Freeway Exercise

Solutions for OEMs, FreeStudio

Thermostat exercise

Schneider Electric

Table of Contents

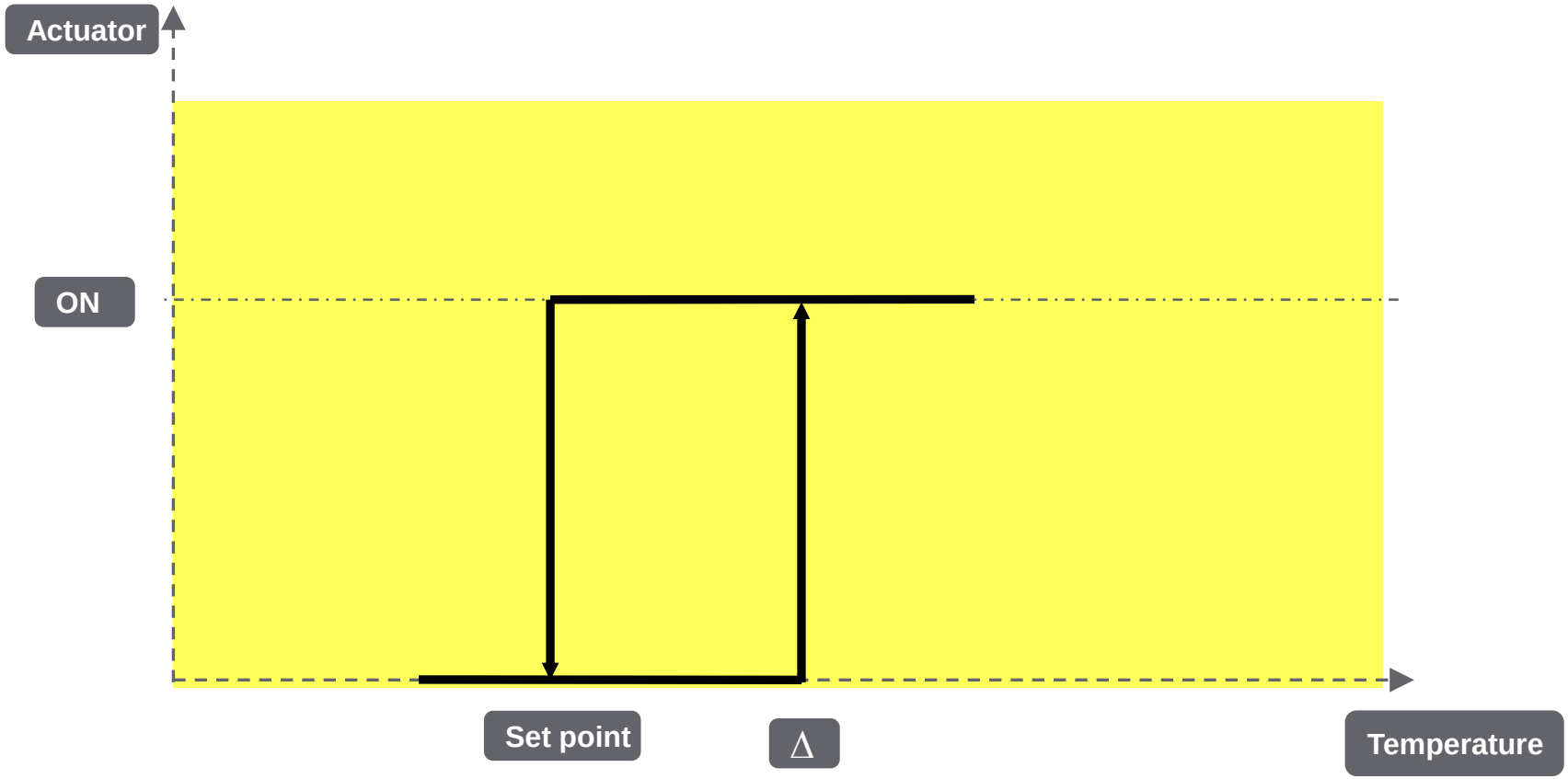
Chapter 1

Function Description

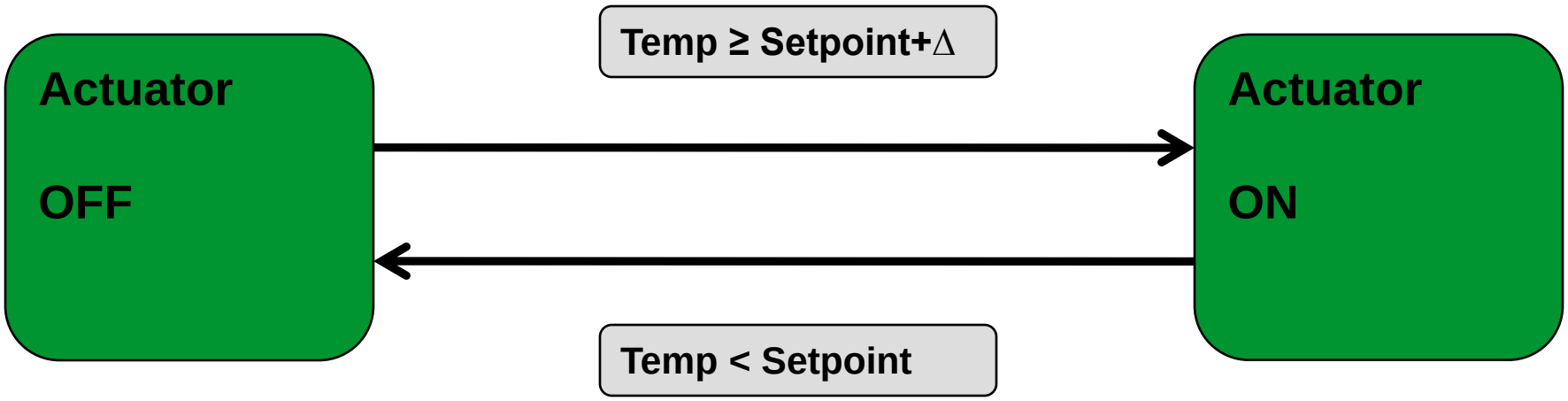
Goal:

Describe thermostat flow chart

Thermostat cycle



Thermostat states (function description)



Chapter 2

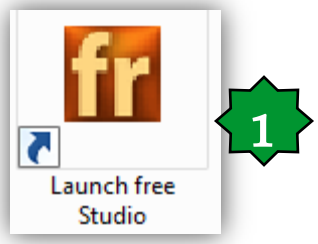
Programming

Goal:

- Familiarizing with programming environment
- Creating Thermostat Function Block

Creating New project

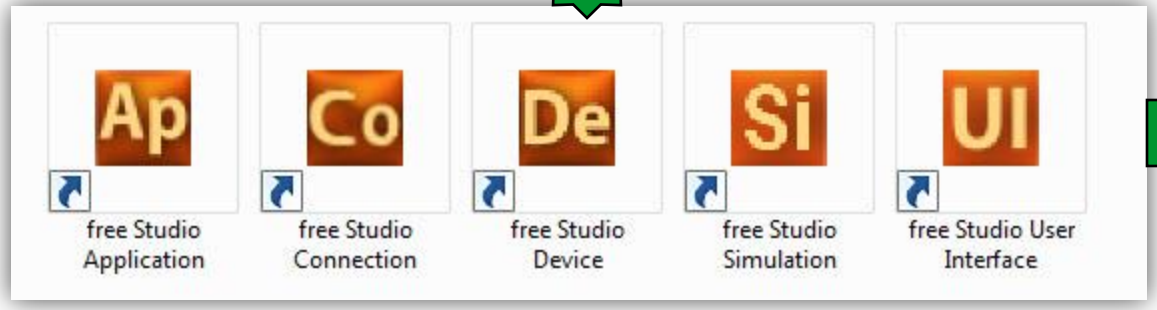
2*click



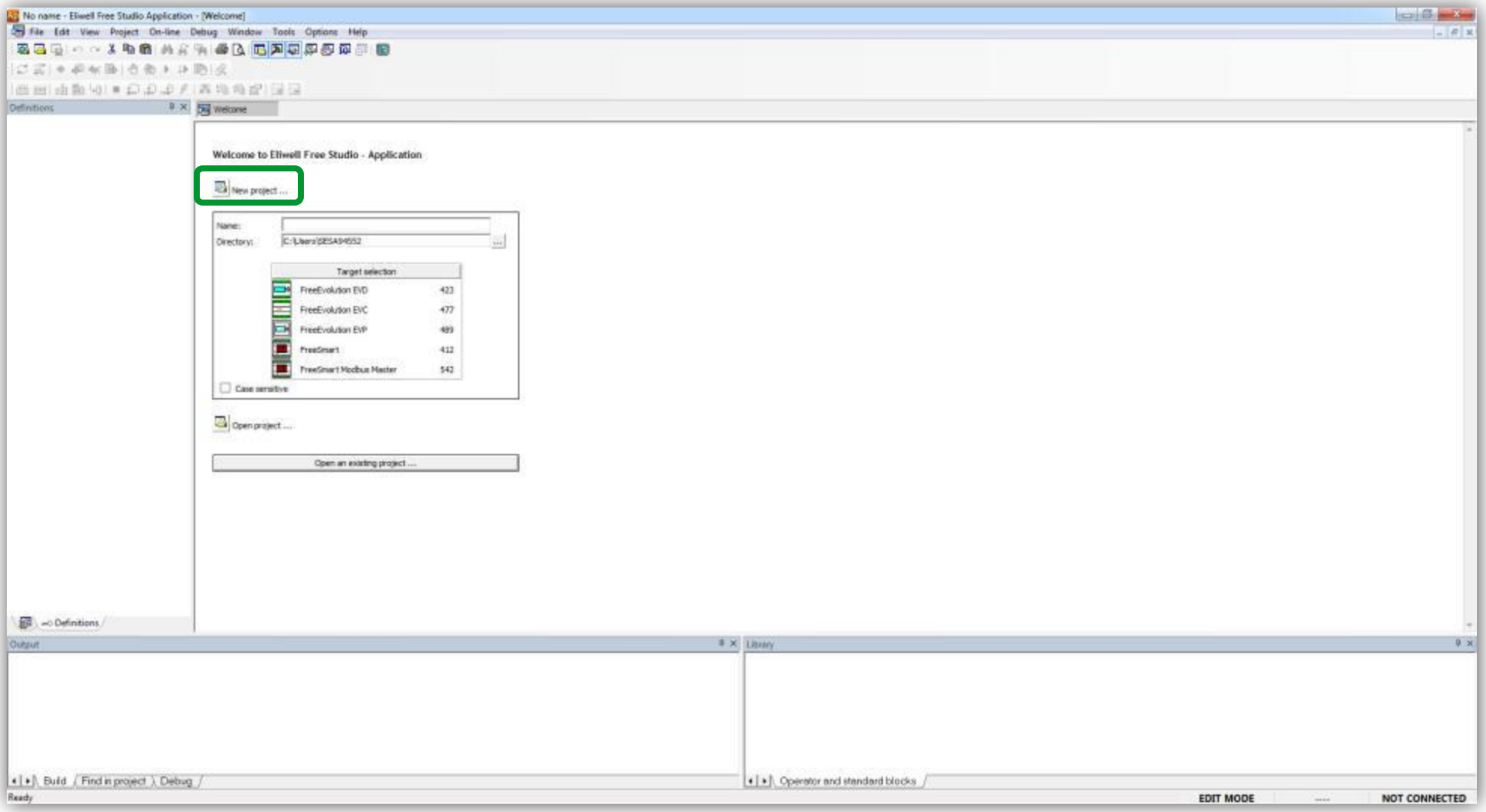
1

2*click

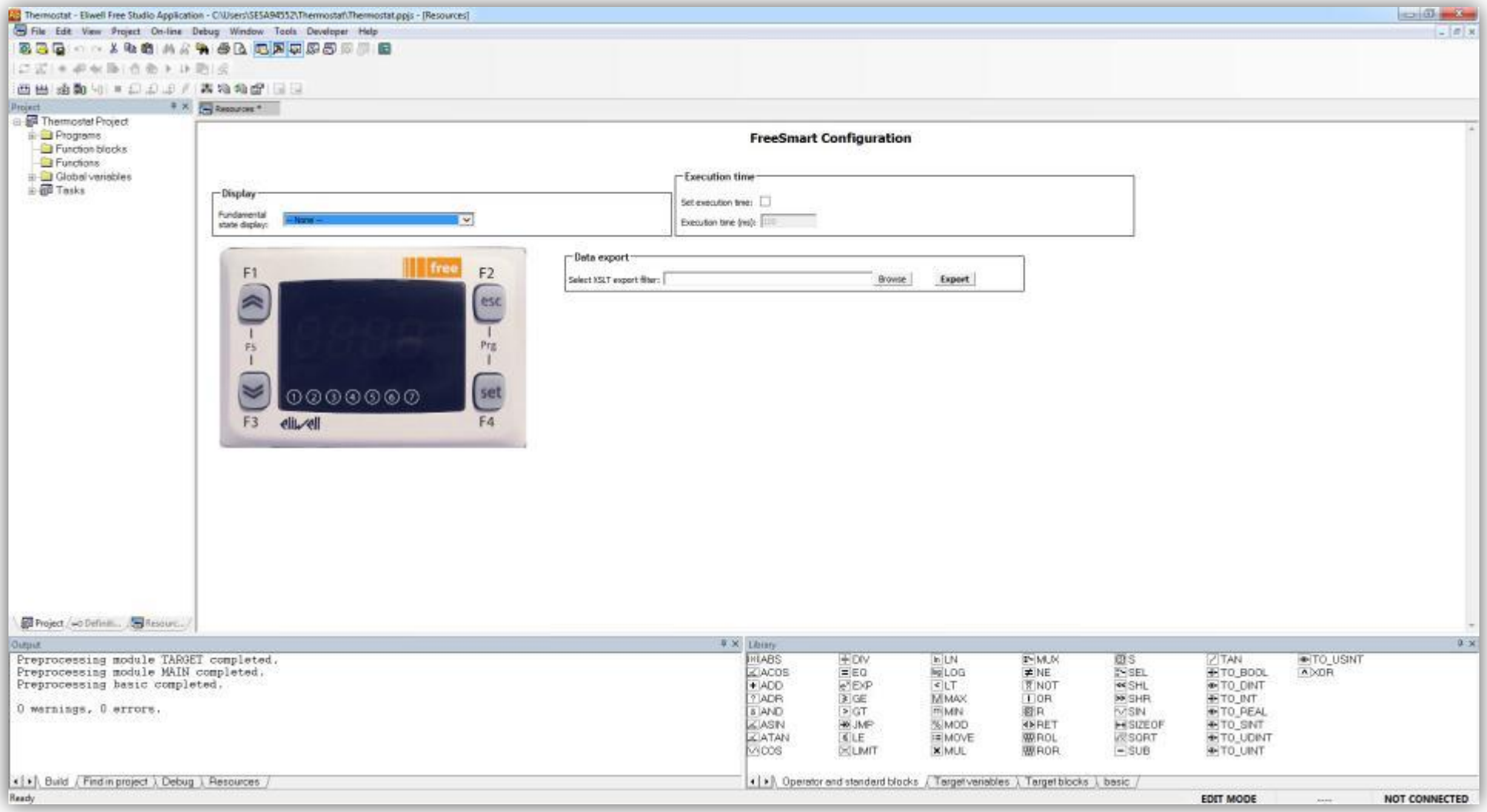
2



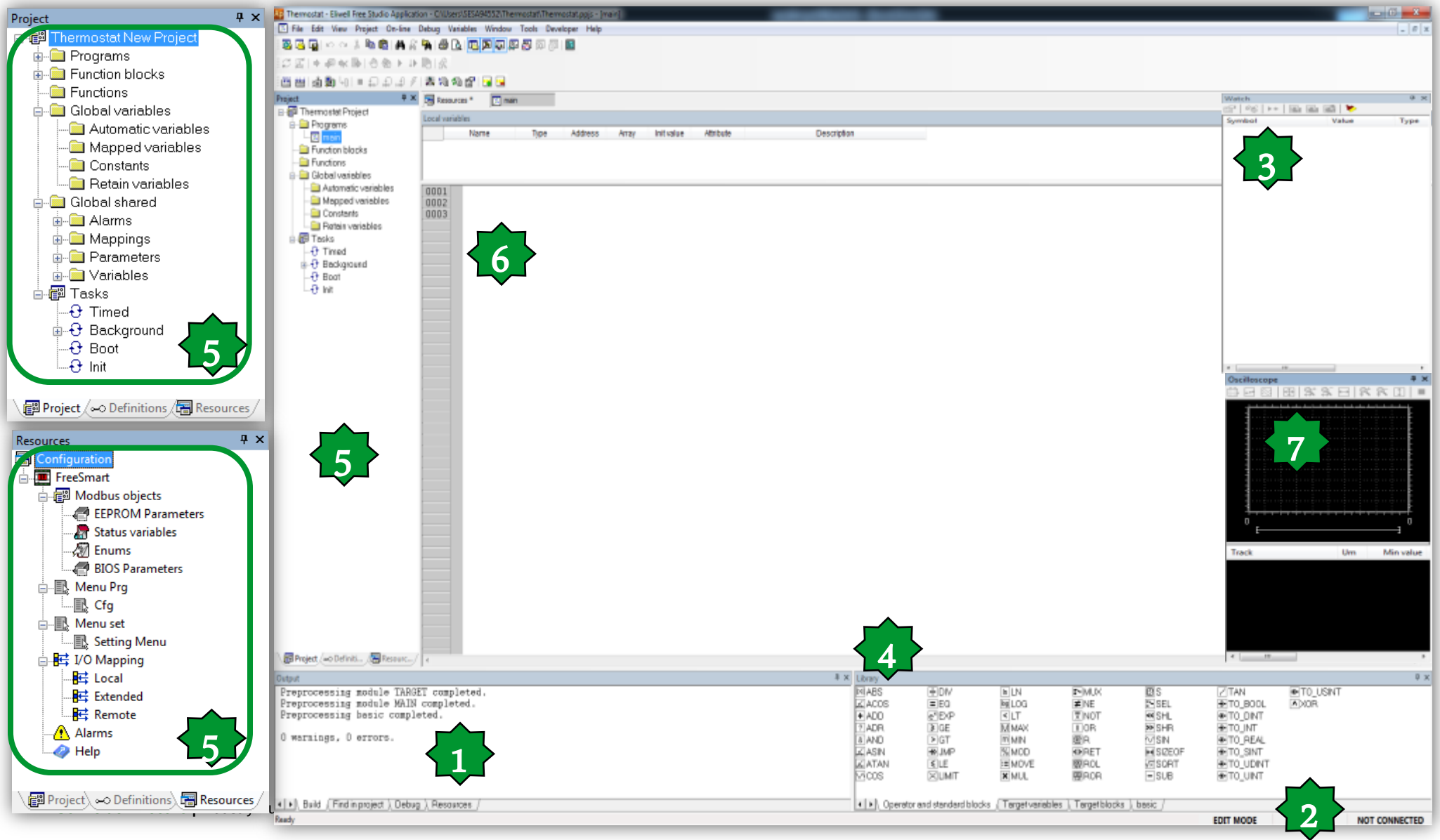
Creating New project



Creating New project

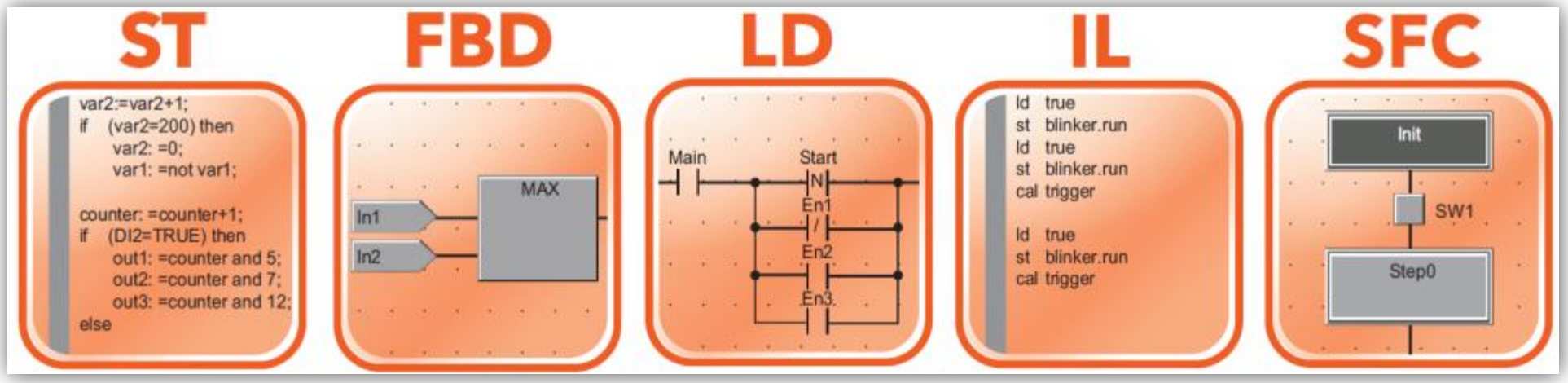


Programming environment



Programming Languages

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



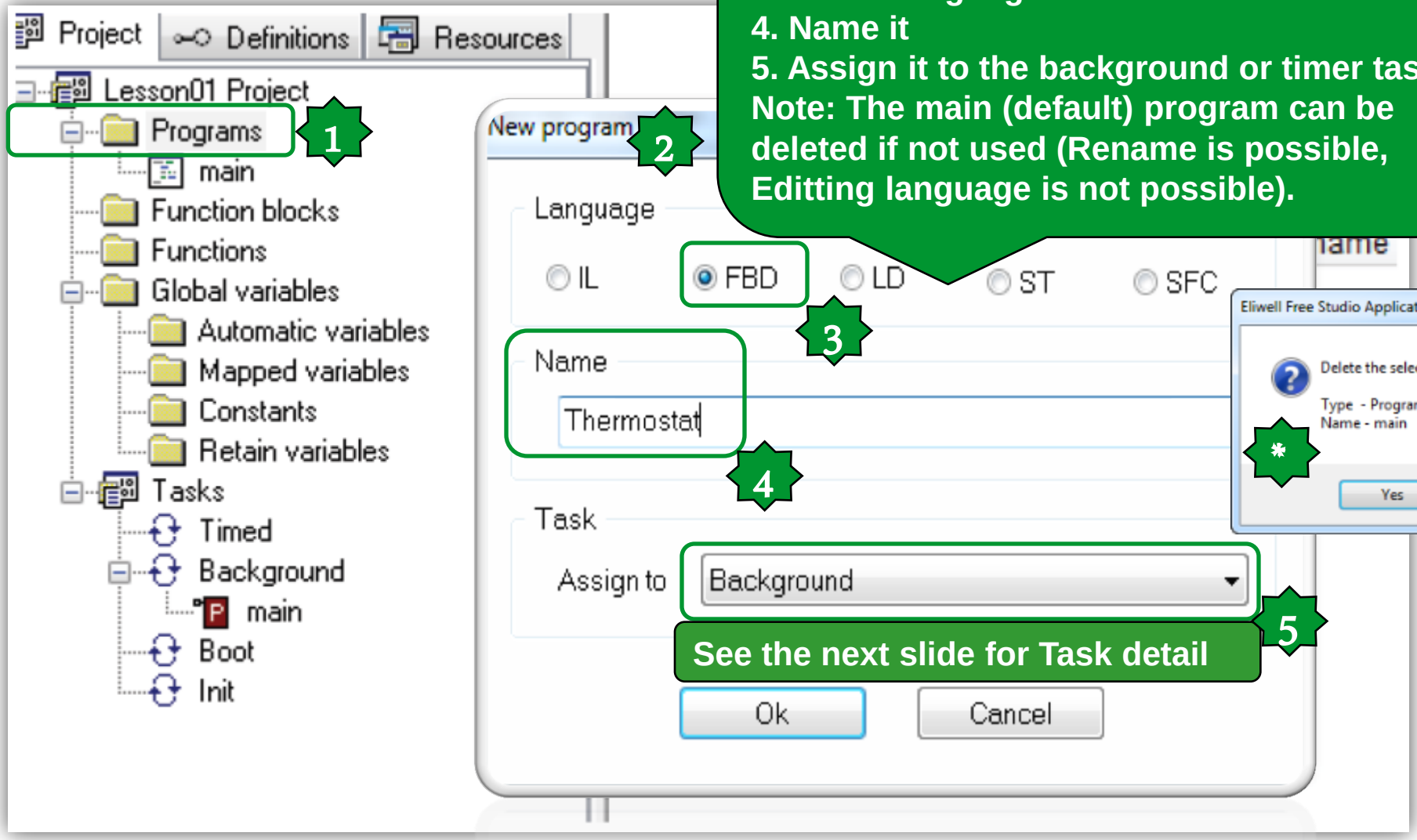
5 programming languages, 2 text-based and 3 graphics-based:

- **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, Editting language is not possible).



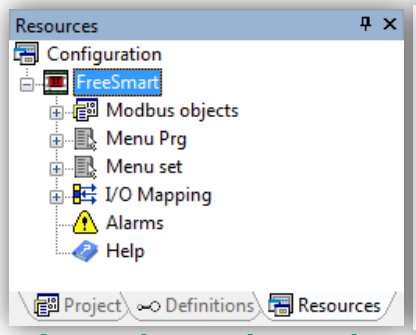
Associating a program to a task

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.



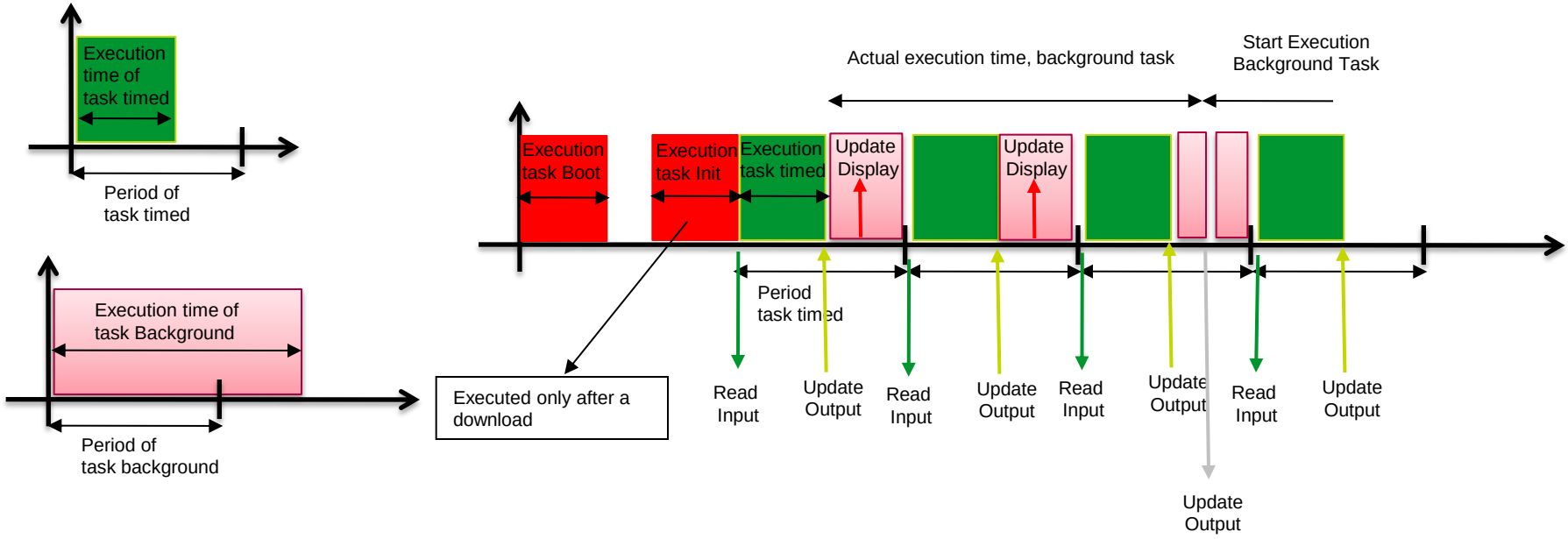
- **Background. Task** runs with low priority after the Timed tasks (between the end of one Timed task and the start of the next), it can be interrupted in case of long execution or executed more than 1time in case short execution.

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).

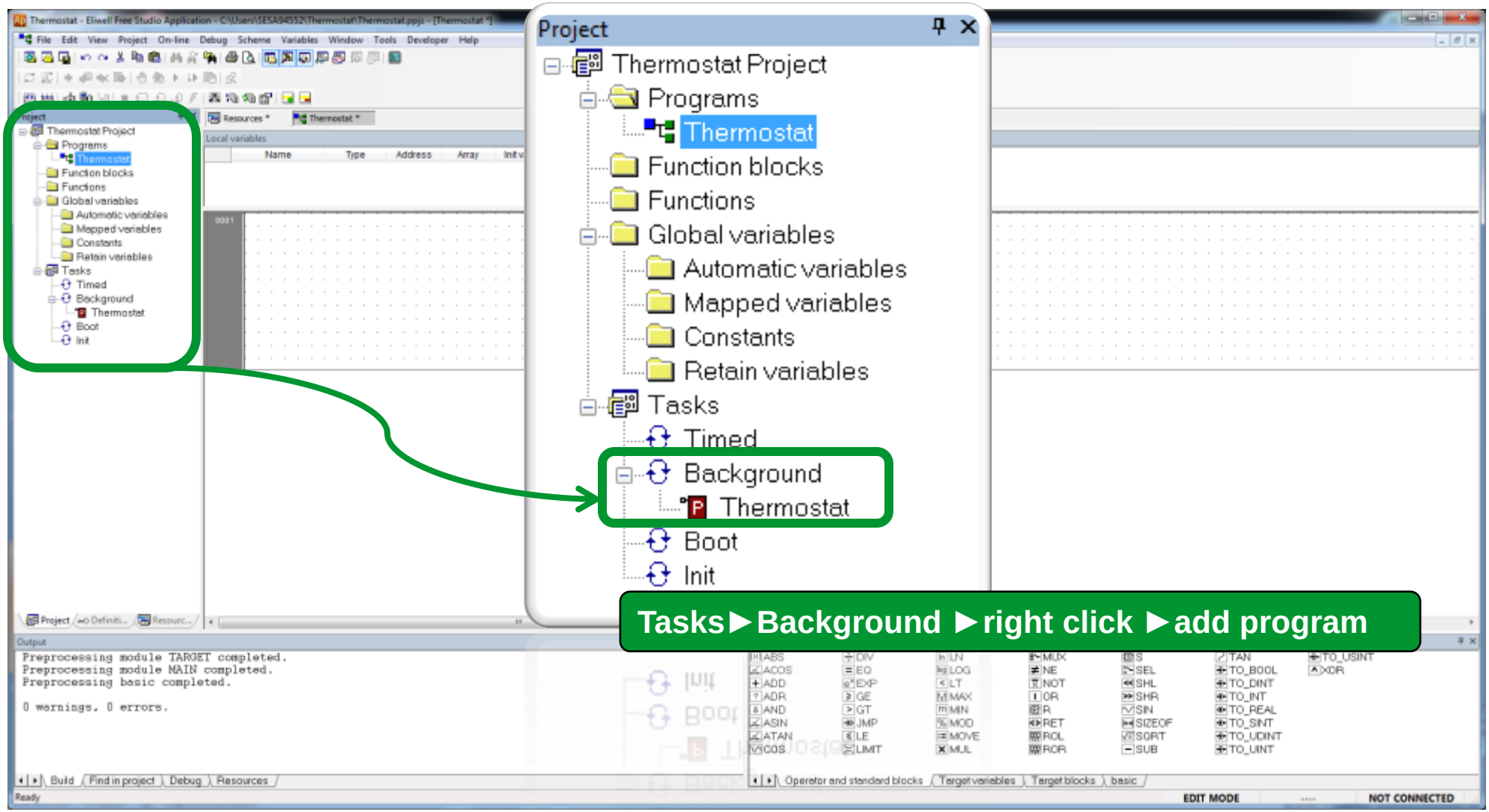
To activate a task, go to the task you want, right-click and select Add program

Tasks

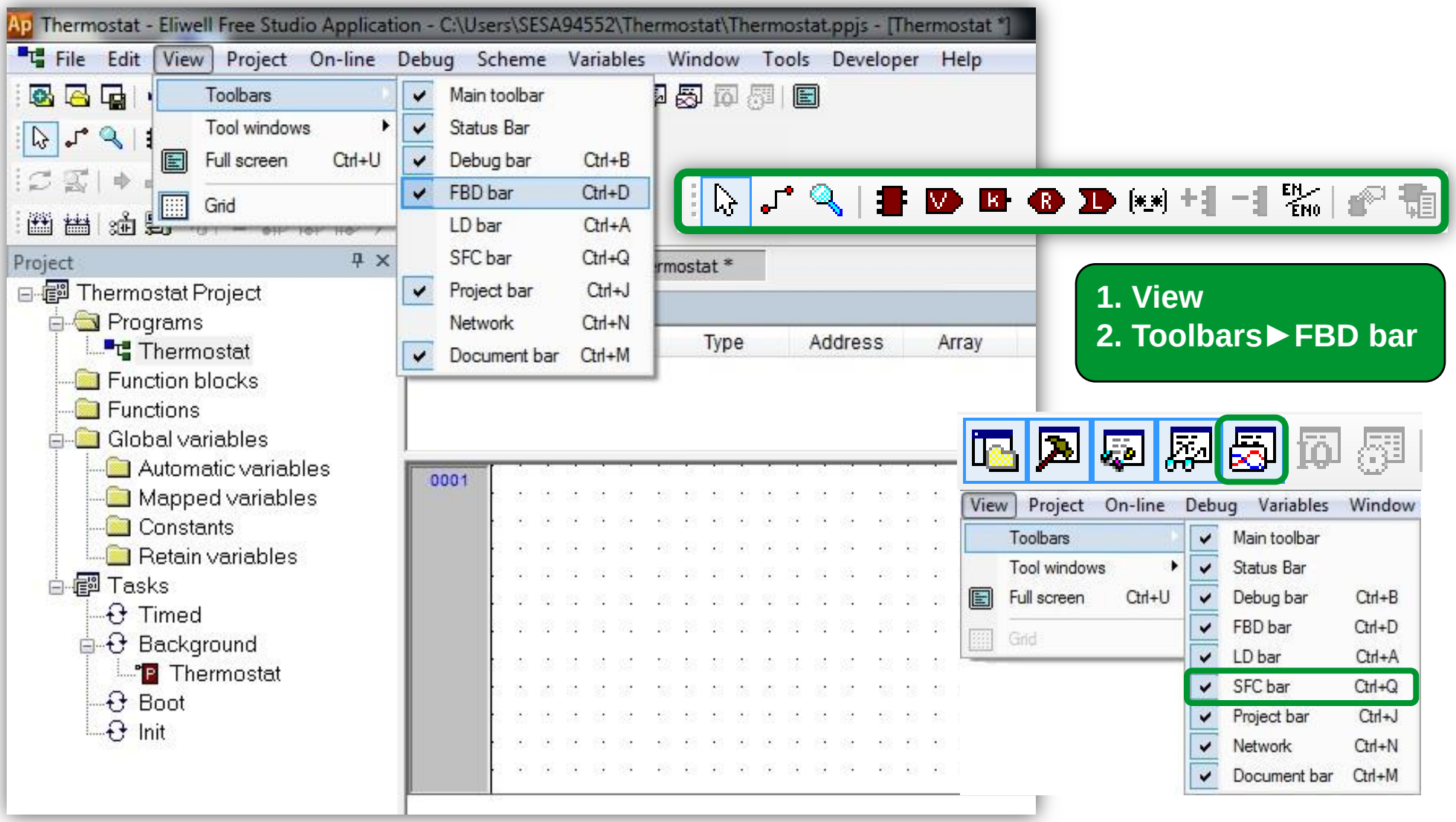
- **BOOT Task** runs once only at system start-up.
- **Init. Task** runs each time the application is downloaded and after **BOOT**.
- **Timed. Task** runs at regular intervals which can be set by the developer. The default setting is 100ms.
- **Background. Task** runs with low priority after the Timed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



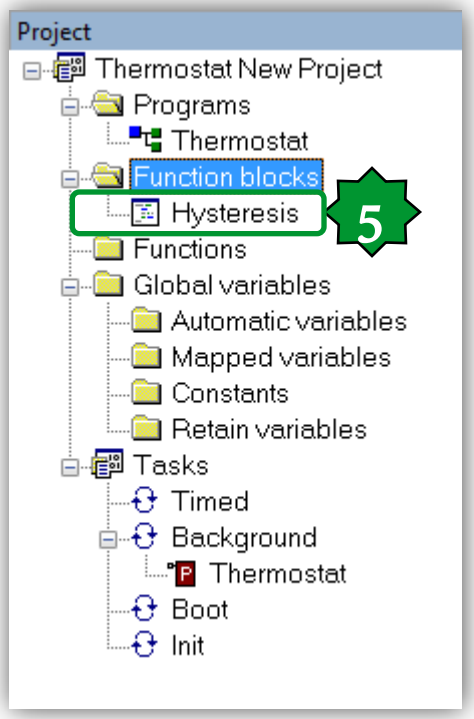
Assigning program to the task



View FBD toolbar

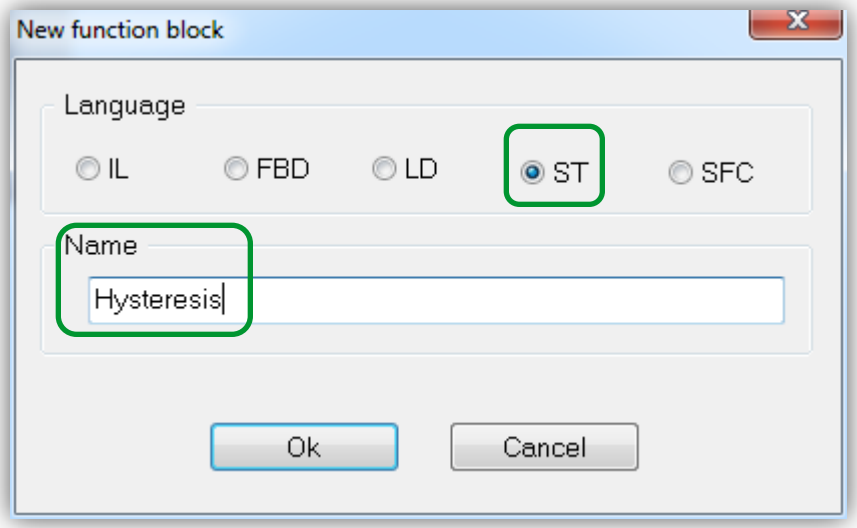


New function block creation

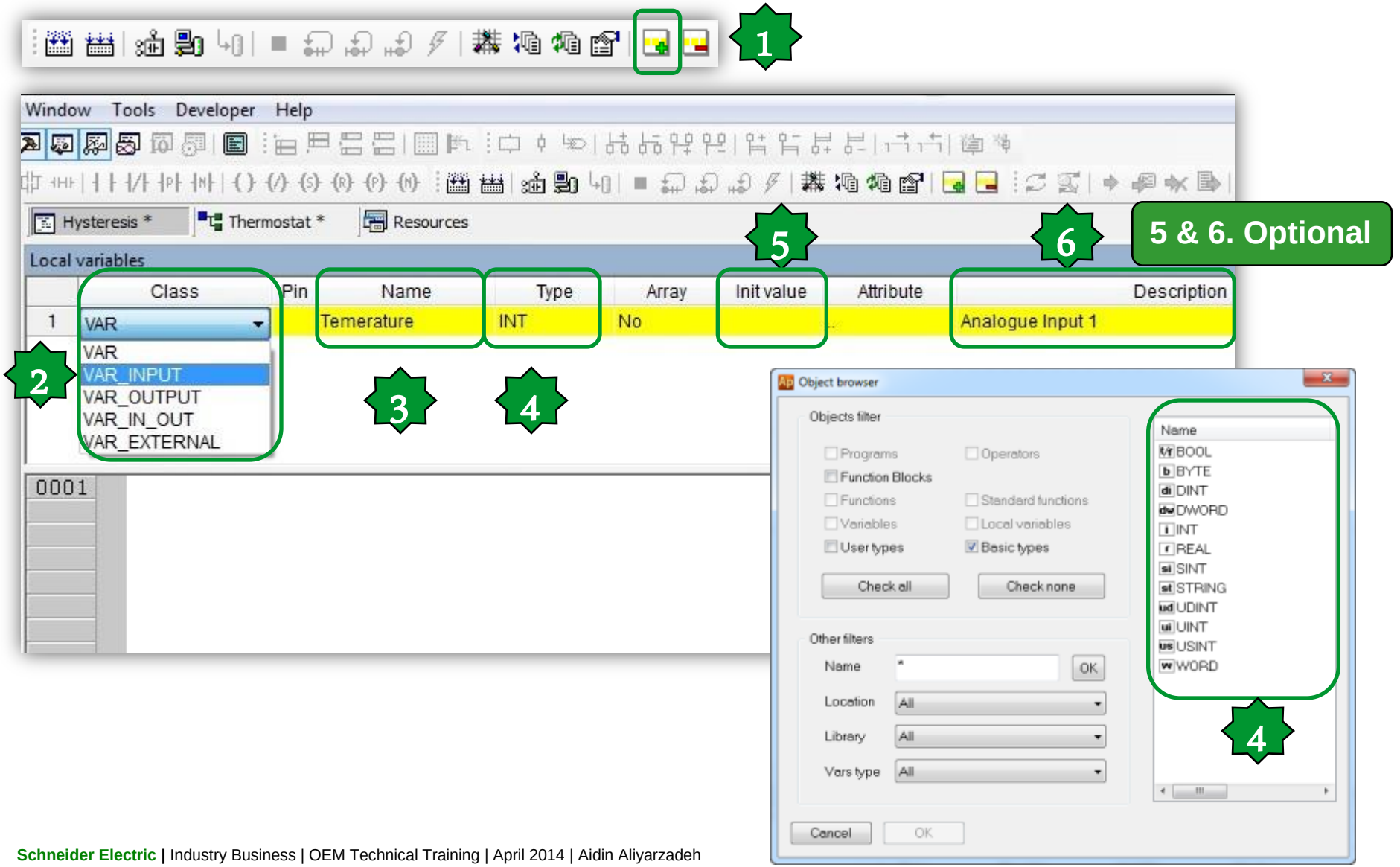


1. Right Click
2. New function block
3. Select the language
4. Assign a name
5. Double click on the Hysteresis to open the editor related to the selected language.

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



Insert record



Inside Hystersis 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  (* 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
```

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

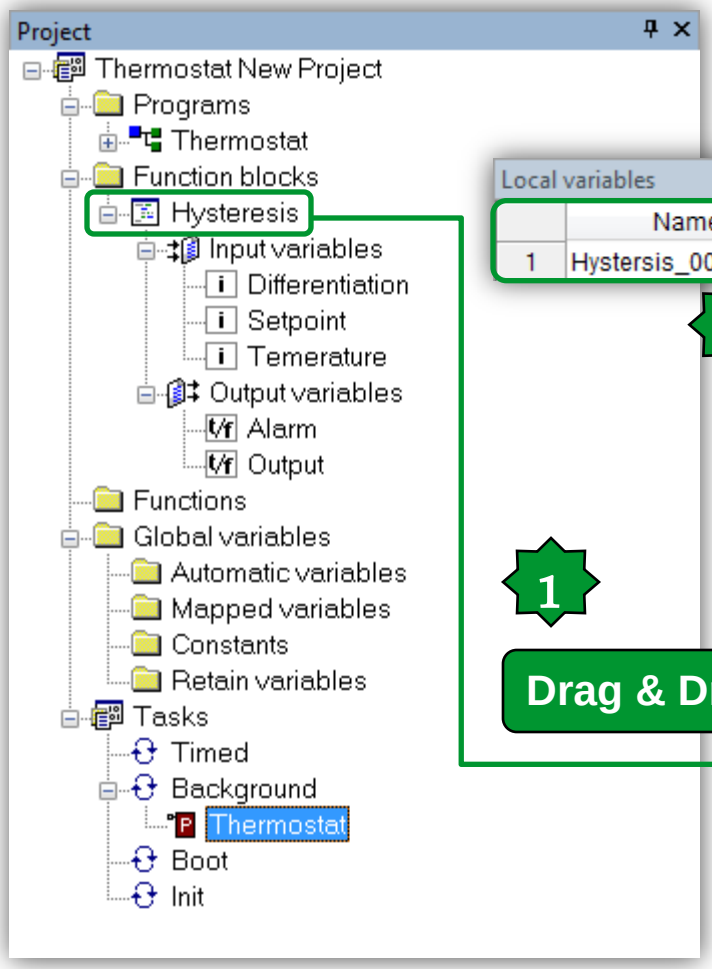
Output

```
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

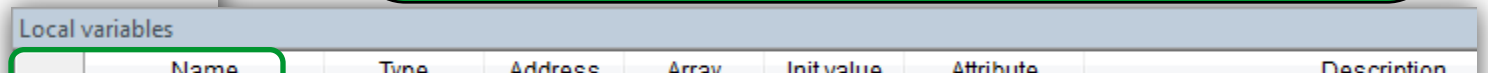
FBD in Background

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

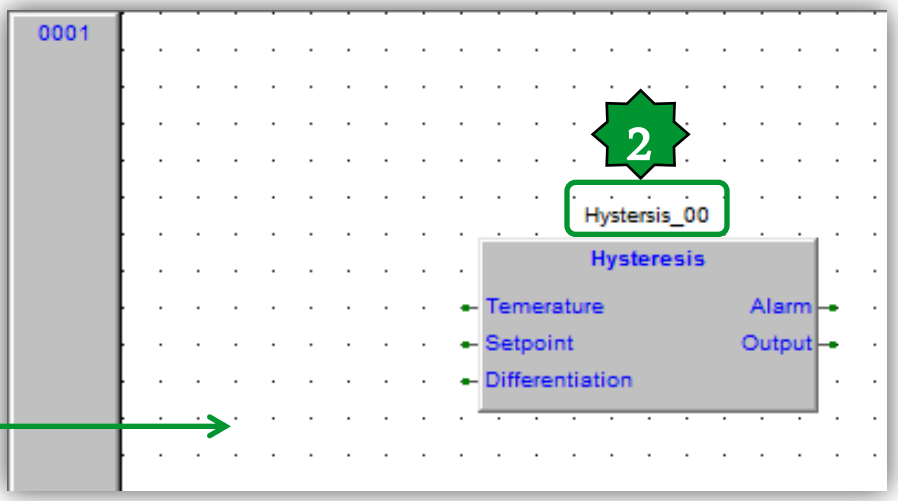


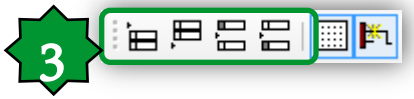
1

Drag & Drop

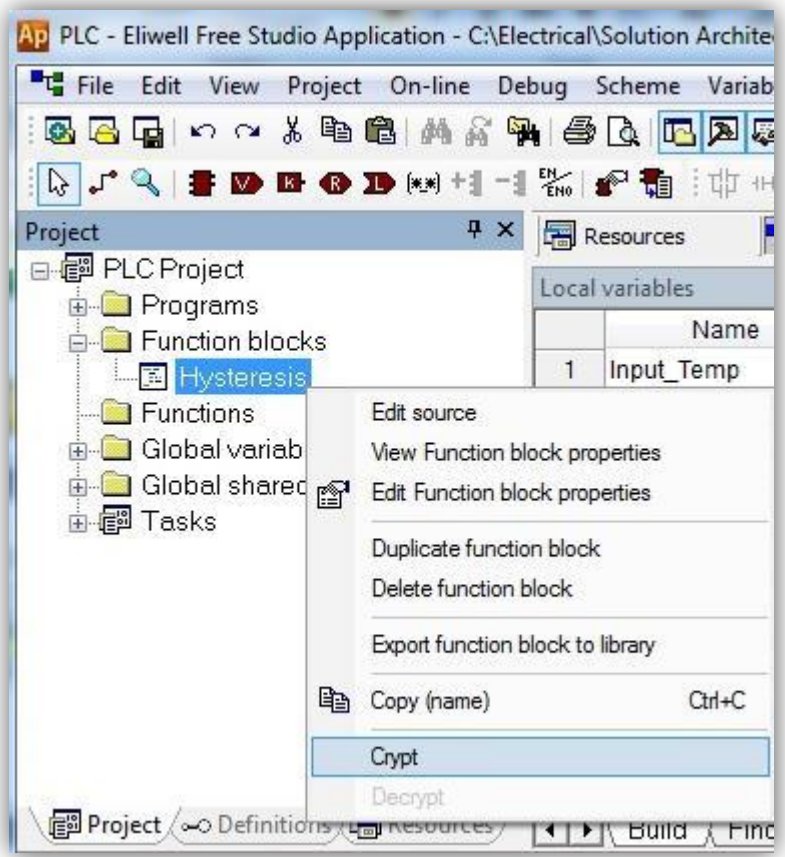


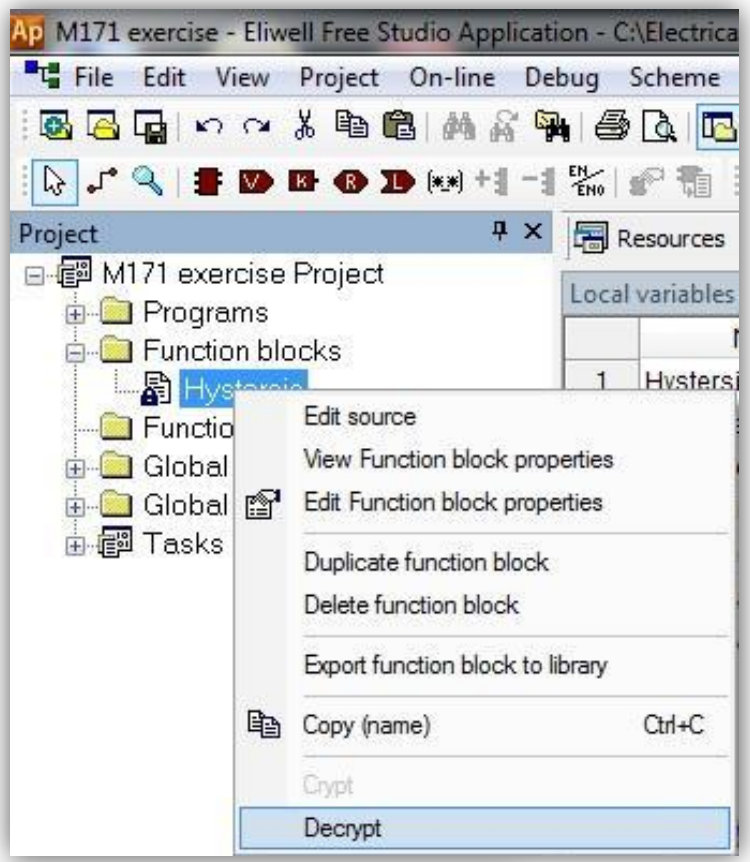
2

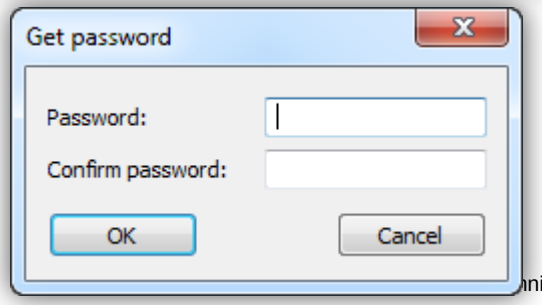


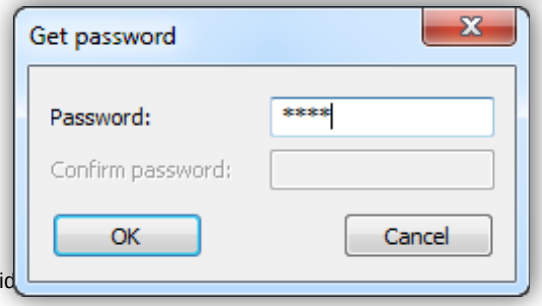


Set password for written FB







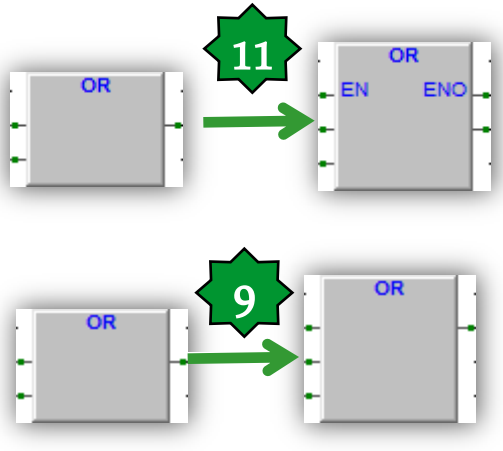


You can prevent access to your written codes inside of FBD by cript.

FBD toolbar…

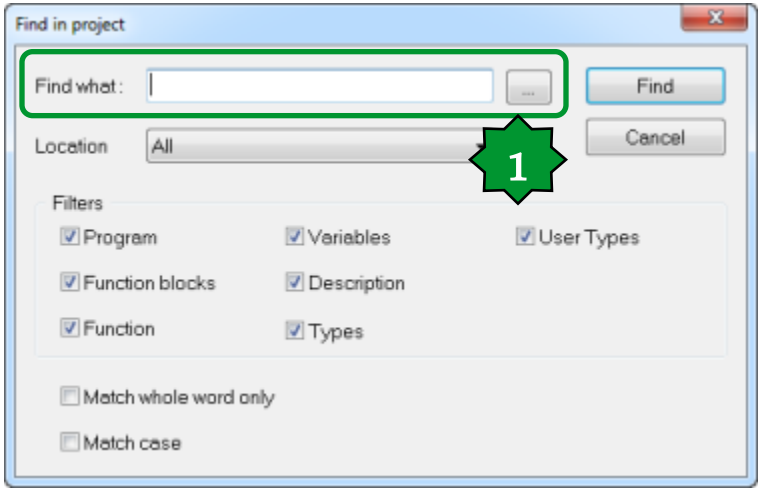
1. Connection
2. Watch
3. New block
4. Variable
5. Constant
6. Return
7. Jump
8. Comment
9. Increase number of pins
10. Decrease number of pins
11. Display enable I/O pins
12. FBD properties
13. View source

11. The output will not update if En=False



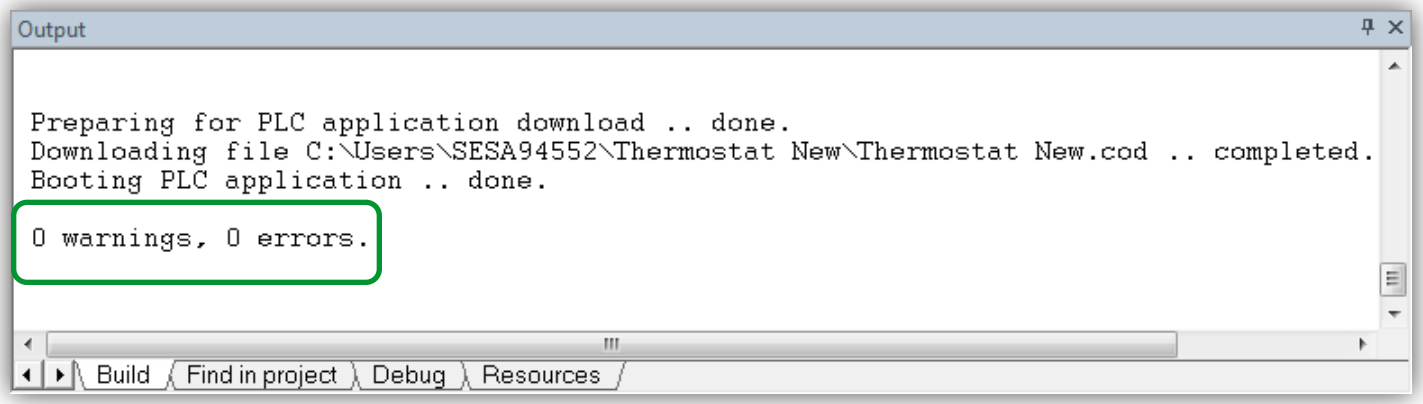
Cross Reference

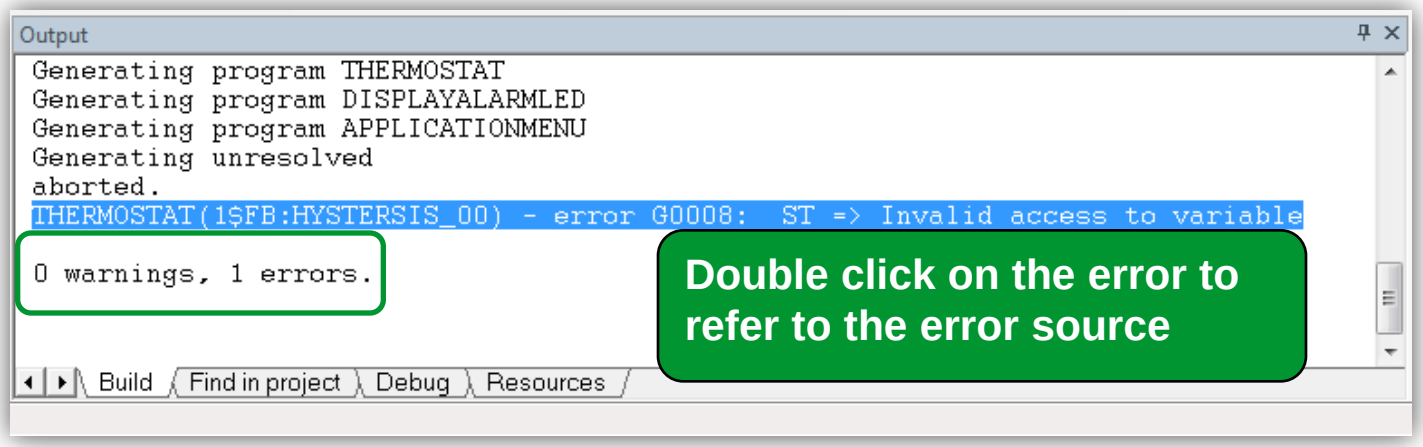
1. Find in project (cross reference)



Compile/Build

Compile





Double click on the error to refer to the error source

Chapter 3

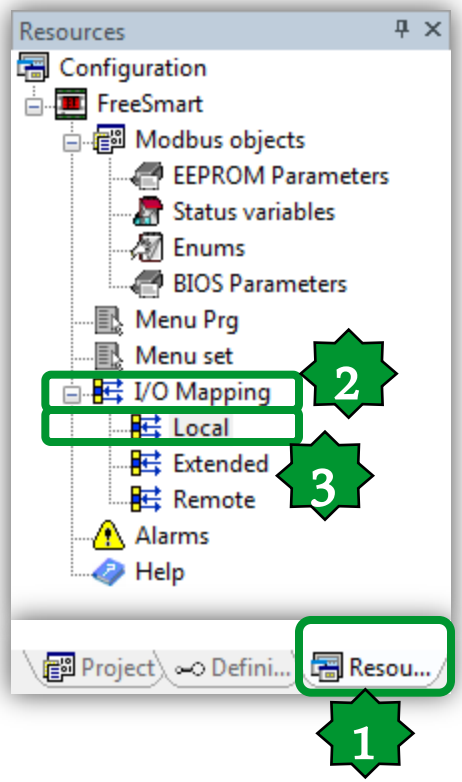
Resources

Goal:

Defining the resources:

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

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



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	Otput_Heating	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

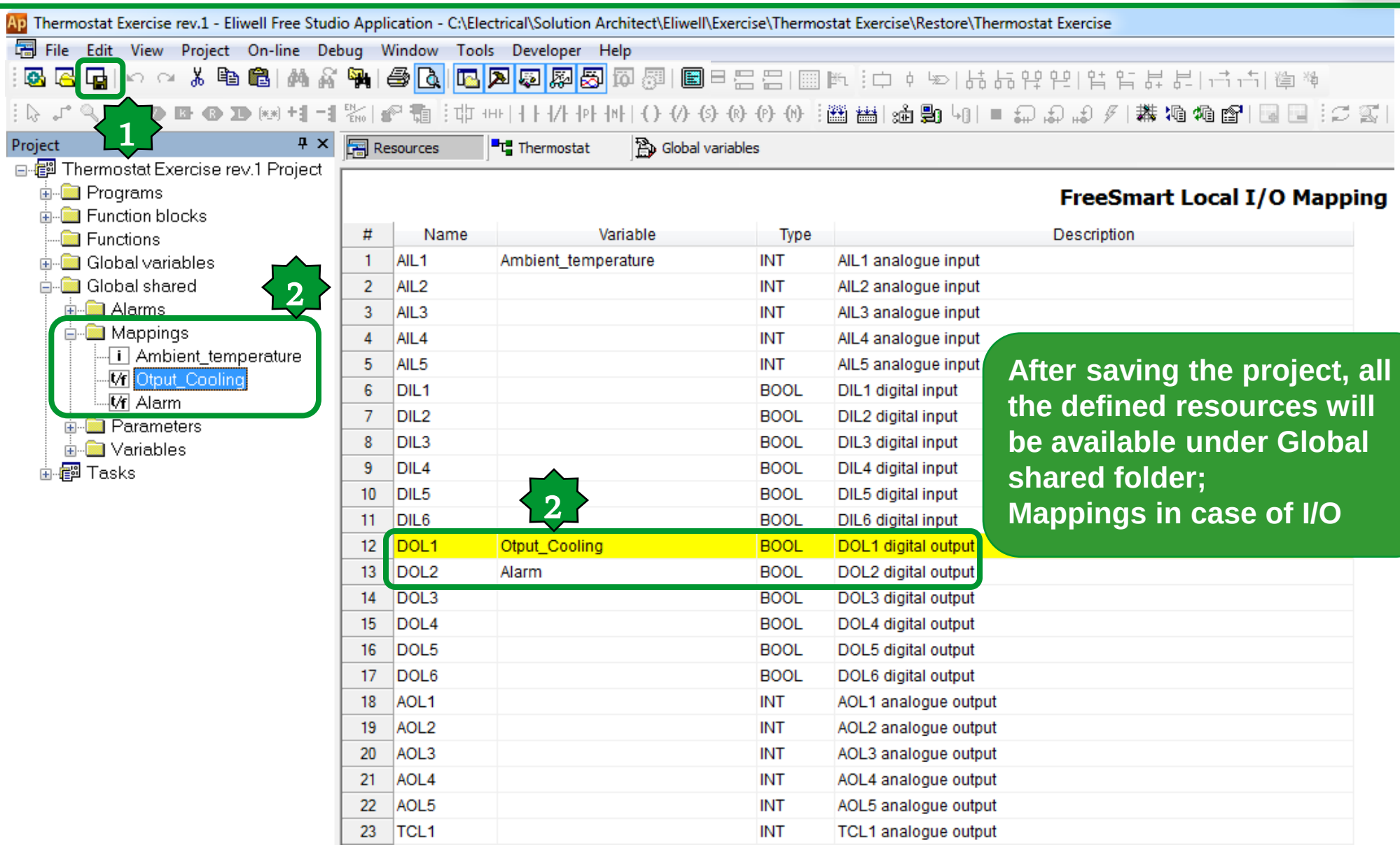
4

2. I/O Mapping definition:

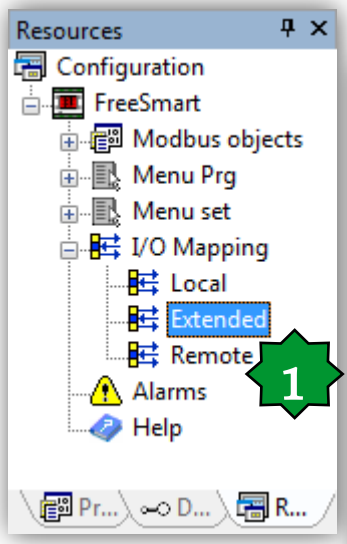
Local: Base I/O
Extend: Expansion
Remote: Keyboard

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

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

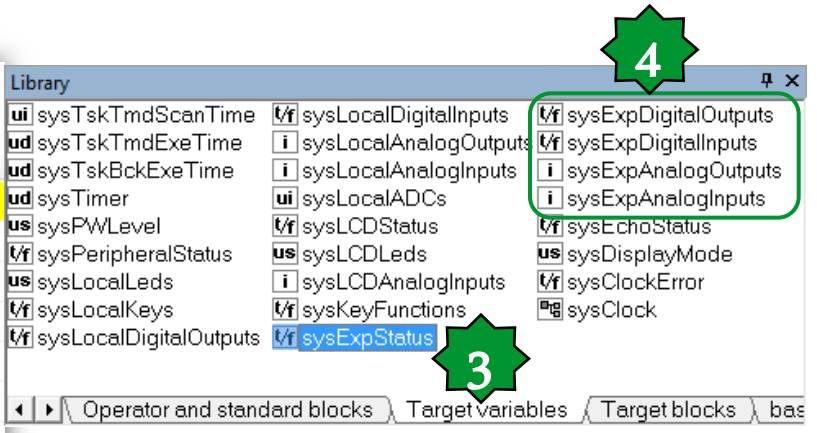


...Physical I/O Mapping (Expansion)



#	Na...	Variable	Type	Description
1	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

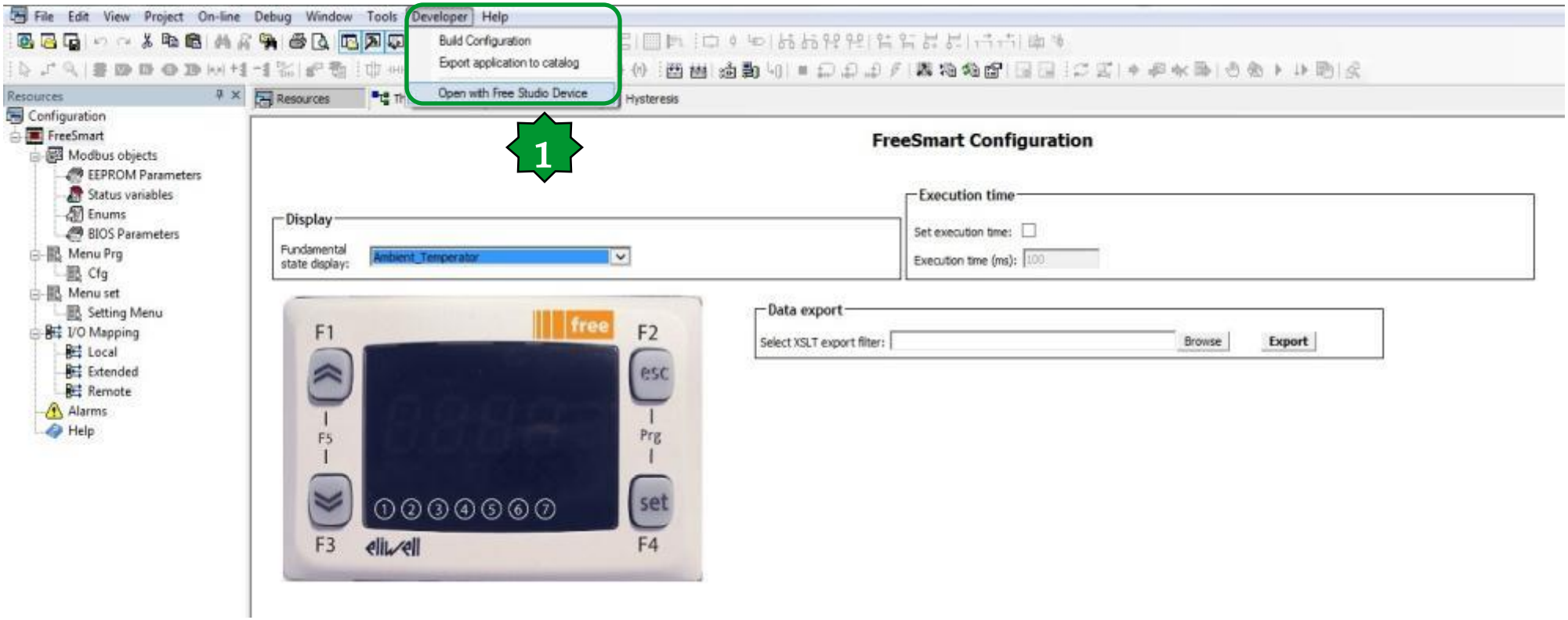
2



Note.
In case of loosing communiucation 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

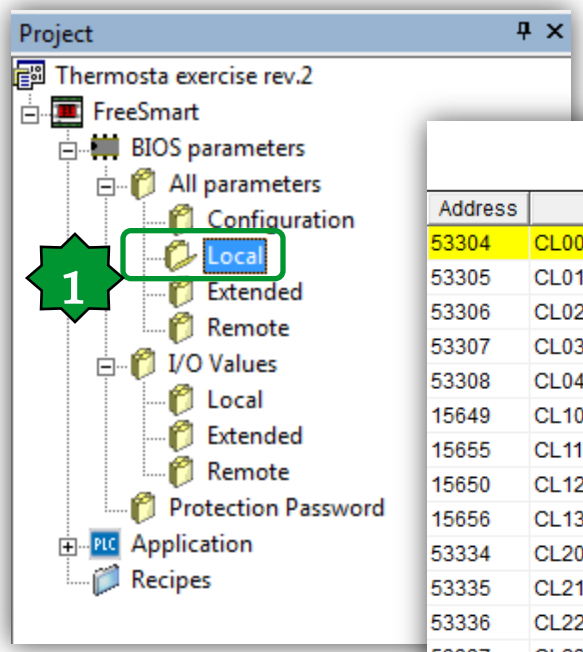
How to configure I/O types, range?



1. Menu Developer ► Open with free studio device

Note: BIOS parameters are also available on the installation manual

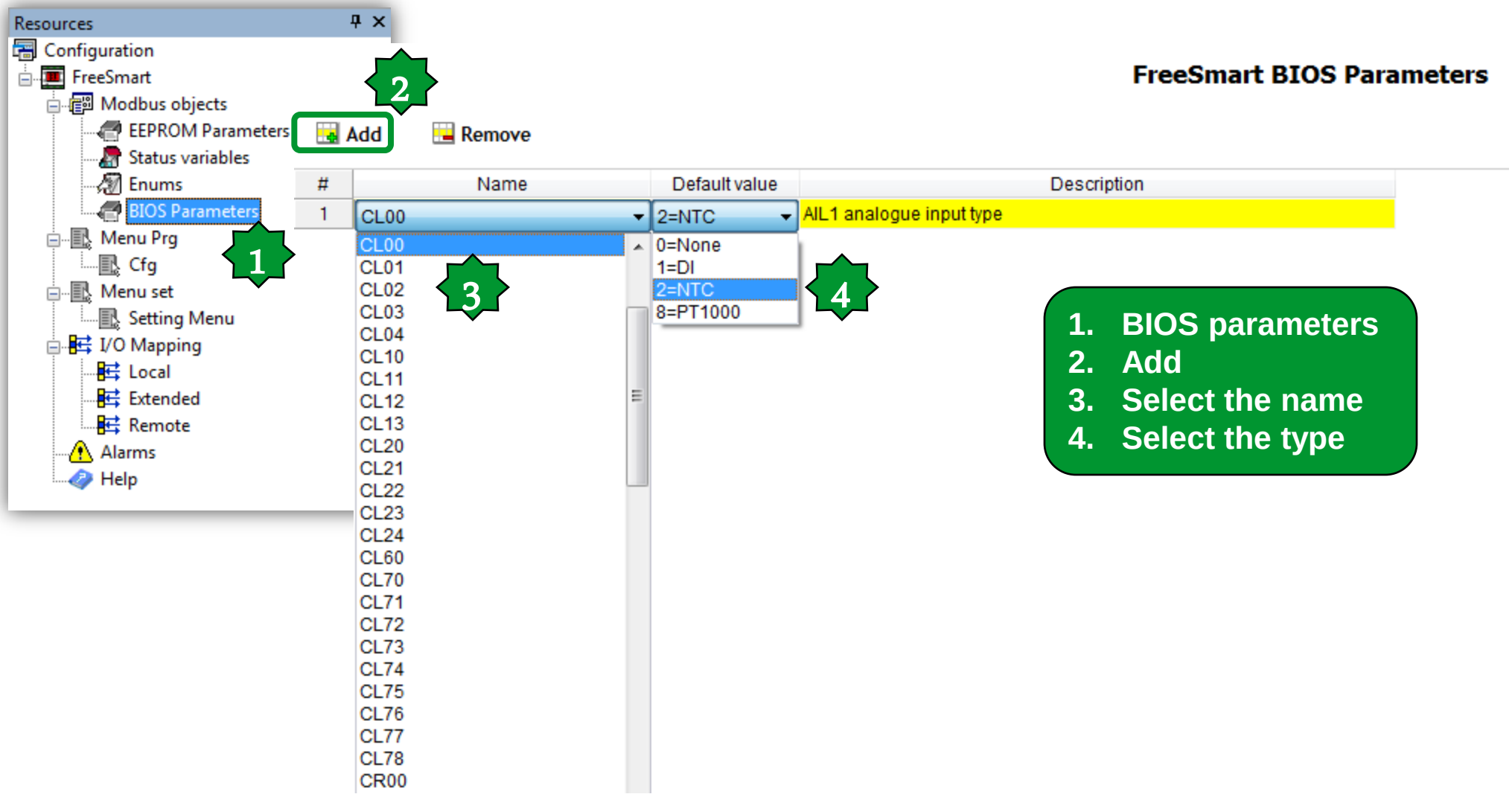
Check FS Device parameters description...



Local

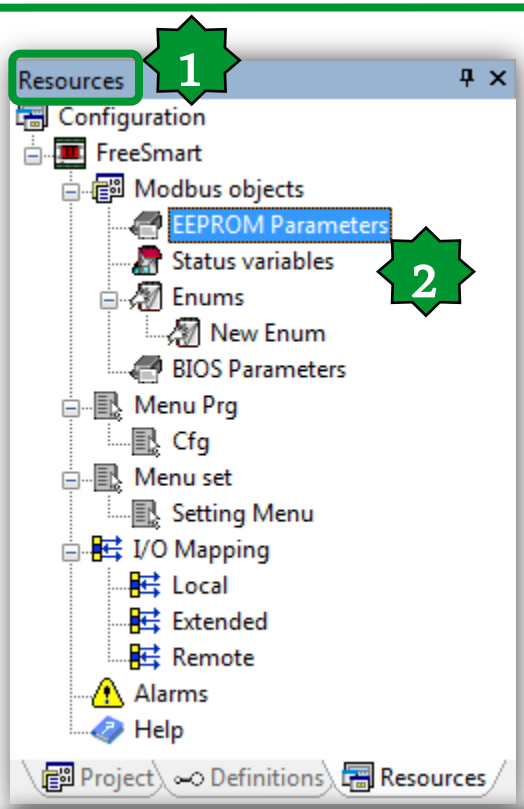
Address	Name	Value	Um	Default	Min	Max	Description
53304	CL00	2=NTC	num	2=NTC	0	8	AIL1 analogue input type
53305	CL01	2=NTC	num	2=NTC	0	8	AIL2 analogue input type
53306	CL02	2=NTC	num	2=NTC	0	7	AIL3 analogue input type
53307	CL03	2=NTC	num	2=NTC	0	7	AIL4 analogue input type
53308	CL04	2=NTC	num	2=NTC	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



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

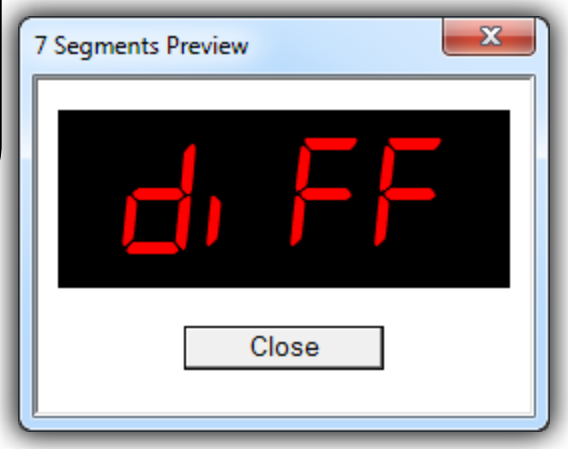
EEPROM parameters



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

5

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		

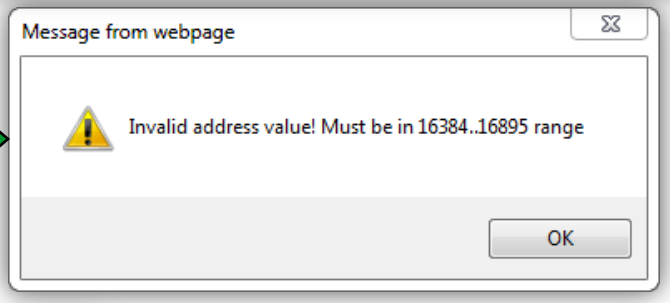
EEPROM Properties

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	

1



2

°C
bar
%R.H.

3

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

4

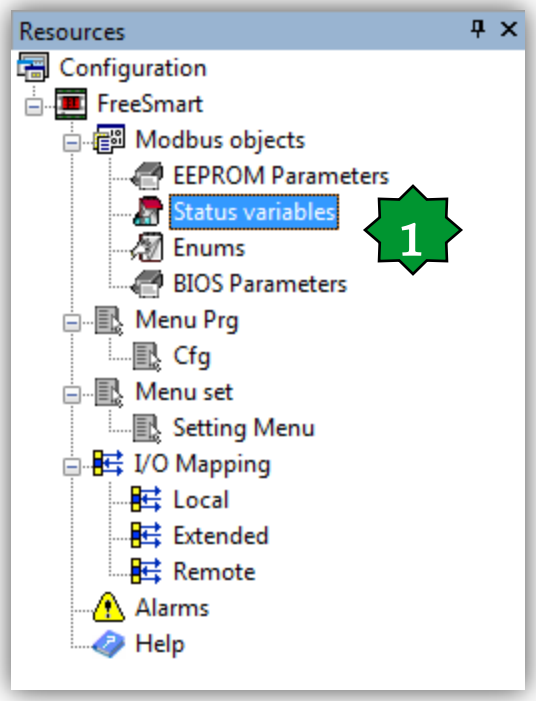
Never visible
Level 1
Level 2
Always visible

EEPROM Parameters:

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

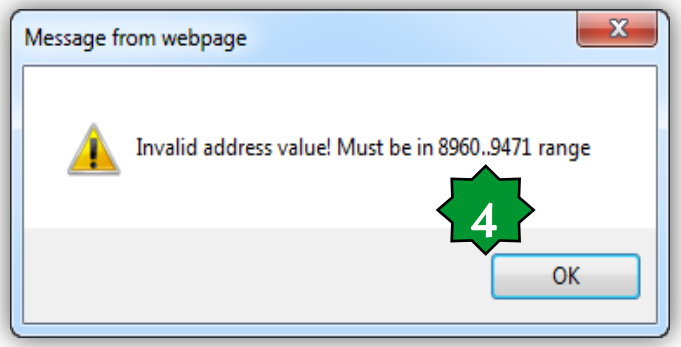
Note.
Dynamic setpoint by the other parameters Min/Maxis possible.

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

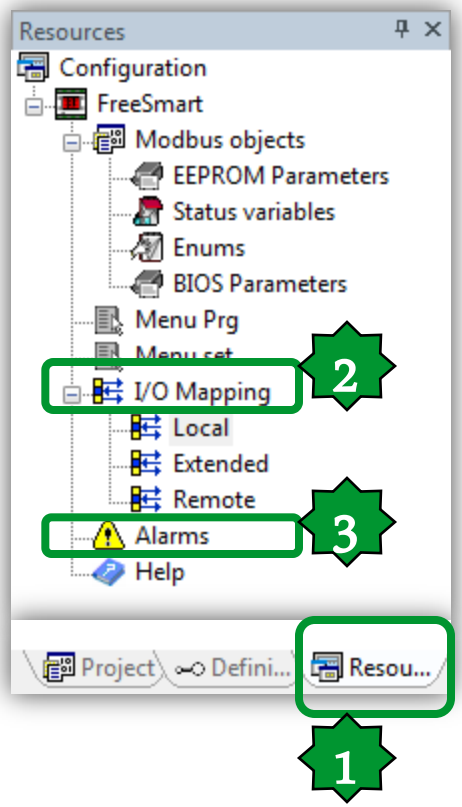
Add Remove Recalc

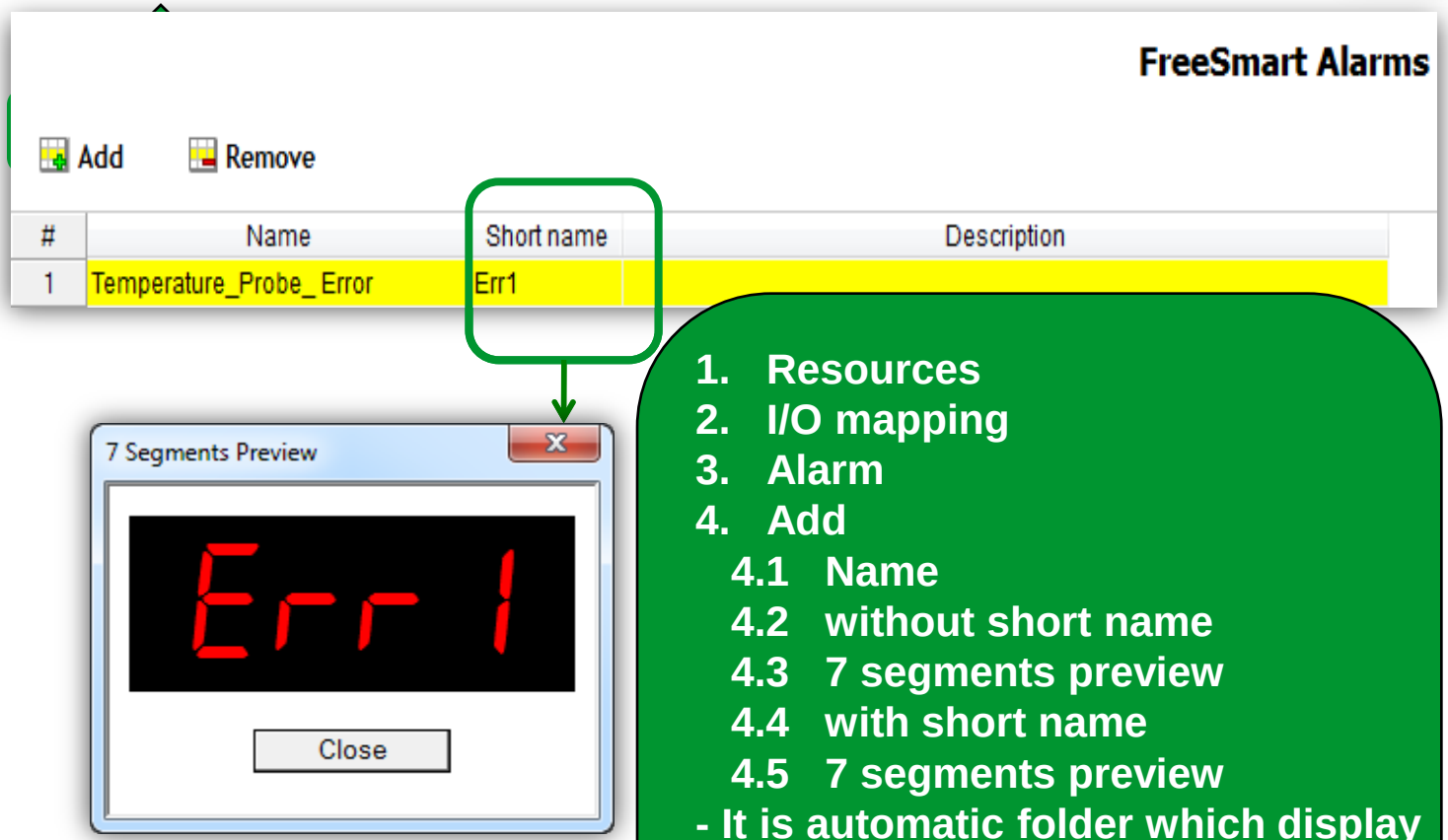
3

#	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

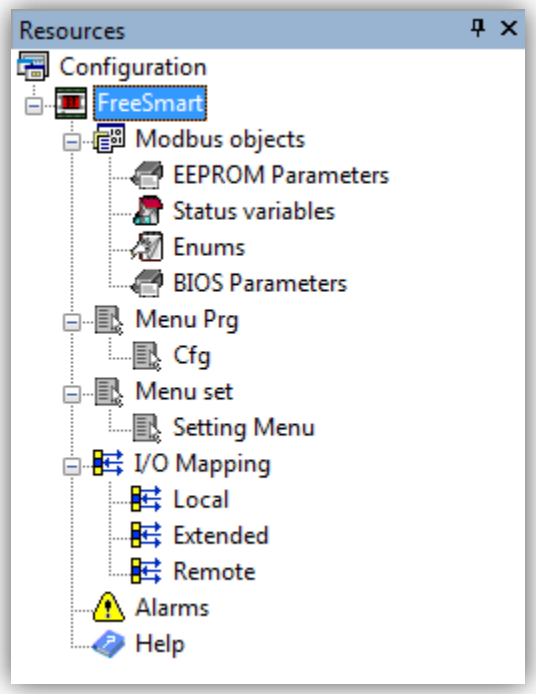


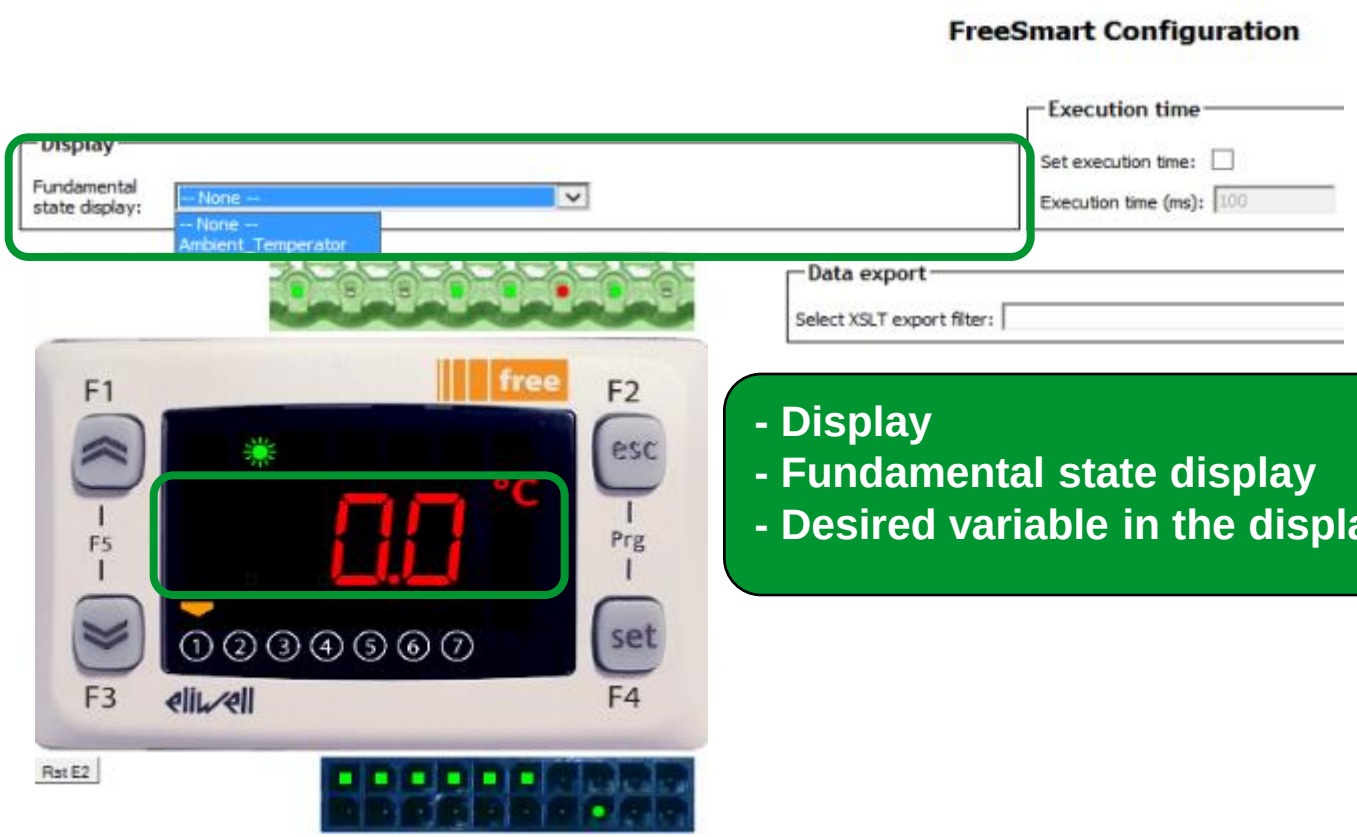


1. Resources
2. I/O mapping
3. Alarm
4. Add
   - 4.1 Name
   - 4.2 without short name
   - 4.3 7 segments preview
   - 4.4 with short name
   - 4.5 7 segments preview

- 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.

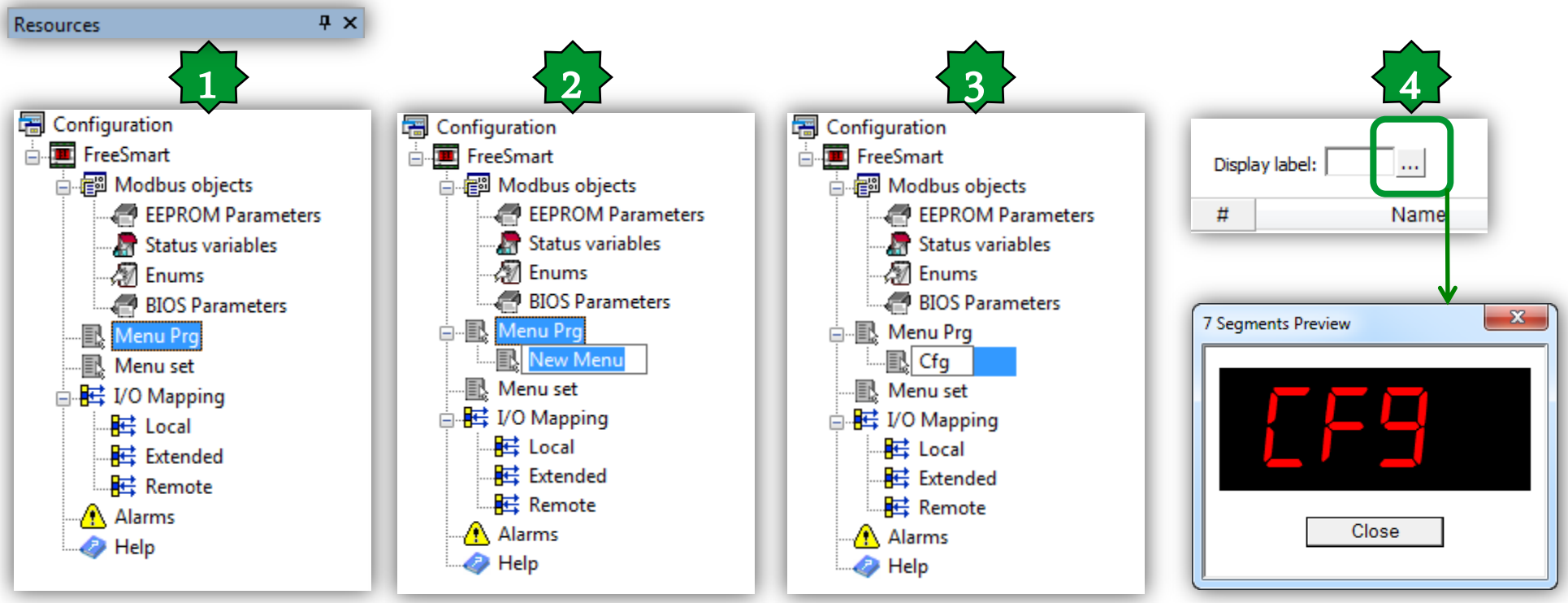
Fundamental state display configuration





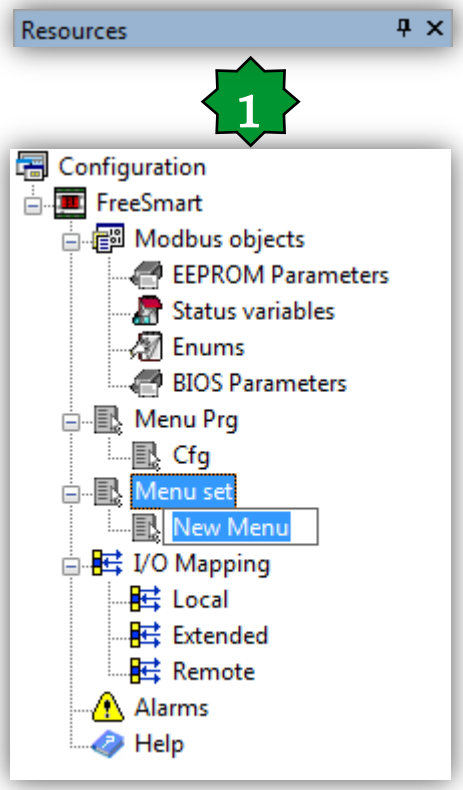
- Display
- Fundamental state display
- Desired variable in the display

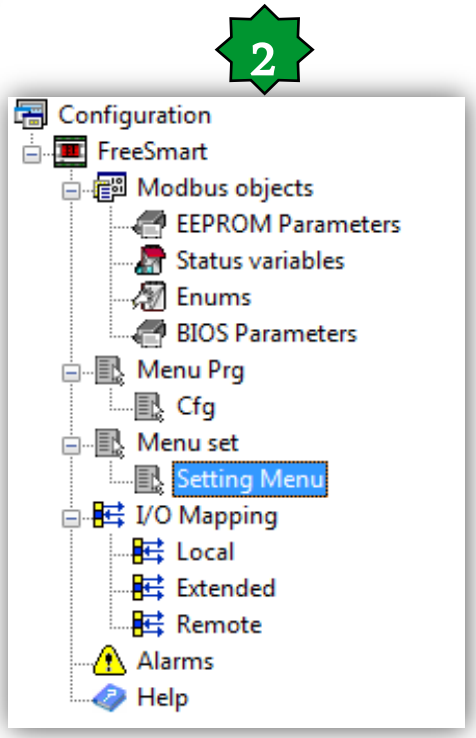
Menu Program – Add Folder

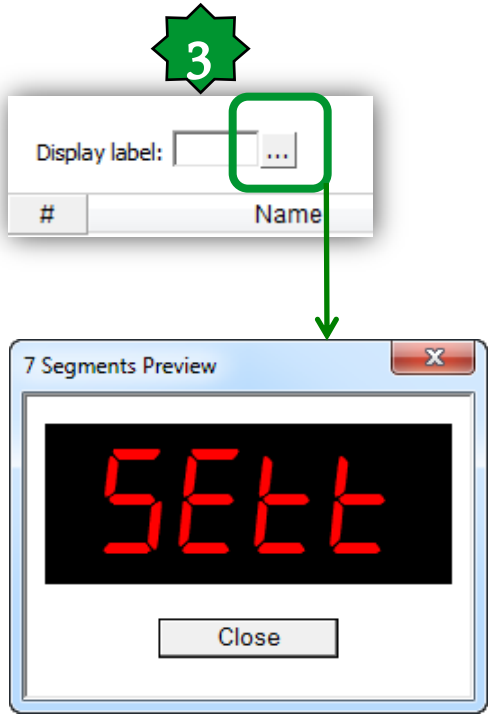


1. Menu Prg.
2. Add Menu
3. New Menu, name it (Cfg)
4. 7 segment preview

Menu Set – Add Folder

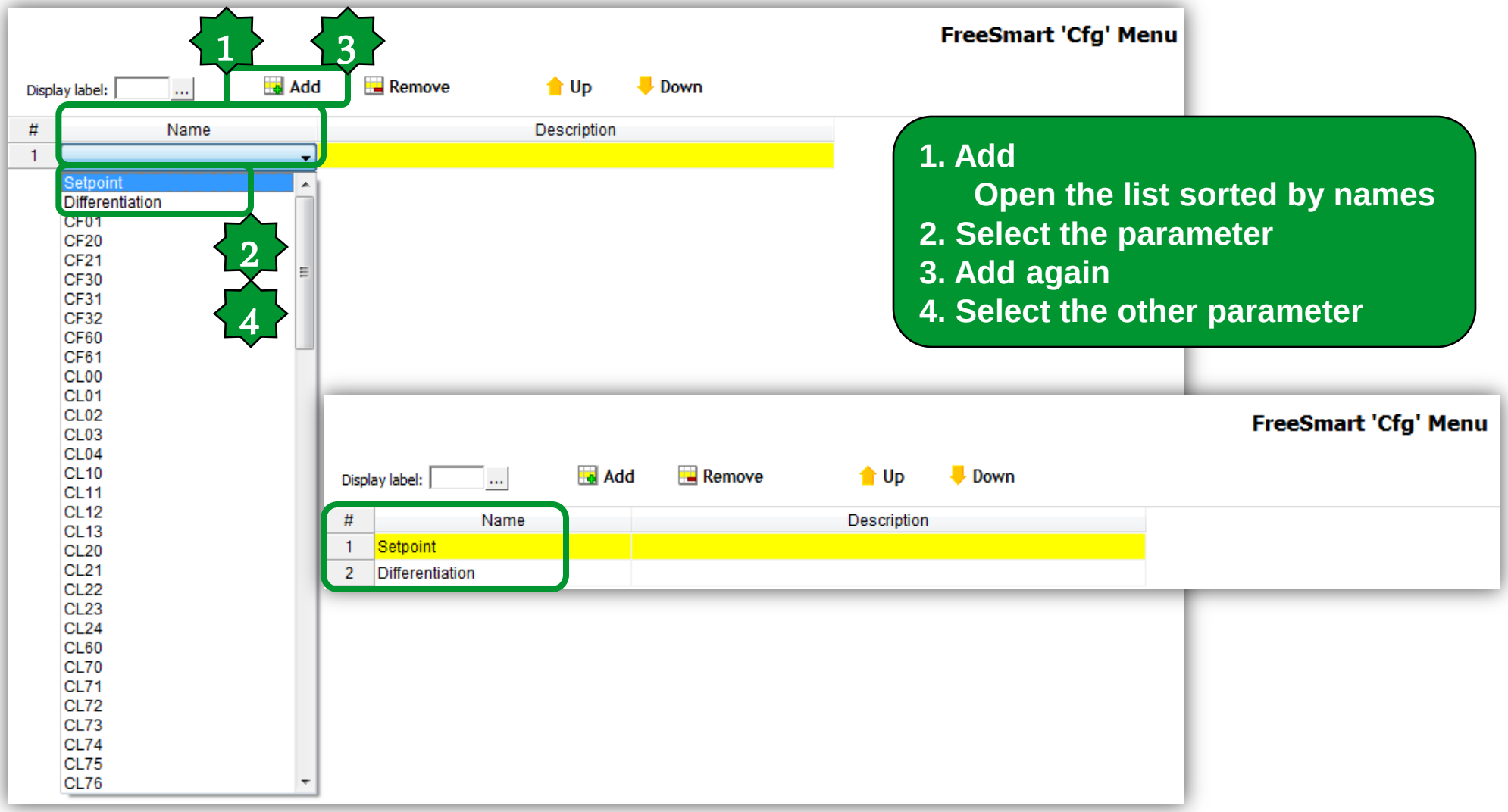




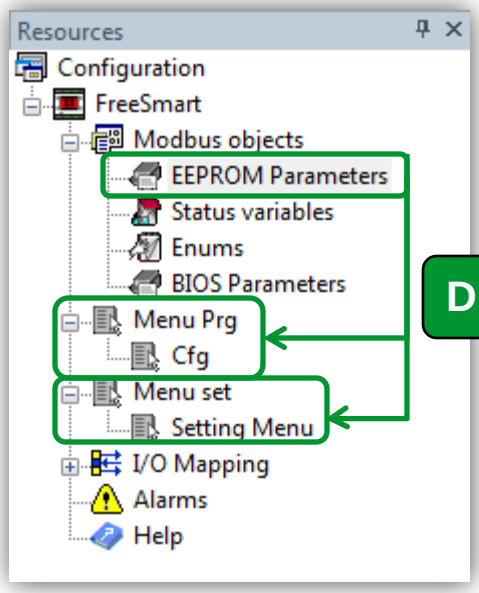


1. **Menu Set, Right Click Add Menu**
2. **New Menu, name it (Setting Menu)**
3. **7 segments preview**

Add/Remove elements to folder



Add/Remove elements by drag & drop



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

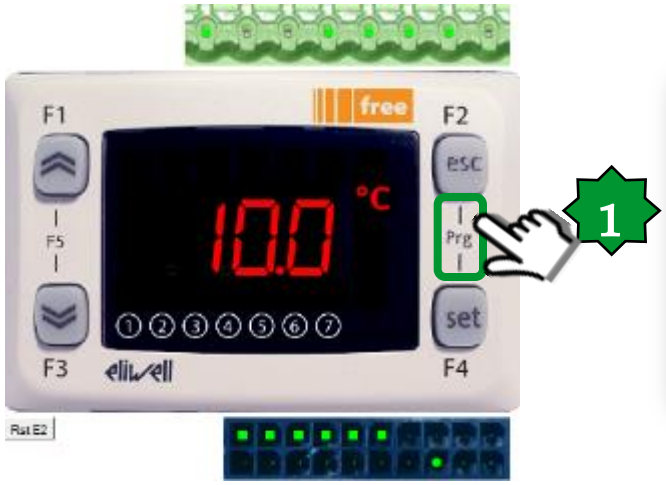
#	Name	Description
1	Setpoint	
2	Differentiation	
3	Ambient_Temperator	

FreeSmart EEPROM Parameters

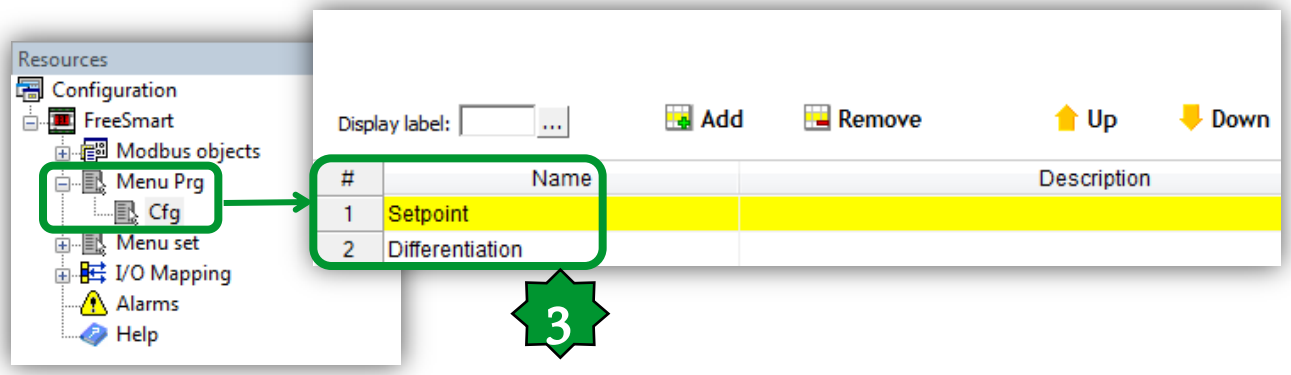
Add Remove Recalc

#	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

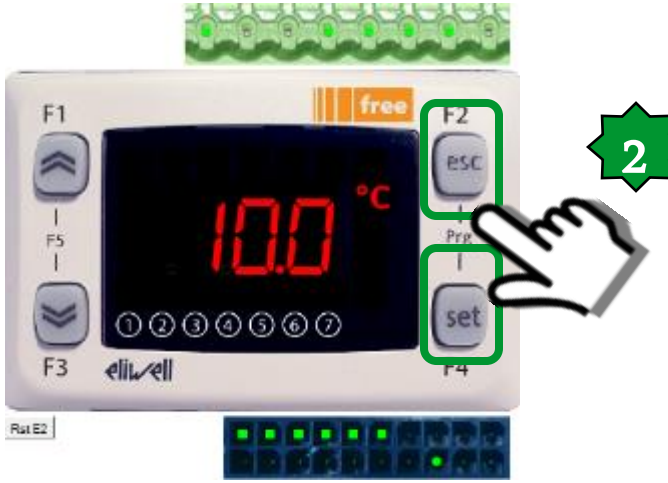
Menu Program – How to Access



1



3

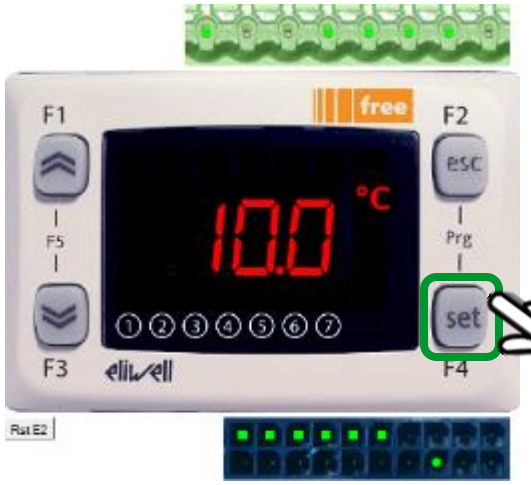


2

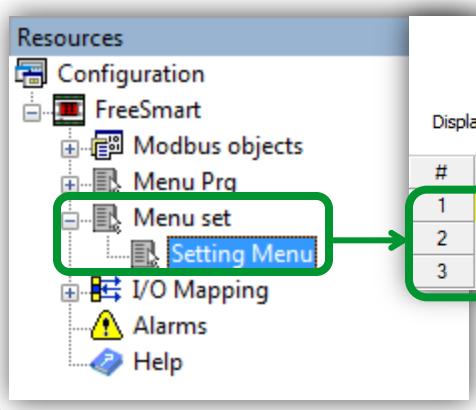
To form & define the program button function:

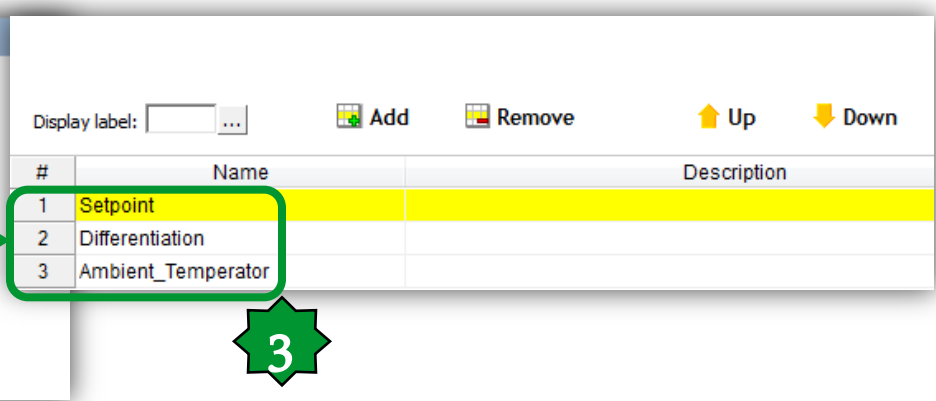
1. **Menu Prg, access by pressing Prg button in simulation**
2. **Menu Prg, access by pressing esc.& set buttons simultaniously on the product**
3. **Scroll up or down into the defined variables ▲▼**

Menu Set – How to Access



1



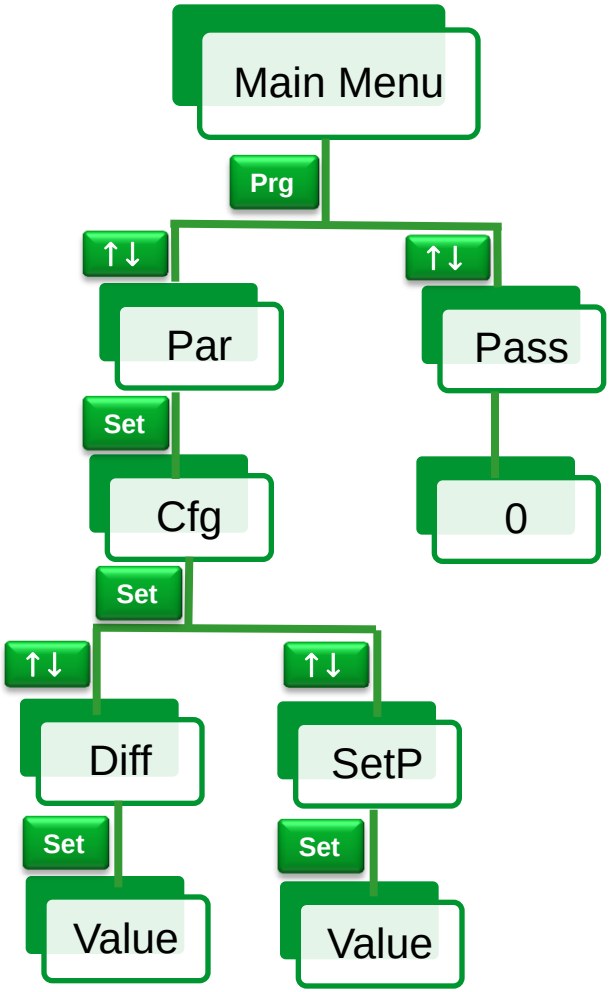


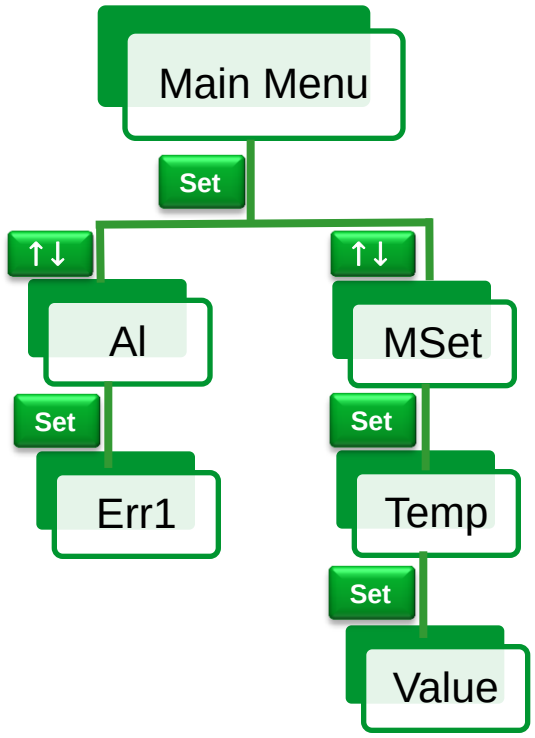
3

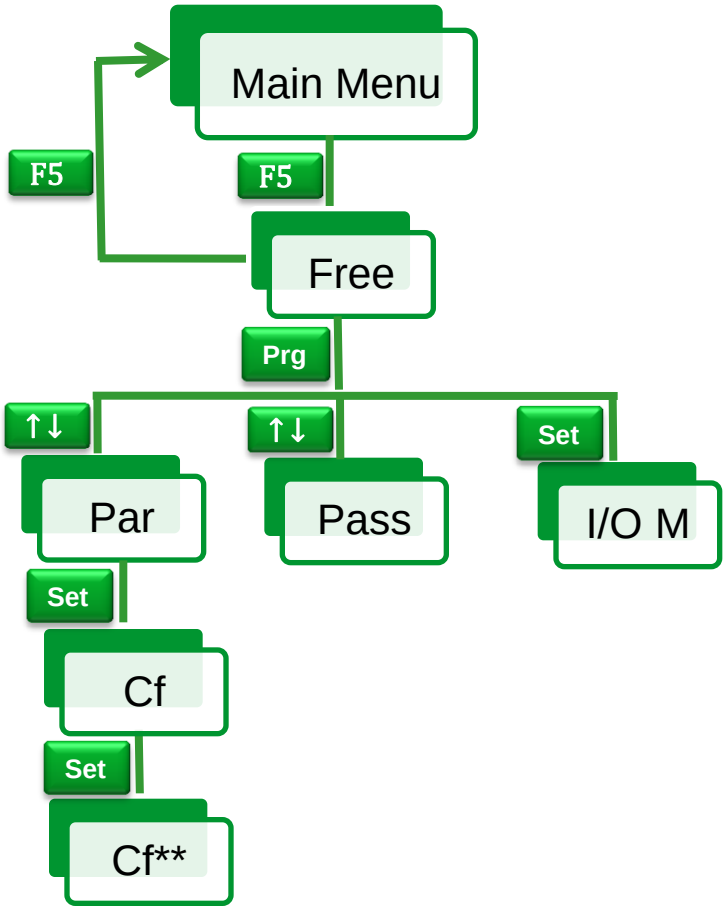
2

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

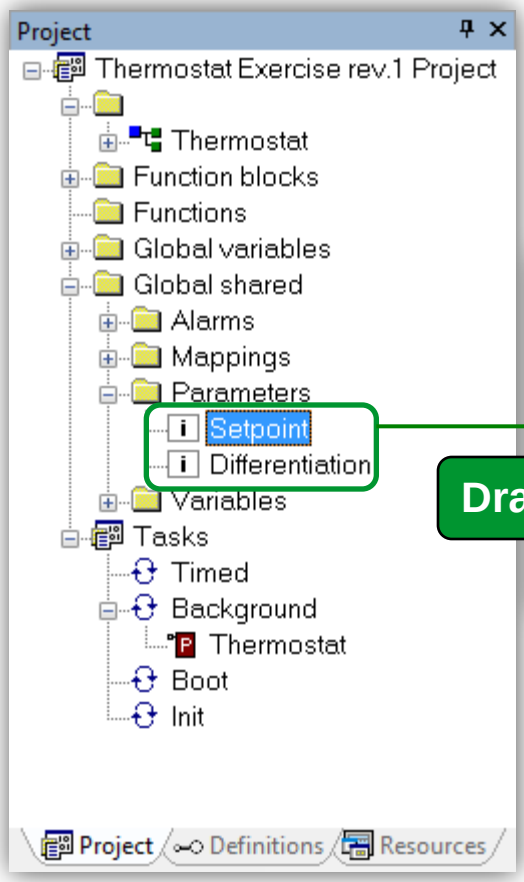




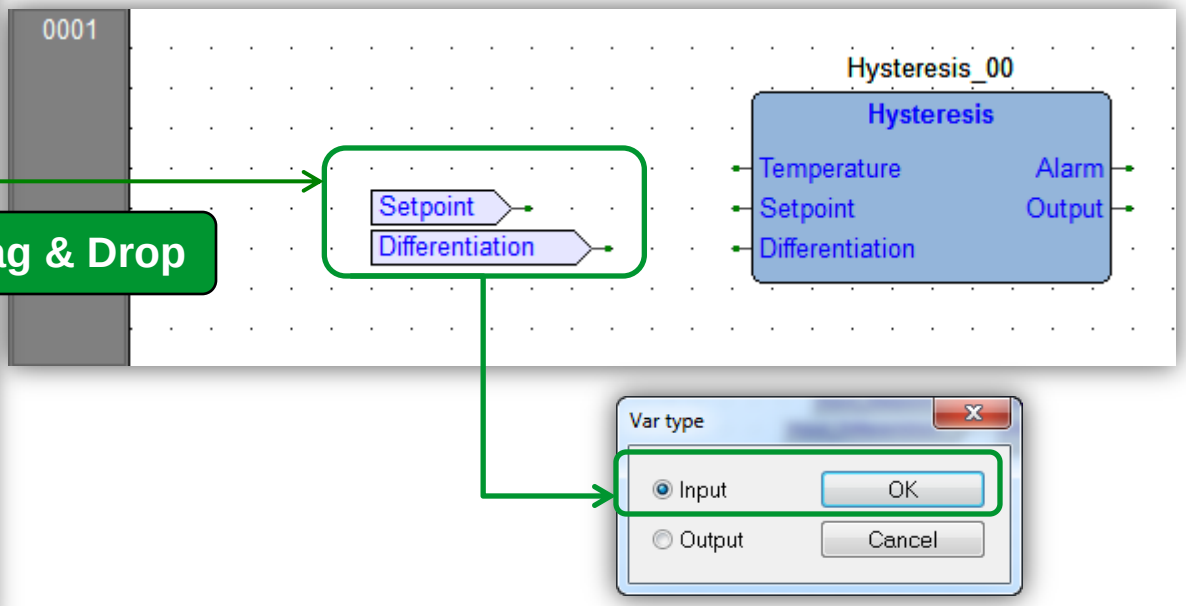


Project / Global Shared

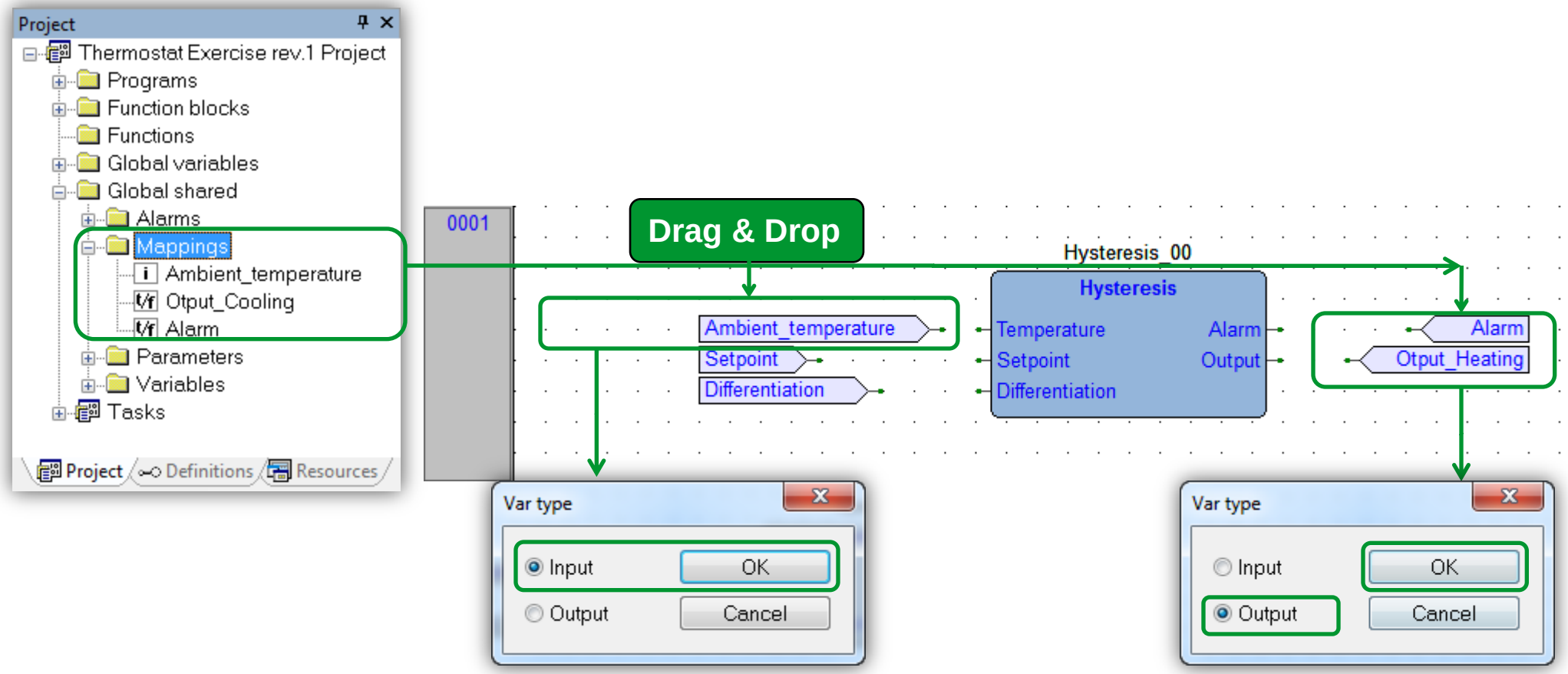
All the resources are available in the project tab under Global Shared folder (after saving or compiling the project)



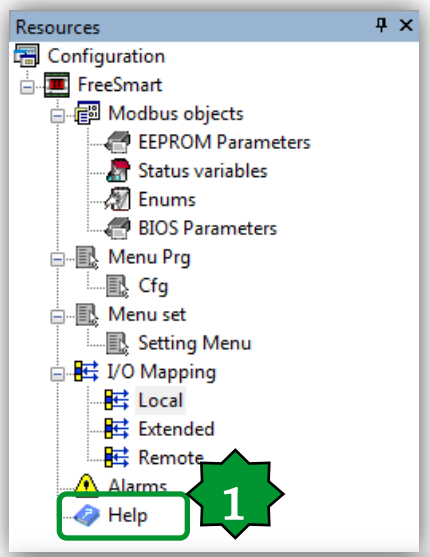
Drag & Drop

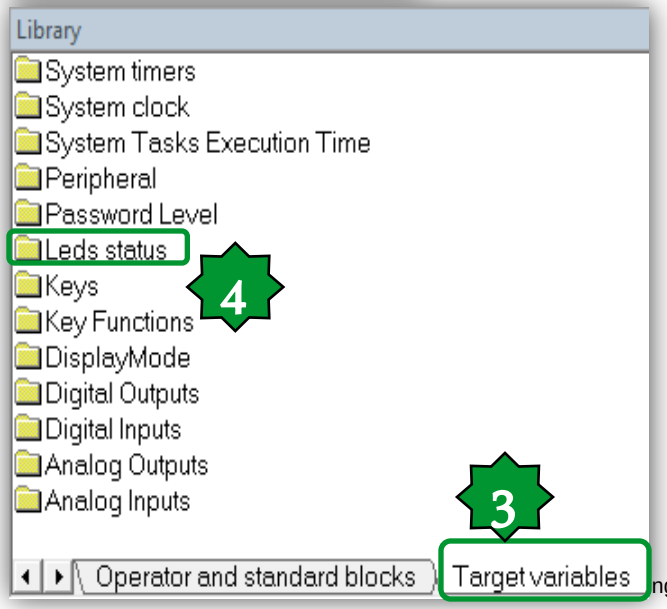


Using physical I/O



System LED setting





2

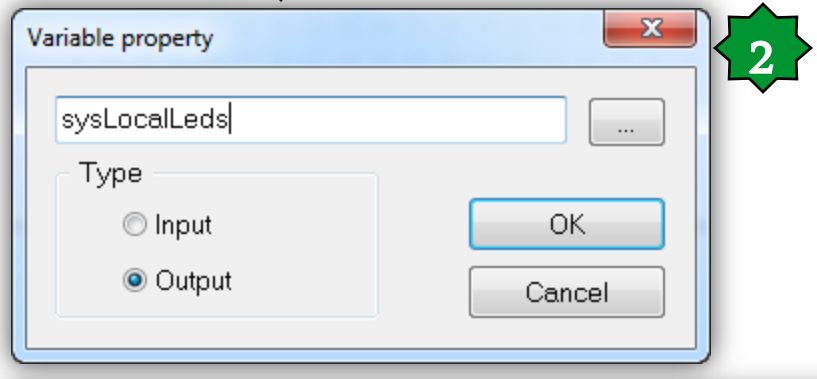
LED reference for the developer

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	ABC	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.

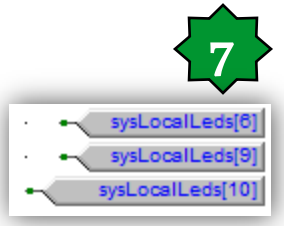
System local LED assigning

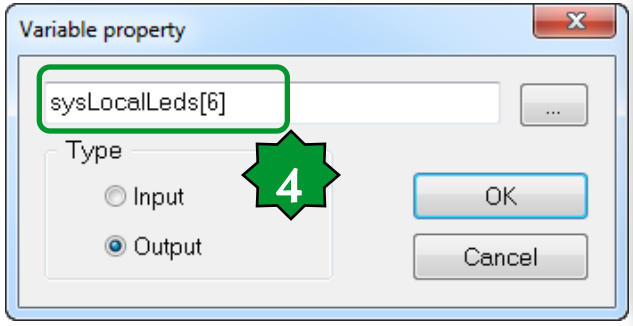


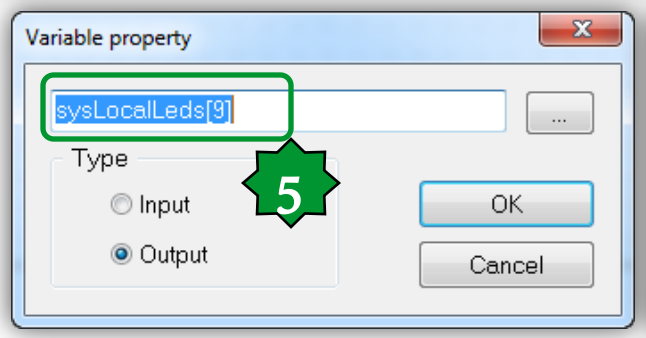
1. 2*click
2. Variable property
3. Dedicate required LED
4. Type [6] ► Output ► OK
5. Type [9] ► Output ► OK
6. Type[10] ► Output ► OK
7. Dedicated LED‘s

3

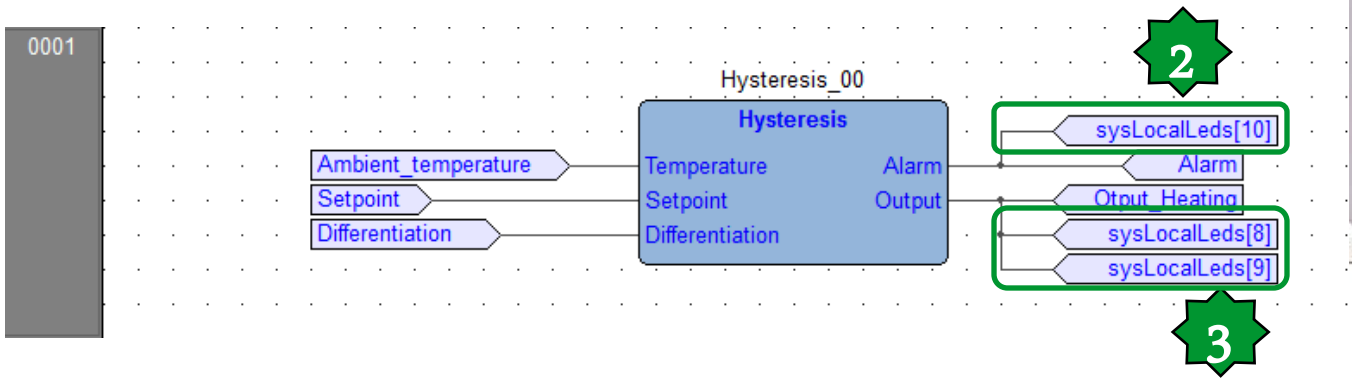
LED number	Symbol or icon	Description	Off	On (steady)	On (blinking)
6		Cooling	SYSLED[6]=0	SYSLED[6]=1	SYSLED[6]=2
9		User-defined 1	SYSLED[9]=0	SYSLED[9]=1	SYSLED[9]=2
10		User-defined 2	SYSLED[10]=0	SYSLED[10]=1	SYSLED[10]=2







Connecting dedicated LED‘s to the FBD



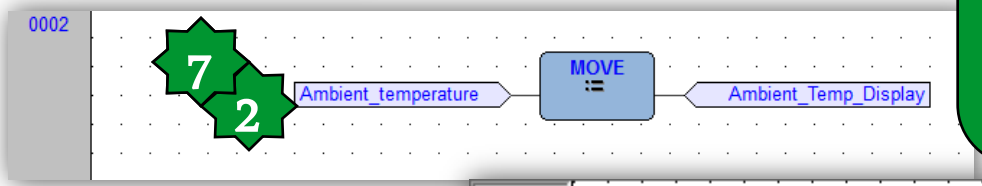
Digital output map

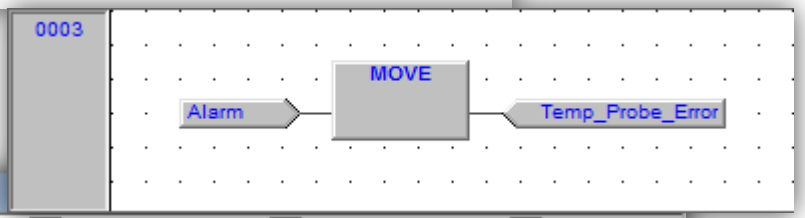
Digital Input map

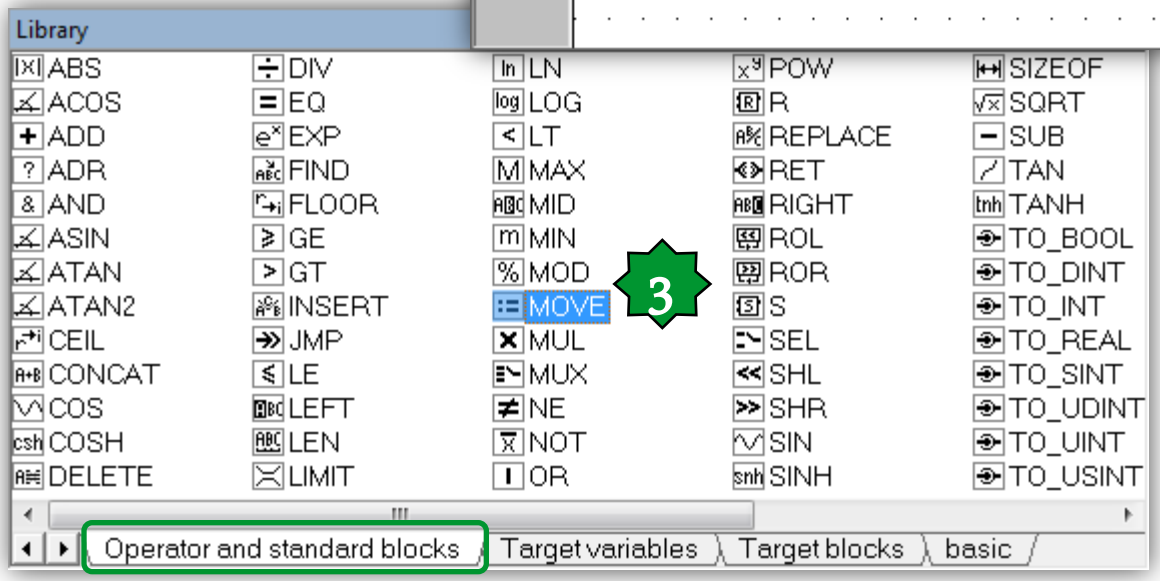
4 4

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

Valorize Fundamental State Display



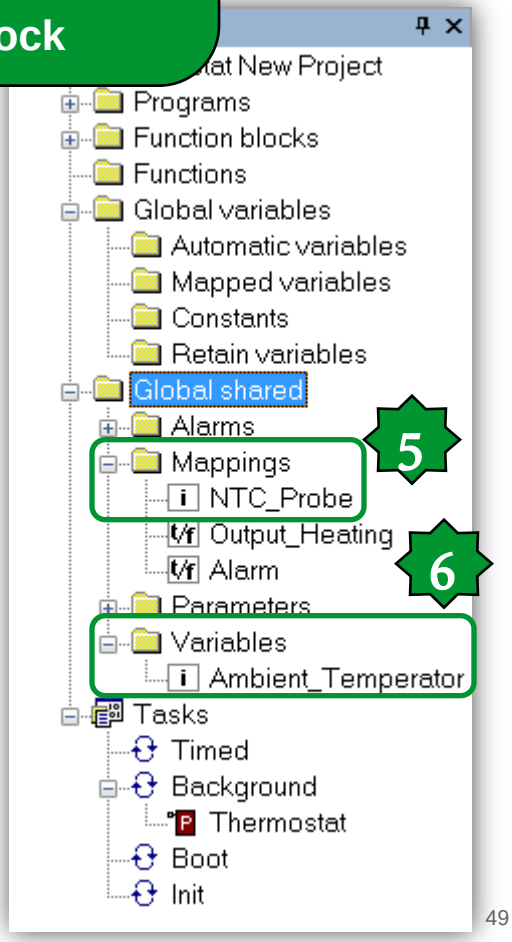




1. Insert bottom (new network)
2. Adding new network
3. Select Move block
4. Drag & drop to new network

5 & 6. Mapping ◄► Variables

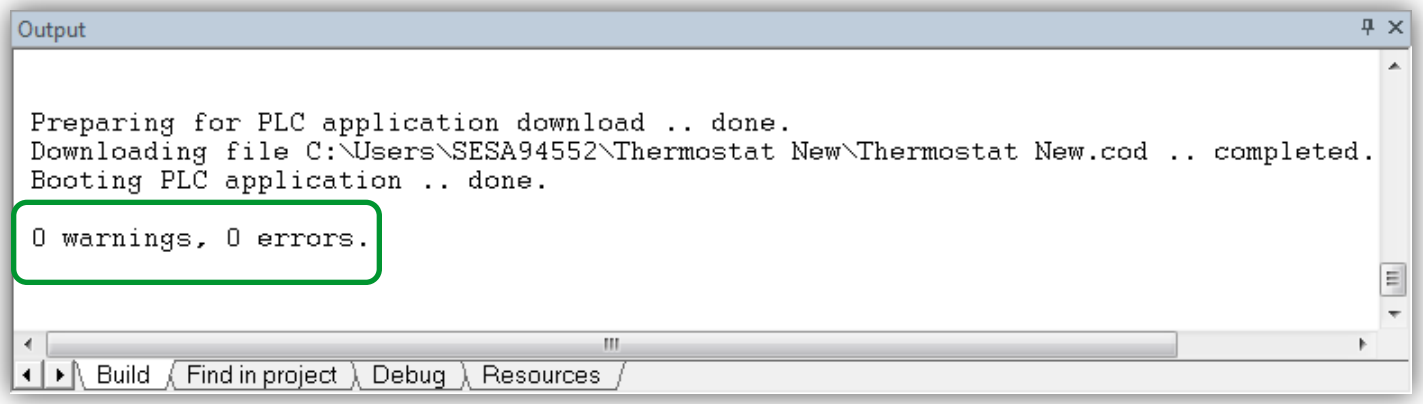
7. Connect to Move block

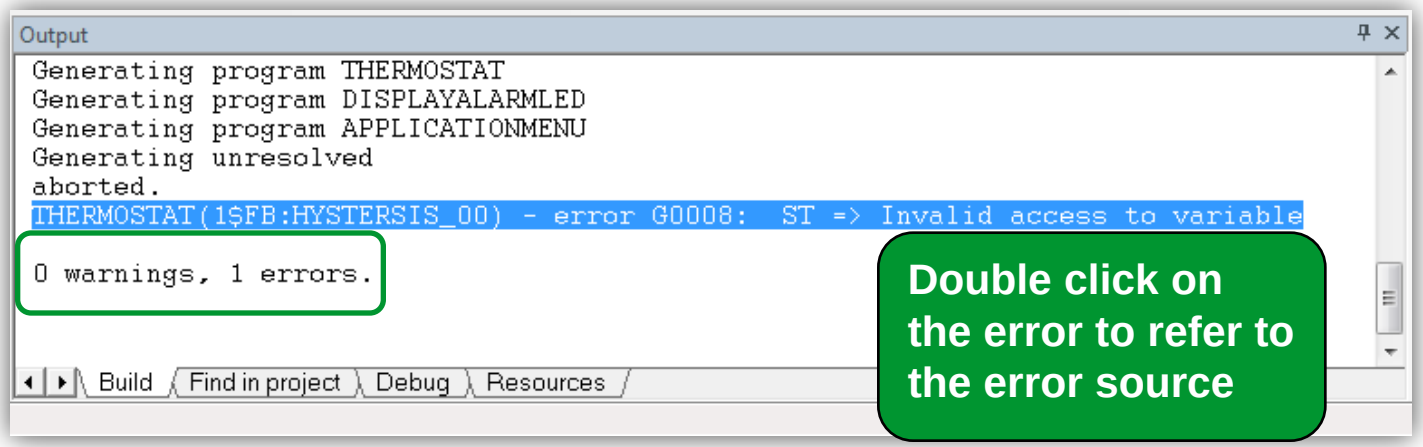


*** Move command is mandetory to connect two variables.**

Compile/Build

Compile





Double click on the error to refer to the error source

Chapter 4

Simulation/Debugging – Part 1

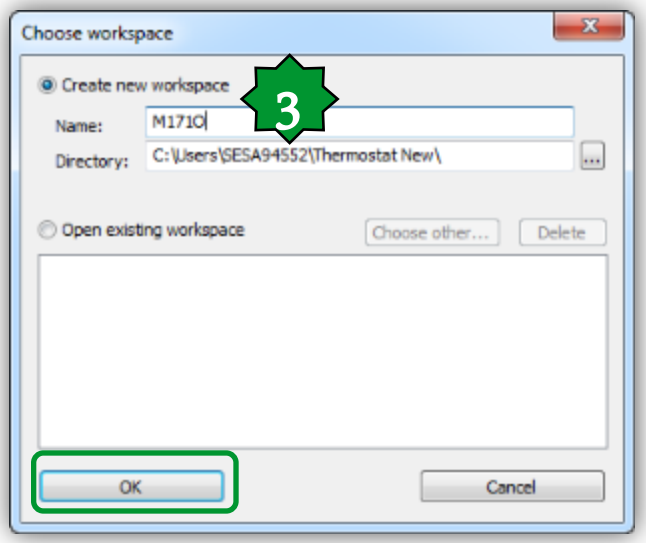
Goal:

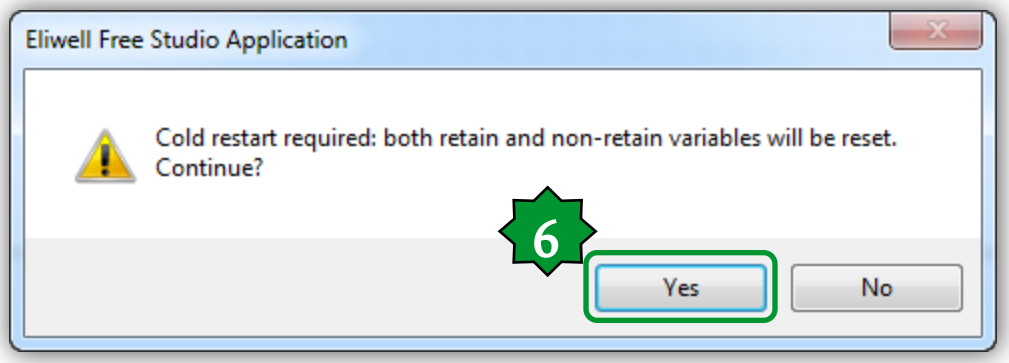
Debugging created FB by different off-line simulation tools such as Watch or Oscilloscope

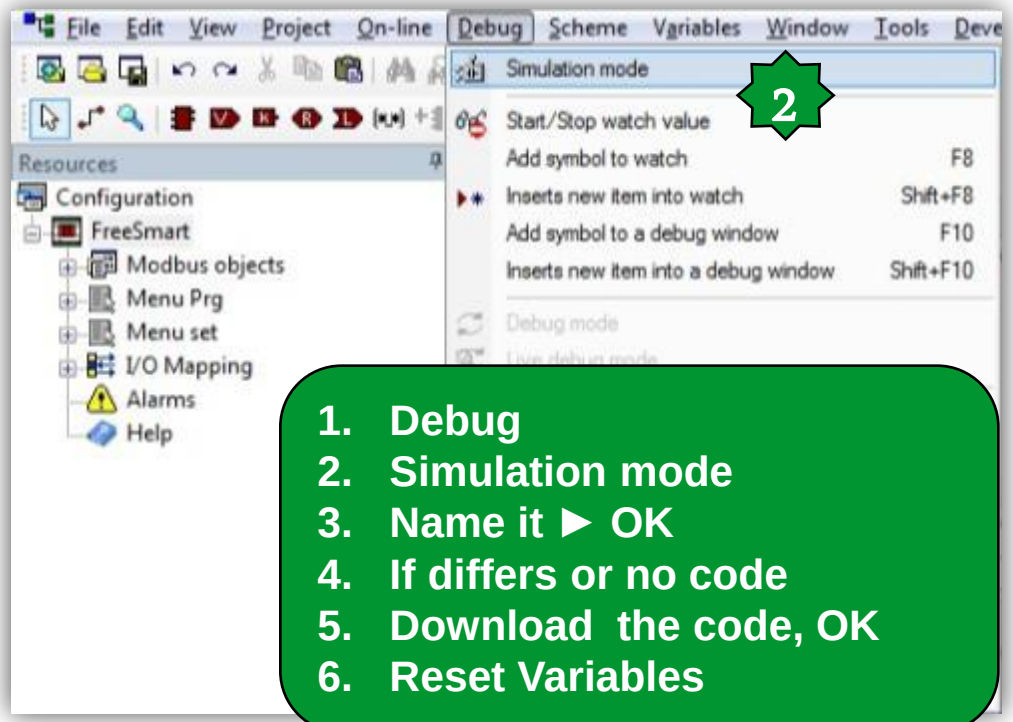
Off line simulation mode

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.**

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.

-Connected: the communication has been established

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.

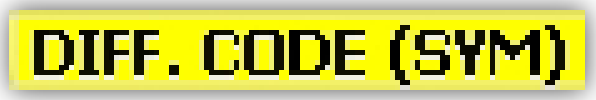
When the connection status is Connected, the application status takes on one of the following values.

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

--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.

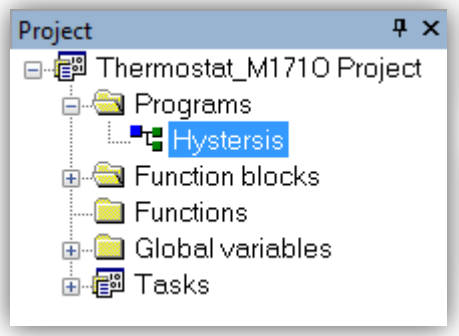
On-Line Status / Application Status

--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.



-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.

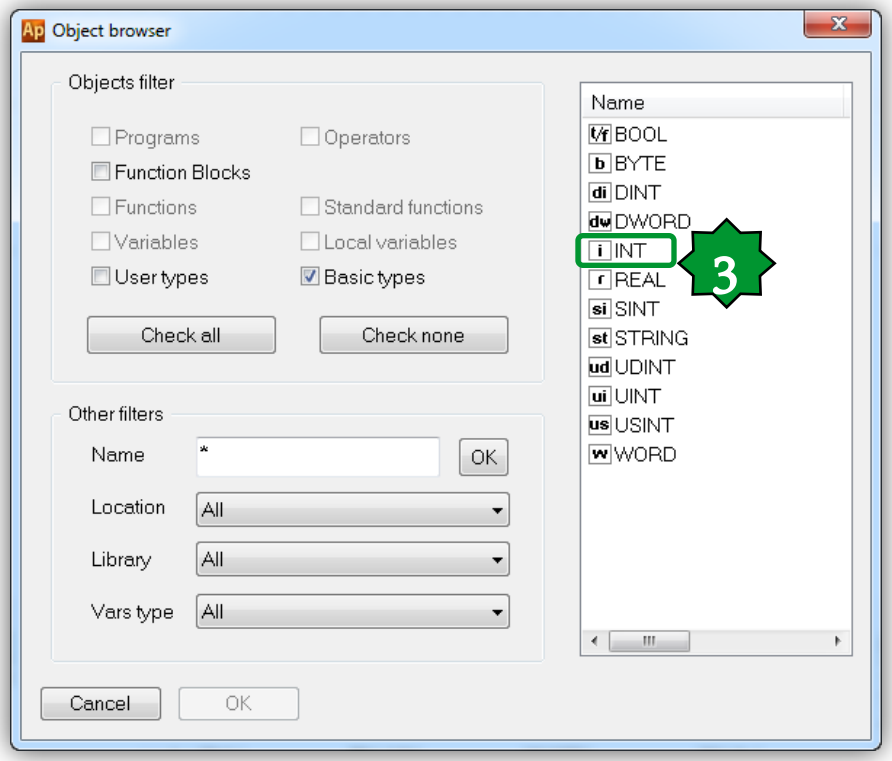
Assigning local variable to the FBD



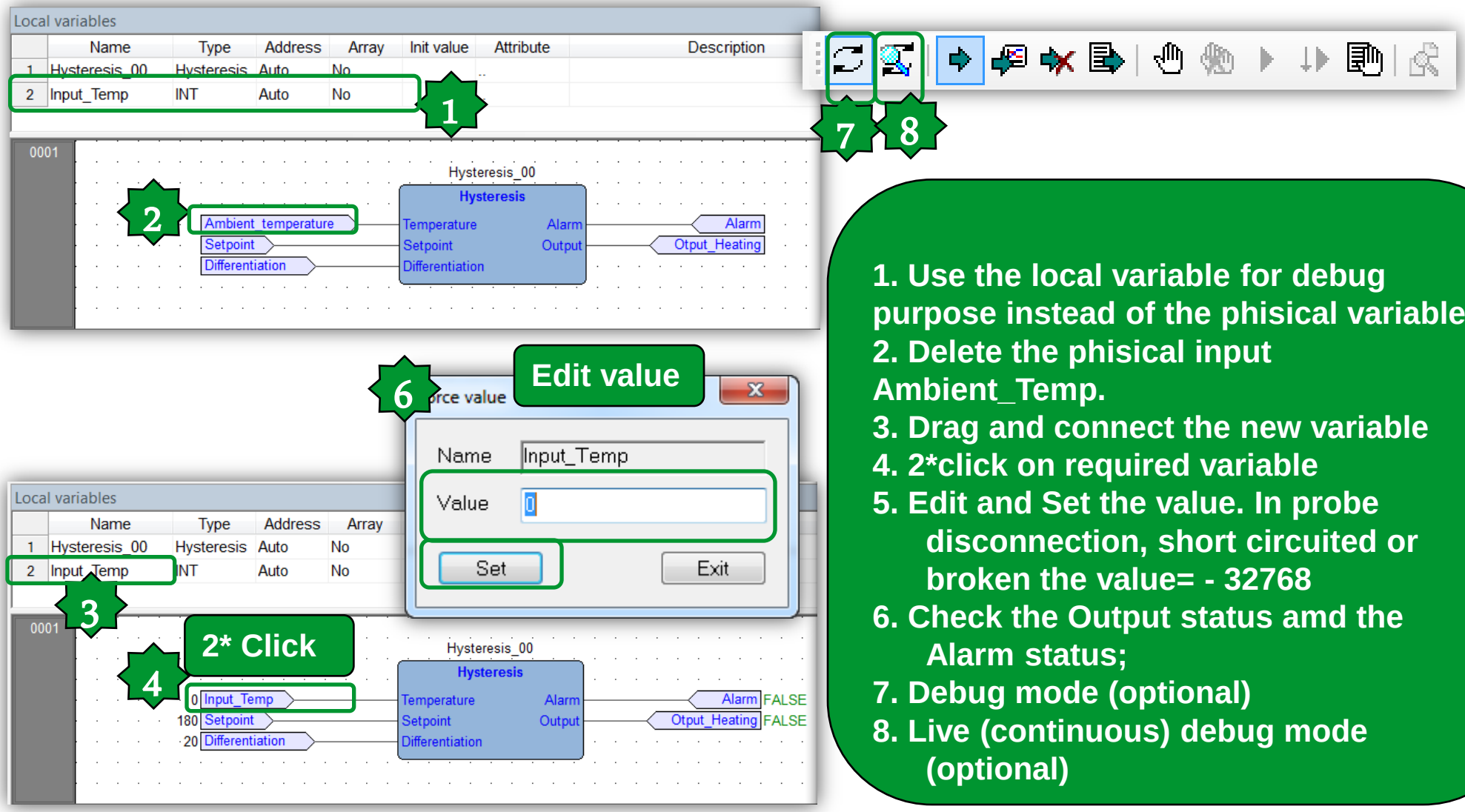
	Name	Type	Address	Array	Init value	Attribute	Description
1	Hystersis_00	Hysteresis	Auto	No		..	
2	Input_Temp	INT	Auto	No		..	

2 3

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



Debug mode/Changing values



1. Use the local variable for debug purpose instead of the phisical variable
2. Delete the phisical input Ambient_Temp.
3. Drag and connect the new variable
4. 2*click on required variable
5. Edit and Set the value. In probe disconnection, short circuited or broken the value= - 32768
6. Check the Output status amd the Alarm status;
7. Debug mode (optional)
8. Live (continuous) debug mode (optional)

Watch configuration

Local variables

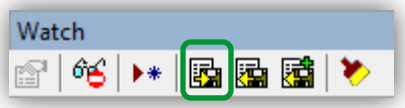
	Name	Type	Address	Array	Init value	Attribute
1	Hysteresis_00	Hysteresis	Auto	No		..
2	Input_Temp	INT	Auto	No		..

Watch list is independant from live debug mode

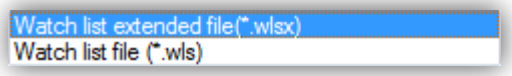
Drag & Drop

Watch

Symbol	Value	Type	Location
HYSTERESIS_00	-	H...	@BACKGROUND...
TEMPERATURE	250	INT	@BACKGROUND...
SETPOINT	180	INT	@BACKGROUND...
DIFFERENTIATION	20	INT	@BACKGROUND...
ALARM	FALSE	BOOL	@BACKGROUND...
OUTPUT	TRUE	BOOL	@BACKGROUND...

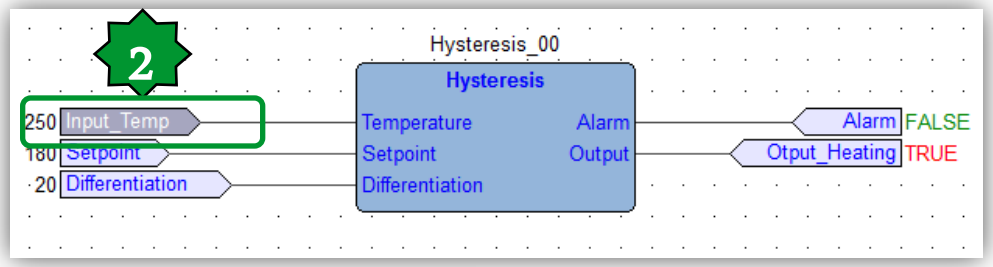


Save watch list

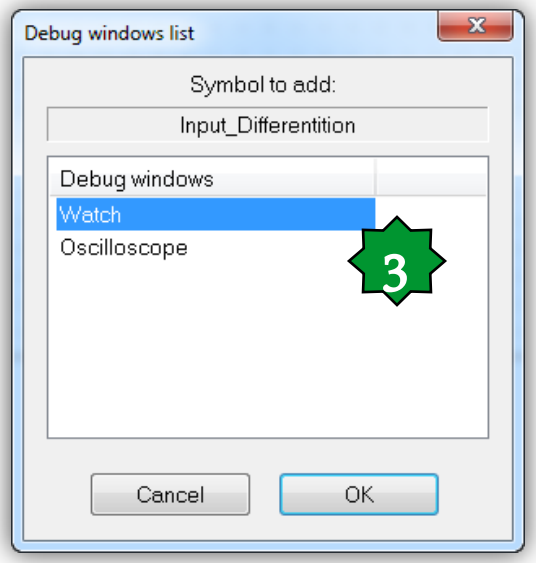


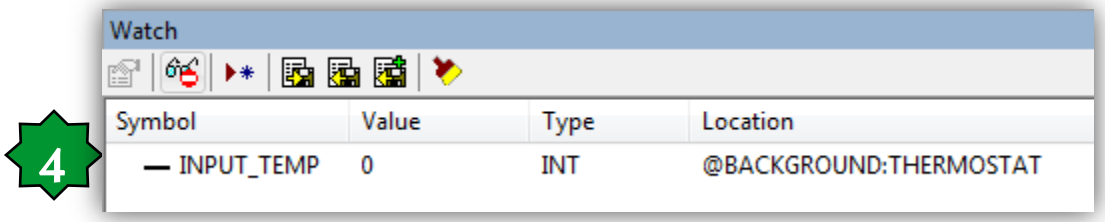
Watch list formats

Watch/ drag & drop



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





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 2

1. Select the variale
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;                    120  *
0010
0011  if Temperature = -32768 then
0012      Alarm := TRUE;
0013      else Alarm := FALSE;
0014  end_if;
0015
```

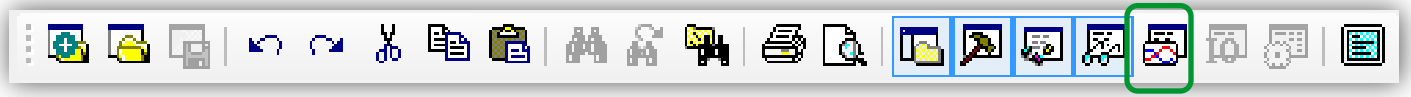
Watch

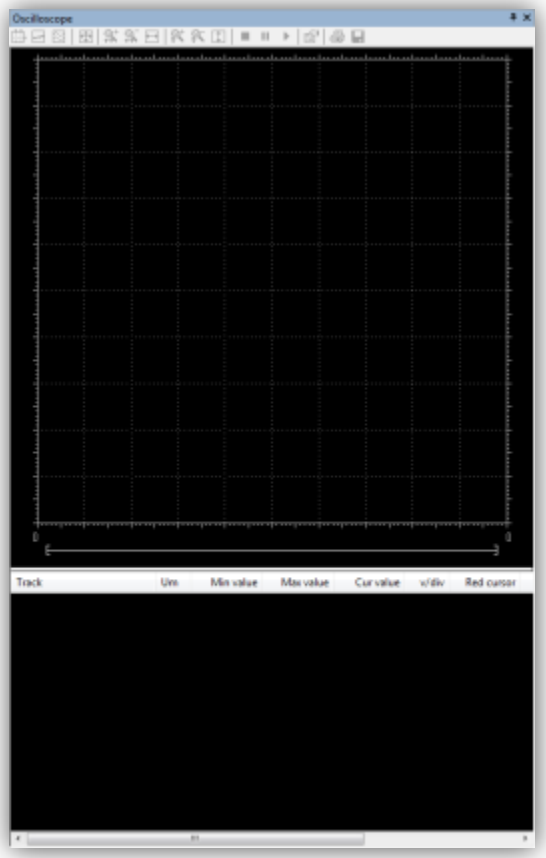
Symbol	Value	Type	Location
HYSTERESIS_00.TEMPERATURE	0	INT	@BACKGROUND:THERMOSTAT

3

Oscilloscope

View ►Tool windows ► Async graphic windows ► 





Assigning variable to the oscilloscope

Local variables — Thermostat

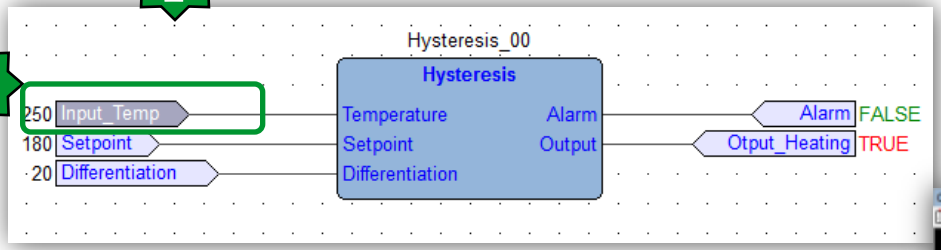
	Name	Type	Address	Array	Init value	Attribute	Description
1	Hystersis_00	Hysteresis	Auto	No		..	
2	Input_Temp	INT	Auto	No		..	
3	Input_Setpoint	INT	Auto	No		..	
4	Input_Differentition	INT	Auto	No		..	

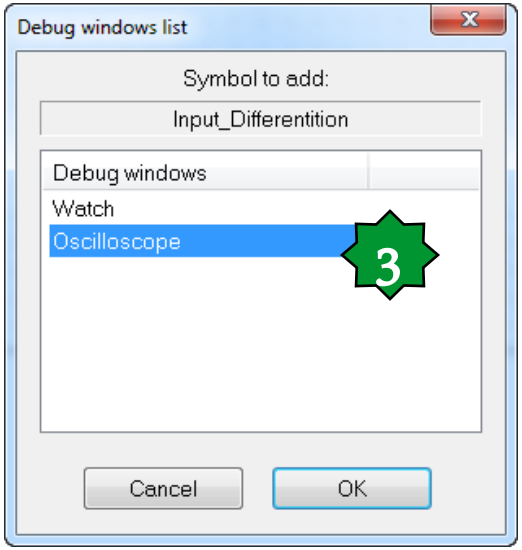
Drag & Drop

Up to 8 channels could be traced simultaneously

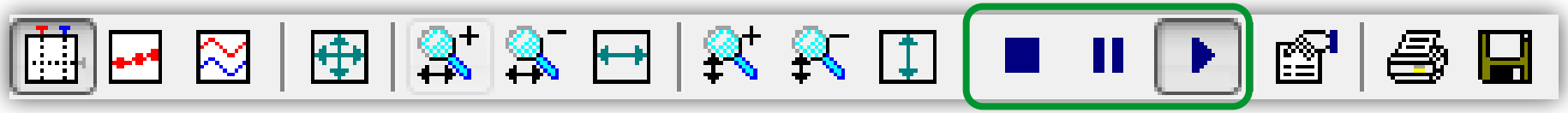
Assigning variable to the oscilloscope

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.

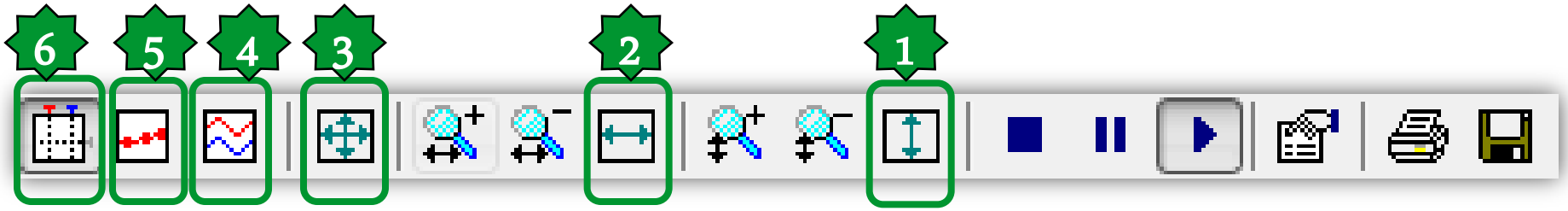
However, you can suspend the acquisition by clicking on **Pause acquisition.**

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. Horizental show all

3. Show all values

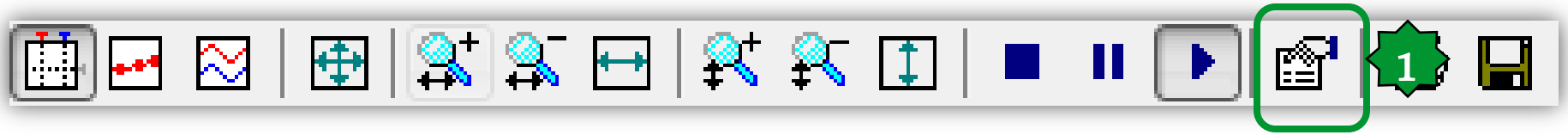
4. When you are watching the evolution of two or more variables, you may want to split the respective tracks.

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.

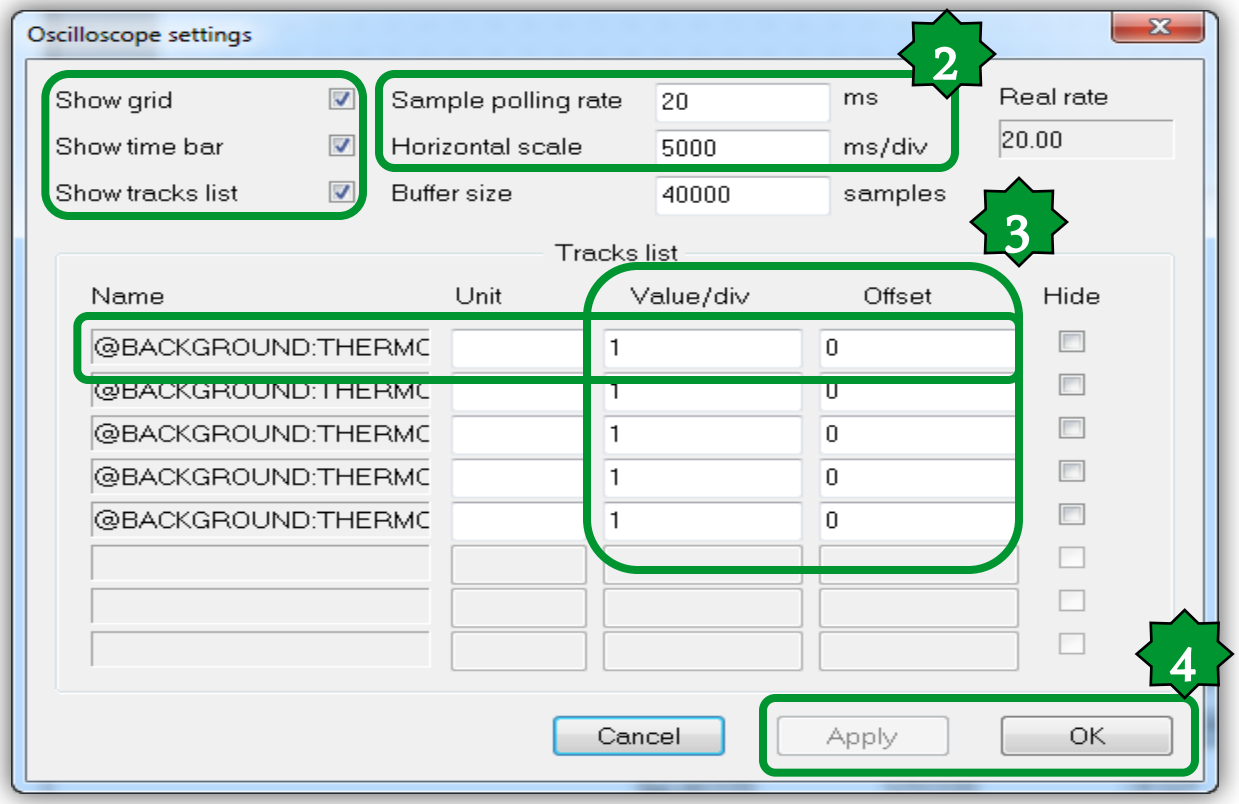
6. The Oscilloscope includes two measure bars, which can be exploited to take some measures on the chart.

Oscilloscope tools/ Setting the scale of the axes

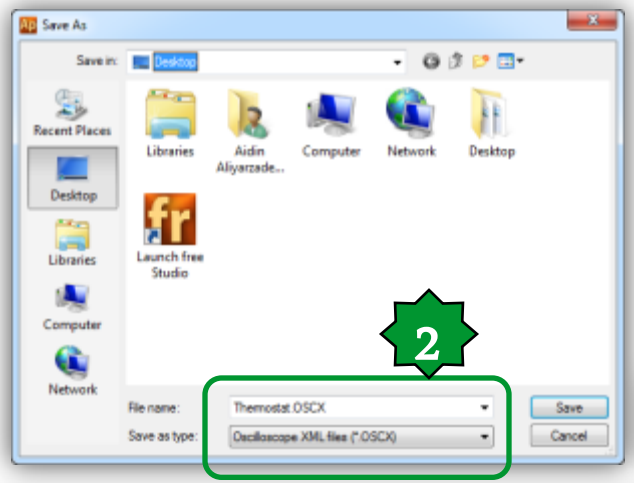


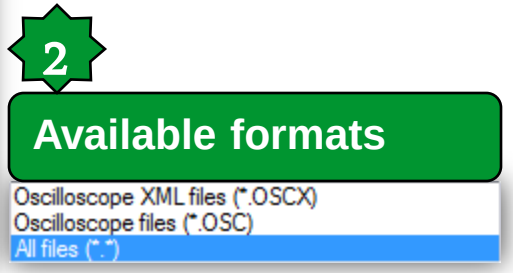
When you open the Oscilloscope, Application applies a default scale to the axes. However, if you want to set a different scale, you may follow this procedure:

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





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

3

Chapter 5

Simulation and Debugging – Part 2

Goal:

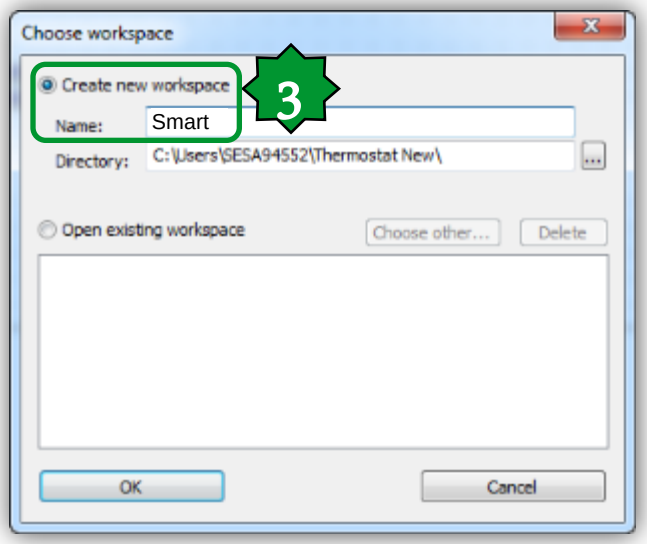
On-Line simulation mode, testing of:

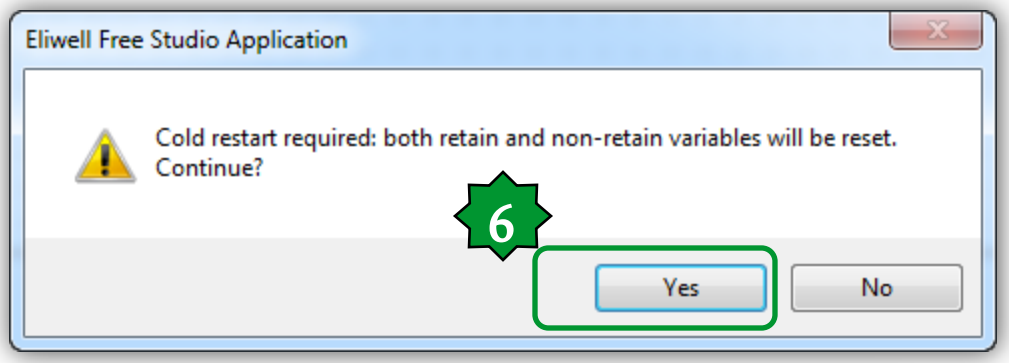
- Physical I/O
- 7 segment display

Off line simulation mode

1 2

Debug ► Simulation mode ►





7 8

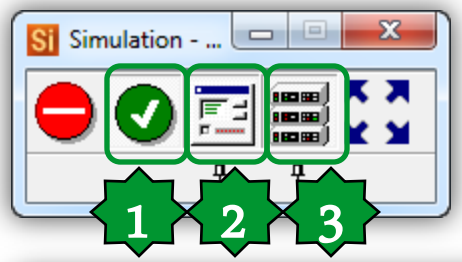
4

5

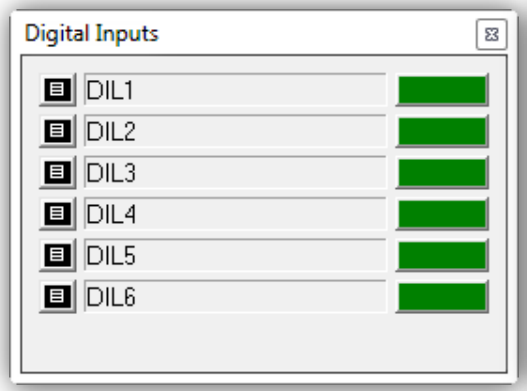
5

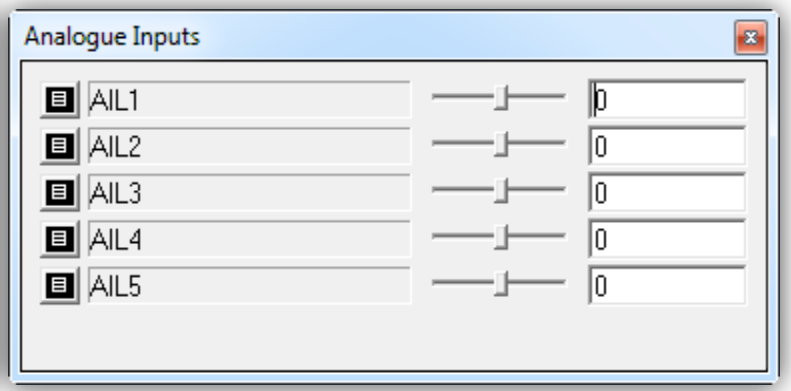
1. Debug
2. Simulation mode
3. Name it ► OK
4. If differs or no code
5. Download code, OK
6. Reset Variables
7. Debug mode (optional)
8. Live debug (Continuous) mode (optional)

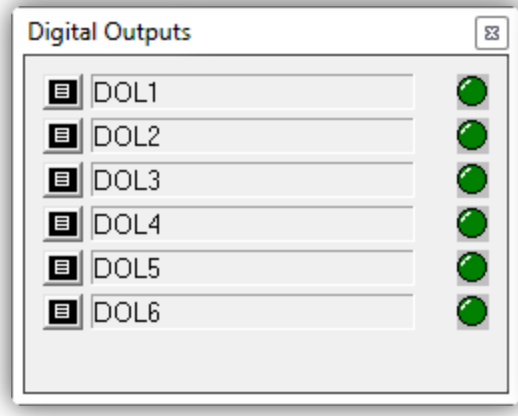
Simulation tools

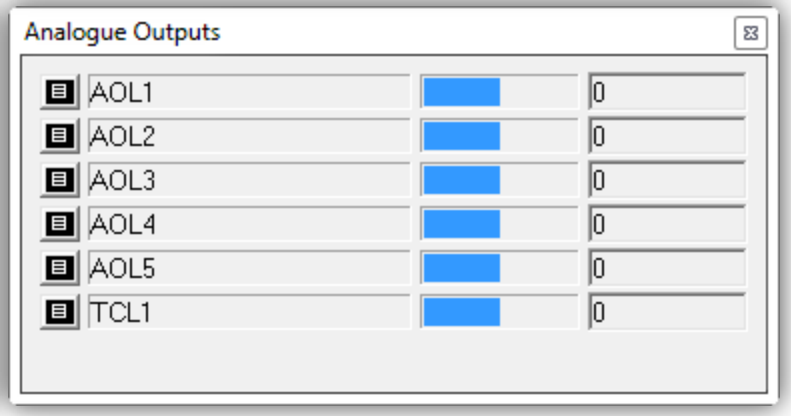


1. Active code execution
2. Show I/O panels
3. Show HMI window

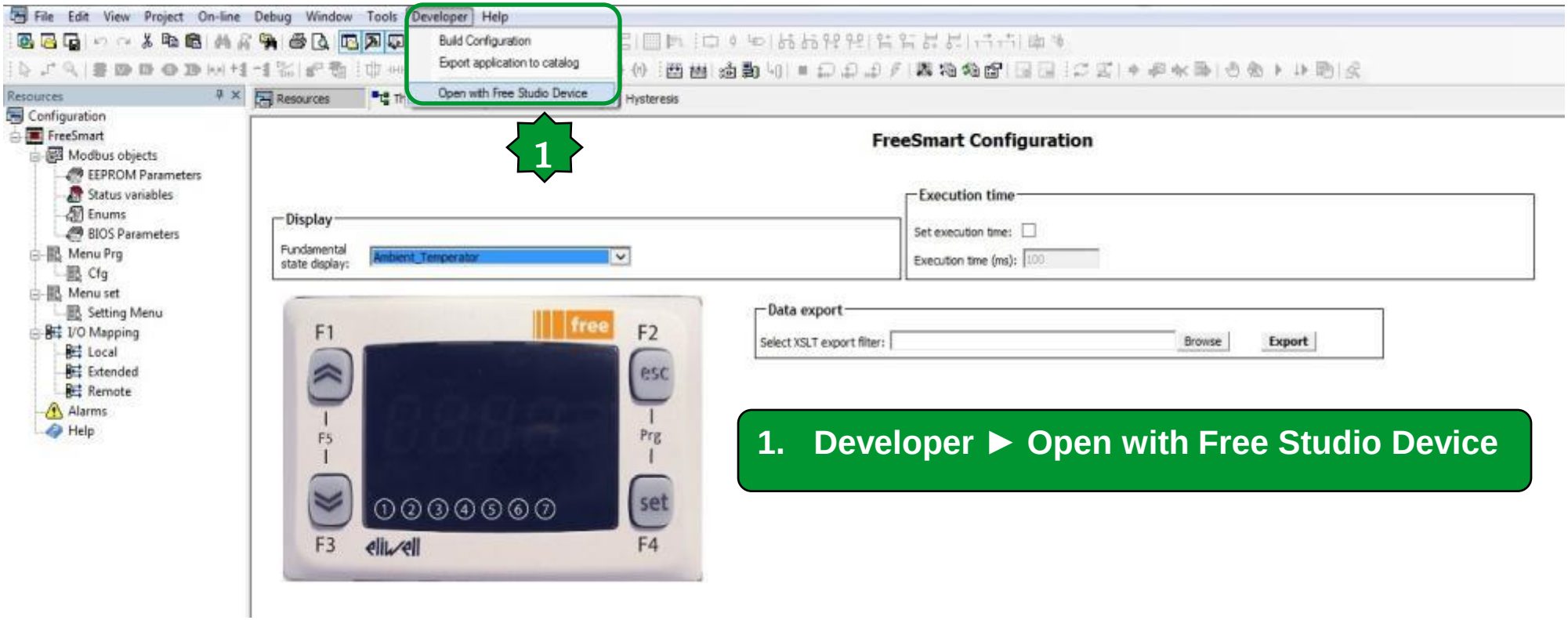






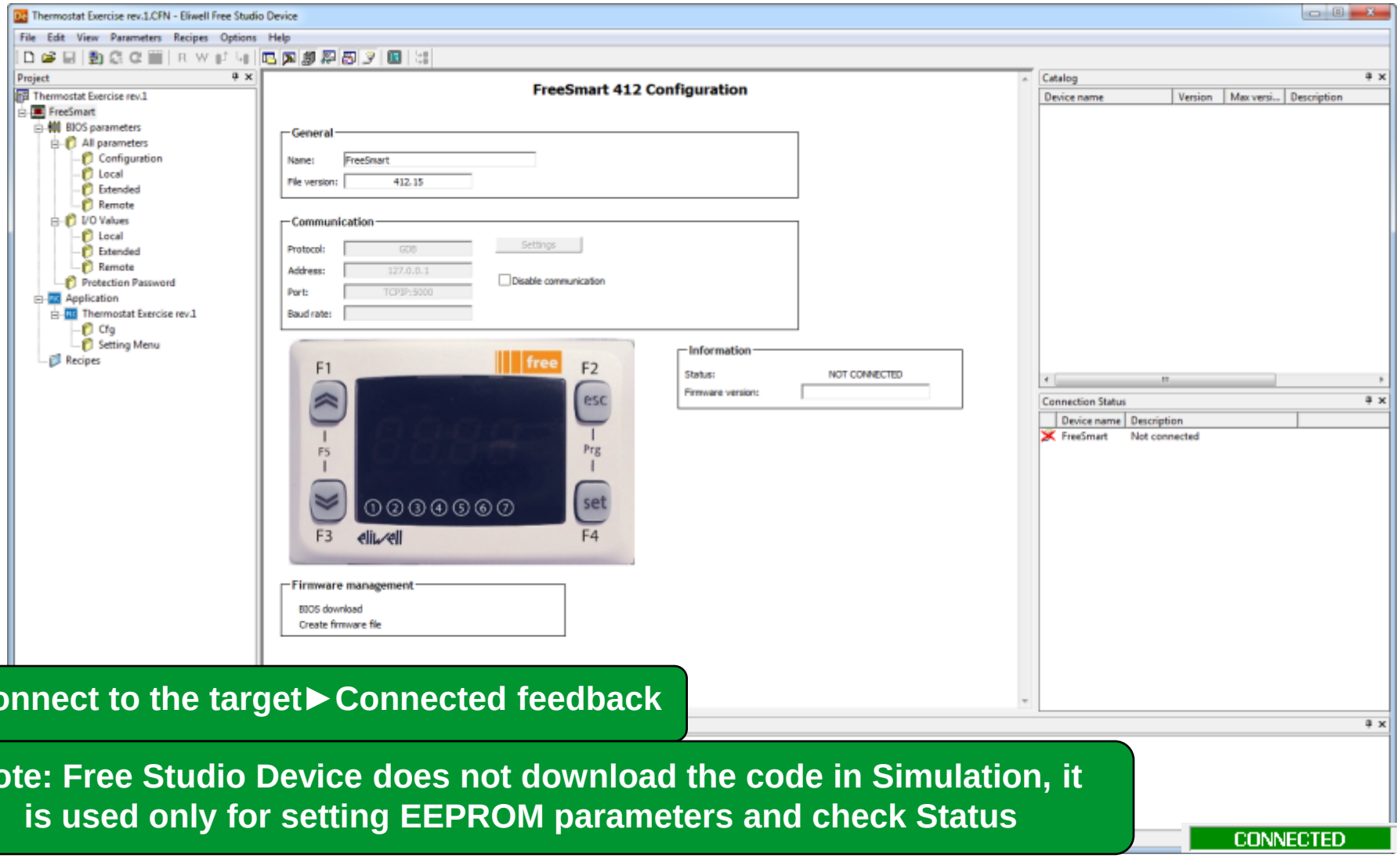


Open Free Studio Device from Application



1. Developer ► Open with Free Studio Device

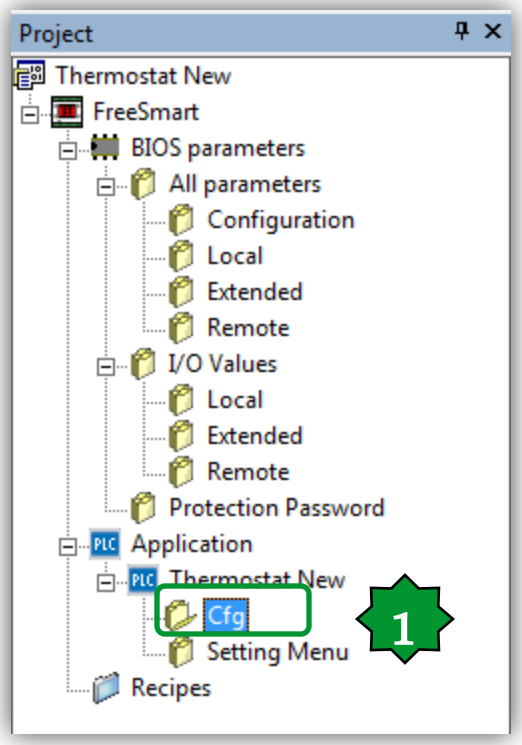
Free Studio Device (Simulation Target)

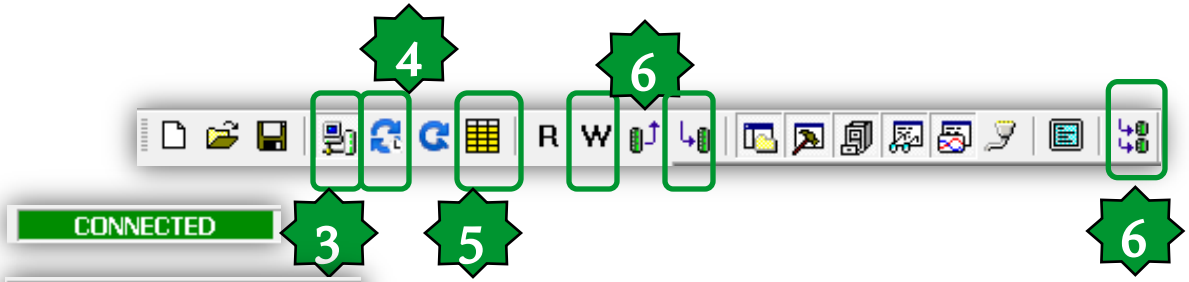


Connect to the target►Connected feedback

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





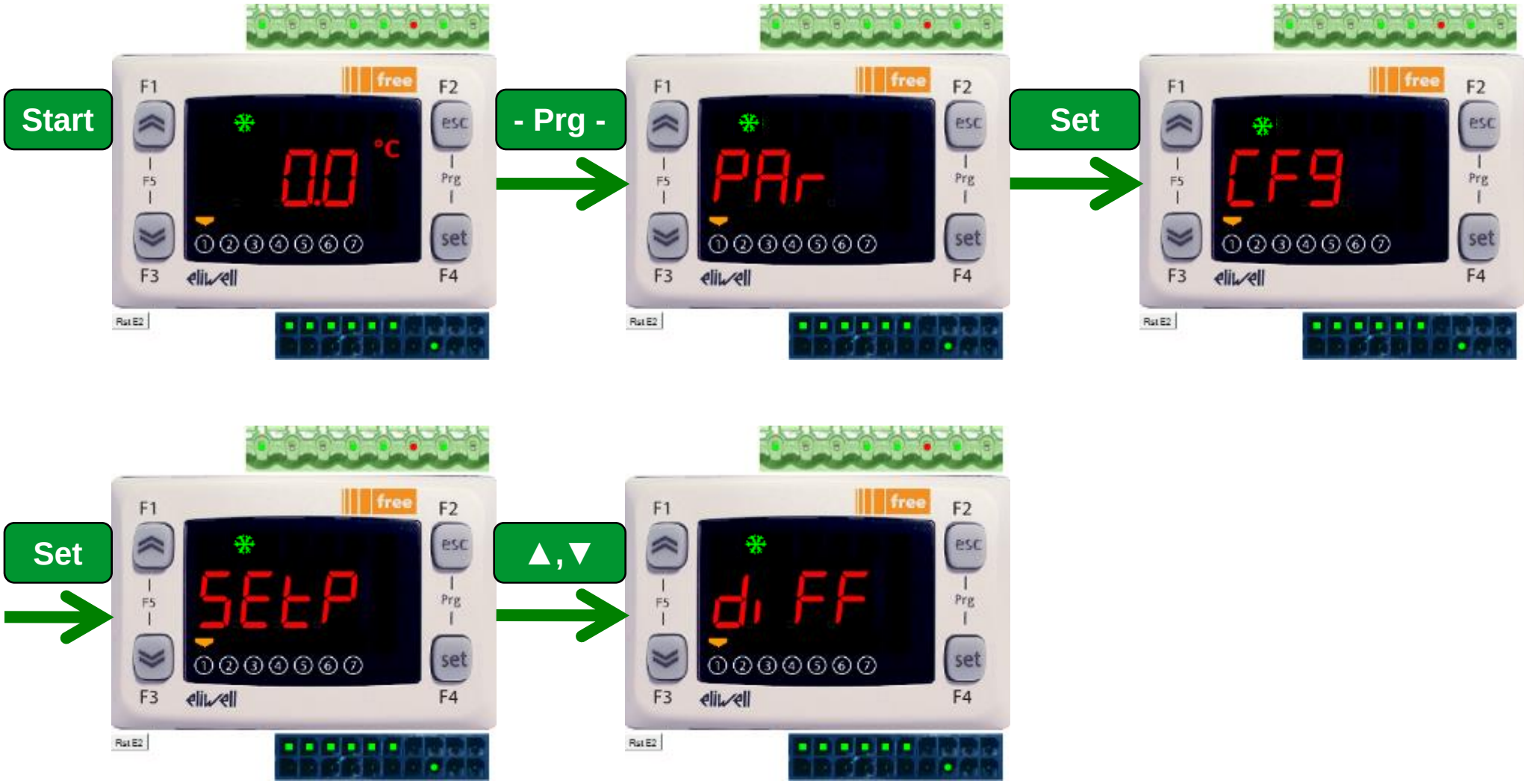
1. Connect to the target►Connected feedback
2. Application►Project►Cfg
3. Cfg menu►non aligned value with target (Red)
4. Auto refresh mode (optional)
5. Select all parameters (or selective)
6. Write parameter (all or selective)+ download all
7. Aligned values with the target (black)

7

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 disply:
- 99.9.....999.9

Free Studio Device does not write default values

Testing program/applying values

- **Setpoint=26.0, Differentiation=10.0 & Ambient_Tempereature =37.0**

⇒ DOL1= ON & ☼ = ON

- **Setpoint=26.0, Differentiation=10.0 & Ambient_Tempereature =25.0**

⇒ DOL1= OFF & ☼ = OFF

- **Setpoint=26.0, Differentiation=10.0 & 26.0<Ambient_Tempereature<36.0**

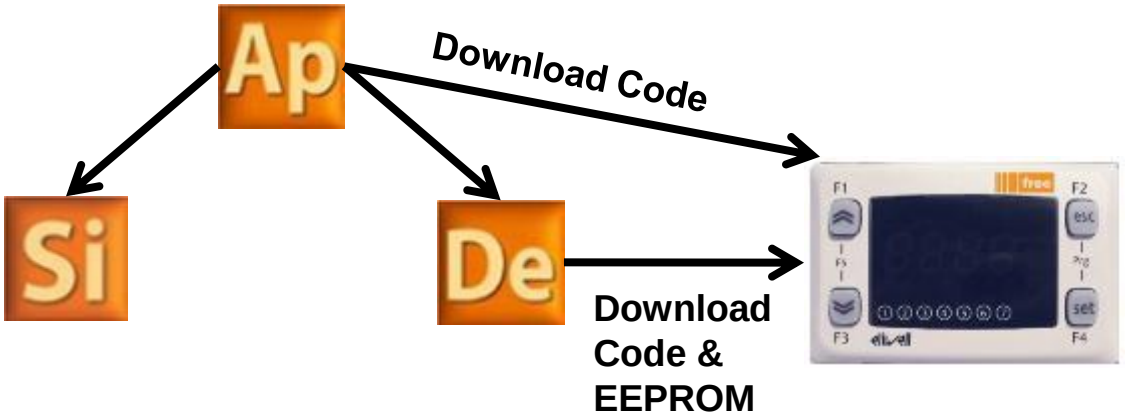
⇒ DOL1= ON & ☼ = ON

- **Ambient_Tempereature =-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

Connection to Smart

Goal:

DMI interface driver installation and connect to the target

Schneider Electric

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:

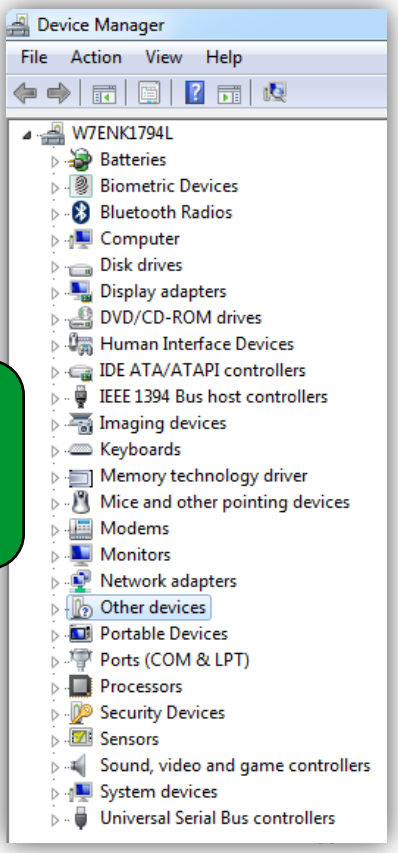
Click on the message to start the Guided installation procedure

Or you can manualy find it at:

Control Panel ▸ All Control Panel Items ▸ System

Device manager ► other devices ►

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



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**

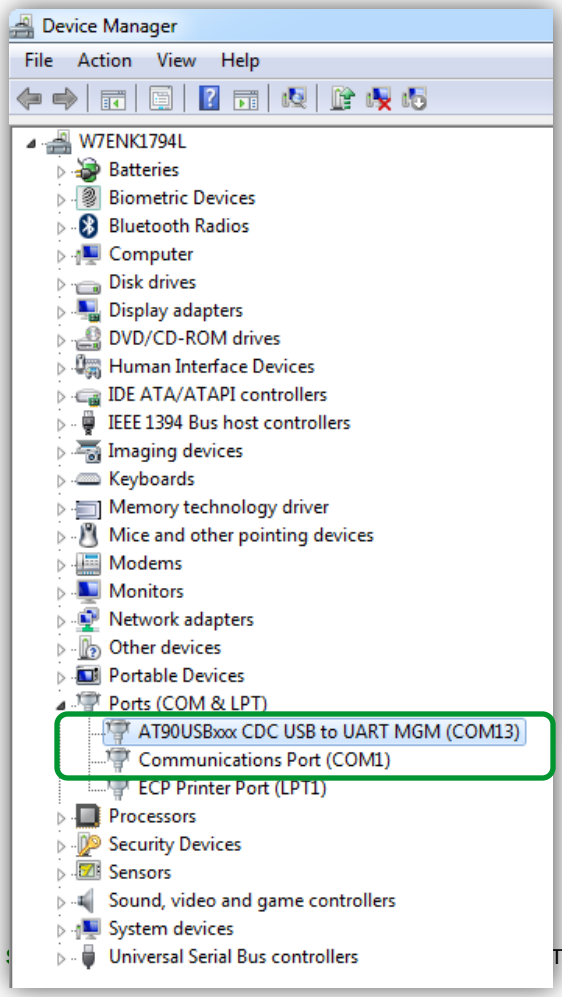
Update driver software

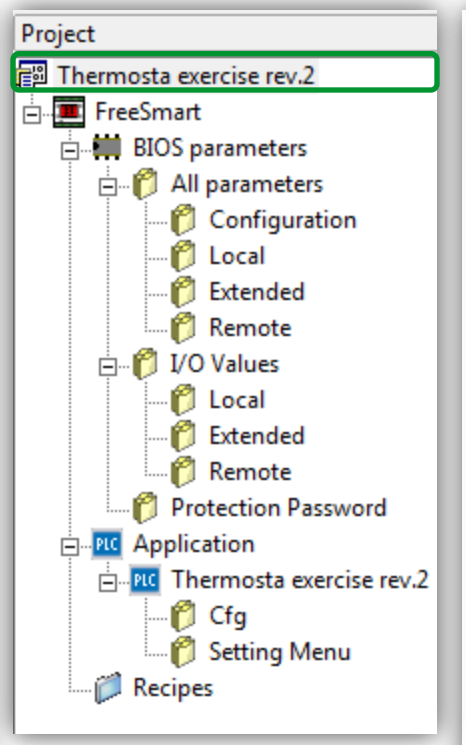
5. The screen shown below will appear, indicating that the action has been performed.

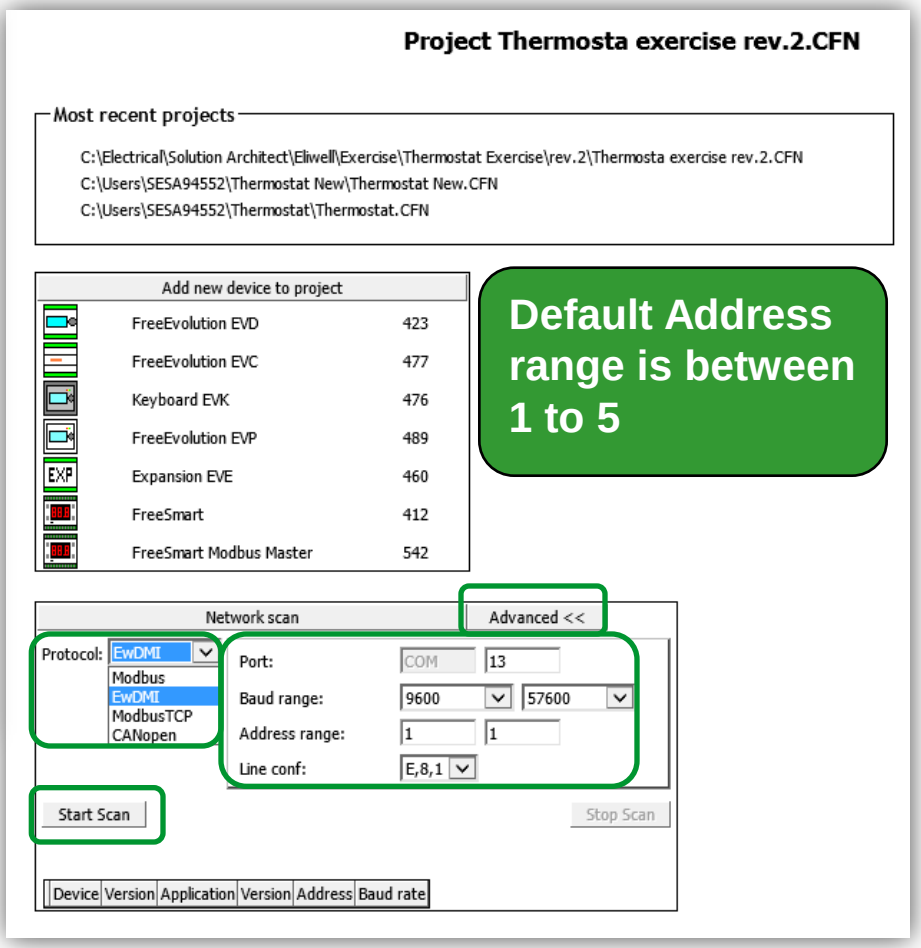
6. On completion of the process, the screen shown below will appear, then close.

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:





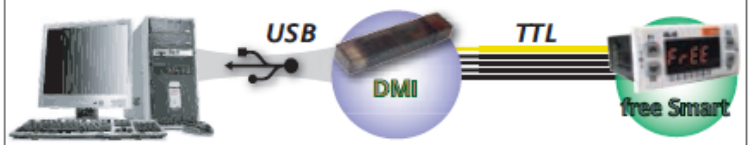


Connection to Smart

To download the IEC applications of **Studio from the personal computer to the Smart target device,**

Direct

PC → **← Smart**



Use yellow TTL cable for DMI - target connection

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

Note: in “Direct”, **Smart must not be connected to earth**

- it can switch on Smart without external power supply

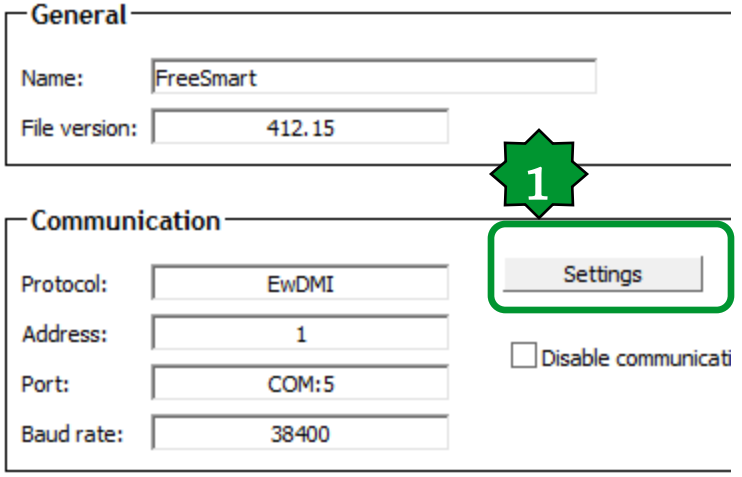
Connection to Smart

Smart

Preliminary operations

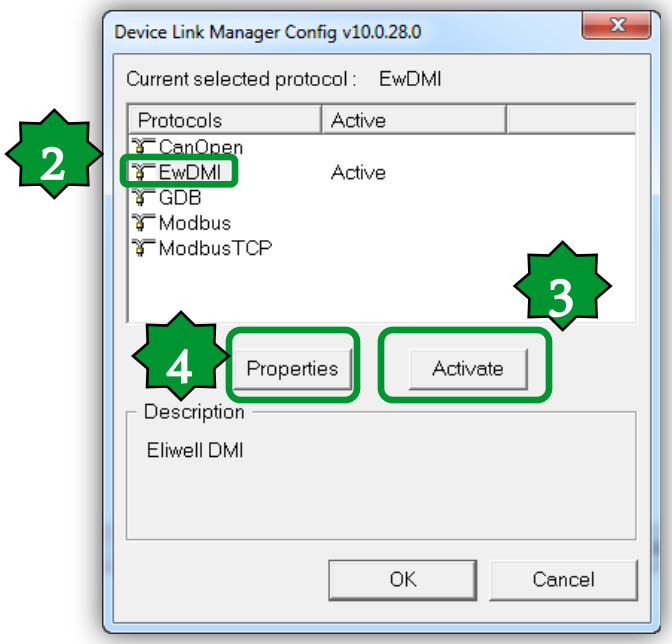
In order to download the application correctly:

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



Press **Settings**

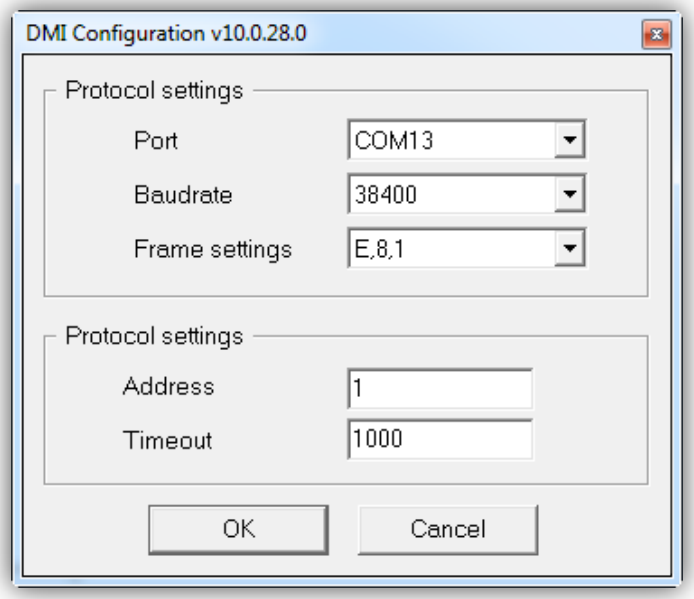
The COM port must previously have been read/set in “Peripherals Management” (see Reading the DMI interface COM port) to be recognized. If there are errors, refer to the paragraph “**DMI interface connection error”.**



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

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)

Connect to the target

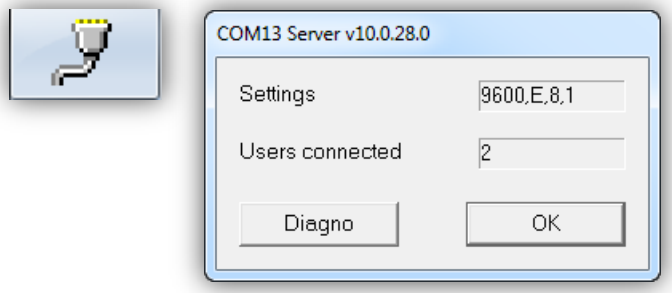
DMI interface connection error

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)

1

2

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

3

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

4

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

5

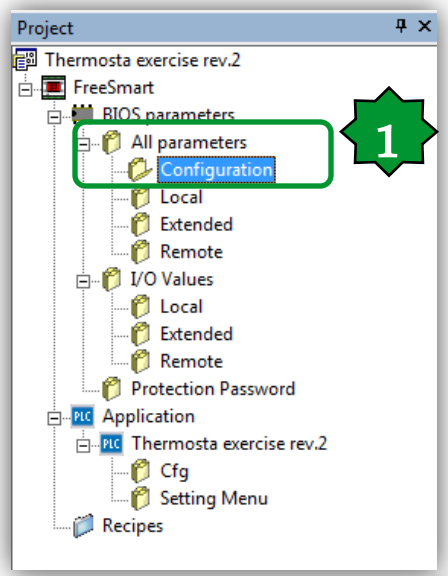
The first parameter shown is CF30. To view the value of the parameter press the set key.

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

6

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 estabilished:

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

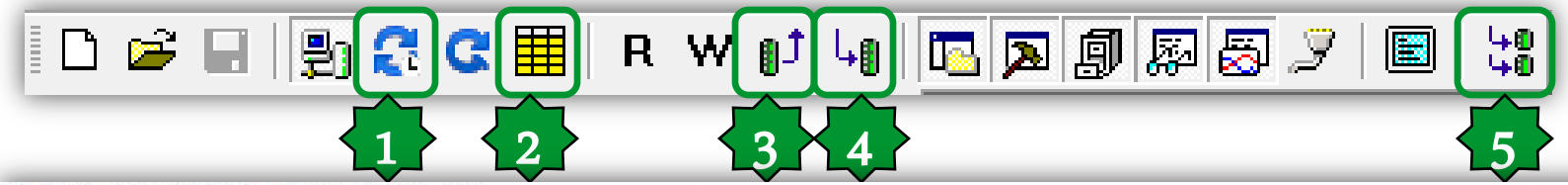
Protocol parameters are loaded at power up, remember to switch off controller after changing them.

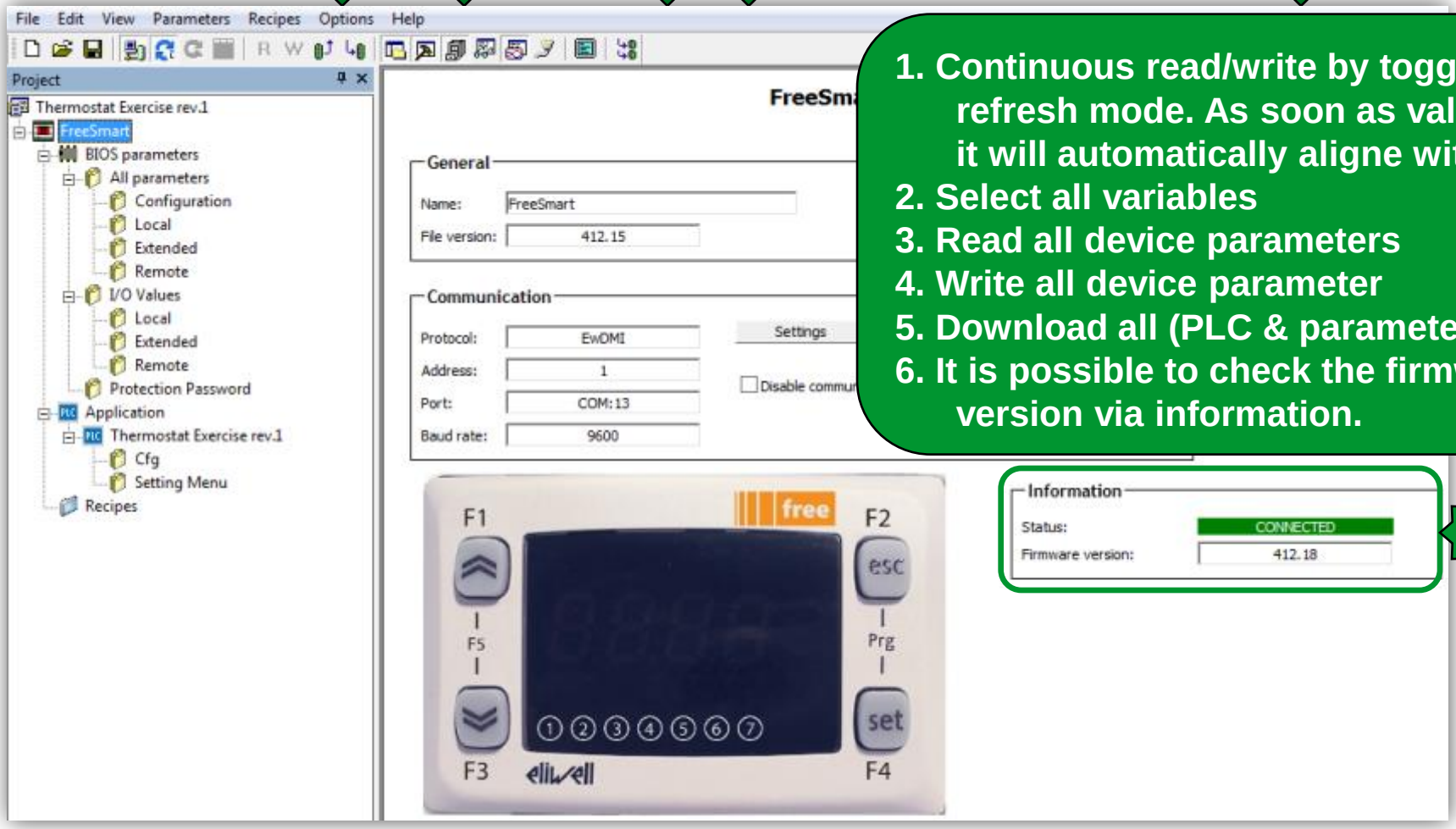
Configuration

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	num	1=Even	1	3	Modbus parity protocol
15639	CF60	2=4800	num	0	0	999	Customer code 1
15640	CF61	3=9600	num	0	0	999	Customer code 2
53456	CF50	4=19200	num	1=Present	0	1	RTC present
15715	Ui26	5=38400	4ms	350	0	999	Key hold time to enable function
15744	Ui27	6=57600	num	1	0	255	Installation engineer password
15745	Ui28	7=115200	num	2	0	255	Manufacturer password
15636	Par_POLI	1026	num	0	0	65535	Polycarbonate code

2

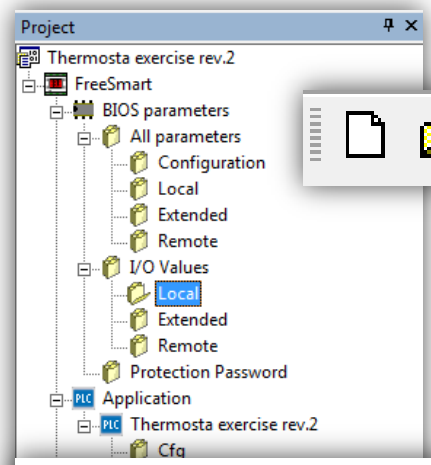
Free Studio Device - Main icons

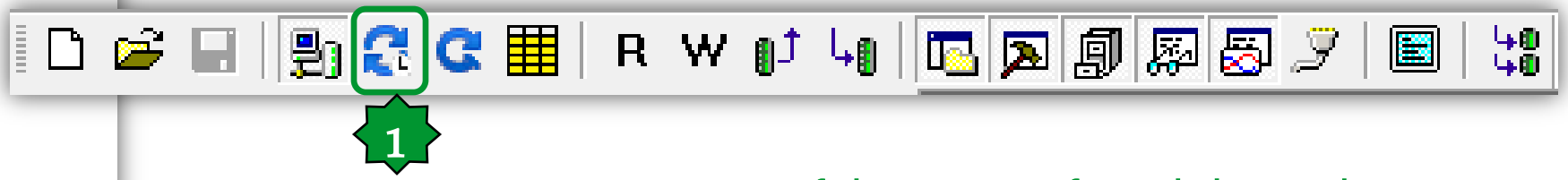




1. Continuous read/write by toggle auto refresh mode. As soon as value changes, it will automatically aligne with the target.
2. Select all variables
3. Read all device parameters
4. Write all device parameter
5. Download all (PLC & parameter)
6. It is possible to check the firmware version via information.

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 referesh is on the column value is continiously updated and values are written as soon as you change them.

Color meanings:

Red: not aligned with the target

Grey: read only data

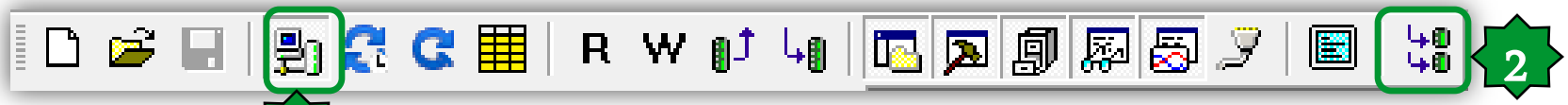
Blue: value is different from default

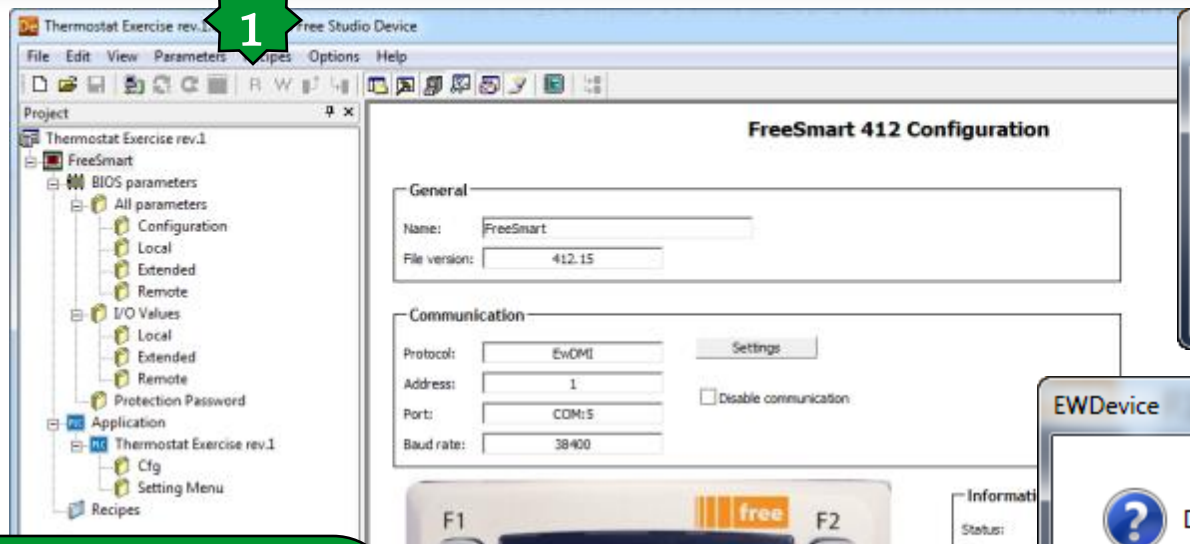
Green: data is not visible in the target

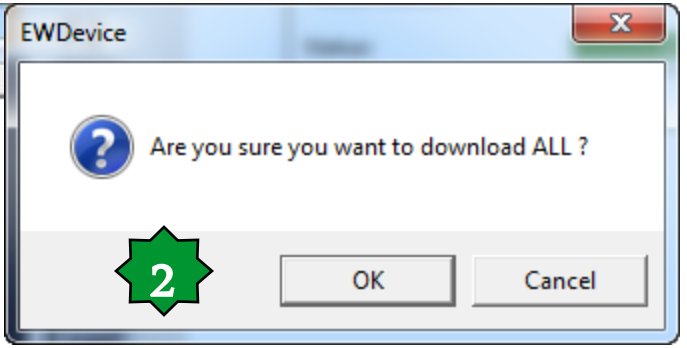
Black: aligned with the target

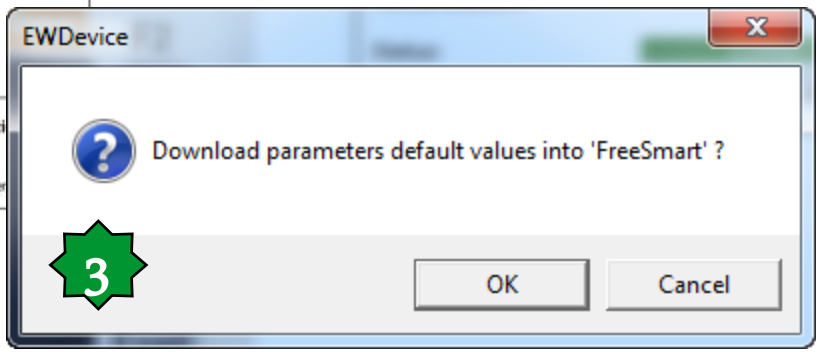
(if auto referesh is enabled) 1

Connect to the target and Download All

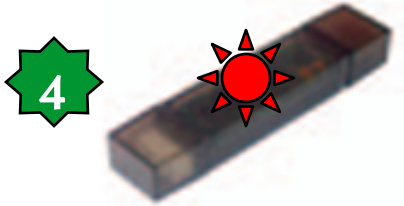








1. Connect
2. Download All
3. Write the default parameter values
4. DMI Blink: Communicating



Editing value

1

CONNECTED

2

Setting Menu

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			

2

Setting Menu

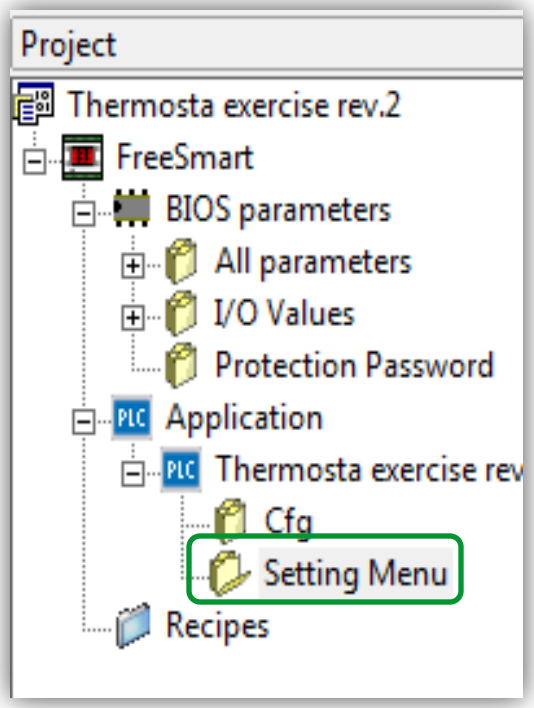
Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	23.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	22.9	°C			

3

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			

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

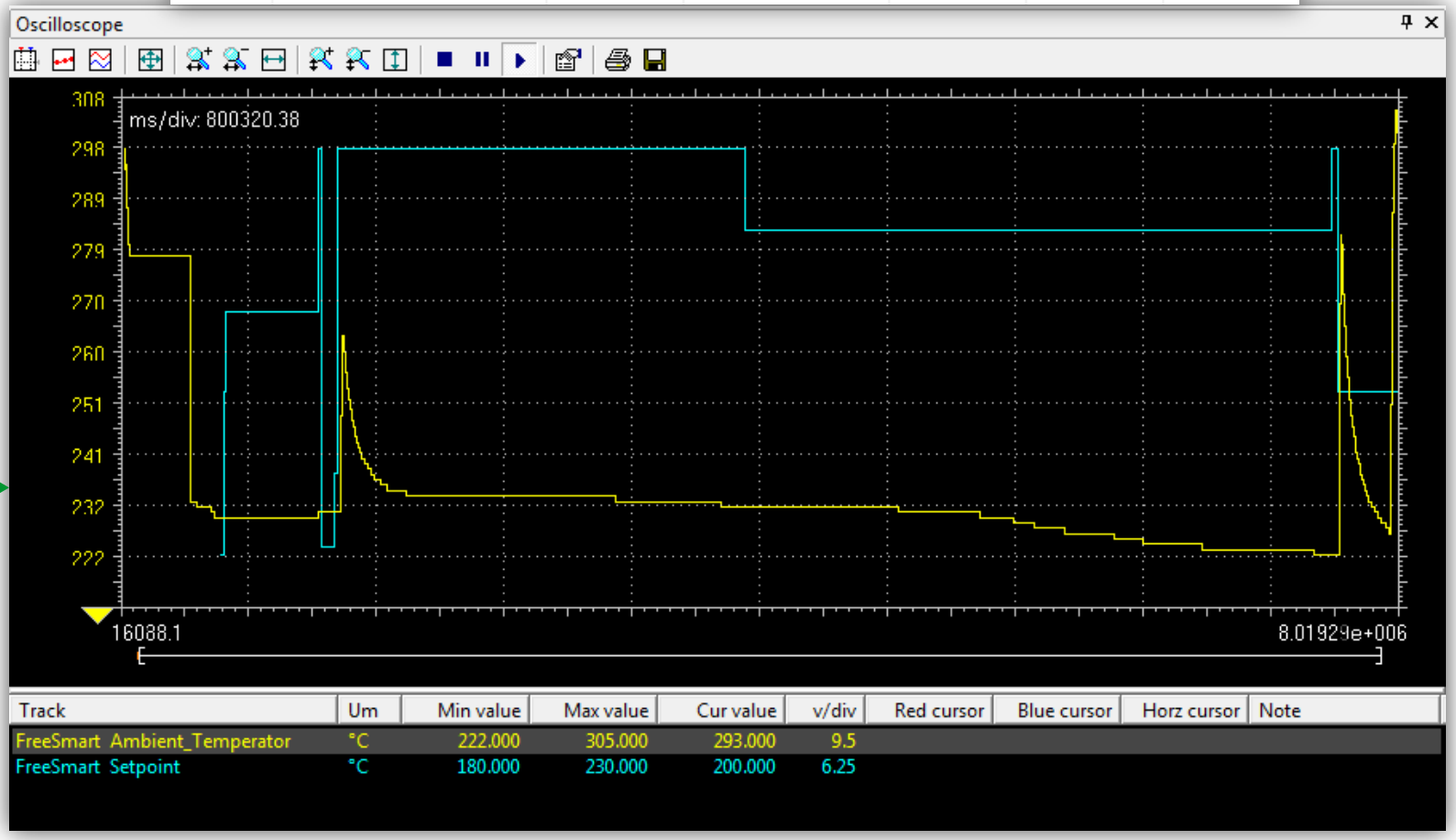


Oscilloscope

Drag & Drop

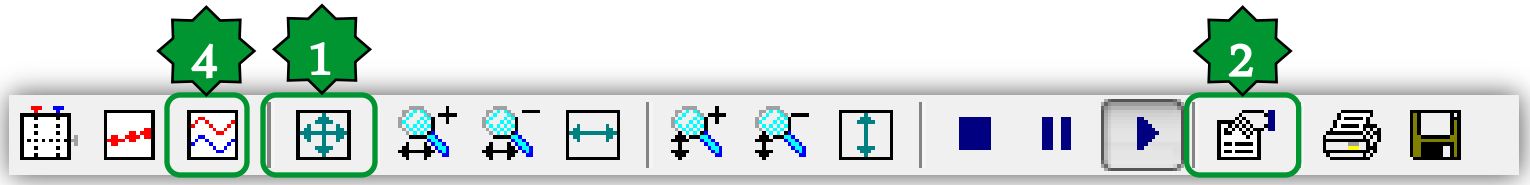
Setting Menu

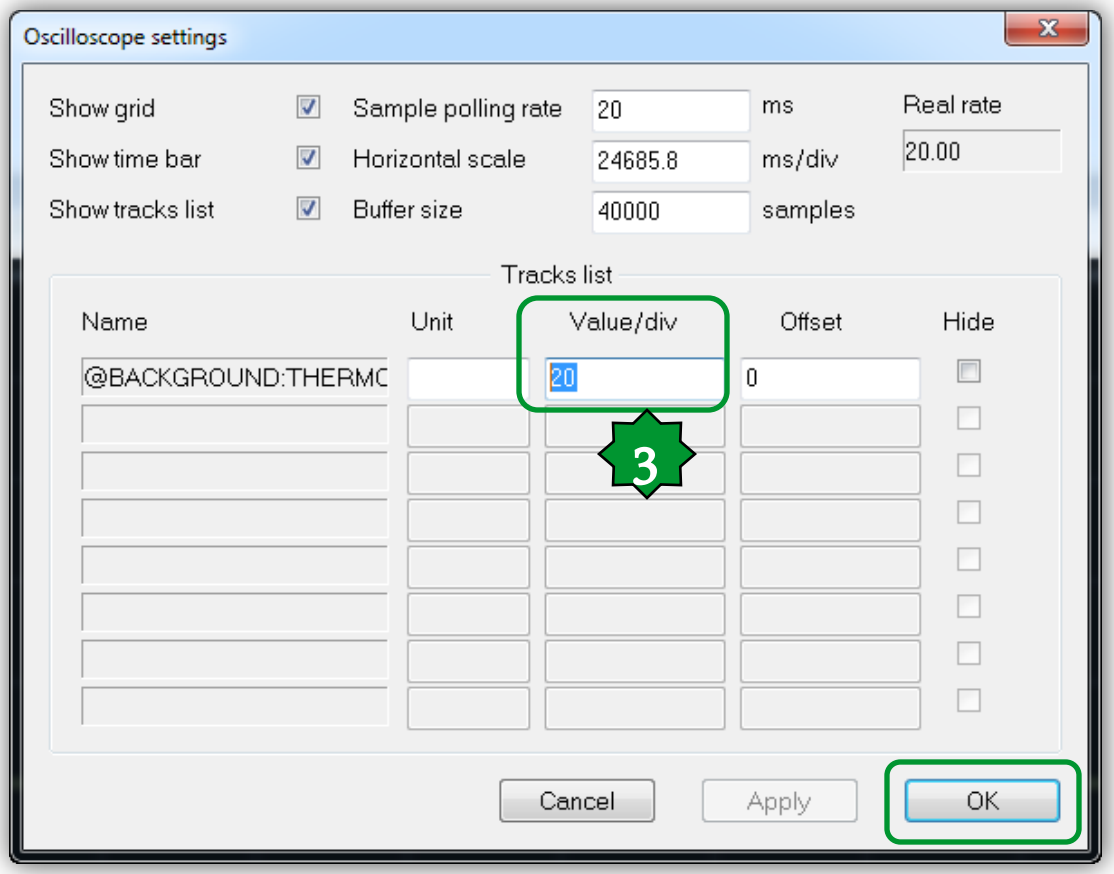
Address	Name	Value	Um	Default	Min	Max
16384	Setpoint	20.0	°C	18.0	15.0	30.0
16385	Differentiation	2.0	°C	2.0	0.5	5.0
8960	Ambient_Temperator	23.1	°C			



Track	Um	Min value	Max value	Cur value	v/div	Red cursor	Blue cursor	Horz cursor	Note
FreeSmart Ambient_Temperator	°C	222.000	305.000	293.000	9.5				
FreeSmart Setpoint	°C	180.000	230.000	200.000	6.25				

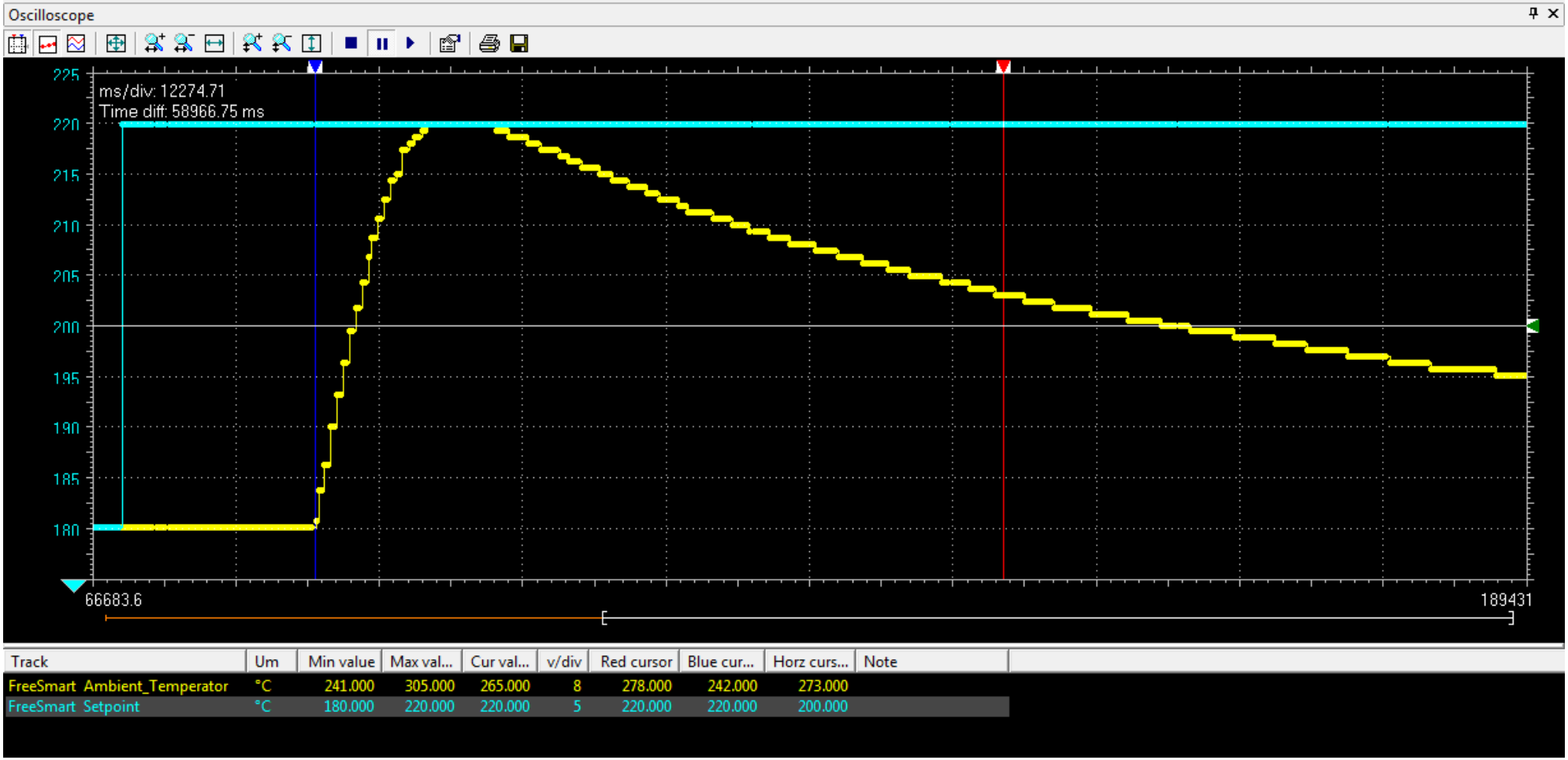
Oscilloscope



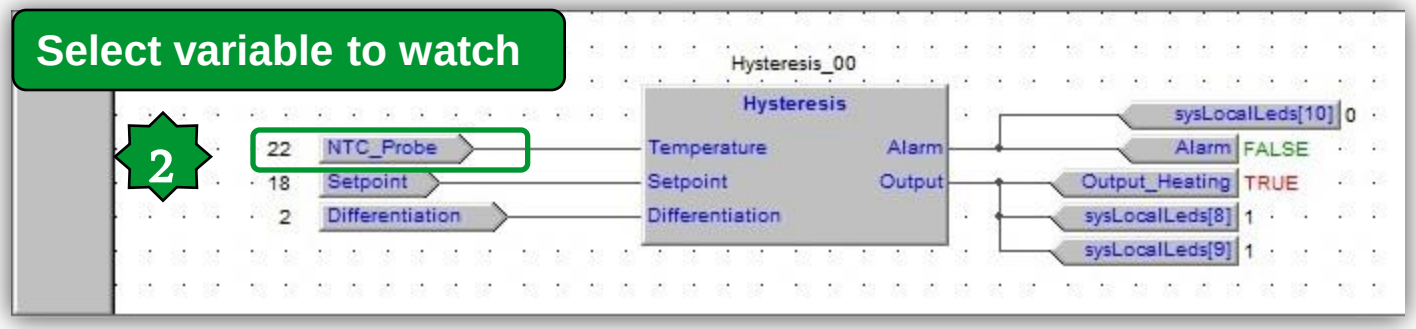


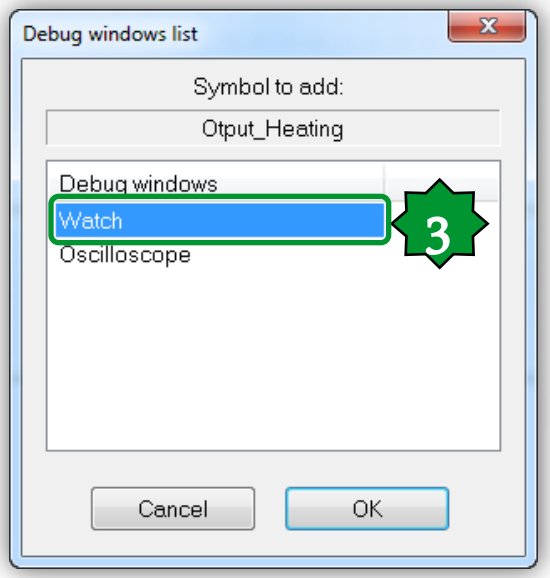
1. **Show all values**
2. **Graph properties**
3. **Value/div=20 ► OK**
4. **Vertical split**

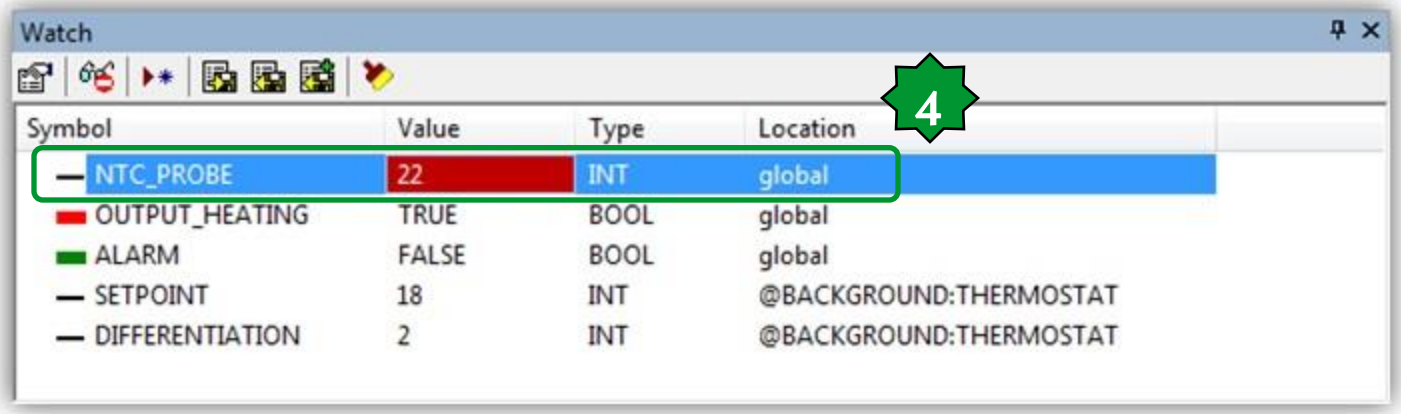
Oscilloscope



Debug on-line/Watch







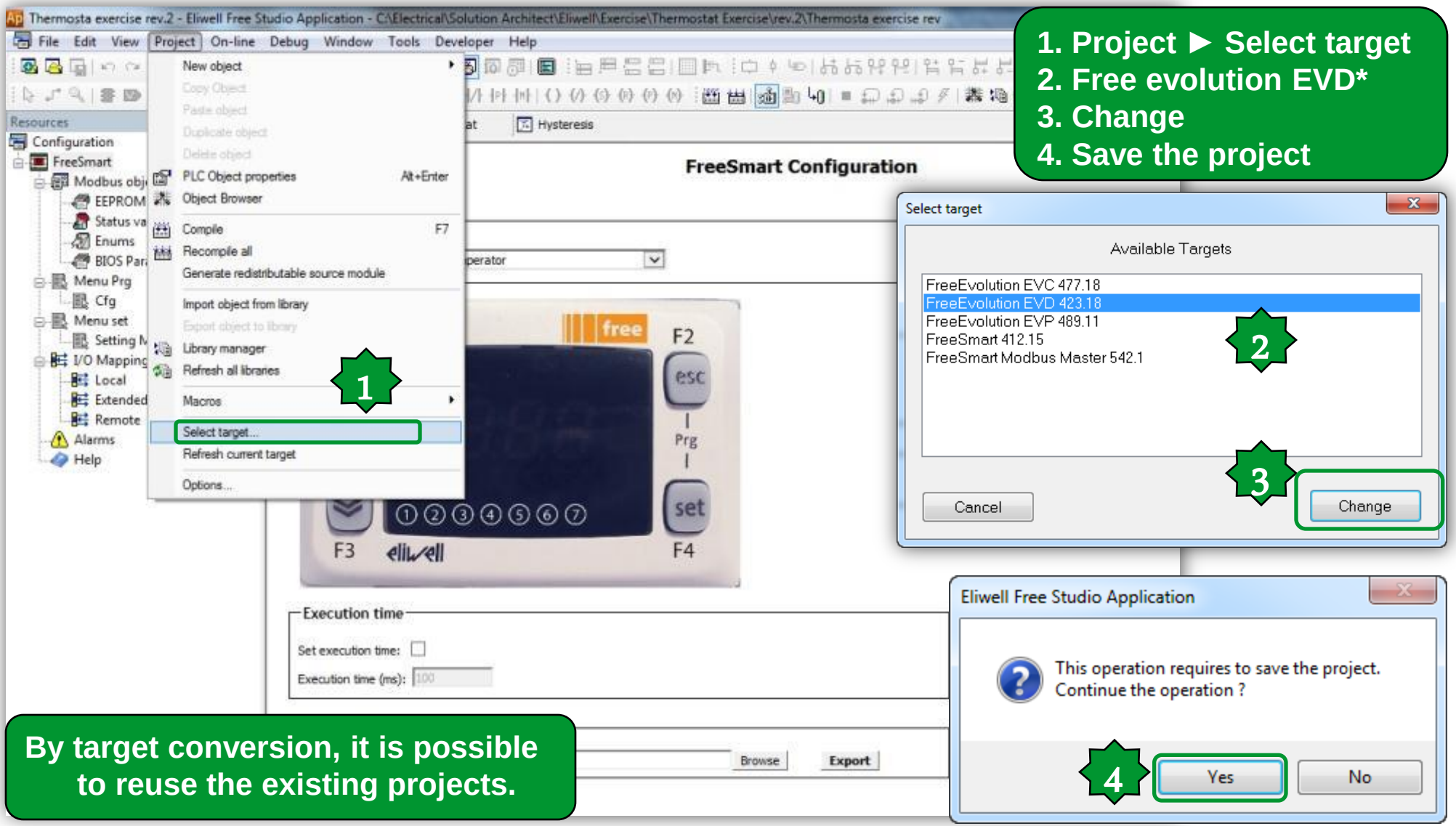
Chapter 7

Target conversion and code import

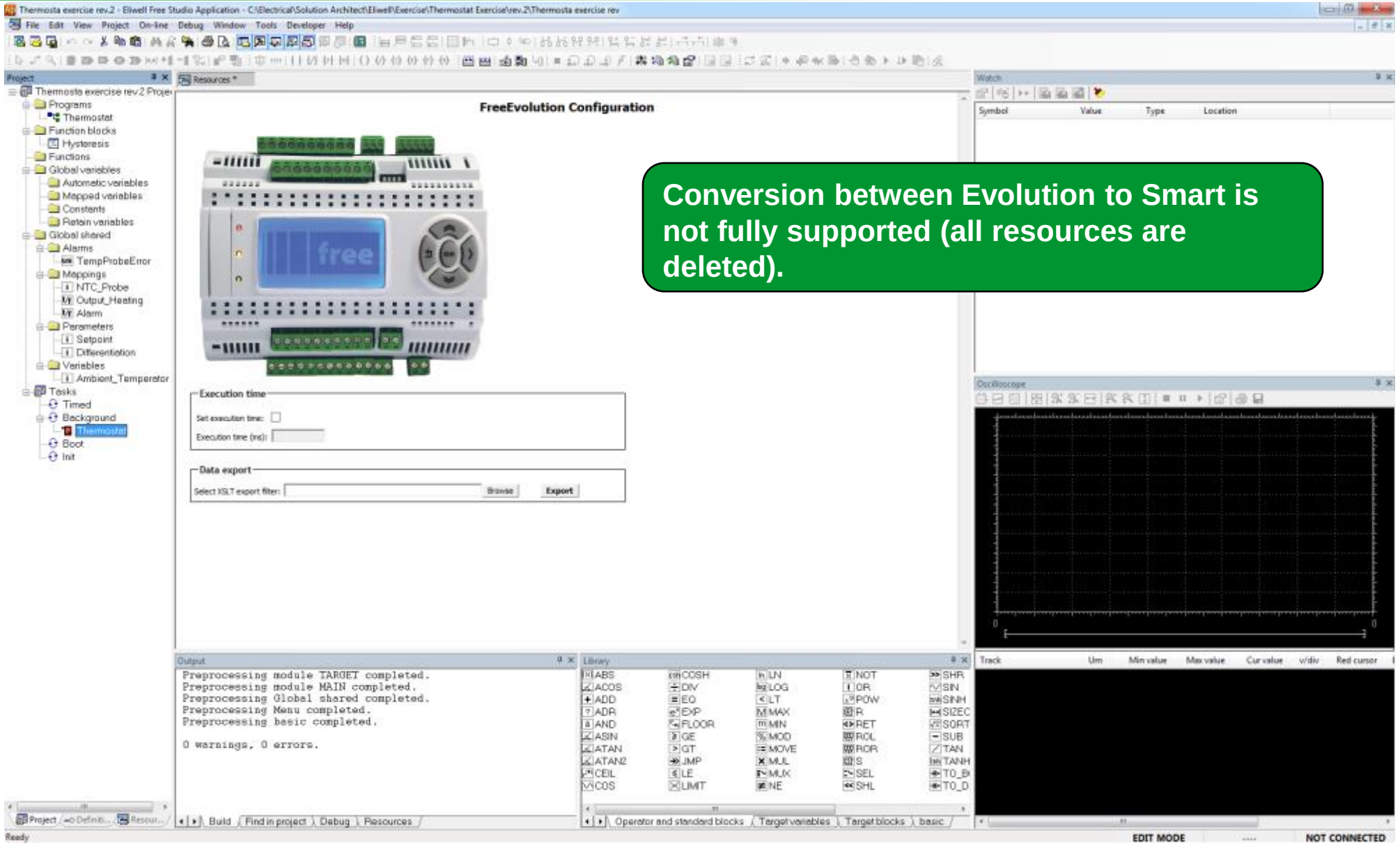
Goal:

Reuse of existing code and libraries

Convert project from Smart to Evolution

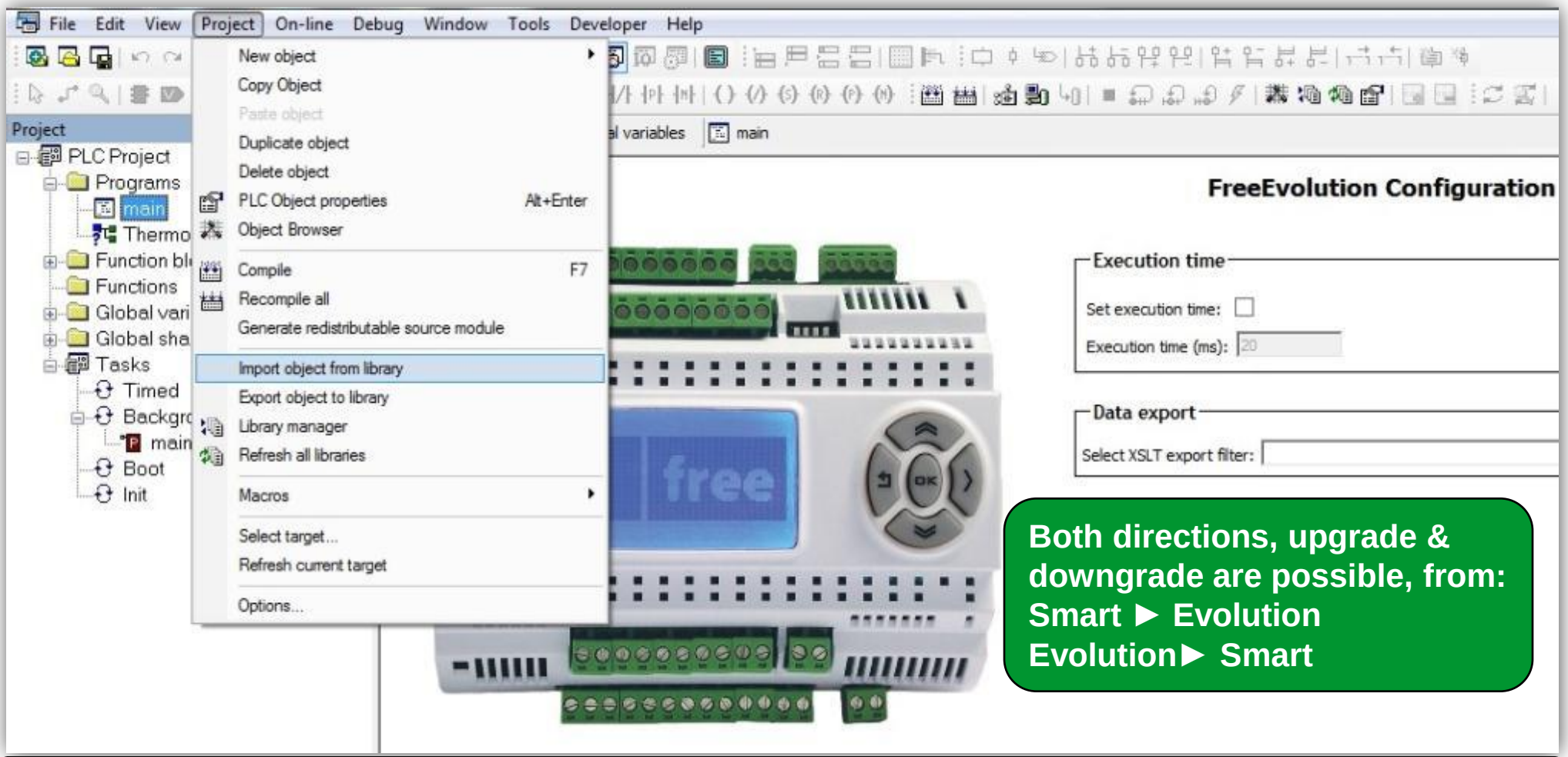


Converted project from Smart to Evolution



Conversion between Evolution to Smart is not fully supported (all resources are deleted).

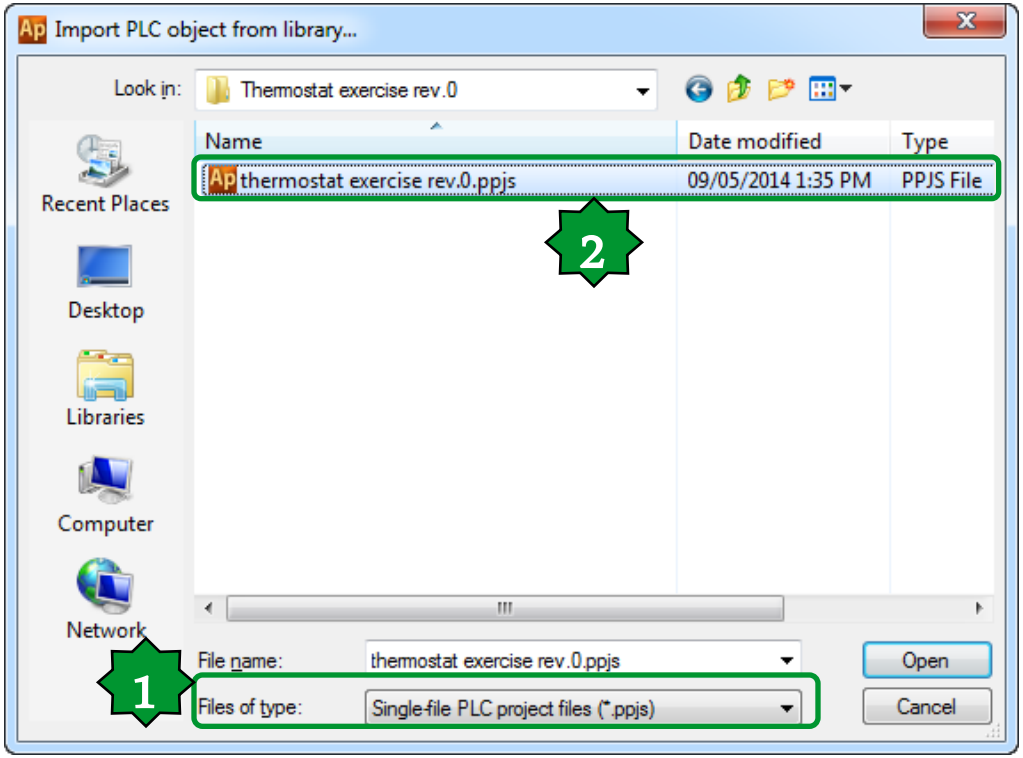
Import Objects from library (or Project)

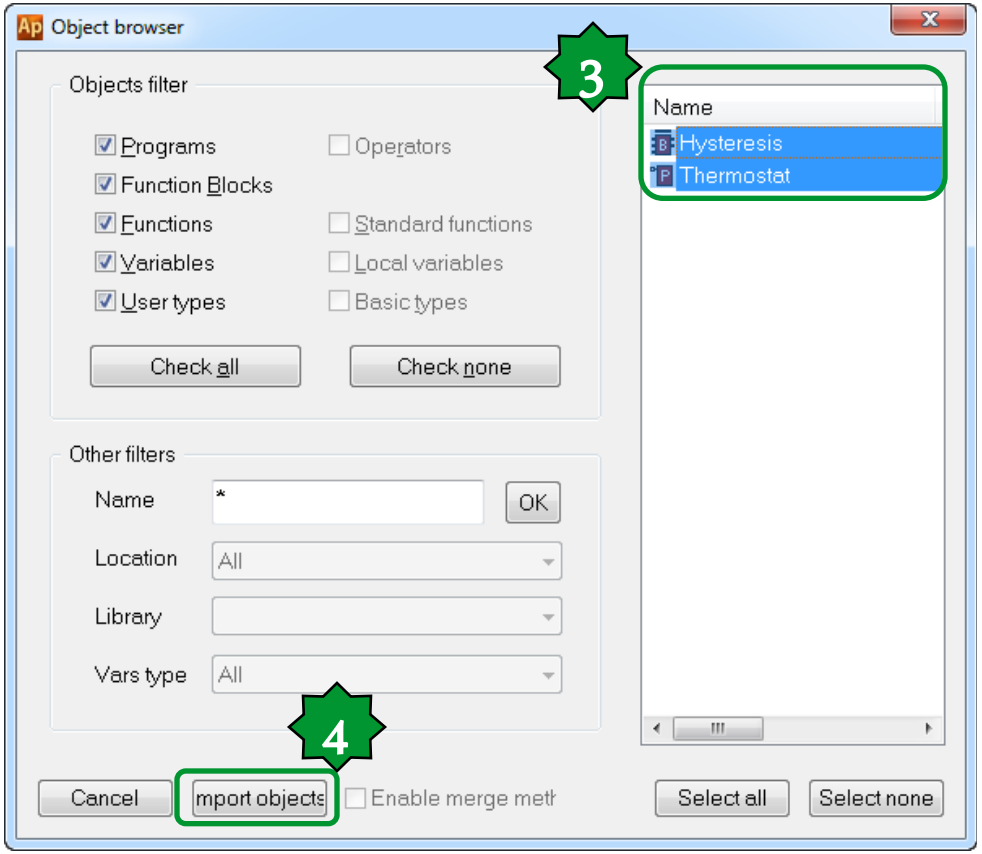


Both directions, upgrade & downgrade are possible, from:
Smart ► Evolution
Evolution► Smart

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

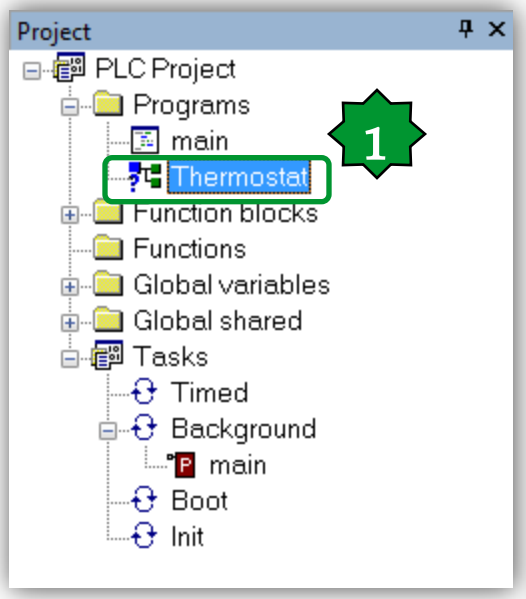
Import Objects from Project...

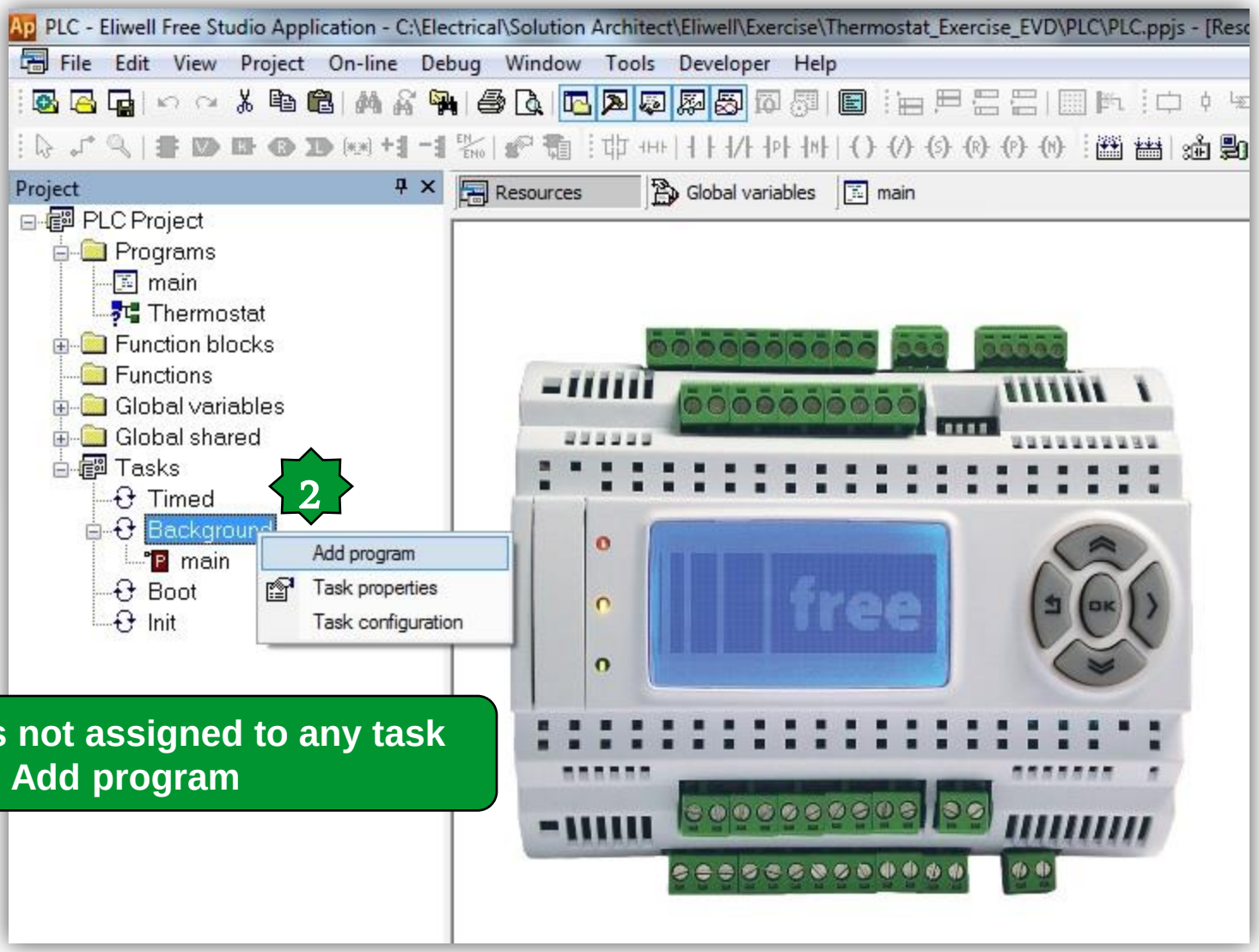




1. Select *.ppjs file type
2. Select desired project (Smart)
3. Select desired program & FBD
4. Import Objects

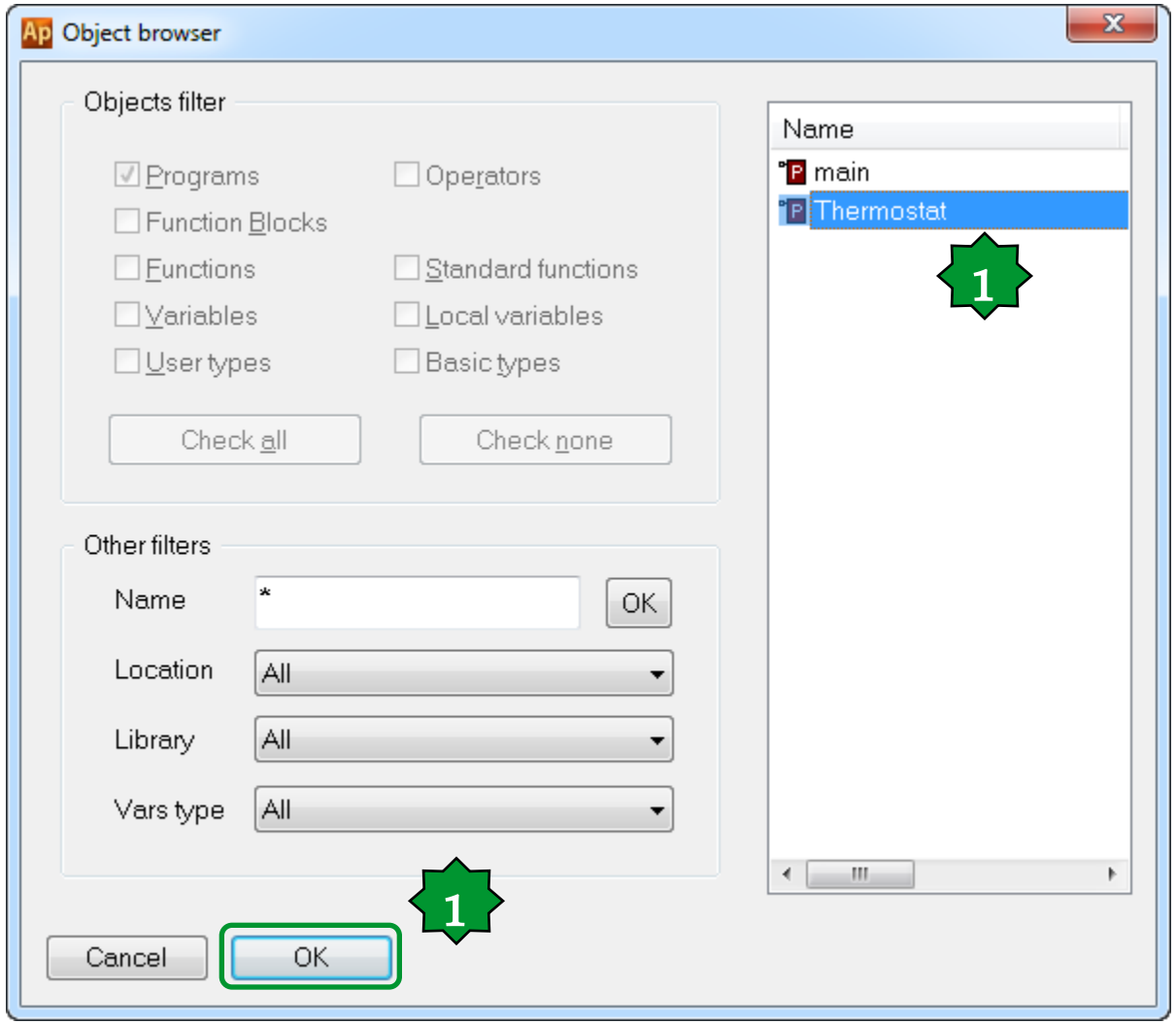
...Assign to Task (in case of program)

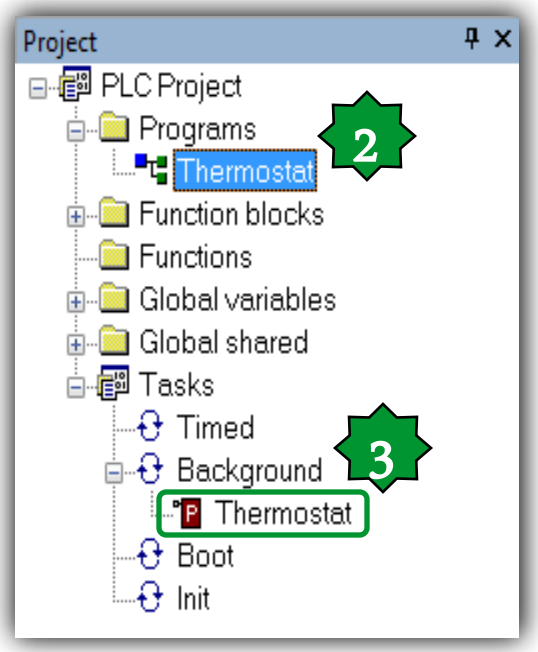




1. ? Means that program is not assigned to any task
2. Tasks ► Background ► Add program

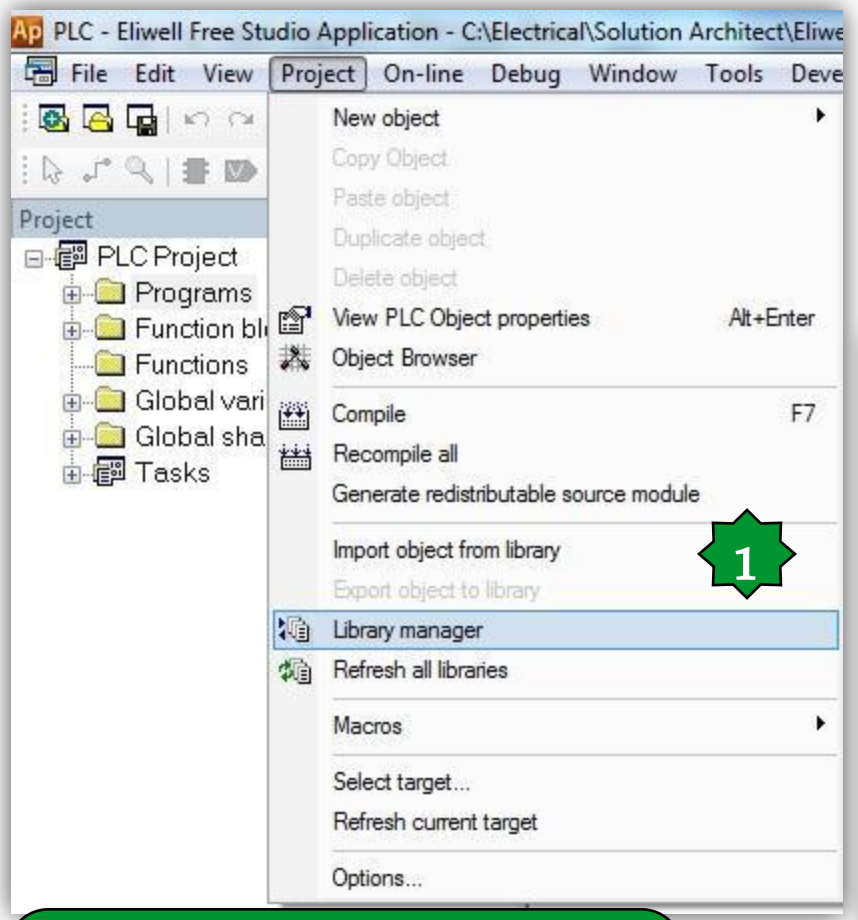
Assigning imported program to the task

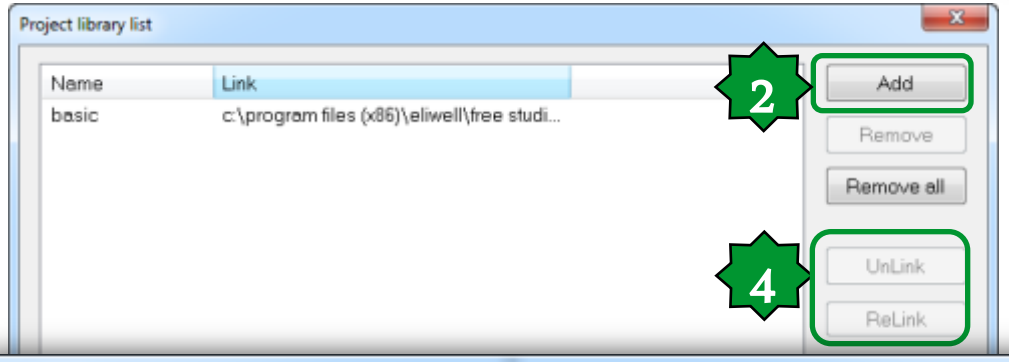


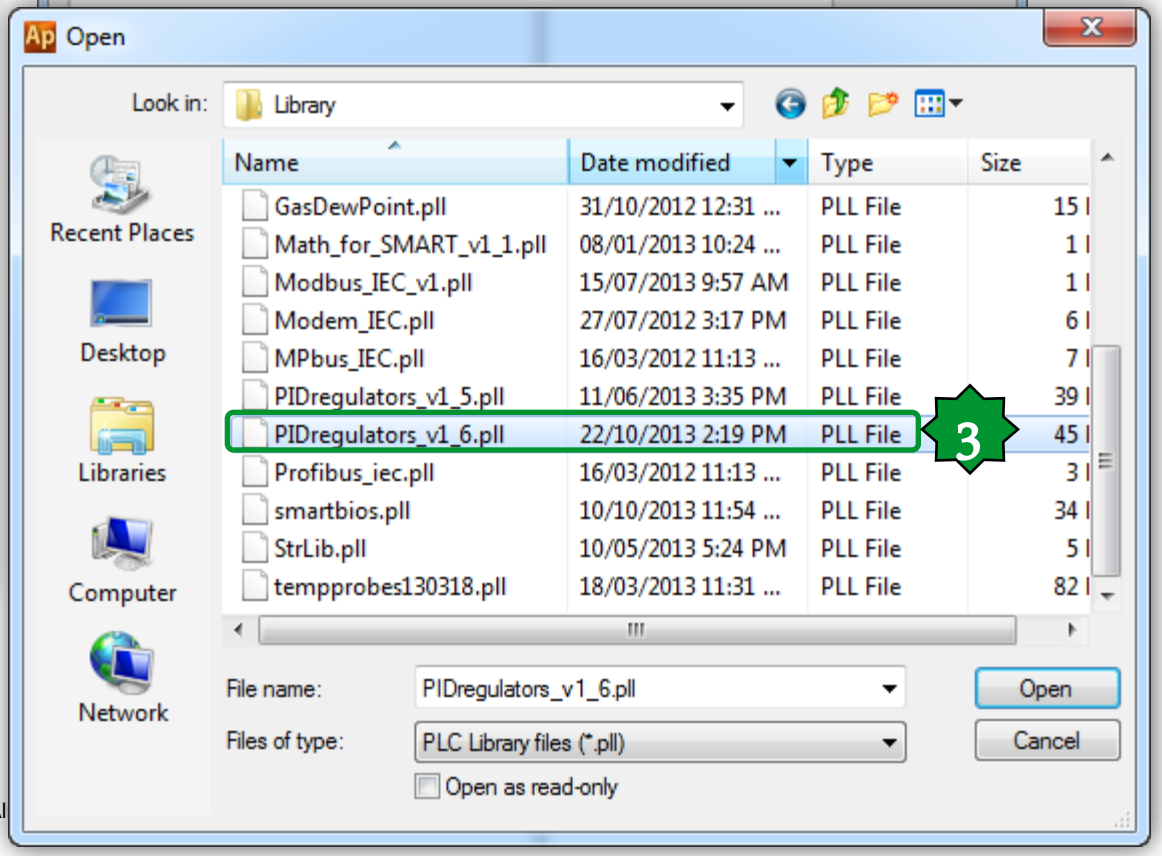


1. Select the desired program name ► OK
2. The ? Disapeares in prgrams
3. It will assign to to desired task (delete non-required programmes)

Link libraries...

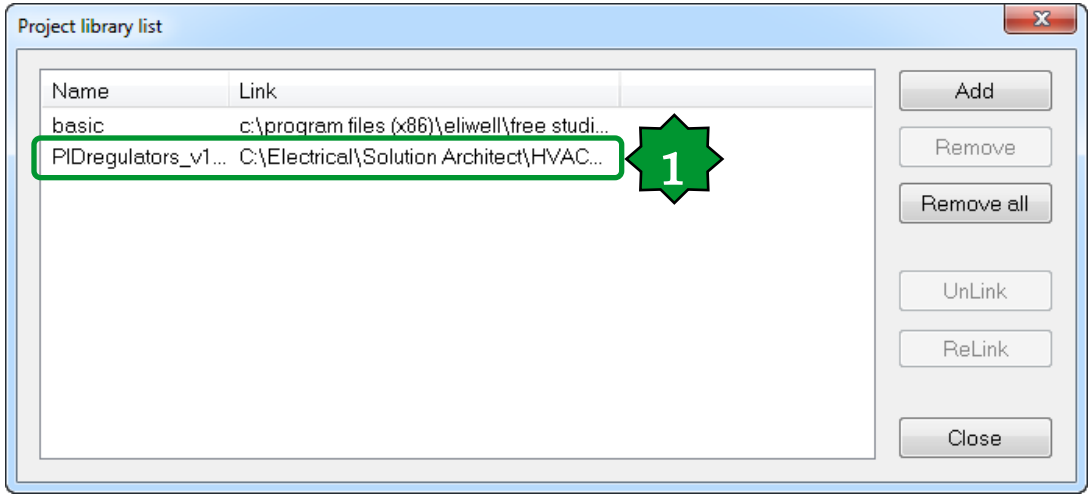


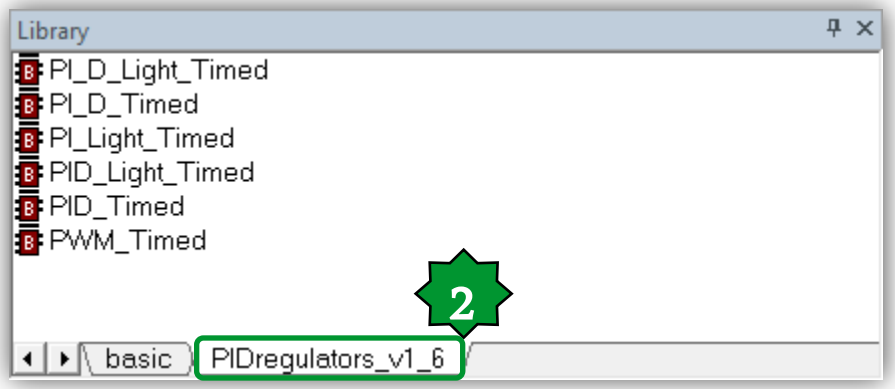




1. Project ► Library Manager
2. Project Library list
3. add/remove
4. Unlink/Relink

...Link Libraries

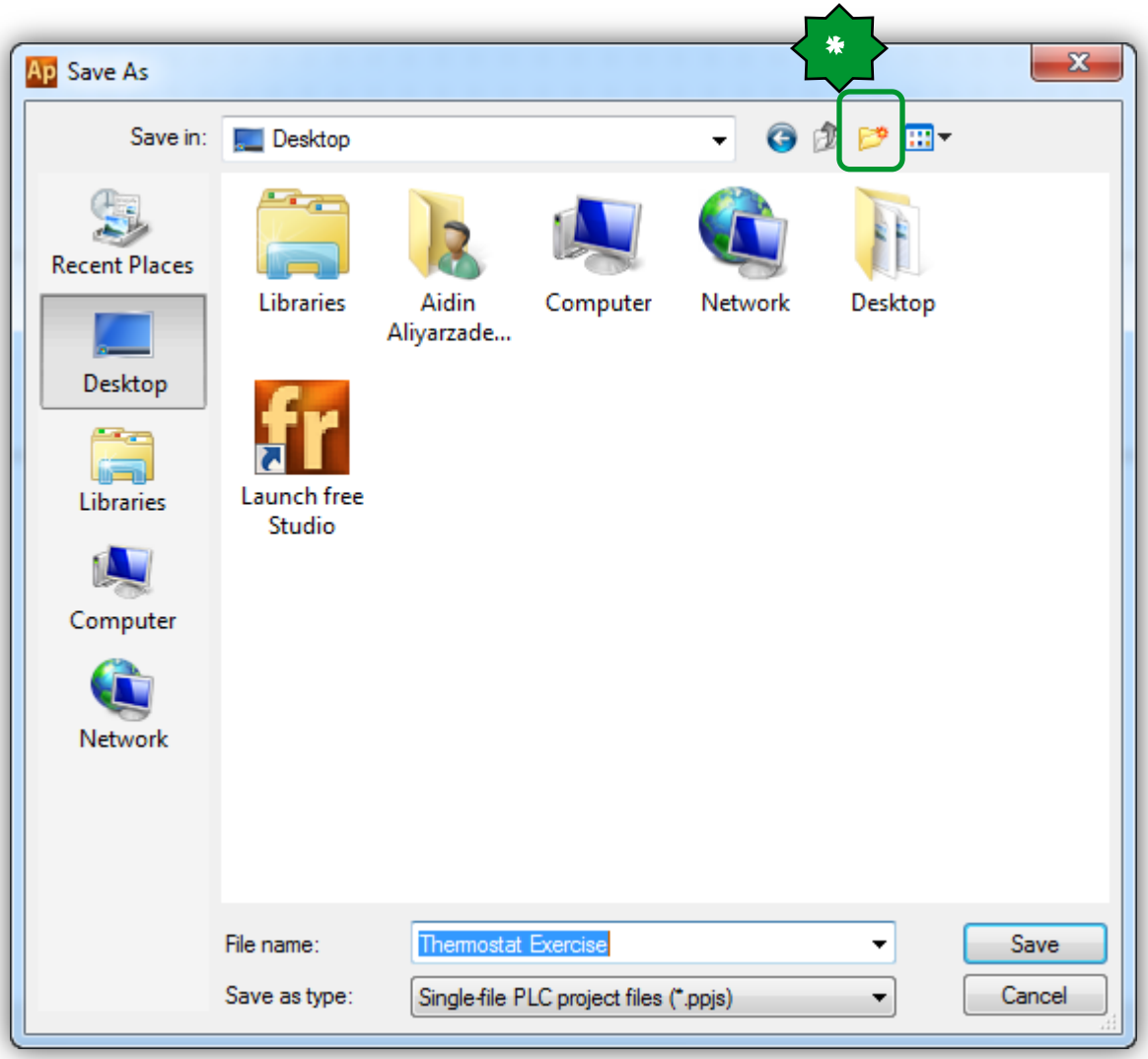




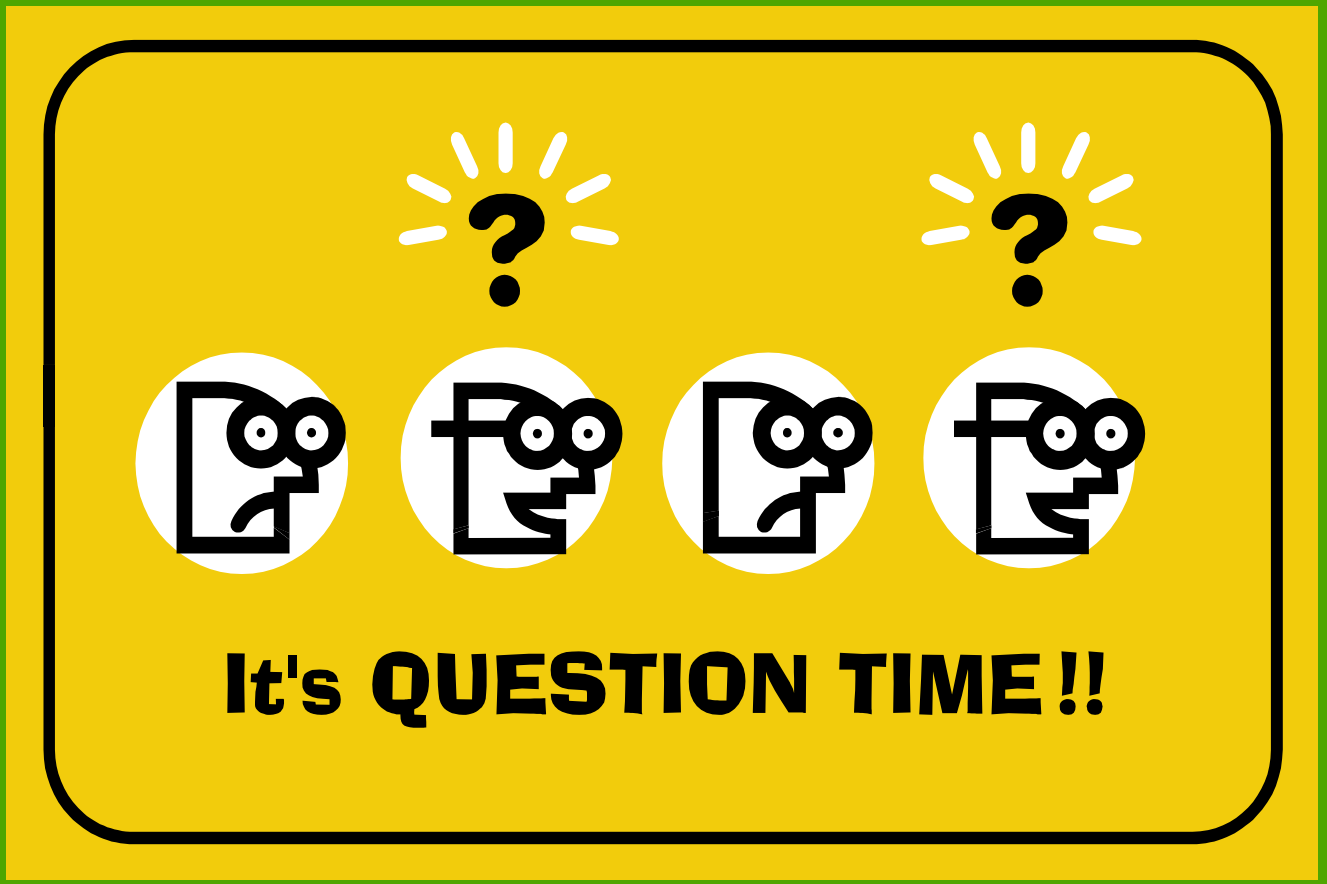
Save a project as:

File ► save a project as :

* Create a folder for the project before saving



Q & A



Thanks