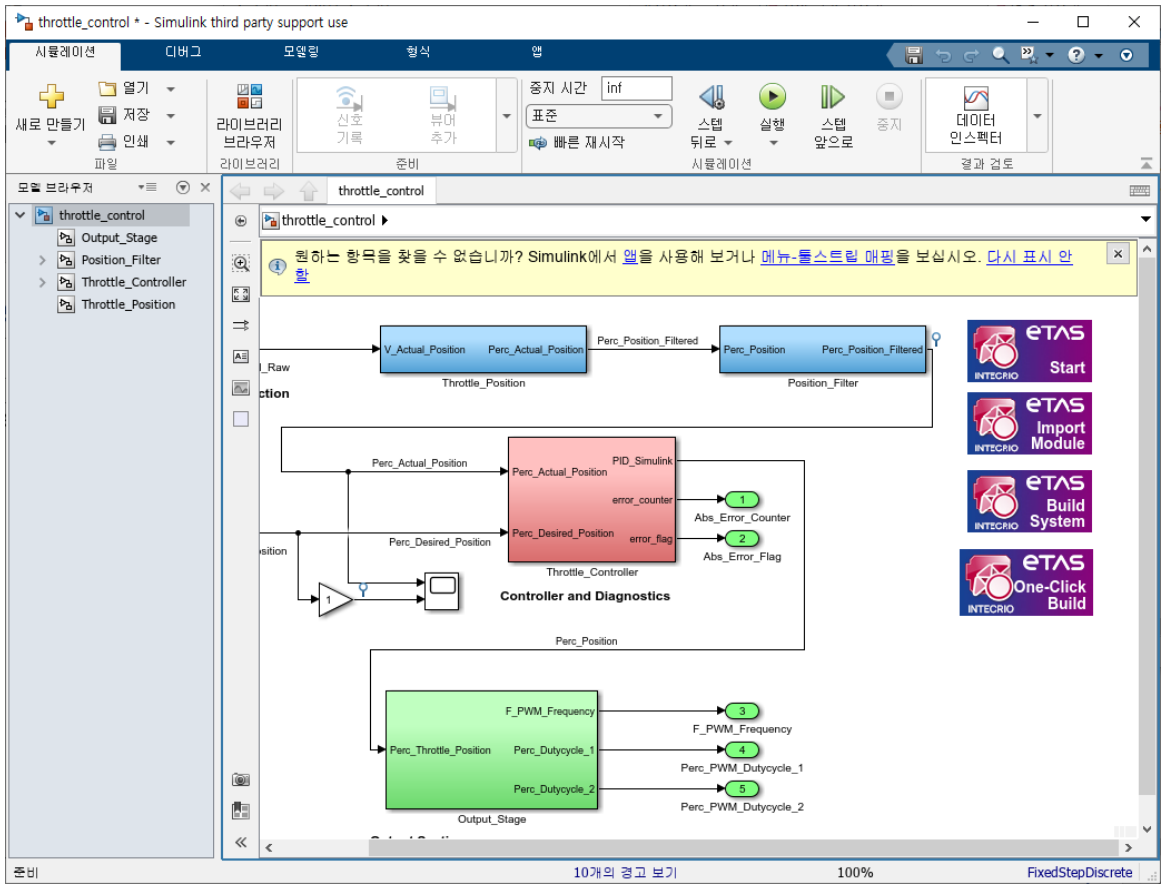
INTECRIO

Tutorial

Reference: INTECRIO V5.0.4 GettingStarted

Simulink Model

Create or Open model for Simulink

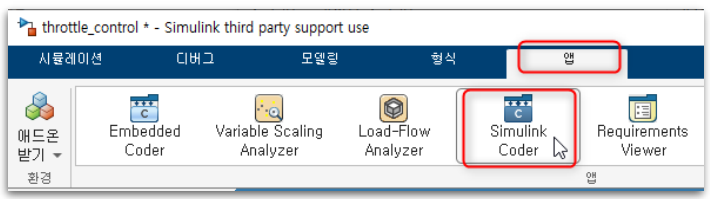


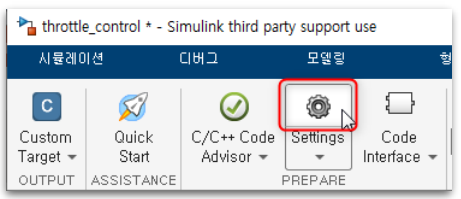
Simulink Model

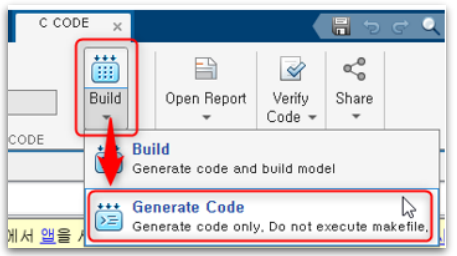
Generate code for Simulink model

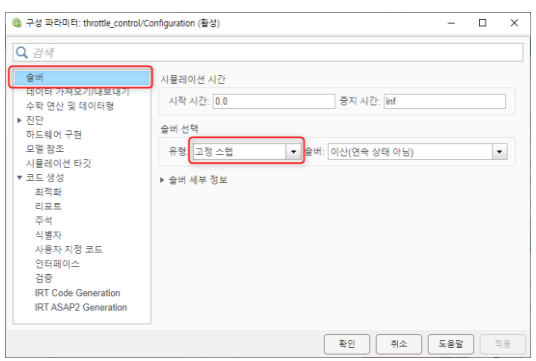
Set the simulation parameters necessary for working with INTECRIO and generate the necessary code

- App > Simulink Coder > Settings > Build > Generate Code



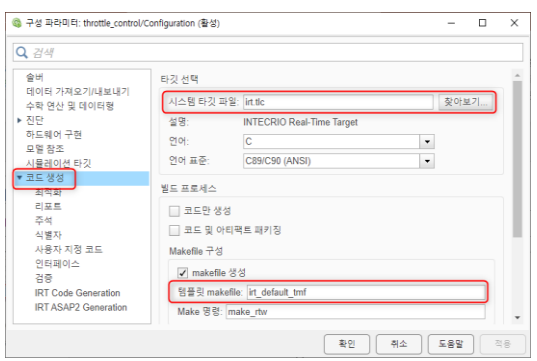






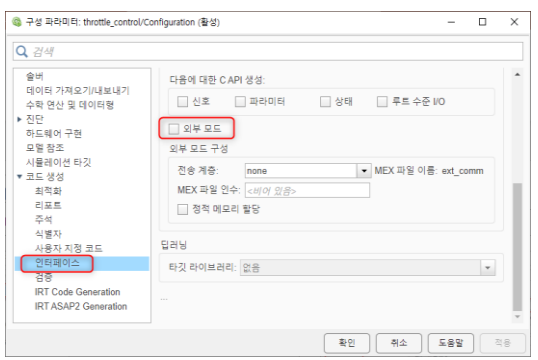
Solver

- Type : Fixed-step



Code Generation

- System target file : irt.tlc
- Template makefile : irt_default_tmf



Interface

- External mode : Deselected

Simulink Model

Generate code for Simulink model

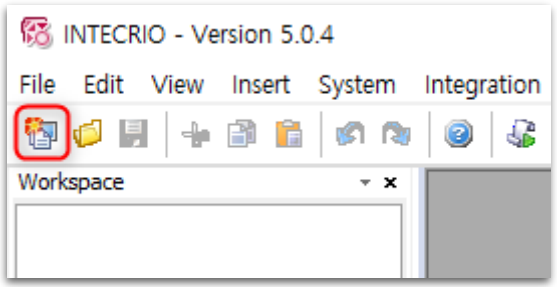
The following generated files are of significance for working with INTECRIO:

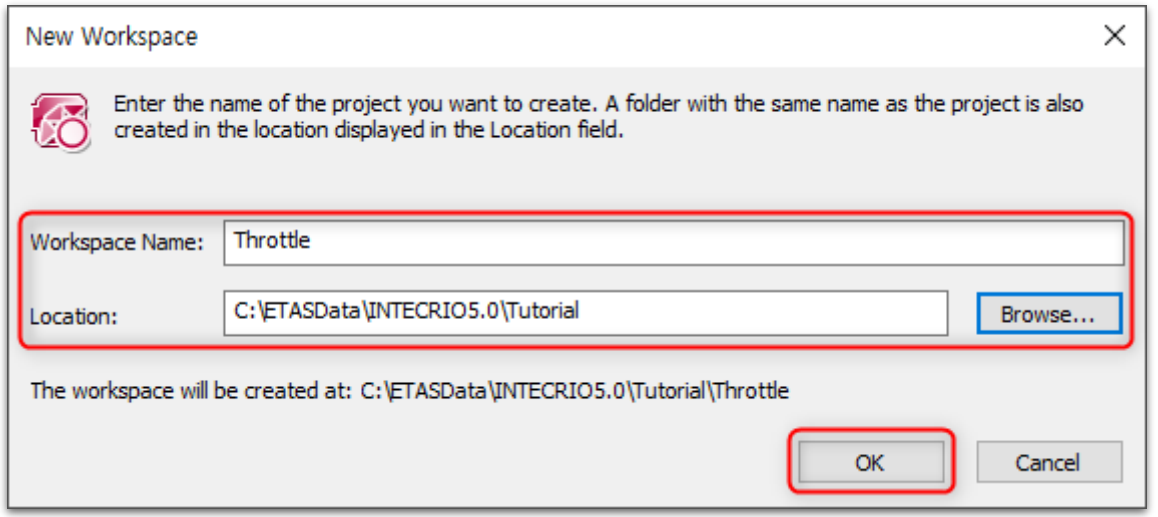
<Model name>.a2l	This is the ASAM-MCD-2MC file generated for working with INTECRIO.
<Model name>.six	This is the interface description file or SCOOP-IX file.
<Model name>_main.c	This file provides the main functionality for the integration in INTECRIO. This functionality consists of several void/void C functions which are mapped as processes to the underlying operating system.
<Model name>_irtmacros.h	This header file contains a few #define instructions for the combination of several modules. It is processed before all the others using the gcc -include <Model name>_irtmacros.h command.

The <Model name>_irt_rtw subdirectory contains further files which are generated during code generation with Simulink and Simulink Coder.

INTECRIO

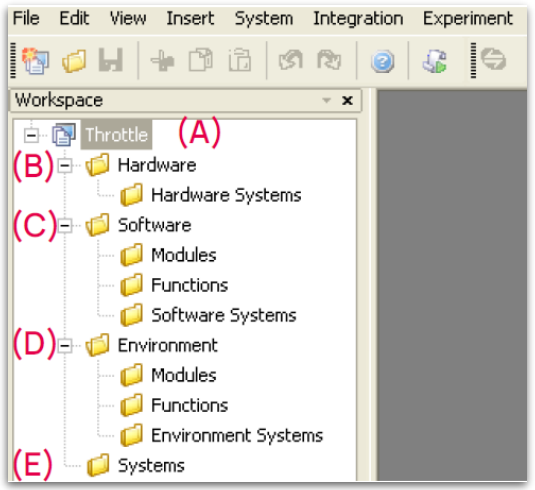
Create workspace





Workspace structure

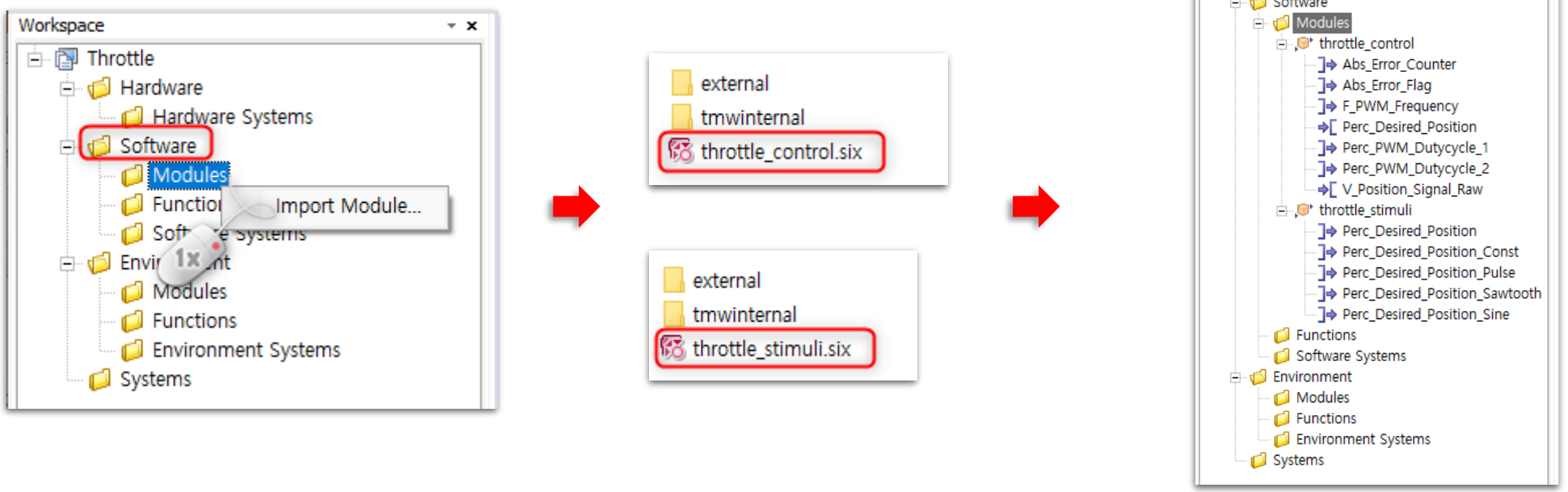
The default entries in the Workspace Browser are the following:



(A)	The top entry is the name of the workspace.
(B) Hardware	This folder contains all hardware systems of the workspace. These elements are provided by the Hardware Configurator (HC) and stored in the Hardware Systems folder which is available by default.
(C) Software	This folder contains the software modules and AUTOSAR software components belonging to the project (subfolder Modules), the functions compiled from the modules (subfolder Functions), and entire software systems (subfolder Software Systems).
(D) Environment	This folder contains the software modules belonging to the project (subfolder Modules), the functions compiled from the modules (subfolder Functions), and entire environment systems (subfolder Environment Systems).
(E) Systems	This folder contains the system project, i.e. references to the hardware and software belonging to the system, the assignment of the software to the hardware and the operating system configuration. For each system project to be created in the workspace, an individual entry has to be generated under Systems.

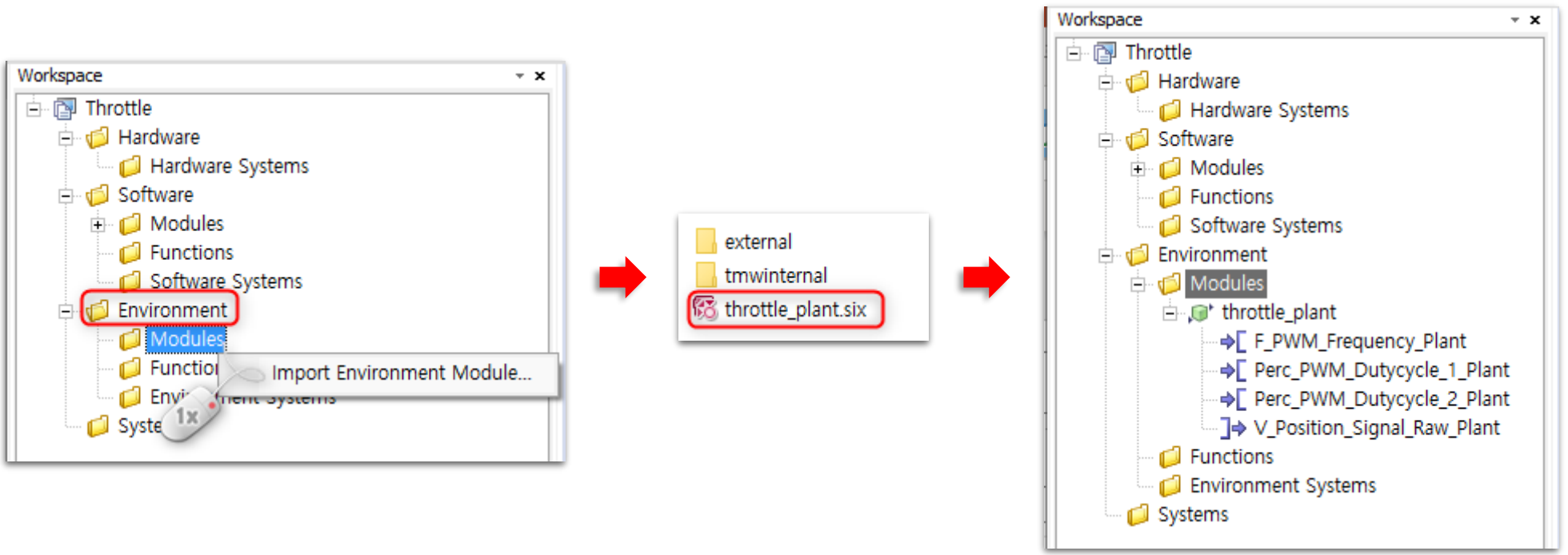
Importing Modules for Software

Modules determine the behavior of the system. They are the smallest modeling unit which can be processed with INTECRIO.



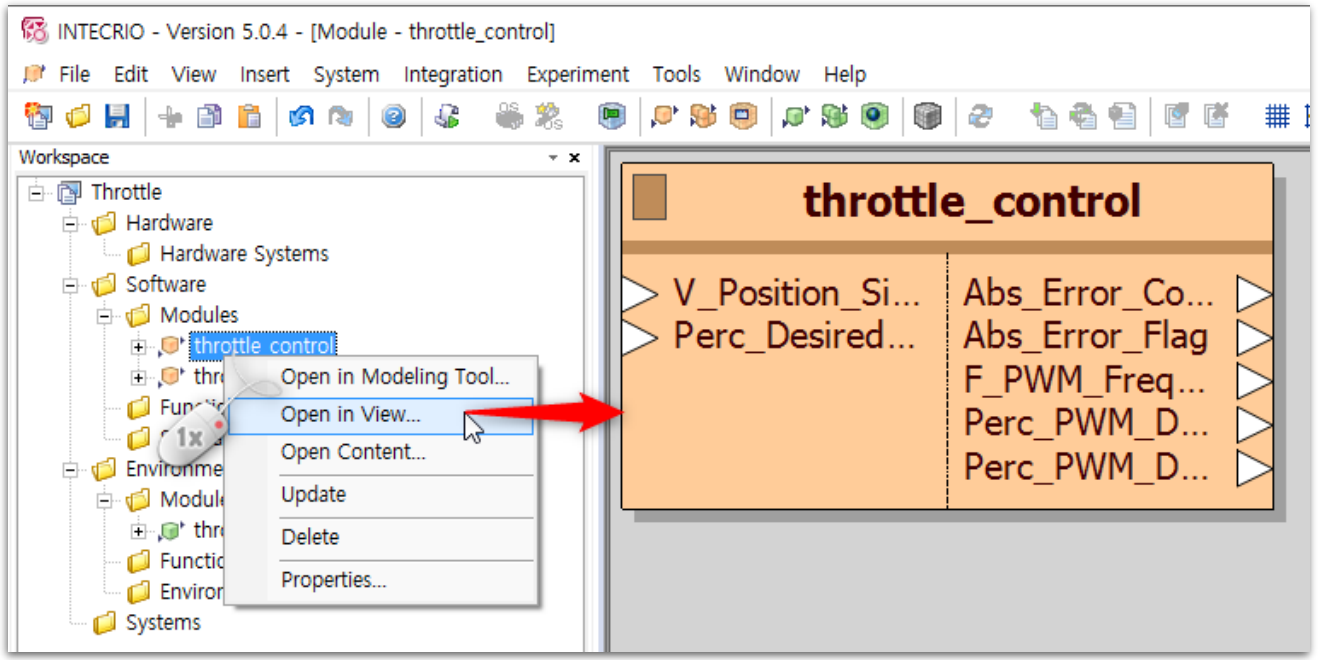
Importing Modules for Environment

Modules determine the behavior of the system. They are the smallest modeling unit which can be processed with INTECRIO.



Open View

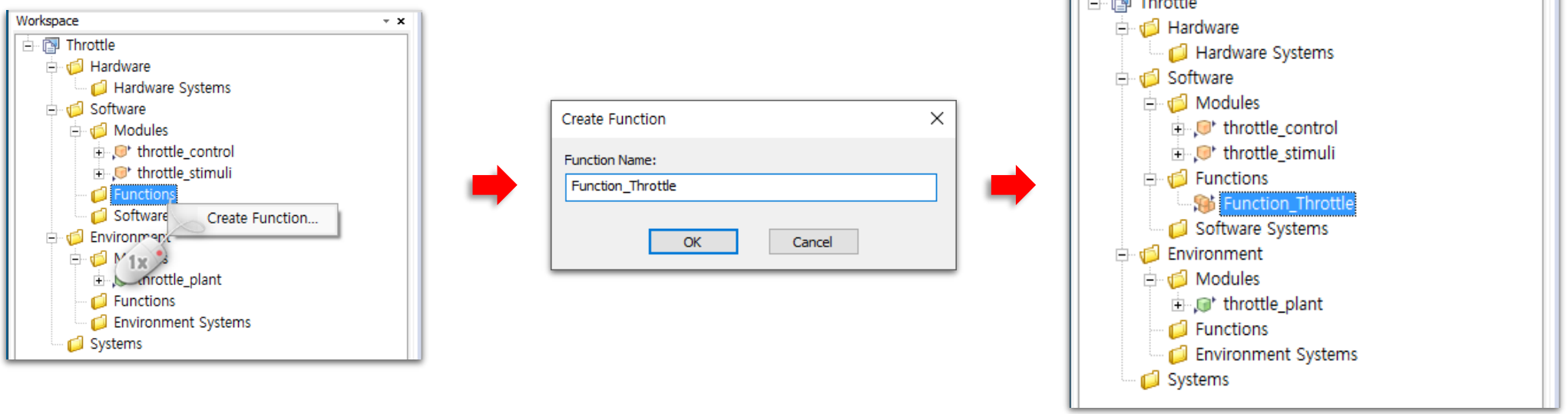
Modules and environment modules can be viewed in the graphic editor.



Creating a Function

Functions are pure structure objects without their own functionality. They are created for better readability and for simple reuse of a g roup of modules. A function consists of the following components:

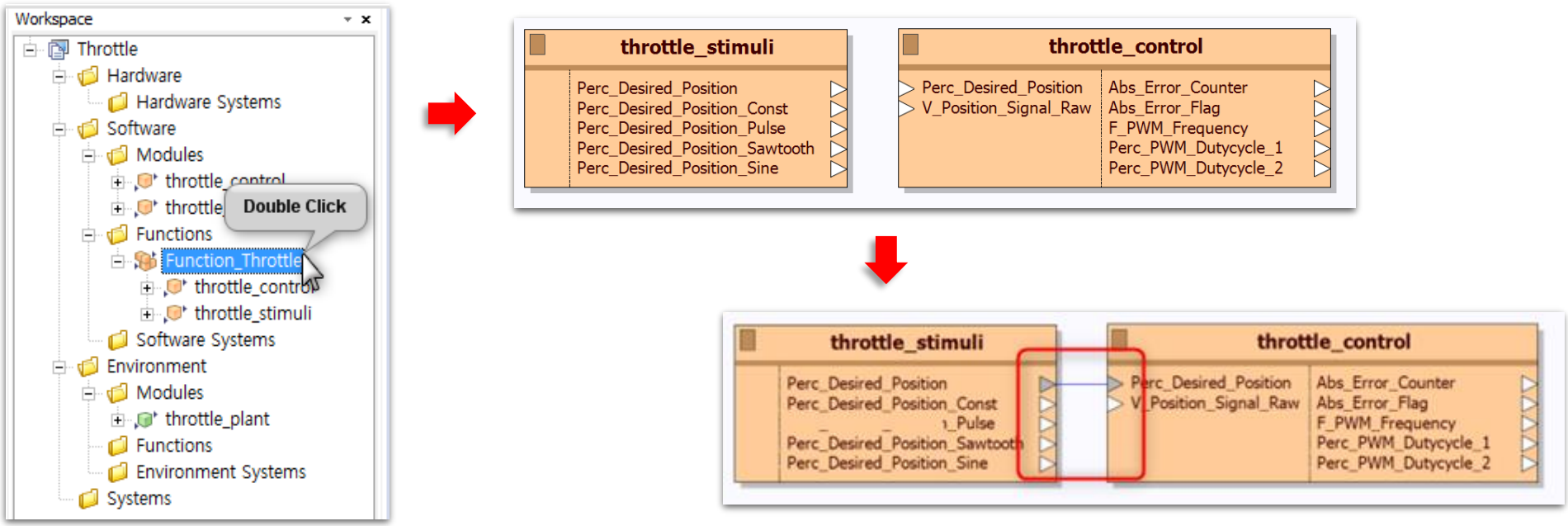
- one or more modules
- connections between inputs and outputs of the modules
- the function interface (inputs, outputs and activation interface)



Add modules in Function

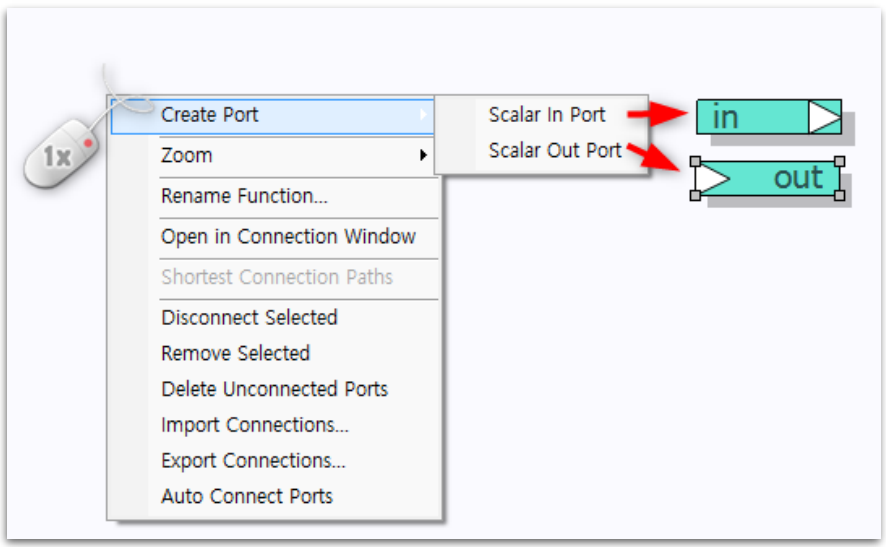
Connection modules

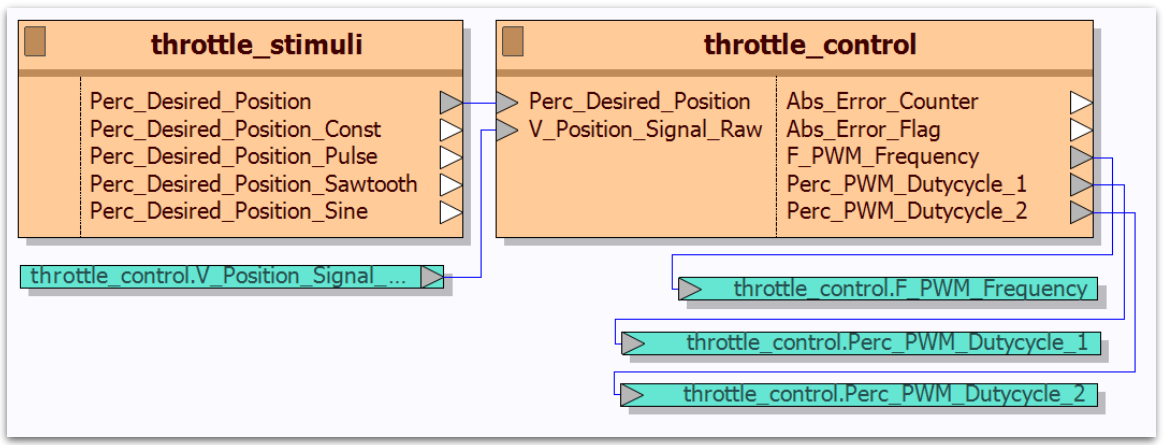
Create the connections in the function view of the graphic editor



Add function interfaces

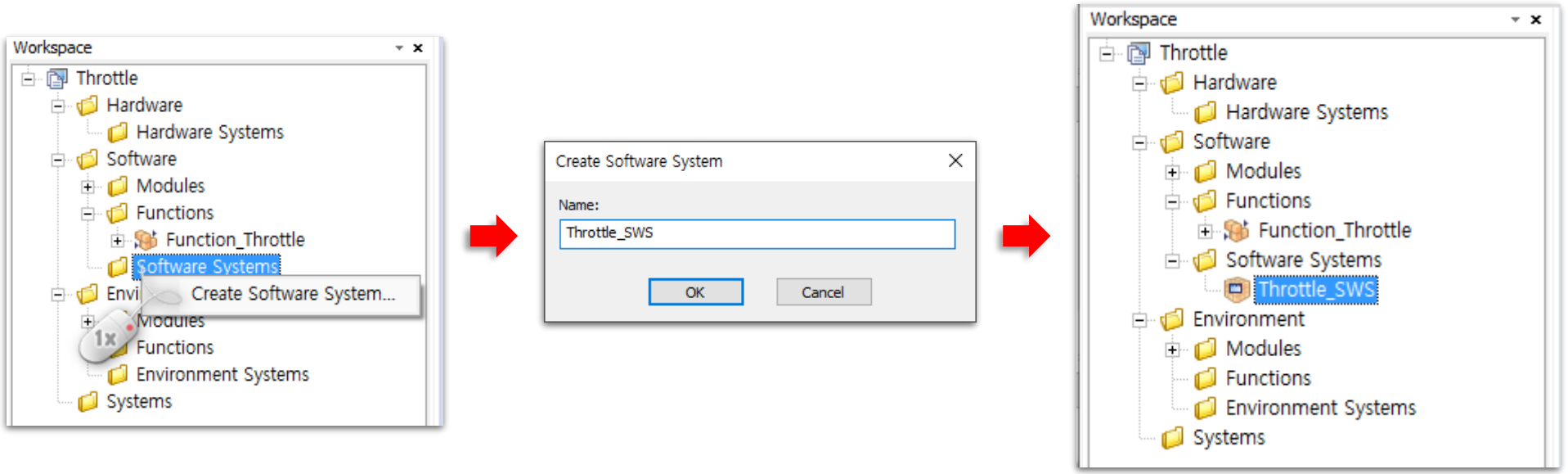
Add the function interfaces (signal sources and sinks of the function) manually and connect these with the relevant signal sources and sinks of the modules.



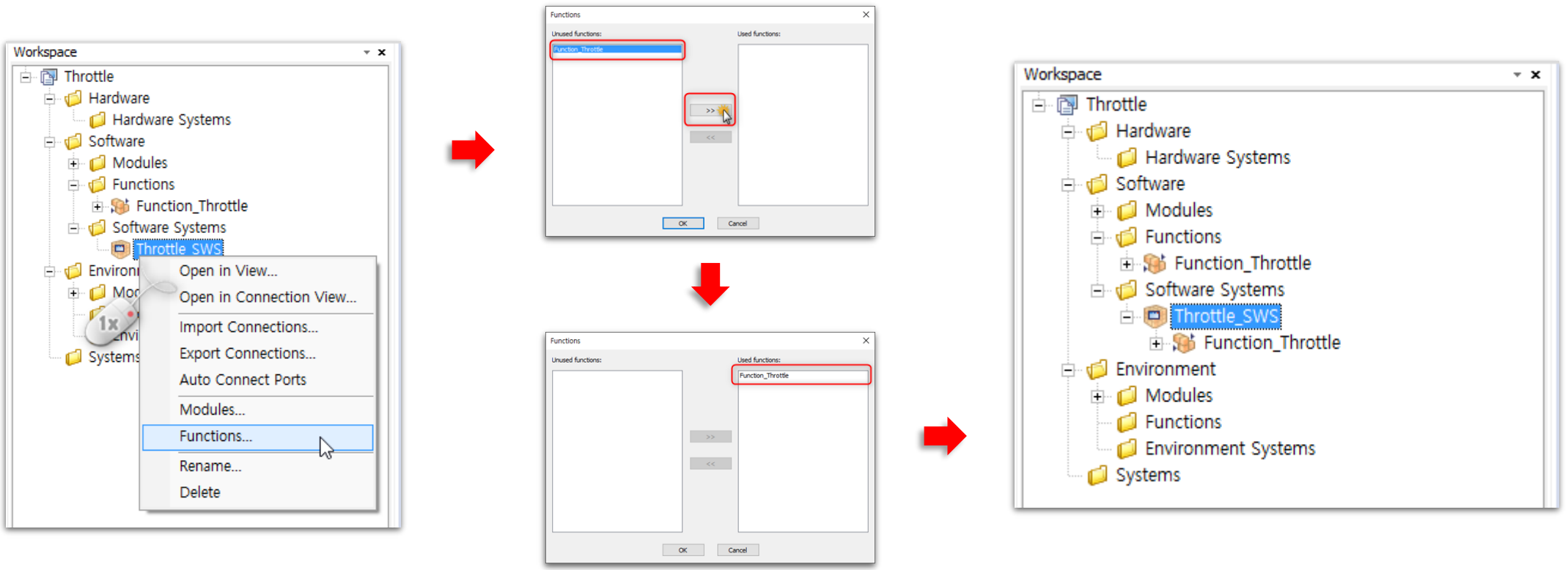


Create a Software System

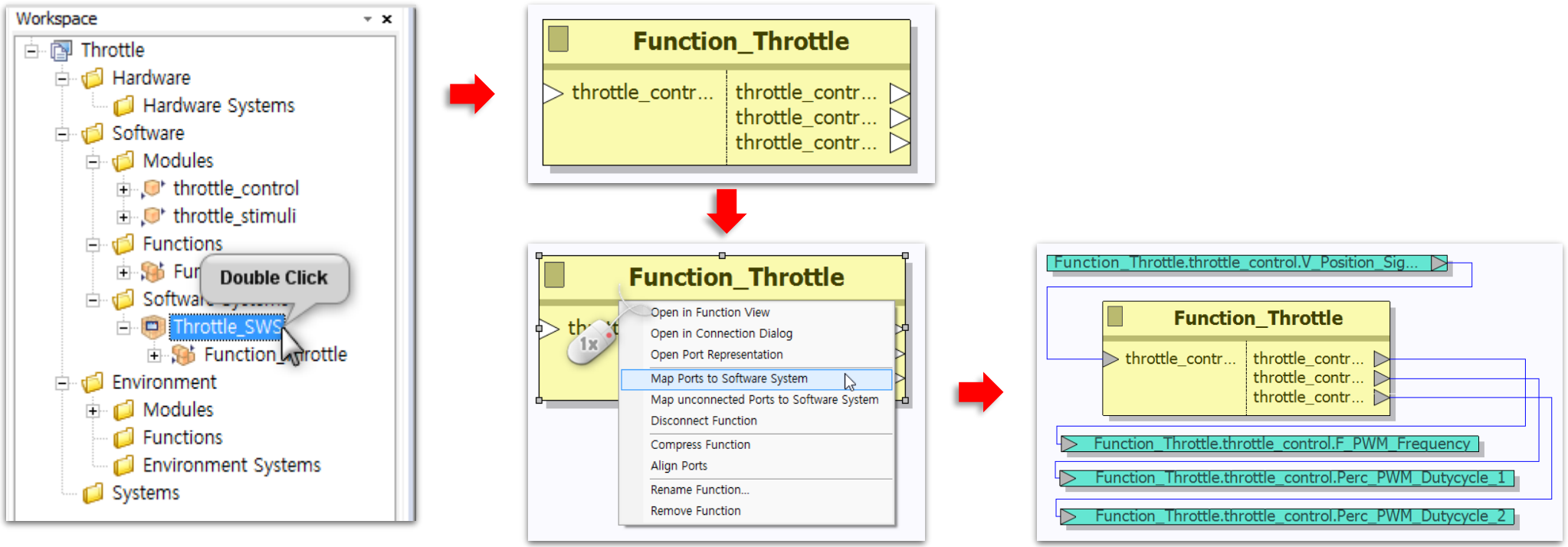
Software system that contains the hardware-independent parts of the ECU description



Add functions in Software System

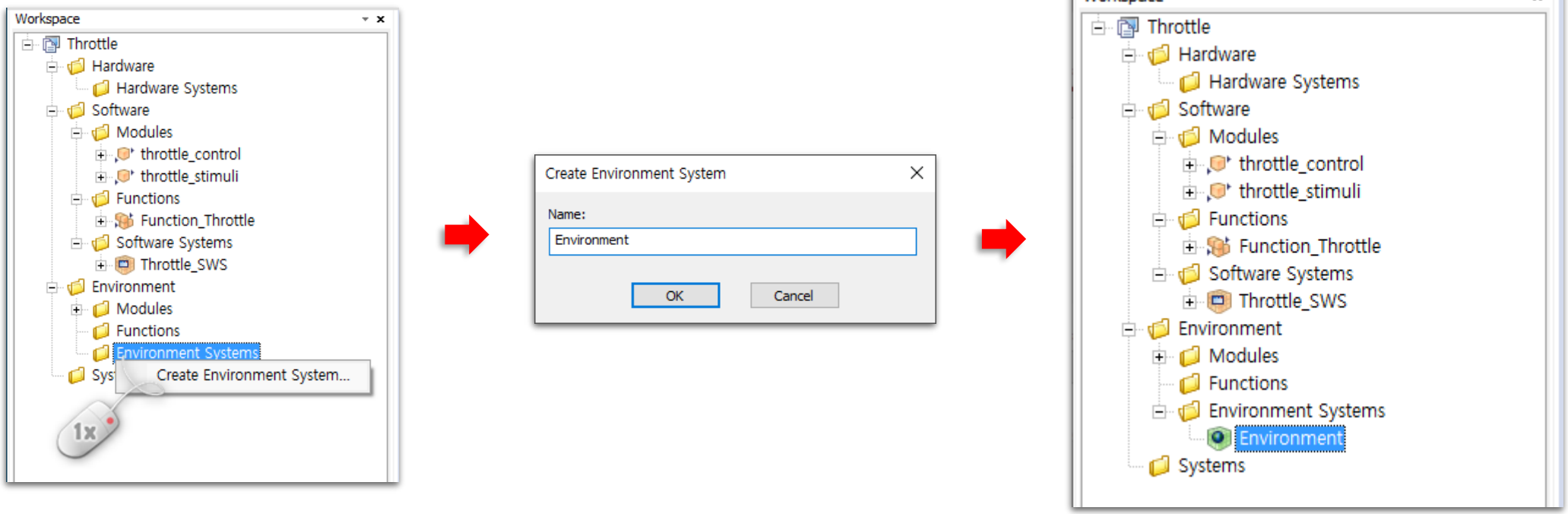


Add interfaces to the Software System

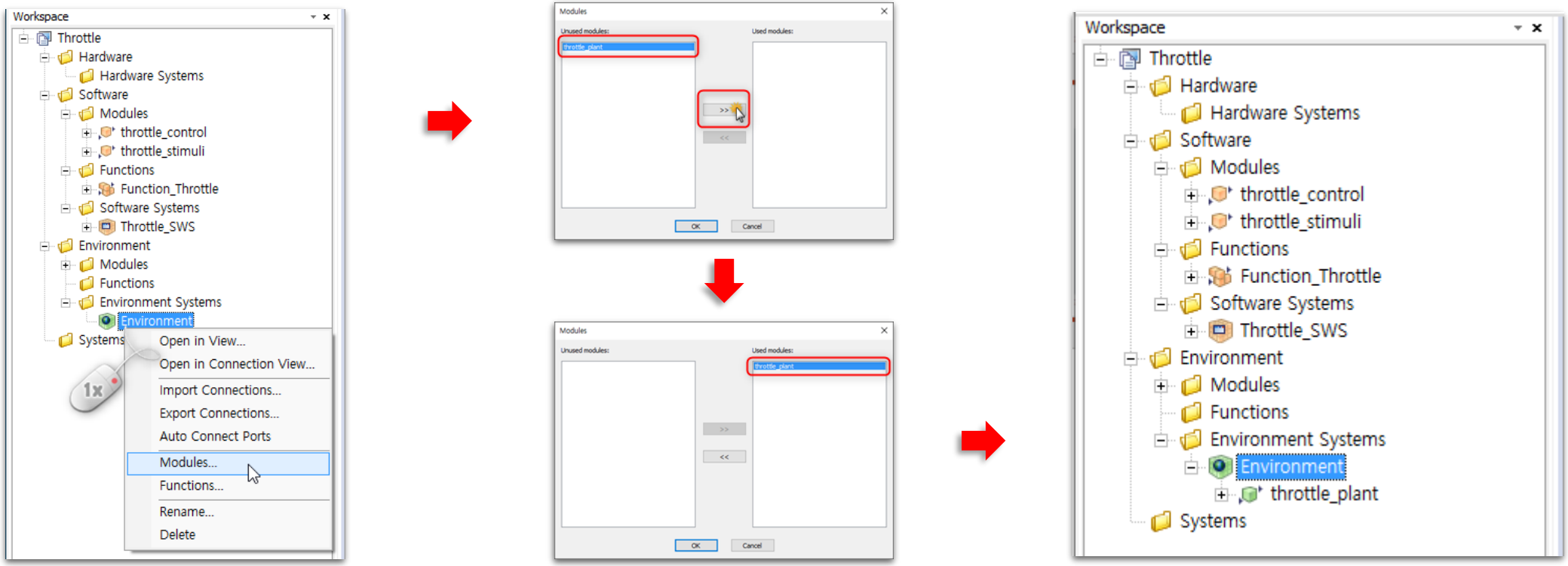


Create an Environment System

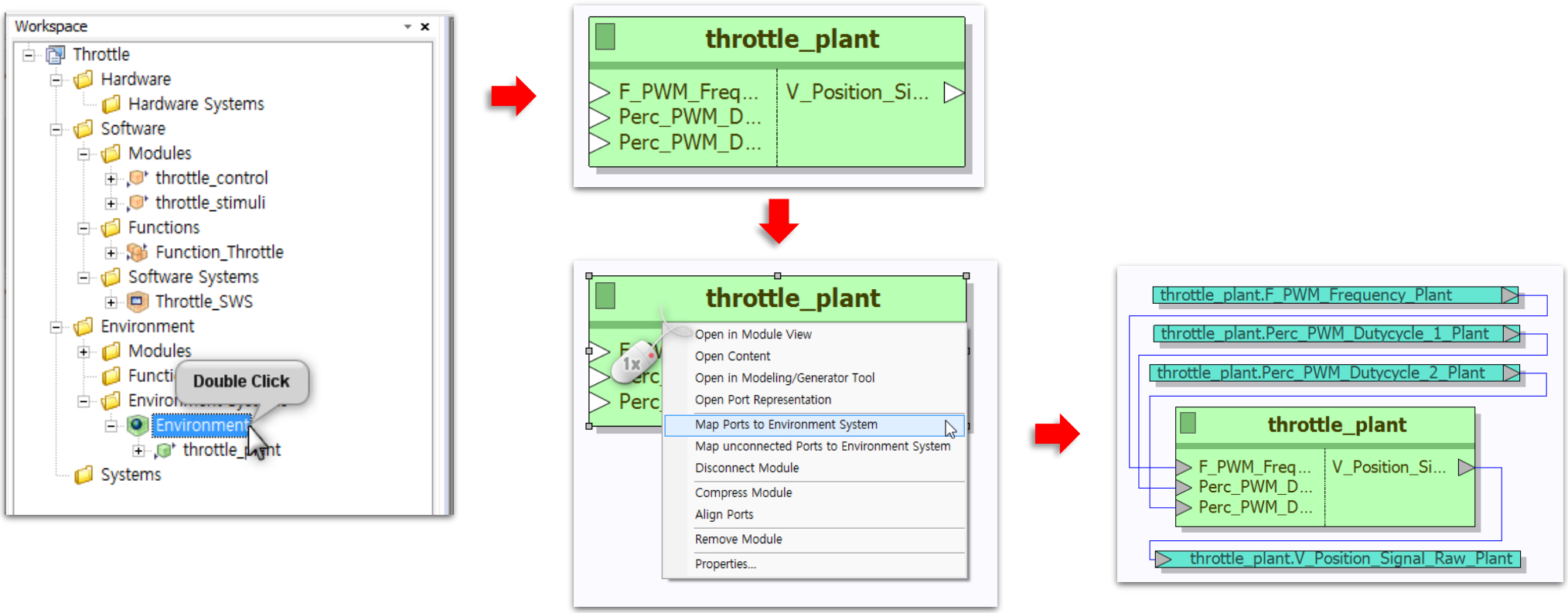
Environment system that contains the plant model



Add modules in Environment System



Add interfaces to the Environment System

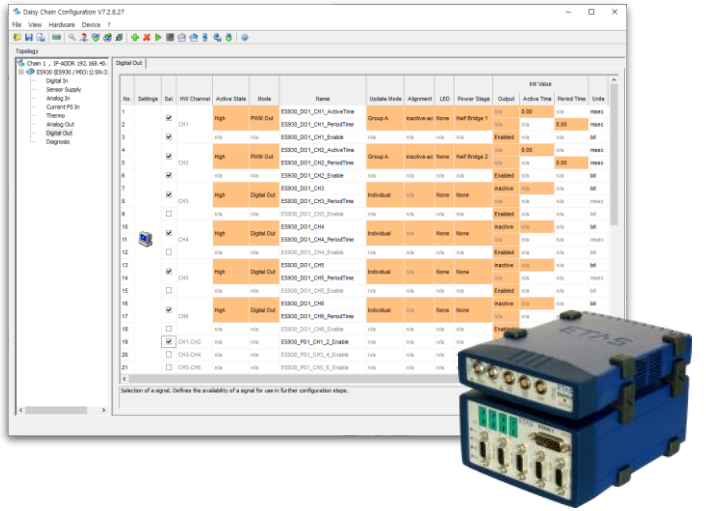


Daisy Chain

Installation

Daisy Chain Configuration Program

The Daisy Chain configuration program, which is either integrated into INCA or provided as a standalone tool, enables you to configure the modules of the **ES4xx**, **ES63x** and **ES93x** product families on your PC.

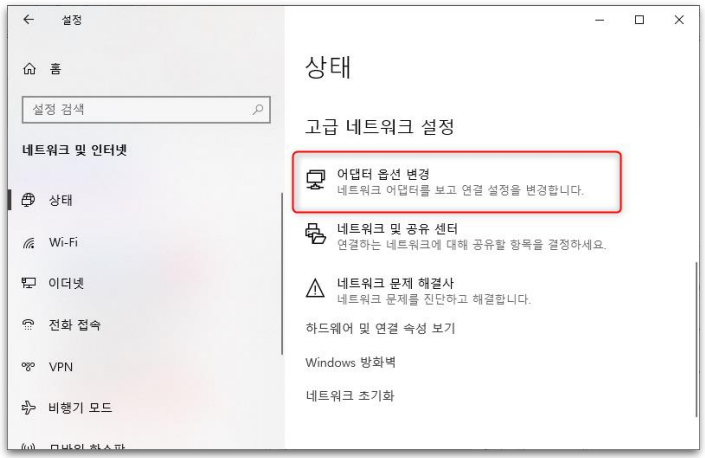


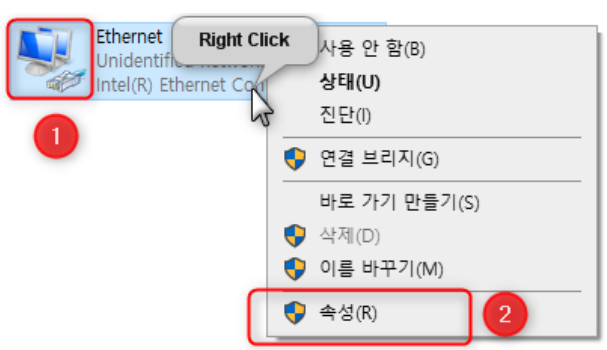
Daisy Chain installation

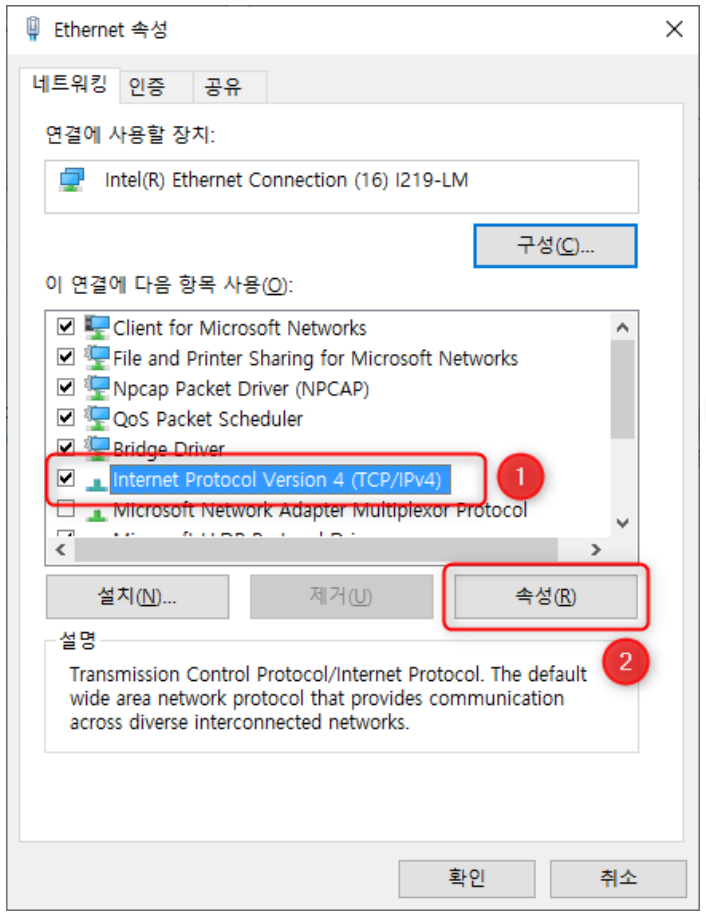
- Download : [Daisy Chain Configuration Tool - 다운로드센터 - ETAS]

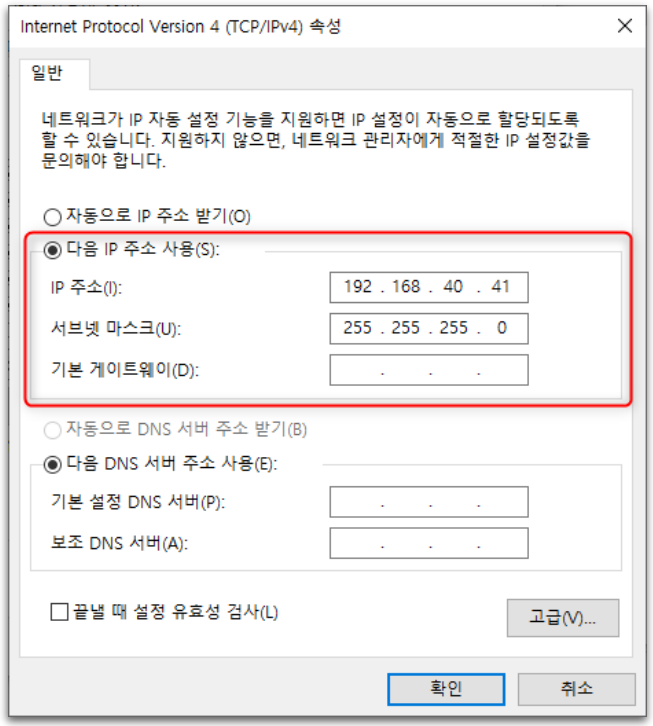
Daisy Chain

PC Network Setting





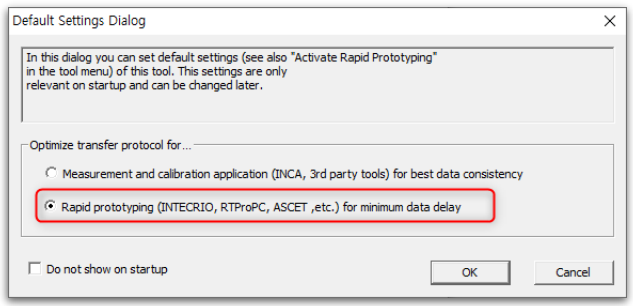


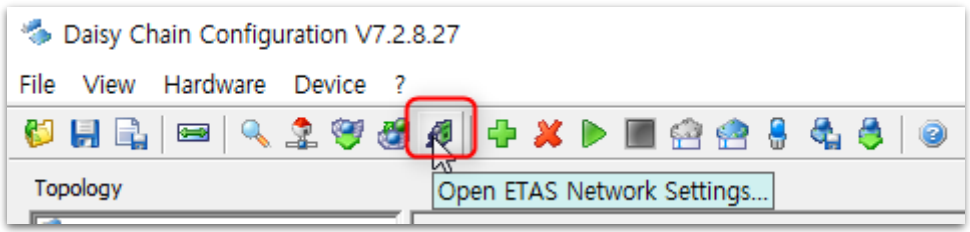


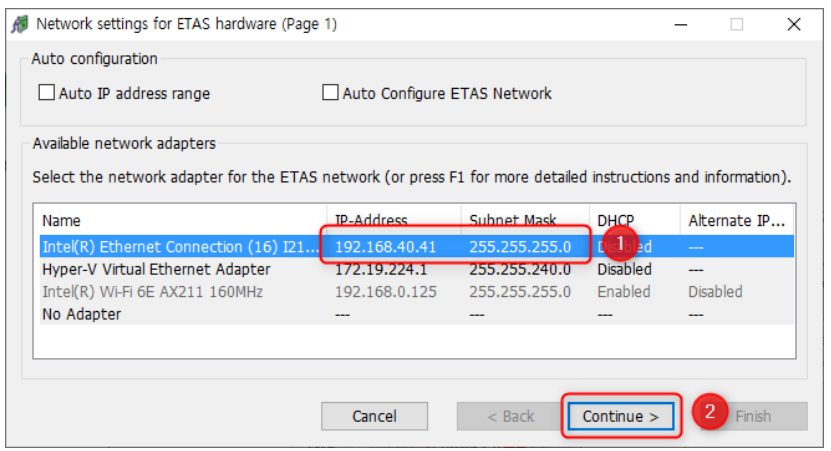
IP address	192.168.40.XX (10 ~ 227)
Subnet mask	Mask255.255.255.0

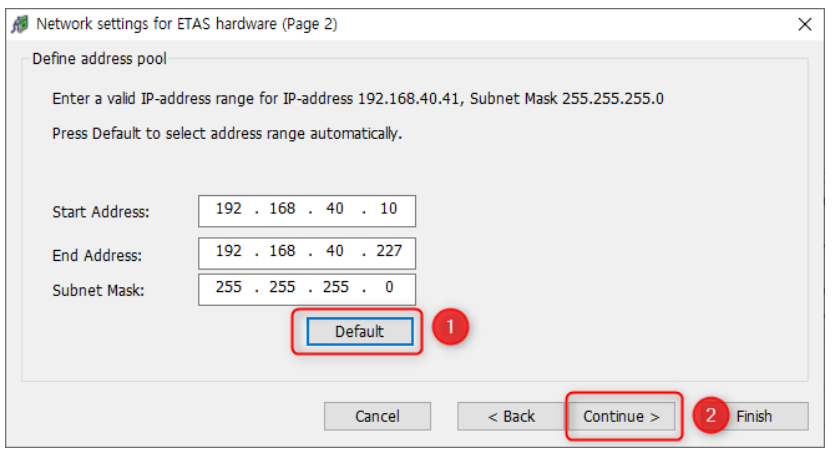
Daisy Chain

ETAS Network settings



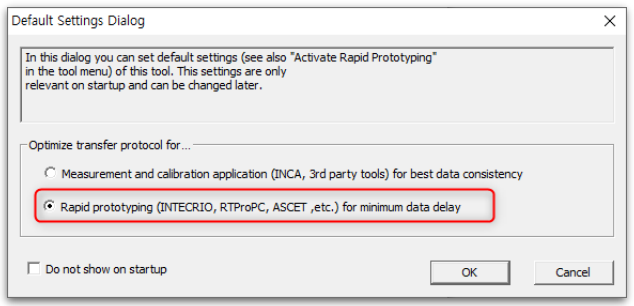


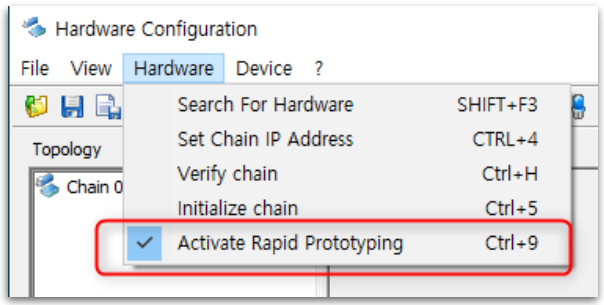


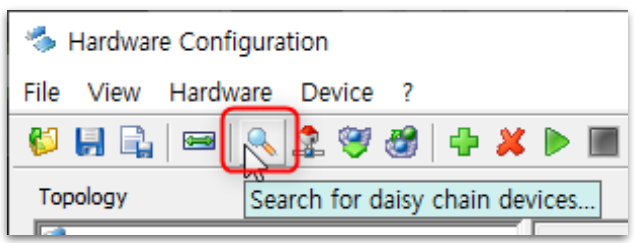


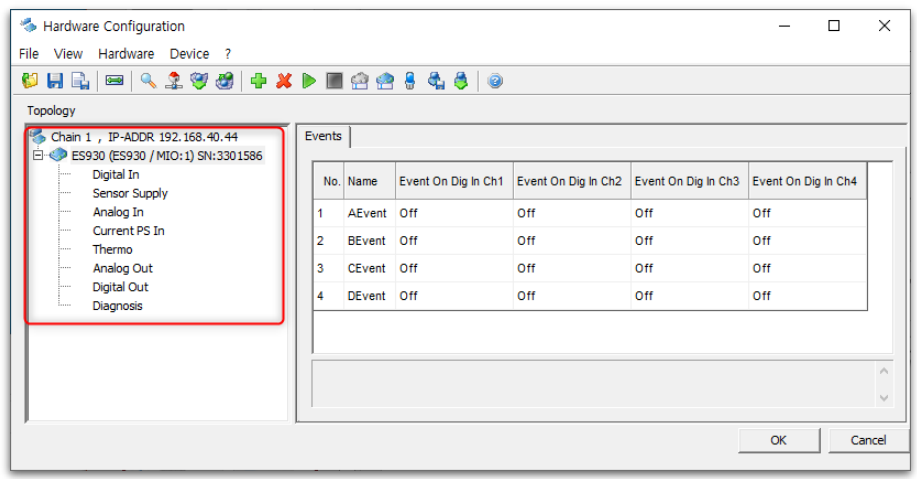
Daisy Chain

Hardware Configuration





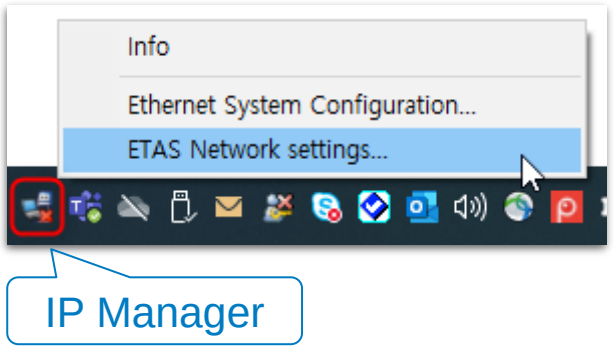


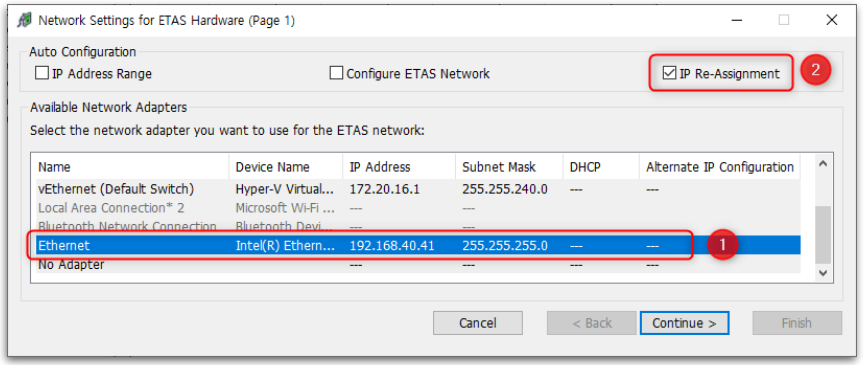


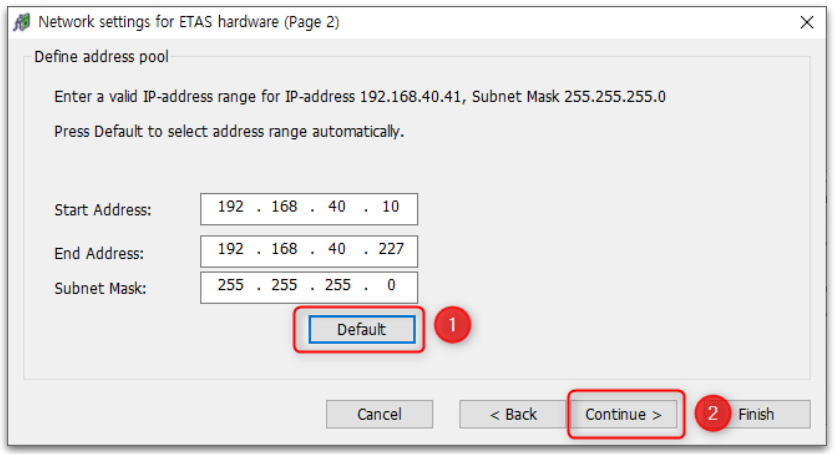
Daisy Chain

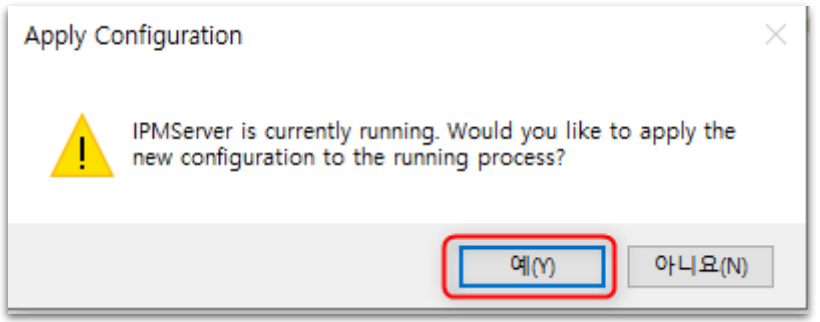
ETAS Network settings

If the connected device is not found







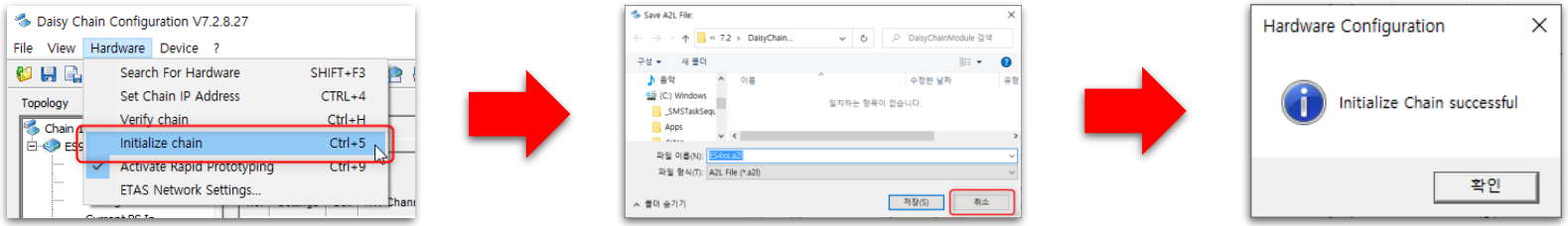


Daisy Chain

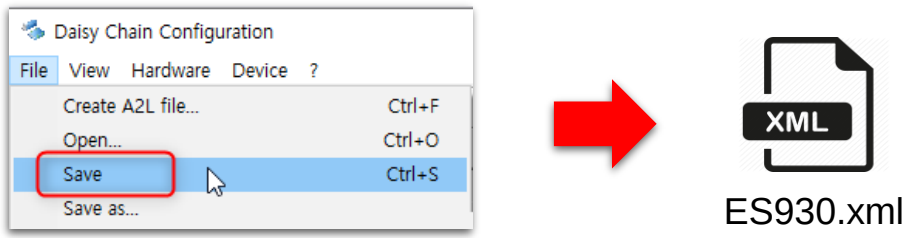
ES930 Configuration

1. Configure each input/output item as needed
   - Refer to the example pages (p.26, p.27)

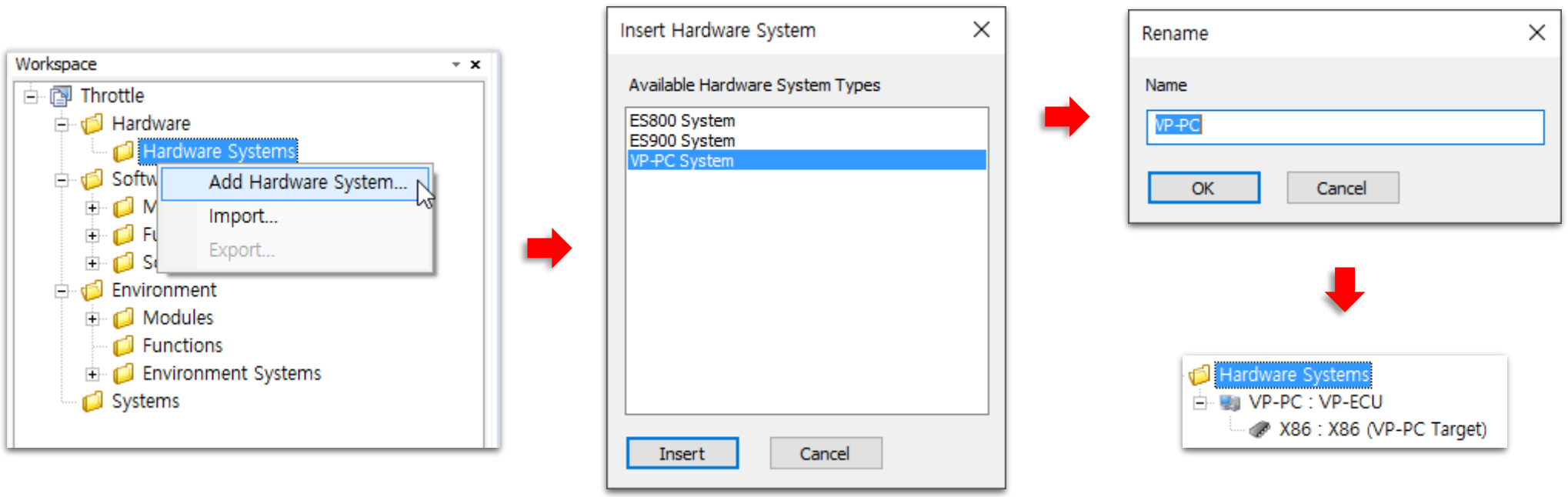
2. Initialize chain (**Important ! :** It must be executed whenever the configuration of the daisy chain changes.)
   - Hardware > Initialize chain



3. save it as a data model (*.xml)
   - File > Save

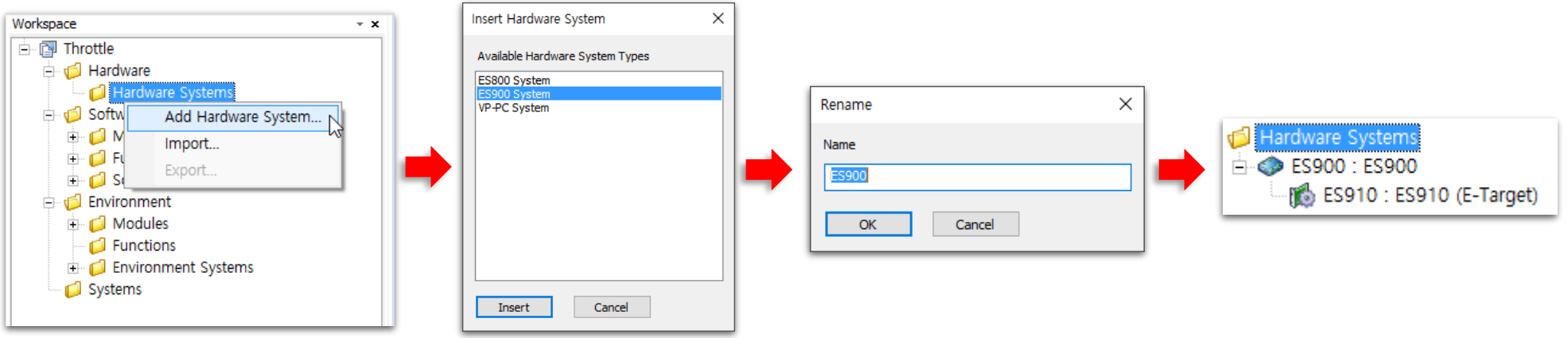


Creating and Setting Up the Hardware System : VP-PC

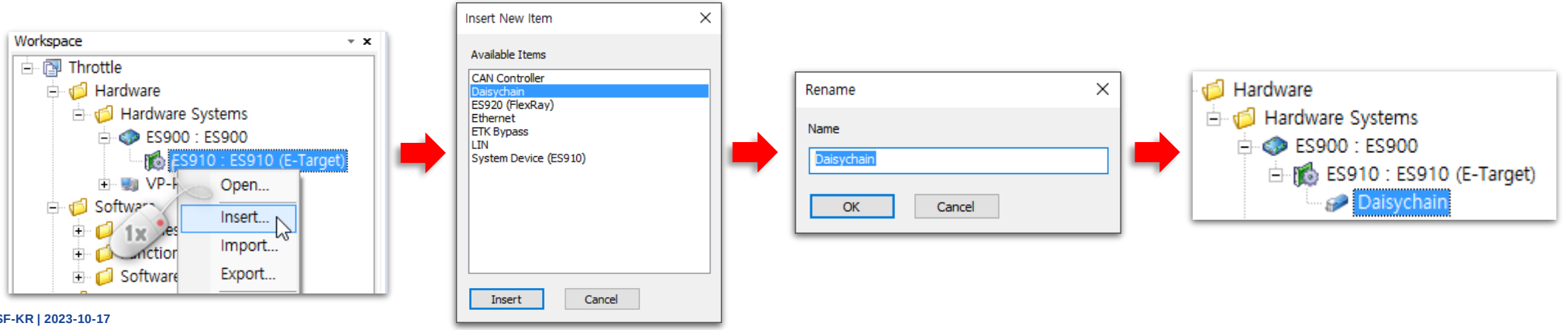


Creating and Setting Up the Hardware System : ES910 – Daisy chain

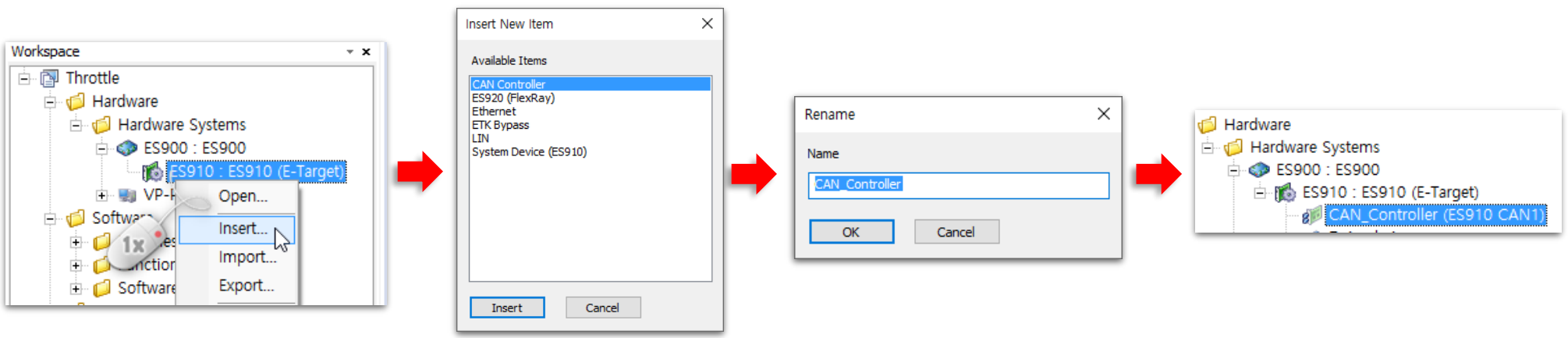
①



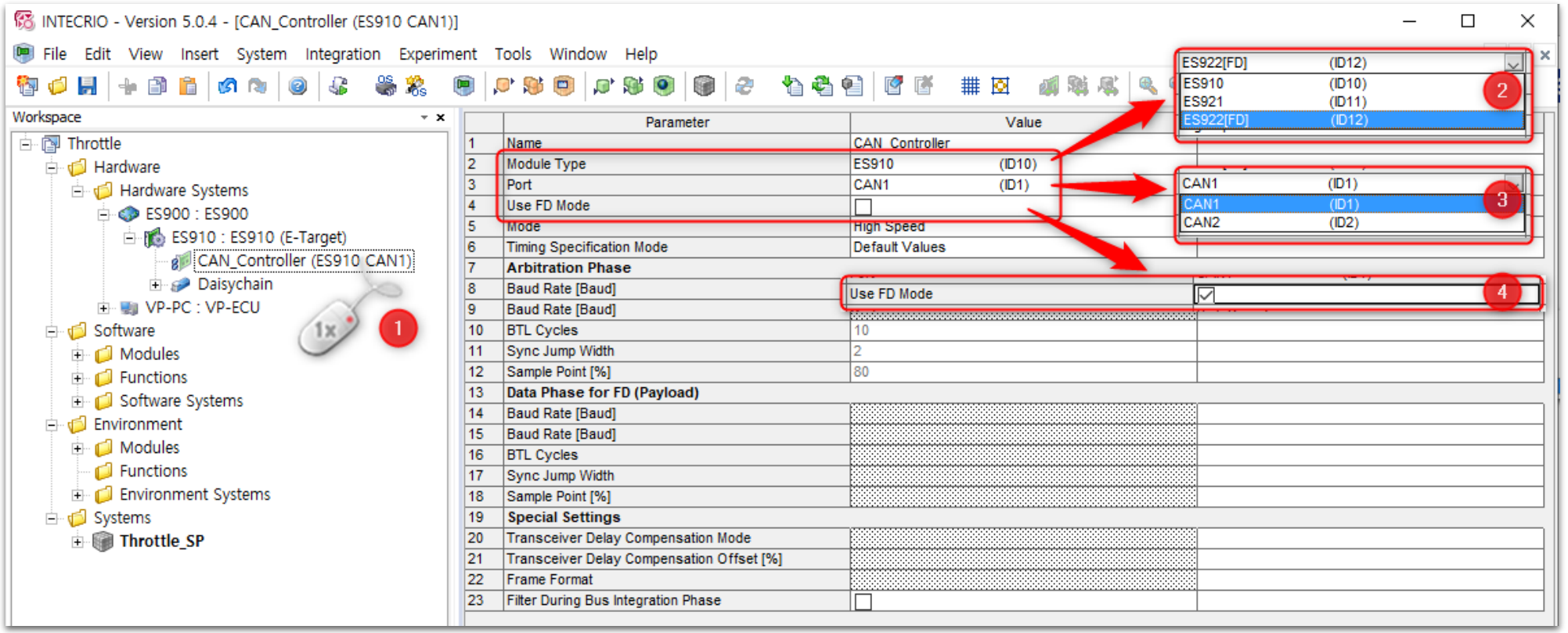
②



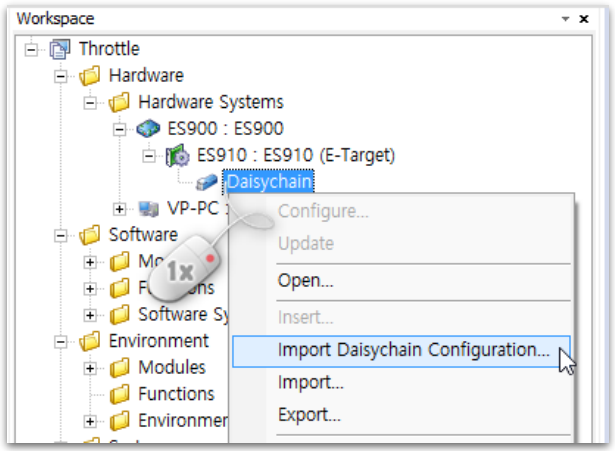
Creating and Setting Up the Hardware System : ES910 – CAN Controller

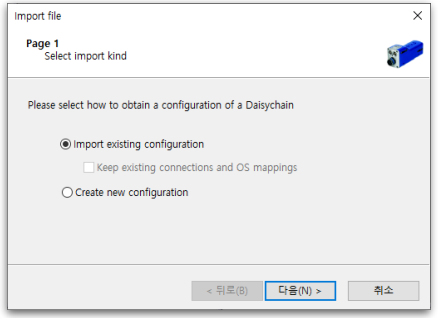


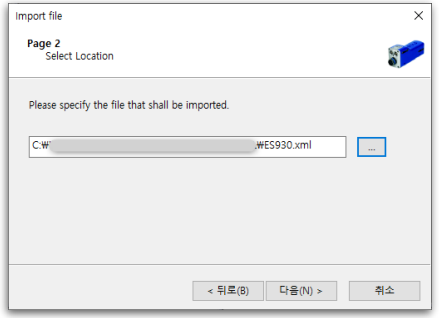
Creating and Setting Up the Hardware System : ES910 – CAN Controller (CAN FD)

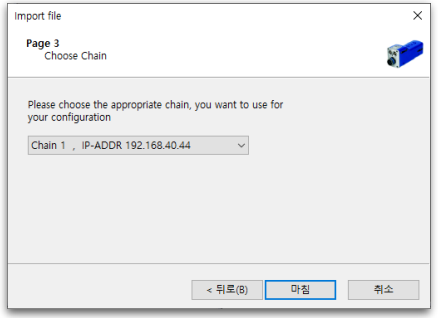


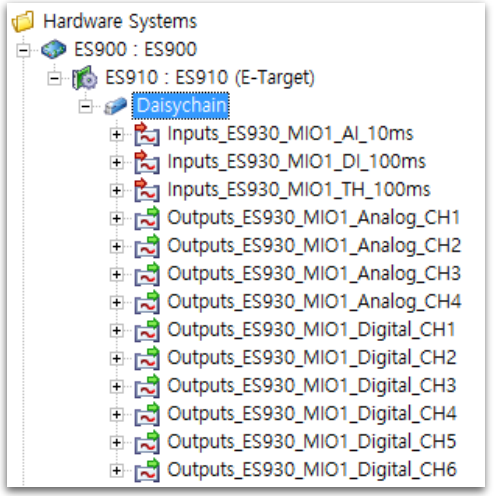
Create the daisy chain device



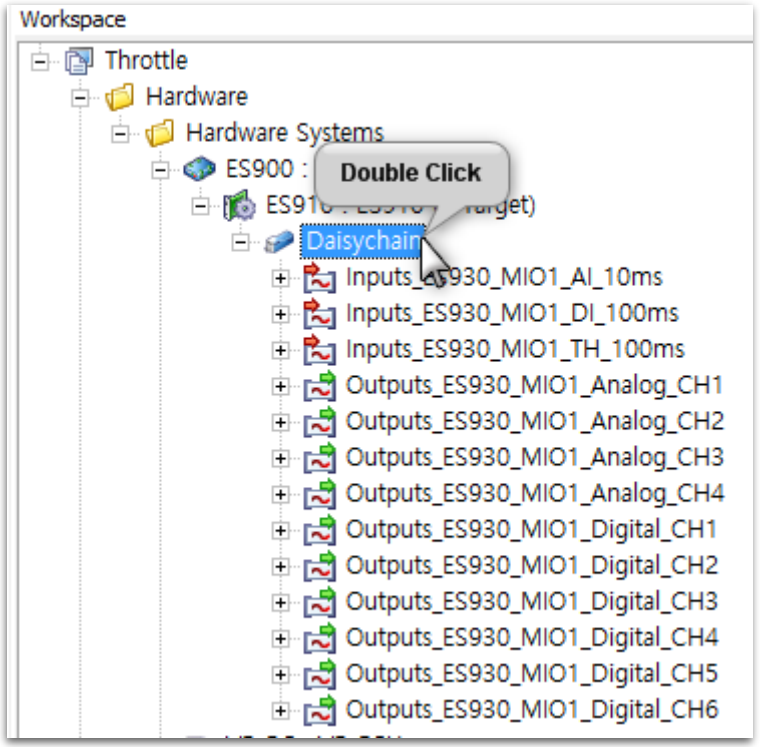


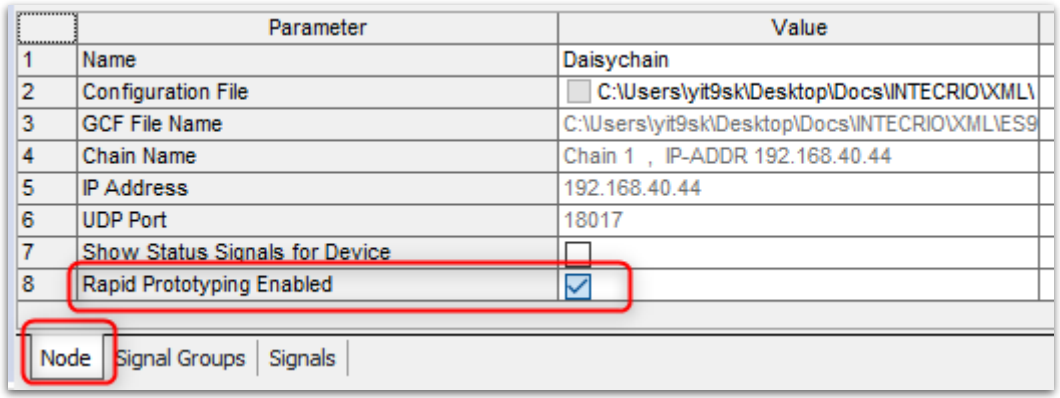






Configure the daisy chain device



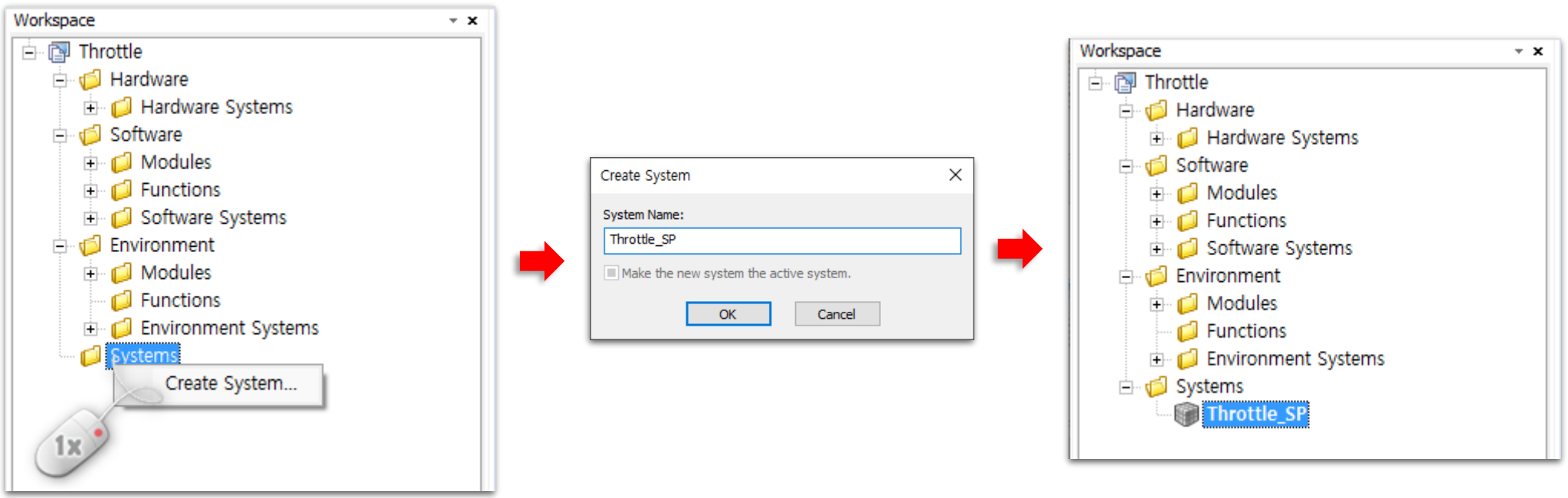


	Parameter	Value
1	Name	Daisychain
2	Configuration File	C:\Users\yit9sk\Desktop\Docs\INTECRIO\XML\
3	GCF File Name	C:\Users\yit9sk\Desktop\Docs\INTECRIO\XML\ES9
4	Chain Name	Chain 1 , IP-ADDR 192.168.40.44
5	IP Address	192.168.40.44
6	UDP Port	18017
7	Show Status Signals for Device	☐
8	Rapid Prototyping Enabled	☑

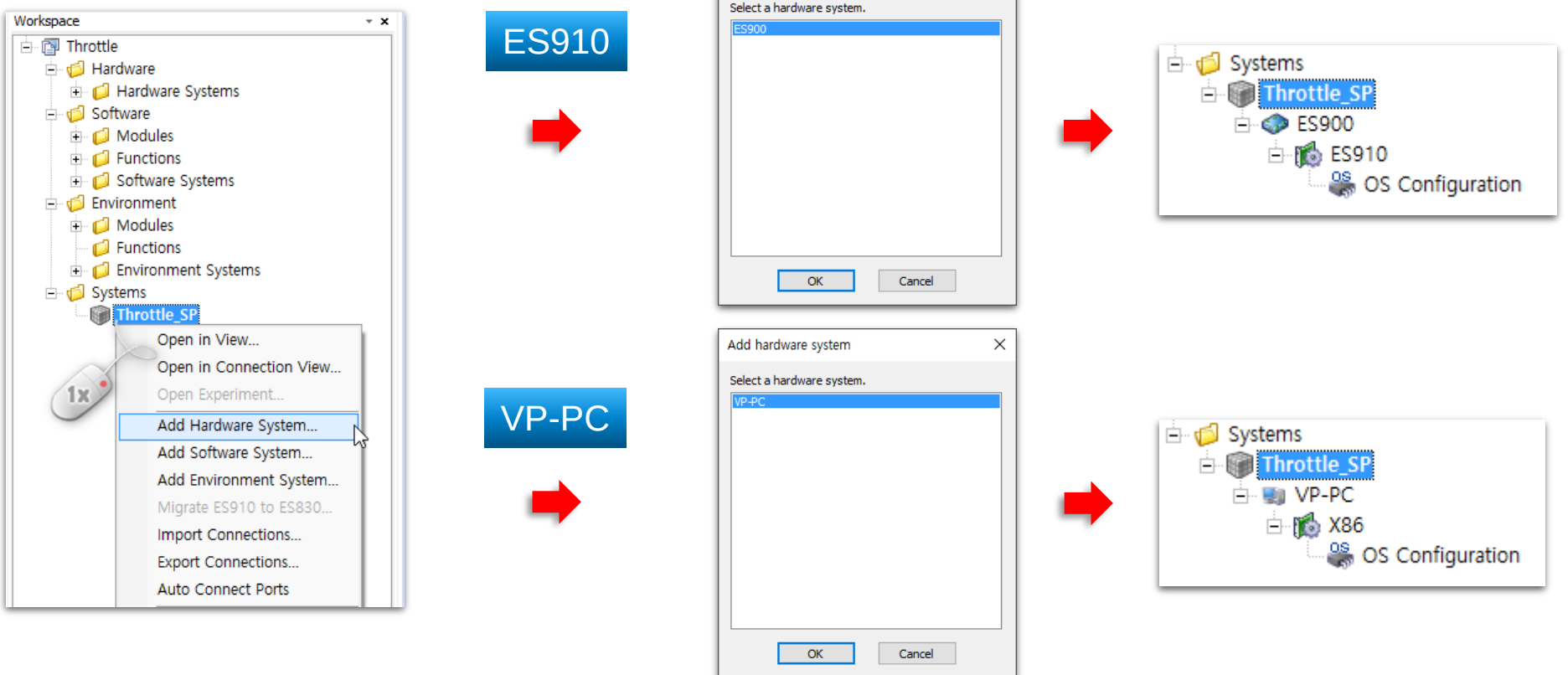
Node | Signal Groups | Signals

Create a system project

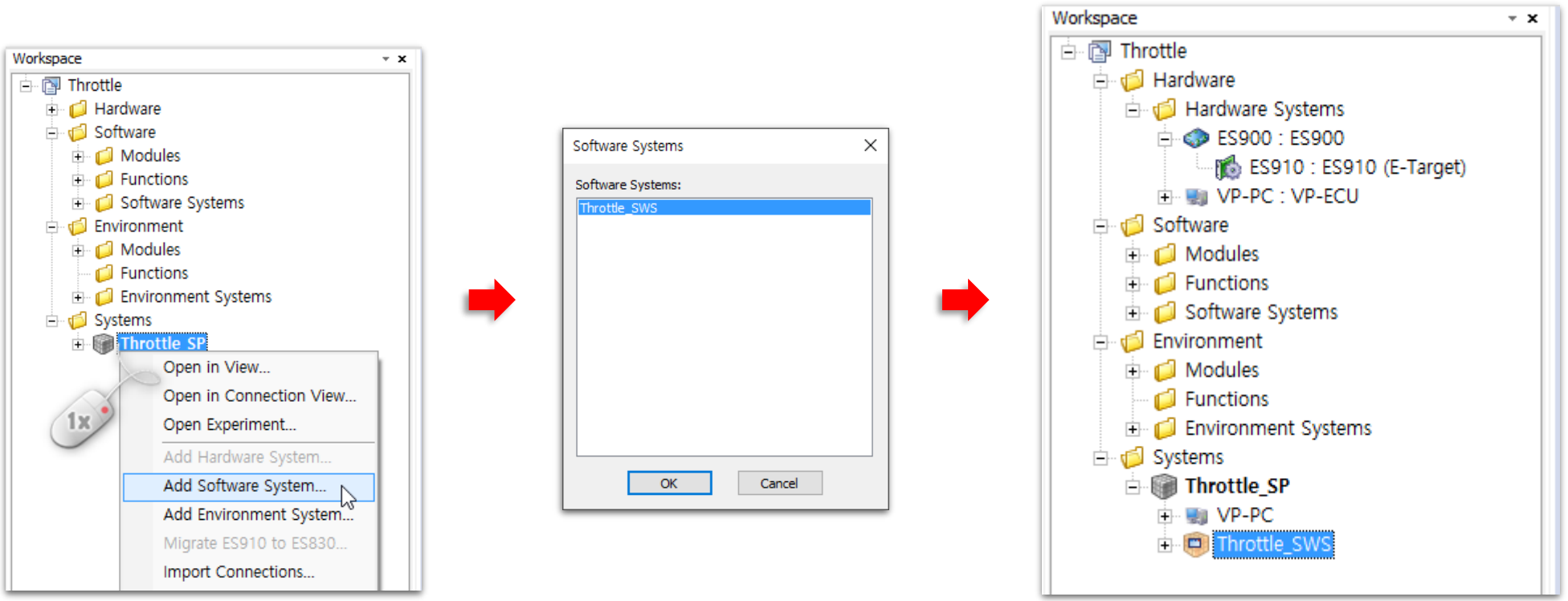
1. Integrate the hardware system in the system project.
2. Create a software system and integrate the function and the other modules.
3. Establish the signal connections in the software system and between the software and hardware.



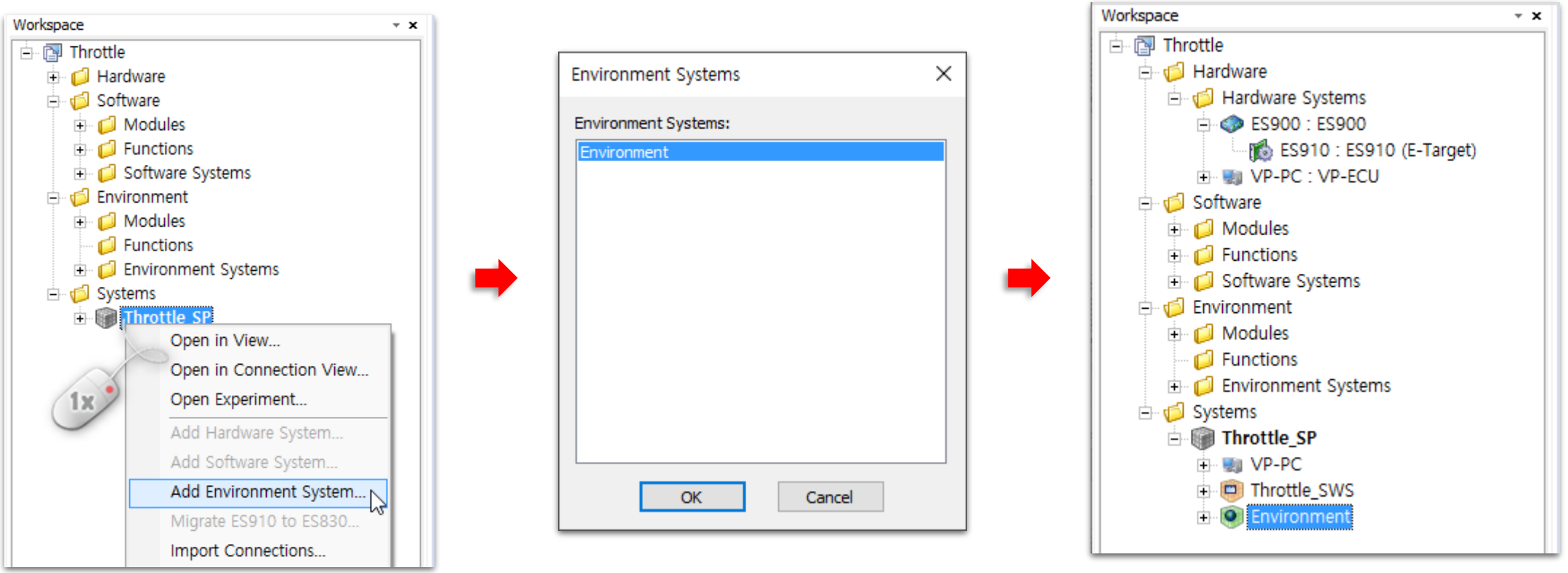
Add Hardware System



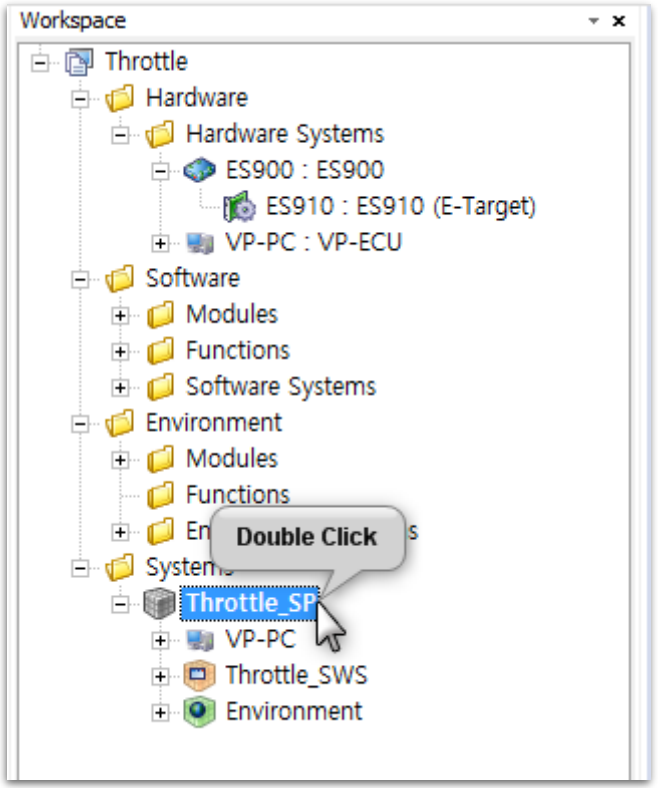
Add Software System



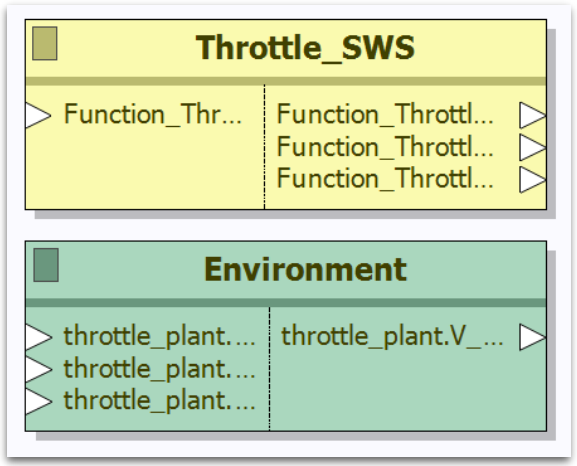
Add Environment System



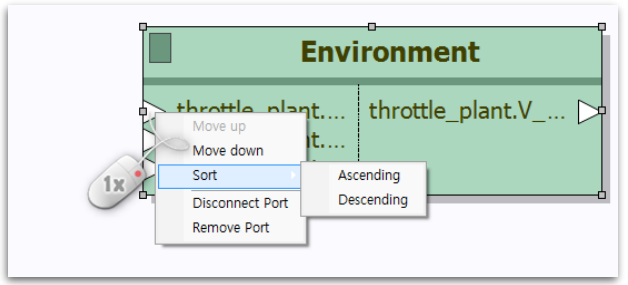
Open View & Sort



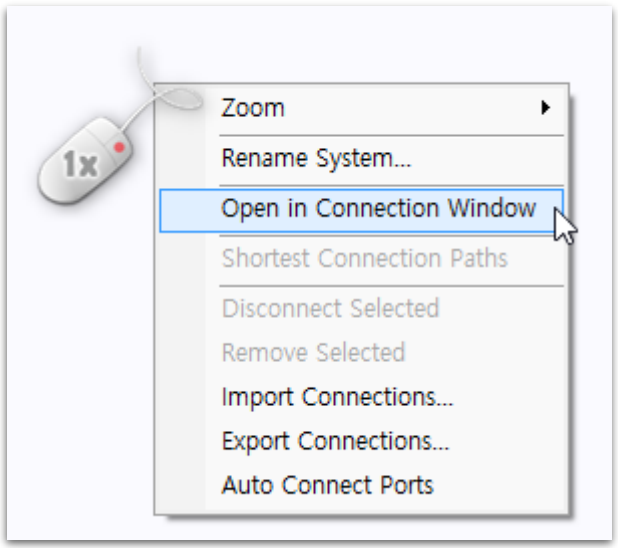
Graphic editor open

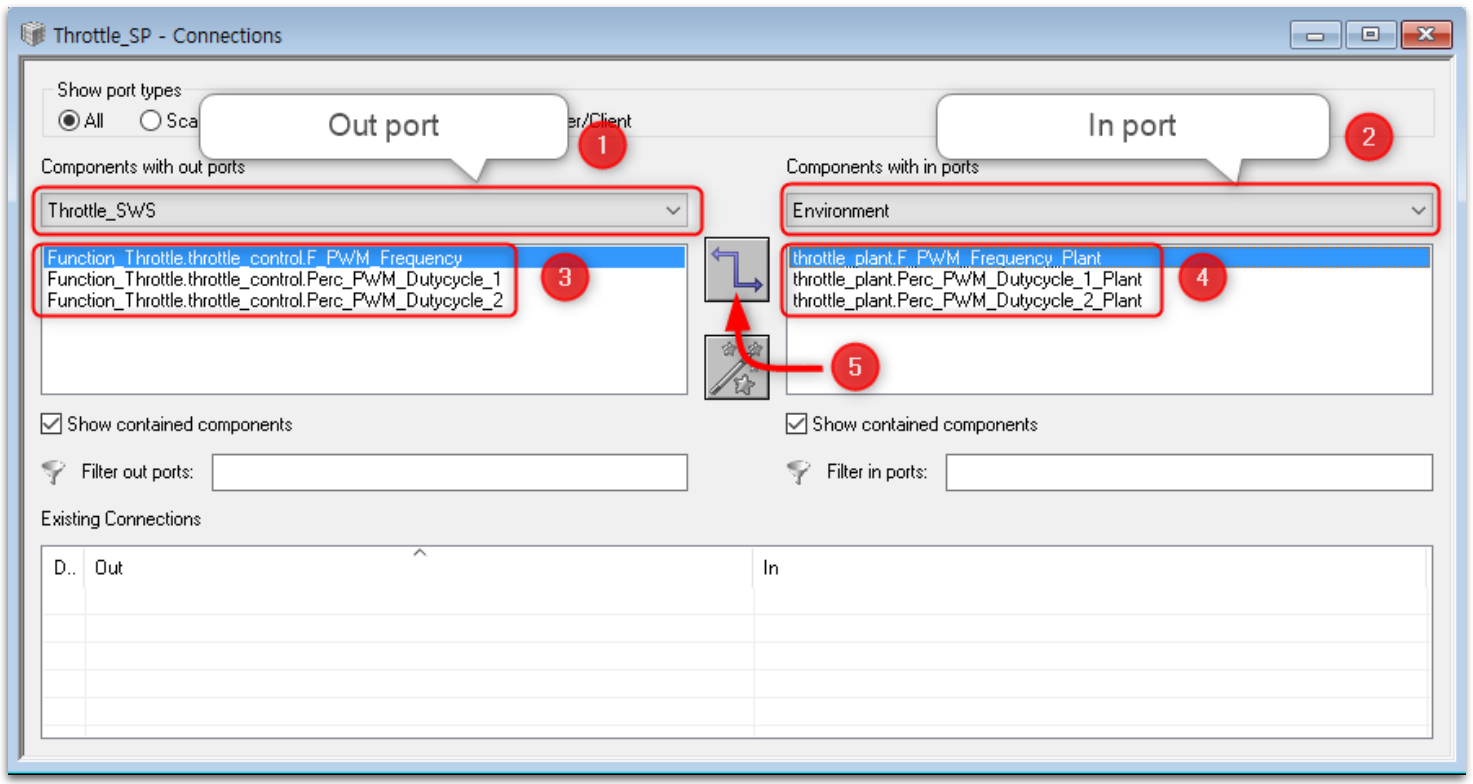


Sort the ports



Connect software system and environment system





Connect software system and environment system

Environment : Out → **Software system : In**

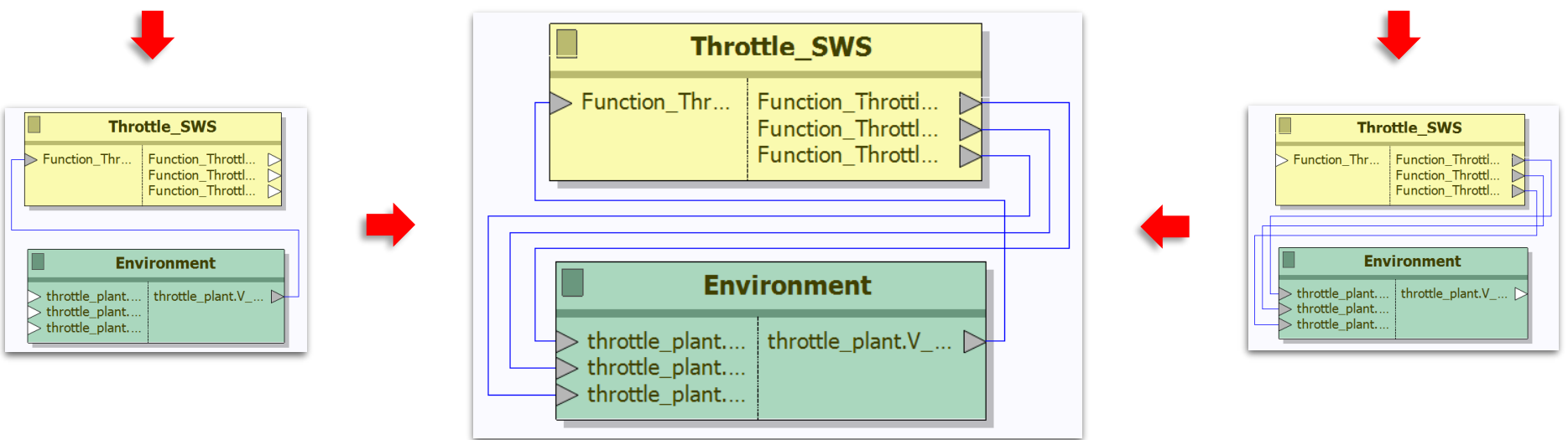
Existing Connections

D..	Out	In
☑	throttle_plant.V_Position_Signal_Raw_Plant	Function_Throttle.throttle_control.V_Position_Signal_Raw

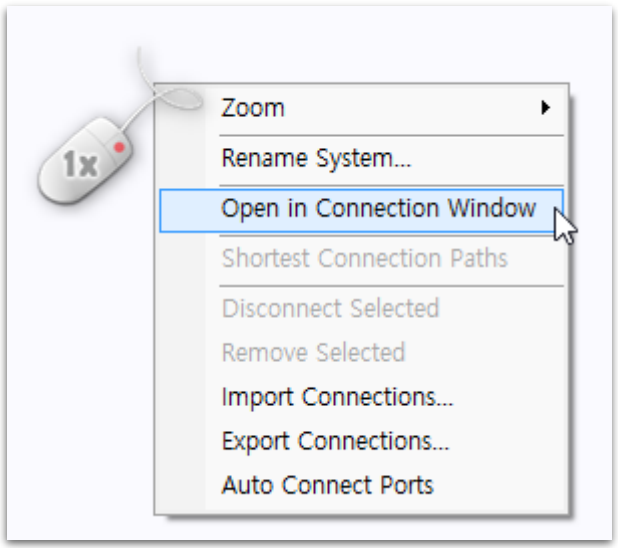
Software system : Out → **Environment : In**

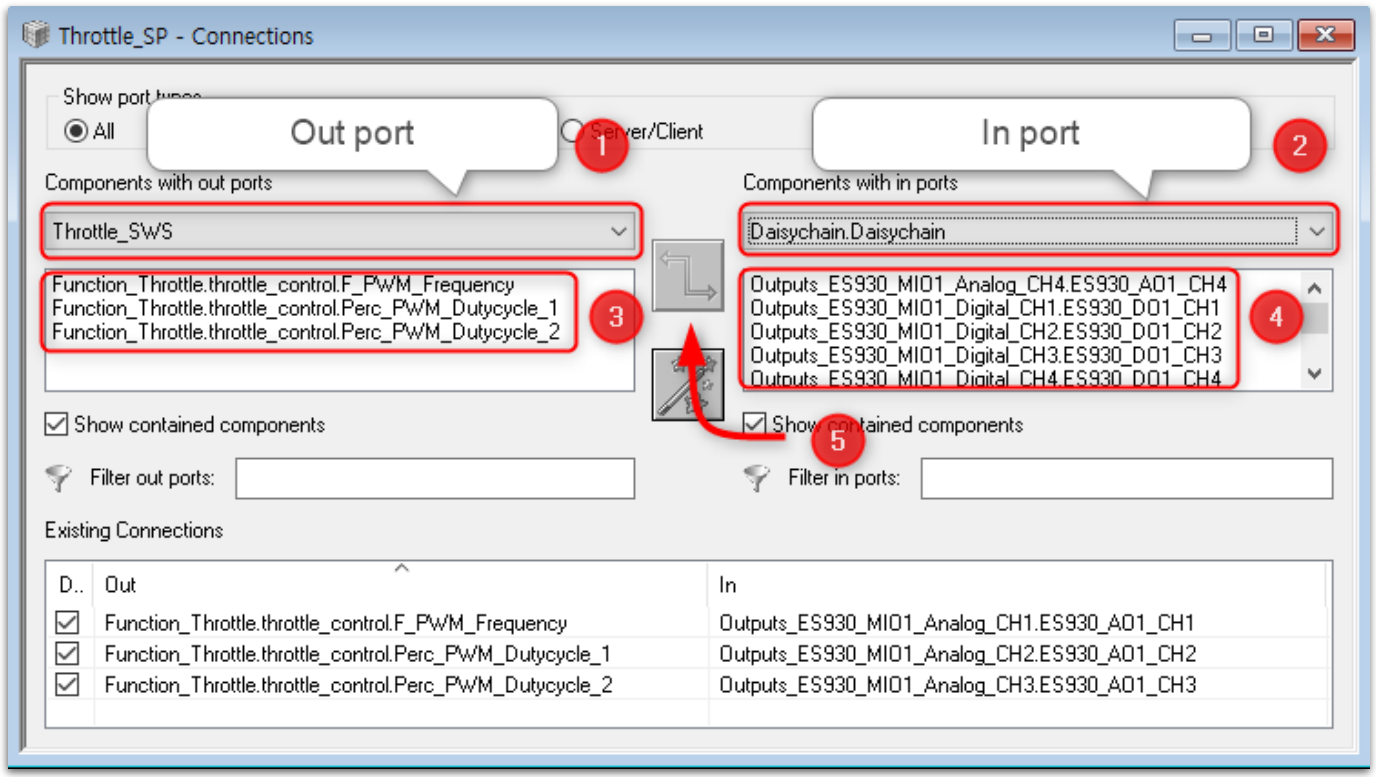
Existing Connections

D..	Out	In
☑	Function_Throttle.throttle_control.F_PWM_Frequency	throttle_plant.F_PWM_Frequency_Plant
☑	Function_Throttle.throttle_control.Perc_PWM_Dutycycle_1	throttle_plant.Perc_PWM_Dutycycle_1_Plant
☑	Function_Throttle.throttle_control.Perc_PWM_Dutycycle_2	throttle_plant.Perc_PWM_Dutycycle_2_Plant



Connect software system and daisy chain





Connect software system and daisy chain

Daisy chain : Out ➡ **Software system : In**

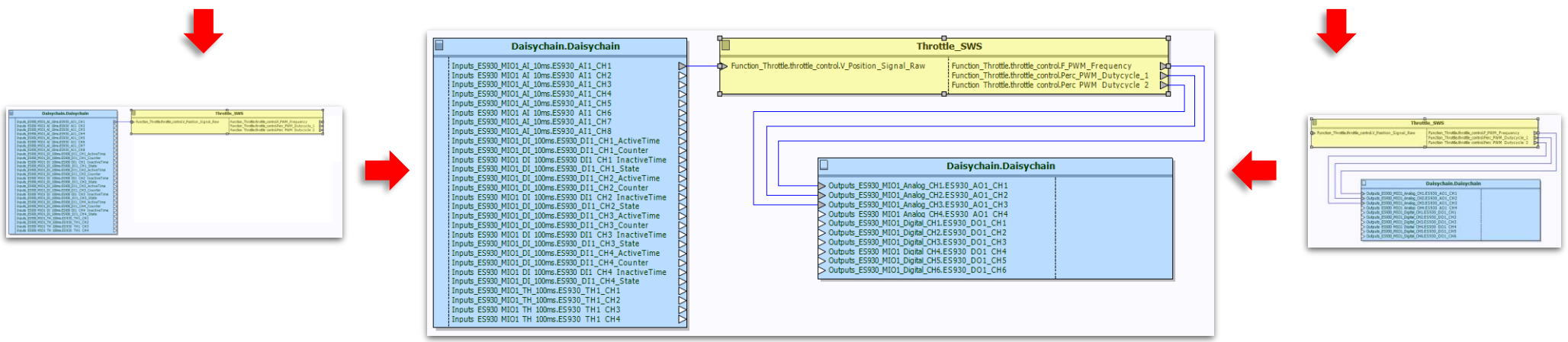
Existing Connections

D..	Out	In
☑	Inputs_ES930_MIO1_AI_10ms.ES930_AI1_CH1	Function_Throttle.throttle_control.V_Position_Signal_Raw

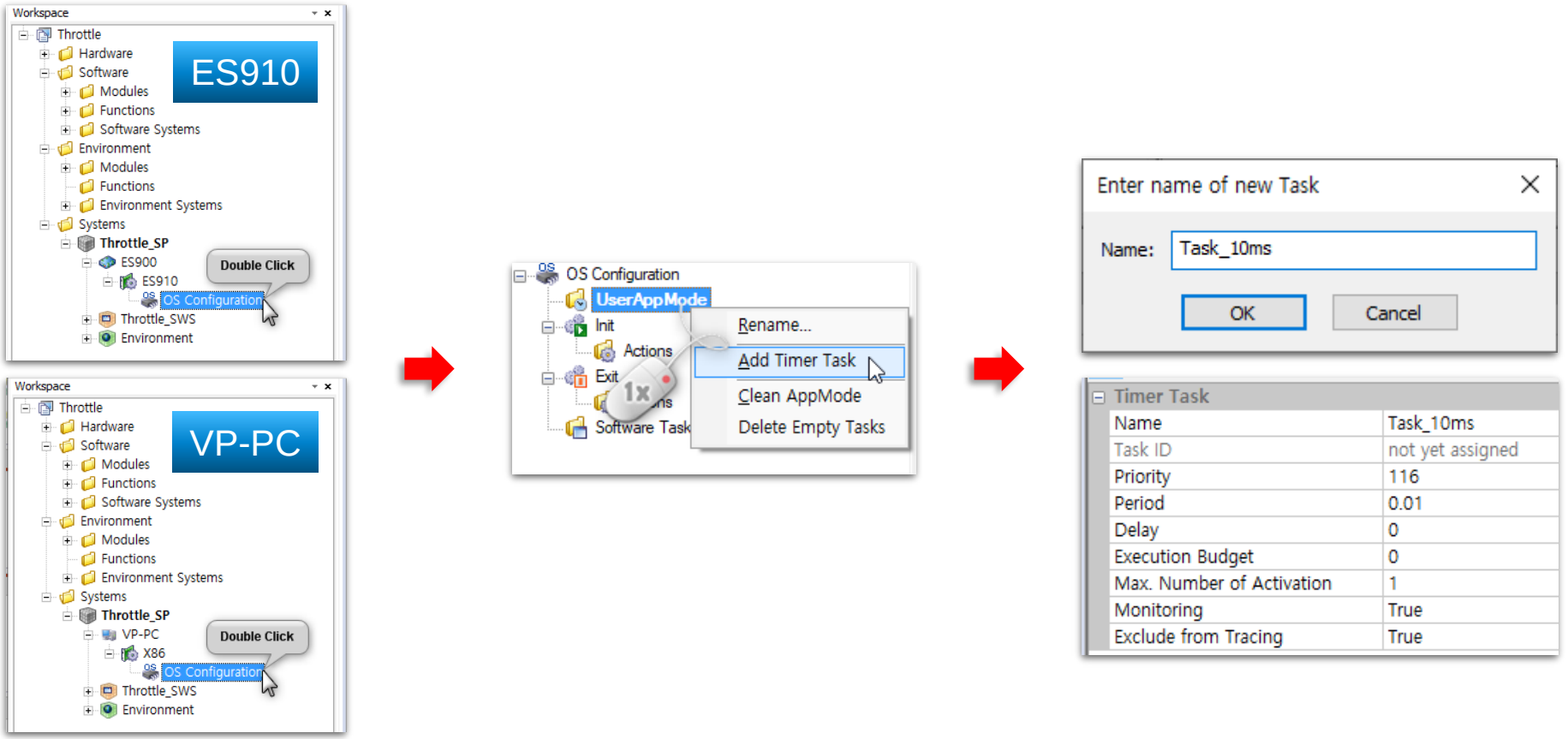
Software system : Out ➡ **Daisy chain : In**

Existing Connections

D..	Out	In
☑	Function_Throttle.throttle_control.F_PWM_Frequency	Outputs_ES930_MIO1_Analog_CH1.ES930_AO1_CH1
☑	Function_Throttle.throttle_control.Perc_PWM_Dutycycle_1	Outputs_ES930_MIO1_Analog_CH2.ES930_AO1_CH2
☑	Function_Throttle.throttle_control.Perc_PWM_Dutycycle_2	Outputs_ES930_MIO1_Analog_CH3.ES930_AO1_CH3

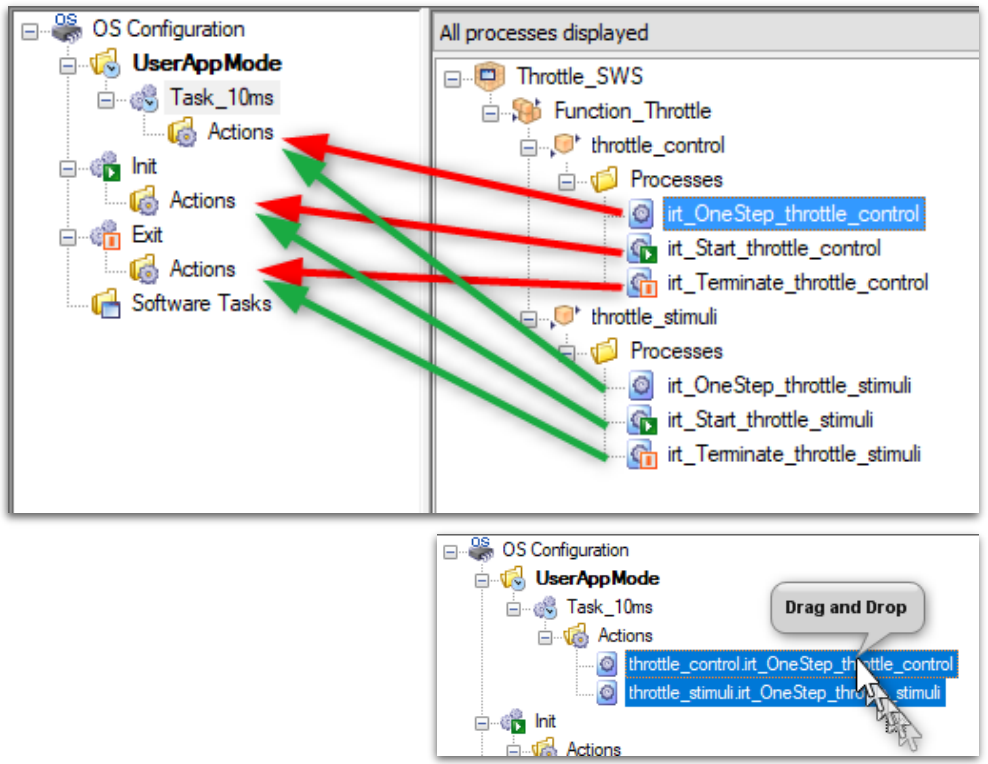


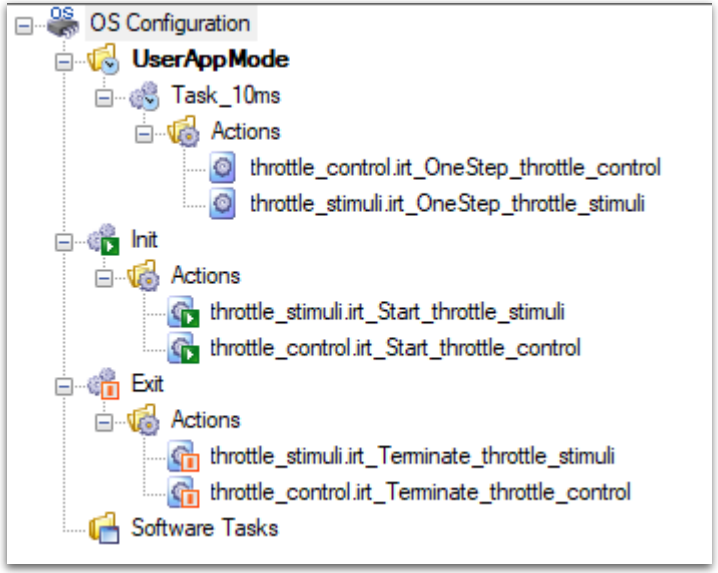
Configuration of the Operating System



OS Configurator

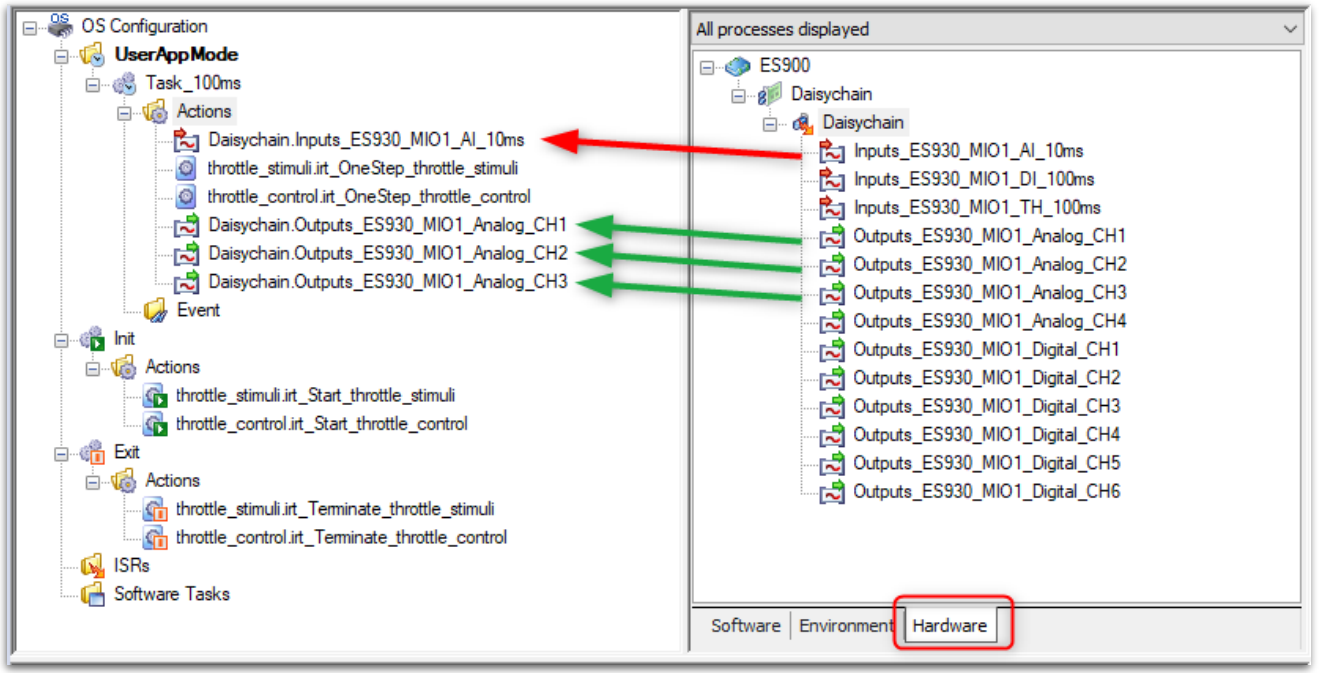
Assign processes to tasks





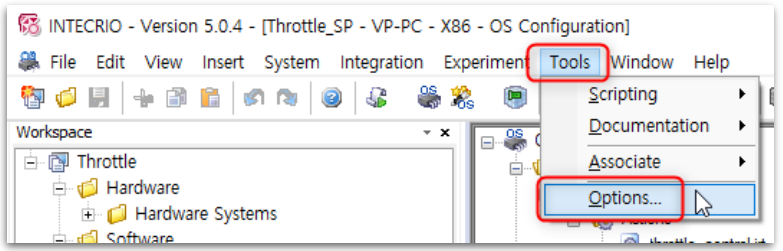
OS Configurator

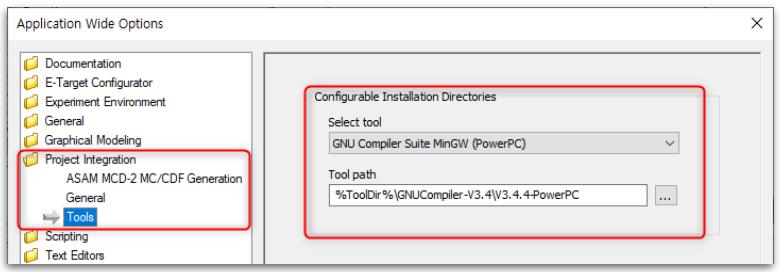
Assign processes to tasks for daisy chain



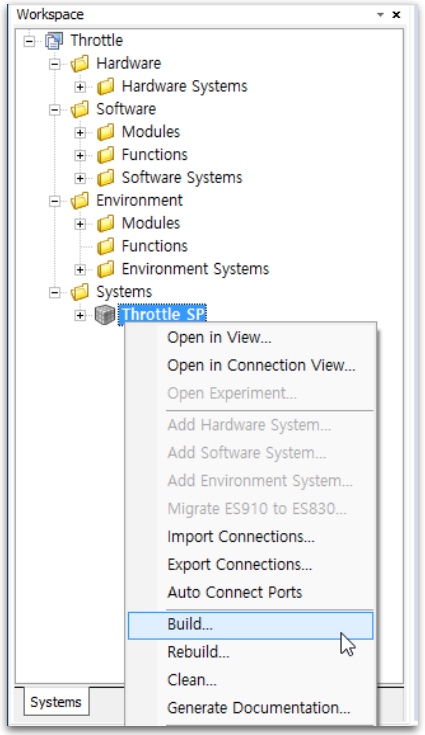
Build Process

Check & Set the compiler path





Build or Rebuild



Experiment Environment

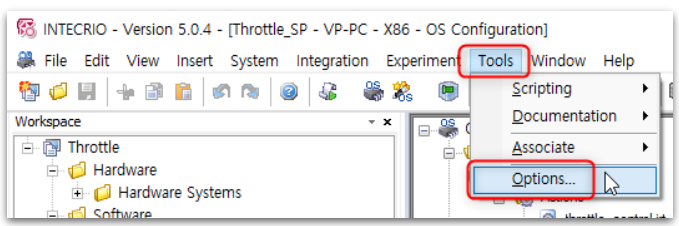
Experiment

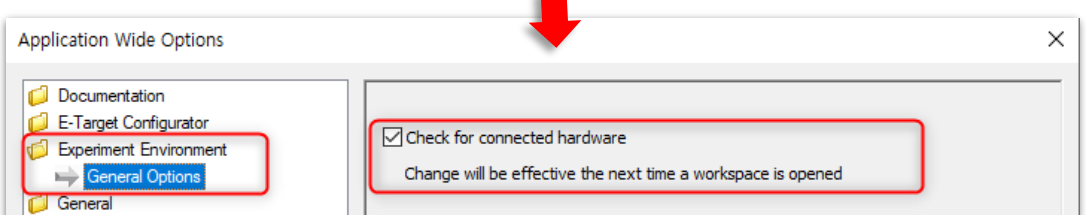
Experiment Environment download

https://www.etas.com/ko/downloadcenter/43016.php

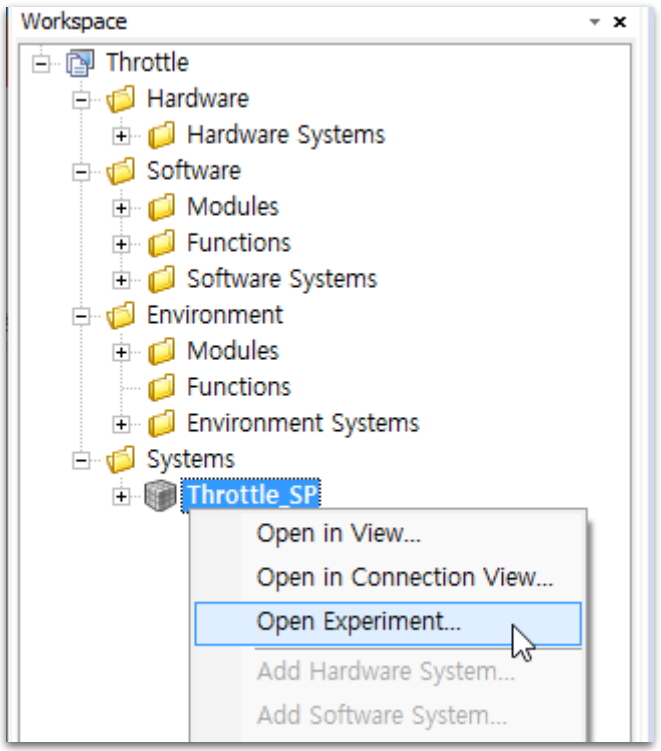
> **NOTE**
>
> Beginning with V5.0.4, INTECRIO supports ETAS Experiment Environment V3.8.4.
> ETAS Experiment Environment V3.7 is *no longer supported*.
> ETAS Experiment Environment V3.9 is *not supported*.
> Instead of the ETAS Experiment Environment, you can use INCA V7.4 with INCA-EIP to experiment with an ES800 hardware system.

Check for connected hardware





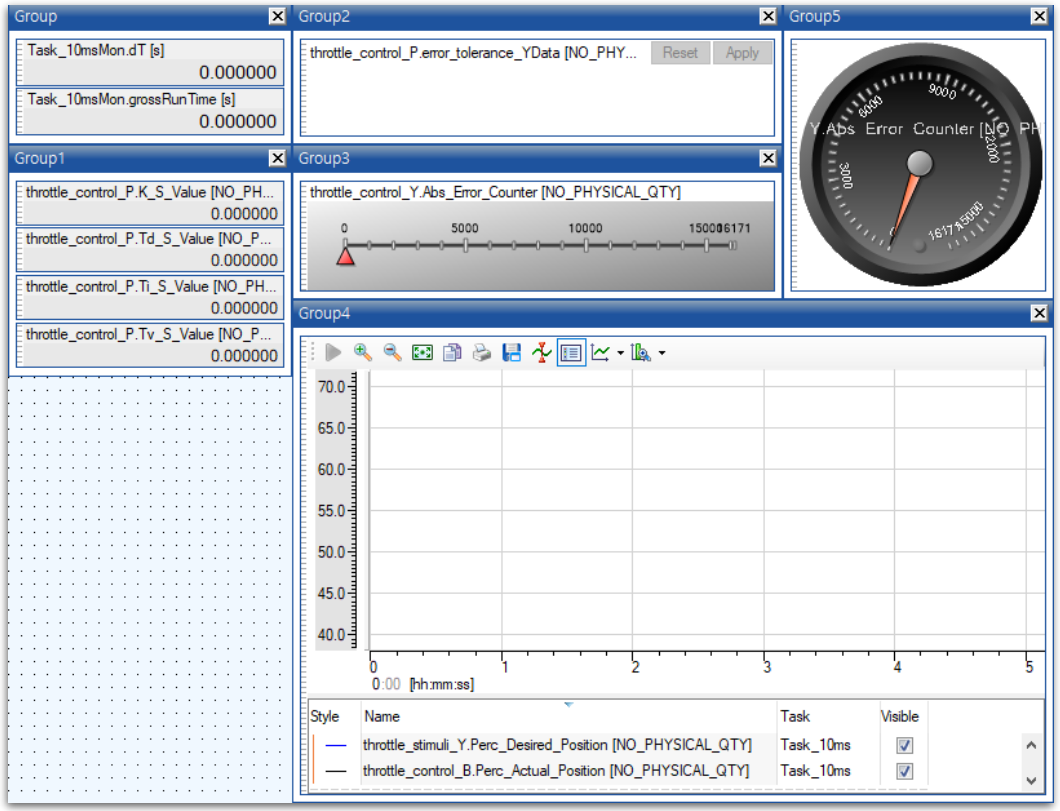
Open Experiment Environment



Experiment Environment

Experiment

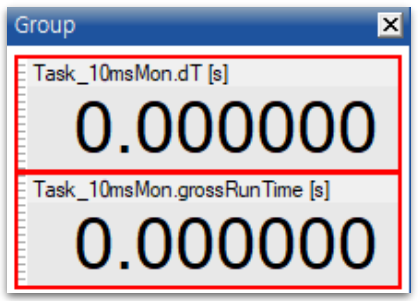
Open Experiment

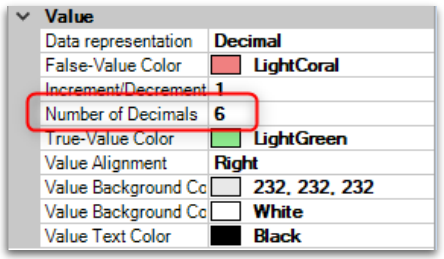


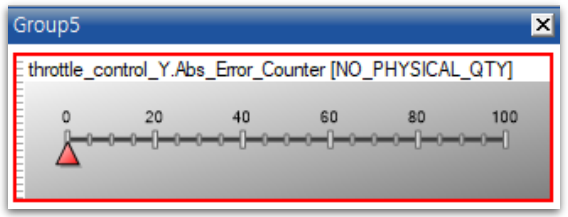
Experiment Environment

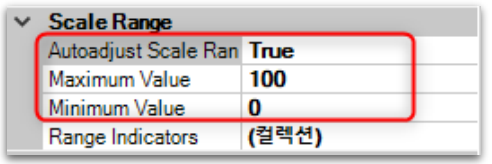
Experiment

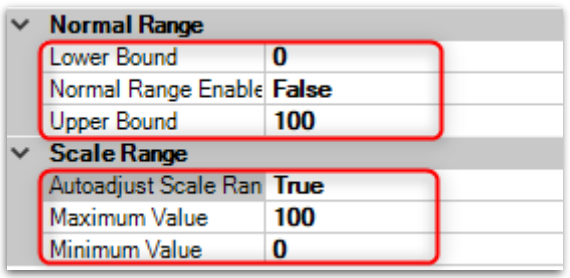
Setting up the Experiment

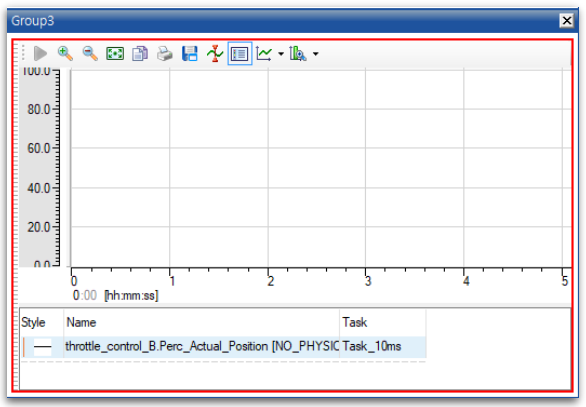


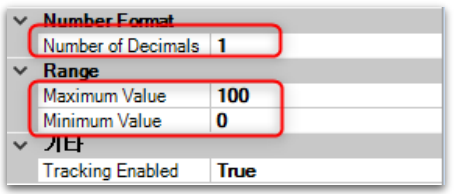


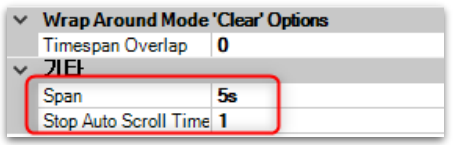








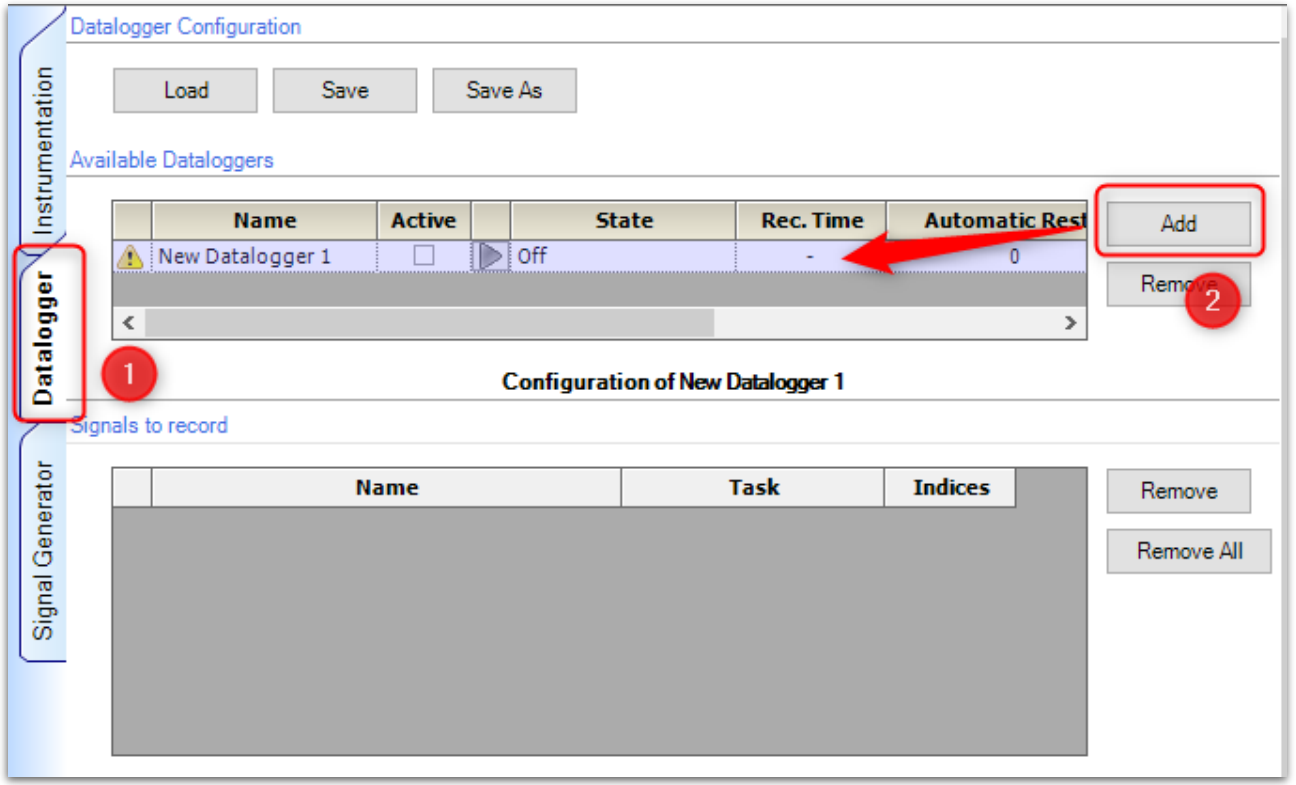




Experiment Environment

Experiment

Configuring Data Acquisition

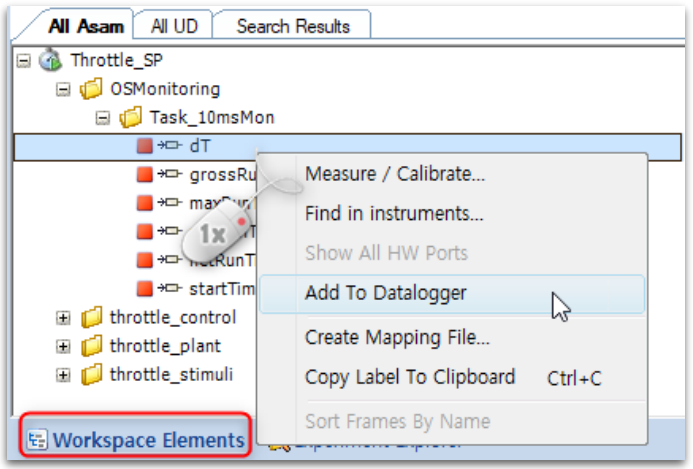


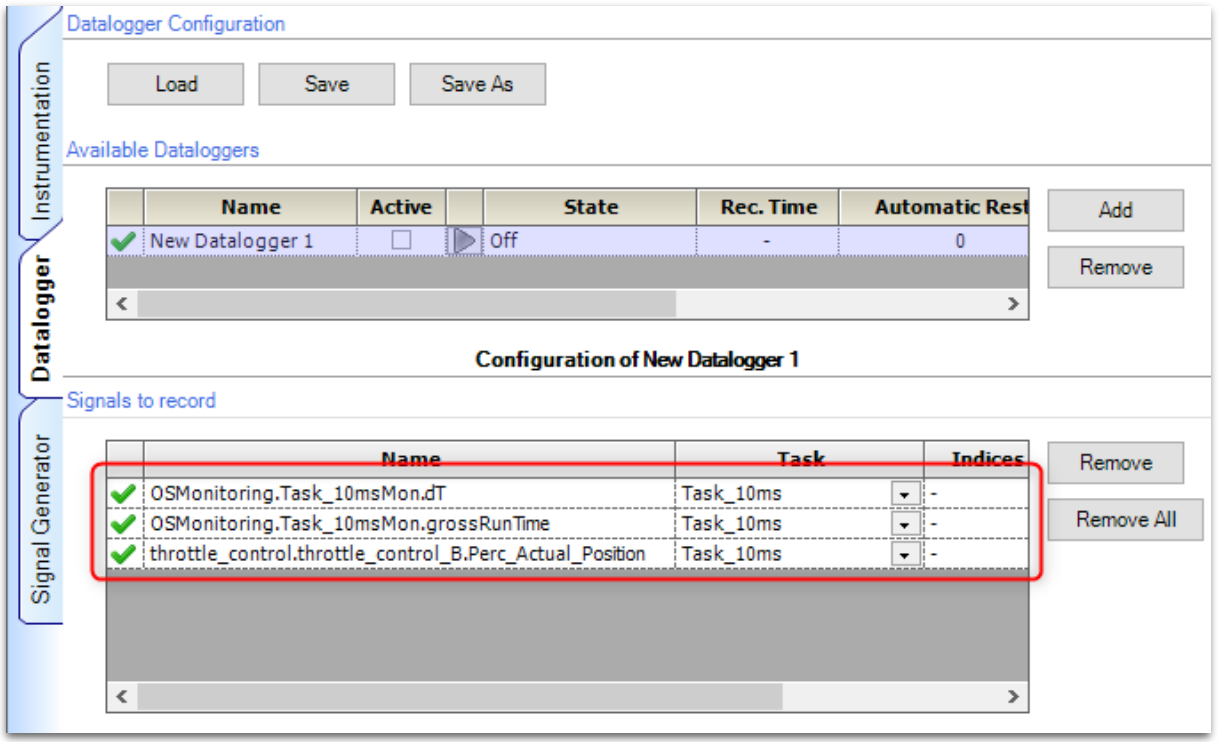
Experiment Environment

Experiment

Create a data logger

Select measurement variables to be acquired



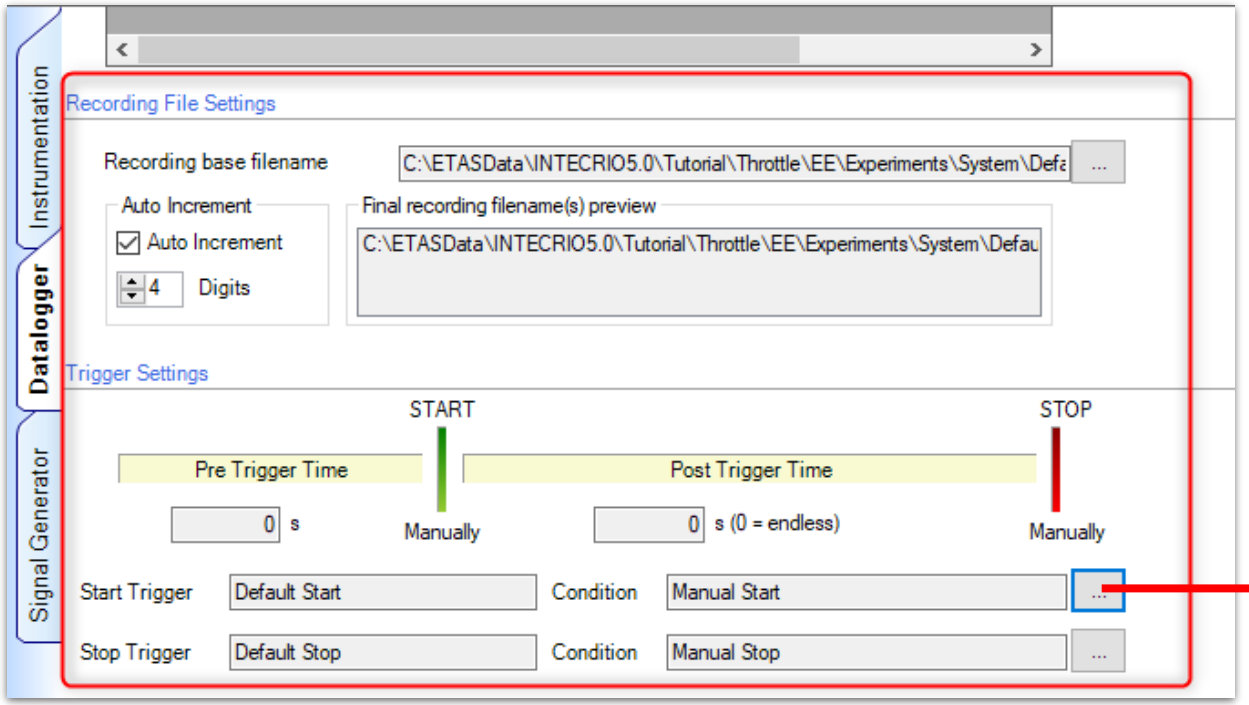


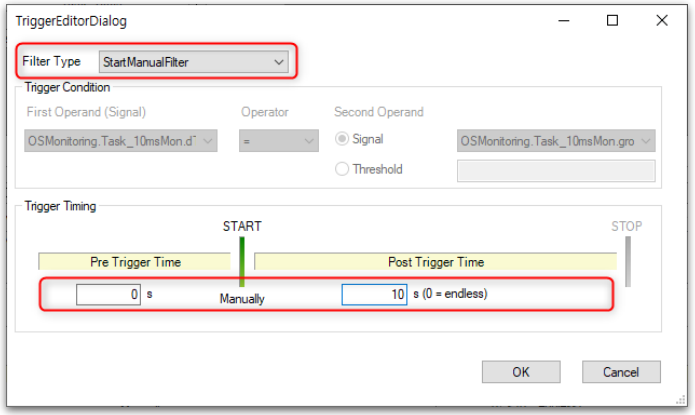
Experiment Environment

Experiment

Create a data logger

Determine a log file & specify acquisition time



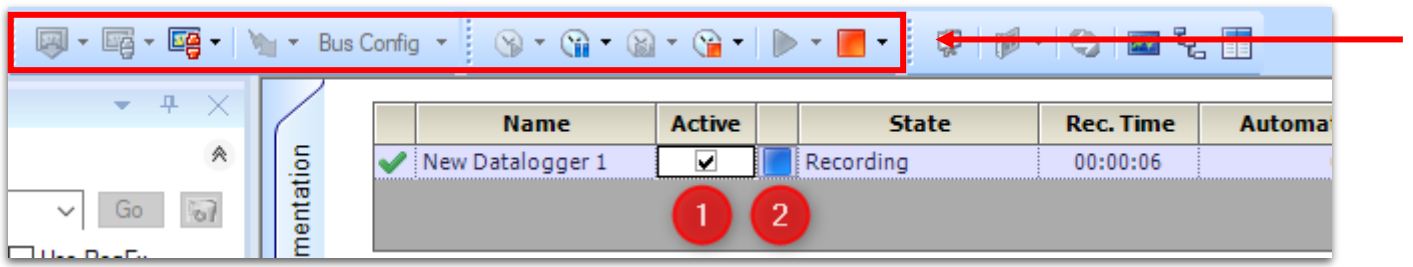


Experiment Environment

Experiment

Data Acquisition

Start measure data acquisition manually while the measurement is running.



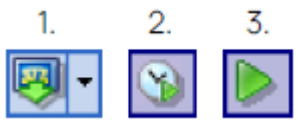
① “Active” column to activate the data logger
② Start data acquisition

The measure data is saved in the specified directory.
You can analyze the data with an appropriate tool.

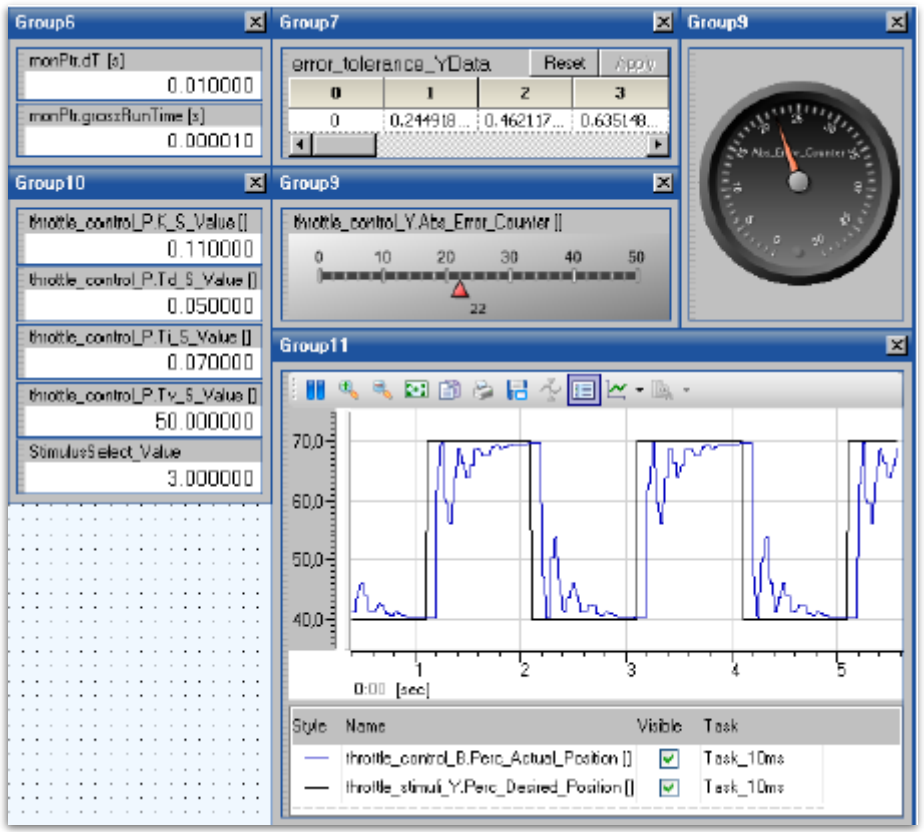
Experiment Environment

Experiment

Starting Simulation



1. Download
2. Start Simulation
3. Start Measurement



Appendix

ES910 (ES920, ES922), ES930, Cables

Rapid Prototyping Devices

ES910

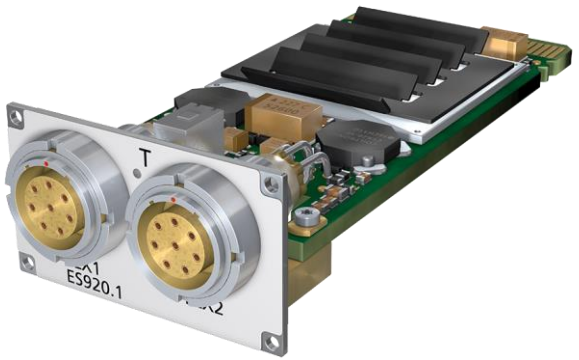
ES910

Rapid prototyping can be executed with the compact module ES910.3-A.

The ES910.3-A has a simulation controller and the ECU interfaces CAN, LIN, ETK and XETK and also one interface for Daisy Chain modules (ES4xx/ES63x/ES93x modules).

Rapid Prototyping Devices

ES920, ES922 Modules



ES920 – FlexRay Module

The ES920 FlexRay Module adds a FlexRay bus interface to the compact ES910 Prototyping and Interface Module. It is plugged into the extension slot of the ES910 module.

ES922 – CAN FD Module

The ES922 CAN FD module provides two additional CAN FD interfaces for the compact ES910 Prototyping and Interface Module. It is plugged into the extension slot of the ES910.3 module.

Rapid Prototyping Devices

ES930

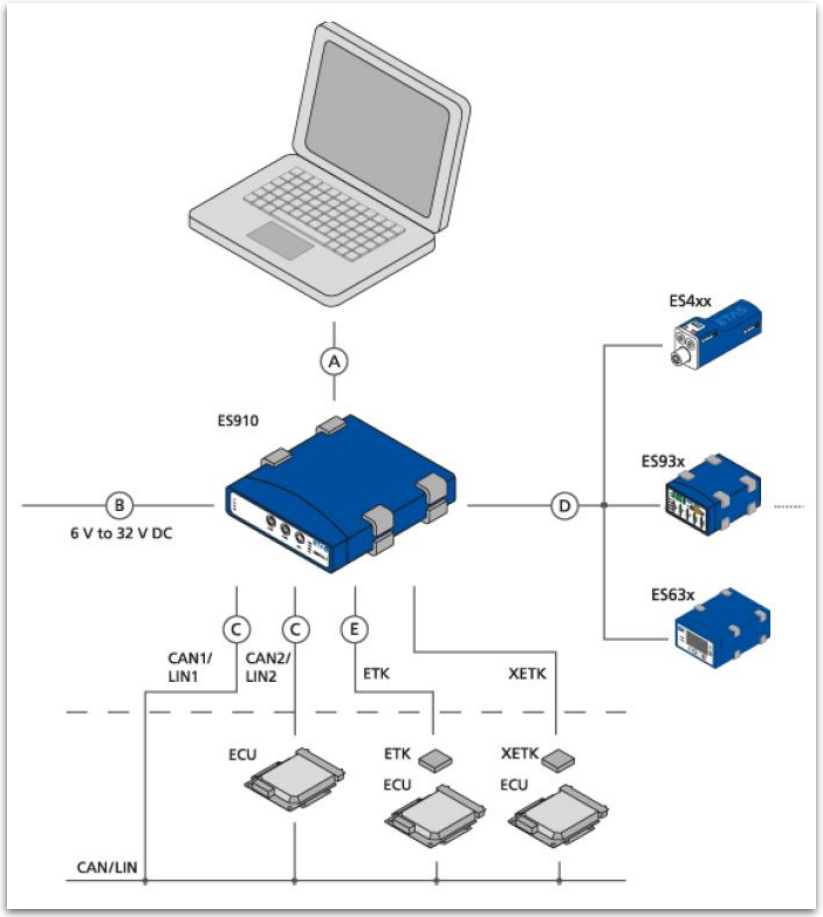
ES930

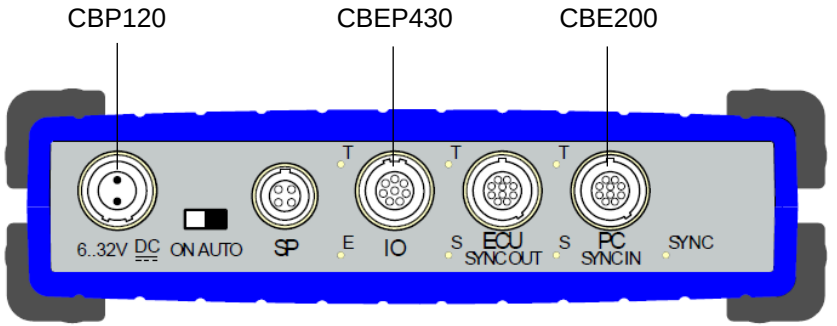
The ES930.1 Multi-I/O Module is a compact, robust and powerful metrology module with numerous input and output channels.

The module can be used for a variety of measuring tasks or for the control of additional hardware in the development, application and validation of electronic vehicle systems in the vehicle or the lab.

Rapid Prototyping Devices

ES910 with Daisy Chain Modules

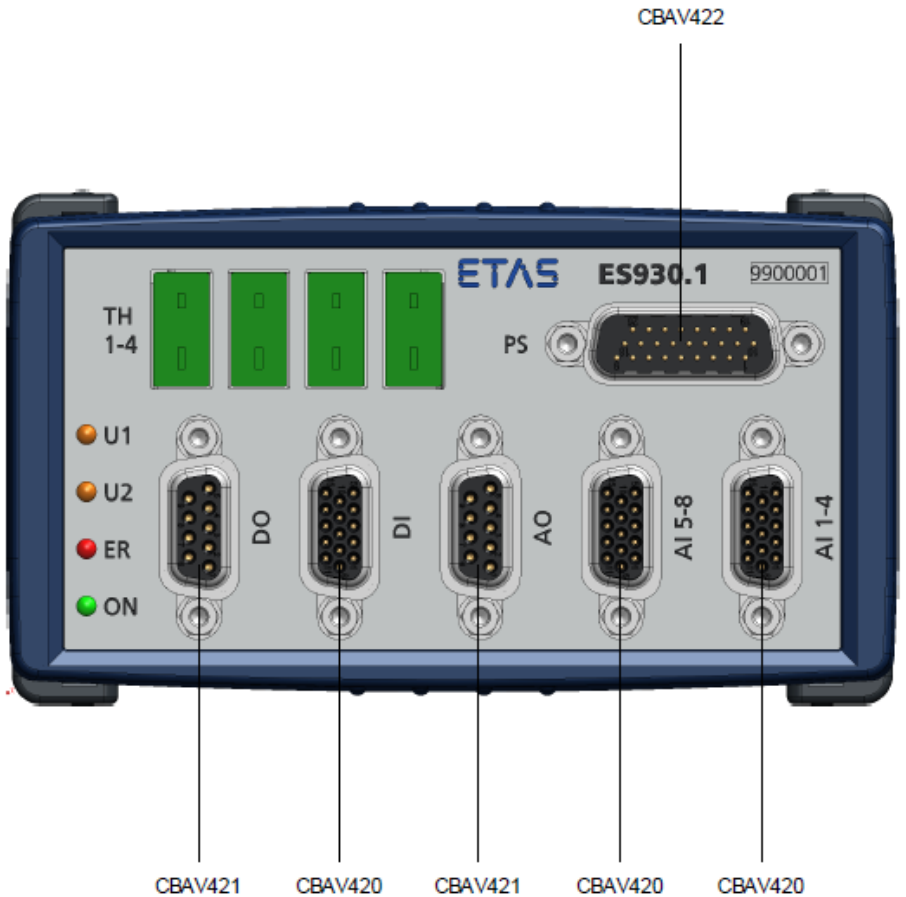




Cables in Fig. 10-7	Function	Short name
A	PC connection cable	CBE200
B	Power supply cable	CBP120
C	CAN/ LIN/ FlexRay connection cable	CBCFI100
D	Combined power supply and Ethernet cable	CBEP430
E	ETK connection cable	CBM150

Rapid Prototyping Devices

Front side of ES930

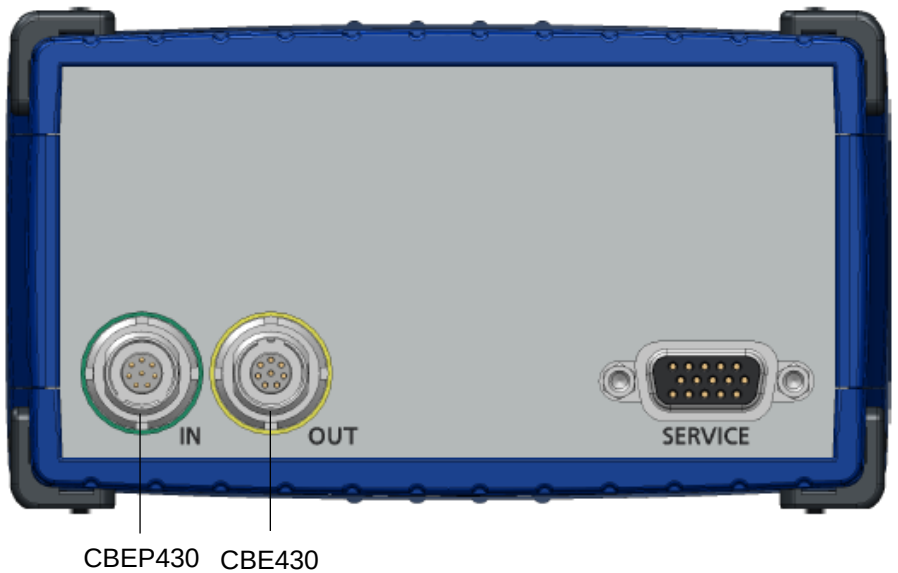


Name	Connection	Meaning
TH1-4	Thermo channel	Thermo measurement (channel 1 to channel 4)
PS	Power stages	Power stages (6 half bridges with current measurement) and external supply
DO	Digital outputs	Digital output channels (channel 1 to channel 6)
DI	Digital inputs	Digital input channels (channel 1 to channel 4)
AO	Analog outputs	Analog output channels (channel 1 to channel 4)
AI 5-8	Analog inputs	Analog input channels (channel 5 to channel 8); sensor supply channels (channel 3 and channel 4)
AI 1-4	Analog inputs	Analog input channels (channel 1 to channel 4); sensor supply channels (channel 1 and channel 2)

LED ER	LED ON	Operating state	Comment
Off	Off	Module off	No power supply, power supply defective
Off	Green	Normal	Module on, no error
Red	Off	Hardware error	Internal error
Red	Green	LED test	Briefly during initialization of the module
Red	Green	Internal error	Module features no valid calibration. Measurements are possible in principle. The measuring accuracy is out of specification. Send the module to ETAS for calibration/ repair.
Red, flashing	Green	Update process	Update of firmware

Rapid Prototyping Devices

Rear side of ES930



Name	Connection	Meaning
IN	Daisy chain In	Input; Ethernet connection to the previous module or the PC, power supply of the module
OUT	Daisy chain Out	Output; Ethernet connection and power supply of the succeeding module
SERVICE	Service	Reserved; for ETAS-internal application only; no provision of functions for the customer

Rapid Prototyping Devices

ES930 - "DO" connection (CBAV421)

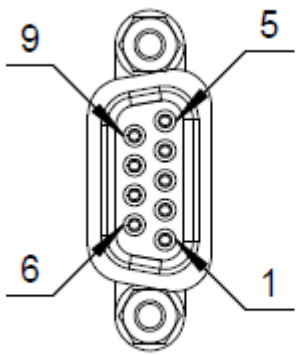


Fig. 13-1 "DO" connection

ES930.1 "DO" connection		Meaning
Pin	**Signal**	
1	DO_CH1	Digital output channel 1
2	DO_CH2	Digital output channel 2
3	DO_CH3	Digital output channel 3
4	DO_CH4	Digital output channel 4
5	DO_CH5	Digital output channel 5
6	DO_CH6	Digital output channel 6
7	DO_GND	Digital output channel, ground *)
8	DO_GND	Digital output channel, ground *)
9	DO_GND	Digital output channel, ground *)

*) : common ground

Rapid Prototyping Devices

ES930 - "DI" connection (CBAV420)

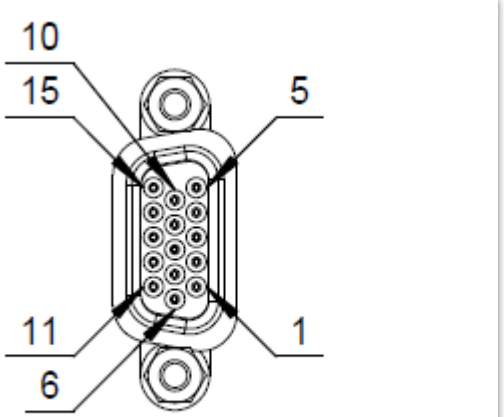


Fig. 13-2 "DI" connection

ES930.1 "DI" connection		Meaning
Pin	Signal	
1	DI_CH1	Digital input channel 1
2	DI_CH2	Digital input channel 2
3	DI_CH3	Digital input channel 3
4	DI_CH4	Digital input channel 4
6	DI_CH1_GND	Digital input channel 1, ground *)
7	DI_CH2_GND	Digital input channel 2, ground *)
8	DI_CH3_GND	Digital input channel 3, ground *)
9	DI_CH4_GND	Digital input channel 4, ground *)
5, 10, 11, 12, 13, 14, 15	N.C.	Not connected

*) : common ground

Rapid Prototyping Devices

ES930 - “AO" connection (CBAV421)

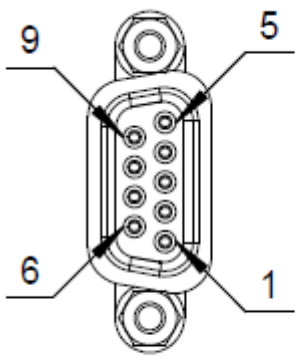


Fig. 13-3 "AO" connection

ES930.1 "AO" connection		Meaning
Pin	Signal	
1	AO_CH1	Digital output channel 1
2	AO_CH2	Digital output channel 2
3	AO_CH3	Analog output channel 3
4	AO_CH4	Analog output channel 4
5	N.C.	Not connected
6	N.C.	Not connected
7	AO_GND	Analog output channel, ground *)
8	AO_GND	Analog output channel, ground *)
9	AO_GND	Analog output channel, ground *)

*) : common ground

Rapid Prototyping Devices

ES930 - “AI" connection (1-4) (CBAV420)

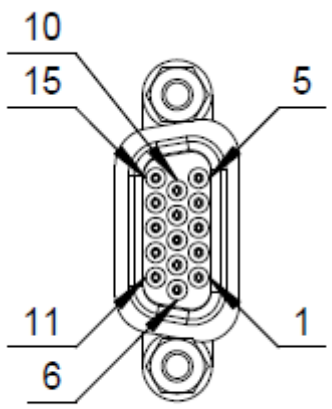


Fig. 13-5 "AI 1-4" connection

ES930.1 "AI 1-4" connection		Meaning
Pin	Signal	
1	AI_CH1	Analog input channel 1
2	AI_CH2	Analog input channel 2
3	AI_CH3	Analog input channel 3
4	AI_CH4	Analog input channel 4
5	N.C.	Not connected
6	AI_CH1_GND	Analog input channel 1, ground
7	AI_CH2_GND	Analog input channel 2, ground
8	AI_CH3_GND	Analog input channel 3, ground
9	AI_CH4_GND	Analog input channel 4, ground
10	N.C.	Not connected
11	SensorSupply_CH1	Sensor power supply, channel 1
12	SensorSupply_CH1_GND	Sensor power supply, channel 1, ground
13	SensorSupply_CH2	Sensor power supply, channel 2
14	SensorSupply_CH2_GND	Sensor power supply, channel 2, ground
15	N.C.	Not connected

Rapid Prototyping Devices

ES930 - “AI" connection (5-8) (CBAV420)

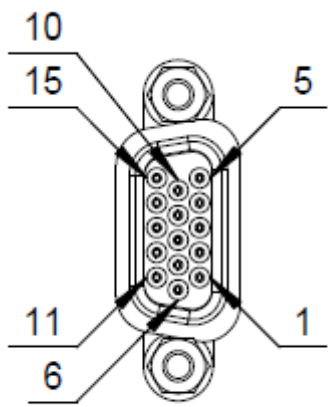


Fig. 13-4 "AI 5-8" connection

ES930.1 "AI 5-8" connection		Meaning
Pin	Signal	
1	AI_CH5	Analog output channel 5
2	AI_CH6	Analog output channel 6
3	AI_CH7	Analog input channel 7
4	AI_CH8	Analog input channel 8
5	N.C.	Not connected
6	AI_CH5_GND	Analog input channel 5, ground
7	AI_CH6_GND	Analog input channel 6, ground
8	AI_CH7_GND	Analog input channel 7, ground
9	AI_CH8_GND	Analog input channel 8, ground
10	N.C.	Not connected
11	SensorSupply_CH3	Sensor power supply, channel 3
12	SensorSupply_CH3_GND	Sensor power supply, channel 3, ground
13	SensorSupply_CH4	Sensor power supply, channel 4
14	SensorSupply_CH4_GND	Sensor power supply, channel 4, ground
15	N.C.	Not connected

Rapid Prototyping Devices

ES930 - “PS" connection (CBAV422)

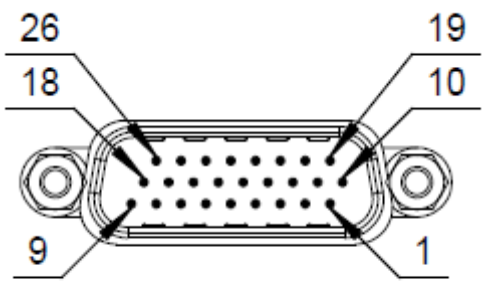


Fig. 13-6 "PS" connection

ES930.1 "PS" connection		Meaning
Pin	**Signal**	
1, 10	PS_CH1	Power stage, channel 1
2, 11	PS_CH2	Power stage, channel 2
3, 12	PS_CH3	Power stage, channel 3
4, 13	PS_CH4	Power stage, channel 4
5, 14	PS_CH5	Power stage, channel 5
6, 15	PS_CH6	Power stage, channel 6
7, 8, 9, 16, 17, 18, 26	PS_GND	Power stage, external power supply ground
19, 20, 21, 22, 23, 24, 25	PS_UBAT	Power stage, external power supply

Rapid Prototyping Devices

ES930 - “TH1-4" connection

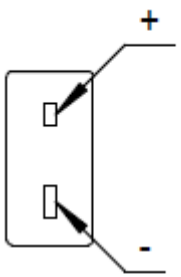


Fig. 13-7 "TH1-4" connection

ES930.1 "TH1-4" connection		Meaning
Pin	Signal	
+	In+	Input (+)
-	In-	Input (-)

Rapid Prototyping Devices

CBAV420.1 cable for use at the connections "DI", "AI 5-8" and "AI 1-4“

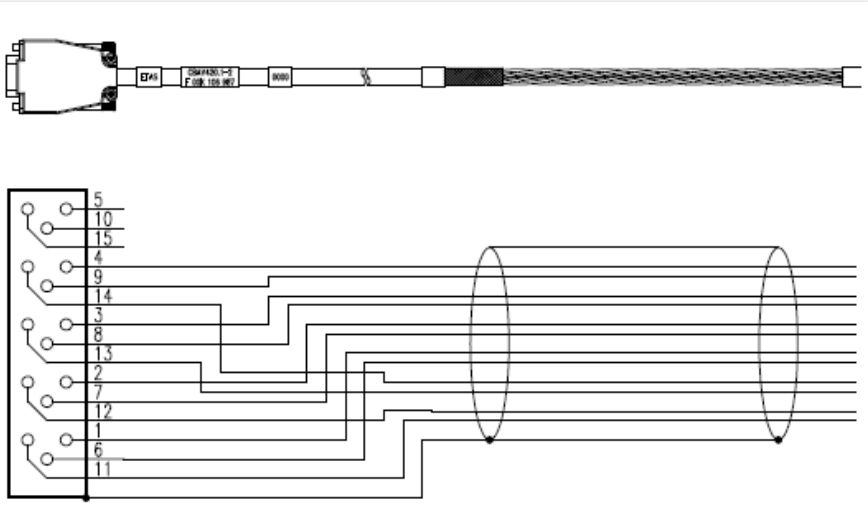


Fig. 13-11 CBAV420.1 cable with wiring plan

Product	Length	Order number
CBAV420.1-2	2 m / 6.5 ft	F 00K 106 987

"DI" / "AI 1-4" / "AI 5-8"	"DI" connection	"AI 5-8" connection	"AI 1-4" connection	CBAV420.1: Open cable end	
Pin	Signal	Signal	Signal	Pair	Color
4	DI_CH4	AI_CH8	AI_CH4	1	white
9	DI_GND	AI_CH8_GND	AI_CH4_GND	1	brown
3	DI_CH3	AI_CH7	AI_CH3	2	green
8	DI_GND	AI_CH7_GND	AI_CH3_GND	2	yellow
2	DI_CH2	AI_CH6	AI_CH2	3	gray
7	DI_GND	AI_CH6_GND	AI_CH2_GND	3	pink
1	DI_CH1	AI_CH5	AI_CH1	4	blue
6	DI_GND	AI_CH5_GND	AI_CH1_GND	4	red
14	N.C.	SensorSupply_CH4_GND	SensorSupply_CH2_GND	5	black
13	N.C.	SensorSupply_CH4	SensorSupply_CH2	5	violet
12	N.C.	SensorSupply_CH3_GND	SensorSupply_CH1_GND	6	gray/pink
11	N.C.	SensorSupply_CH3	SensorSupply_CH1	6	red/blue
5, 10, 15	N.C.	N.C.	N.C.		
Housing				Shield	

Rapid Prototyping Devices

CBAV421.1 cable for use at the connections "DO" and "AO"

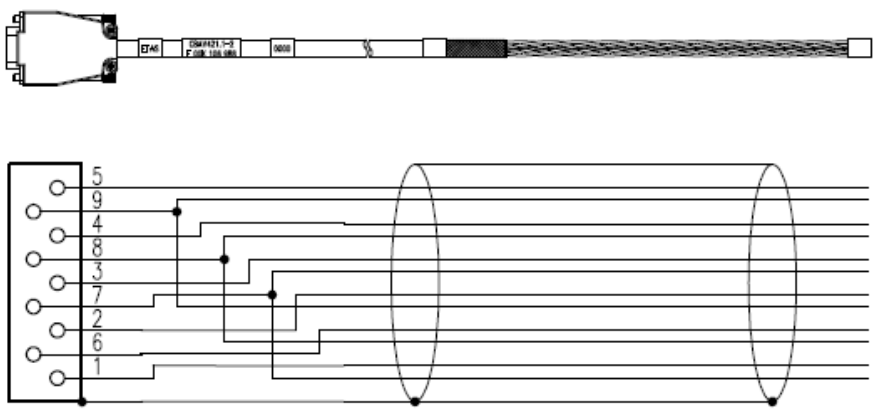


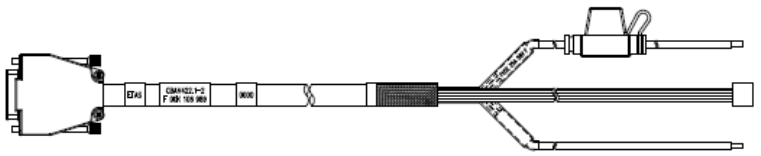
Fig. 13-12 CBAV421.1 cable with wiring plan

Product	Length	Order number
CBAV421.1-2	2 m / 6.5 ft	F 00K 106 988

DO / AO	DO connection	AO connection	CBAV421.1: Open cable end	
Pin	Signal	Signal	Pair	Color
5	DO_CH5	N.C.	1	white
9	DO_GND	AO_GND	1	brown
4	DO_CH4	AO_CH4	2	green
8	DO_GND	AO_GND	2	yellow
3	DO_CH3	AO_CH3	3	gray
7	DO_GND	AO_GND	3	pink
2	DO_CH2	AO_CH2	4	blue
9	DO_GND	AO_GND	4	red
6	DO_CH6	N.C.	5	black
8	DO_GND	N.C.	5	violet
1	DO_CH1	AO_CH1	6	gray/pink
7	DO_GND	AO_GND	6	red/blue
Housing				

Rapid Prototyping Devices

CBAV422.1 cable



Page A

Page B
Page C
Page D

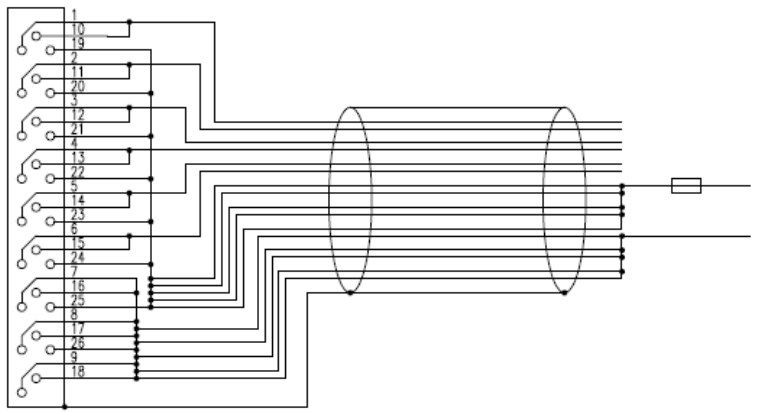


Fig. 13-13 CBAV422.1 cable with wiring plan

Product	Length	Order number
CBAV422.1-2	2 m / 6.5 ft	F 00K 106 989

HD-SUBD Pin	Signal	Open cable end Color	
1, 10	PS_CH1	white	Page C
2, 11	PS_CH2	brown	
3, 12	PS_CH3	green	
4, 13	PS_CH4	yellow	
5, 14	PS_CH5	gray	
6, 15	PS_CH6	pink	
19, 20, 21, 22, 23, 24, 25	PS_UBAT	blue	Page B
	PS_UBAT	red	
	PS_UBAT	black	
	PS_UBAT	violet	
	PS_UBAT	gray/pink	
7, 8, 9, 16, 17, 18, 26	PS_GND	red/blue	Page D
	PS_GND	white/green	
	PS_GND	brown/green	
	PS_GND	white/yellow	
	PS_GND	yellow/brown	
Housing		Shield	

Thank you!