	1	5	181	Read Input 1h to 8h	BOOL	1		
7	6000	1	1	6	181	Read Input 1h to 8h	BOOL	1		
8	6000	1	1	7	181	Read Input 1h to 8h	BOOL	1		
9	6000	2	1	8	181	Read Input 9h to 16h	BOOL	1		
10	6000	2	1	9	181	Read Input 9h to 16h	BOOL	1		
11	6000	2	1	10	181	Read Input 9h to 16h	BOOL	1		
12	6000	2	1	11	181	Read Input 9h to 16h	BOOL	1		
13	6401	1	2	0	281	Analogue Input 1	INT	16		
14	6401	2	2	16	281	Analogue Input 2	INT	16		
15	6401	3	2	32	281	Analogue Input 3	INT	16		
16	6401	4	2	48	281	Analogue Input 4	INT	16		
17	6401	5	3	0	381	Analogue Input 5	INT	16		
18	6401	6	3	16	381	Analogue Input 6	INT	16		
19	2230	0	5	0	481	Counter	UDINT	32		
20	2232	0	5	32	481	Frequency	UDINT	32		

Digital Inputs

Dip switches

Analogue Inputs

Fast Digital Input

- Select the Analogue Input 1 of EVE_1, PDO Tx – Input

- Press Assign

- Link the Physical input to the desired Application variable

- Repeat this for each EVE Input used in your project

- Use PDO Rx – Output for EVE Output

Assign/UnAssign of physical I/O



Expansion EVE Configuration

General

SDO Set

PDO Tx - Input

PDO Rx - Output



Assign UnAssign

1. PDO Tx-Input
2. Choose PLC variable DI
3. Choose PLC variable AI
4. Assign

#	Idx	Sub	PDO	Bit	COBID	Object Name	Type	Size	Label	DataBlock
1	6000	1	1	0	181	Read Input 1h to 8h	BOOL	1	DI1_E	IX10.0
2	6000	1	1	1	181	Read Input 1h to 8h	BOOL	1	DI2_E	IX10.1
3	6000	1	1	2	181	Read Input 1h to 8h	BOOL	1		
4	6000	1	1	3	181	Read Input 1h to 8h	BOOL	1		
5	6000	1	1	4	181	Read Input 1h to 8h	BOOL	1		
6	6000	1	1	5	181	Read Input 1h to 8h	BOOL	1		
7	6000	1	1	6	181	Read Input 1h to 8h	BOOL	1		
8	6000	1	1	7	181	Read Input 1h to 8h	BOOL	1		
9	6000	2	1	8	181	Read Input 9h to 16h	BOOL	1		
10	6000	2	1	9	181	Read Input 9h to 16h	BOOL	1		
11	6000	2	1	10	181	Read Input 9h to 16h	BOOL	1		
12	6000	2	1	11	181	Read Input 9h to 16h	BOOL	1		
13	6401	1	2	0	281	Analogue Input 1	INT	16	AI1_E	IW11.0
14	6401	2	2	16	281	Analogue Input 2	INT	16		
15	6401	3	2	32	281	Analogue Input 3	INT	16	AI3_E	IW11.1
16	6401	4	2	48	281	Analogue Input 4	INT	16		
17	6401	5	3	0	381	Analogue Input 5	INT	16		
18	6401	6	3	16	381	Analogue Input 6	INT	16		
19	2230	0	5	0	481	Counter	UDINT	32		
20	2232	0	5	32	481	Frequency	UDINT	32		



Choose PLC variable

Filter:

FreeEvolution EVD_1: DI1_E (BOOL)

FreeEvolution EVD_1: DI2_E (BOOL)

Choose PLC variable

Filter:

FreeEvolution EVD_1: AI1_E (INT) - NTC Probe

FreeEvolution EVD_1: AI3_E (INT)

FreeEvolution EVD_1: Ambient_Temperature (INT)

Assign/UnAssign of physical I/O



Expansion EVE Configuration

1. PDO Rx-Output
2. Choose PLC variable DO
3. Choose PLC variable AO
4. Assign

4

1

General

SDO Set

PDO Tx - Input

PDO Rx - Output

Assign

UnAssign

#	Idx	Sub	PDO	Bit	COBID	Object Name	Type	Size	Label	DataBlock
1	6200	1	1	0	201	Write Output 1h to 8h	BOOL	1		
2	6200	1	1	1	201	Write Output 1h to 8h	BOOL	1		
3	6200	1	1	2	201	Write Output 1h to 8h	BOOL	1	DO3_E	QX11.0
4	6200	1	1	3	201	Write Output 1h to 8h	BOOL	1	DO4_E	QX11.1
5	6200	1	1	4	201	Write Output 1h to 8h	BOOL	1		
6	6200	1	1	5	201	Write Output 1h to 8h	BOOL	1		
7	6200	1	1	6	201	Write Output 1h to 8h	BOOL	1		
8	6411	1	2	0	301	Analogue Output 1	INT	16	AO1_E	QW10.0
9	6411	2	2	16	301	Analogue Output 2	INT	16		
10	6411	3	2	32	301	Analogue Output 3	INT	16		
11	6411	4	2	48	301	Analogue Output 4	INT	16		
12	6411	5	3	0	401	Analogue Output 5	INT	16		
13	21c0	0	5	0	501	LED1	USINT	8		
14	21c1	0	5	8	501	LED2	USINT	8		
15	21c2	0	5	16	501	LED3	USINT	8		

Choose PLC variable

Filter:

FreeEvolution EVD_1: DO3_E (BOOL)

FreeEvolution EVD_1: DO4_E (BOOL)

Choose PLC variable

Filter:

FreeEvolution EVD_1: AO1_E (INT)

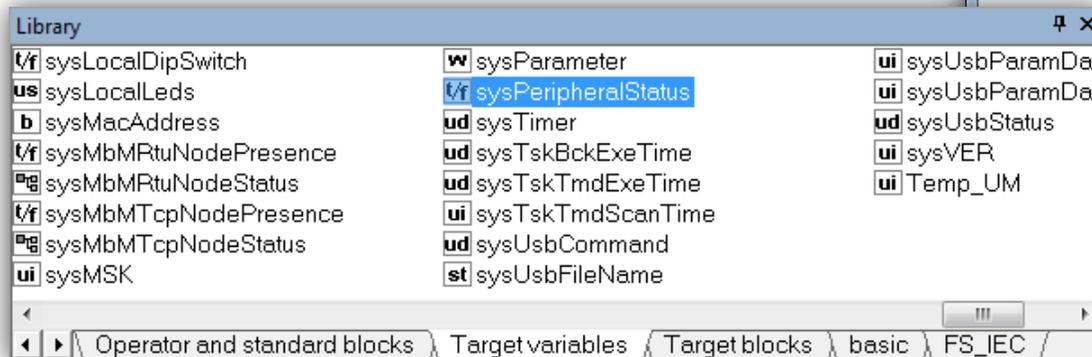
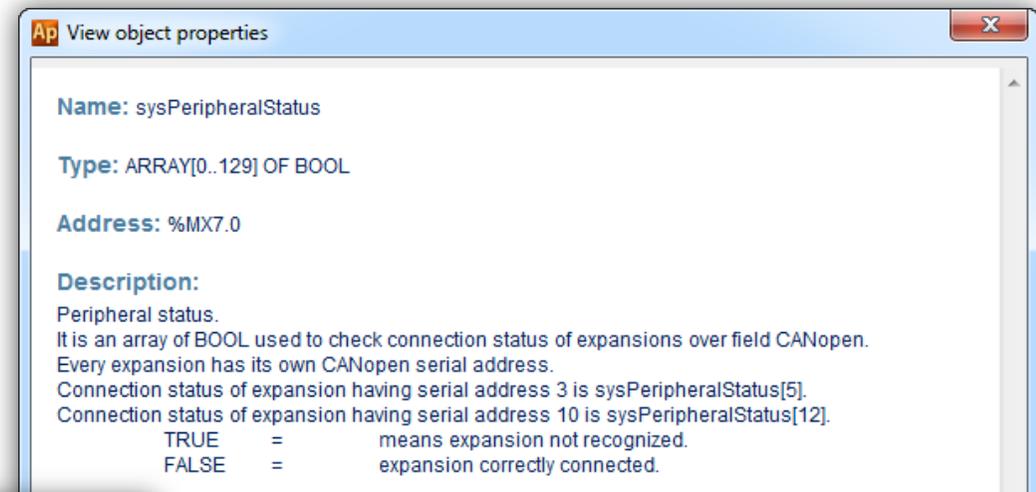
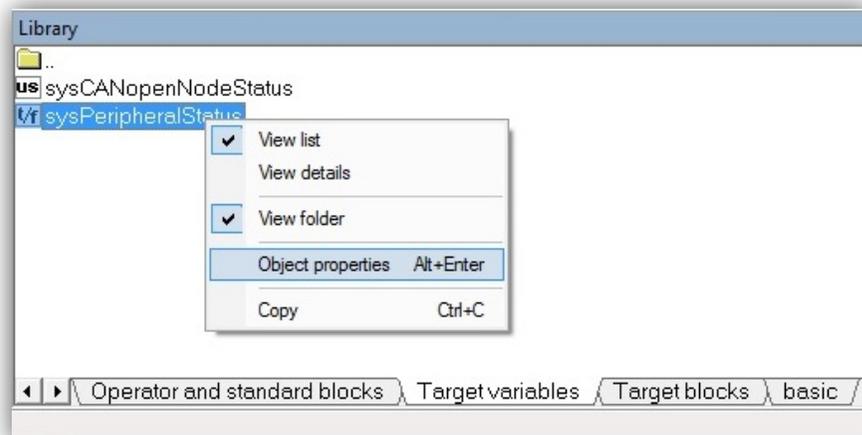
FreeEvolution EVD_1: Ambient_Temperature (INT)

Application Project



You can create your Application project in the usual way using local and field I/O

- `sysPeripheralStatus[3]` tells the communication status with `EVE_1`

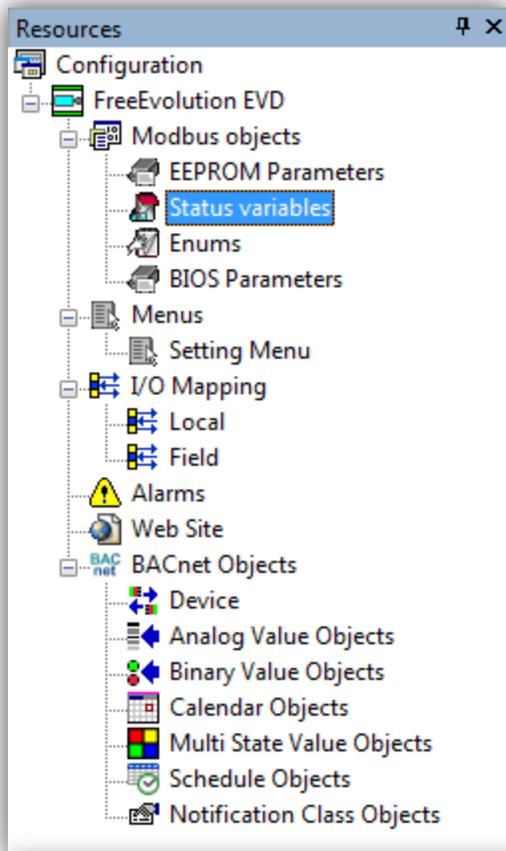


Note: index to be used with `sysPeripheralStatus[]`, index = node number + 2

Status Variable



- Create Status Variables readable via Modbus

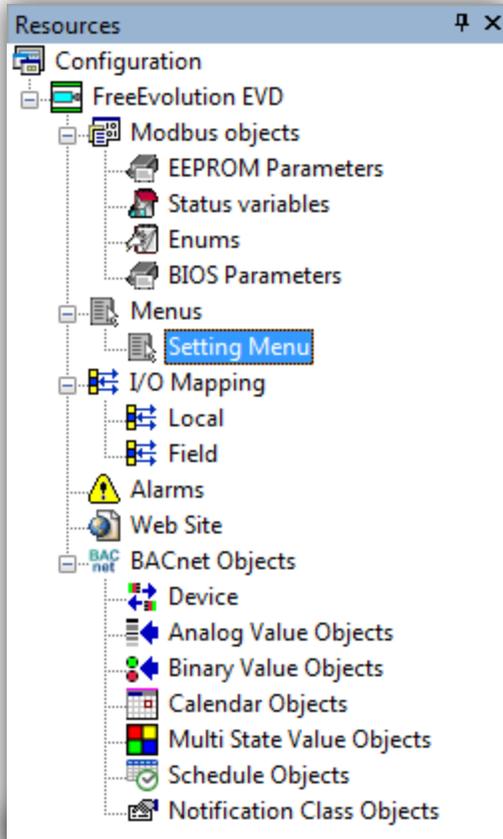


FreeEvolution Status Variables

Add
 Remove
 Recalc

#	Address	Name	Device type	Application type	Size	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Read only
1	8960	Ambient_Temperature	Signed 16-bit	INT					1	0	°C	XXX.Y	Always visible	True

Setting Menu



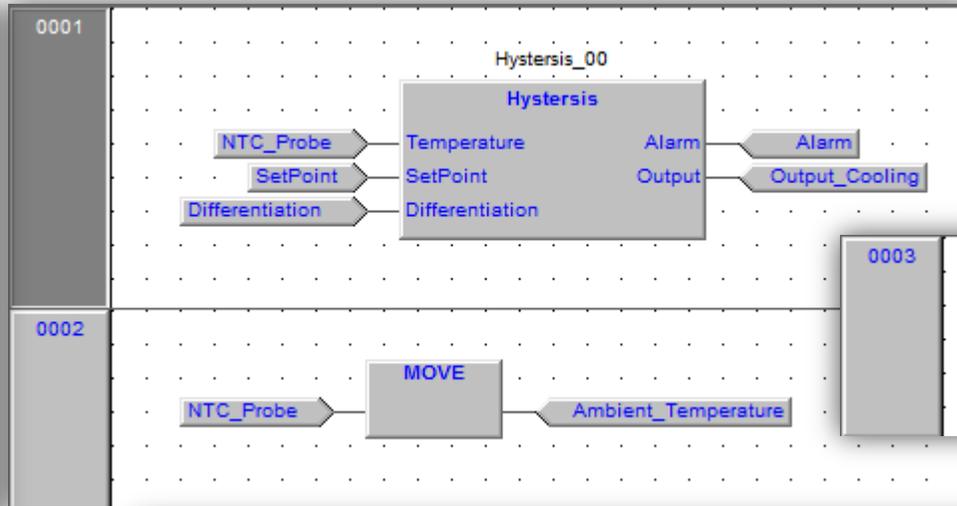
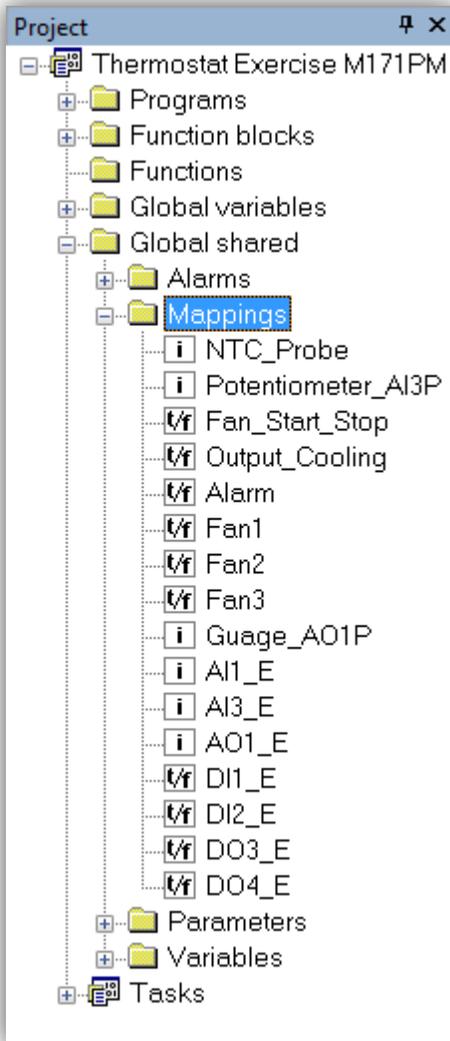
- Create folder to be shown on Free Studio Device

FreeEvolution 'Setting Menu' Menu

Add Remove Up Down

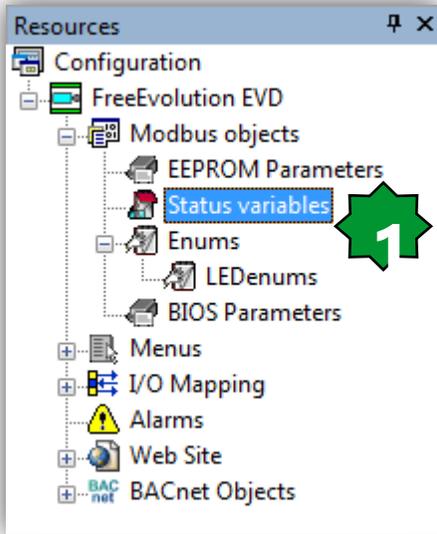
#	Name	Description
1	SetPoint	
2	Differentiation	

Communication Alarm Checking, Link I/O of EVE



```
0001 (* Hysteresis FBD *)
0002
0003 if Temperature >= Setpoint + Differentiation then
0004     Output := TRUE;
0005 end_if;
0006
0007 if Temperature < Setpoint then
0008     Output := FALSE;
0009 end_if;
0010
0011 (* Probe disconnection detector *)
0012
0013 if Temperature = -32768 then
0014     Alarm := TRUE;
0015     else Alarm := FALSE;
0016 end_if;
0017
0018
```

Green LED management



1. Resources ► Status variables
2. Add
3. Define: Name, device & application types



FreeEvolution Status Variables



Remove

Recalc

#	Address	Name	Device type	Application type	Size	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Read only
1	8960	Ambient_Temperature	Signed 16-bit	INT					1	0	°C	XXX.Y	Always visible	True
2	8964	Green_LED_EVE1	Unsigned 8-bit	USINT					1	0			Always visible	True
3	8965	EVE_Alarm	Boolean	BOOL					1	0			Always visible	True



Green LED management



Resources

- Configuration
 - FreeEvolution EVD
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - LEDenums**
 - BIOS Parameters
 - Menus
 - I/O Mapping
 - Alarms
 - Web Site
 - BACnet Object

Project Defin...

FreeEvolution 'LEDenums' Enumerator

#	Value	Description
1	0	0=off
2	1	1=on
3	2	2=blink

FreeEvolution Status Variables

#	Address	Name	Device type	Application type	Size	Default value	Min	Max	Scale	Offset	Unit	Format	AccessLevel	Read only
1	8960	Ambient_Temperature	Signed 16-bit	INT					1	0	°C	XXX.Y	Always visible	True
2	8964	Green_LED_EVE1	LEDenums	USINT					1	0			Always visible	True
3	8965	EVE_Alarm	Boolean	BOOL					1	0			Always visible	True

Resources

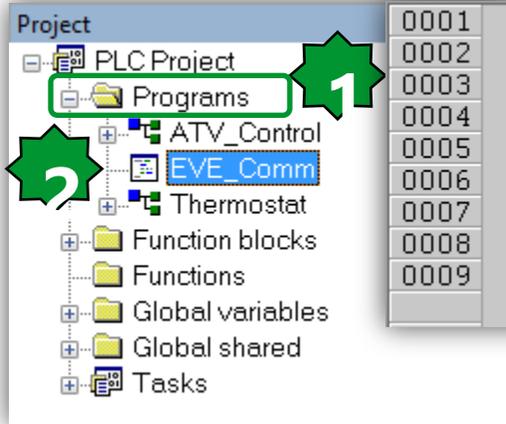
- Configuration
 - FreeEvolution EVD
 - Modbus objects
 - Menus
 - Setting Menu
 - EVE Menu**
 - I/O Mapping
 - Alarms
 - Web Site
 - BACnet Objects

Project Defin... Reso...

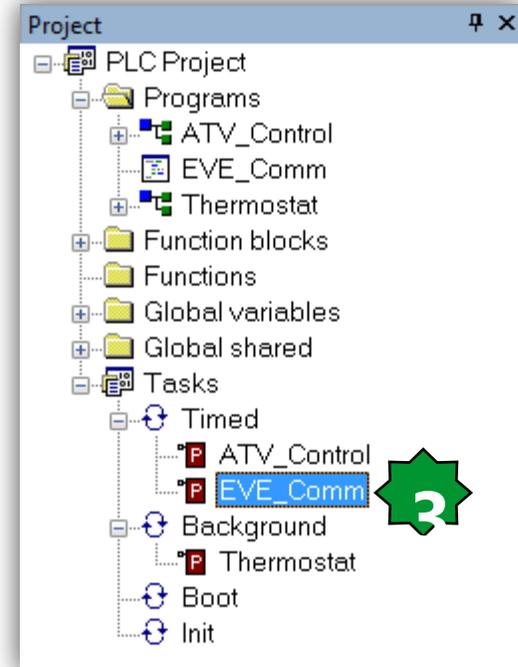
FreeEvolution 'EVE Menu' Menu

#	Name	Description
1	EVE_Alarm	
2	Green_LED_EVE1	

Green LED management



```
0001 (* Green Led will blink when communication works *)  
0002 Green_LED_EVE1 := 2;  
0003  
0004 (* D01_E of EVE IS ON when AI1_E is measuring more than 20 degree *)  
0005 D01_E := (AI1_E >= 200);  
0006 (* D02 of EVE is ON when AI1_E probe is disconnected *)  
0007 D02_E := (AI1_E = -32768);  
0008 (* EVE communication alarm *)  
0009 EVE_Alarm := sysPeripheralStatus[3];
```



Name: sysPeripheralStatus

Type: ARRAY[0..129] OF BOOL

Address: %MX7.0

Description:

Peripheral status.

It is an array of BOOL used to check connection status of expansions over field CANopen.

Every expansion has its own CANopen serial address.

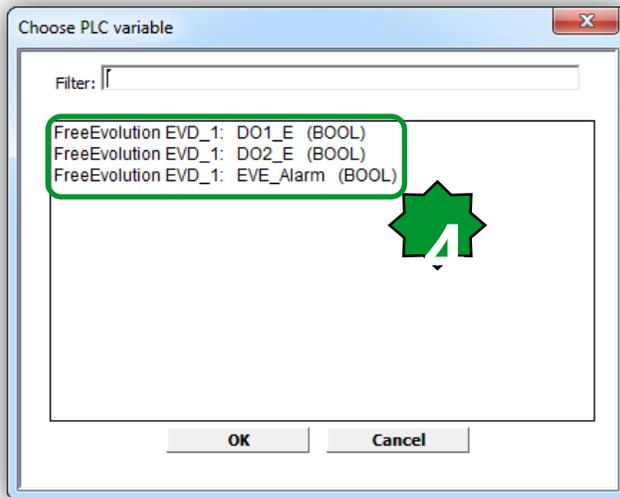
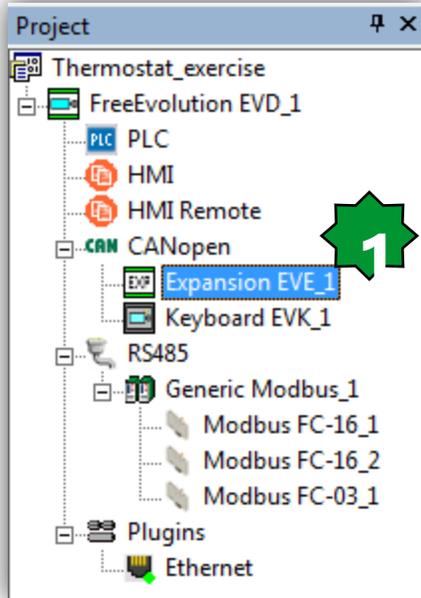
Connection status of expansion having serial address 3 is sysPeripheralStatus[5].

Connection status of expansion having serial address 10 is sysPeripheralStatus[12].

TRUE	=	means expansion not recognized.
FALSE	=	expansion correctly connected.

1. Project ► Programs ► new program
2. Name it as: EVE_Comm
3. Assign it to the timed task
4. Program
5. Communication configuration ► OK

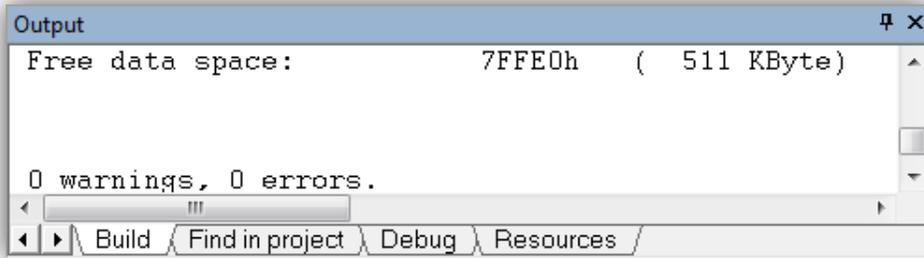
Green LED management/Output



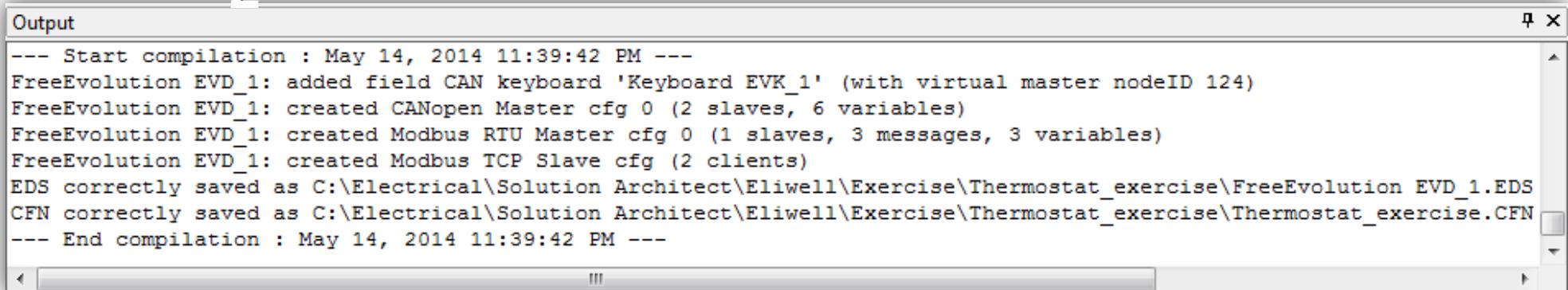
Expansion EVE Configuration

General		SDO Set		PDO Tx - Input		PDO Rx - Output				
		Assign		UnAssign						
#	Idx	Sub	PDO	Bit	COBID	Object Name	Type	Size	Label	DataBlock
1	6200	1	1	0	201	Write Output 1h to 8h	BOOL	1	DO1_E	QX11.0
2	6200	1	1	1	201	Write Output 1h to 8h	BOOL	1	DO2_E	QX11.1
3	6200	1	1	2	201	Write Output 1h to 8h	BOOL	1		
4	6200	1	1	3	201	Write Output 1h to 8h	BOOL	1		
5	6200	1	1	4	201	Write Output 1h to 8h	BOOL	1		
6	6200	1	1	5	201	Write Output 1h to 8h	BOOL	1		
7	6200	1	1	6	201	Write Output 1h to 8h	BOOL	1		
8	6411	1	2	0	301	Analogue Output 1	INT	16		
9	6411	2	2	16	301	Analogue Output 2	INT	16		
10	6411	3	2	32	301	Analogue Output 3	INT	16		
11	6411	4	2	48	301	Analogue Output 4	INT	16		
12	6411	5	3	0	401	Analogue Output 5	INT	16		
13	21c0	0	5	0	501	LED1	USINT	8	Green_LED_EVE1	MW110.4
14	21c1	0	5	8	501	LED2	USINT	8		
15	21c2	0	5	16	501	LED3	USINT	8		

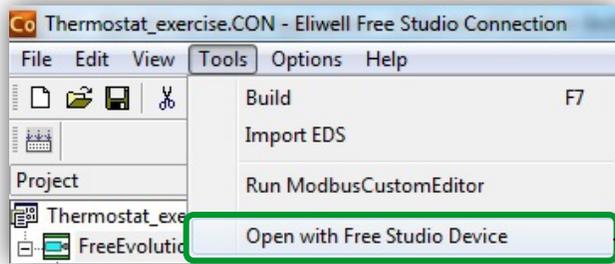
Build the connection



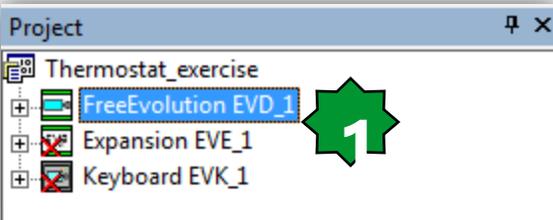
Note:
To apply the changes to the network, free studio asks you to reboot.



Open with free studio device



Download via RS485



FreeEvolution 423 Configuration

General

Name: FreeEvolution EVD_1

File version: 423.18

Communication

Protocol: Modbus

Address: 1

Port: COM:1

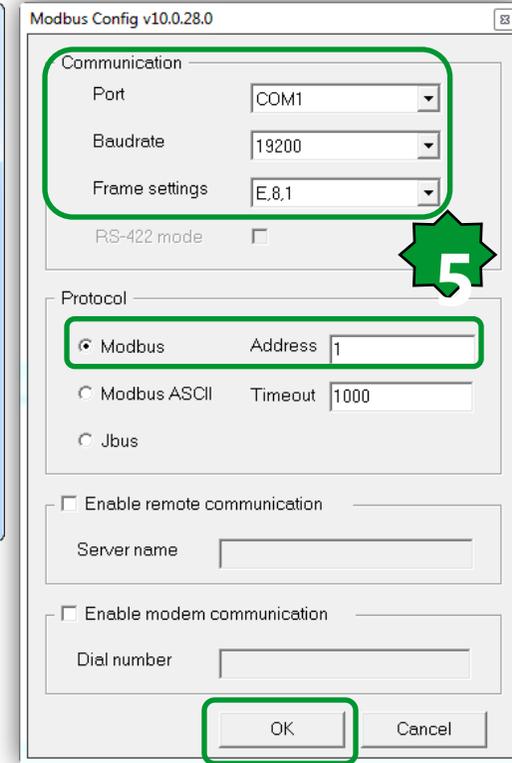
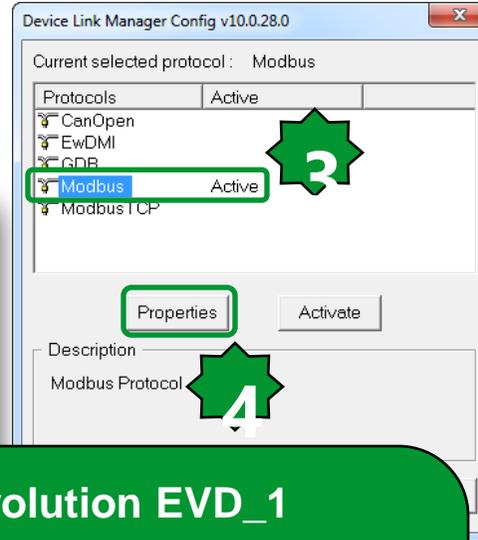
Baud rate: 38400

Disable communication

Settings

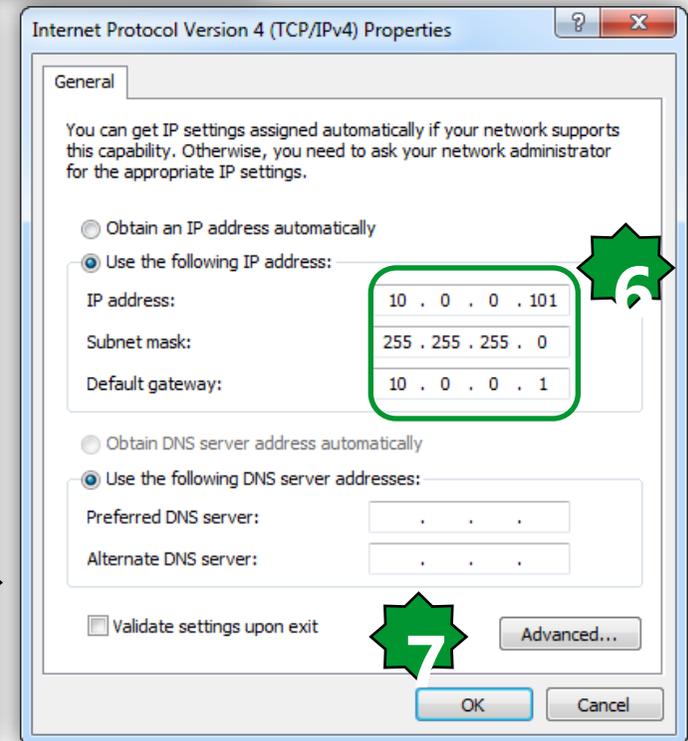
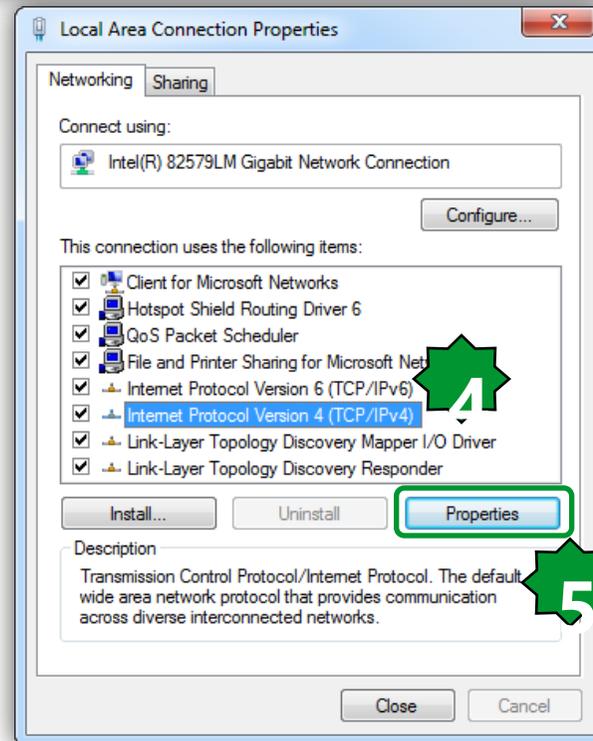
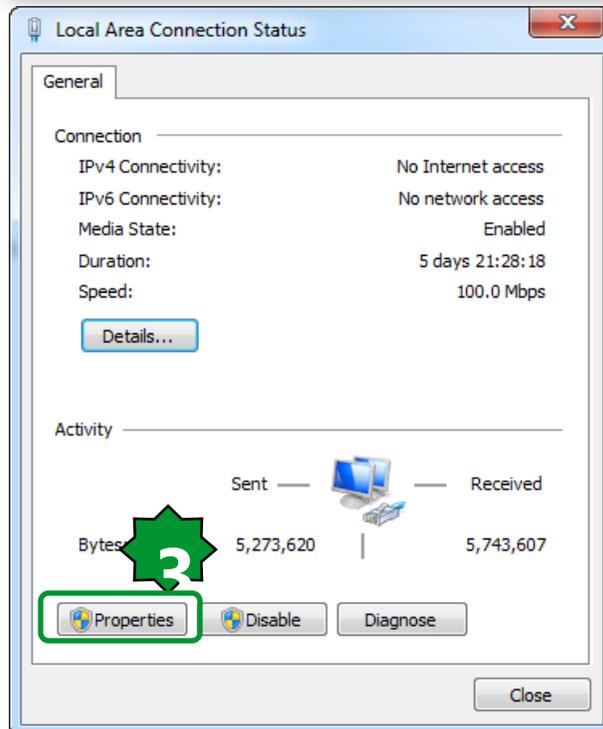
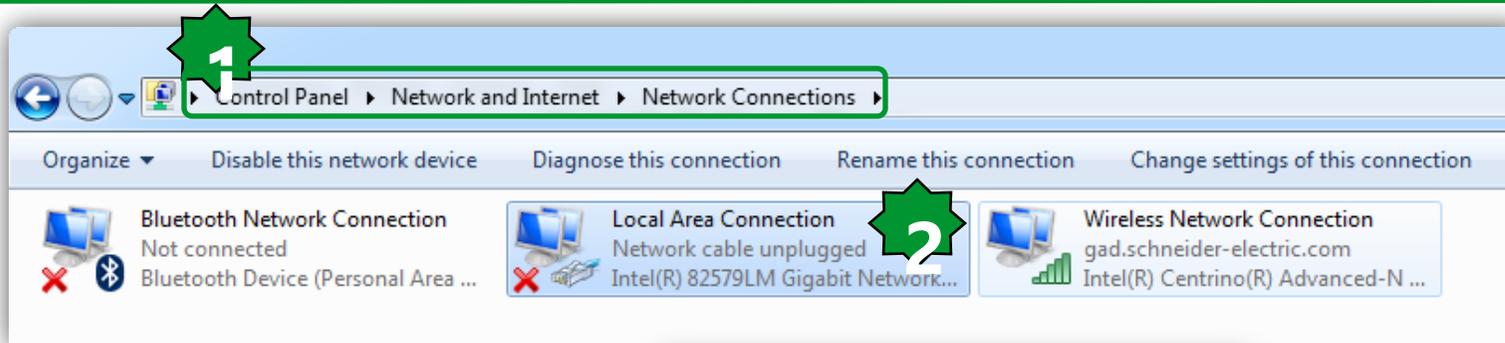


1. Project ► FreeEvolution EVD_1
2. Settings
3. Activate Modbus
4. Properties
5. Communication configuration ► OK
6. Connect to the target
7. Download all

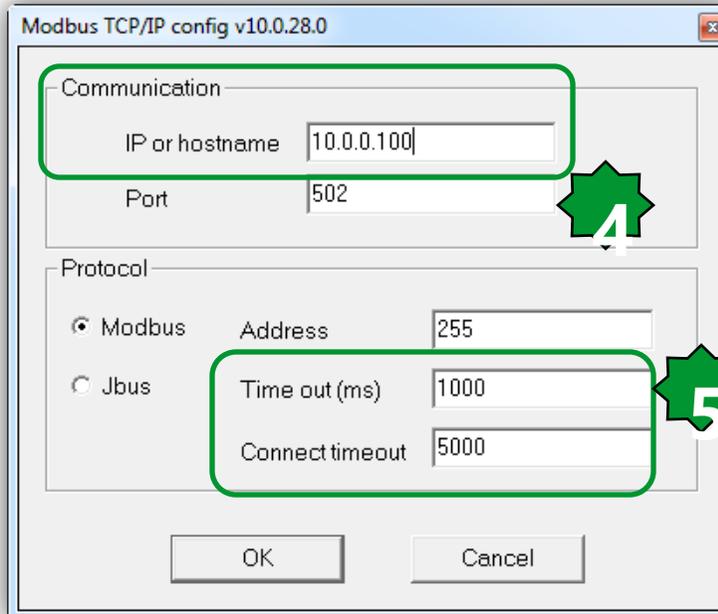
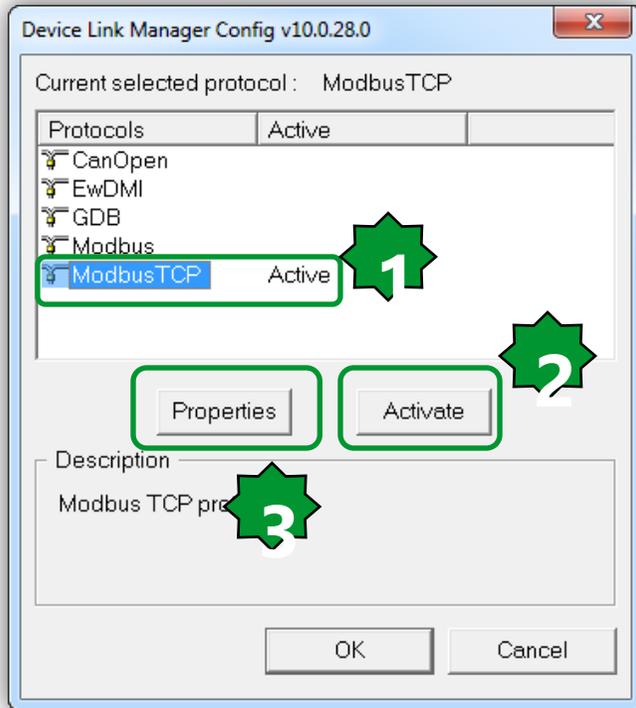


- Other operations
- BIOS download
 - Open file browser
 - Web site download
 - Web site preview

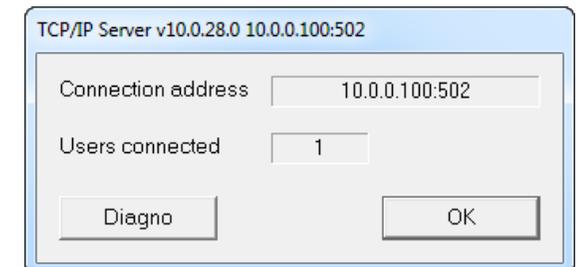
PC TCP/IP configuration



Modbus TCP/download



5.change Timeout and Connect Timeout based on the Ethernet band available. If the connection it is not direct it is better to increase both of them 10000-20000



Chapter 12

Modbus Communication

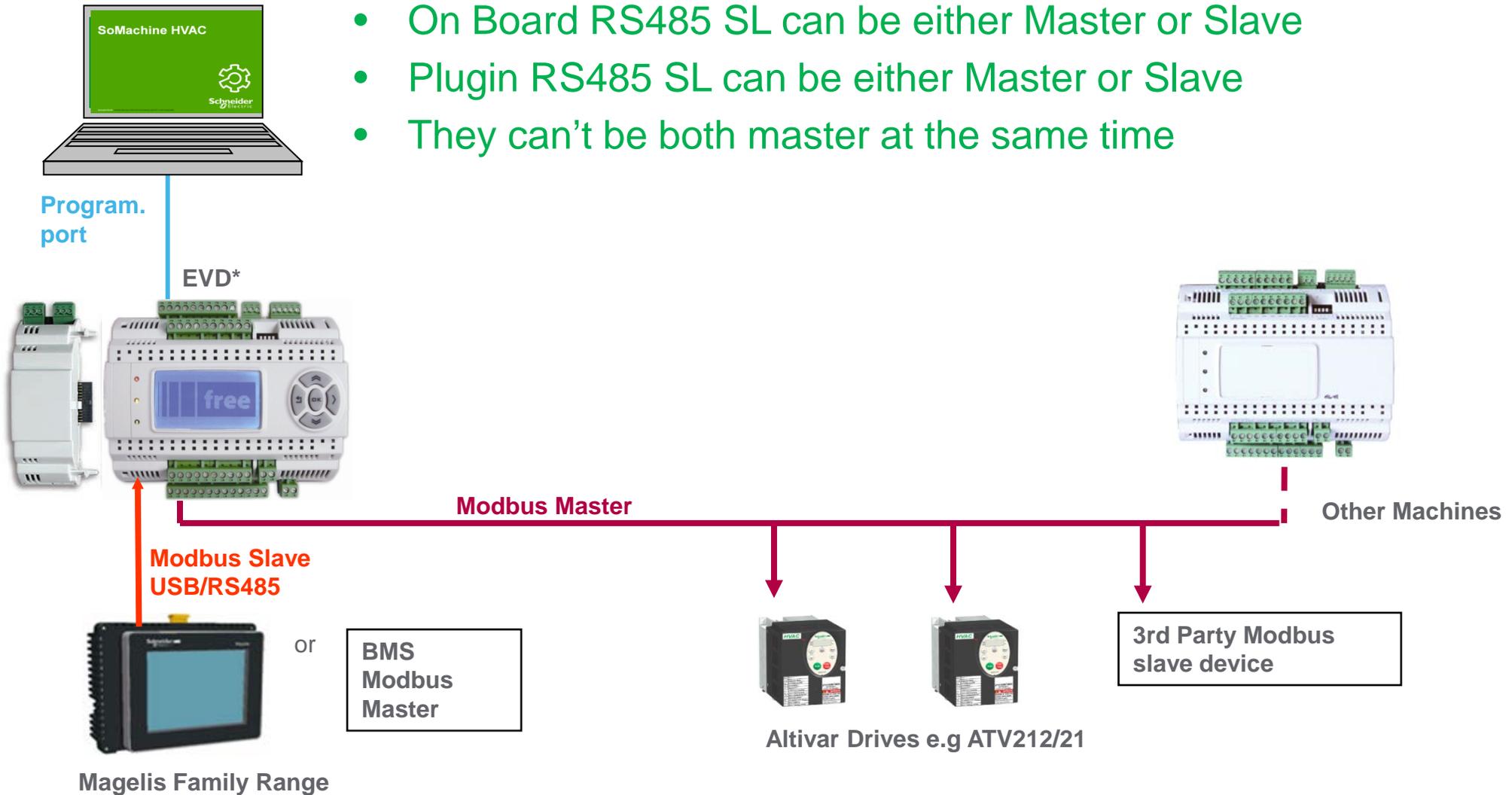
Goal:

Connection ATV21/212 to the Evolution via Modbus serial line, write the command + speed reference and read the output frequency



Machines architecture

- On Board RS485 SL can be either Master or Slave
- Plugin RS485 SL can be either Master or Slave
- They can't be both master at the same time



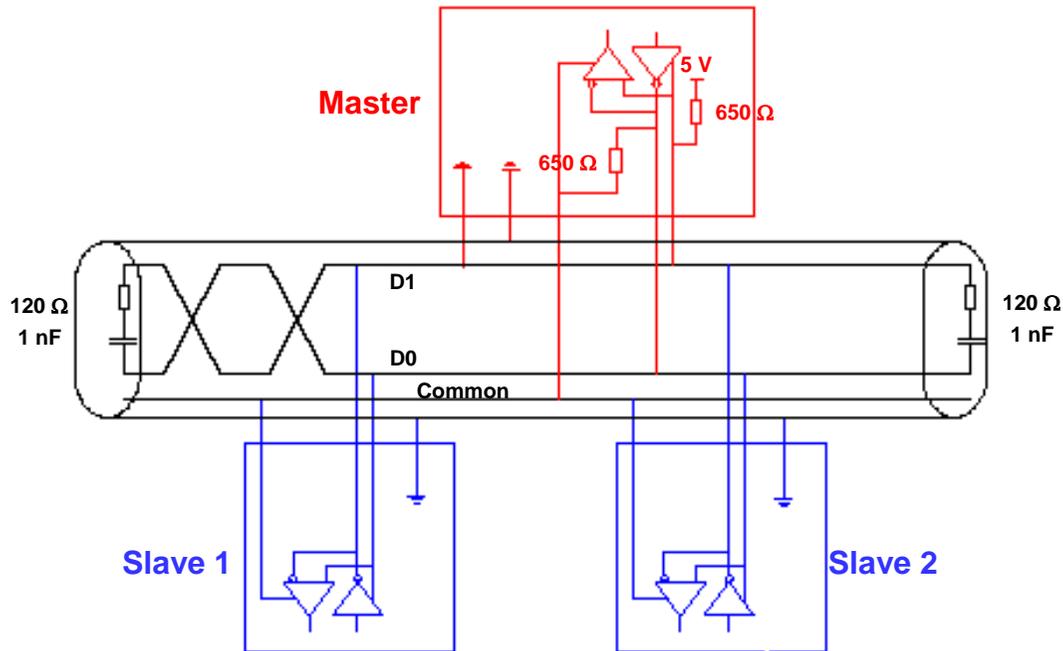
ATV 21/212 via Modbus



Set ups at ATV21:

- LOC / REM = off
- CN0d = 2 Enables Start / Stop control via network
- FN0d = 4 Enables frequency reference to be Controlled by network.
- F800: 1 (default) = 19200bps
- F801: 1 (default) = even parity
- F802: 1 = Address of ATV21
- F803: 4 = Timeout in seconds
- F829: 1 (default) = Protocol Modbus RTU
- F851: 1 = Communication fault setting
- (Last commanded operation continues)

Modbus RS485 standard schematic



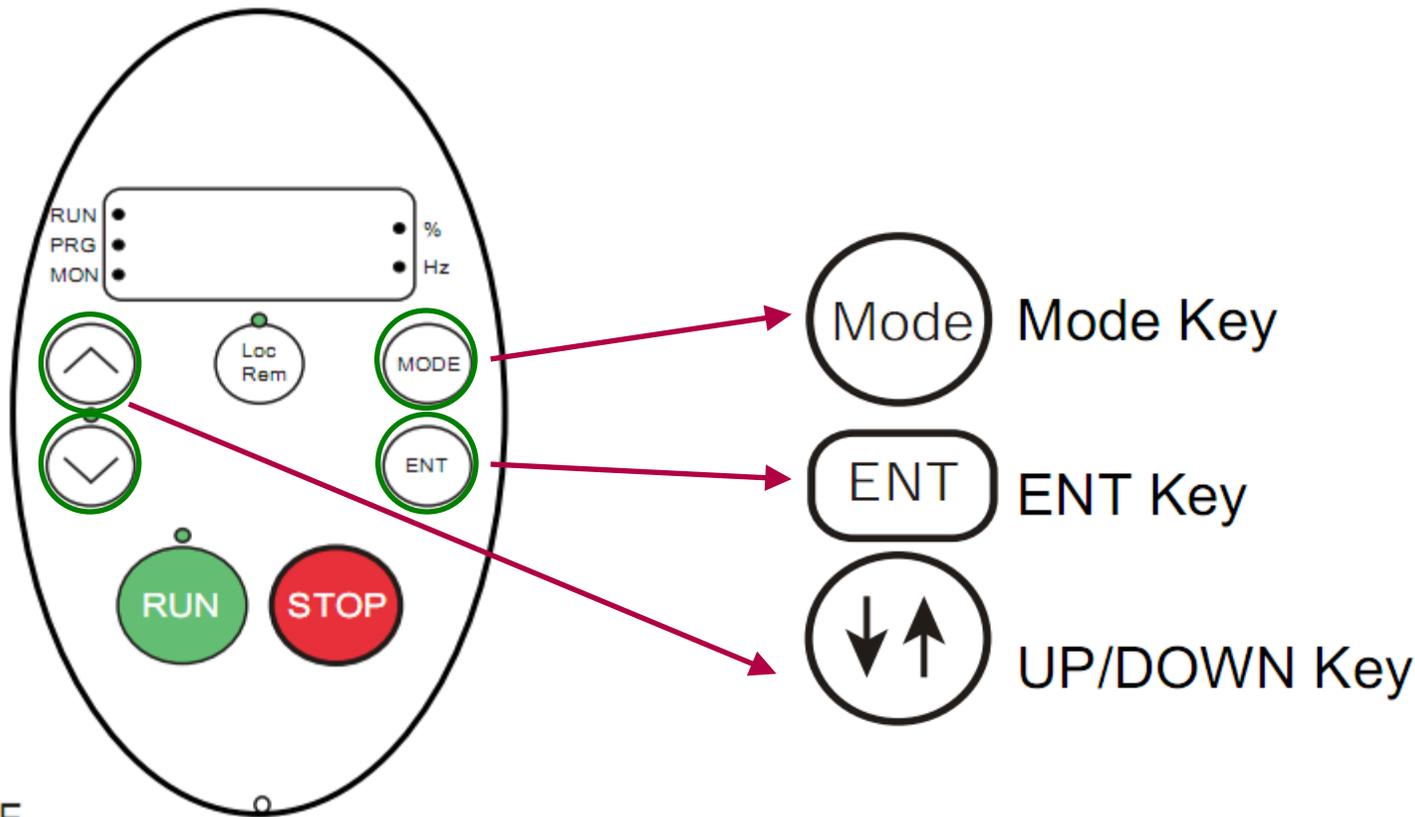
Maximum length of bus	1000 m at 19200 bps
Maximum number of stations (without repeater)	32 (31 slaves)
Maximum length of tap links	20 m for one tap link 40 m divided by the number of tap links
Bus polarisation	650 Ω at 5V and common for the master
Line terminator	120 Ω - 0,25Wm in series with 1nF 10V
Common polarity	Yes (Common) connected to the PG

Modbus – ATV21/212



- Drive (slave)

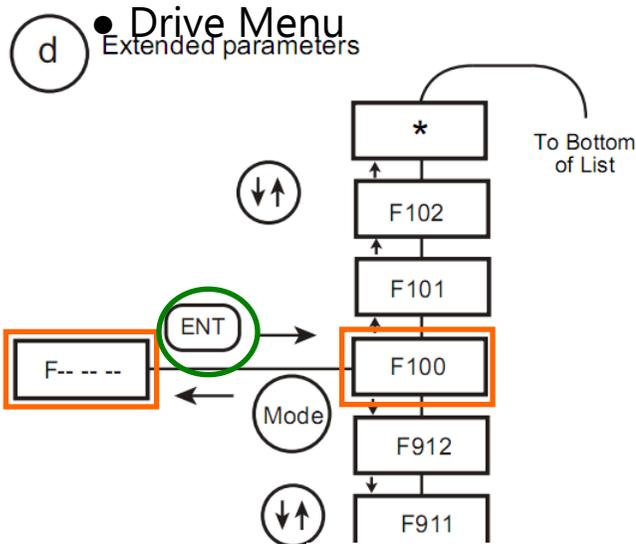
- use Drive Keypad for setting Modbus parameters



Modbus – ATV21/212 configuration



● Drive (slave)

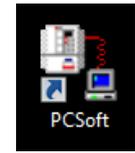


1. Press **DOWN** key repeatedly advance to **F829**
2. press **ENTER** key to change setting
3. with **UP/DOWN** keys change value
4. press **ENTER** to confirm and exit
5. repeat for parameters listed

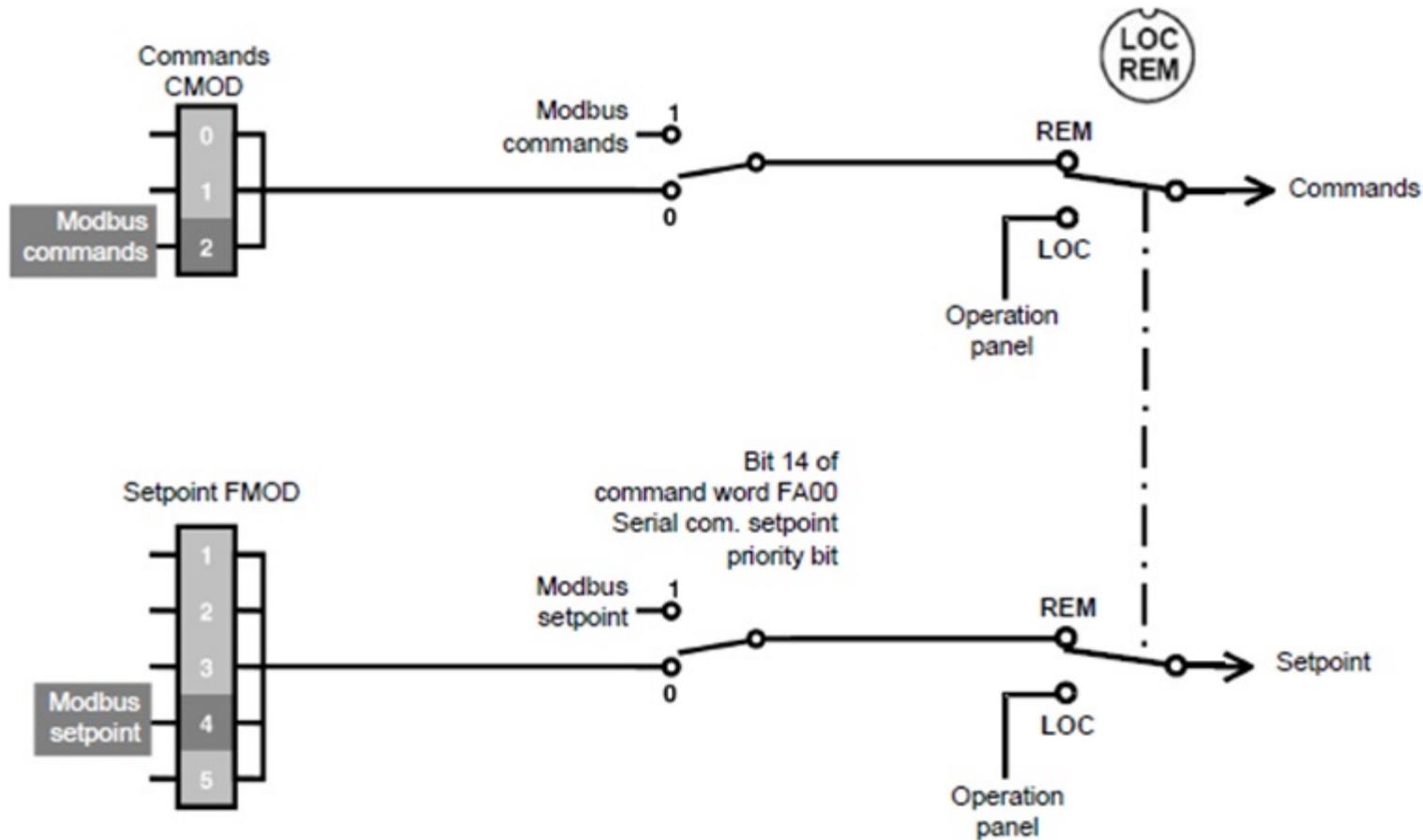
Important: Cycle power on drive after changing Modbus settings for changes to become effective.

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F829	0829	Selection of communication protocol	0 ... 4 1: Modbus-RTU protocol	-	1 <input type="text" value="1"/>	After reset
F800	0800	Baud rate	0: 9600 bps 1: 19200 bps	-	1 <input type="text" value="1"/>	After reset
F801	0801	Parity	0: NON (No parity) 1: EVEN (Even parity) 2: ODD (Odd parity)	-	1 <input type="text" value="1"/>	After reset
F802	0802	Modbus address	0 ... 247	-	1 <input type="text" value="1"/>	After setting

Modbus – ATV21/212 configuration Command & Speed Reference



Parameter title	Function number	Function description
CNOO	2	Serial communication
FNOO	4	Serial communication



Modbus – ATV21/212 configuration Command & Speed Reference



Code	Name/Description	Adjustment range	Factory setting
<div style="border: 1px solid green; padding: 2px; display: inline-block; color: green;">C P O d</div> <div style="text-align: center; font-size: 2em; color: green; margin: 10px 0;">1</div> <div style="text-align: center; font-size: 2em; color: green; margin: 10px 0;">2</div> <div style="text-align: center; font-size: 2em; color: green; margin: 10px 0;">4</div>	<p><input type="checkbox"/> Remote Mode Start/Stop Control</p> <p>The setting of parameter C P O d determines the source of start, stop, forward, and reverse operation commands when the drive is in remote mode.</p> <p>The drive must be stopped to make changes to parameter C P O d.</p> <p>See diagram on page 31 for more information on the source of the drive's operation commands.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Control terminal logic inputs. <input type="checkbox"/> Graphic display terminal. <input type="checkbox"/> Serial communication 	-	0
<div style="border: 1px solid green; padding: 2px; display: inline-block; color: green;">F P O d</div> <div style="text-align: center; font-size: 2em; color: green; margin: 10px 0;">3</div> <div style="text-align: center; font-size: 2em; color: green; margin: 10px 0;">4</div>	<p><input type="checkbox"/> Remote Mode Primary Speed Reference Source</p> <p>The setting of parameter F P O d determines the source of the drive's speed reference when the drive is in remote mode.</p> <p>The drive must be stopped to make changes to parameter F P O d.</p> <p>See diagram on page 31 for more information on the source of the drive's speed reference.</p> <ul style="list-style-type: none"> <input type="checkbox"/> VIA <input type="checkbox"/> VIB <input type="checkbox"/> Graphic display terminal <input type="checkbox"/> Serial communication <input type="checkbox"/> +/- Speed 	-	1

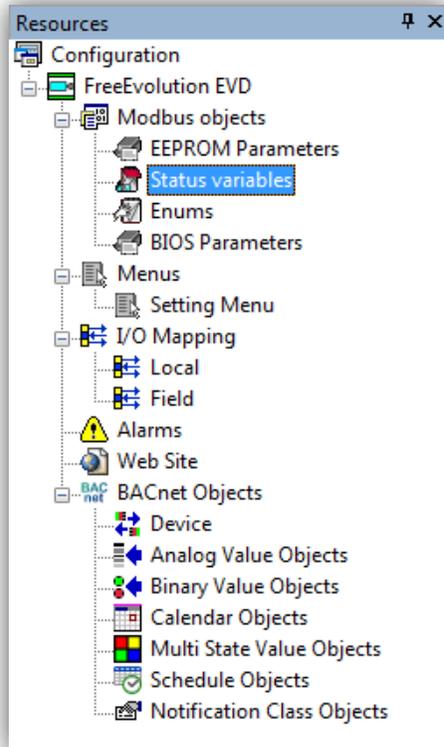


Mode ▶ AUF ▶ 4*▲ ▶ cmod ▶ ENT
 ▶ edit value ▶ ENT to validate



Mode ▶ AUF ▶ 5*▲ ▶ fmod ▶ ENT
 ▶ edit value ▶ ENT to validate

Modbus link



- Developer must define a set of variables corresponding to what he wants to read or write via Modbus using Status Variables.
- In case of 32-bit Modbus registers to be read/write, developer should define 2 16-bit Status variable and merge them later.

Registers:

- Command= 64000+1 (W ▶ FC16)
- Frequency = 64001+1 (W▶ FC16)
- Output Frequency = 64768+1 (R▶ FC03)

Message for ATV command:

- Start Command= 50176
- Stop Command= 49152

FreeEvolution Status Variables

Add Remove Recalc

#	Address	Name	Device type	Application type	AccessLevel	Read only	Description
1	8960	Ambient_Temperature	Signed 16-bit	INT	Always visible	True	
2	8961	ATV_Command	Signed 16-bit	INT	Always visible	False	
3	8962	ATV_Speed_Reference	Signed 16-bit	INT	Always visible	False	
4	8963	ATV_Output_Frequency	Signed 16-bit	INT	Always visible	True	

Modbus Master Configuration



Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - PLC
 - HMI
 - HMI Remote
 - CAN
 - CANopen
 - Expansion EVE_1
 - Keyboard EVK_1
 - RS485
 - Plugins

RS485 Configuration

Mode

Not used

Modbus Master (for field)

Baud rate

9600 b/s

19200 b/s

38400 b/s

57600 b/s

115200 b/s

Serial Mode

E,8,1 (Even parity, 8 data bits, 1 stop bit) ▼

Catalog

Device name	Version	Description
EXP Expansion EVE	460	Expansion EVE
Generic Modbus	1	Generic Modbus RTU node

1. Project ► RS485

2. Modbus configuration

3. Select Generic Modbus from the catalogue list

4. Drag & Drop it into the RS485

Generic Modbus



Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CAN CANopen
 - Expansion EVE_1
 - Keyboard EVK_1
 - RS485
 - Generic Modbus_1**
 - Plugins

Generic Modbus RTU node

General

Settings

Name:

Modbus address: (0 .. 247, 0=broadcast)

Node number: (0 .. 127)

Catalog

Device name	Version	Description	DeviceID
Modbus FC-01	1	Read Coils - Function 01 (0x01)	FC01
Modbus FC-02	1	Read Discrete Inputs - Function 02 (0x02)	FC02
Modbus FC-03	1	Read Holding Register - Function 03 (0x03)	FC03
Modbus FC-04	1	Read Input Registers - Function 04 (0x04)	FC04
Modbus FC-06	1	Write Single Register - Function 06 (0x06)	FC06
Modbus FC-15	1	Write Multiple Coils - Function 15 (0x0F)	FC15
Modbus FC-16	1	Write Multiple Register - Function 16 (0x10)	FC16

1. After drag & drop
2. Name it & define the Modbus address.
It is recommended to set the Node number the same as the Modbus address
3. Select the desired function code from catalogue

* Note: Vectors `sysMbRtu*` in the folder `Modbus Master` are addressed by node number



Library

- USB-Host handling
- System Timers
- System Tasks Execution Time
- System Parameters: Parameters image in RAM (read)
- System Parameters: EEPROM image in RAM (read)
- System Impulse Counter Input
- System Clock
- System BIOS version
- Plug-In identification
- Peripheral
- Modbus Master**
- MAC Address
- Led & Backlight Status
- General purpose Data Blocks
- Dip Switch
- Digital Outputs
- Digital Inputs
- Analog Outputs
- Analog Inputs

Operator and standard blocks Target variables Target blocks basic



Modbus Function Code



Device name	Version	Description	DeviceID
Modbus FC-01	1	Read Coils - Function 01 (0x01)	FC01
Modbus FC-02	1	Read Discrete Inputs - Function 02 (0x02)	FC02
Modbus FC-03	1	Read Holding Register - Function 03 (0x03)	FC03
Modbus FC-04	1	Read Input Registers - Function 04 (0x04)	FC04
Modbus FC-06	1	Write Single Register - Function 06 (0x06)	FC06
Modbus FC-15	1	Write Multiple Coils - Function 15 (0x0F)	FC15
Modbus FC-16	1	Write Multiple Register - Function 16 (0x10)	FC16



1. Select the required function code
 2. Drag & drop it into the Project
 - ▶ RS485 ▶ Generic Modbus 1
 3. Do the general settings
- Registers:
Command= 64000+1 (W → FC16)
Frequency = 64001+1 (W → FC16)
Output Frequency = 64768+1 (R → FC03)

Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CAN CANopen
 - Expansion EVE_1
 - Keyboard EVK_1
 - RS485
 - Generic Modbus_1
 - Modbus FC-16_1
 - Plugins



Modbus FC 16(0x10) - Write Multiple Register

General

Multiple Reg.

Settings

Start address: (1 .. 65536)

Polling time: ms (0 = write on variation)

Time out: ms

Wait before send: ms



Message for ATV command:
Start Command= 50176
Stop Command= 49152

Important: Some slave devices requires an offset of one to register Address: ATV requires it, Evolution doesn't need it.

Modbus Function Code/Settings



Modbus FC 16(0x10) - Write Multiple Register

General **Multiple Reg.**

Settings

Start address: (1 .. 65536)

Polling time: ms (0 = write on variation)

Time out: ms

Wait before send: ms

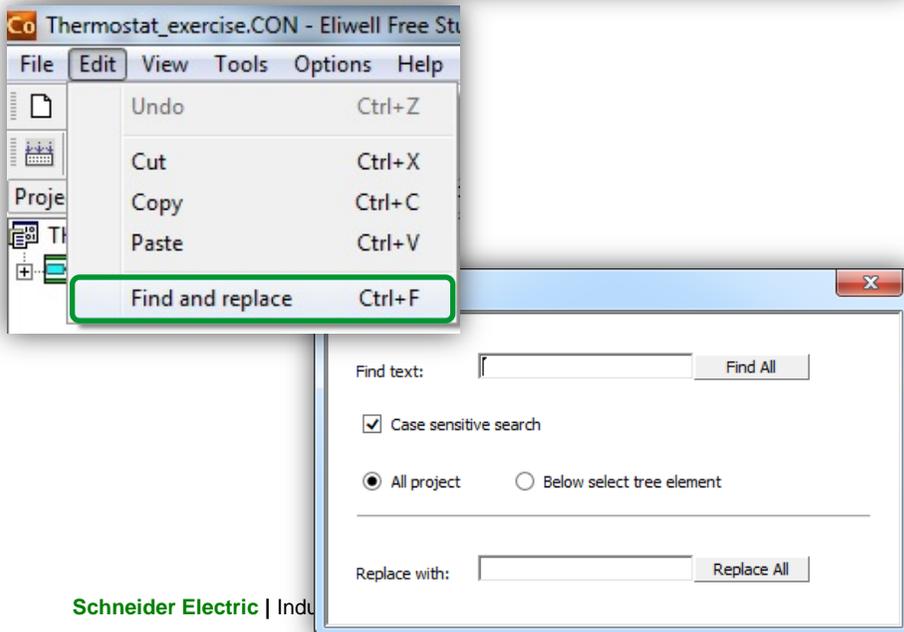
1. Start address: address of the first modbus object to read or write (1..65536).
2. Polling time: minimum waiting period between 2 message processing (ms); for writing operations, 0 means to write it only on variation of the value, for reading operations 0 means maximum speed.
3. Timeout: the operation will fail when this time-out expires (ms).
4. Wait before send: Waiting time after end of previous message response (suggested time ≥ 10 ms).

3. Timeout: the operation will fail when this time-out expires (ms).

4. Wait before send: Waiting time after end of previous message response (suggested time ≥ 10 ms).

Note: Follow below order in Modbus:

1. Write (FC16)
2. Read (FC3)



Multiple Reg.



Modbus FC 16(0x10) - Write Multiple Register

General | **Multiple Reg.**

Add Remove Assign UnAssign

#	Name	ObjType	Label	Address	DataBlock	Description
1	Register	WORD	ATV_Command	64001	MW110.1	

Choose PLC variable

Filter:

- FreeEvolution EVD_1: AO1_P (INT)
- FreeEvolution EVD_1: DO4_P (BOOL)
- FreeEvolution EVD_1: DO3_P (BOOL)
- FreeEvolution EVD_1: Ambient_Temperature (INT)
- FreeEvolution EVD_1: ATV_Command (INT)**
- FreeEvolution EVD_1: ATV_Speed_Reference (INT)
- FreeEvolution EVD_1: ATV_Output_Frequency (INT)

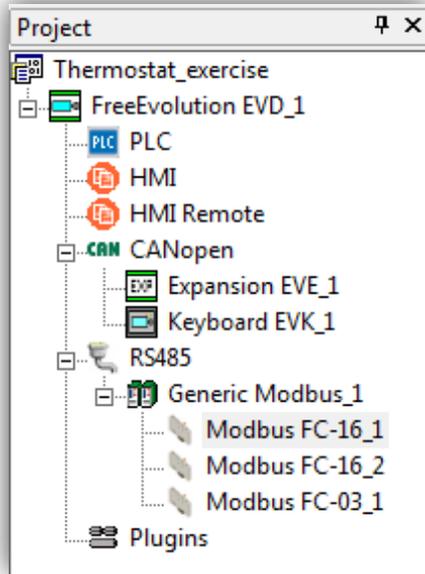
OK Cancel

1. Press Add/Remove in order to define how many registers should be written
2. Assign
3. Choose PLC variable ► OK

Note:

- ATV does not support more than 1 read/ write register with the same message
- Waiting time after end of previous message response (suggested time $\geq 10\text{ms}$)

Generic Modbus\Register



Modbus FC 16(0x10) - Write Multiple Register

General | **Multiple Reg.**

Add Remove Assign UnAssign

#	Name	ObjType	Label	Address	DataBlock	Description
1	Register	WORD	ATV_Command	64001	MW110.1	

Modbus FC 16(0x10) - Write Multiple Register

General | **Multiple Reg.**

Add Remove Assign UnAssign

#	Name	ObjType	Label	Type	Address	DataBlock	Description
1	Register	WORD	ATV_Output_Frequency	INT	64002	MW110.3	

Modbus FC 03(0x03) - Read Holding Register

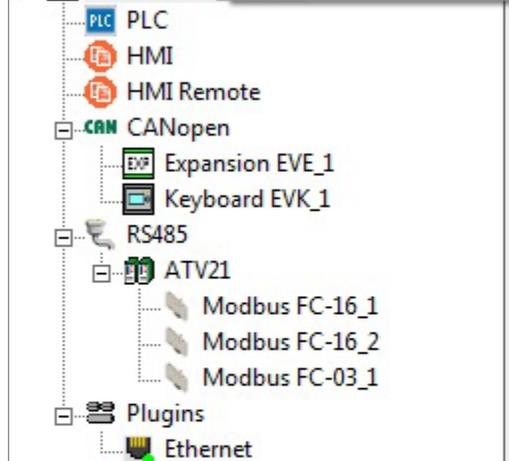
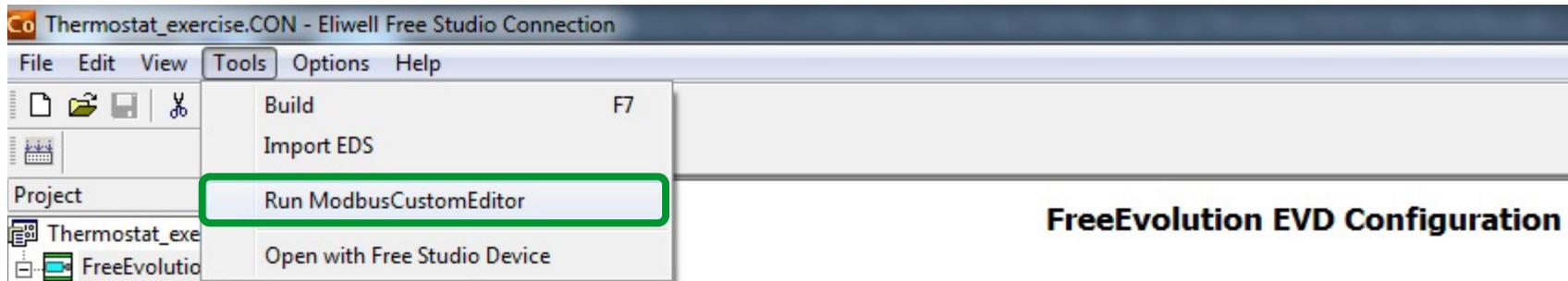
General | **Holding Reg.**

Add Remove Assign UnAssign

#	Name	ObjType	Label	Type	Address	DataBlock	Description
1	Register	WORD	ATV_Output_Frequency	INT	64769	MW110.3	

If a status variable is used to write a value on variation and to read the same value, the related write message must be listed in Connection before the corresponding read message

...Creating a new Modbus custom device



General

Name:

Version:



Note: To create a new Modbus custom device, choose Tools / Run ModbusCustomEditor; the external ModbusCustomEditor tool will be launched, with a new empty document.

Creating a new Modbus custom device...



3

1

2

File View Tools Help

Name:

Description:

Version:

Max message size (bit):

Max message size (reg.):

Allow objects with the same address

Add Remove Up Down

#	Address	Label	Type	Read only	Modbus type	Description
1	64001	ATV_Command	INT	False	Holding Register (16 bit)	
2	64002	ATV_Output_Frequency	INT	False	Holding Register (16 bit)	
3	64769	ATV_Speed_Reference	INT	False	Holding Register (16 bit)	

Save As

Save in: ModbusCustom

Name	Date modified	Type
html	20/06/2014 2:12 PM	File folder
ModbusCustom.pct	14/05/2014 1:58 PM	ModbusC

File name:

Save as type: ModbusCustomEditor Files (*.PCT)

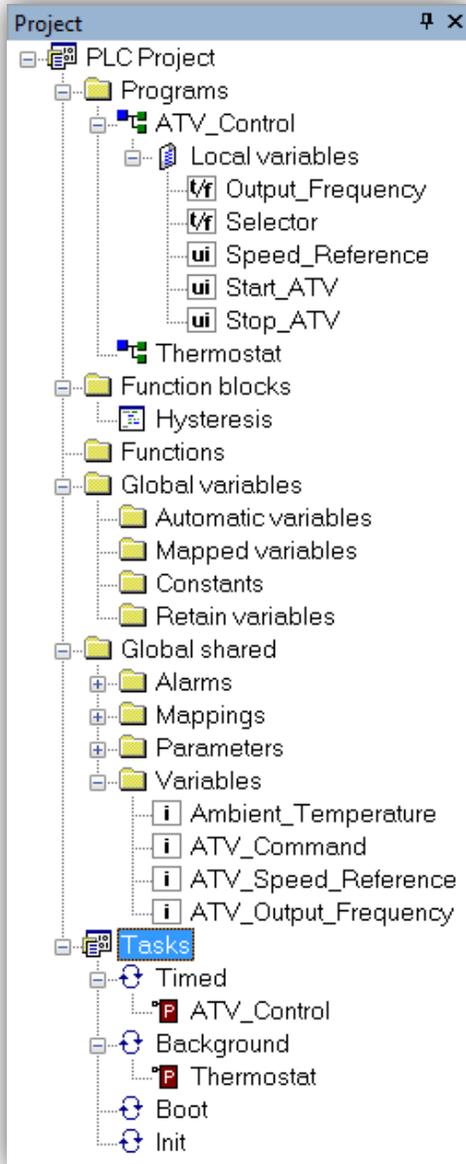
Save Cancel

4

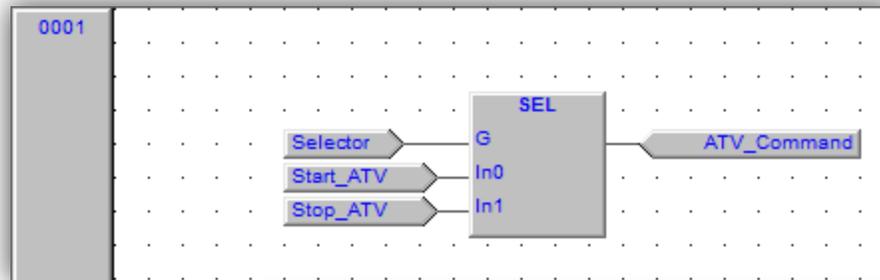
Note:

Advantage: Easier to be used in Connection
Disadvantage: Message are not optimized & common polling time for all messages

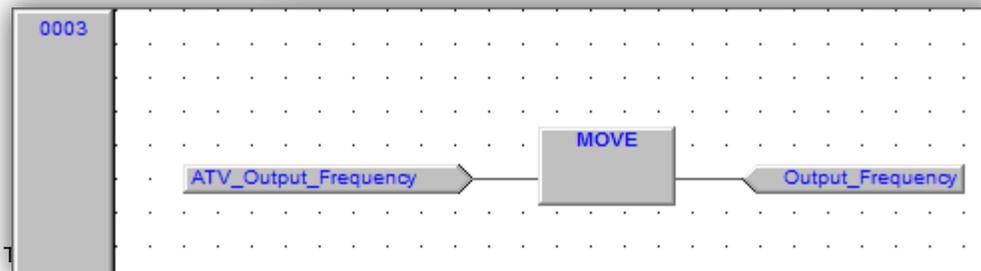
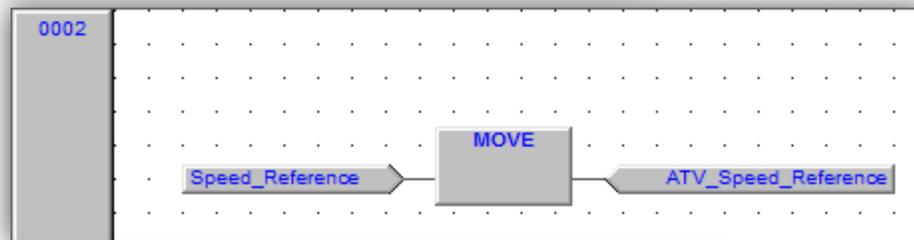
ATV control, Local variable definition



Local variables						
	Name	Type	Address	Array	Init value	Attribute
1	Selector	BOOL	Auto	No	False	..
2	Speed_Reference	INT	Auto	No		..
3	Output_Frequency	INT	Auto	No		..
4	Start_ATV	UINT	Auto	No	50176	CONSTANT
5	Stop_ATV	UINT	Auto	No	49152	CONSTANT



Note: Two independant group of blocks must be place in two separate networks



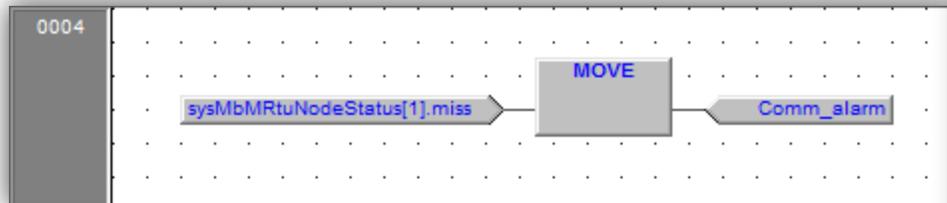
Modbus Communication Alarm



Library

ud sysGPArrayOf_UDINT	tf sysLocalDipSwitch	ud sysUsbCommand
ui sysGPArrayOf_UINT	us sysLocalLeds	st sysUsbFileName
us sysGPArrayOf_USINT	b sysMacAddress	ui sysUsbParamDatMaxAddress
pg sysImpulseCounter	tf sysMbMRtuNodePresence	ui sysUsbParamDatMinAddress
tf sysImpulseCounter_as_FDI	pg sysMbMRtuNodeStatus	ud sysUsbStatus
tf sysImpulseCounter_ResetCounter	tf sysMbMTcpNodePresence	ui sysVER
w sysLangID	pg sysMbMTcpNodeStatus	ui Temp_UM
ui sysLocalADCs	ui sysMSK	
i sysLocalAnalogInputs	w sysParameter	
i sysLocalAnalogOutputs	tf sysPeripheralStatus	
tf sysLocalDigitalInputs	ud sysTimer	
ud sysLocalDigitalInputsImpulseCounter	ud sysTskBckExeTime	
tf sysLocalDigitalInputsResetCounter	ud sysTskTmdExeTime	
tf sysLocalDigitalOutputs	ui sysTskTmdScanTime	

Operator and standard blocks | Target variables | Target blocks | basic



View object properties

Name: sysMbMRtuNodeStatus

Type: ARRAY[0..127] OF MBMNODESTATUS

Address: %MB2001.0

Description:
System Modbus Master RTU communication status. It is a structure of type MBMNODESTATUS composed by the following fields:

com_hdlr :	BYTE; Communication handler
addr_1 :	USINT; Network address part 1
addr_2 :	USINT; Network address part 2
addr_3 :	USINT; Network address part 3
addr_4 :	USINT; Network address part 4
cfg :	BOOL; Configured
pres :	BOOL; Present
miss :	BOOL; Slave failure
missCnt :	UINT; Number of Task Timed cycles with Slave failure
state :	UINT; Slave failure error code

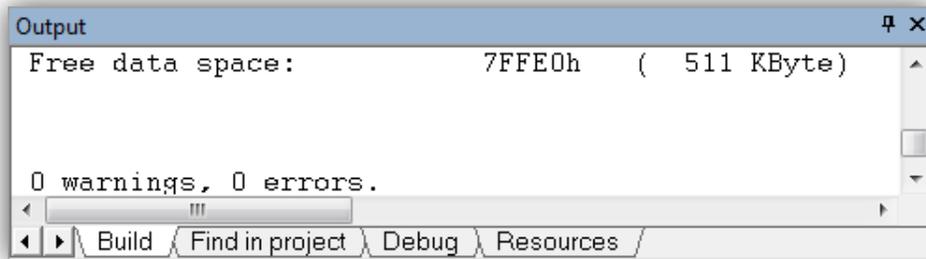
state could have the following meanings:
(valid only if miss is TRUE, never set to 0)

- 0 = No errors
- 1 = Tx data failed
- 2 = Rx time out (at starting)
- 3 = System error
- 4 = Rx time out (frame not ended)

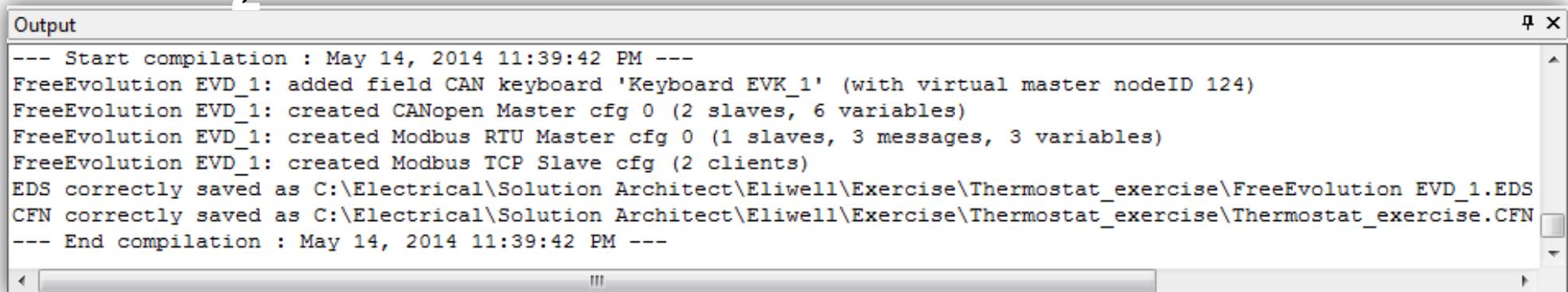
Close

See next chapter for download details

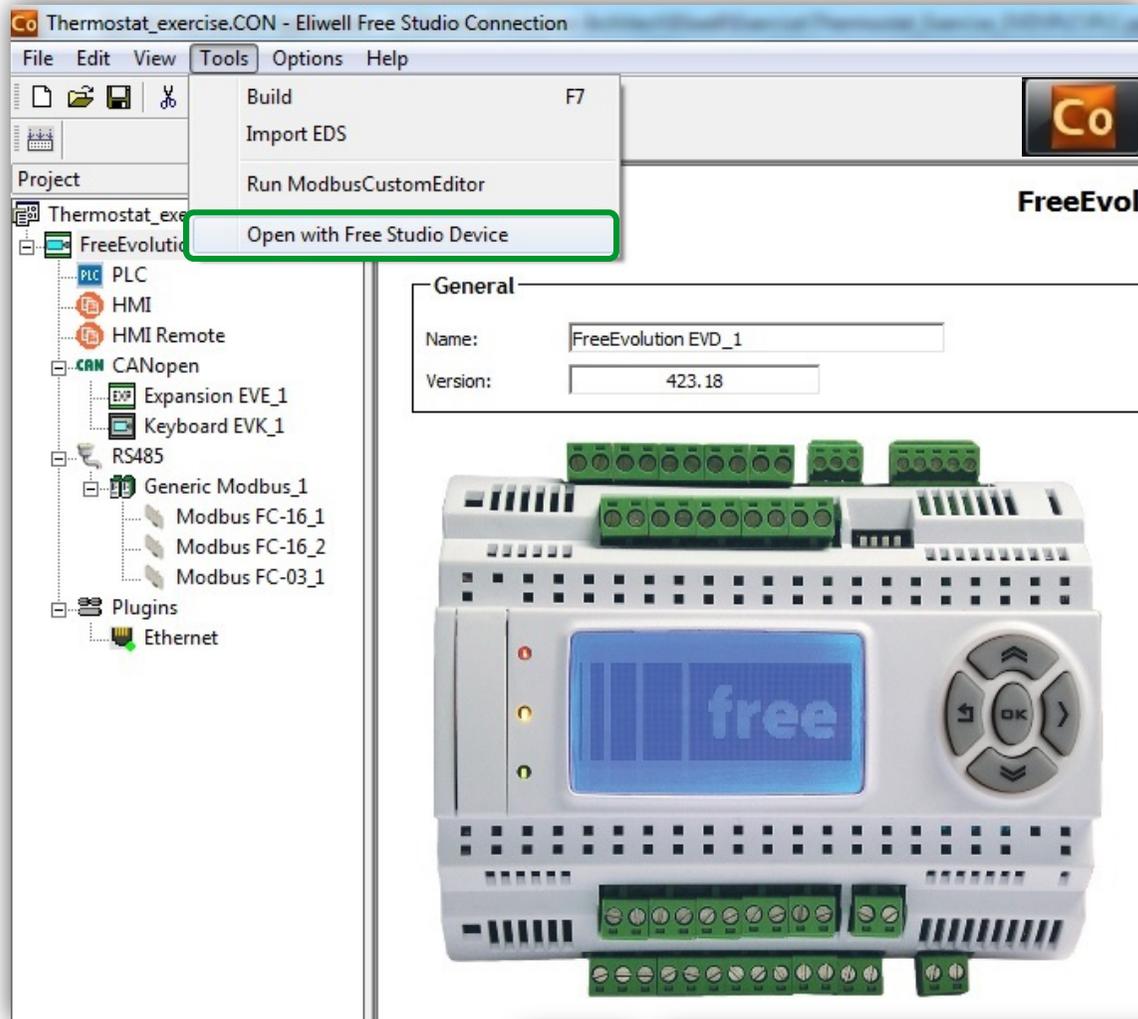
Recompile & Build



Note:
To apply the changes to the network,
free studio asks you to reboot.
Yes: if you want to validate it.
Cancel: if you want to dismiss



Open with free studio device



See next chapter for further details on download via TCP

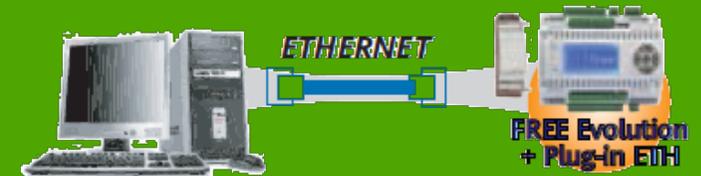


Chapter 13

Modbus TCP

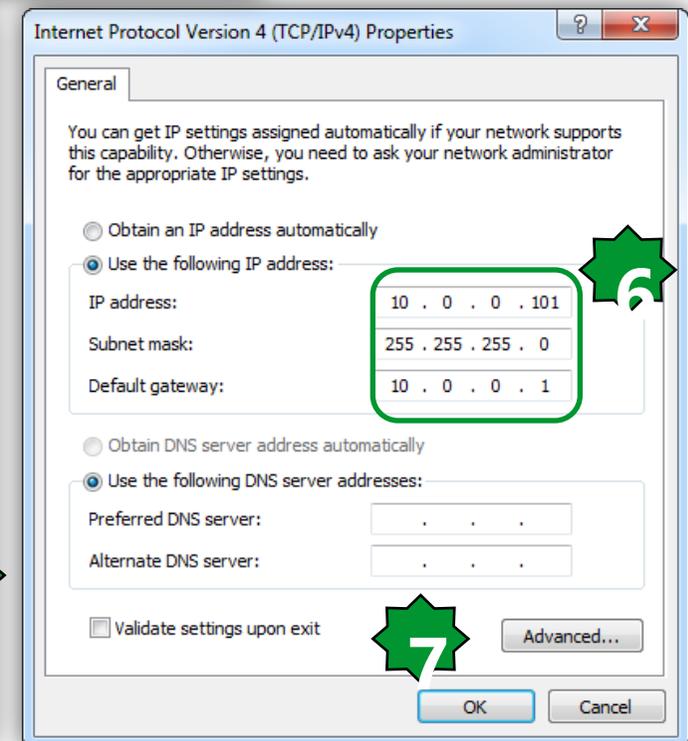
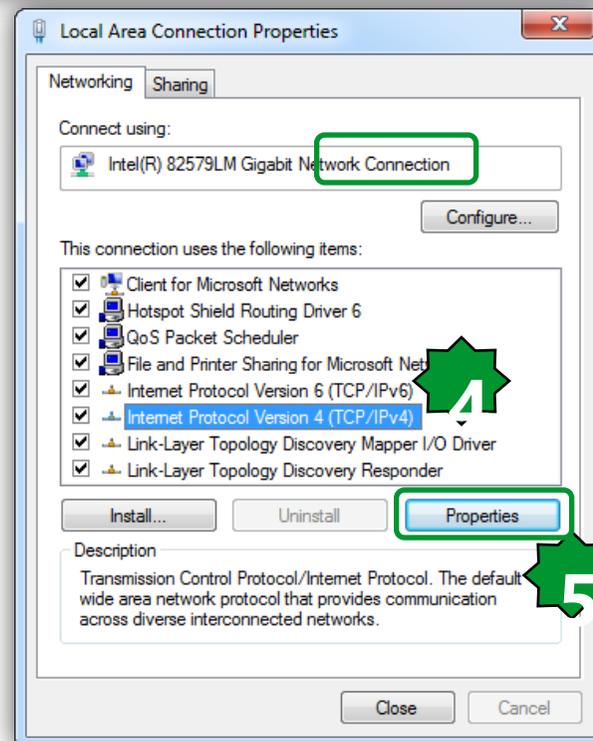
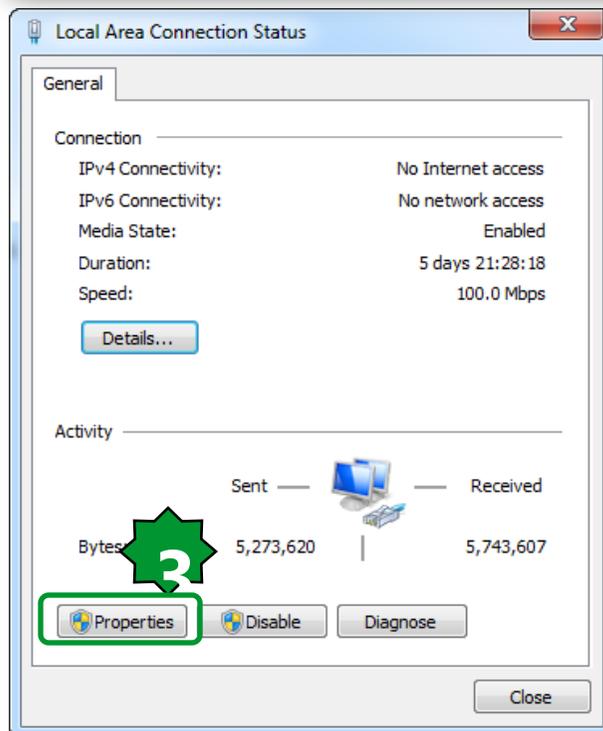
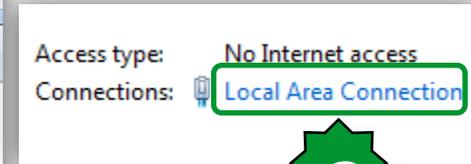
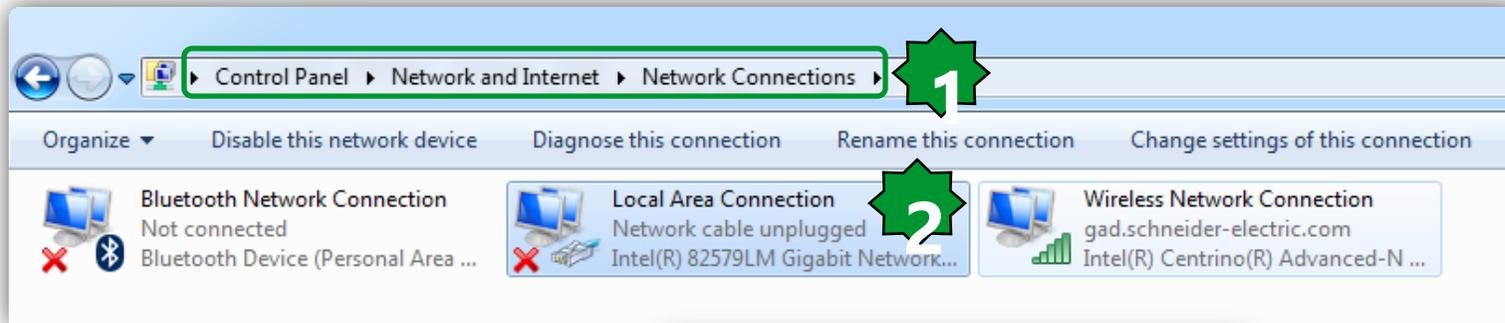
Goal:

Modbus TCP configuration, project download and socket management

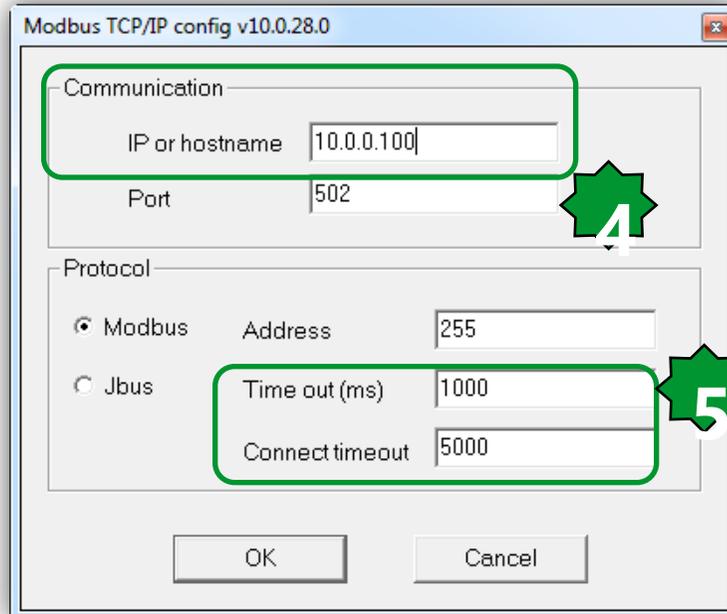
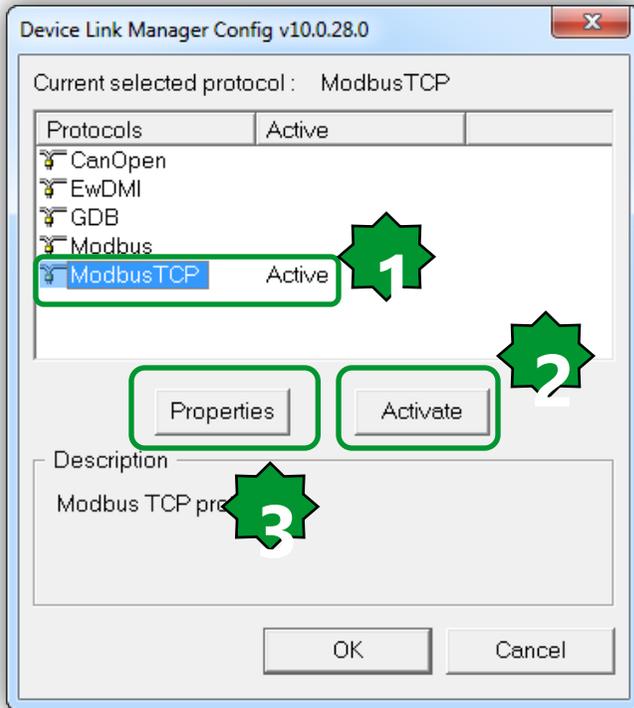


Schneider
Electric

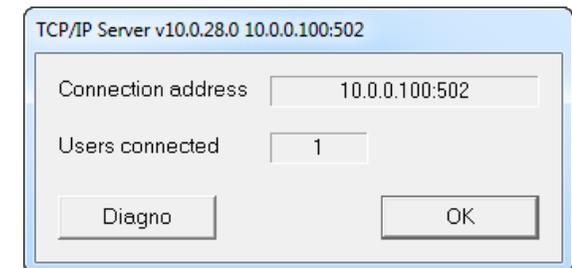
PC TCP/IP configuration



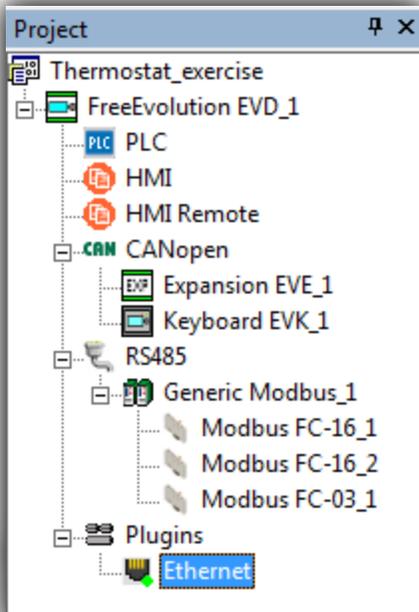
Modbus TCP/download



5.change Timeout and Connect Timeout based on the Ethernet band available. If the connection it is not direct it is better to increase both of them 10000-20000



Modbus TCP socket



Device name	Version	Description	DeviceID
CAN CANopen	1	FreeEvolution_CANopen	FreeEvolution_CANopen
Ethernet	1	FreeEvolution_Ethernet	FreeEvolution_Ethernet
RS232	1	FreeEvolution_RS232	FreeEvolution_RS232
RS485	1	FreeEvolution_RS485	FreeEvolution_RS485
Profibus DPV0	1	FreeEvolution_ProfibusDPV0	FreeEvolution_ProfibusDPV0

1.Plugins

2. Catalogue ► drag & drop Ethernet into the plugins part

3. Set the Network: Ethernet1

Maximum 9 additional sockets(+2 opened by default).

Note that 5 sockets are related to Webserver

Note (Additional Modbus TCP sockets):

If you have to increase the number of Modbus/TCP sockets (by default they are 3) or if you have to implement binding between Evolution.

General

Enable Modbus Master (for binding)

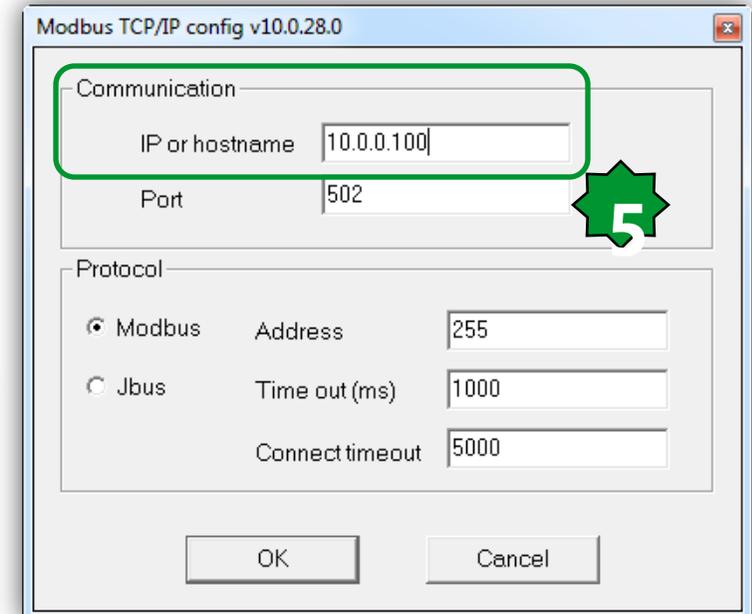
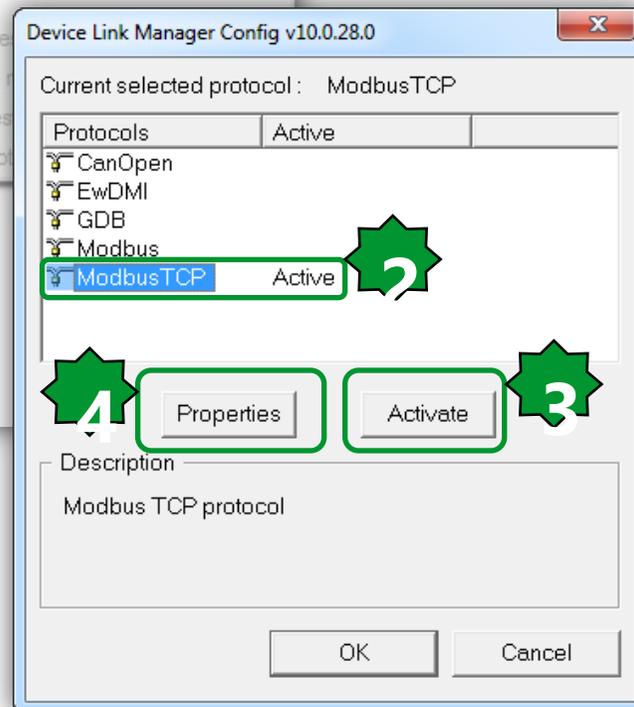
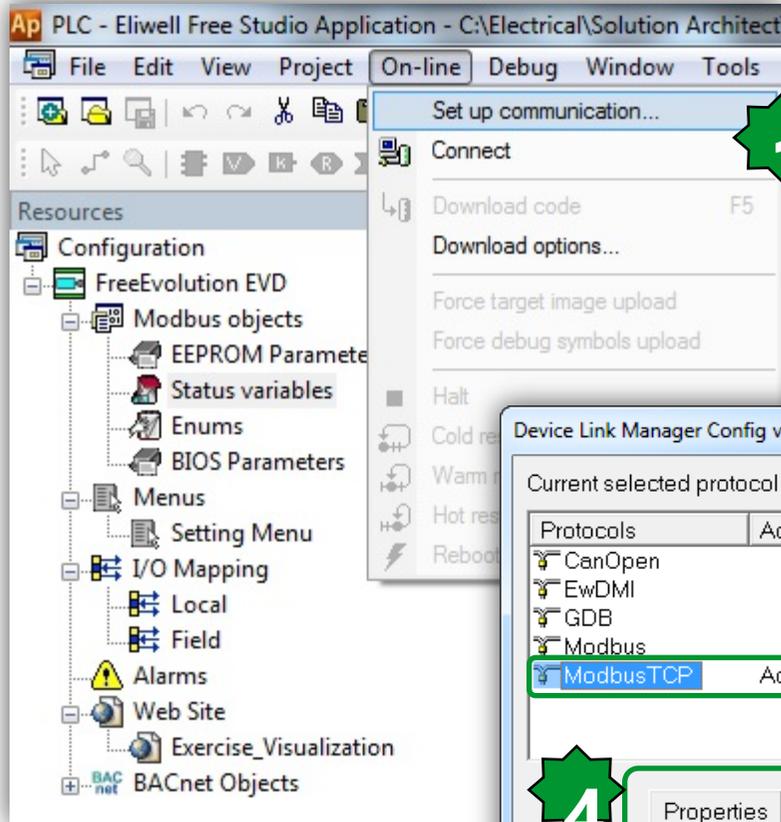
IP Address:

Settings

Network:

Additional ModbusTCP sockets:

Modbus TCP/debugging



Chapter 14

Modbus Slave

Goal:

Configuration of Free Studio to create connection between Vijeodesigner & Evolution



Modbus Slave



- Status variables and EEPROM parameters have a modbus address and they are all Holding Registers, regardless the type of variable defined into Device Type

FreeEvolution Status Variables

Add Remove Recalc

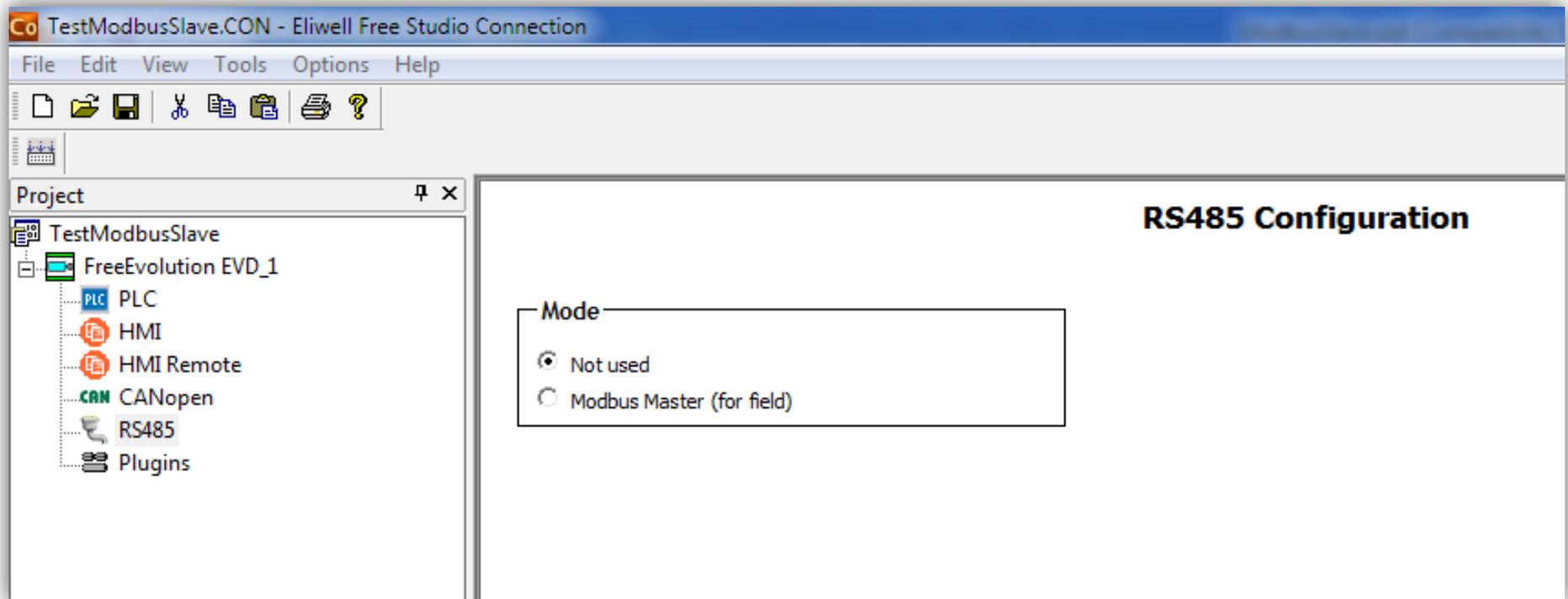
#	Address	Name	Device type	Application type	Size	Offset	Unit	AccessLevel	Read only
1	8960	TestWord	Unsigned 16-bit	UINT		0		Always visible	False
2	8961	TestBit	Boolean	BOOL		0		Always visible	False

- EEPROM parameters are always R/W
- Status Variables are RO by default
 - Set to False Read Only in case of R/W Status Variable

Modbus Slave



- In Free Studio Connection, set the Mode of RS485 of the controller to Not used
 - It means that the RS485 on board is configured as a slave port



Modbus Slave



- In Free Studio Device, in Bios parameters, click on RS485 On Board
- Configure the Modbus communication:
 - ➔ Address of the controller
 - ➔ Baudrate
 - ➔ Stop bits
 - ➔ Parity

The screenshot shows the 'RS485 On Board' configuration table in the Free Studio Device interface. The table has columns for Address, Name, Value, Um, Default, Min, Max, and Description. A red box highlights the 'Value' column for the first four rows, which correspond to the Modbus communication settings mentioned in the text: Address (1), Protocol (3=Modbus/RT), Data bit number (8), and Parity (2=Even).

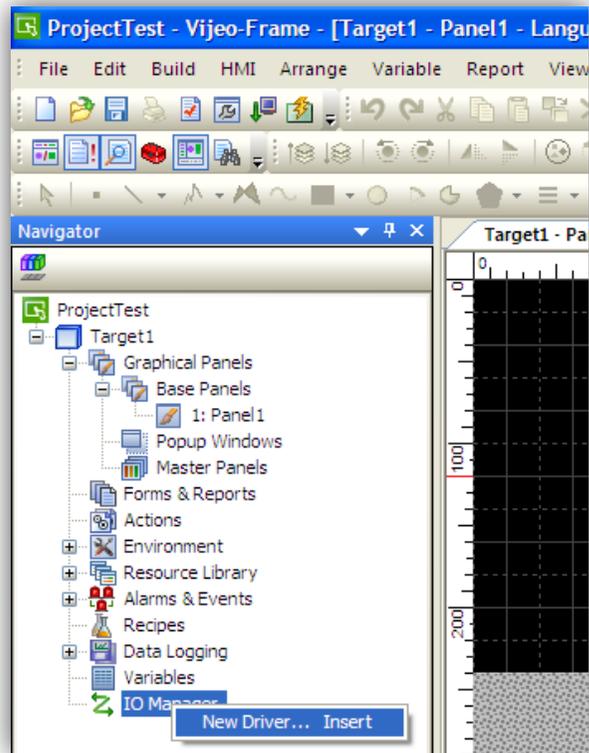
Address	Name	Value	Um	Default	Min	Max	Description
15774	Addr_RS485_OB	1	num	1	0	255	RS485 On Board address
15775	Proto_RS485_OB	3=Modbus/RT	num	3=Modbus/RT	2	3	Select RS485 On Board protocol
15776	DataBit_RS485_OB	8	num	8	8	8	RS485 On Board Data bit number
15777	StopBit_RS485_OB	1	num	1	1	2	RS485 On Board stop bit number
15778	Parity_RS485_OB	2=Even	num	2=Even	0	2	RS485 On Board parity protocol
15779	Baud_RS485_OB	1=19200	num	2=38400	0	5	RS485 On Board baud rate protocol

- Change to communication settings require a controller restart

How to connect Freeway to VijeoDesigner target



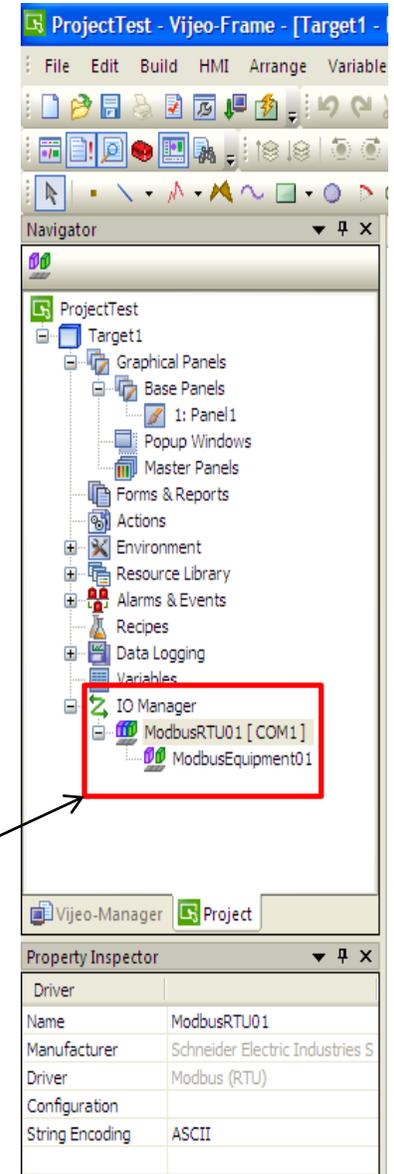
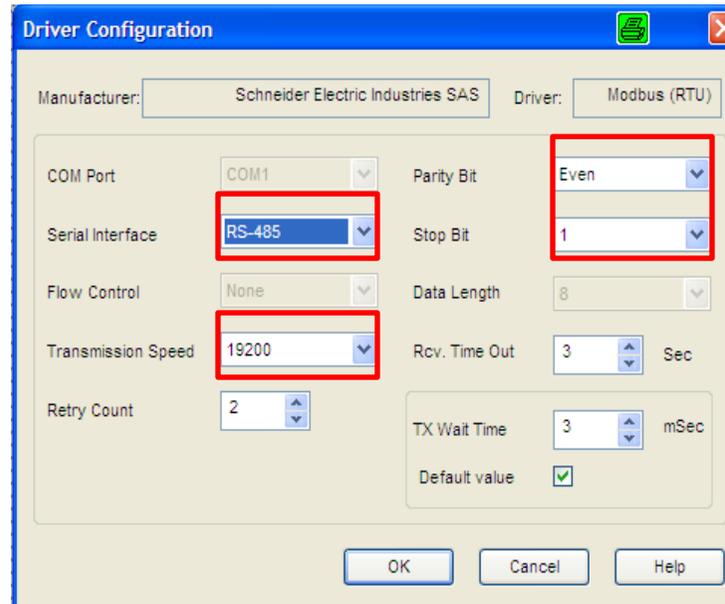
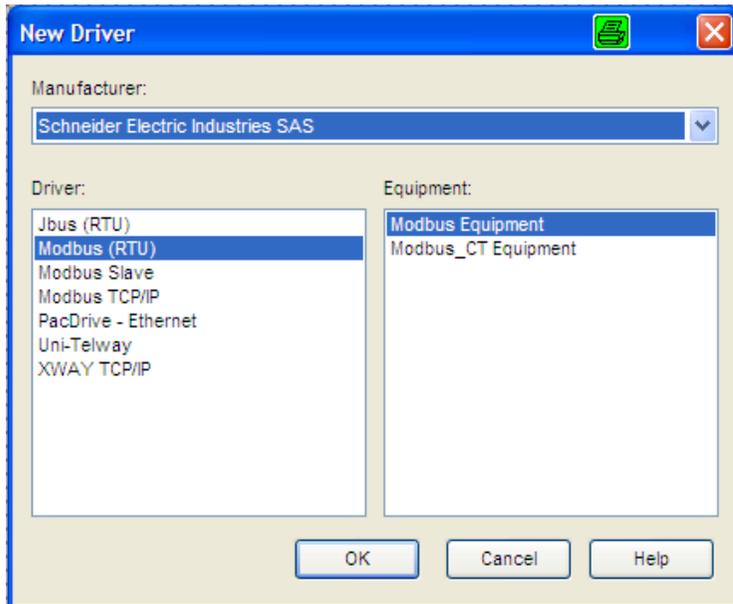
- Create a new driver



Vijeo Designer



- Configure the driver as configured in Free Studio

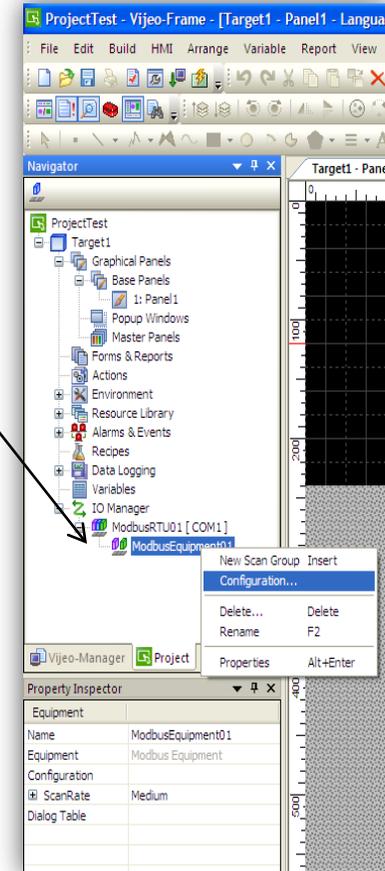
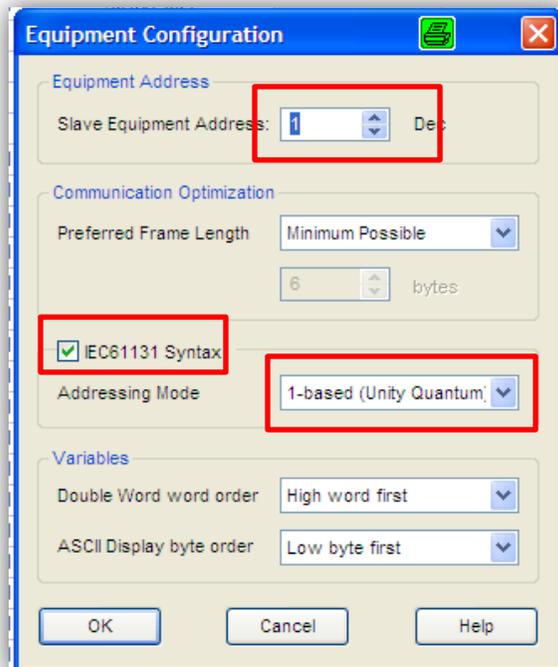


- A new Modbus equipment has been created

Vijeo Designer



- Configure the Modbus equipment (right click):
 - Enter the address as set in Free Studio
 - Select IEC61131 Syntax
 - Addressing mode: 1-based (Unity Quantum)



Vijeo Designer



- Create your variables:

The screenshot shows the 'Target1 - Variable Editor' window. On the left is a 'Navigator' pane with a tree view of the project structure. The main area contains a table with the following data:

	Name	Data Type	Data Source	Scan Group	Device Address	Alarm Group	Logging Group
1	BOOL01	BOOL	External	ModbusEquipment01	%MW8961:X0	Disabled	None
2	UINT01	UINT	External	ModbusEquipment01	%MW8960	Disabled	None

- Define the Data Source: External
- Define the Scan Group: name of your Modbus equipment you have created
- Specify the register address of the variable

Chapter 15

Web server

Goal:

Embedded & customized web pages



Web visualization



FreeEvolution 423 Configuration

General

Name:

File version:

Communication

Protocol:

Address:

Port: Disable communication

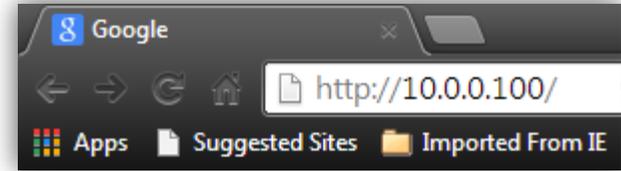
Baud rate:



Information

Status: CONNECTED

Firmware version:



Other operations

- BIOS download
- Open file browser
- Web site download
- Web site preview

1. Connect to the target ► FreeEvolution EVD_1
2. Open internet browser (Google Chrome)
3. Type 10.0.0.100 in the address bar
4. In the windows security pop-up:
Default Username: administrator
Default Password: password
► OK

Embedded web pages



- free Evolution embedded Web server -



[Click here to enter site](#)

- free Evolution embedded Web server -

[Human Interface]

[Dip-Switch & Leds](#)

[System Clock \(read\) & System Clock \(adjust\)](#)

[I/O Values]

[Analogue Inputs](#)

[Digital Inputs](#)

[Analogue Outputs V/I](#)

[Digital Outputs](#)

[Parameters]

[Ethernet Plugin Passive](#)

[Analogue Inputs](#)

[Analogue Outputs V/I](#)

Embedded web pages



free Evolution [Index](#)

Dip-Switch Status (read) & Leds Status (read/write)

Item	Status
SW1:	<input type="checkbox"/> 0
SW2:	<input type="checkbox"/> 0
SW3:	<input type="checkbox"/> 0
SW4:	<input type="checkbox"/> 0

Item	Status/Setting
LED1 (green):	Off ▾
LED2 (red):	Off ▾
LED3 (yellow):	Off ▾
BACKLIGHT:	Off ▾

free Evolution [Index](#)

Digital Outputs Status (read/write)

Item	Status/Setting
DOL1:	Open ▾
DOL2:	Open ▾
DOL3:	Open ▾
DOL4:	Open ▾
DOL5:	Open ▾
DOL6:	Open ▾
DOL7:	Open ▾

free Evolution [Index](#)

System Clock Adjust

Item	Value
Time [hh:mm:ss]:	0 : 0 : 0
Date [dd/mm/yy]:	11 / 6 / 13
Day week:	2
Adjust	FALSE ▾

free Evolution [Index](#)

Analogue Outputs V/I Status (read/write)

Item	Value [%]
AOL1:	0.0
AOL2:	0.0
AOL3:	0.0
AOL4:	0.0
AOL5:	0.0

free Evolution [Index](#)

Analogue Inputs Status (read)

Item	Value
AIL1:	-3276.8
AIL2:	-3276.8
AIL3:	-3276.8
AIL4:	-3276.8
AIL5:	-3276.8
AIL6:	-3276.8

free Evolution [Index](#)

Digital Inputs Status (read)

Item	Status
DIL1:	<input type="checkbox"/>
DIL2:	<input type="checkbox"/>
DIL3:	<input type="checkbox"/>
DIL4:	<input type="checkbox"/>
DIL5:	<input type="checkbox"/>
DIL6:	<input type="checkbox"/>
DIL7:	<input type="checkbox"/>
DIL8:	<input type="checkbox"/>

Application web pages



Resources

- Configuration
 - FreeEvolution EVD
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - BIOS Parameters
 - Menus
 - Setting Menu
 - I/O Mapping
 - Local
 - Field
 - Alarms
 - Web Site
 - Add Table Page**
 - Import Custom Page
 - Add Template Page

'Exercise_Visualization' Web table page

Refresh (ms): (0=disable refresh) Password:

Page title: Filename:

Site template:

#	Name	Control	Label	Section	Text size	Img filename	Img X
1					10		

'New Menu' Web table page

Refresh (ms): (0=disable refresh) Password:

Page title: Filename:

Site template:

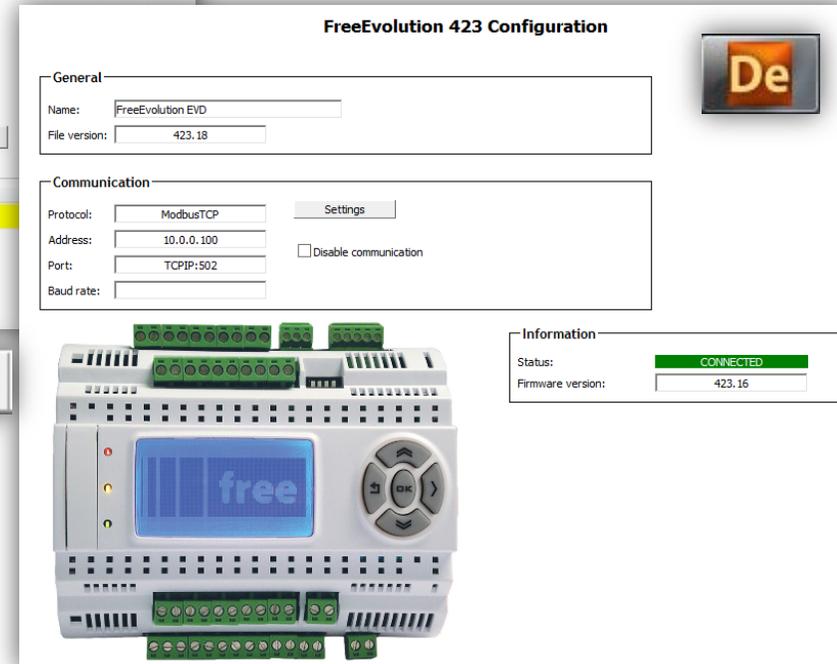
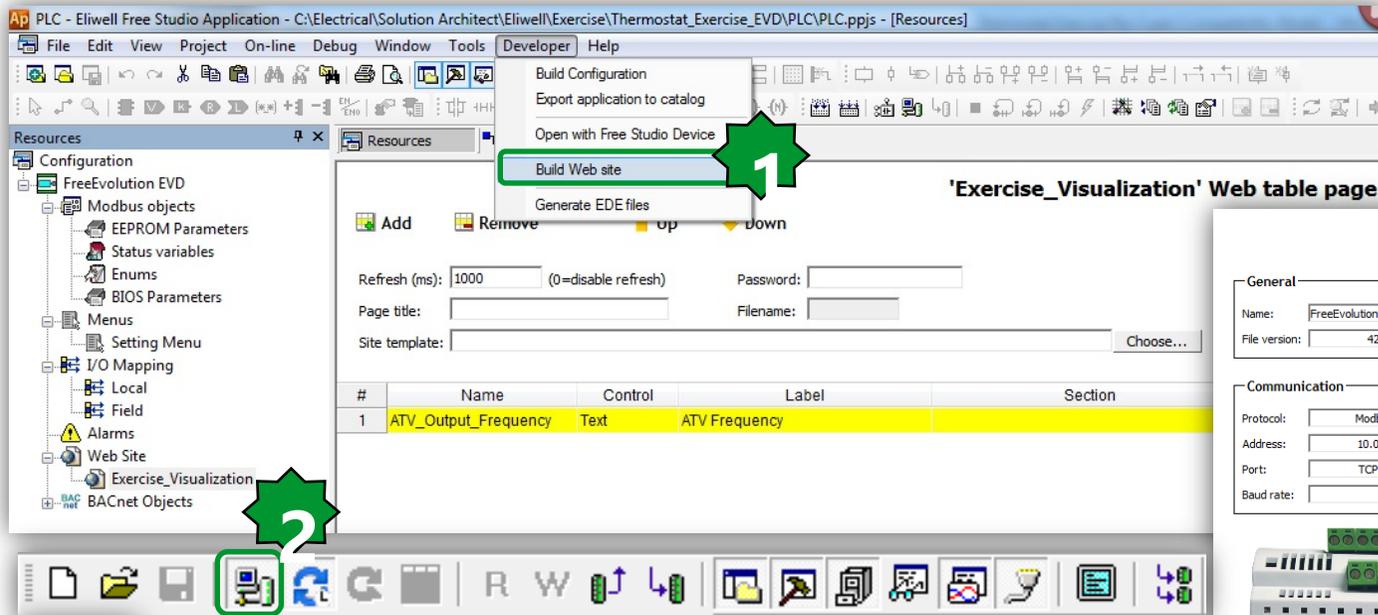
#	Name	Control	Label	Section	Text size	Img filename	Img X	Img Y	Enum values
1	ATV_Output_Frequency	Text	ATV Frequency		10				

Resources

- Configuration
 - FreeEvolution EVD
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - BIOS Parameters
 - Menus
 - Setting Menu
 - I/O Mapping
 - Local
 - Field
 - Alarms
 - Web Site
 - Exercise_Visualization
- BACnet Objects

1. Resources ► Web site ► Add table page
2. Name it (Exercise Visualization)
3. Add a new record
4. Select the desired parameter from list
5. Title the page & Select the site template
6. Define the control type & Label it

Web visualization/customized page



1. Developer ► Build Web site
2. Connect ► Device ► FreeEvolution Configuration
Web site download
Web site preview

Note: Embedded Web Pages are no longer available if Application Web Pages are used

Other operations

- BIOS download
- Open file browser
- Web site download
- Web site preview

Custom web page preview



Exercise_Visualization 

Exercise_Visualization

ATV Control

Address	Name	Value	Um
8963	ATV Frequency	<input type="text" value="0"/>	
8962	ATV Ref.	<input type="text" value="0"/>	
8961	ATV Cmd.	<input type="text" value="49152"/>	

Use below address to return back to the embedded page: <http://10.0.0.100/evoindex.htm>

Custom page address: <http://10.0.0.100/index.htm>

If the device type is Boolean or Enums other types of control type are selectable.

- Text
- Select
- Button
- Image
- Radio
- Checkbox

Web folder is located in PLC
▶ Web to edit the header

sysHTTP_ListableFilesExt library



View object properties

Name: sysHTTP_ListableFilesExt

Type: Function

Return Value: USINT

Language Type:

Description:
Load/Clear extension list for listable file from Web browser.
Calling this function with action=TRUE the extension ext, if possible, will be put into the list of the listable files from the Web browser. No more than tree extensions can be put into the list. Calling this function with action=FALSE will clear the list, so no files will be listable by the browser. At power on the extensions list is empty.
Extension must be written in upper case.

The function return a USINT which could have the following meanings:
0 = Extension correctly loaded into the extension list.
255 = Extension too long, extension not loaded into extension list.
254 = Extension list full, extensionnot loaded into extension list.

Input:

Name	Type	Description
action	BOOL	TRUE=put the extension into the list, FALSE=clear all list
ext	STRING	File's extension string, max 3 chars

Close

Library

MBMNODESTATUS	sysDataPush_Start	sysINT_TO_STRING	sysSTREQU
STRUCTIMPULSECOUNTER	sysDNS_GetIpByName	sysPlugInRelay	sysSTREXT
sysAnswerDelayIncTime	sysDNS_Reset	sysPwmDO	sysSTRINGtoINT
sysAOasOC	sysExecutionPassword	sysSetDI_SamplingMode	sysTFTP_Enabling
sysBridge	sysHmi_Message	sysSMTP_Reset	sysUART_getbuff
sysClockWrite	sysHTTP_Authentication	sysSMTP_SendEmail	sysUART_init
sysDataPush_Reset	sysHTTP_ListableFilesExt	sysSTRCAT	sysUART_putbuff

Operator and standard blocks | Target variables | Target blocks | basic

Note: FILES.CGX and FILES.CGI can be provided as example pages

Chapter 16

Firmware update

Goal:

Updating Smart & Evolution firmwares by Free Studio Device



Firmware update

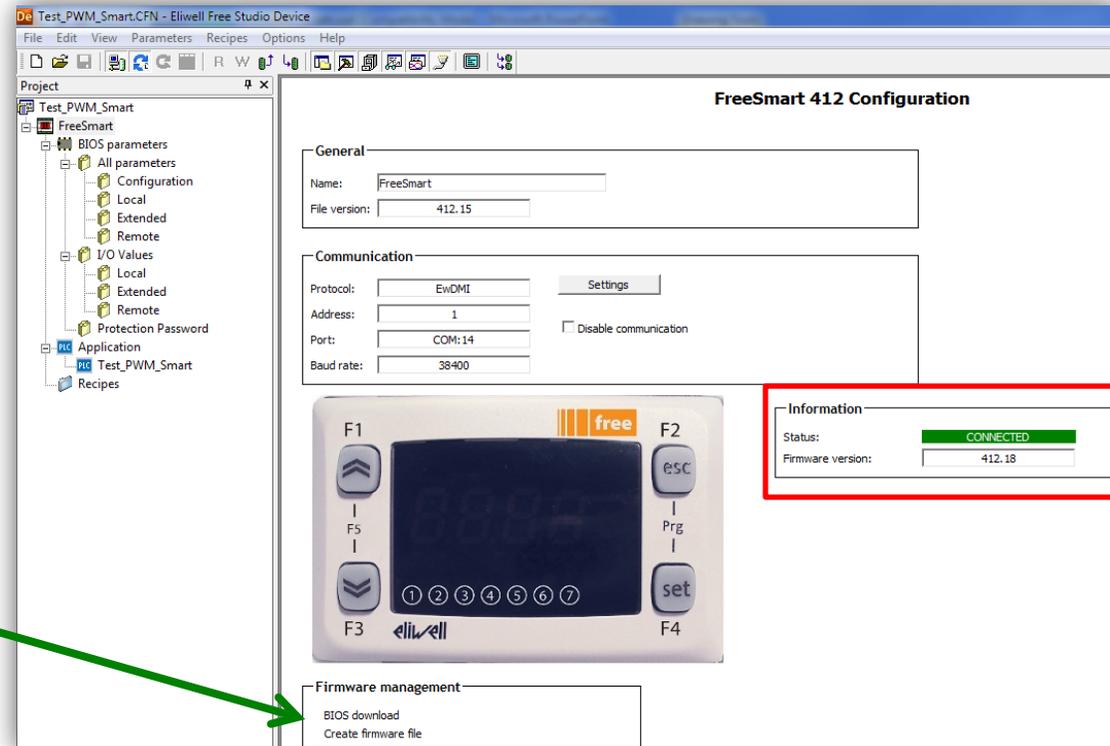


In Free Studio Device

- Click on “Connects to Target”
- Once the device is connected,
- Check the firmware version

- If the firmware version is not the last one, click on BIOS download

Note.
Smart: Application Lost
Evolution: Application kept

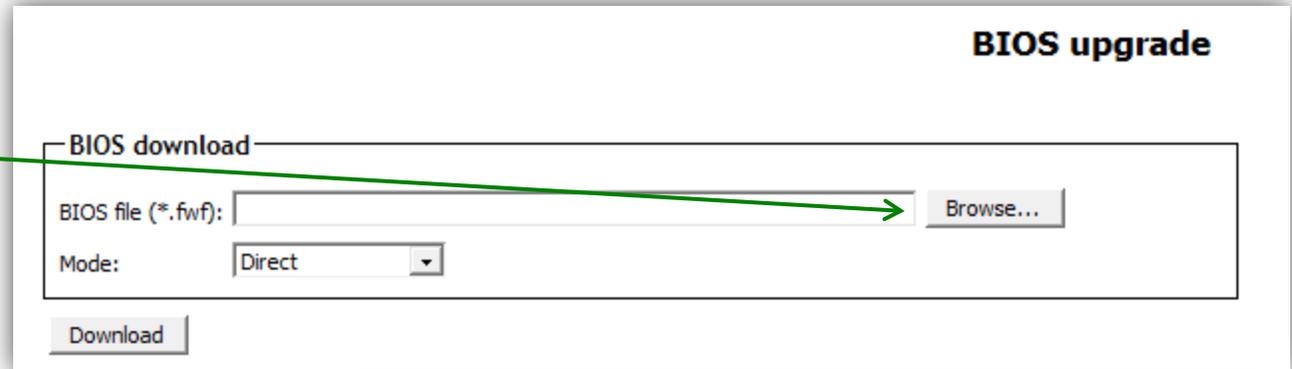


Note: Smart, the controller must be powered only by DMI.

Firmware update

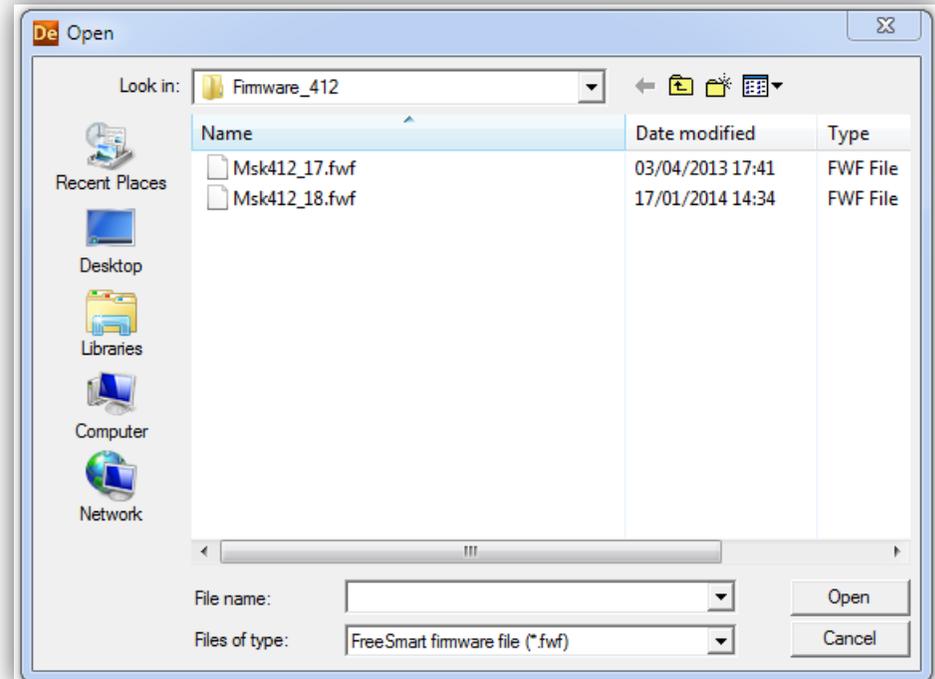


- Click on Browse



- The default folder opened contains the last firmware version released with the software.

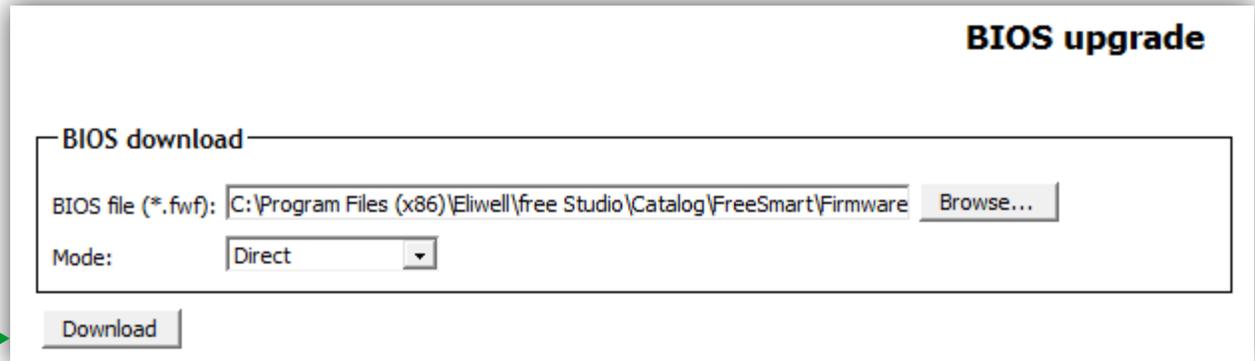
- ➔ Select the last firmware version
- ➔ Click on Open



Firmware update

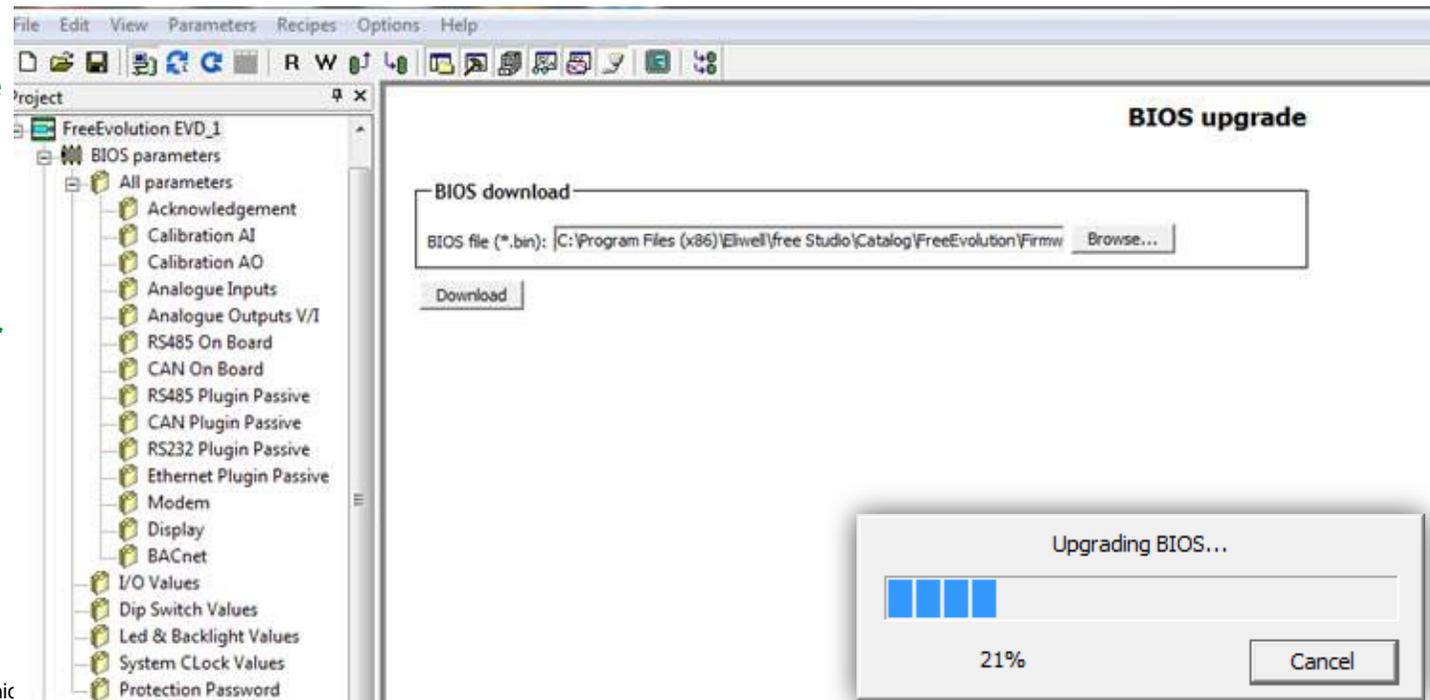


- Select Direct Mode



- Click on Download

- The same procedure can be applied to Evolution except for Mode selection (not available) and power supply to be provided.



Chapter 17

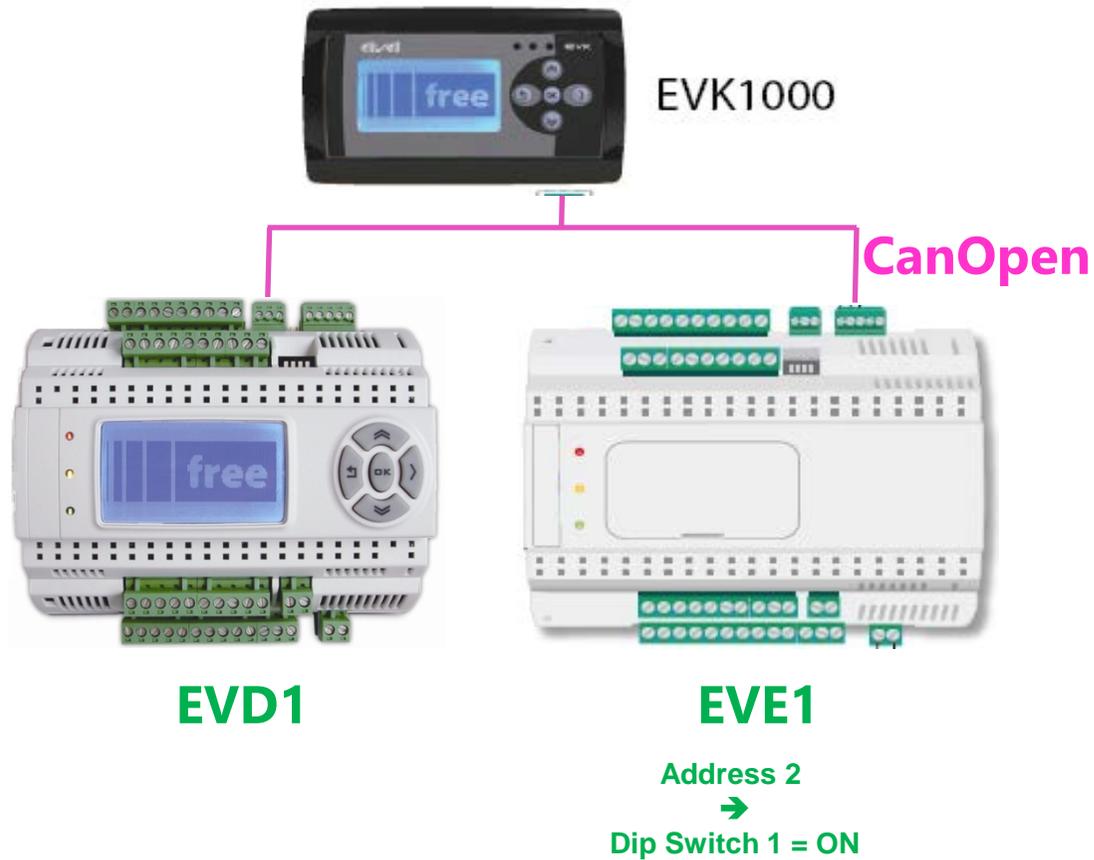
User Interface

Goal:

Local & Remote display programming by User Interface



DemoField Example



NOTE: Leave the CanOpen end resistor jumpers only to the endline Devices, in this case EVD and EVE1

Keyboard EVK configuration



The image illustrates the steps for configuring a Keyboard EVK in a software application. The steps are numbered 1 through 7:

1. Open the software application.
2. Click 'Add' in the Project window.
3. Select 'Keyboard EVK' in the Device catalog.
4. Select 'FreeEvolution EVD_1' in the Project tree.
5. Click the 'Add' icon in the toolbar.
6. Enter 'Thermostat M171P UI' in the Name field of the 'Save new Connection project' dialog.
7. The final project tree structure is shown.

Device name	Version	Description
FreeEvolution EVD	423	FreeEvolution EVD with display
FreeEvolution EVC	477	FreeEvolution EVC (no display)
Keyboard EVK	476	Keyboard EVK
FreeEvolution EVP	489	FreeEvolution Panel EVP

Project tree structure (Step 7):

- Project
 - Untitled
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CANopen
 - RS485
 - Plugins

Keyboard EVK configuration



Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CANopen
 - Expansion EVE_1
 - Keyboard EVK_1**
 - RS485
 - Plugins

Keyboard EVK Configuration

General

Name:

Version:

Network settings

Node number (126,127):



The image shows a physical Keyboard EVK device. It has a black casing with a blue LCD screen displaying the word 'free'. To the right of the screen is a control panel with several buttons: a left arrow, an 'OK' button, a right arrow, and two vertical arrow buttons (up and down). The Eliwell logo is on the top left and 'EVK' is on the top right of the device.

Network settings should be aligned to the real address of the EVK (127 is the factory default).

CANopen configuration



Thermostat_exercise.CON - Eliwell Free Studio Connection

File Edit View Tools Options Help

Project

- Thermostat_exercise
 - FreeEvolution EVD_1
 - PLC
 - HMI
 - HMI Remote
 - CANopen
 - Expansion EVE_1
 - Keyboard EVK_1
 - RS485
 - Plugins

CANopen Configuration

Mode

- Not used
- Master (for field)
- Slave (for binding)

Baud rate

- 500 Kb/s
- 250 Kb/s
- 125 Kb/s
- 50 Kb/s

Master Settings

Node ID (1..122,125): ?

Heartbeat time (ms):

Sync COBID:

Sync Cycle (ms):

Information: This nodeID is used to communicate with Free Studio or a supervisor. Other two master channels will be opened to communicate with keyboards:
channel1 = 124
channel2 = 123

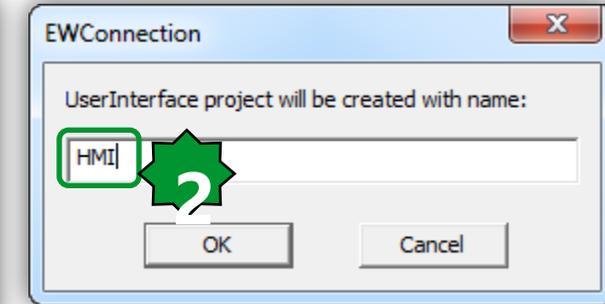
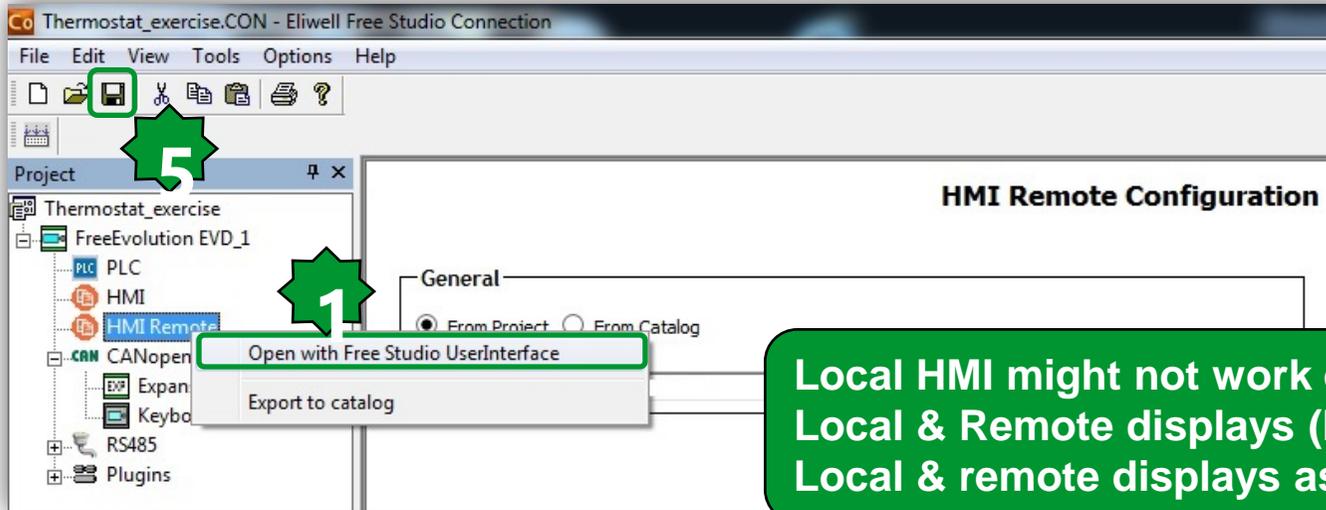
- 124 or 123 are the addresses to be used in the HMI management menu of EVK



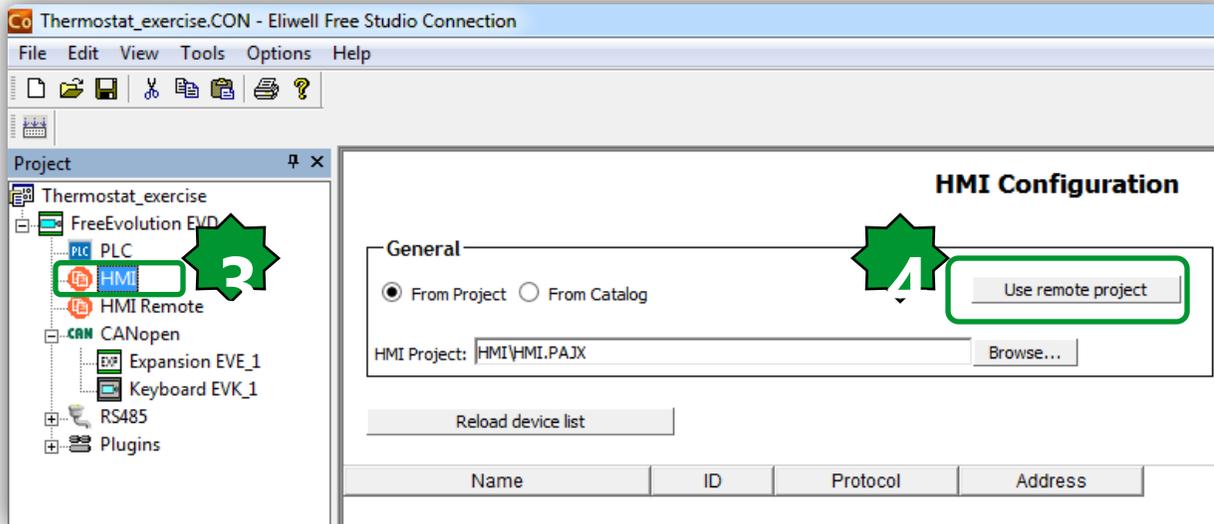
- 124 is the factory default

1 keyboard to communicate with base ► set the channel=124
Second keyboard to communicate with base ► set the channel=123

HMI project linking/creation



Local HMI might not work on remote display
Local & Remote displays (Identical) ► HMI remote
Local & remote displays as future option ► HMI remote



HMI:Local Display
HMI Remote: EVK1000

2. Name it ► OK ► User Interface project starts automatically
3 & 4. Local display will have the same HMI of the remote one.

Preliminary: Actions

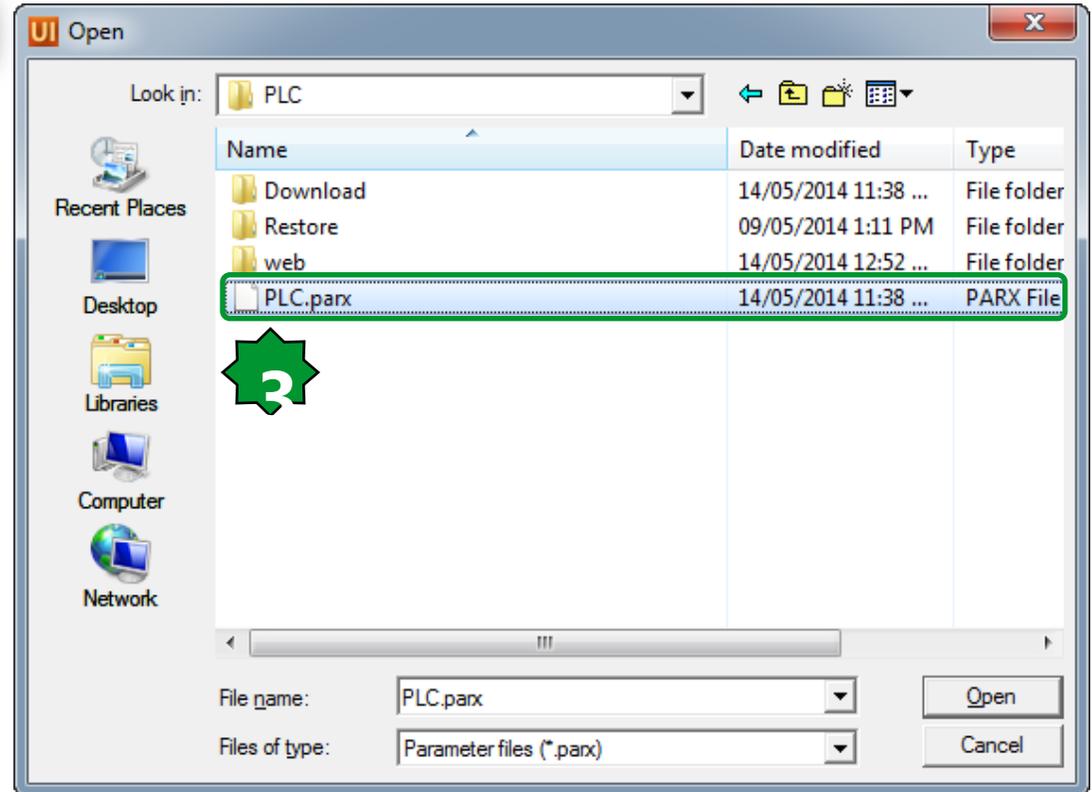
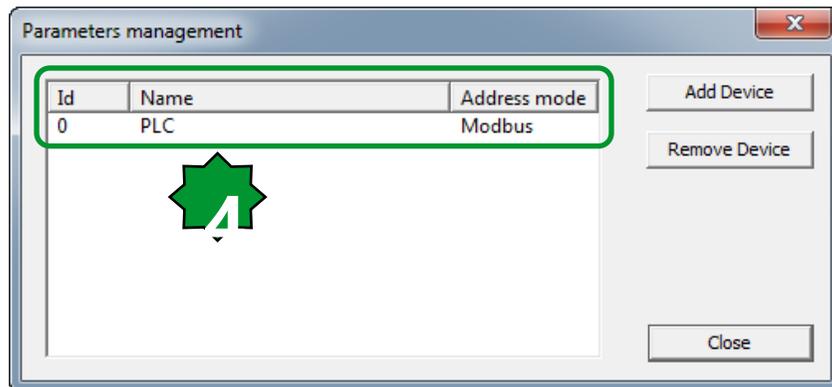
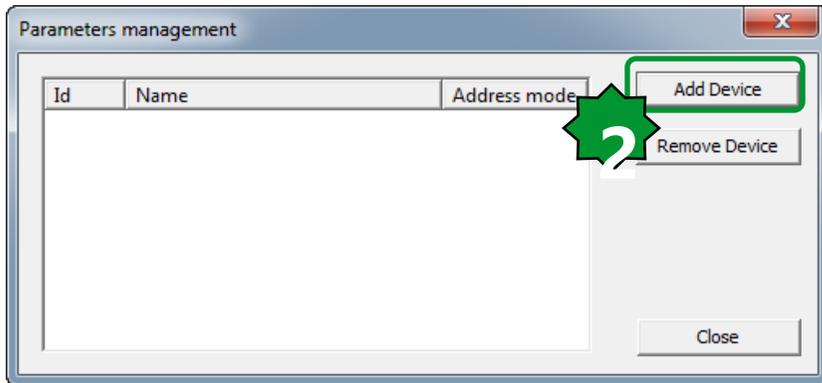


- Define the global action related to the buttons
- 1. Activate action bar icon
- 2. Global actions
- 3. New action
- 3. Define the Key
- 4. Define the Action

Actions		
Local actions		Global actions
Key	Action	Link
Enter	Edit	
Left	PrevField	
Right	NextField	
Up	PrevField	
Down	NextField	
LongLeft	Close	

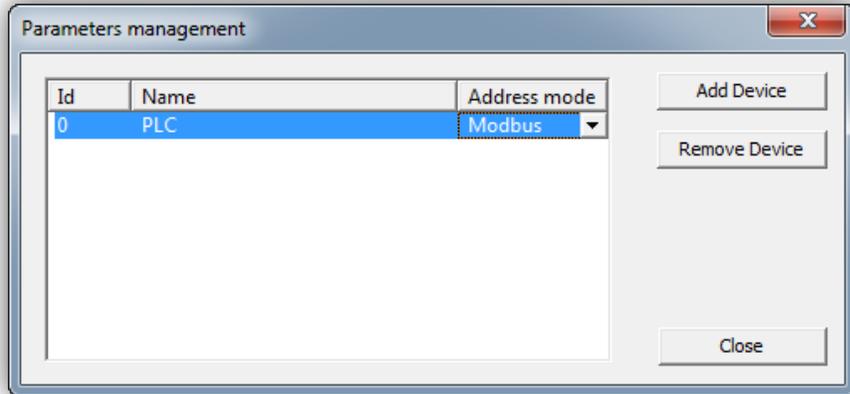


Preliminary: Link parameter file



- Link the parameters file of your application project.
- Select short name to prevent long variable names

Target Vars & parameters

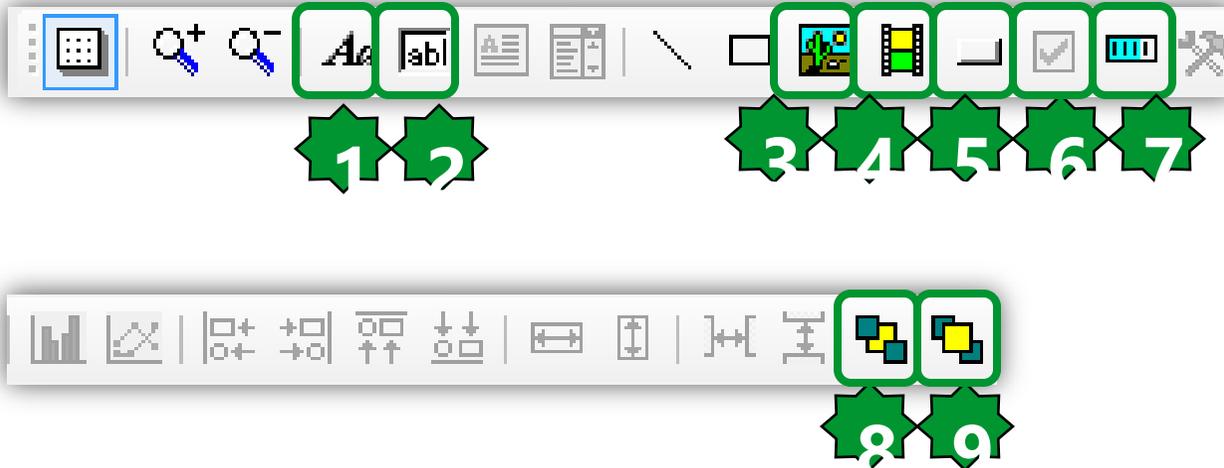


Name	Type	Address	Min	Max	Um	Description
sysClockSet_dayweek	USINT	Modbus:8747:0	0	6	num	Day of week value (write)
sysClockSet_daymonth	USINT	Modbus:8748:0	1	31	num	Day of the month value (write)
sysClockSet_month	USINT	Modbus:8749:0	1	12	num	Month value (write)
sysClockSet_year	USINT	Modbus:8750:0	10	99	num	Year value (write)
sysClockSet_Upload	BOOL	Modbus:8751:0	0	1	flag	RTC upload
PASSWORD	UDINT	Modbus:24320:0	0	4294967295	num	Numeric Password for Applicatio...
Load_BACnet_E2_Defaults	BOOL	Modbus:15766:0			flag	Load default values for BACnet pa...
Port_BACnet_IP	UINT	Modbus:15768:0	0	65535	num	BACnet/IP Port number, 0 is equa...



- Name can be eventually changed manually in order to adapt the same UI to different project without changing the set already defined (@ syntax)
- The list of parameters/status variables will appear
- Note: Remember to refresh parameters file every time you change the related Application project

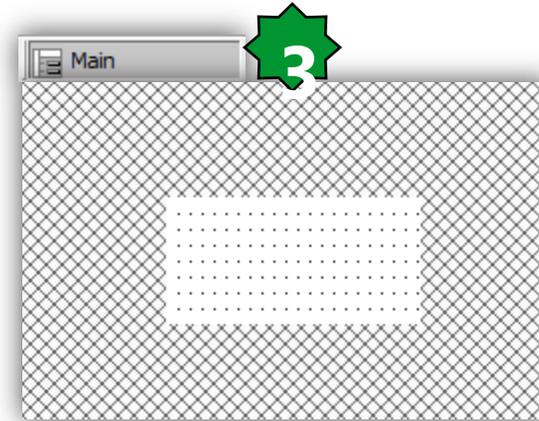
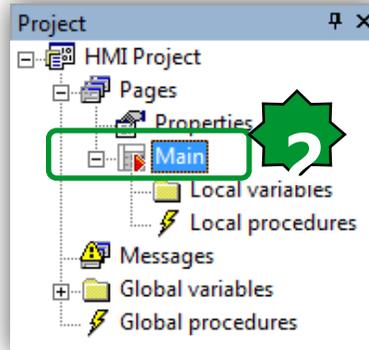
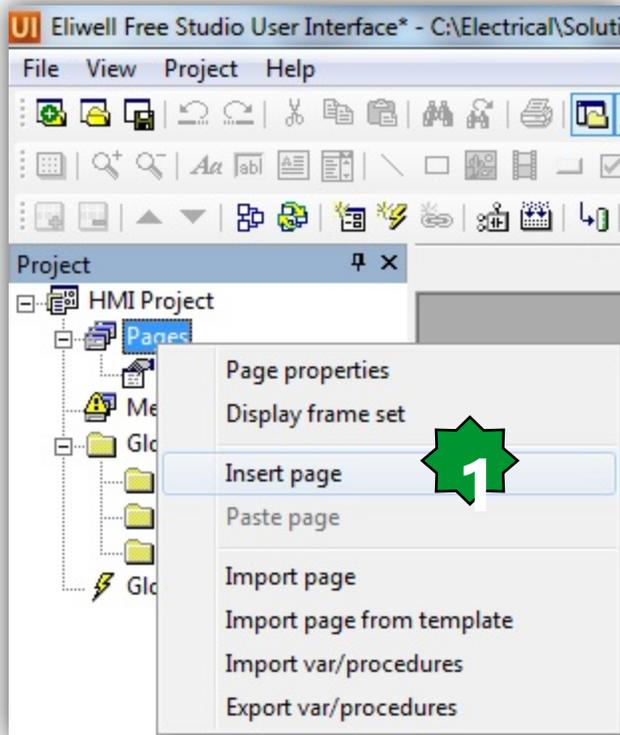
Toolbar description



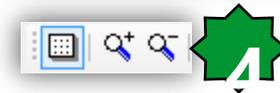
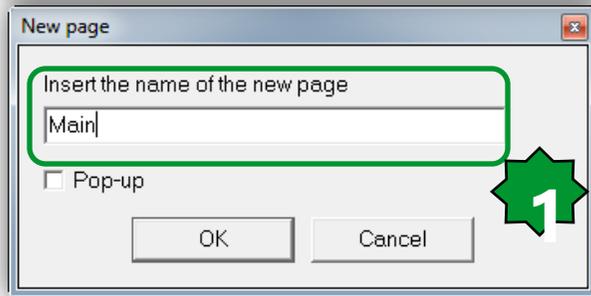
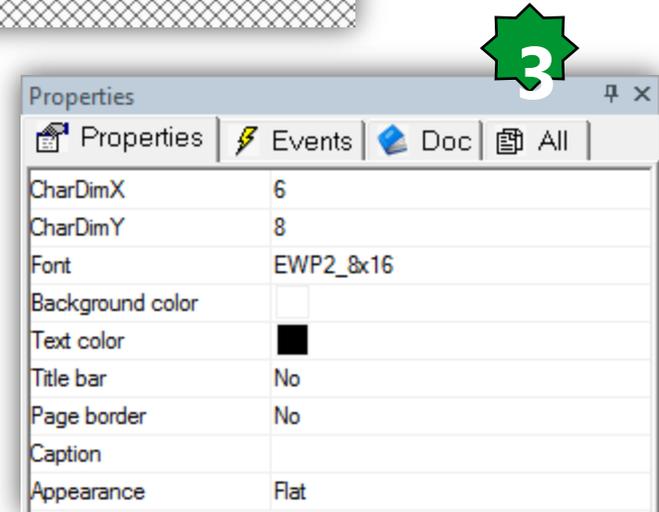
1. Insert static
2. Insert new edit
3. Insert new image
4. Insert new animation
5. Insert new button
6. Insert new check box
7. Insert new progress
8. Bring to front
9. Sent to back

We will see how to manage all these objects...

Page creation & page properties



Note.
Press Enter to apply the changes otherwise it will be lost.



Page Customization



• Main Page Properties

- Customize grid
- Insert Title Bar
- Define Font size
- Define Title

The screenshot shows the 'Main' page in an HMI design tool. The main canvas is a grid with a black title bar at the top containing the text 'My First Page'. The Properties panel on the right shows the following settings:

- CharDimX: 1
- CharDimY: 1
- Font: EWP2_6x8
- Background color: [Black]
- Text color: [Black]
- Title bar: Yes
- Page border: No
- Caption: My First Page
- Appearance: Flat

The Actions panel shows the following table:

Key	Action
Enter	Edit
Left	PrevField
Right	NextField
Up	PrevField
Down	NextField

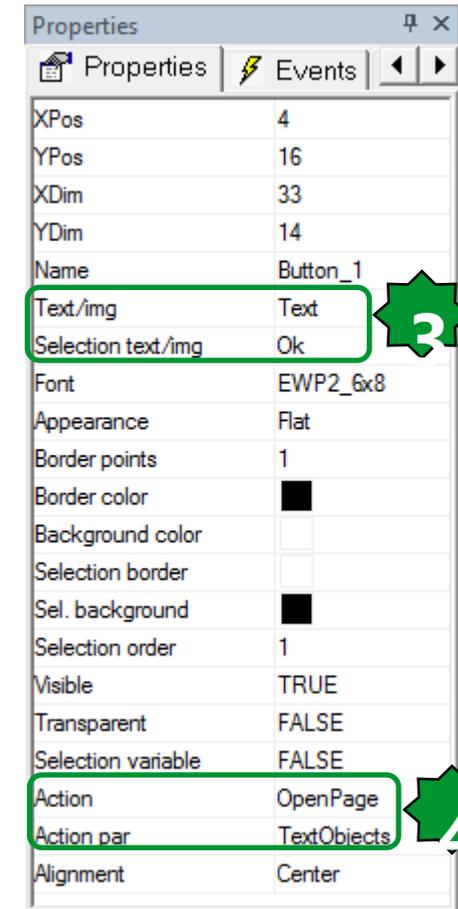
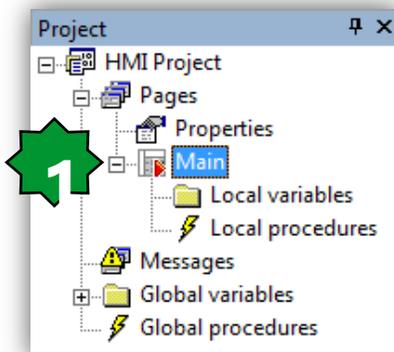
Page Navigation by Graphic Button



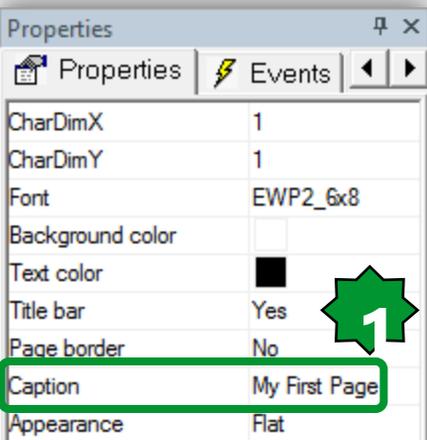
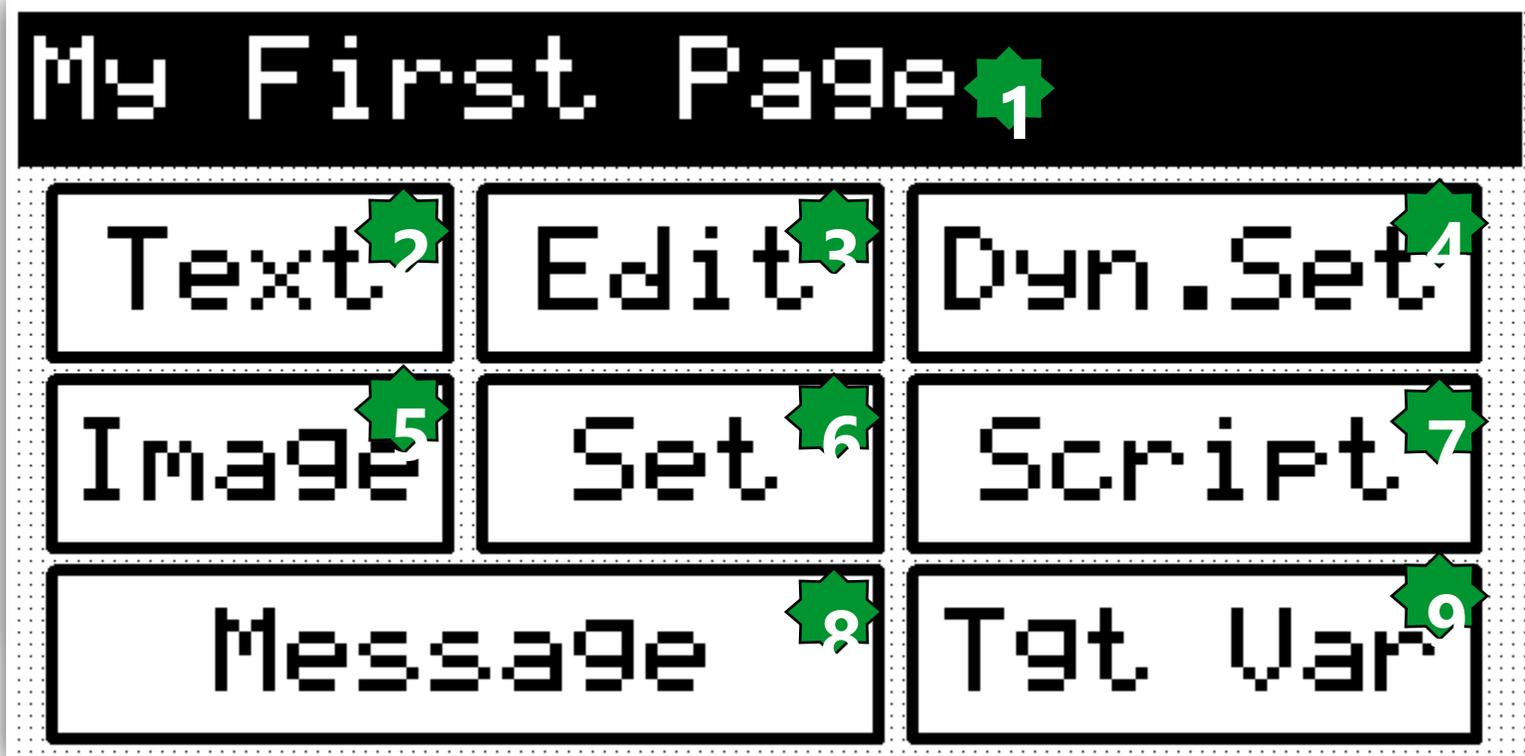
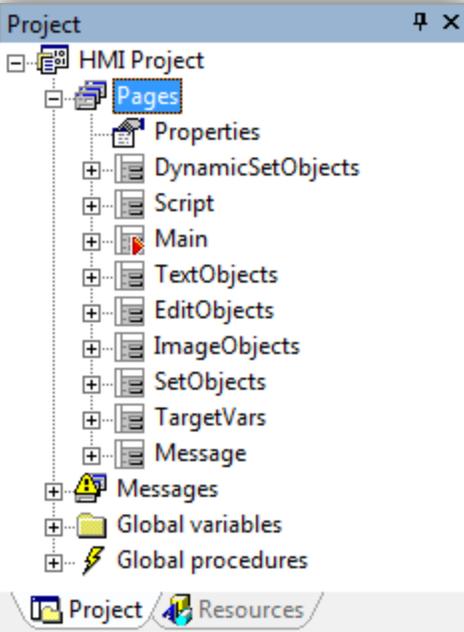
1. Define a new page
2. Create a button in the source page



3. Text/img can be changed base on selection status
4. Define the Action and Action Par properties of the button



Main/My First Page...



Text Objects



Text Objects

Big Text

Small Text

Properties	
Properties	Events
XPos	3
YPos	17
Name	String_1
Text	Big Text
Font	EWP2_8x16
Background color	
Text color	■
Sel. background	■
Sel. foreground	■
Appearance	Flat
Border points	0
Border color	■
Number of chars	0
Alignment	Left
Refresh	FALSE
Select	FALSE
Visible	TRUE

Close

Properties	
Properties	Events
XPos	3
YPos	35
Name	String_2
Text	Small Text
Font	EWP2_6x8
Background color	
Text color	■
Sel. background	■
Sel. foreground	■
Appearance	Flat
Border points	0
Border color	■
Number of chars	0
Alignment	Left
Refresh	FALSE
Select	FALSE
Visible	TRUE

Properties	
Properties	Events
XDim	34
YDim	13
Name	Button_4
Text/img	ID_Close
Selection text/img	ID_Close
Font	EWP2_6x8
Appearance	Flat
Border points	1
Border color	■
Background color	
Selection border	
Sel. background	■
Selection order	1
Visible	TRUE
Transparent	FALSE
Selection variable	FALSE
Action	Close
Action par	
Alignment	Center

1. Insert static text

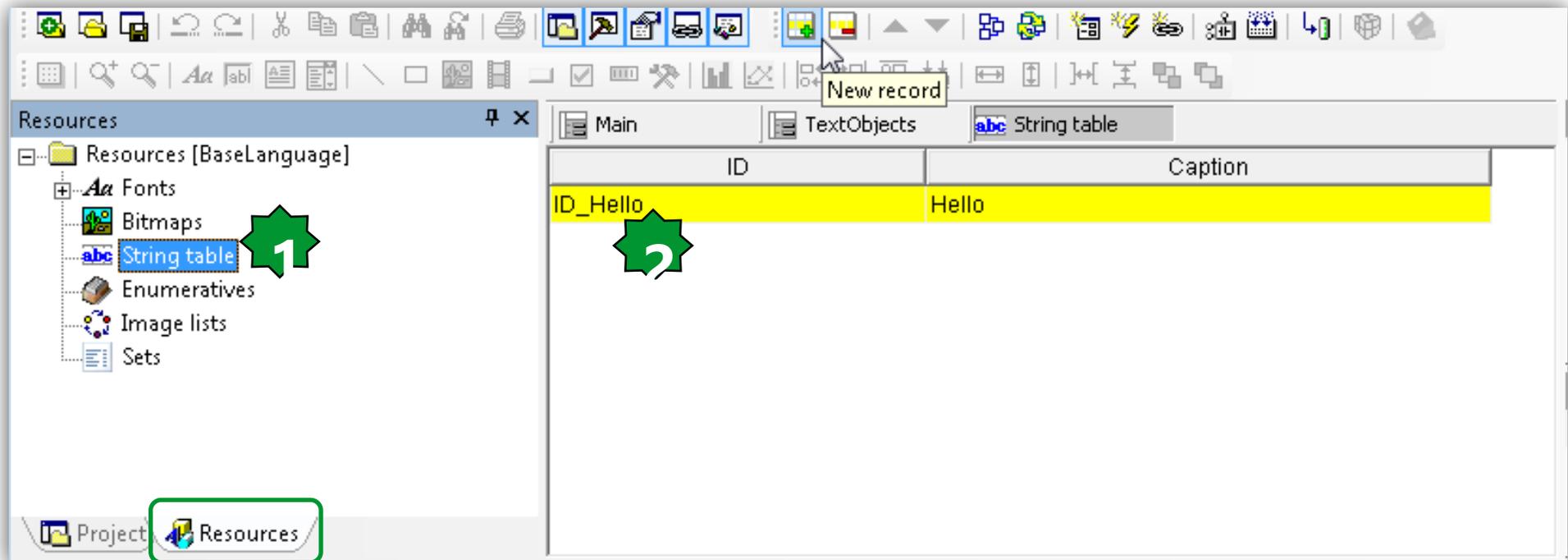
Define the required font size
(2 sizes are available)

Text Objects...



- Text to be translated:

1. Define the string ID and the string in the current language
2. Use the ID instead of static string

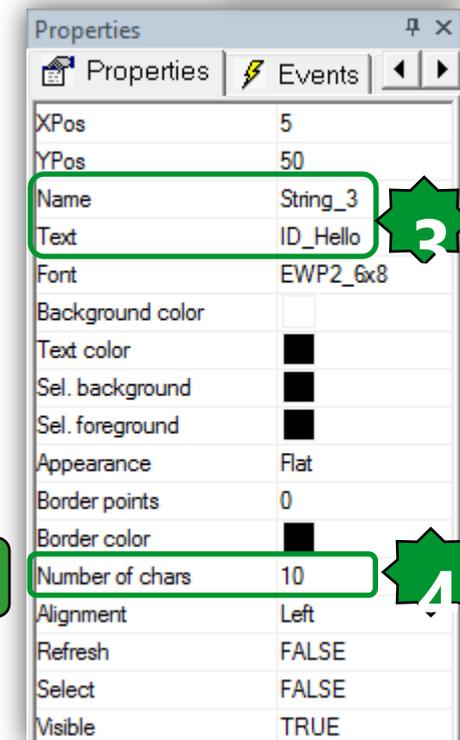
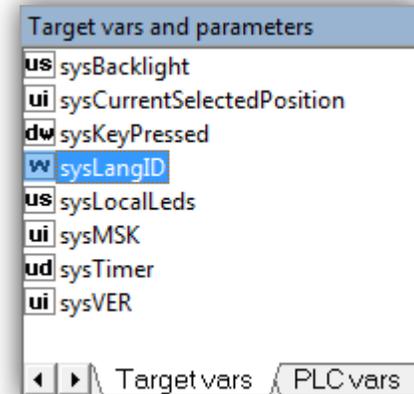
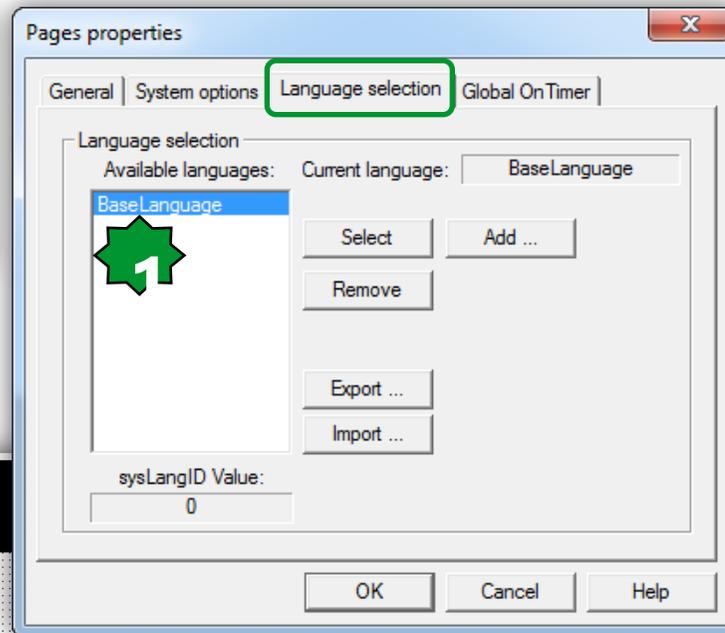
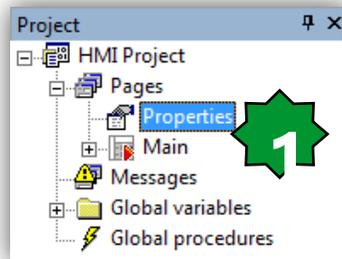


...Text Objects



- Text to be translated:

1. Languages are defined in the language selection tab
2. String table can be exported/imported and translated



Text Objects

Big Text

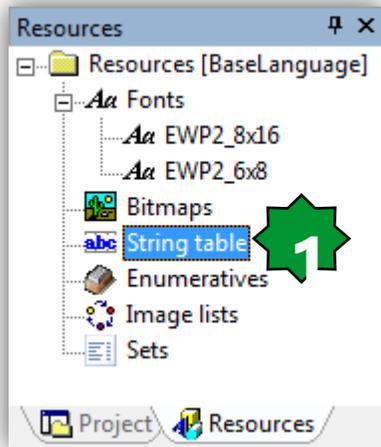
Small Text

Hello

Close

4. Max = 19 Chars

String Table



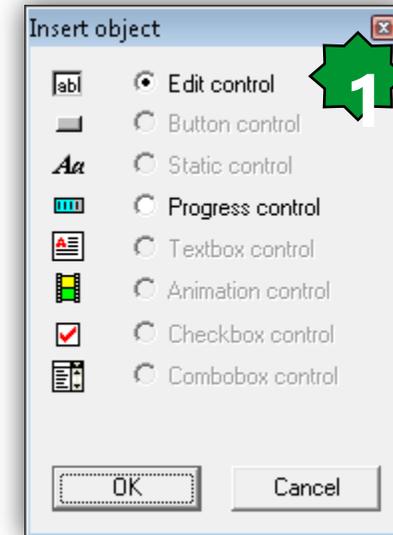
ID	Caption
ID_Hello	Hello
ID_EditObjectTitle	Edit
ID_AmbientTemp	Ambient:
ID_Setpoint	Setpoint:
ID_GreenLed	Green Led:
ID_Close	Close
ID_Image	Image
ID_Set	Set
ID_Script	Script
ID_Differential	Differential:
ID_EveAlarm	Er01-EVE Alarm
ID_DIL2Alarm	Er02-DIL2
ID_DIL3Alarm	Er03-DIL3
ID_DIL4Alarm	Er04-DIL4
ID_DynSet	Dyn.Set

Let's define our String table...

Edit Objects - Values



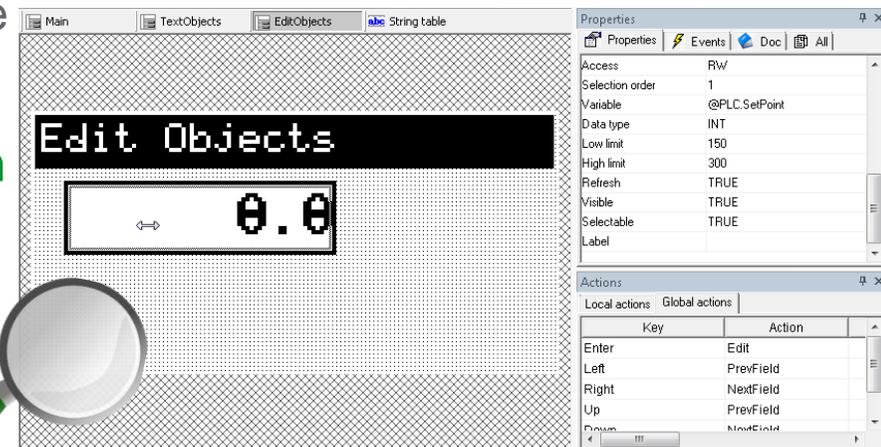
1. Select object or Drag and drop desired variable from from PLC tab



• Main Properties

- Variable: syntax used is: @PLC.<application var name>
- Format
- Selectable: True for R/W, False for RO
- Refresh
- High/Low Limit: shows ----- outside the range

- Select the @PLC.<var> desired
- Default Properties comes from Ap definition
- Selectable: False means, not editable.



Edit Objects - Values



Edit Objects

Note:

- EEPROM & status variable use syntax `@PLC.<application var name>`
- Global, local, target var & PLC vars use standard syntax : **Just the var name**

Properties

Access	RW
Selection order	1
Variable	@PLC.SetPoint
Data type	INT
Low limit	150
High limit	300
Refresh	TRUE
Visible	TRUE
Selectable	TRUE
Label	

Actions

Key	Action
Enter	Edit
Left	PrevField
Right	NextField
Up	PrevField
Down	NextField

Enumerative creation



The screenshot illustrates the process of creating an enumerative resource in a software application. It shows the 'Resources' tree on the left, the 'Add new' icon in the toolbar, a table with the name 'LedEnum', and the final state of the 'Resources' tree with 'LedEnum' added under the 'Enumeratives' folder.

1. Resources ► Enumeratives
2. Add new
3. Name/Rename it ► Open
4. Enumeratives tree

Enumeratives



1 Select the Enumerative (LedEnum) in the Resources tree.

Value	Description
0	Off
1	On
2	Blink

2 Highlight the Enumerative value (2) in the table.

3 Set the Integer format to HH:MM in the Integer format dialog.

3 Set the Format to %d in the Properties panel.

Note: Target format HH:MM convert a number into Hours:Minute format

Resources [BaseLanguage]

- Fonts
- Bitmaps
- String table
- Enumeratives
 - LedEnum
- Image lists
- Sets

Main | TextObjects | EditObjects | Enumeratives

Integer format

- Integers (1-31) 1
- Decimals (1-7) 1
- Hexadecimal Uppercase (...00H)
- Hexadecimal Lowercase (...00h)
- Fill with zeroes
- View always sign
- Password
- Target metric
- Target custom format
HH:MM
- Enumerative
 - LedEnum

Properties

- Background color
- Text color
- Sel. background
- Sel. foreground
- Border points 0
- Border color
- Number of chars 2
- Format %d
- Alignment Right
- Access RW
- Selection order 2

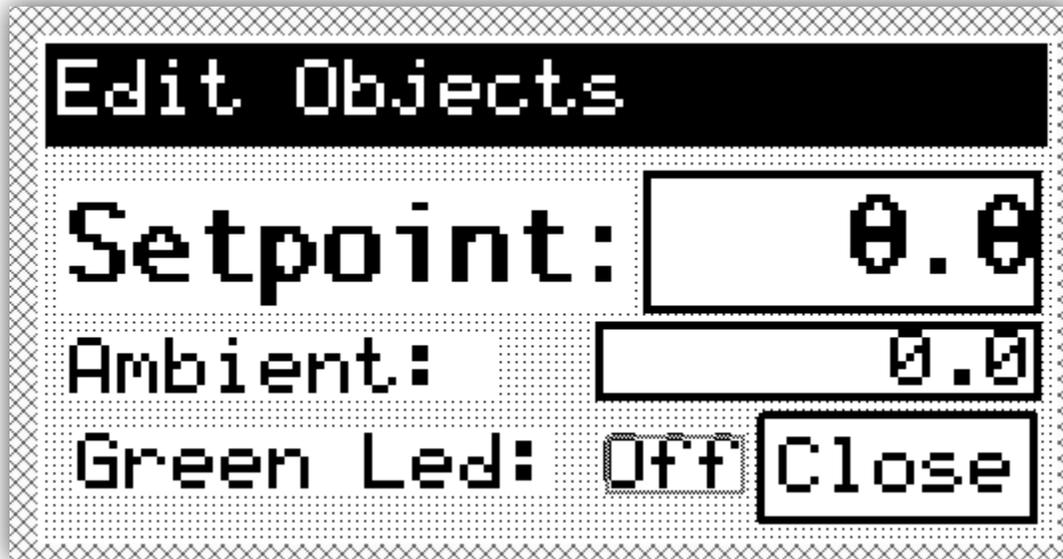
Actions

Key	Action
Enter	Edit
Left	PrevField
Right	NextField
Up	PrevField
Down	NextField

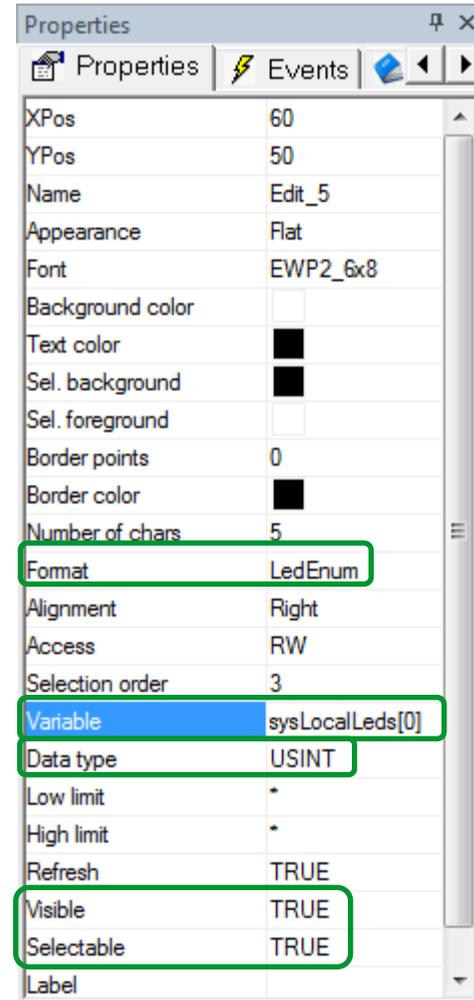
Address | Min | Max

Modbus:8961:0
Modbus:8962:0

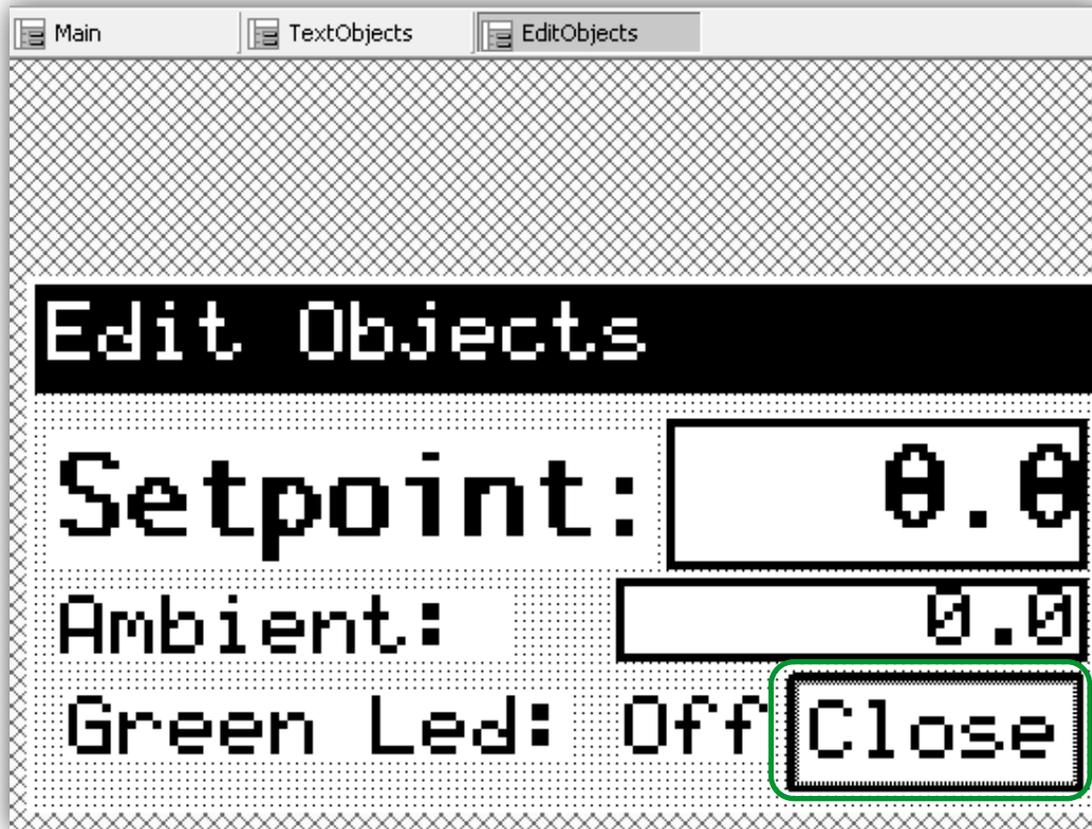
Enumeratives



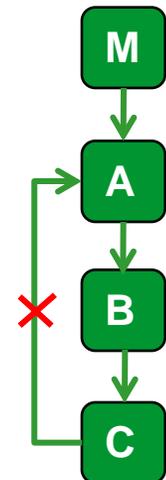
Enumeratives are translatable



Page Navigation – Close Action



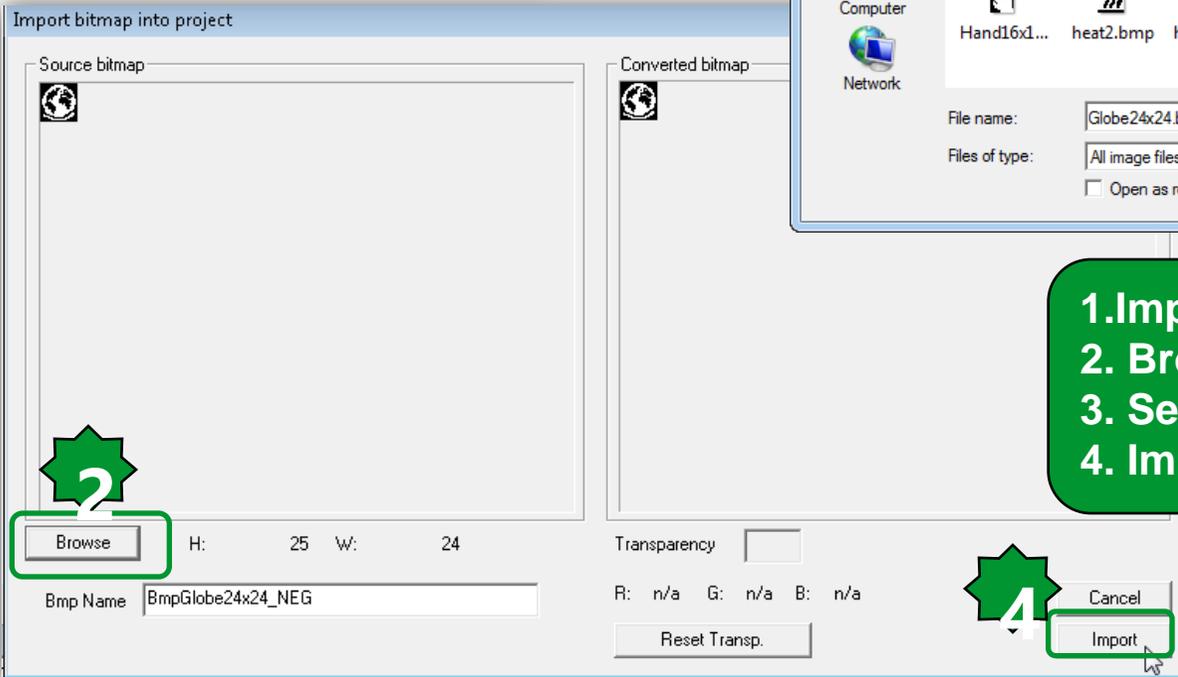
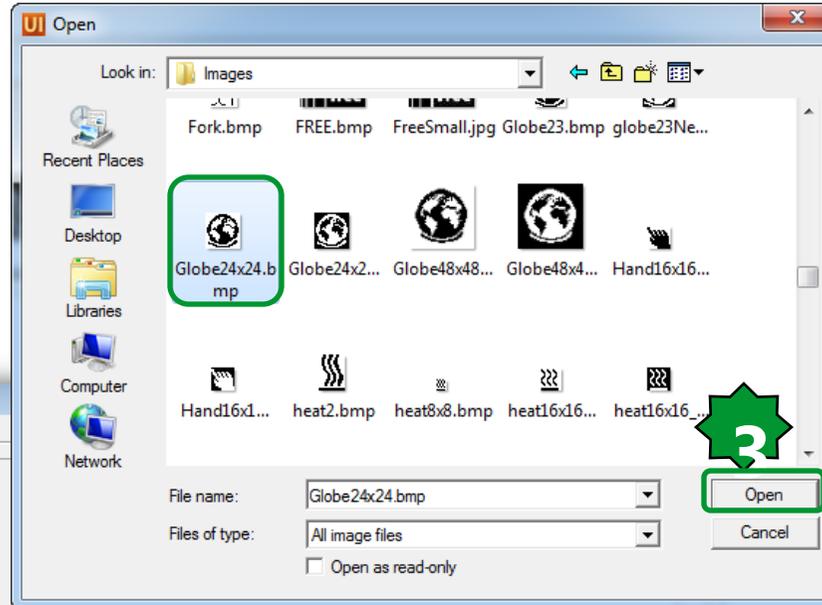
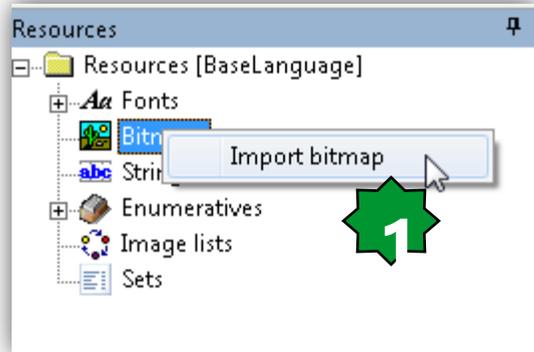
Properties	
Properties	Events
XPos	91
YPos	48
XDim	34
YDim	13
Name	Button_7
Text/img	ID_Close
Selection text/img	ID_Close
Font	EWP2_6x8
Appearance	Flat
Border points	1
Border color	■
Background color	■
Selection border	■
Sel. background	■
Selection order	4
Visible	TRUE
Transparent	FALSE
Selection variable	FALSE
Action	Close
Action par	
Alignment	Center



Note:

- An already opened page can't be opened: i.e. from this page it is not possible to open Main.
- Main can be reached only through a Close Action (close current and open previous page)

Image Object

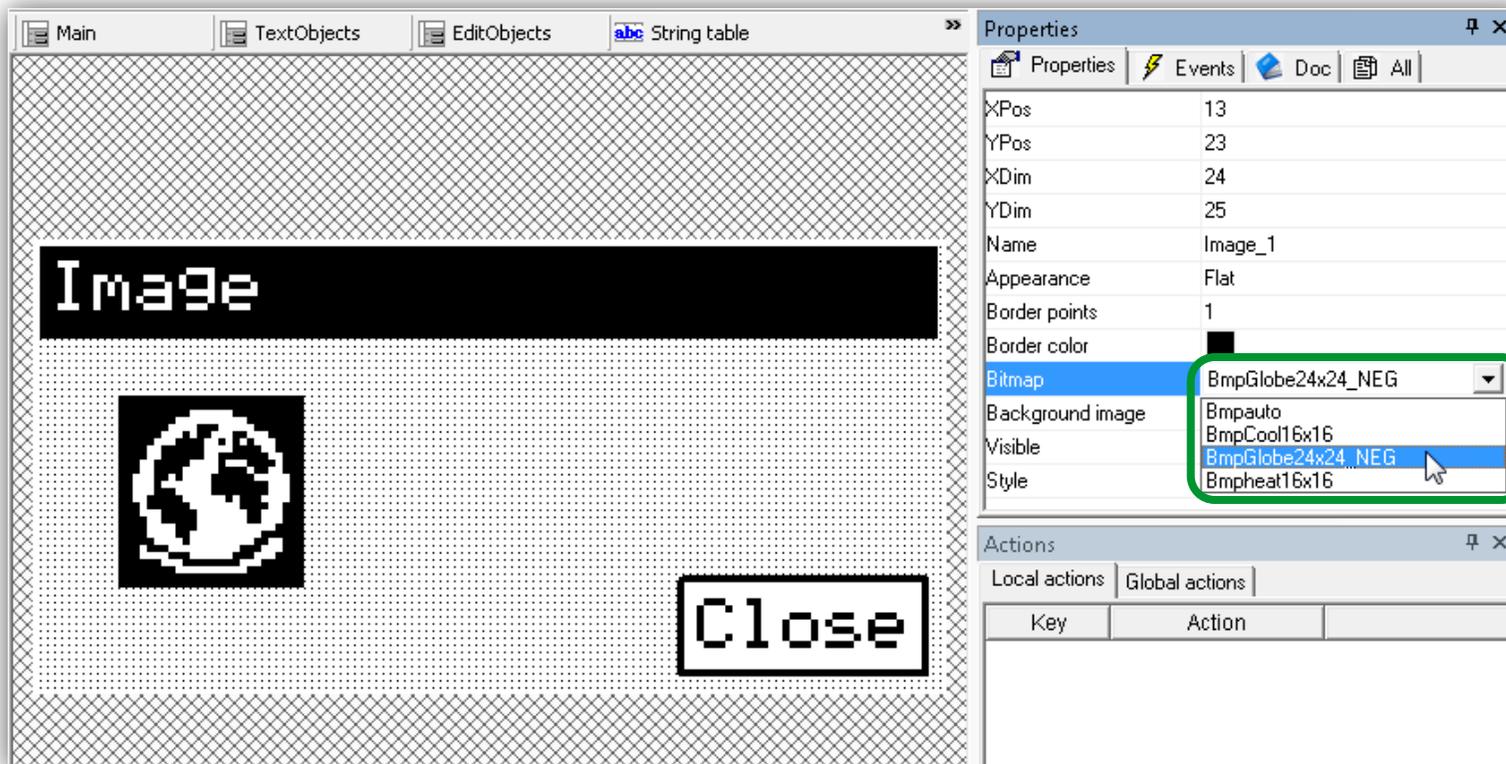


1. Import bitmap
2. Browse ► select form image library
3. Select the desired image ► Open
4. Import

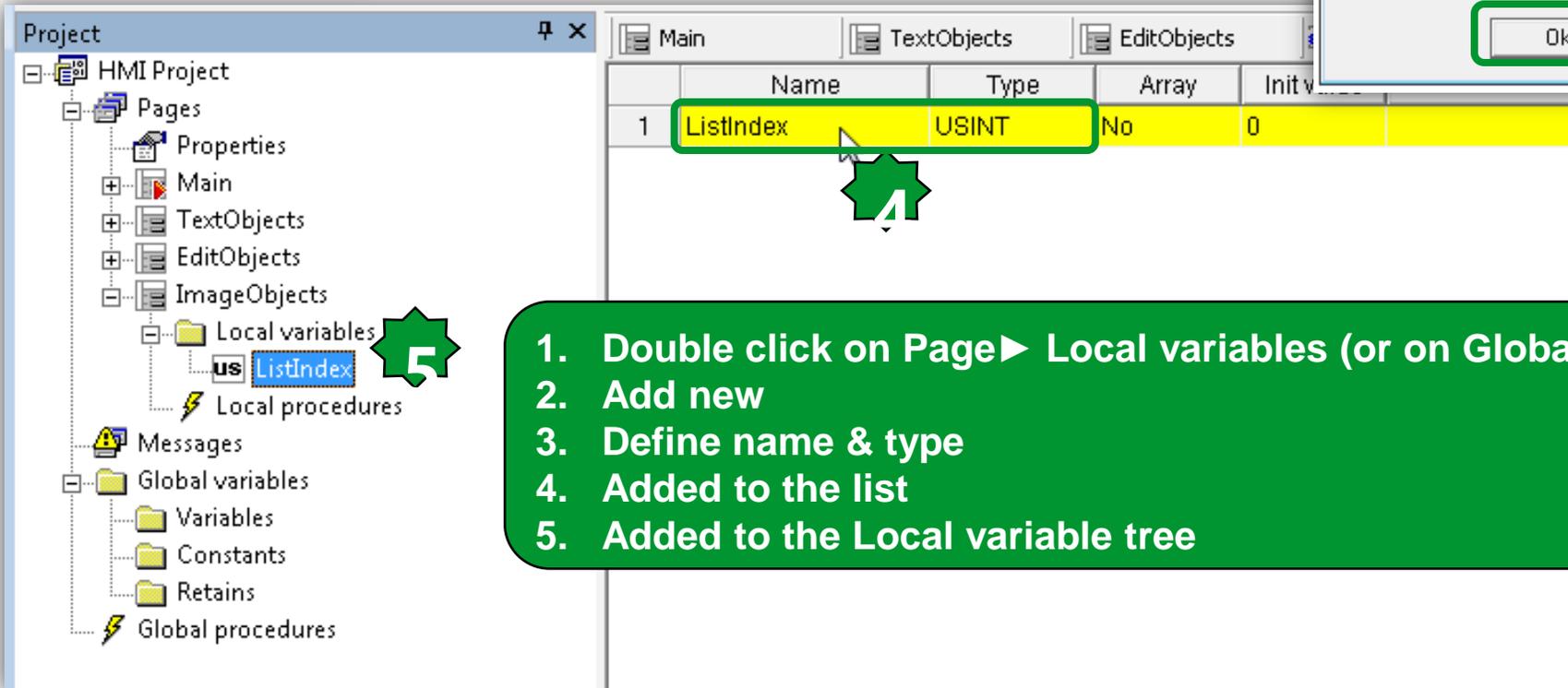
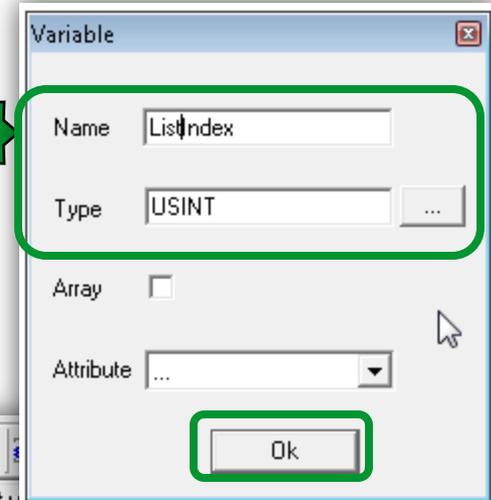
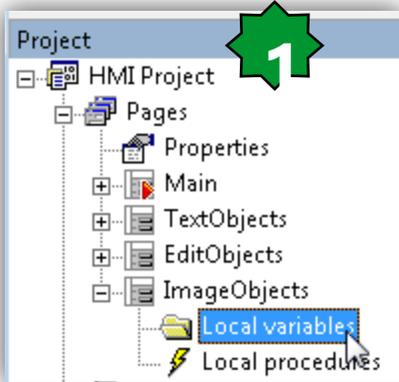
Image Object



1. Inset new image
2. Properties ► Bitmap ► select the desired image from imported list



Local and Global Variables



1. Double click on Page ► Local variables (or on Global variables)
2. Add new
3. Define name & type
4. Added to the list
5. Added to the Local variable tree

Animation



Property definition

Variable selection

@PLC.sysClock_dayweek	@PLC.Temp_UM
@PLC.sysClock_Error	ListIndex
@PLC.sysClock_hours	sysBacklight
@PLC.sysClock_minutes	sysCurrentSelectedPosition
@PLC.sysClock_month	sysKeyPressed
@PLC.sysClock_seconds	sysLangID
@PLC.sysClock_year	sysLocalLeds
@PLC.sysClockSet_daymonth	sysMSK
@PLC.sysClockSet_dayweek	sysTimer
@PLC.sysClockSet_hours	sysVER
@PLC.sysClockSet_minutes	
@PLC.sysClockSet_month	
@PLC.sysClockSet_seconds	
@PLC.sysClockSet_Upload	
@PLC.sysClockSet_year	

Filter: All

Value selection

None
Variable

5. Filter variables as page locals

Properties

XPos	108
YPos	21
XDim	16
YDim	17
Name	Animation_3
Appearance	Flat
Border points	0
Border color	■
Image list	ModeList
Animation variable	ListIndex
Data type	USINT
Visible	TRUE

Properties

XPos	85
YPos	22
Name	Edit_4
Appearance	Flat
Font	EWP2_6x8
Background color	■
Text color	■
Sel. background	■
Sel. foreground	■
Border points	1
Border color	■
Number of chars	3
Format	%d
Alignment	Right
Access	RW
Selection order	1
Variable	ListIndex
Data type	USINT
Low limit	0
High limit	2
Refresh	TRUE
Visible	TRUE
Selectable	TRUE
Label	

Main TextObjects Edit

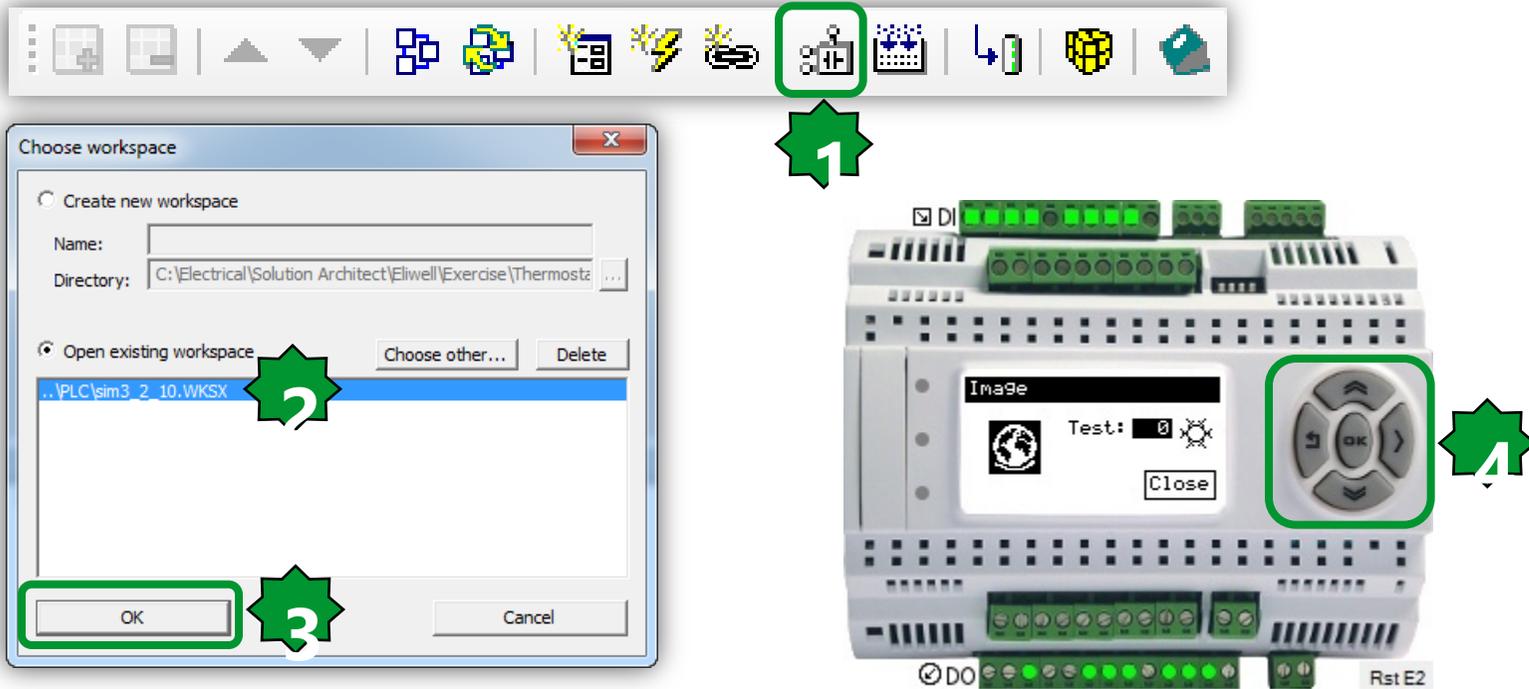
Image

Test: [] []

Close

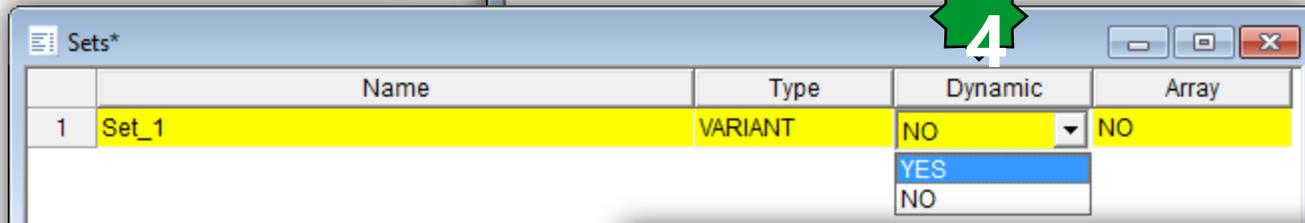
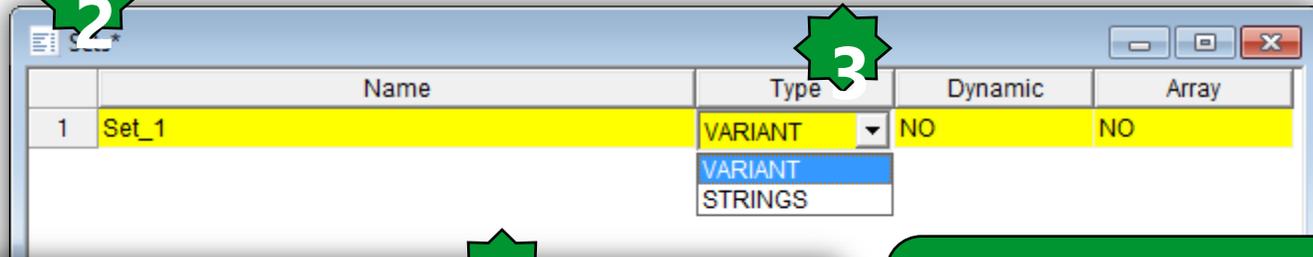
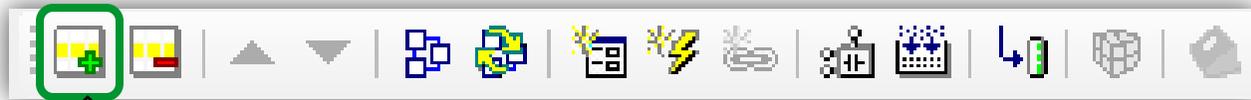
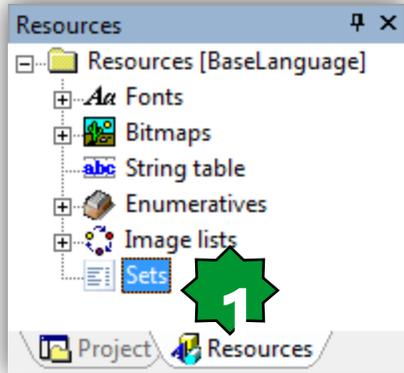
1. Insert new animation
2. Rename it if needed (optional)
3. Select from Image list
4. Select from property definition

UI simulation

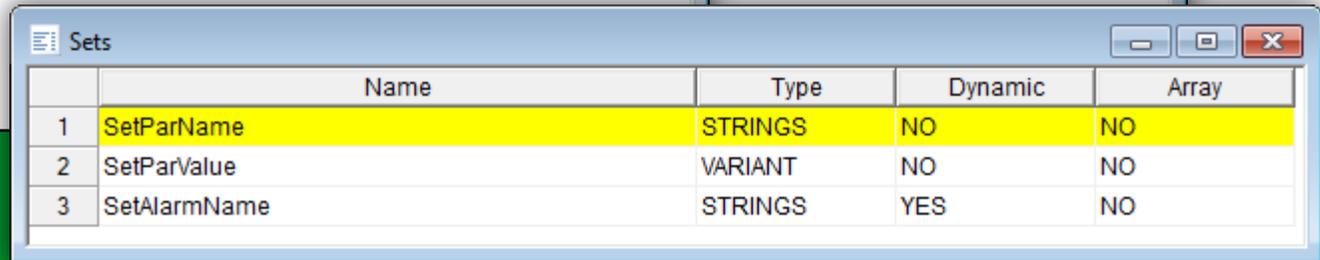


There are two parallel, identical ways to simulate, via UI or Ap

Sets creation

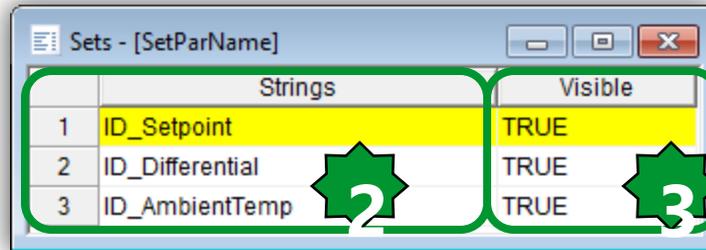
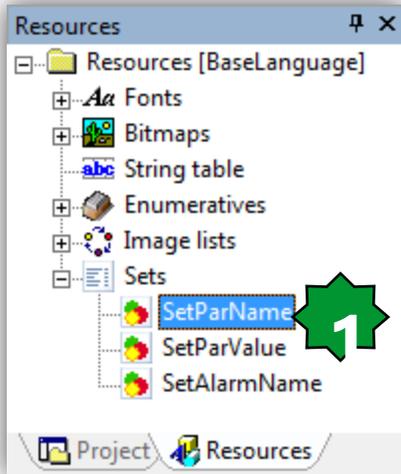


Goal: creating a list of variables & strings with scroll up/down ability



- 1. Double clicks
- 2. Add
- 3. Type
 - 3.1 Variant: Variable/parameter sets even of not equal type
 - 3.2 Strings: text
- 4. Dynamic: compresses the list when invisible variable/parameter are used

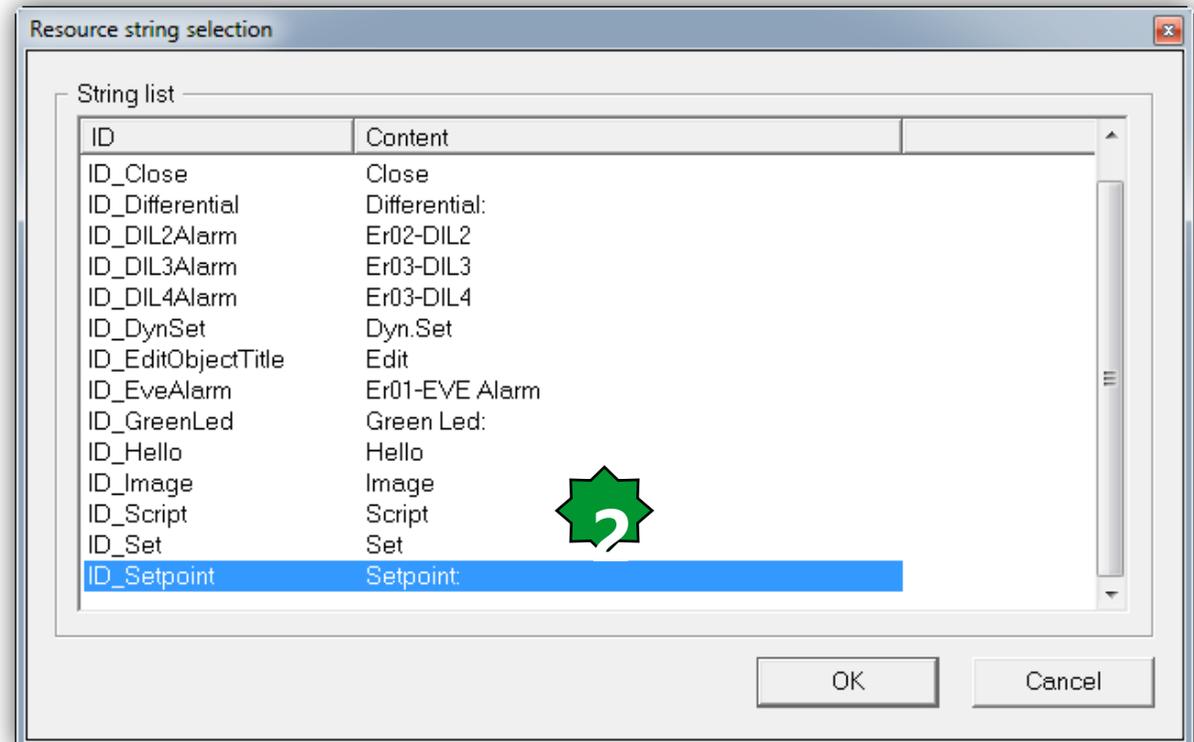
Strings Set filling



1. Double clicks
2. Select the string form the list
3. Define the visible field

Dynamic visibility:

If the visible field is False, then empty parameter's rows will be removed from the list and the list could be shrink pack.



Variant Set filling



Resources

- Resources [Baselanguage]
- Fonts
- Bitmaps
- String table
- Enumeratives
- Image lists
- Sets
 - SetParName
 - SetParValue**
 - SetAlarmName

Project Resources

Sets - [SetParValue]

	Variable/Parameter	Format	Text align	Min	Max	Visible	Selectable
1	@PLC.SetPoint	%1d	Right	150	300	TRUE	TRUE
2	@PLC.Differentiation	%1d	Right	5	50	TRUE	TRUE
3	@PLC.Ambient_Temperature	%1d	Right			TRUE	FALSE

Property definition

Variable selection

@PLC.Addr_CAN_OB	@PLC.AOL4	@PLC.Calibration_AI5
@PLC.Addr_CAN_PI	@PLC.AOL5	@PLC.Calibration_AI6
@PLC.Addr_RS232_PI	@PLC.ATV_Command	@PLC.Cfg_AI1
@PLC.Addr_RS485_OB	@PLC.ATV_Output_Frequency	@PLC.Cfg_AI2
@PLC.Addr_RS485_PI	@PLC.ATV_Speed_Reference	@PLC.Cfg_AI3
@PLC.AIL1	@PLC.BACKLIGHT	@PLC.Cfg_AI4
@PLC.AIL2	@PLC.Baud_CAN_OB	@PLC.Cfg_AI5
@PLC.AIL3	@PLC.Baud_CAN_PI	@PLC.Cfg_AI6
@PLC.AIL4	@PLC.Baud_RS232_PI	@PLC.Cfg_AO1_AO5
@PLC.AIL5	@PLC.Baud_RS485_OB	@PLC.Cfg_AO2
@PLC.AIL6	@PLC.Baud_RS485_PI	@PLC.Cfg_AO3
@PLC.Ambient_Temperature	@PLC.Calibration_AI1	@PLC.Cfg_AO4
@PLC.AOL1	@PLC.Calibration_AI2	@PLC.DataBit_RS232_PI
@PLC.AOL2	@PLC.Calibration_AI3	@PLC.DataBit_RS485_OB
@PLC.AOL3	@PLC.Calibration_AI4	@PLC.DataBit_RS485_PI

Filter: All

Add variable

Value selection

Variable
TRUE
FALSE

OK Cancel

Integer format

Integers (1-31) 1

Decimals (1-7) 1

Hexadecimal Uppercase (...00H)

Hexadecimal Lowercase (...00h)

Fill with zeroes

View always sign

Password

Target metric

Target custom format

HH:MM

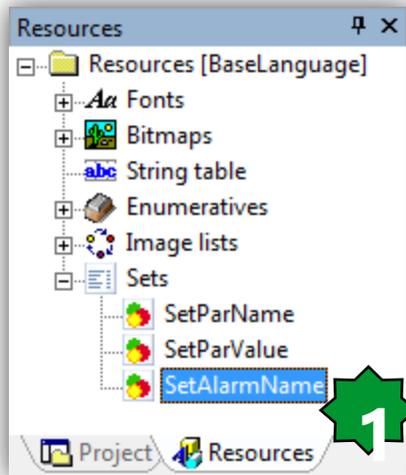
Enumerative

LedEnum

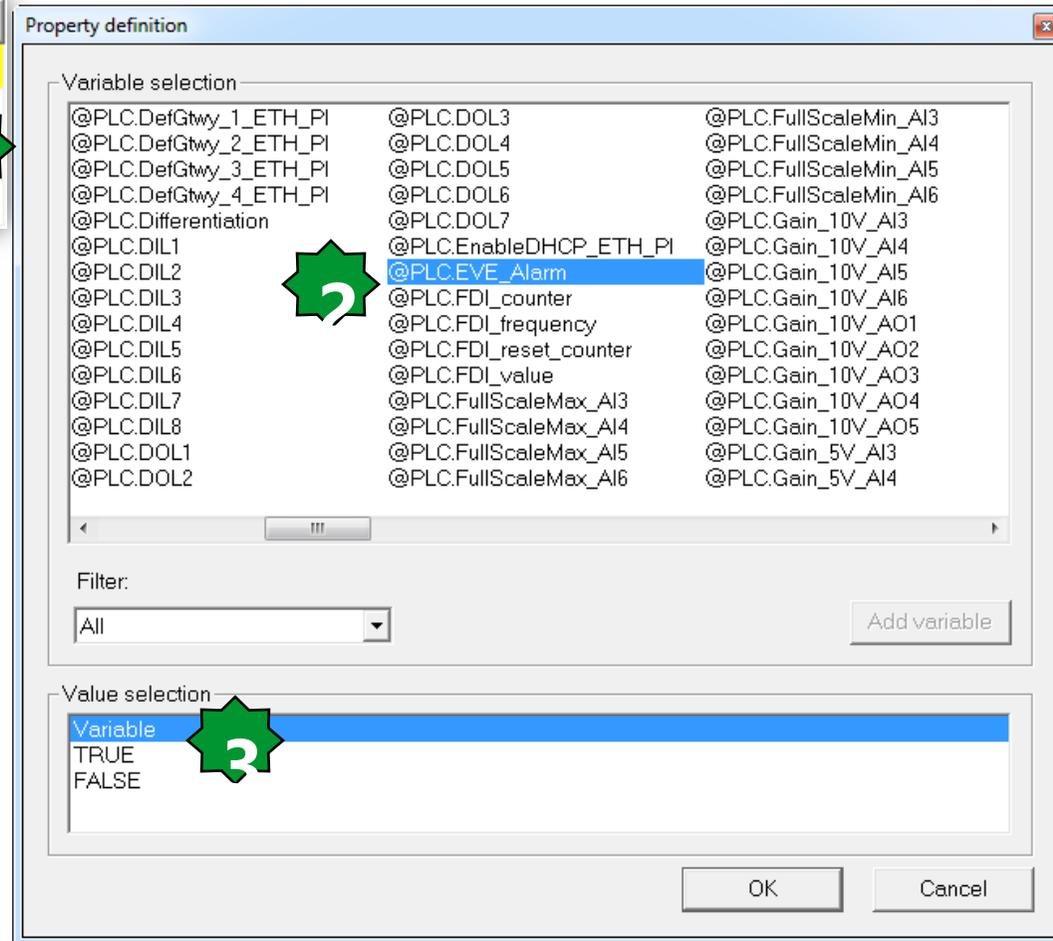
OK Cancel

- 1. Sets
- 2. Format: One decimal point
- 3. Selectable False in case of RO elements

Dynamic Set filling

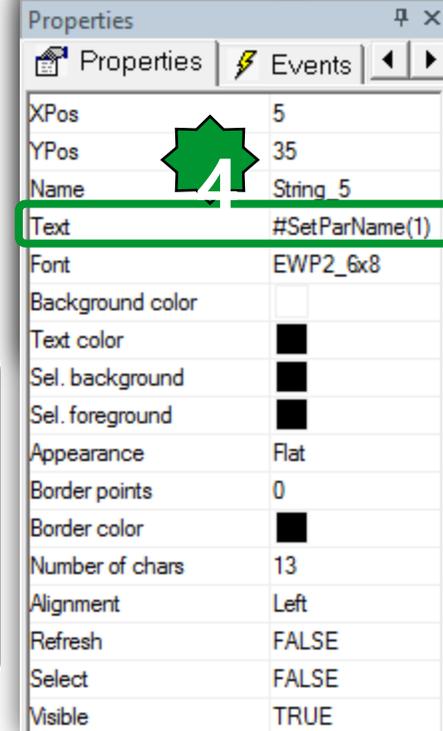
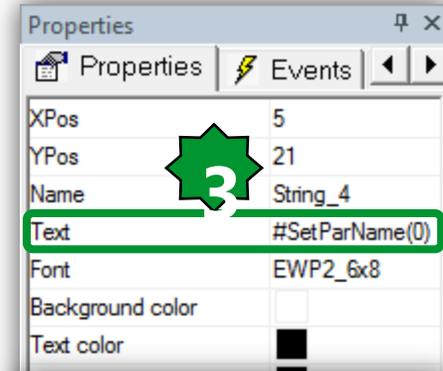
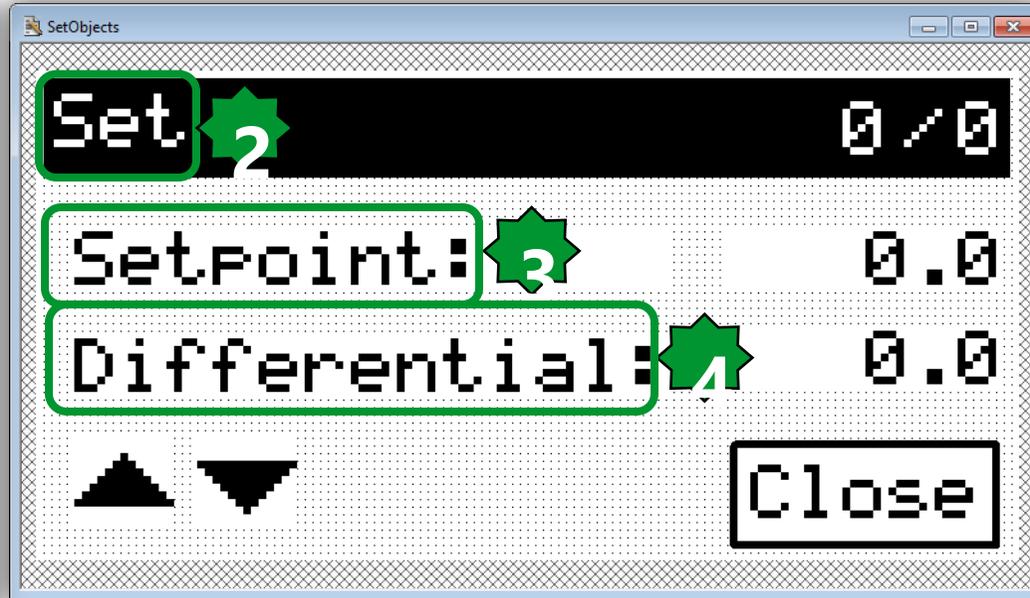
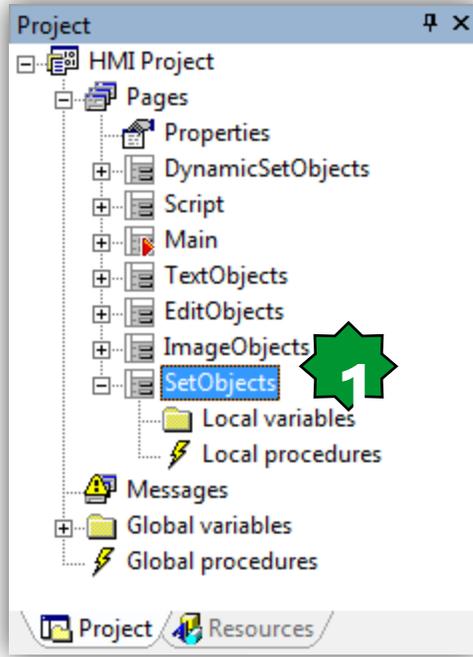


	Strings	Visible
1	ID_EveAlarm	@PLC.EVE_Alarm
2	ID_DIL2Alarm	@PLC.DIL2
3	ID_DIL3Alarm	@PLC.DIL3
4	ID_DIL4Alarm	@PLC.DIL4



Note: the item is displayed only if Visible field is TRUE

Set Objects...



Note: The number of elements of the sets shown in the same page should be equal

Syntax:

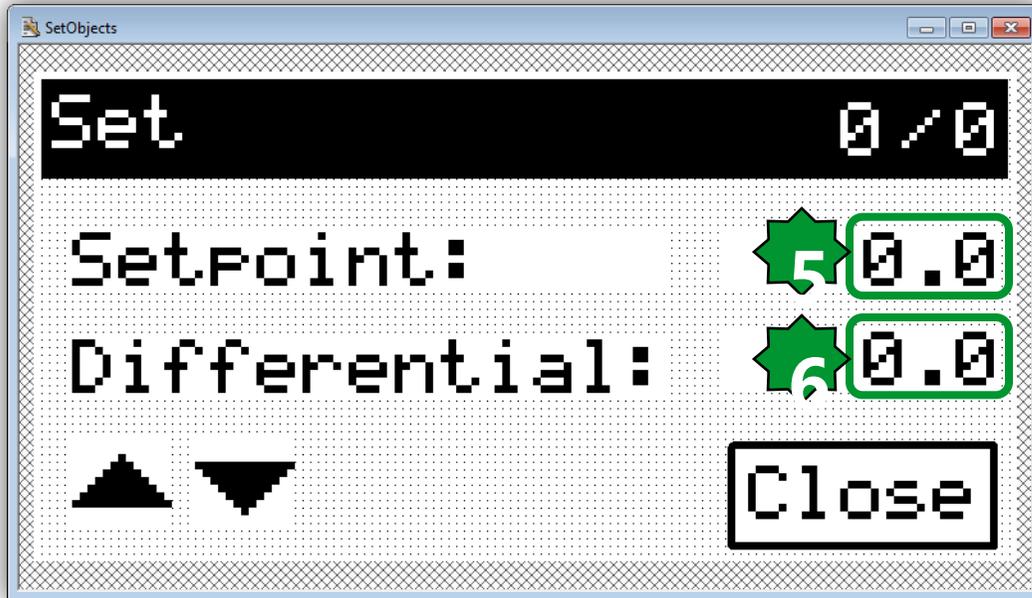
String:

#Setparname(0), #Setparname(1), ..., #Setparname(element x page -1)

Variant:

#Setparvalue(0), #Setparvalue(0), ..., #Setparvalue(element x page -1)

Set Objects...



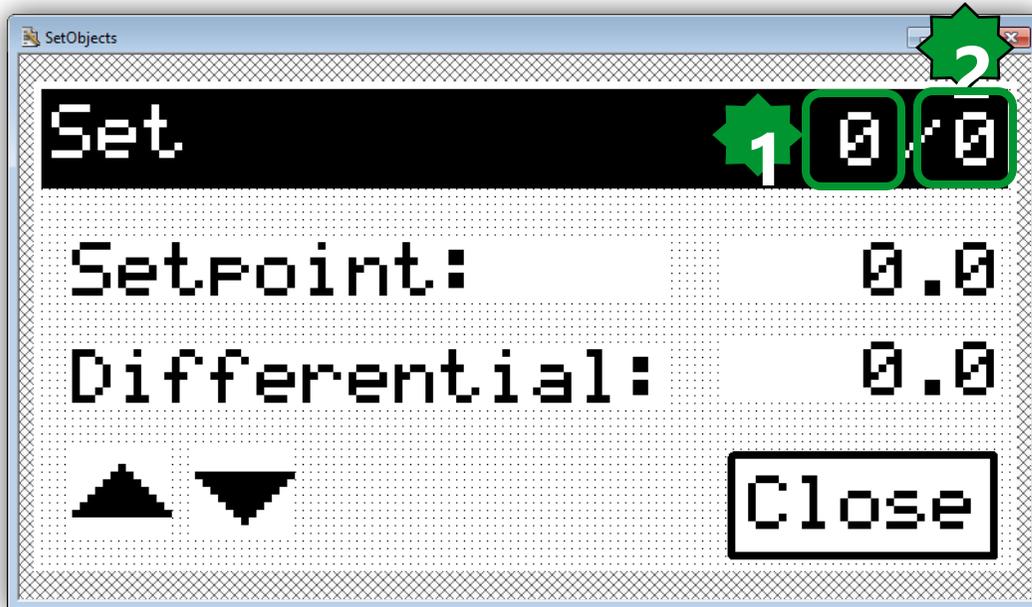
Properties			
Properties	Events	Doc	All
XPos	90		
YPos	21		
Name	Edit_6		
Appearance	Flat		
Font	EWP2_6x8		
Background color			
Text color	■		
Sel. background	■		
Sel. foreground			
Border points	0		
Border color	■		
Number of chars	6		
Format	%.1d		
Alignment	Right		
Access	RW		
Selection order	3		
Variable	#SetParValue(0)		
Data type	INT		
Low limit	150		
High limit	300		
Refresh	TRUE		
Visible	TRUE		
Selectable	TRUE		
Label			

Properties		
Properties	Events	Doc
XPos	90	
YPos	34	
Name	Edit_7	
Appearance	Flat	
Font	EWP2_6x8	
Background color		
Text color	■	
Sel. background	■	
Sel. foreground		
Border points	0	
Border color	■	
Number of chars	6	
Format	%.1d	
Alignment	Right	
Access	RW	
Selection order	4	
Variable	#SetParValue(1)	
Data type	INT	
Low limit	5	
High limit	50	
Refresh	TRUE	
Visible	TRUE	
Selectable	TRUE	
Label		

Syntax Variant:
#Setparvalue(0), #Setparvalue(0), ...,
#Setparvalue(element x page -1)

- Size the text dimension based on the longest string to be displayed
- Size the Edit dimension base on the biggest digits to be displayed

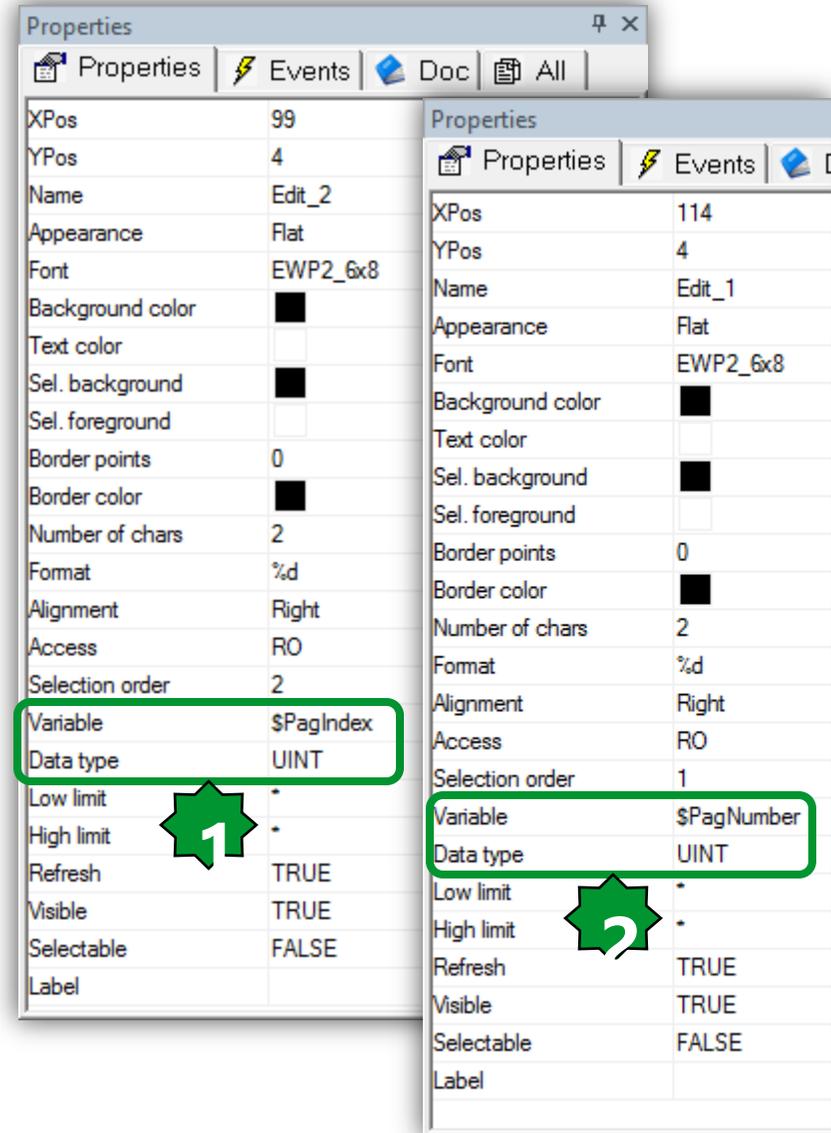
Set/Objects/Page x out of Y



Note:

Data type will be define automatically as soon as variable recognized, if not there is a mistake in the variable name.

1. \$PagIndex=Current Page Number
2. \$PagNumber= Total pages number



Dynamic Set Objects



Project HMI Project

- Pages
 - Properties
 - DynamicSetObjects**
 - Local variables
 - Local procedures
 - Script
 - Main
 - TextObjects
 - EditObjects
 - ImageObjects
 - SetObjects
 - Local variables
 - Local procedures
- Messages
- Global variables

Project Resources

Properties

Properties	Events	Doc
CharDimX	1	
CharDimY	1	
Font	EWP2_8x16	
Background color		
Text color	■	
Title bar	Yes	
Page border	No	
Caption	ID_DynSet	
Appearance	Flat	

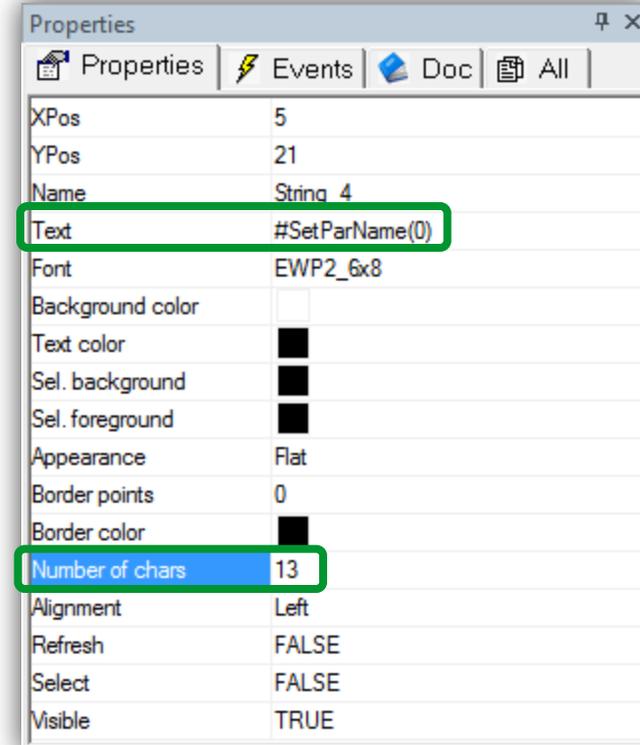
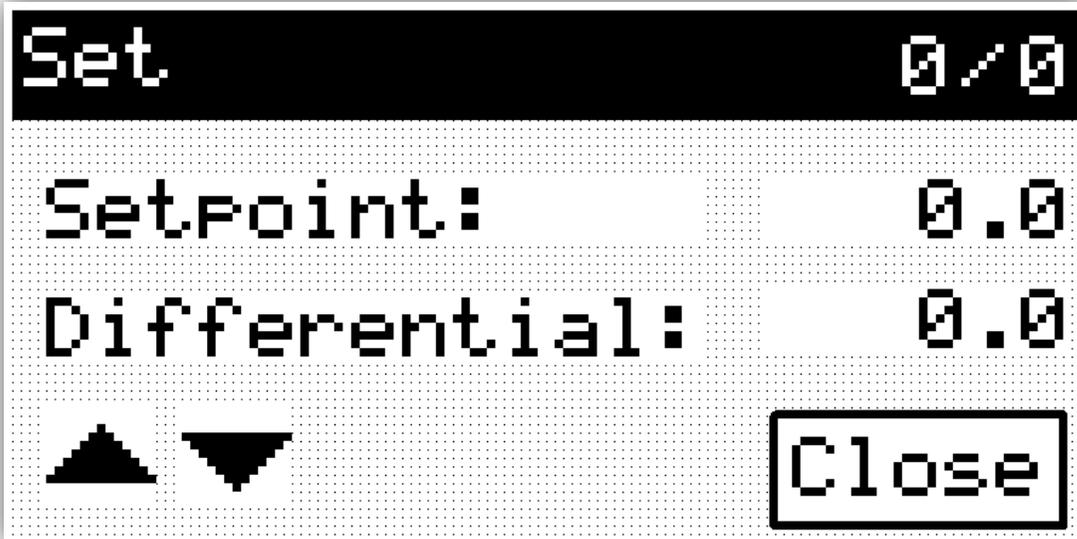
Properties

Properties	Events	Doc	All
XPos	5		
YPos	21		
Name	String 4		
Text	#SetAlarmName(0)		
Font	EWP2_6x8		
Background color			
Text color	■		
Sel. background	■		
Sel. foreground	■		
Appearance	Flat		
Border points	0		
Border color	■		
Number of chars	19		
Alignment	Left		
Refresh	FALSE		
Select	FALSE		
Visible	@PLC.EVE_Alarm		

Properties

Properties	Events	Doc	All
XPos	5		
YPos	35		
Name	String 5		
Text	#SetAlarmName(1)		
Font	EWP2_6x8		
Background color			
Text color	■		
Sel. background	■		
Sel. foreground	■		
Appearance	Flat		
Border points	0		
Border color	■		
Number of chars	19		
Alignment	Left		
Refresh	FALSE		
Select	FALSE		
Visible	@PLC.DIL2		

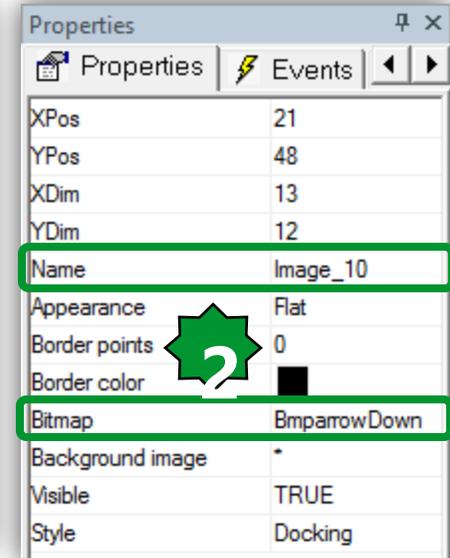
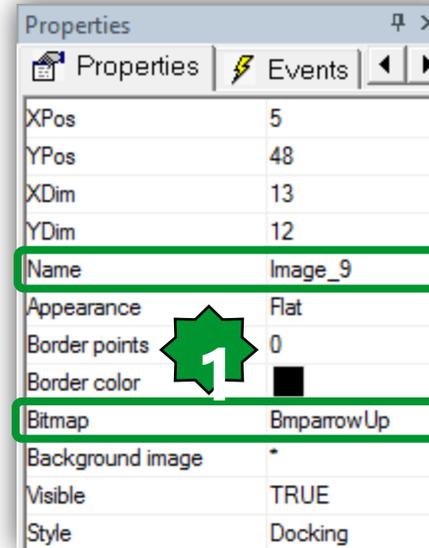
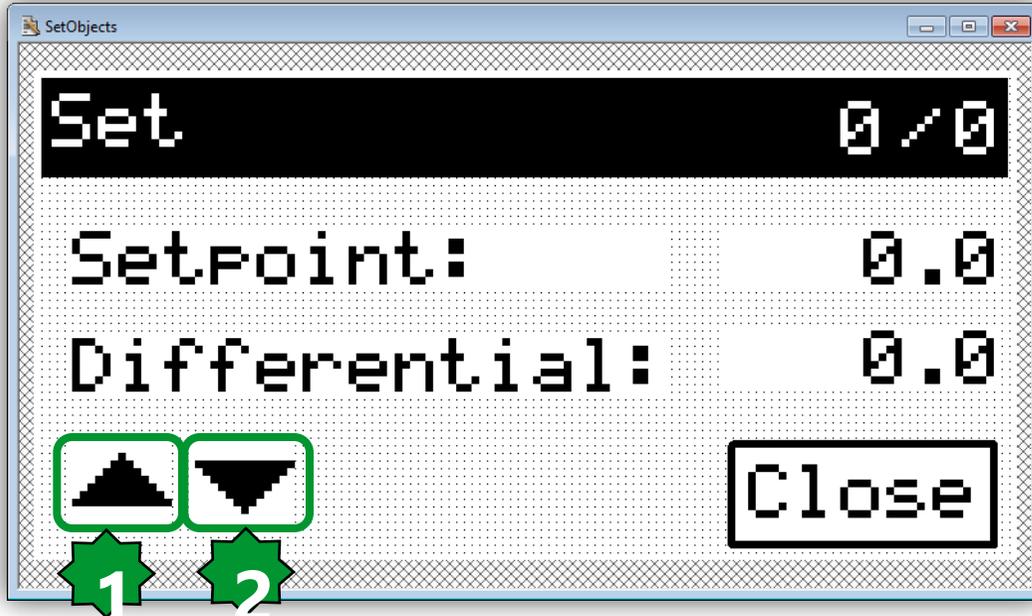
Maximum number of characters



Number of Chars:

If you do not resize the related window will be 0, and you might face with refresh problem. It is possible to set it maximum 21 characters (>21 Chars=> out of display)

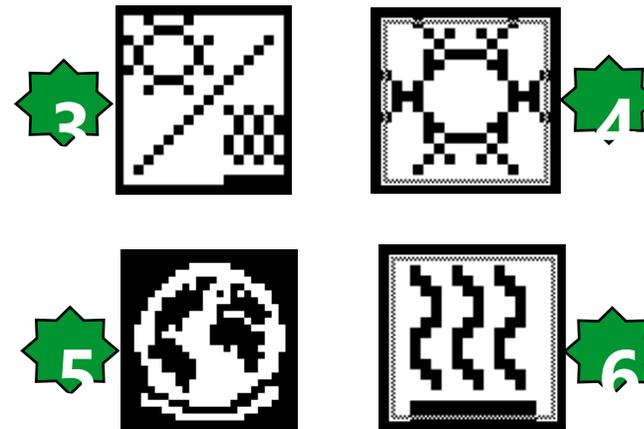
Set Objects/up & down arrows



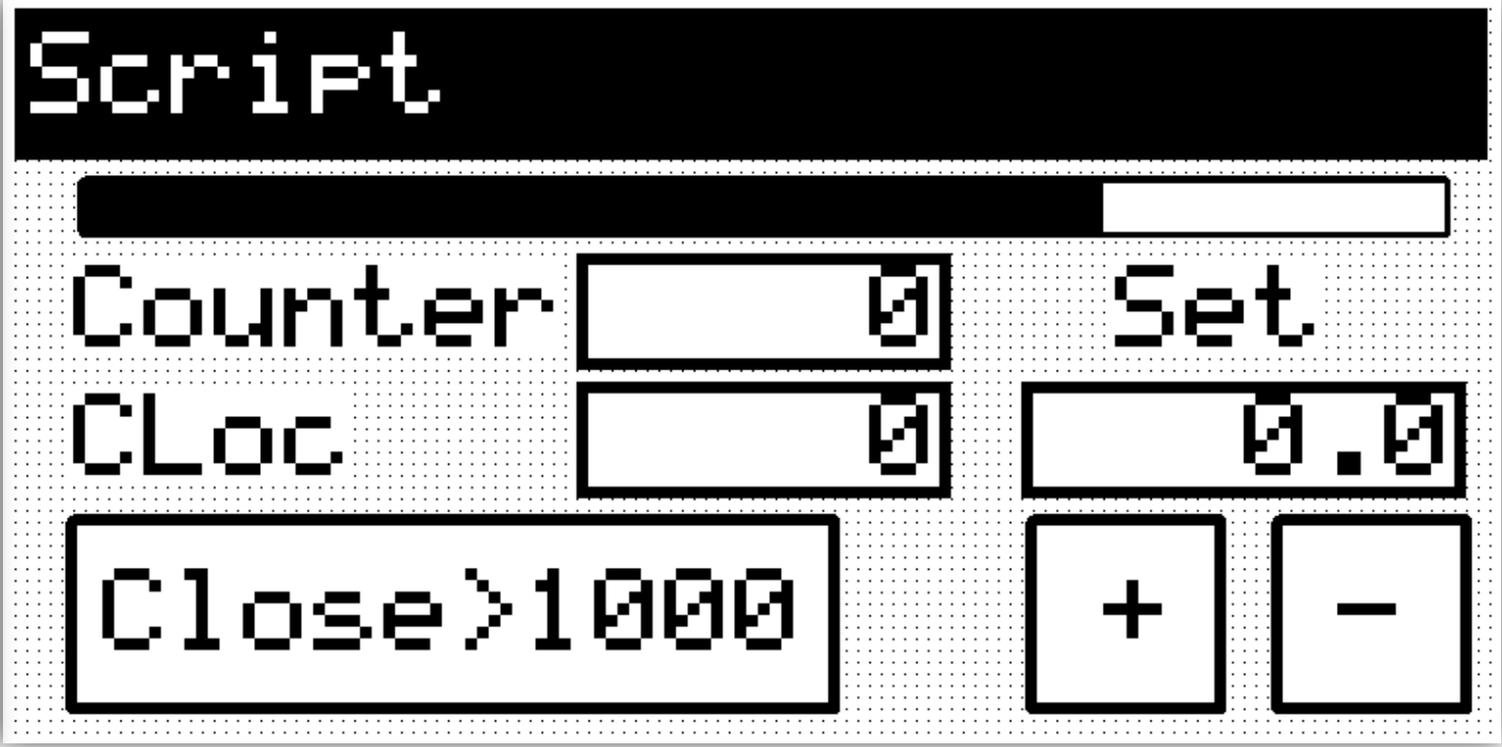
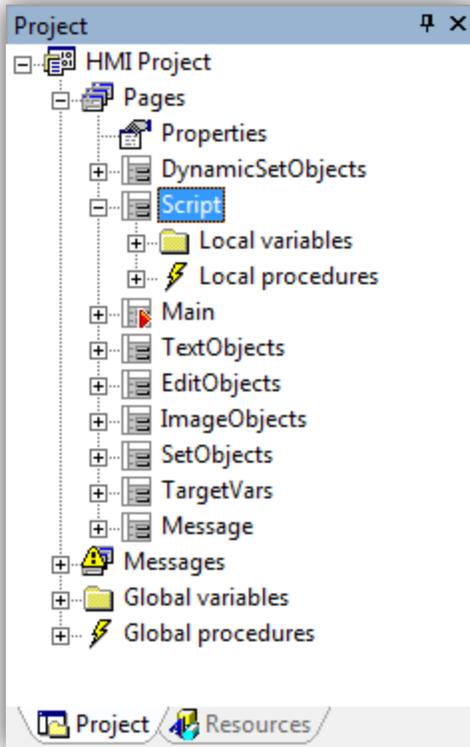
Bitmap

- BmparrowDown
- BmparrowUp
- Bmpauto
- BmpCool16x16
- BmpGlobe24x24
- Bmpheat16x16

1. BmparrowDown:
2. BmparrowUp:
3. Bmpauto:
4. BmpCool 16*16:
5. BmpGlobe 24*24:
6. Bmpheat 16*16:



Script



Global Variables To Be Defined



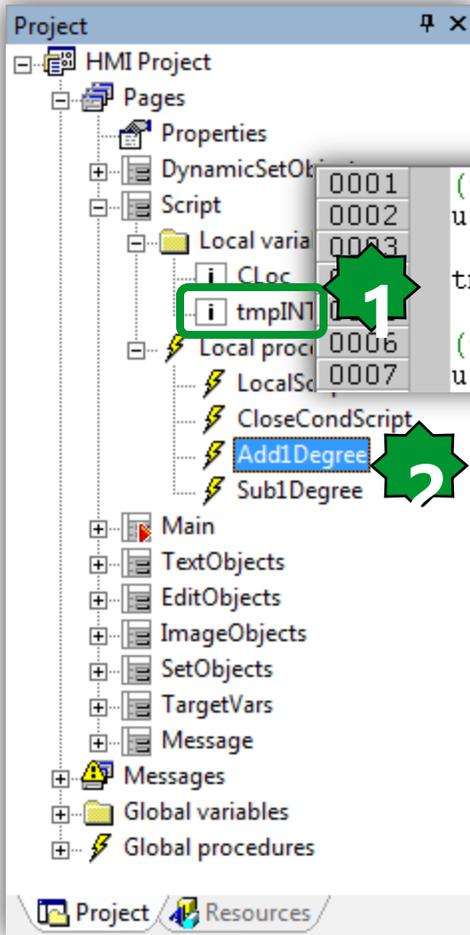
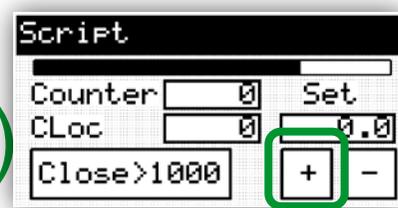
Project

- HMI Project
 - Pages
 - Properties
 - DynamicSetObjects
 - Script
 - Main
 - TextObjects
 - EditObjects
 - ImageObjects
 - SetObjects
 - TargetVars
 - Message
 - Messages
 - Global variables
 - Variables
 - Counter
 - dummy
 - MessageEnable
 - StartTimeoutTmr
 - TimeOutCtd
 - tmpBOOL
 - uint_ret
 - Constants
 - SETPOINTMODBUS
 - Retains
 - Global procedures

	Name	Type	Address	Group	Array	Init value	Attribute
1	Counter	UINT	Auto		No	0	..
2	StartTimeoutTmr	UDINT	Auto		No	0	..
3	dummy	USINT	Auto		No	0	..
4	uint_ret	UINT	Auto		No	0	..
5	TimeOutCtd	UDINT	Auto		No	0	..
6	MessageEnable	BOOL	Auto		No	FALSE	..
7	tmpBOOL	BOOL	Auto		No	FALSE	..

	Name	Type	Address	Group	Array	Init value	Attribute
1	Counter	UINT	Auto		No	0	..
2	StartTimeoutTmr	UDINT	Auto		No	0	..
3	dummy	USINT	Auto		No	0	..
4	uint_ret	UINT	Auto		No	0	..
5	TimeOutCtd	UDINT	Auto		No	0	..
6	MessageEnable	BOOL	Auto		No	FALSE	..
7	tmpBOOL	BOOL	Auto		No	FALSE	..
8	SETPOINTMODBUS	UINT	Auto		No	16384	CONSTANT

Video_GetParam() Video_SetParam()

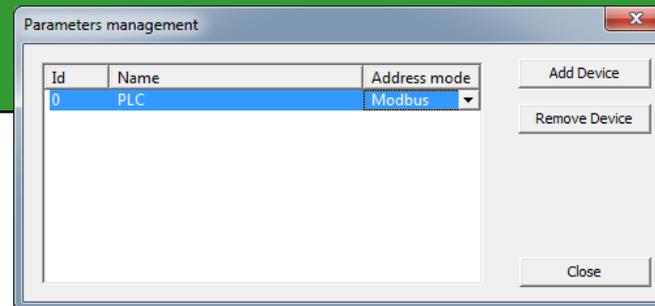
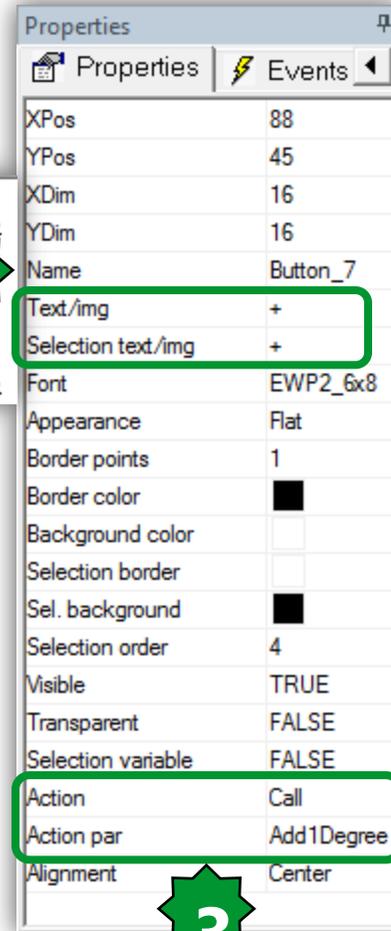


	Name	Type	Array	Init value	Description
1	CLoc	INT	No	0	
2	tmpINT	INT	No	0	

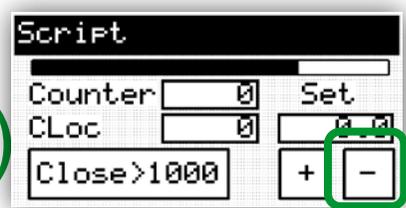
```

0001 (* Read Modbus Address SETPOINTMODBUS and copy into tmpINT *)
0002 uint_ret:= Video_GetParam( 0, SETPOINTMODBUS, 0, ?tmpINT, tyInt);
0003
0004 tmpINT := tmpINT+10;
0005
0006 (* tmpINT is written to Modbus Address SETPOINTMODBUS *)
0007 uint_ret:= Video_SetParam( 0, SETPOINTMODBUS, 0, ?tmpINT, tyInt );
    
```

- Video_GetParam() read and value from the parameter file Id, with address SETPOINTMODBUS. Result is copied into tmpINT.
- Video_SetParam() write tmpINT



Video_GetParam() Video_SetParam()



- Video_GetParam() read and value from the parameter file Id, with address SETPOINTMODBUS. Result is copied into tmpINT.
- Video_SetParam() write tmpINT

```

0001 (* Read Modbus Address SETPOINTMODBUS and copy into tmpINT *)
0002 uint_ret:= Video_GetParam( 0, SETPOINTMODBUS, 0, ?tmpINT, tyInt );
0003
0004 tmpINT := tmpINT-10;
0005
0006 (* tmpINT is written to Modbus Address SETPOINTMODBUS *)
0007 uint_ret:= Video_SetParam( 0, SETPOINTMODBUS, 0, ?tmpINT, tyInt );
    
```

XPos	109
YPos	45
XDim	16
YDim	16
Name	Button_10
Text/img	
Selection text/img	-
Font	EWP2_6x8
Appearance	Flat
Border points	1
Border color	■
Background color	
Selection border	
Sel. background	■
Selection order	6
Visible	TRUE
Transparent	FALSE
Selection variable	FALSE
Action	Call
Action par	Sub1Degree
Alignment	Center

Id	Name	Address mode
0	PLC	Modbus

Script: Video_SendEvent()



```

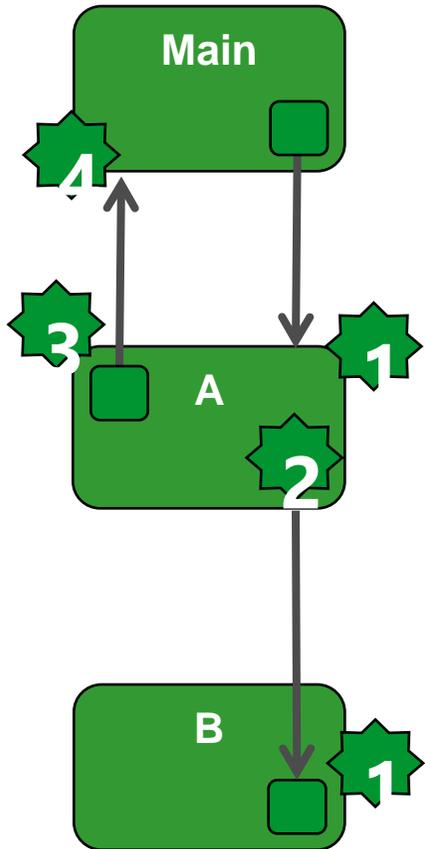
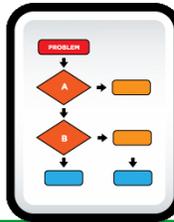
0001  if Counter>1000 then
0002      (*Close Current Page for Timeout *)
0003      dummy:=Video_SendEvent(kWM_KEY,kKEY_LongLeft);
0004      Counter := 0;
0005  end_if;
    
```

- When counter is greater than 1000 the script emulates a Long Left button press using function Video_SendEvent().
- Long Left action causes a page Close

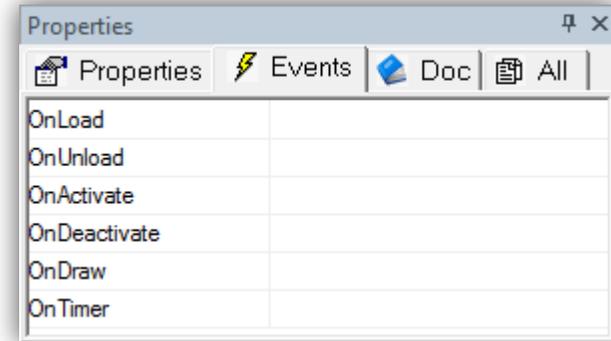
Property	Value
XPos	6
YPos	45
XDim	65
YDim	16
Name	Button_6
Text/img	Close>1000
Selection text/img	Close>1000
Font	EWP2_6x8
Appearance	Flat
Border points	1
Border color	Black
Background color	White
Selection border	Black
Sel. background	Black
Selection order	3
Visible	TRUE
Transparent	FALSE
Selection variable	FALSE
Action	Call
Action par	CloseCondScript
Alignment	Center

Actions	
Key	Action
Enter	Edit
Left	PrevField
Right	NextField
Up	PrevField
Down	NextField
LongLeft	Close
VK_F1	Close

Pages Events



1. OnLoad
2. OnDeactivated
3. OnUnload
4. OnActivate



Event	Description
<i>OnLoad</i>	On loading this page, i.e. when calling from parent page.
<i>OnUnload</i>	On closing this page, when the page returns and the parent page will be restored.
<i>OnDeactivate</i>	On calling a child page and the current page is no more active. This event does not exist in main page.
<i>OnActivate</i>	When the previous opened child page will be closed. This event does not appear in leaf page, i.e in the pages which do not call child pages.
<i>OnDraw</i>	When the page starts drawing all the objects. The page has just drawn border, background, and title.
<i>OnTimer</i>	Asynchronous event. The user can link a procedure and it will be executed cyclically.

Pages Events



Project HMI Project

- Pages
 - Properties
 - DynamicSetObjects
 - Script
 - Local variables
 - Local procedures
 - LocalScript**
 - CloseCondScr
 - Add1Degree
 - Sub1Degree
- Main
- TextObjects
- EditObjects
- ImageObjects
- SetObjects
- TargetVars
- Message
- Messages
- Global variables
- Global procedures

Script

Counter Set

CLoc

Close > 1000

```
0001 CLoc := CLoc+1;  
0002  
0003
```

Event: CLoc counts the number of times Script page is displayed

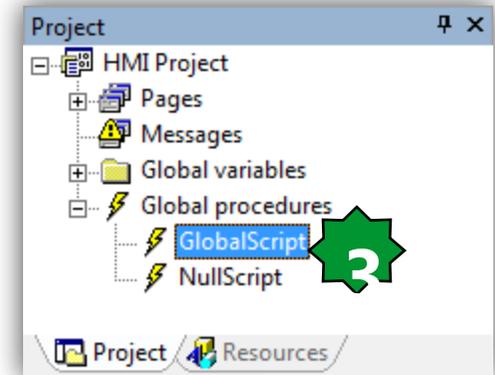
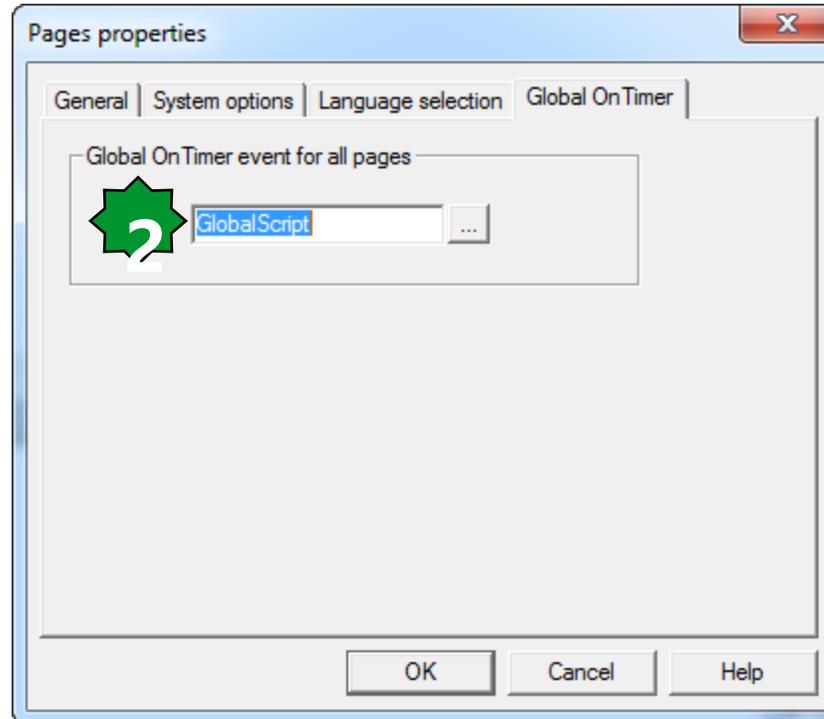
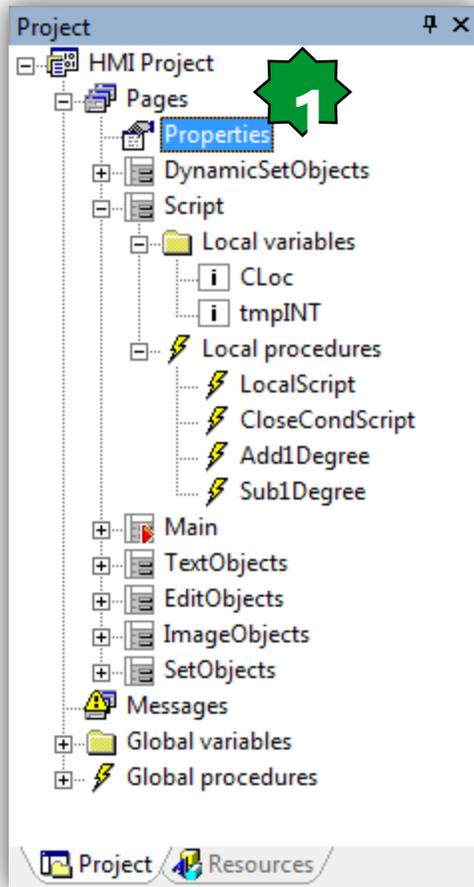
Properties

CharDimX	1
CharDimY	1
Font	EWP2_6x8
Background color	
Text color	■
Title bar	Yes
Page border	No
Caption	ID_Script
Appearance	Flat

Properties Events

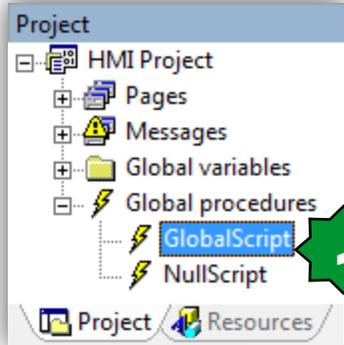
OnLoad	LocalScript
OnUnload	
OnActivate	LocalScript
OnDeactivate	
OnDraw	
OnTimer	

Global On Timer Script



Note:
Global On Timer always runs in background

Global On Timer Script – Page Timeout



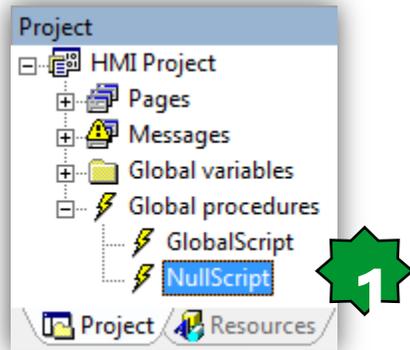
Force a page close if no button has been pressed for 20sec

Actions	
Key	Action
Enter	Edit
Left	PrevField
Right	NextField
Up	PrevField
Down	NextField
LongLeft	Close
VK_F1	Close

```

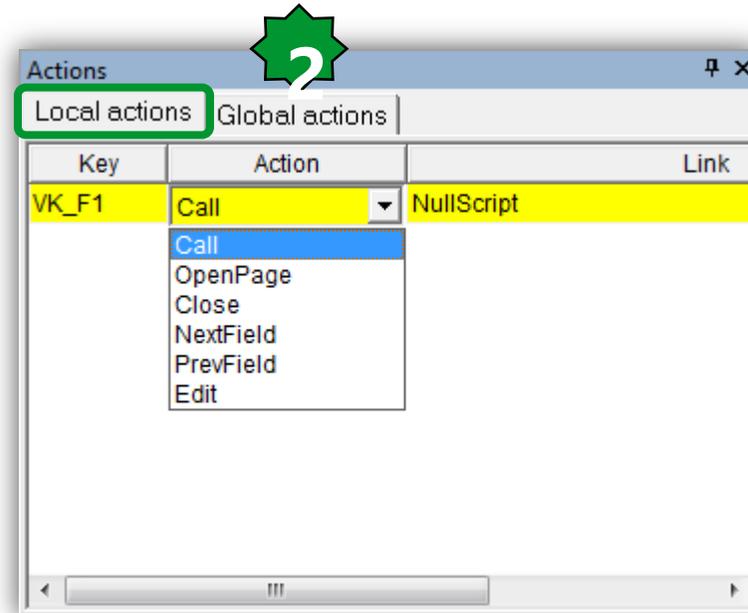
0001
0002 (*-----*)
0003 (* 20sec Timeout Inactivity based on sysTimer *)
0004 (*-----*)
0005
0006 IF (sysKeyPressed AND 2)=0 AND sysKeyPressed<>0 THEN
0007
0008     (* A key has been pressed and not yet detected *)
0009     StartTimeoutTmr := sysTimer;
0010
0011 END_IF;
0012
0013
0014 IF (sysTimer-StartTimeoutTmr) > 20000 THEN
0015
0016     (*Close Current Page for Timeout *)
0017     dummy:=Video_SendEvent(kWM_KEY,kKEY_VK_F1);
0018     StartTimeoutTmr := sysTimer;
0019
0020 END_IF;
0021
0022 (* Raise the second bit in order to detect new key press *)
0023 (* In this way sysKeyPressed can be used also by other scripts *)
0024
0025 sysKeyPressed := sysKeyPressed OR 2;
0026 (*-----*)
0027
0028 (*-----*)
0029 (* Seconds to next timeout event [sec/10] *)
0030 (*-----*)
0031 TimeOutCtd := (20000-(sysTimer-StartTimeoutTmr))/100;
0032 (*-----*)
0033
0034 (*-----*)
0035 (* Counter used in Script Page *)
0036 (*-----*)
0037 IF Counter<10000 THEN
0038     Counter := Counter + 1;
0039 END_IF;
    
```

Global On Timer Script – Page Timeout



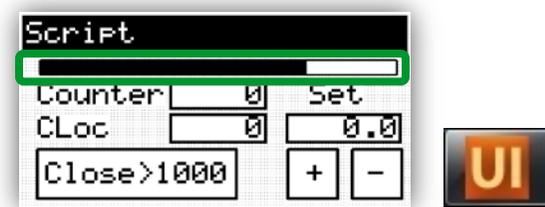
```
0001 Counter:=Counter;  
0002
```

Script can not be empty



**Main Page can't be closed:
Global actions is bypassed by
local ones**

Progress Bar



Properties

XPos	7
YPos	16
XDim	116
YDim	4
Name	Progress_5
Appearance	Flat
Border points	1
Border color	■
Bar color	■
Background color	□
Visible	TRUE
Refresh trigger	TRUE
Progress variable	Counter
Data type	UINT
Low limit	0
High limit	10000
Orientation	Horizontal

Green callouts: 1 (points to progress bar icon), 2 (points to Visible property), 3 (points to High limit property)

Property definition

Variable selection

@PLC.sysClock_dayweek	@PLC.Temp_UM	TimeOutCtd
@PLC.sysClock_Error	CLoc	tmpBOOL
@PLC.sysClock_hours	Counter	tmpINT
@PLC.sysClock_minutes	dummy	uint_ret
@PLC.sysClock_month	MessageEnable	
@PLC.sysClock_seconds	SETPOINTMODBUS	
@PLC.sysClock_year	StartTimeoutTmr	
@PLC.sysClockSet_daymonth	sysBacklight	
@PLC.sysClockSet_dayweek	sysCurrentSelectedPosition	
@PLC.sysClockSet_hours	sysKeyPressed	
@PLC.sysClockSet_minutes	sysLangID	
@PLC.sysClockSet_month	sysLocalLeds	
@PLC.sysClockSet_seconds	sysMSK	
@PLC.sysClockSet_Upload	sysTimer	
@PLC.sysClockSet_year	sysVER	

Filter: All

Add variable

Value selection

None
Variable

OK Cancel

Messages...



Project tree structure:

- HMI Project
 - Pages
 - Messages
 - DIOPENED
 - Local variables
 - Counter
 - Local procedures
 - Timeout
 - LowLim
 - Local variables
 - Counter
 - Local procedures
 - Timeout
 - Uplim
 - Local variables
 - Counter
 - Local procedures
 - Timeout
 - Global variables
 - Global procedures



```
0001 Counter := Counter+1;
0002
0003 if Counter>15 then
0004
0005     dummy:=Video_SendEvent(kWM_KEY,kKEY_VK_F1);
0006     Counter:=0;
0007
0008 end_if;
0009
```

Properties	Events	Doc	All
Msg ID	1		
XDim	106		
YDim	30		
XPos	12		
YPos	15		
CharDimX	1		
CharDimY	1		
Font	EWP2_8x16		
Background color	■		
Text color			
Title bar	No		
Page border	Yes		
Caption			

- Message can be opened from every page but it can't have child page
- Message is identified by its Msg ID
- Message can be opened using Video_SendEvent(kWM_MSG, MsgID)
- Msg ID 101-102 are automatically opened with low/up range error

... Message



Ap View object properties

Name: sysHmi_Message

Type: Function

Return Value: BOOL

Language Type:

Description:
Open a Message window on display.
The function return a BOOL which could have the following meanings:
TRUE = Command accepted.
FALSE = Error entering id value or HMI not running or function called into task timed

Input:

Name	Type	Description
id	USINT	User Message window ID [1..99]

Close

Library

MBMNODESTATUS	sysHmi_Message	sysSTREXT
STRUCTIMPULSECOUNTER	sysHTTP_Authentication	sysSTRINGtoINT
sysAnswerDelayIncTime	sysHTTP_ListableFilesExt	sysTFTP_Enabling
sysAOasOC	sysINT_TO_STRING	sysUART_getbuff
sysBridge	sysPlugInRelay	sysUART_init
sysClockWrite	sysPwmDO	sysUART_putbuff
sysDataPush_Reset	sysSetDI_SamplingMode	sysWD_Background
sysDataPush_Start	sysSMTP_Reset	sysWD_Timed
sysDNS_GetIpByName	sysSMTP_SendEmail	sysWriteParBOOL
sysDNS_Reset	sysSTRCAT	sysWriteParBYTE
sysExecutionPassword	sysSTREQU	sysWriteParDINT

Operator and standard blocks | Target variables | Target blocks | basic | FS_IEC



Testing Messages



Project Explorer showing the structure of an HMI Project. The 'Message' folder is selected, showing sub-items like Local variables (DIL1_loc), Local procedures (OnTimer), and Messages.

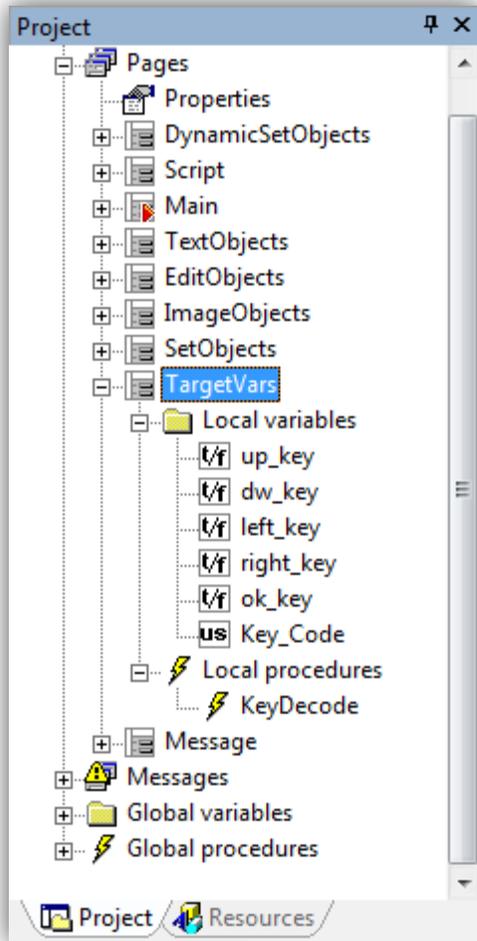
Messages
Range Test
Setpoint: 0.0
Timeout: 0.0

```
0001 uint_ret:= Video_GetParam( 0, 8192, 0, ?tmpBOOL, tyBool );  
0002  
0003  
0004 IF NOT(tmpBOOL) AND DIL1_loc THEN  
0005     (* Open Message window with msgid=1 *)  
0006     uint_ret:=Video_SendEvent( kWMSG, 1 );  
0007 END_IF;  
0008  
0009 DIL1_loc := tmpBOOL;  
0010  
0011
```

Access	RW
Selection order	1
Variable	@PLC.SetPoint
Data type	INT
Low limit	150
High limit	300
Refresh	FALSE
Visible	TRUE
Selectable	TRUE

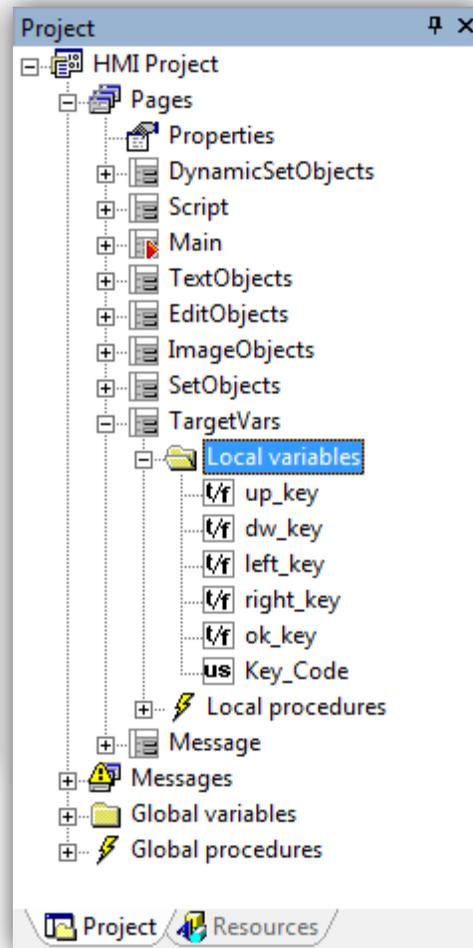
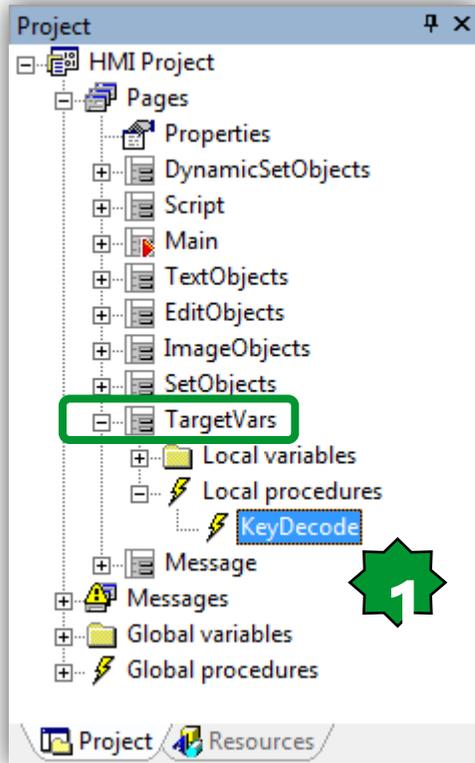
Access	RW
Selection order	2
Variable	TimeOutCtd
Data type	UDINT
Low limit	*
High limit	*
Refresh	TRUE
Visible	TRUE
Selectable	FALSE

Target Vars



```
Target Vars
Obj Selected: 000   0
Timer:           0
Last Key:       None
Backlight:      Off
                Bios: 0. 0
```

Target Vars: sysKeyPressed



```
0001 (*
0002 sysKeyPressed
0003
0004 KEY_NULL = 0x00000000
0005 KEY_UP = 0x00100001
0006 KEY_OK = 0x00200001
0007 KEY_RIGHT = 0x00800001
0008 KEY_DOWN = 0x01000001
0009 KEY_LEFT = 0x02000001
0010 KEY_UP_LONG = 0x80100001
0011 KEY_OK_LONG = 0x80200001
0012 KEY_RIGHT_LONG = 0x80800001
0013 KEY_DOWN_LONG = 0x81000001
0014 KEY_LEFT_LONG = 0x82000001
0015 *)
0016
0017
0018 up_key := (sysKeyPressed AND 16#00100000) <>0;
0019 ok_key := (sysKeyPressed AND 16#00200000) <>0;
0020 right_key := (sysKeyPressed AND 16#00800000) <>0;
0021 dw_key := (sysKeyPressed AND 16#01000000) <>0;
0022 left_key := (sysKeyPressed AND 16#02000000) <>0;
0023
0024 IF (sysKeyPressed AND 16#80000000) <>0 THEN
0025
0026 Key_Code := 6*TO_USINT(up_key)+
0027 7*TO_USINT(ok_key)+
0028 8*TO_USINT(right_key)+
0029 9*TO_USINT(dw_key)+
0030 10*TO_USINT(left_key);
0031
0032 ELSE
0033
0034 Key_Code := TO_USINT(up_key)+
0035 2*TO_USINT(ok_key)+
0036 3*TO_USINT(right_key)+
0037 4*TO_USINT(dw_key)+
0038 5*TO_USINT(left_key);
0039
0040 END_IF;
0041
```

Target Vars



Target Vars		
Obj Selected:	000	1 0
Timer:		2 0
Last Key:		3 None
Backlight:		4 Off
Bios:		5 0 . 6 0

1. sysCurrentSelectedPosition changed value based on the current selected object
2. sysTimer works as in Ap
3. Key_Code (see previous slide)
4. sysBackLight
5. sysMSK is the firmware mask
6. sysVER is the firmware version

Value	Description
0	Off
1	On
2	Blink
3	Timed
4	Timed Run

Value	Description
0	None
1	Up
2	Ok
3	Right
4	Down
5	Left
6	L-Up
7	L-Ok
8	L-Right
9	L-Down
10	L-Left

Remember to align Ap UI and Co projects



- “Recompile all” the Application Project



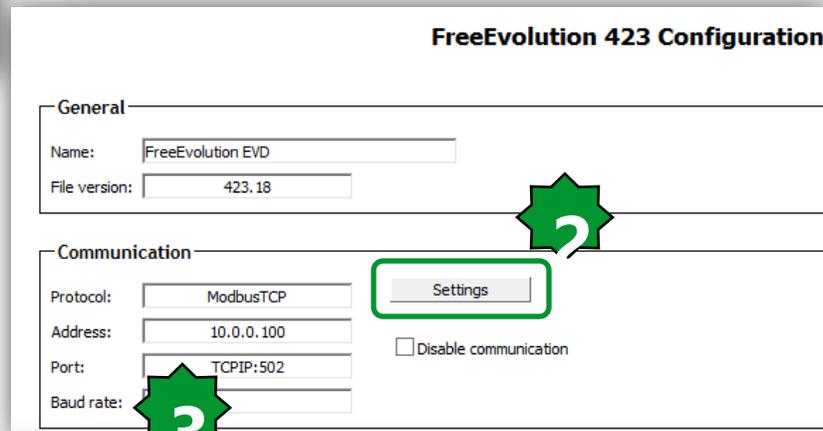
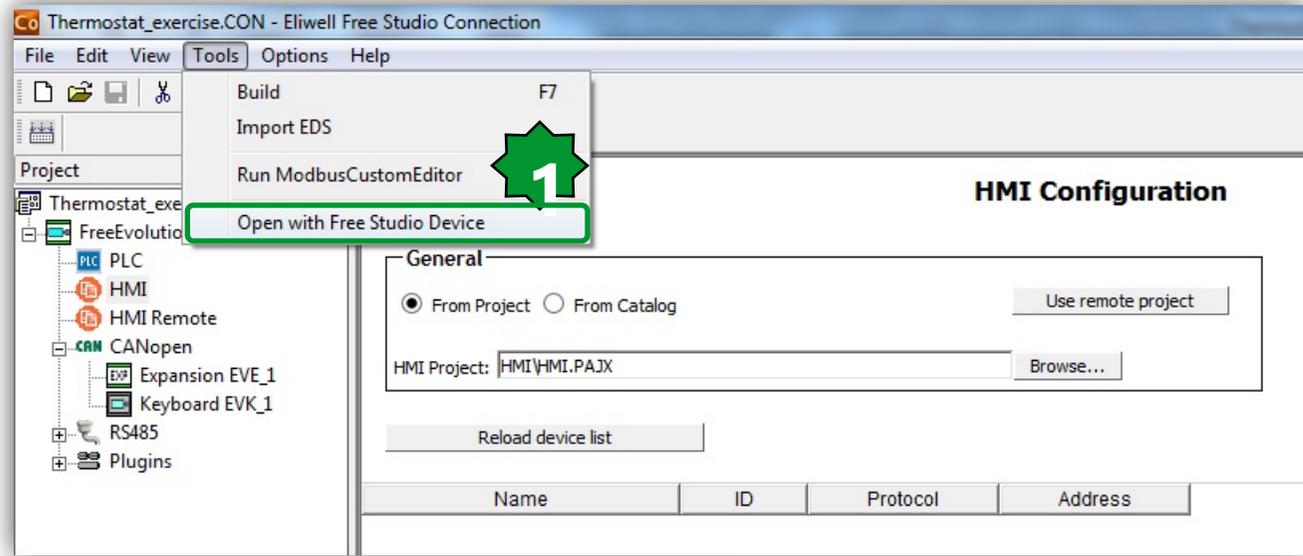
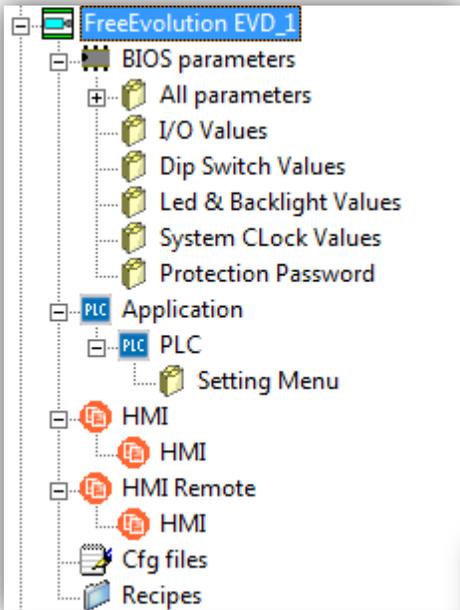
- Compile the User Interface project



- Build the Connection project in order to align it to the linked Ap and UI project



Open Free Studio Device



- 1. Tools ► Open with free Studio Device
- 2. Define settings
- 3. Connect to the EVD
- 4. Download all



Upload HMI from EVD to EVK...



In the BIOS Menu of EVK (Long press of down + left if a HMI is already loaded).

In order to run HMI:

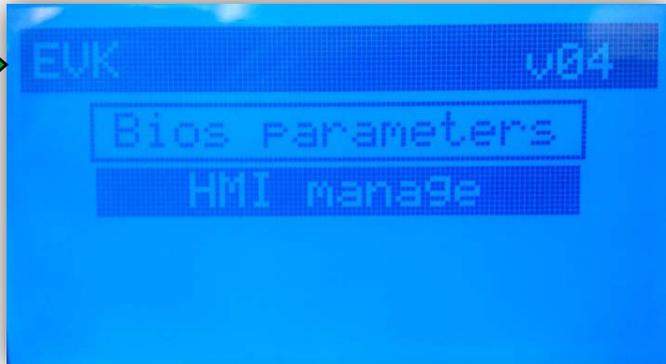
1. Select HMI Manage
2. upload
3. Press OK to confirm
4. Press to run HMI



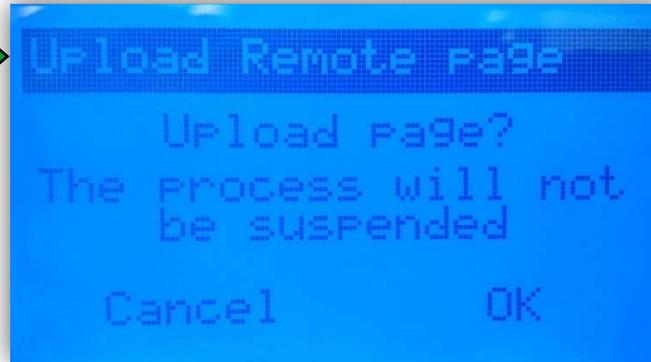
Upload HMI from EVD to EVK...



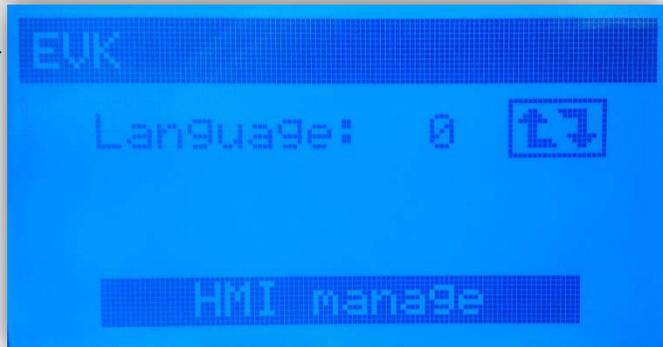
1



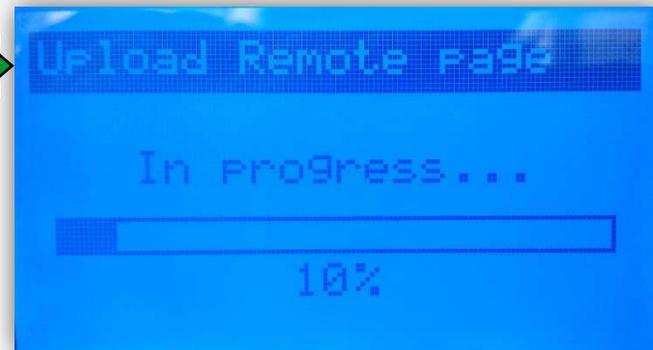
4



2



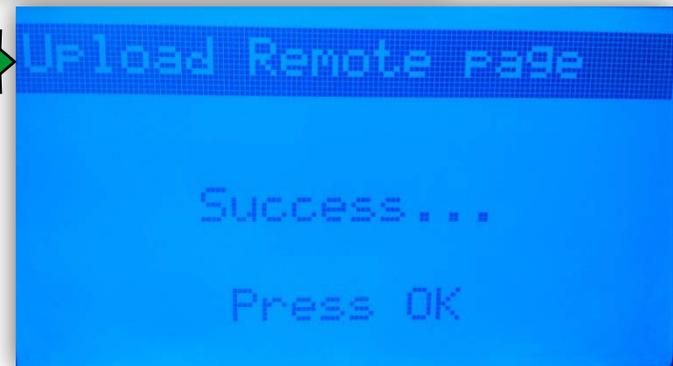
5



3



6



Chapter 18

Evolution USB

Goal:

- DownLoad/UpLoad via USB
- Retain variable configuration



USB device (PC ◀▶ target)



- **Type A USB (HOST).** Used to connect a standard USB to download the application/BIOS.
- **Type B mini USB (DEVICE).** Used to connect FREE Evolution to a PC or third party device via mini A/B USB cable to up/download the application, files or documentation. This can be done from a PC or other device. ¹

CASE 1
USB Host
USB → ← FREE

Data downloading direction	→	←
Parameter map	✓	✓
IEC application	✓	-
HMI application	✓	-
Data file	✓	✓
BIOS	✓	-

CASE 2
USB device
PC → ← FREE

Data downloading direction	→	←
Parameter map	-	-
IEC application	✓	✓
HMI application	✓	✓
Data file	✓	✓
BIOS	-	-

CASE 3
USB-RS485 /USB-CANOpen
ETHERNET + Plugin
PC → ← FREE

Data downloading direction	→	←
Parameter map	✓	✓
IEC application	✓	-
HMI application	✓	-
Data file	✓	✓
BIOS	✓	-

USB Formated FAT32

What is inside Evolution Filesystem or USB ?



Inside both Evolution/USB Pen Drive:

- PLCIEC.COD** : Application binary file
- HMIIEC.COD** : User Interface binary file (not mandatory)
- HMIREM.KBD** : Remote User Interface binary file (not mandatory)
- CONNEC.PAR** : Master Connectivity settings (not mandatory)

Inside Evolution:

- Webserver files
- Logging file
- Others...

Inside USB Pen Drive:

- PARAM.DAT (.RAW)** : Parameter Map file

Parameter map file



PARAM.DAT file includes a set of Evolution BIOS& IEC parameter values.

PARAM.DAT can be renamed as PARAM.raw in order to skip parameters' range limit check (used in case of par limited by other pars).

PARAM.DAT file can be created via IEC code using the target var (see next slides)

PARAM.DAT (.RAW) can be manually created/modified in order to contain even a subset of the full map.

Use USB host from IEC code



- Upload an application from the pen drive to Evolution
- Upload/Download a parameter map from evolution to the pen drive.

sysUSBCommand is the system command to upload/download to/from USB-Host:

7 = load PARAM.BIN from USBH

8 = load PLCIEC.COD from USBH

9 = load HMIIEC.COD from USBH

10 = load PARAM.DAT from USBH

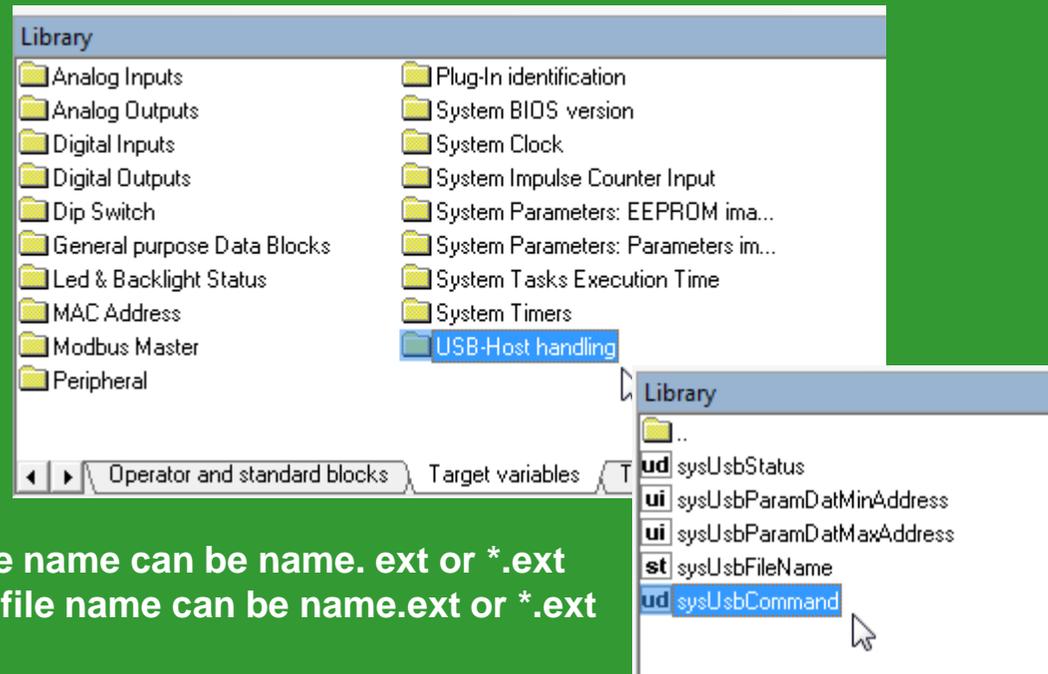
11 = save PARAM.DAT to USBH

12 = load CONNEC.PAR from USBH

13 = load HMIREM.KBD from USBH

14 = save sysUsbFileName file to USBH, file name can be name. ext or *.ext

15 = load sysUsbFileName file from USBH, file name can be name.ext or *.ext





Automatic Upload via USB pen drive

Uploading automatically an application via USB pen drive

- Copy into a pen drive the COD/PAR/DAT files
- Edit an UPLOAD.TXT file containing the list of the files to be uploaded

Note. PARAM.DAT (.RAW) file can be uploaded only if FREE Evolution has been rebooted with related application, therefore PARAM.DAT (.RAW) cannot be uploaded at the same time of PLCIEC.COD

The upload file can have a prefix from 00 to 15, for example 03UPLOAD.TXT:

- Copy into a pen drive the UPLOAD.TXT (03UPLOAD.TXT) files as well
- Files with numeric prefix are uploaded only if the Evolution dip-switches match the prefix; in this way it is possible to store on the same USB pen drive one or more Evolution applications.

USB-LED status during upload



The upload process starts when the pen drive is plugged and can be monitored through the led status which, during the upload process, are controlled directly by Evolution bios.

The process results which will switch on the red led are the ones related to a value of `sysUsbStatus>1`.

After the process, Evolution must be restarted in order to run the new application. File PARAM.DAT is uploaded by an Evolution only if the Bios Mask and Par_POLI7 of the Evolution that has generated the PARAM.DAT are the same as the destination Evolution.

The parameters' map update does not require to switch off Evolution.

LED		Upload
RED	Blinking 2 seconds	Failed
YELLOW	On	Underway
GREEN	Blinking	Completed successfully

Firmware Update By USB



How To Update:

- Copy the relevant .bin file into a USB pen drive (e.g. msk423_18.bin)
- Connect USB pen drive to Evolution
- Firmware will be downloaded into Evolution
- Yellow LED will blink during download.
- Remove USB pen drive as soon as Yellow LED will switch off
- Evolution will automatically reset and will reboot

BIOS are available @<C:\Programs>\Eliwell\free Studio\Catalog\FreeEvolution\<firmware>
<firmware> = msk423 for EVD, msk477 for EVC.

Please Note: a SYSTEM FAULT message will appear - DO NOT CONSIDER -
BIOS upgrade has been completed successfully

Note: Evolution make a filter based on the filename in order to prevent user mistakes

Using the USB Device - Adding library



PLC - Eliwell Free Studio Application - C:\Electrical\Solution Architect\Eliwell

File Edit View Project On-line Debug Window Tools Deve

New object
Copy Object
Paste object
Duplicate object
Delete object
PLC Object properties Alt+B
Object Browser
Compile F7
Recompile all
Generate redistributable source module
Import object from library
Export object to library
Library manager 1
Refresh all libraries
Macros
Select target...
Refresh current target
Options...

Project
PLC Project
Programs
Function bl
Functions
Global vari
Global sha
Tasks

sys_F_CLOSE sys_FA_READ
sys_F_EOF sys_FA_WRITE
sys_F_FILELENGTH sys_FM_READ
sys_F_REMOVE sys_FM_WRITE
sys_F_ROPEN sys_USBD_Command 4
sys_F_WOPEN sys_USBD_Status 4
sys_F_WOPENA

Project library list

Name	Link
basic	c:\program files (x86)\eliwell\free studi...

Add
Remove

Windows (C:) > Program Files (x86) > Eliwell > free Studio > Catalog > FreeEvolution > PLC

Project library list

Name	Link
basic	c:\program files (x86)\eliwell\free studi...
FS_IEC 4	C:\Program Files (x86)\Eliwell\free Stu...

Add
Remove
Remove all
UnLink
ReLink

IMPORTANT NOTE:

1. USB Device is disabled by default
2. Do not forget: safe to remove the target
3. Do not access Evolution through USB device meanwhile any application is accessing Evolution filesystem

Enable/Disable PC host access to file System Function



Ap View object properties

Name: sys_USBD_Command 

Type: Function

Return Value: USINT 

Language Type:

Description: 

Enable/disable PC host access to File System.
The function return a USINT which could have the following meanings:

0	=	Command accepted.
1	=	Command executed but failed.
2	=	Command code non valid.
3	=	Command not executed, function called into task timed.

Input:

Name	Type	Description
cmd	USINT	Command: 0=disable, 1=enable 

Sys_USBD_Command (USINT Command)

Close

PC host connection status function



Ap View object properties

Name: sys_USBD_Status 

Type: Function

Return Value: USINT 

Language Type:

Description: 

PC host connection status.
The function return a USINT which could have the following meanings:

0	=	USB device Disconnected.
1	=	USB device Connected.
2	=	USB device Suspended.
3	=	Command not executed, function called into task timed.

Input:

Name	Type	Description
dummy	USINT	Dummy input 

Sys_USBD_status (USINT dummy)

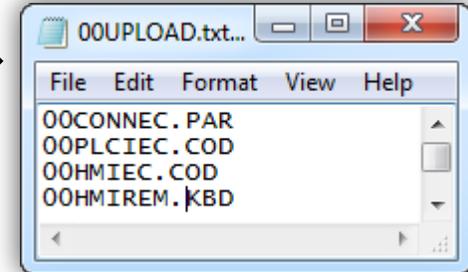
Close

USB application download workflow



Cfg_Node name.par @ project root

Create Text file as shown



Rename it as CONNEC:PAR

Copy them to the USB stick

Project name(PLC).bin @project root ► PLC ► Download

Rename it as PLCIEC.COD

Power cycle to apply them into the RAM

Project name(HMI).bin @project root ► HMI ► Download

Rename it as HMIIEC.COD

Project name(HMI).bin @project root ► HMI ► Download

Rename it as HMIREM.KBD

Note.
Always use Capital letter in renaming TXT files

USB data upload workflow...



EDIT MODE

SOURCE OK

CONNECTED



View object properties

Name: sysUsbCommand

Type: UDINT

Address: %MD30.0

Description:
System command to upload/download to/from USB-Host

7	=	load PARAM.BIN from USBH
8	=	load PLCIEC.COD from USBH
9	=	load HMIIEC.COD from USBH
10	=	load PARAM.DAT from USBH
11	=	save PARAM.DAT to USBH
12	=	load CONNEC.PAR from USBH
13	=	load HMIREM.KBD from USBH
14	=	save sysUsbFileName file to USBH, file name can be name.ext or *.ext
15	=	load sysUsbFileName file from USBH, file name can be name.ext or *.ext
16	=	load file sysUsbFileName from filesystem, file must have PARAM.DAT format and filename name.DAT or name.RAW

Library

ud	sysLocalDigitalInputsImpulseCounter	w	sysParameter
t/f	sysLocalDigitalInputsResetCounter	t/f	sysPeripheralStatus
t/f	sysLocalDigitalOutputs	ud	sysTimer
t/f	sysLocalDipSwitch	ud	sysTskBckExeTime
us	sysLocalLeds	ud	sysTskTmdExeTime
b	sysMacAddress	ui	sysTskTmdScanTime
t/f	sysMbMRtuNodePresence	ud	sysUsbCommand
mg	sysMbMRtuNodeStatus	st	sysUsbFileName
t/f	sysMbMTcpNodePresence	ui	sysUsbParamDatMaxAddress
mg	sysMbMTcpNodeStatus	ui	sysUsbParamDatMinAddress
ui	sysMSK	ud	sysUsbStatus

Target variables Target blocks basic FS_IJC



1. Connect to the target via Ap
2. Drag & drop sysUsbCommand into the watch window
3. Write value=11

Watch

Symbol	Value	Type	Location
- SYSUSBCOMMAND	11	UDINT	global



...USB data upload workflow



View object properties

Name: sysUsbStatus

Type: UDINT

Address: %MD31.0

Description:
System status of operation on USB-Host

0	=	command completed
1	=	command processing
255	=	command failed
254	=	file not present
253	=	file too long
252	=	USBH not connected
251	=	file not compatible
250	=	some parameters fails
249	=	write file failed
248	=	open file in write failed

Library

- sysParameter
- sysPeripheralStatus
- sysTimer
- sysTskBckExeTime
- sysTskTmdExeTime
- sysTskTmdScanTime
- sysUsbCommand
- sysUsbFileName
- sysUsbParamDatMaxAddress
- sysUsbParamDatMinAddress
- sysUsbStatus**
- sysVER
- Temp_UM

Watch

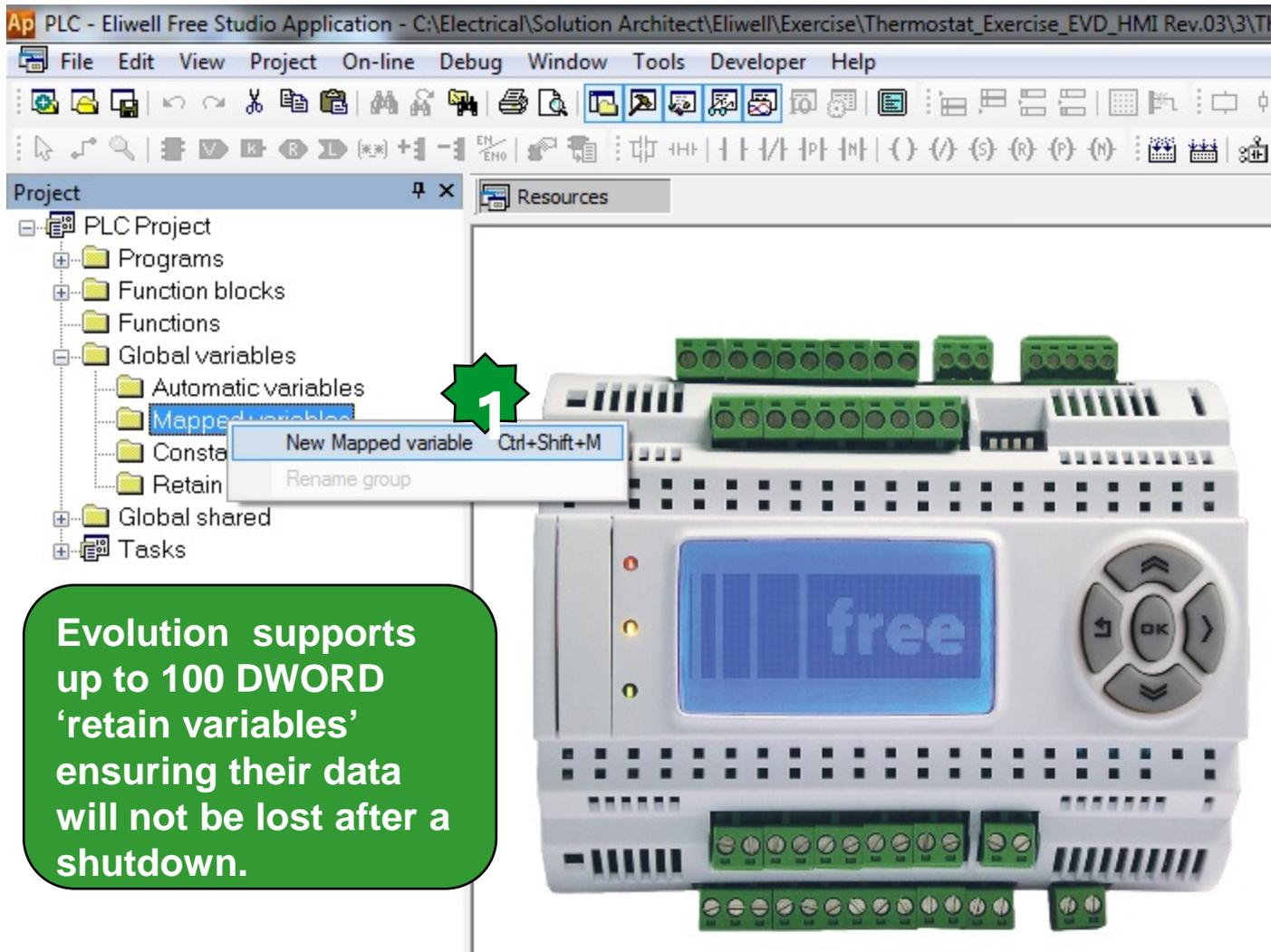
Symbol	Value	Type	Location
— SYSUSBSTATUS	0	UDINT	global
— SYSUSBCOMMAND	11	UDINT	global

Watch

Symbol	Value	Type	Location
— SYSUSBSTATUS	0	UDINT	global
— SYSUSBCOMMAND	0	UDINT	global

**To monitor the USB-Host status:
Drag & drop sysUsbStatus into the watch window**

Evolution - Retain Variables



Evolution supports up to 100 DWORD 'retain variables' ensuring their data will not be lost after a shutdown.

A **RETAIN** variable indicates that the variables within the structuring elements are retentive, i.e. they keep their value even after the target device has been reset or switched off.

Retain variable values can be changed several times without affecting internal memory performance.

Note: **RETAIN** variables cannot be displayed in the Watch window

Evolution - Retain Variables



Mapped variable declaration

Name: **Retain0** (1) Data type: **DWORD** (2)

Group: [] Size: No

Data block: **M.D** **102** (3)

Subindex: 0

Location	I/O data block	Base addr.	Size	Unused
	Backlight Status. 0 = Off...	%QB3.0	1	1
	Expansion Digital Inputs	%IX10.0	96	96
	Expansion Digital Outputs	%QX11.0	84	84
	Local ADC values	%IW2.0	6	6
	Local Analog Inputs	%IW1.0	6	6
	Local Analog Outputs	%QW0.0	5	5
	Local Digital Inputs	%IX0.0	8	8
	Local Digital Inputs Imp...	%MD55.0	8	8

Description: []

Ok (1) Cancel

Variable address

Automatic address

Size

Bit

Byte (8 bit)

Word (16 bit)

Double word (32 bit) (6)

Location

Input

Output

Memory

Data block: **102** Index: **0** (5)

Cancel OK

Object browser

Objects filter

Programs Operators

Function Blocks Standard functions (3)

Functions Local variables

Variables Basic types

User types

Check all Check none

Other filters

Name: * OK

Location: All

Library: All

Vars type: All

Name
f BOOL
b BYTE
di DINT
dw DWORD
i INT
r REAL
si SINT
st STRING
ud UDINT
ui UINT
us USINT
w WORD

Cancel OK

• Set as variable address size DW (double WORD) and data block 102.0.xx where xx=0,...99

Chapter 19

Documentation

Goal:

Creating document and exporting by Application, Device & User Interface as report or as using them by other products such as Vijeodesigner



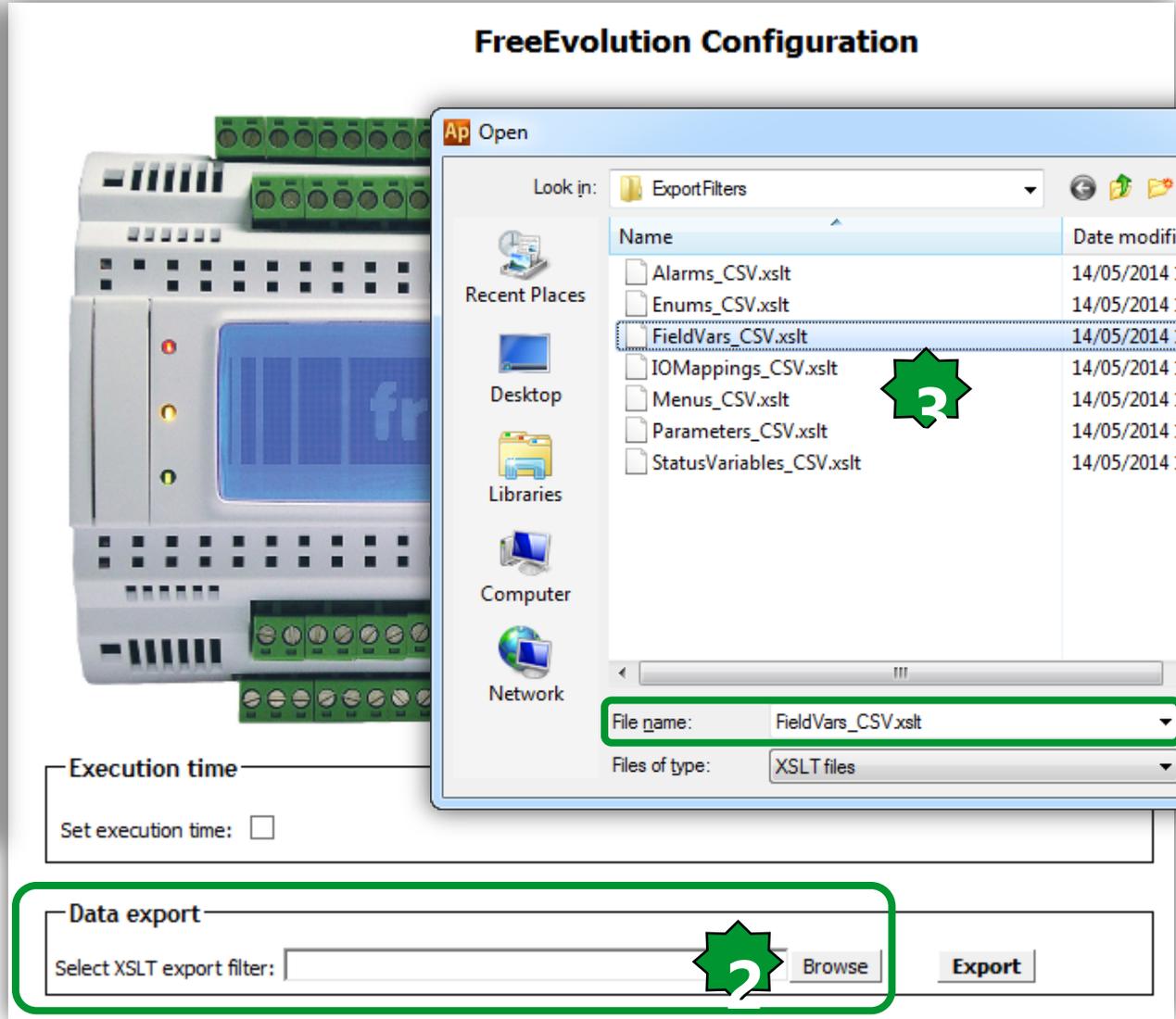
Application - Export to Excel...



Resources

- Configuration
 - FreeEvolution EVD** 
 - Modbus objects
 - EEPROM Parameters
 - Status variables
 - Enums
 - BIOS Parameters
 - Menus
 - Setting Menu
 - I/O Mapping
 - Local
 - Field
 - Alarms
 - Web Site
 - Exercise_Visualization
- BACnet Objects
 - Device
 - Analog Value Objects
 - Binary Value Objects
 - Calendar Objects
 - Multi State Value Objects
 - Schedule Objects
 - Notification Class Objects

FreeEvolution Configuration



Execution time

Set execution time:

Data export

Select XSLT export filter:  Browse **Export**

Open

Look in: ExportFilters

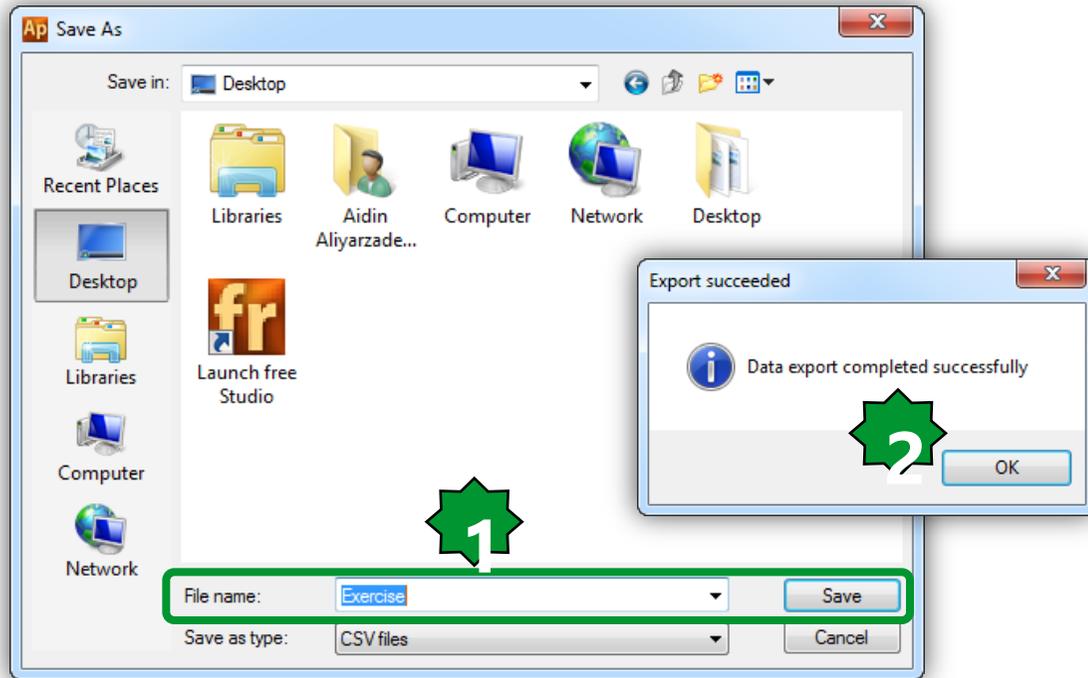
Name	Date modified	Type
Alarms_CSV.xslt	14/05/2014 1:59 PM	XSLT File
Enums_CSV.xslt	14/05/2014 1:59 PM	XSLT File
FieldVars_CSV.xslt 	14/05/2014 1:59 PM	XSLT File
IOMappings_CSV.xslt	14/05/2014 1:59 PM	XSLT File
Menus_CSV.xslt	14/05/2014 1:59 PM	XSLT File
Parameters_CSV.xslt	14/05/2014 1:59 PM	XSLT File
StatusVariables_CSV.xslt	14/05/2014 1:59 PM	XSLT File

File name: FieldVars_CSV.xslt 

Files of type: XSLT files

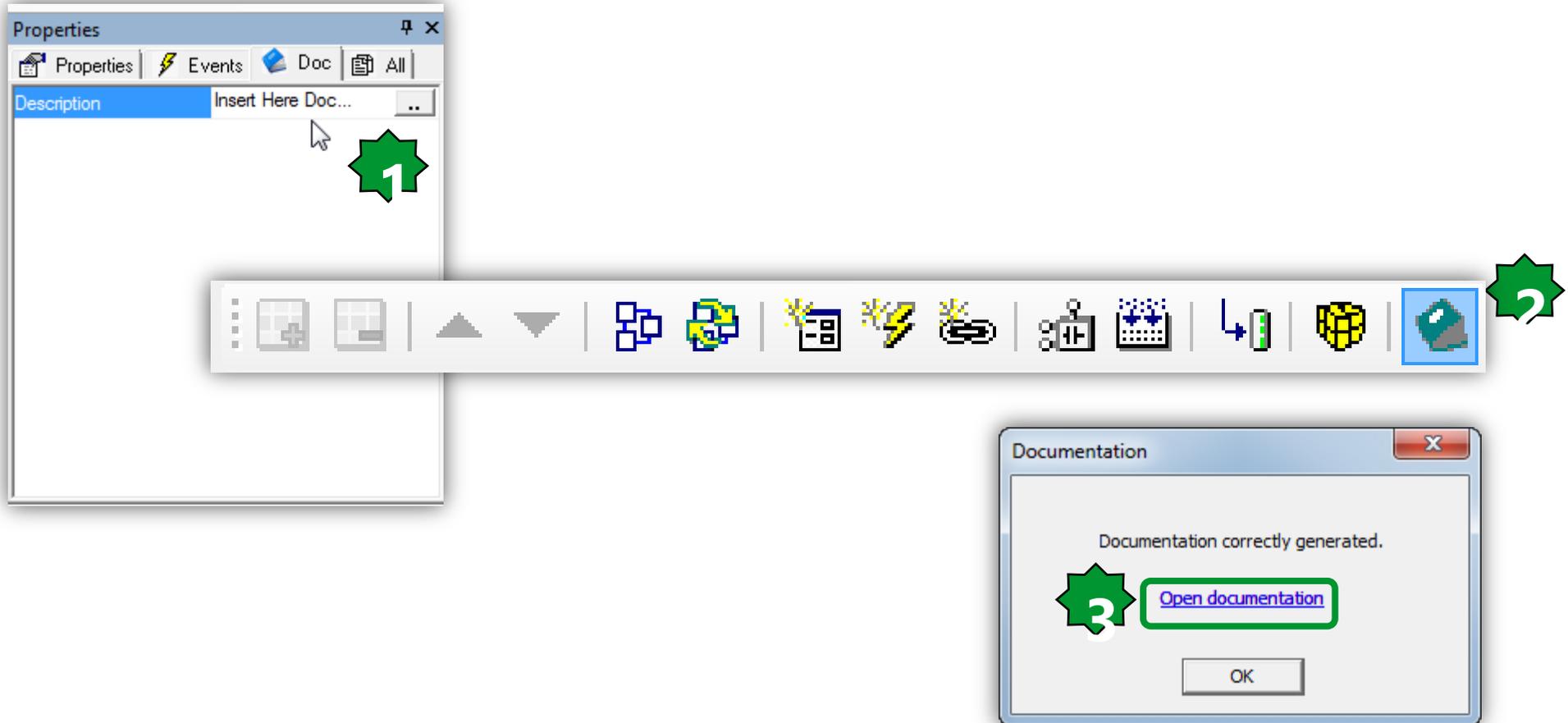
Open Cancel

... Export to Excel



Name	Type	In/Out	Description
AI1_E	INT	in	
DI1_E	BOOL	in	
DI2_E	BOOL	in	
DO1_E	BOOL	out	
DO2_E	BOOL	out	

User Interface - Documentation



User Interface - Documentation



Project HMI

file:///C:/Electrical/Solution%20Architect/Eliwell/Exercise/Thermostat_Exercise_EVD_HMI%20Rev.03/3/Thermostat_Exercise_EVD_HMI/HMI/HMI.html

Apps Suggested Sites Imported From IE (210 unread) - aidin....

DI1OPENED

DI 1 Opened

Msg ID 102 is special ID for Overrange

LowLim

Out of range
<<

Msg ID 101 is special ID for Underrange

UpLim

Out of range
>>

Msg ID 102 is special ID for Overrange

DynamicSetObjects

Dyn.Set 0/0

Er01-EVE Alarm

Er02-DIL2

▲ ▼

Close

Edits: 2

Edit_1	Min: *	Max: *	Var: \$PagNumber
Edit_2	Min: *	Max: *	Var: \$PageIndex

User Interface Project: HMI

Last update: 06/06/2014 - 16:41:24

Project infos:

Number of pages: 12

Languages:

- Italian
- BaseLanguage

Start page: Main

Script

Script

Counter Set

CLoc

Close>1000

+ -

Progresses: 1

Progress_5	Min: 0	Max: 10000	Var: Counter
------------	--------	------------	--------------

Edits: 3

Edit_1	Min: *	Max: *	Var: Counter
Edit_3	Min: *	Max: *	Var: CLoc
Edit_8	Min: 150	Max: 300	Var: @PLC.SetPoint

Device - Export to Text file...



Project

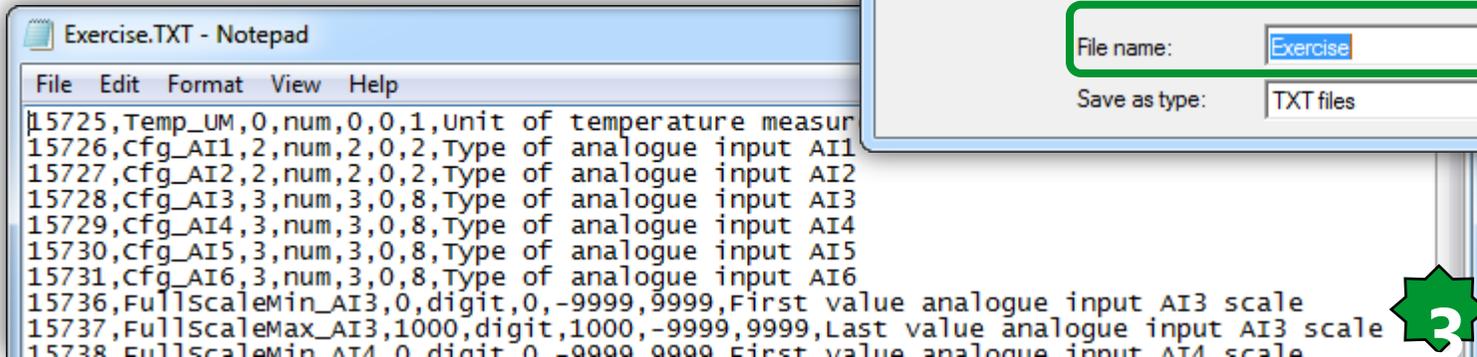
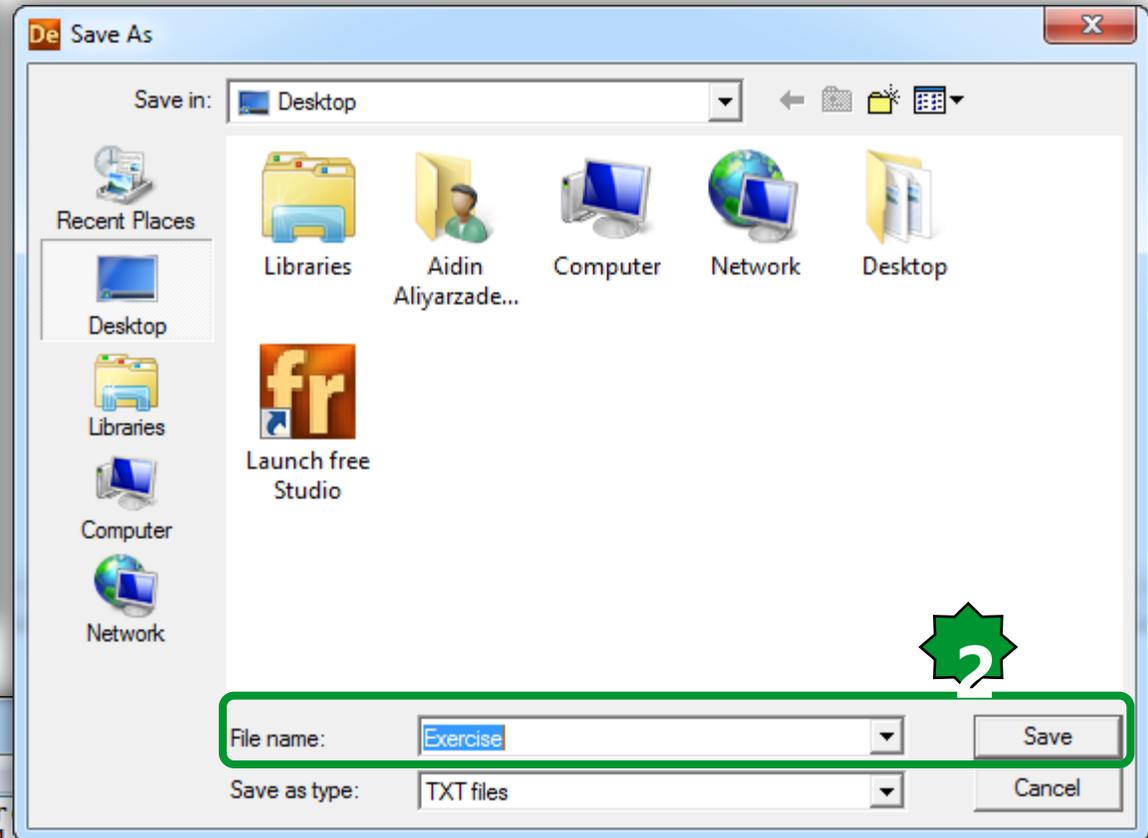
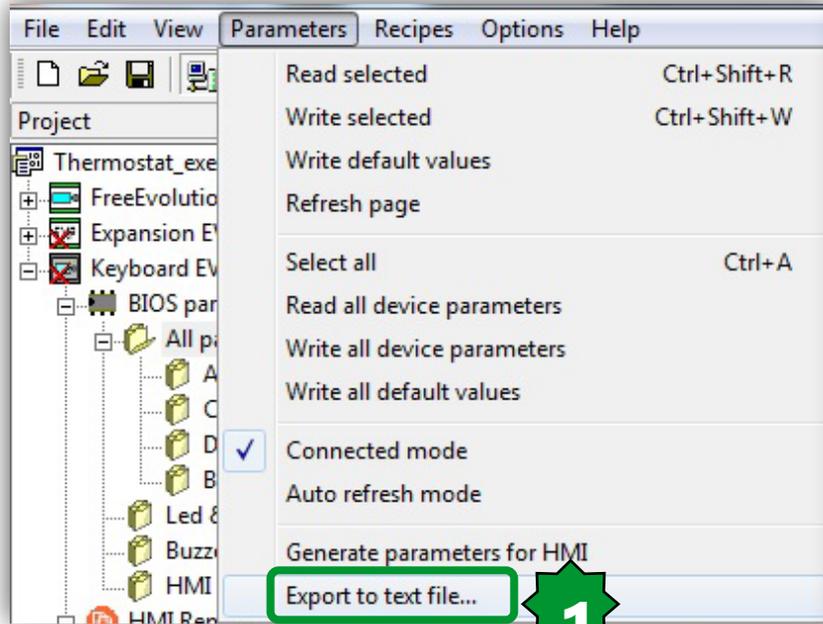
- PLC
 - FreeEvolution EVD
 - BIOS parameters
 - All parameters
 - Acknowledgement
 - Calibration AI
 - Calibration AO
 - Analogue Inputs
 - Analogue Outputs V/I
 - RS485 On Board
 - CAN On Board
 - RS485 Plugin Passive
 - CAN Plugin Passive
 - RS232 Plugin Passive
 - Ethernet Plugin Passive
 - Modem
 - Display
 - BACnet
 - I/O Values
 - Dip Switch Values
 - Led & Backlight Values
 - System CLock Values
 - Protection Password
 - Application
 - HMI
 - HMI Remote
 - Cfg files
 - Recipes

Select a Table

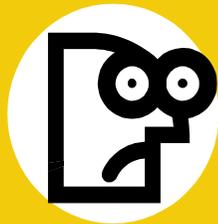
Analogue Inputs

Address	Name	Value	Um	Default	Min	Max	Description
15725	Temp_UM	0=°C	num	0=°C	0	1	Unit of temperature measurement
15726	Cfg_AI1	2=NTC(103AT	num	2=NTC(103AT	0	2	Type of analogue input AI1
15727	Cfg_AI2	2=NTC(103AT	num	2=NTC(103AT	0	2	Type of analogue input AI2
15728	Cfg_AI3	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI3
15729	Cfg_AI4	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI4
15730	Cfg_AI5	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI5
15731	Cfg_AI6	3=4÷20mA	num	3=4÷20mA	0	8	Type of analogue input AI6
15736	FullScaleMin_AI3	0	digit	0	-9999	9999	First value analogue input AI3 scale
15737	FullScaleMax_AI3	1000	digit	1000	-9999	9999	Last value analogue input AI3 scale
15738	FullScaleMin_AI4	0	digit	0	-9999	9999	First value analogue input AI4 scale
15739	FullScaleMax_AI4	1000	digit	1000	-9999	9999	Last value analogue input AI4 scale
15740	FullScaleMin_AI5	0	digit	0	-9999	9999	First value analogue input AI5 scale
15741	FullScaleMax_AI5	1000	digit	1000	-9999	9999	Last value analogue input AI5 scale
15742	FullScaleMin_AI6	0	digit	0	-9999	9999	First value analogue input AI6 scale
15743	FullScaleMax_AI6	1000	digit	1000	-9999	9999	Last value analogue input AI6 scale
15748	Calibration_AI1	0	°C/10,°F/10	0	-180	180	Analogue input AI1 differential
15749	Calibration_AI2	0	°C/10,°F/10	0	-180	180	Analogue input AI2 differential
15750	Calibration_AI3	0	digit	0	-1000	1000	Analogue input AI3 differential
15751	Calibration_AI4	0	digit	0	-1000	1000	Analogue input AI4 differential
15752	Calibration_AI5	0	digit	0	-1000	1000	Analogue input AI5 differential
15753	Calibration_AI6	0	digit	0	-1000	1000	Analogue input AI6 differential

Device - Export to Text file...



Q & A



It's QUESTION TIME!!

Thanks





Schneider
Electric

