Programmable I/O

GN-937x / GN-948x / GL-997x
M937x / ML997x

User Manual

Version 1.04

2023 CREVIS Co.,Ltd

DOCUMENT Revision History				
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1.00	-	New Released	2019/04/30	ydsong
1.01	14	Power supply	2020/09/18	Rachel
1.02	48	Removing 7.3.2 TCP Slave Setting	2021/01/21	ydsong
1.03	82	502 port - Disable	2023/09/27	ydsong
1.03	93	MQTT Sparkplug B	2023/09/27	ydsong
1.03	113	Online Change	2023/09/27	ydsong
1.03	115, 117	TFTP, SQL4	2023/09/27	ydsong
1.03	119	External Feature Library	2023/09/27	ydsong
1.03	127	CPU Usage	2023/09/27	ydsong
1.03	152	Product Lists	2023/09/27	ydsong
1.03	General Spec	Runtime Update 3.5.11.3 → 3.5.17.3	2023/09/27	ydsong
1.03	General Spec	Non-volatile memory & battery spec	2023/09/27	ydsong
1.04	105	Boot Application added in Event Log page	2024/01/19	ydsong

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1. Important Notes

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls describes some important differences between solid state equipment and hard-wired electromechanical devices.
Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will CREVIS be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.
The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, CREVIS cannot assume responsibility or liability for actual use based on the examples and diagrams.

Warning!

✓ **If you don't follow the directions, it could cause a personal injury, damage to the equipment or explosion**

• Do not assemble the products and wire with power applied to the system. Else it may cause an electric arc, which can result into unexpected and potentially dangerous action by field devices. Arching is explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power appropriately before assembling or wiring the modules.

• Do not touch any terminal blocks or IO modules when system is running. Else it may cause the unit to an electric shock or malfunction.

• Keep away from the strange metallic materials not related to the unit and wiring works should be controlled by the electric expert engineer. Else it may cause the unit to a fire, electric shock or malfunction.

Caution!

✓ **If you disobey the instructions, there may be possibility of personal injury, damage to equipment or explosion. Please follow below Instructions.**

• Check the rated voltage and terminal array before wiring. Avoid the circumstances over 60℃ of temperature. Avoid placing it directly in the sunlight.

• Avoid the place under circumstances over 90% of humidity.

• Do not place Modules near by the inflammable material. Else it may cause a fire.

• Do not permit any vibration approaching it directly.

- Go through module specification carefully, ensure inputs, output connections are made with the specifications. Use standard cables for wiring.

- Use Product under pollution degree 2 environment.

1.1. Safety Instruction

1.1.1. Symbols

DANGER	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death property damage or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury, property damage, or economic loss. Attentions help you to identity a hazard, avoid a hazard, and recognize the consequences.

1.1.2. Safety Notes

DANGER	The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components.

1.1.3. Certifications

2. FnIO G/M Series System

2.1.   Electrical Interface
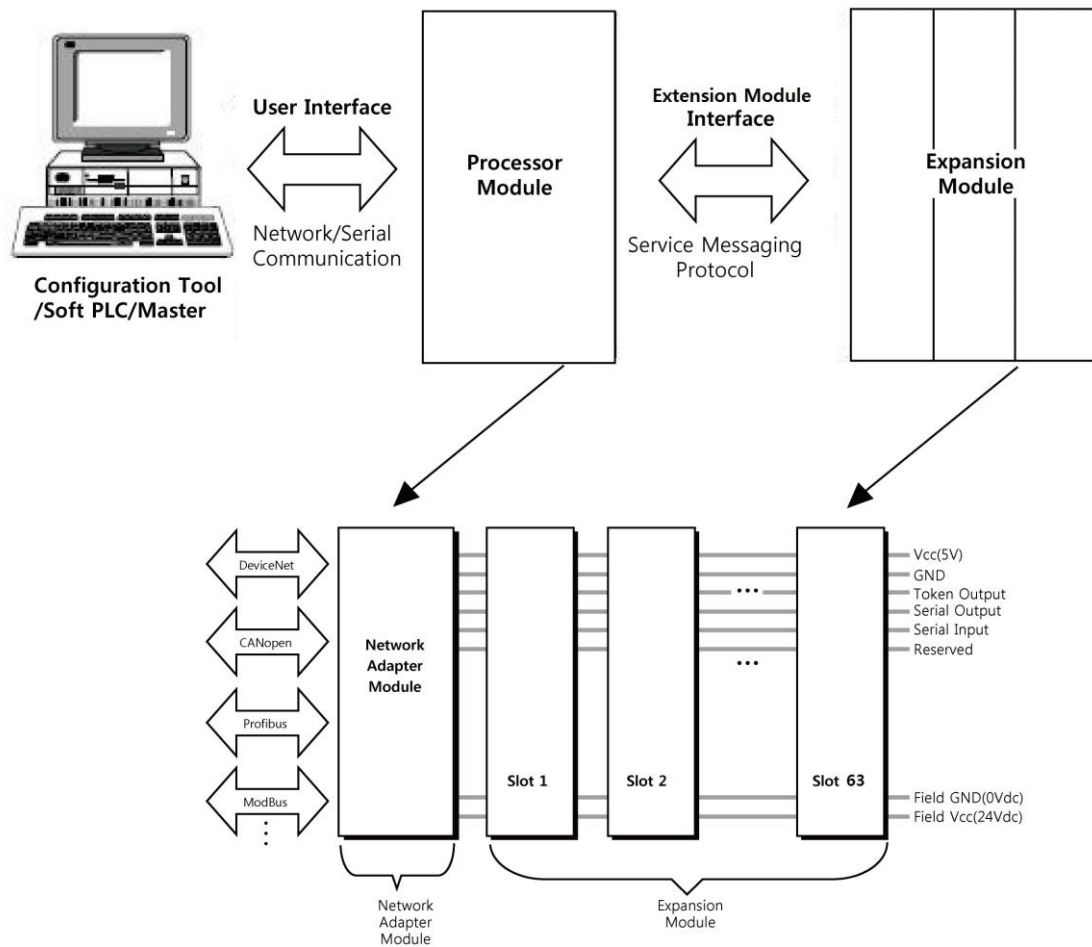
• Network Adapter Module

The Network Adapter Module forms the link between the field bus and the field devices with the Expansion Modules. The connection to different field bus systems can be established by each of the corresponding Network Adapter Module, e.g. for MODBUS TCP, Ethernet IP, EtherCAT, PROFINET, CC-Link IE Field, PROFIBUS, CANopen, DeviceNet, CC-Link, MODBUS/Serial etc.

• Expansion Module

The Expansion Modules are supported a variety of input and output field devices. There are digital and analog input/output modules and special function modules.

• Two types of Message

Service Messaging / I/O Messaging

2.2. I/O Process Image Map

An expansion module may have 3 types of data as I/O data, configuration parameter and memory register. The data exchange between network adapter and expansion modules is done via an I/O process image data by internal-protocol. The following figure shows the data flow of process image between network adapter and expansion modules.
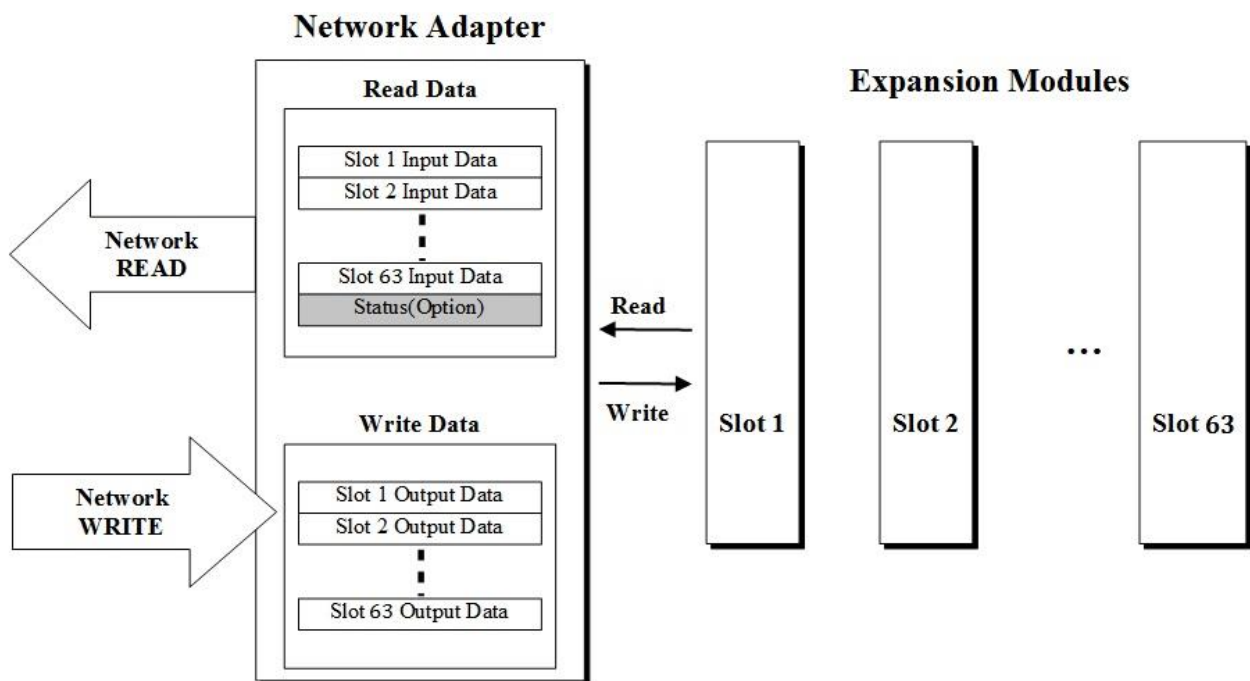
3. GN-937x - Specification

3.1. General Specification

General Specification	
UL System Power	Supply Voltage : 24Vdc nominal, Class 2
System Power	Supply Voltage : 24Vdc nominal Supply Voltage range : 15~30Vdc Protection : Output current limit (Min. 1.5A) Reverse polarity protection
Power Dissipation	110mA typical @ 24Vdc
Current for I/O Module	1.5A @5Vdc
Isolation	System Power to internal logic : Non-Isolation System Power I/O driver : Isolation
Field Power	Supply Voltage : 24Vdc typical (Max. 30Vdc) *Field Power Range is different depending on IO Module series. Refer to IO Module`s Specification.
Max. Current Field Power Contact	DC 10A Max.
Wiring	I/O Cable Max. 2.0mm2(AWG 14)
Torque	
Weight	<167g
Module Size	54mm x 99mm x 70mm

3.2. Environment Specification

Environment Condition	
Operating Temperature	-20℃ to 60℃（based on UL）
Storage Temperature	-40℃ to 85℃
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
Shock Operating	IEC 60068-2-27
Vibration/shock resistance	IEC 60068-2-6, 4g
Industrial Immunity Industrial Emission	EN 61000-6-2 : 2019 EN 61000-6-4/ALL : 2011
Installation Pos. / Protect. Class	Vertical and Horizontal / IP20
Product Certifications	CE, UL

3.3. Interface Specification

Programmable Specification			
Module list	GN-9371	GN-9372	GN-9373
Programming	CODESYS V3.5.17.3 with FW Rev 3.xxx CODESYS V3.5.11.3 with FW Rev 1.xxx, FW Rev 2.xxx		
Run-Time System	Multiple PLC Tasks		
Program Languages	IEC 61131-3 (LD, IL, ST, FBD, SFC)		
Program Memory	512 Kbytes	16 Mbytes	
Data Memory	96 Kbytes	16 Mbytes	
	- I/O Input: %IW0 ~%IW2047 (2048 words)		
	- I/O Output: %QW0 ~%QW2047 (2048 words)		
	- Memory: %MW0 ~ %MW8191 (8192 words)		
Non-Volatile Memory	4 Kbytes	12 Kbytes	
	Retain: 2 Kbytes	Retain: 6 Kbytes	
	Persistent: 2 Kbytes	Persistent: 6 Kbytes	
MQTT 1)	O	O	
MQTT Sparkplug B	X	O	
SSL/TLS	X	X	
User management 2)	X	O	
IIOT Library	X	X	
SNMP (Agent Only) 3)	O	O	
SNTP	O	O	
OPC DA Server	X	O	
OPC UA Server & Client	X	O	
Online Change	X	O	
Source Upload/Download	X	O	
File system	X	O	
File transmit	X	O	
TFTP	X	O	
SQL4CODESYS	X	O	
Breakpoint	X	O	
Weather Forecast	X	O	
Web Visualization 4)	X	X	O
Max. Task	10		
Max. Cycle Task	10		
Max. Status Task	10		
Process Time	1usec	7usec	
RTC 5)	Retain Time : < 15 days - Accuracy : < 2min per a month		
	Recommendation : Battery should be fully recharged at 25℃.		

1) MQTT can't support the TLS.
2) The functionality can be available in a limited form.
3) The standard format "RFC1213-MIB" can be supported.
4) Web Visualization can't be can't be available with Internet Explorer.

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5) RTC (at 25℃)

Battery charging time	Retain time at 25℃	
		*** RTC Warning There will be 2 operating problems when the battery is discharged.
4 hours	> 2 day	- Retain data will not be saved.
12 hours	> 12 day	- RTC data will not be stored and will be the initial value.
16 hours	> 15 day	

- Recommend charging for at least 16 hours when the battery is discharged.
- Retain time may vary depending on temperature and environment.
- The battery is one of components on PCB in the plastic housing.
  It means that it can't be checked visually but can be charged by supplying the voltage to the system power.

Interface Specification	
Adapter Type	Master & Slave Node (Modbus TCP, Modbus RTU)
Max. Expansion	63 Slots
Max. Data Size	Max. 128Byte each slot
Max. Nodes	Limited by Ethernet Specification
Baud rate	10/100Mbps, Auto-negotiation, Full Duplex
Ethernet Interface	RJ-45 socket (x 2pcs)
Ethernet Protocol	Modbus TCP, Modbus UDP, SNTP, SNMP DHCP/BOOTP, HTTP (Web-Server)
Max. Socket	GN-9371 – UDP: 16, TCP: 16 GN-9372/73 – UDP: 16, TCP: 64
Serial Interface	RS232/RS485
Serial Protocol	Modbus RTU (Baud Rate : 2400~115200 bps / Default: 115200 bps)
Indicator	6 LEDs 1 Green/Red, Module Status (MOD) 1 Green/Red, Network Status (NET) 1 Green/Red, PLC Run/Stop Status (RUN) 1 Green/Red, Expansion I/O Module Status (IOS) 1 Green, System Power Status 1 Green, Field Power Status

3.4. GN-937x - Ethernet Connection Specification

Function*	Model	Max. number of concurrent communications
Web Visualization	GN-9373 only	One for each functions are available at the same time.
ARTI (OPC-server)	GN-9372/73	
CODESYS link	GN-9371/72/73	
Network-Variable	GN-9371/72/73	
Modbus/TCP Master	GN-9371	16 Modbus/TCP Slaves can be connected
	GN-9372/73	64 Modbus/TCP Masters can be connected
Modbus/TCP Slave	GN-9371	16 Modbus/TCP Masters can be connected
	GN-9372/73	64 Modbus/TCP Masters can be connected
Web-Server	GN-9371	16 clients can be opened
	GN-9372/73	64 clients can be opened

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* The maximum number of sockets (GN-9371: 16, GN-9372/73: 64) can be used at the same time.

4. Module Description

4.1. GN-937x - (MODBUS Programmable I/O)
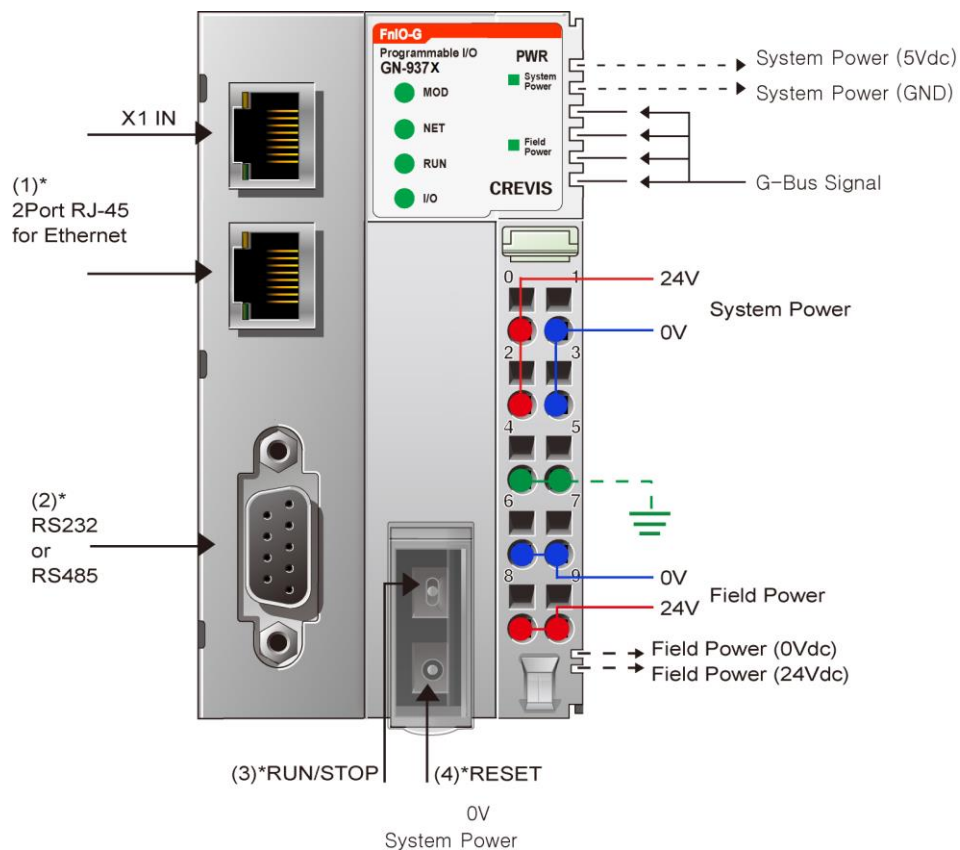
Pin No.	Signal Description	Signal Description	Pin No.
0	System Power, 24V	System Power, Ground	1
2	System Power, 24V	System Power, Ground	3
4	F.G	F.G	5
6	Field Power, Ground	Field Power 0V, Ground	7
8	Field Power, 24V	Field Power, 24V	9

System power and Field power must be supplied separately by using the different power source

ATTENTION	
⚠	The modules are not hot swappable.
	It means that they should be not removed in power on condition.

* How to supply the power correctly
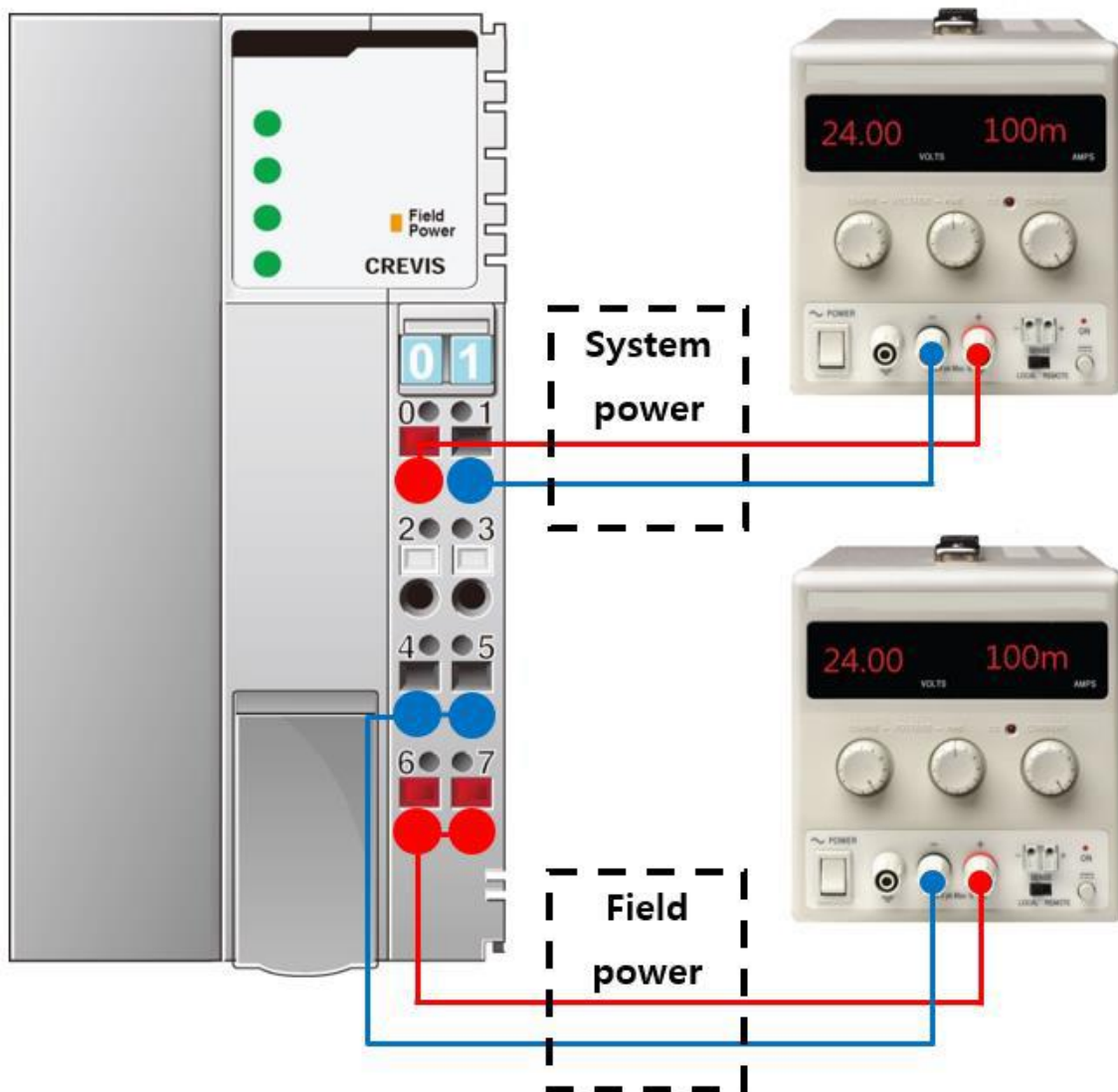
- Refer the pin map of power RTB before wiring.
- Current capacity margin should be considered when you supply the power.
- Supply voltage 24Vdc which is recommended voltage level.
- System and Field power must be supplied separately as the picture above.

※ If the power is supplied to each System and Field power from same power source, it would be vulnerable to power noise.

4.2. LED Indicator
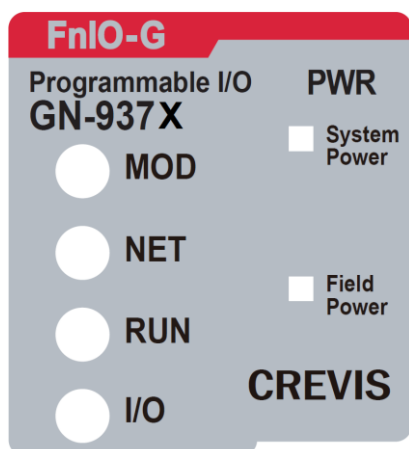
4.2.2. Module Status LED (MOD)

State	LED is	To indicate
No Power	Off	No power is supplied to the unit.
Device Operational	Green	The unit is operating in normal condition.
Device in Standby	Blinking Green	The EEPROM parameter is not initialized yet. Serial Number is zero value (0x00000000)
IAP Mode	Toggle Green/Red	IAP Mode : Available for firmware download using FireFox.
Unrecoverable Fault	Red	The unit has occurred unrecoverable fault in self-testing. - Firmware fault

*The IP address to access IAP web server during IAP Mode : 192.168.100.10 (Recommended to use FireFox)

4.2.3. Network Status LED (NET)

State	LED is	To indicate
Off-line	Off	Network Offline.
On-line (Connect)	Green	On-line Mode and network is connected.
Error	Red	Network Error
Diagnostic	Blinking Red	Diagnostic Mode

* Blinking MOD & NET LED : BootP/DHCP is requesting the address data for new IP address.
 (The IP setting mode can be selectable and please refer to this manual in the part of IP set-up.)

4.2.4. PLC Run/Stop Status LED (RUN)

State	LED is	To indicate
Not Programmed	Off	Power is not supplied or PIO is not programmed
Run	Green	PLC Run
Stop	Blinking Green	PLC Stop
Program Error	Blinking Red	User PLC Program Error

4.2.5. Extension Module Status LED (IOS)

State	LED is	To indicate
Not Powered No Expansion Module	Off	Device has no expansion module or may not be powered
On-line, Do not Exchanging I/O	Blinking Green	I/O Communication is normal but does not exchange I/O data. (Passed the expansion module configuration).
Connection, Run Exchanging IO	Green	Exchanging I/O data
Connection Fault during Exchanging IO	Blinking Red	One or more expansion module occurred in fault state. - Check the expanded module configuration. - Failed the expanded module communication. - Overflowed Input/Output size.
Expansion Configuration Failed	Red	Failed to initialize expansion module - Detected invalid expansion module ID. - Overflowed Input / Output Size - Oversized expansion module - Initial protocol failure - Mismatch vendor code between adapter and I/O module.

4.2.6. Field Power Status LED

State	LED is :	To indicate :
Not Supplied Field Power	Off	Not supplied 24V dc field power.
Supplied Field Power	Green	Supplied 24V dc field power.

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4.2.7. Additional LED status

To indicate	LED			
	MOD	**NET**	**RUN**	**IOS**
Program reset	-	-	RED/GREEN (Toggle every 0.25s)	-
Factory reset	RED/GREEN (Toggle every 0.25s)			
IO Watchdog error	RED	-	RED	-
CODESYS Task Watchdog error	-	-	RED	-
CODESYS License error	-	-	RED/GREEN (Toggle every 2s)	-
Heap memory over flow	RED	RED	-	-
Stack memory over flow or Assertion error	RED	-	-	-
Hard Fault	RED			

4.3.   RJ-45 Socket , RS232/485 Port

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

RS 232/485	Signal Name	Description
1	-	
2	TXD	RS232 TXD
3	RXD	RS232 RXD
4	-	
5	GND	RS232 GND
6	D+	RS 485 D+
7	-	
8	D-	RS485 D-
9	-	

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4.4. Toggle Switch, Push Button

Toggle Switch Status	Module is	Description
UP	RUN	PLC Run
DOWN	STOP	PLC Stop

Push Button	Module is	Description
Press and detach.	Reset	Reset the PLC and then stop.
Push for 5sec and power Reset	PLC Reset	Erase PLC user program and Retain memory
Push for 20sec and power reset	Factory default	Erase PLC user program and PLC parameter reset
Hold down and reset the power.	IAP mode	Available for firmware download using FireFox
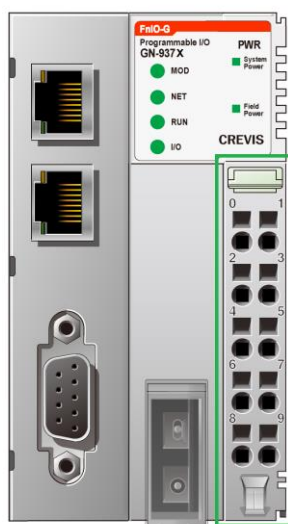
1 Toggle Switch (Run / Stop) **2** Push Button (Reset / IAP Mode)

4.5. RTB Terminal Block

Pin No.	Signal Description	Signal Description	Pin No.
0	System Power, 24V	System Power, Ground	1
2	System Power, 24V	System Power, Ground	3
4	F.G	F.G	5
6	Field Power, Ground	Field Power, Ground	7
8	Field Power, 24V	Field Power, 24V	9

- System Power: The power for starting up CPU.

- Field Power: The power for input and output line.

DANGER

Do not use an incorrect voltage/frequency!
The use of an incorrect supply voltage or frequency can cause severe damage to the component.

4.6.   Pin Description

Communication between the Network adapter and the expansion module as well as system / field power supply of the bus modules is carried out via the internal bus. It is comprised of 6 data pins and 2 field power pins.
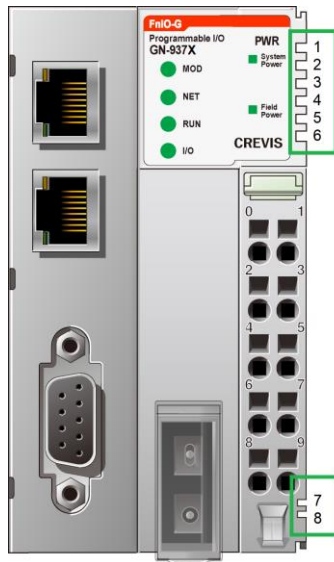
No.	Name	Description
1	System Vcc	System supply voltage (5V dc).
2	System GND	System Ground.
3	Token Output	Token output port of Processor module.
4	Serial Output	Transmitter output port of Processor module.
5	Serial Input	Receiver input port of Processor module.
6	Reserved	Reserved for bypass Token.
7	Field GND	Field Ground.
8	Field Vcc	Field supply voltage (24Vdc).

DANGER	Do not touch data and field power pins in order to avoid soiling and damage by ESD noise. To prevent ESD noise, it is recommended to use the END module.

4.7.   Dimension (mm)
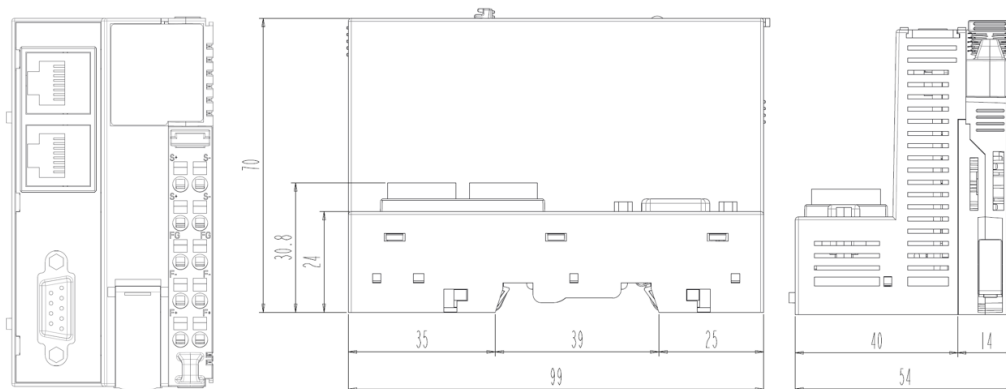
5.   Mechanical Setup

5.1.   How to mount on Din-Rail
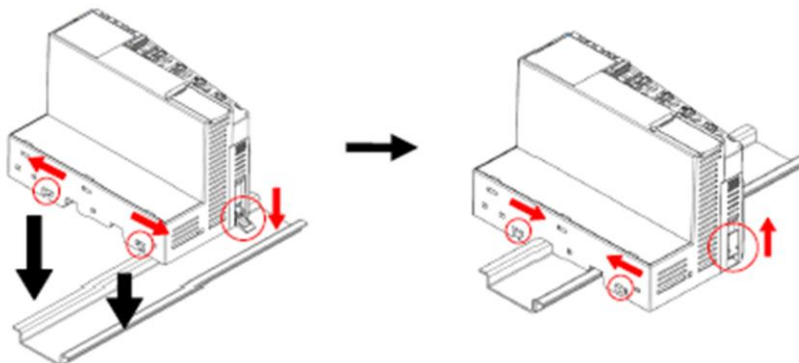
5.2.   How to dismount on Din-Rail
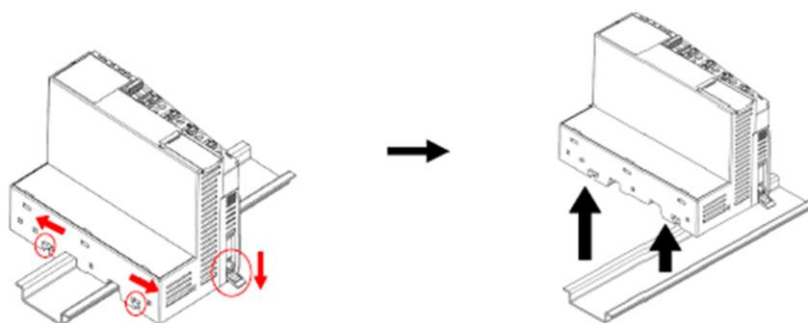
As above figure in order to safeguard the FnIO module from jamming, it should be fixed onto the DIN rail with locking level. To do so, fold on the upper of the locking lever. To pull out the FnIO module, unfold the locking lever as above figure.

DANGER ⚠	Before starting the work on the components, the voltage supply must be turned off.

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5.3.   Removable Terminal Block (RTB)
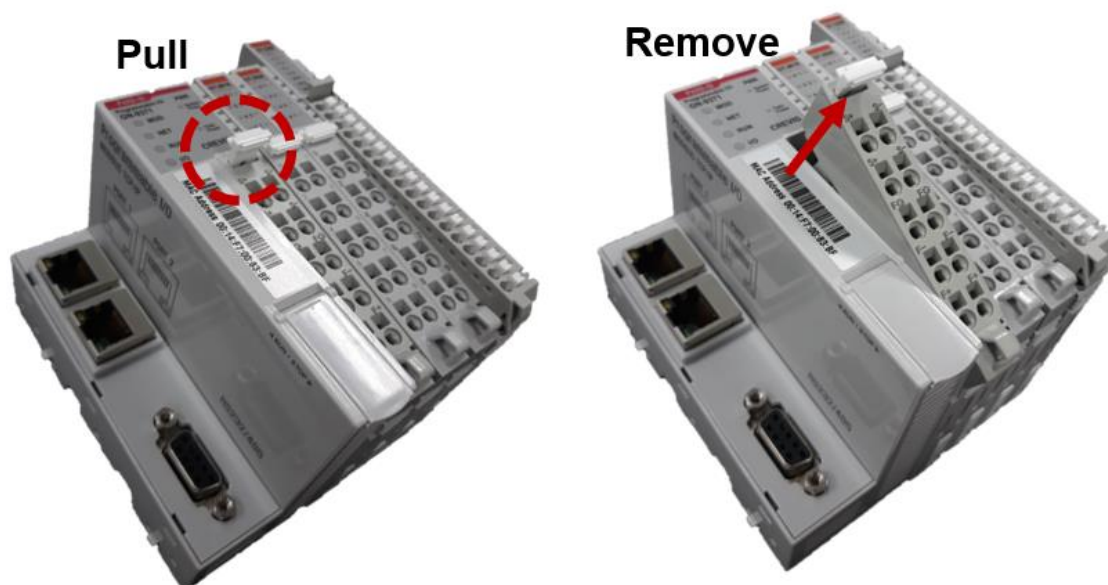
5.4.   Method of Wiring.
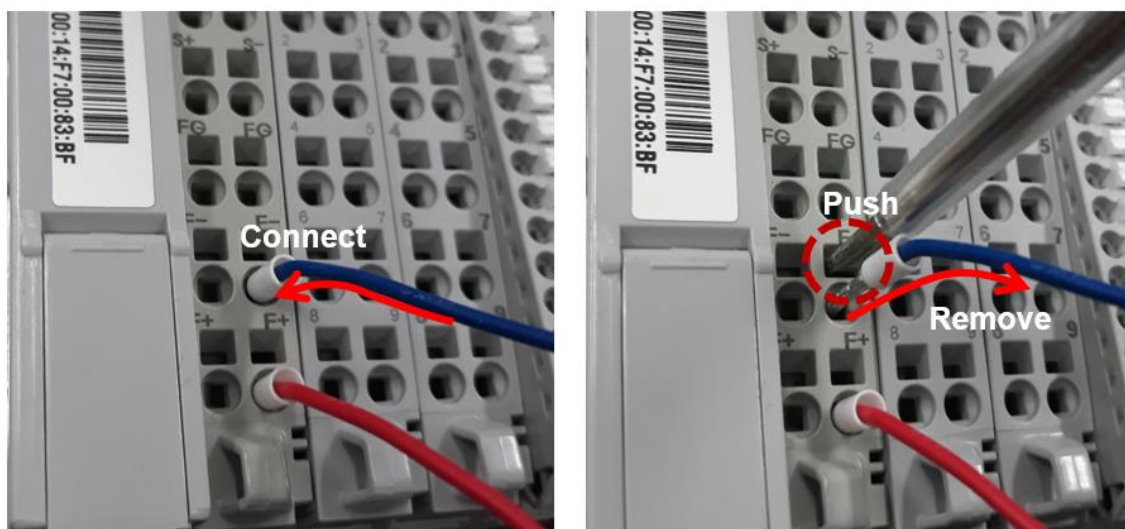
Connecting or removing the cable by pushing the terminal button for the relevant points.

ATTENTION

⚠

The use of an incorrect supply voltage or frequency can cause severe damage to the component.

6. GL-997x - Specification

6.1. General Specification

General Specification		
Power Dissipation	GL-9971	60mA typical @ 24Vdc
	GL-9972/73	50mA typical @ 24Vdc
	GL-9974/75	70mA typical @ 24Vdc
UL System Power		Supply voltage: 24Vdc nominal, Class 2
System Power		Supply voltage: 24Vdc nominal Supply voltage range: 18 ~ 28.8Vdc Reverse polarity protection
UL Field Power		Supply voltage: 24Vdc nominal, Class 2
Field Power		Supply voltage: 24Vdc typical (Max. 30Vdc)
Current Field Power Contact		Max. DC 8A
Wiring		I/O Cable Max. 2.0mm2(AWG 14)
Torque		0.8 Nm(7 lb-in)
Current for Expansion Module		1.0A @ 5Vdc
Isolation		System power to internal logic : Non-isolation System power I/O driver : Isolation
Weight	GL-9971	76g
	GL-9972/73	84g
	GL-9974/75	82g
Module Size		22mm x 109mm x 70mm

6.2. Environment Specification

Environment Condition	
Operating Temperature	-20℃ to 60℃（based on UL）
Storage Temperature	-40℃ to 85℃
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
Shock Operating	IEC 60068-2-27
Vibration/shock resistance	IEC 60068-2-6, 4g
Industrial Immunity Industrial Emission	EN 61000-6-2 : 2019 EN 61000-6-4/ALL : 2011
Installation Pos. / Protect. Class	Vertical and Horizontal / IP20
Product Certifications	CE, UL

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6.3. Interface Specification

Programmable Specification					
Module List	**GL-9971**	**GL-9972**	**GL-9973**	**GL-9974**	**GL-9975**
Programming	CODESYS V3.5.17.3 with FW Rev 3.xxx CODESYS V3.5.11.3 with FW Rev 1.xxx, FW Rev 2.xxx				
Program Memory	256 Kbytes	16 Mbytes			
Data Memory	40 Kbytes	16 Mbytes			
Non-Volatile Memory	4 Kbytes	32 Kbytes			
	Retain: 2 Kbytes Persistent: 2 Kbytes	Retain: 16 Kbytes Persistent: 16 Kbytes			
Run-Time System	Multiple PLC Tasks				
Program Languages	IEC 61131-3 (LD, IL, ST, FBD, SFC)				
MQTT 1)	O	O			
MQTT Sparkplug B	X	O			
SSL/TLS	X	X			
User management 2)	X	O			
IIOT Library	X	X			
SNMP (Agent Only) 3)	X	O			
SNTP	O	O			
OPC DA Server	X	O			
OPC UA Server & Client	X	O			
Online Change	X	O			
Source Upload/Download	X	O			
File system	X	O			
File transmit	X	O			
TFTP	X	O			
SQL4CODESYS	X	O			
Breakpoint	X	O			
Web Visualization 4)	X	X	O	X	O
Max. Task	10				
Max. Cycle Task	10				
Max. Status Task	10				
Max. Data Size	Max 128Byte each slot				
Max. Expansion Module	10 Slots	63 Slots			
Process Time	0.0270us	0.1440usec			
RTC 5)	Retain Time : < 15 day / Accuracy : < 2min/month Recommendation : Battery should be fully recharged at 25℃.				

1) MQTT does not support TLS.
2) Provide functionality in a limited form.
3) Only the standard format "RFC1213-MIB" is provided.
4) Web Visualization can't be available with Internet Explorer.

5) RTC (at 25℃)

Battery charging time	Retain time at 25℃	*** RTC Warning
4 hours	> 2 day	There will be 2 operating problems when the battery is discharged. - Retain data will not be saved.
12 hours	> 12 day	
16 hours	> 15 day	- RTC data will not be stored and will be the initial value.

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- Recommend charging for at least 16 hours when the battery is discharge.
- Retain time may vary depending on temperature and environment.
- The battery is one of components on PCB in the plastic housing.
  It means that it can't be checked visually but can be charged by supplying the voltage to the system power.

GL-9971/74/75 Interface Specification		
Adapter Type		Master & Slave node (Modbus TCP)
Ethernet Interface		RJ-45 socket x2
Baud rate		10/100Mbps, Auto-negotiation, Full Duplex
Ethernet Protocol		Modbus TCP, Modbus UDP, SNTP, SNMP DHCP/BOOTP, HTTP (Web-Server)
Max. Socket	GL-9971	UDP: 10, TCP: 10
	GL-9974/75	UDP: 16, TCP: 64
Indicator (4 LEDs)	MOD	1 Green/Red, Module Status
	NET	1 Green/Red, Network Status
	RUN	1 Green/Red, PLC Run/Stop Status
	IOS	1 Green/Red, Expansion I/O Module Status

GL-9972/73 Interface Specification		
Adapter Type		Master & Slave node (Modbus TCP, Modbus RTU)
Ethernet Interface		RJ-45 socket x1
- Baud rate		10/100Mbps, Auto-negotiation, Full Duplex
- Ethernet Protocol		Modbus TCP, Modbus UDP, SNTP, SNMP DHCP/BOOTP, HTTP (Web-Server)
- Max. Socket		UDP: 16, TCP: 64
Serial Interface		RJ-45 socket * 1pcs
- Serial Protocol		Modbus RTU Baud Rate : 2400~115200 bps (Default: 115200 bps)
Indicator (4 LEDs)	MOD	1 Green/Red, Module Status
	NET	1 Green/Red, Network Status
	RUN	1 Green/Red, PLC Run/Stop Status
	IOS	1 Green/Red, Expansion I/O Module Status

6.4. Ethernet Connection Specification

Function*	Model	Max. number of concurrent communications
Web Visualization	GL-9973/75	One for each functions are available at the same time
ARTI (OPC-server)	GL-9972/73/74/75	
CODESYS link	GL-9971/72/73/74/75	
Network-variable	GL-9972/73/74/75	
Modbus/TCP Master	GL-9971	1 Modbus/TCP Slaves can be connected
	GL-9972/73/74/75	64 Modbus/TCP Slaves can be connected
Modbus/TCP Slave	GL-9971	10 Modbus/TCP Masters can be connected
	GL-9972/73/74/75	64 Modbus/TCP Masters can be connected
Web-server	GL-9971	10 clients can be opened
	GL-9972/73/74/75	64 clients can be opened

6.5. Serial connection Specification

Function	Model	Max. number of concurrent communications
Modbus RTU Master	GL-9972/73	RS232: 1 Slaves can be connected RS485: 31 Slaves can be connected

6.6.   GL-997x wiring Diagram
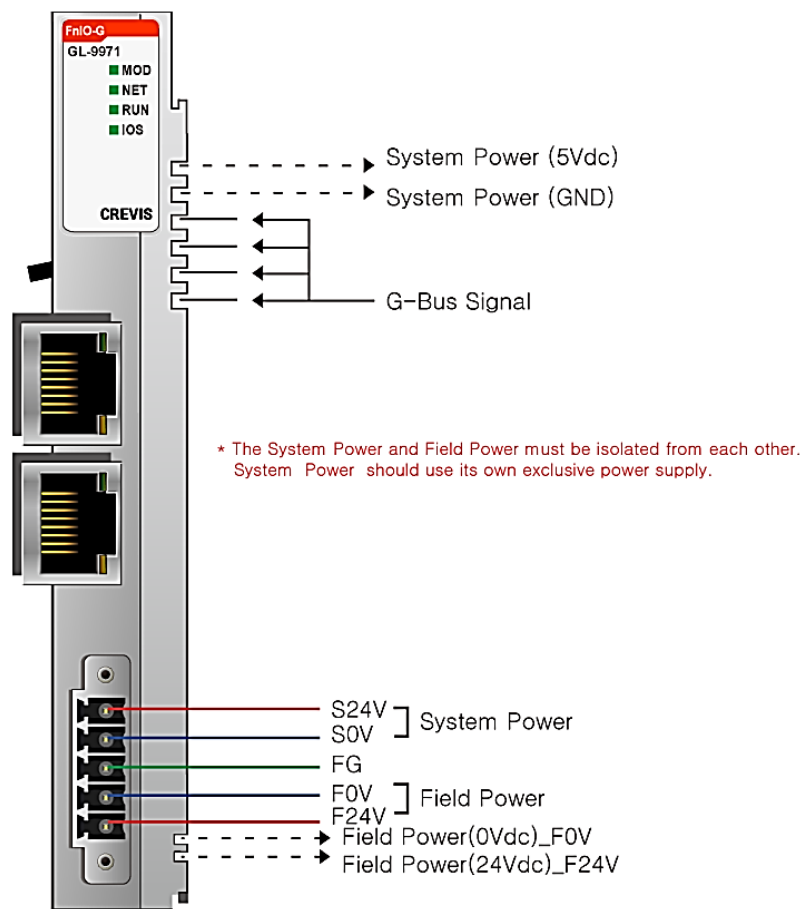
6.7.   GL-997x Power Description

Pin No.	Signal Description
1	System Power, 24V
2	System Power, Ground
3	F.G
4	Field Power, Ground
5	Field Power, 24V

* **Warning**
- The System Power and Field Power must be isolated from each other.
- System Power should use its own exclusive power supply.

6.8. GL-997x LED Indicator

LED No.	LED Description	LED Color
MOD	Module Status	Green
NET	Network Status	Green
RUN	Custom	Green/Red
IOS	Expansion IO Status	Green/Red

6.8.1. MOD (Module Status LED)

Status	LED is	To indicate
Not Powered	Off	Device has no power supplied.
Normal operation	Green	The device is operating normally.
Diagnostic	Red	Stack memory over flow or Assertion error.
	Red Blinking	Eeprom or file system error.

6.8.2. NET (Network Status LED)

Status	LED is	To indicate
Not Linked	Off	Not physically connected to Ethernet port.
Link	Green	physically connected to the Ethernet port.

6.8.3. RUN (PLC Run/Stop Status LED)

Status	LED is	To indicate
No PLC Program	Off	Device has no program.
PLC Run	Green	The PLC program is in the running state.
PLC Stop	Green Blinking	The PLC program is in a stopped state.
Codesys Task Watchdog	Red	Codesys task watchdog has occurred.
Diagnostic	Red Blinking	PLC program and expansion I/O modules do not match.

6.8.4. IOS (Expansion Module Status LED)

Status	LED is	To indicate
No Expansion I/O	OFF	Device has no expansion modules.
Have Expansion I/O	Green	Device has expansion modules.
Configuration Fault	Red	Replace expansion modules or fail to initialize. - Detect invalid expansion module ID. - Initial protocol failure. - Mismatch vendor code between adapter and expansion module. - Changed expansion module configuration.
Connection Fault	Red Blinking	One or more expansion module occurred in fault state. - Exceeded number of expansion modules. - Communication failure. - I/O size overflow.

6.8.5. Exception indication

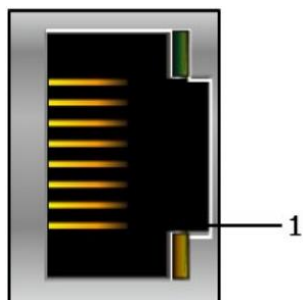| To indicate	LED			
	MOD	NET	RUN	IOS
Booting 1)	Green Blinking	Green Blinking	-	-
IAP Mode 2)	Green/Red Toggle	-	Off	Off
Program reset	-	-	Green/Red Toggle (every 0.25s)	-
Factory reset	Green/Red Toggle (every 0.25s)			
IO Watchdog error	Red	-	Red	-
CODESYS License error	-	-	Green/Red Toggle (every 2s)	-
Heap memory over flow	Red	Red	-	-
Hard Fault	Red			

'-' : Current LED status

1) BOOTP/DHCP requests a new IP address.
   (IP setting mode can change. Refer to Modbus Register 0x160B.)
2) The IP Address to access IAP web-server during IAP Mode: 192.168.100.10
   (Recommended to use FireFox)

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6.9. Electrical Interface

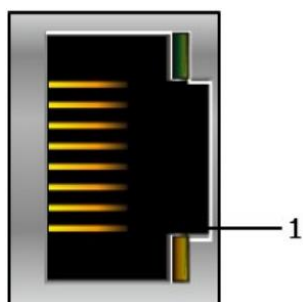### 6.9.1. GL-9971/74/75 RJ-45 Socket

- Ethernet Socket * 2pcs

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

Ethernet Socket * 2pcs

6.9.2. GL-9972/73 RJ-45 Socket

- Ethernet Socket * 1pcs + Serial Socket * 1pcs

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

Ethernet Socket * 1pcs

RJ-45	Signal Name	Description
1	D+	RS485 D+
2	D-	RS485 D-
3	GND	
4	/ISP	/ISP
5	-	
6	GND	
7	TXD	RS232 TXD
8	RXD	RS232 RXD
Case	Shield	

Serial Socket * 1pcs

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6.9.3. Toggle Switch

Toggle Switch	Signal Name	Description
UP	RUN	PLC Run
DOWN	STOP	PLC Stop

6.9.4. Push Switch

Push Switch	Module is	Description
Push < 5sec	Stop State	Transition to PLC stop state.
Push > 5sec	PLC Reset	The PLC program and retain memory will be erased.
Push > 20sec	Factory Reset	The PLC program and parameters will be erased.
Push hold and Power Reset	IAP mode	Firmware download. (Recommended to use FireFox.)

6.9.5. Dip Switch

Dip Swtich		Description
1	2	
ON	ON	RS485 terminating resistor enabled (1 kΩ)
OFF	OFF	RS485 terminating resistor disabled

* 2 poles DIP Switches only for GL-9972 and GL-9973.

Dip Switch	Description
-	No function (Reserved)

7. GN-948x - Specification

7.1. General Specification

General specification	
UL System Power	Supply voltage : 24Vdc nominal, Class 2
System Power	Supply voltage : 24Vdc nominal Supply voltage range : 15~30Vdc Protection : Output current limit (Min. 1.5A) / Reverse polarity protection
Power Dissipation	75mA typical @ 24Vdc
Current for I/O Module	1.5A @ 5Vdc
Isolation	System power to internal logic : Non-isolation System power I/O driver : Isolation
UL Field Power	Supply voltage : 24Vdc nominal, Class 2
Field Power	Supply voltage : 24Vdc typical (Max. 30Vdc) * Field Power Range is different depending on IO Module series. Refer to IO Module`s Specification.
Max. Current Field Power Contact	DC 10A Max
Weight	<167g
Wiring	I/O Cable Max. 2.0mm^2(AWG 14)
Torque	0.8 Nm(7 lb-in)
Module Size	54mm x 99mm x 70mm

7.2. Environment Specification

Environment Condition	
Operating Temperature	-20℃ to 60℃ (based on UL)
Storage Temperature	-40℃ to 85℃
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
Shock Operating	IEC 60068-2-27
Vibration/shock resistance	IEC 60068-2-6, 4g
Industrial Immunity Industrial Emission	EN 61000-6-2 : 2019 EN 61000-6-4/ALL : 2011
Installation Pos. / Protect. Class	Vertical and Horizontal / IP20
Product Certifications	CE, UL

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7.3.   Interface Specification

Programmable Specification			
Module Lists	**GN-9481**	**GN-9482**	**GN-9483**
Programming	CODESYS V3.5.17.3 with FW Rev 3.xxx CODESYS V3.5.11.3 with FW Rev 1.xxx, FW Rev 2.xxx		
Program Memory*	512 Kbytes	16 Mbytes	
Data Memory	96 Kbytes	16 Mbytes	
	IO Input: %IW0 ~%IW2047 (2048 words) IO Output: %QW0 ~%QW2047 (2048 words) Memory: %MW0 ~ %MW8191 (8192 words)		
Non-Volatile Memory	4 Kbytes	12 Kbytes	
	Retain: 2 Kbytes Persistent: 2 Kbytes	Retain : 6 Kbytes Persistent: 6 Kbytes	
Run-Time System	Multiple PLC Tasks		
Program Languages	IEC 61131-3 (LD, IL, ST, FBD, SFC)		
MQTT **1)**	O	O	
MQTT_Sparkplug B	X	O	
SSL/TLS	X	X	
User management **2)**	X	O	
IIOT Library	X	X	
SNMP (Agent Only) **3)**	O	O	
SNTP	O	O	
OPC DA Server	X	O	
OPC UA Server & Client	X	O	
Online Change	X	O	
Source Upload/Download	X	O	
File system	X	O	
File transmit	X	O	
TFTP	X	O	
SQL4CODESYS	X	O	
Breakpoint	X	O	
Weather Forecast	X	O	
Webvisualization **4)**	X	X	O
RTC **5)**	Retain Time : < 15 day / Accuracy : < 2min/month		
	Recommendation : Battery should be fully recharged at 25℃.		
Max. Task	10		
Max. Cycle Task	10		
Max. Status Task	10		
Process Time	0.0306us	0.1667usec	

1) MQTT does not support TLS.
2) Provide functionality in a limited form.
3) Only the standard format "RFC1213-MIB" is provided.

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4) Web Visualization cannot be supported in Internet Explorer.

5) RTC (at 25℃)

Battery charging time	Retain time (at 25℃)	*** RTC Warning
4 hours	> 2 day	There will be 2 operating problems when the battery is discharged.
12 hours	> 12 day	- Retain data will not be saved.
16 hours	> 15 day	- RTC data will not be stored and will be the initial value.

- Recommend charging for at least 16 hours when the battery is discharge.
- Retain time may vary depending on temperature and environment.
- The battery is one of components on PCB in the plastic housing.
  It means that it can't be checked visually but can be charged by supplying the voltage to the system power.

Interface Specification		
Ethernet		
Adapter Type	Modbus TCP Master & Slave	
Baud rate	10/100Mbps, Auto-negotiation, Full Duplex	
Interface	RJ-45 socket x1	
Max. Nodes	Limited by Ethernet Specification	
Ethernet Protocol	GN-9481	Modbus/TCP, Modbus/UDP, SNTP, SNMP, MQTT, HTTP (Web-Server), DHCP/BOOTP
	GN-9482/83	Modbus/TCP, Modbus/UDP, SNTP, SNMP, MQTT, HTTP (Webvisualization, Web-Server), DHCP/BOOTP, OPC-server
Max. Socket	GN-9481	UDP: 16, TCP: 16
	GN-9482/83	UDP: 16, TCP: 64
EtherCAT		
Adapter Type	EtherCAT Slave	
Baud rate	100Mbps	
Interface	RJ-45 socket x2	
Max. PDO	RxPDO	64 ea
	TxPDO	64 ea
Max. Socket	GN-9481	UDP: 16, TCP: 16
	GN-9482/83	UDP: 16, TCP: 64
Max. Size	Moduler	The maximum size is adjusted according to the IO size.
	Non-Moduler	256 bytes.
Max. Network Nodes	65,535	
Common		
Max. Expansion Module	63 Slots	
Max. Data Size	Max 128Byte each slot	
Serial Interface	RS232/RS485 (supporting Touch Panel)	
Serial Protocol	Modbus RTU / Baud Rate : 2400~115200 bps (Default: 115200 bps)	
Indicator	6 LEDs 　1 Green/Red, Module Status (MOD) 　1 Green/Red, Network Status (NET) 　1 Green/Red, PLC Run/Stop Status (RUN) 　1 Green/Red, Expansion I/O Module Status (I/O) 　1 Green, System Power Status 　1 Green, Field Power Status	

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7.4.   GN-948x - Ethernet Connection Specification

Function*	Model	Max. number of concurrent communications
Web Visualization	GN-9483 only	One for each functions are available at the same time
ARTI (OPC-server)	GN-9482/83	
CODESYS link	GN-9481/82/83	
Network-variable	GN-9481/82/83	
Modbus/TCP Master	GN-9481	16 Modbus/TCP Slaves can be connected
	GN-9482/83	64 Modbus/TCP Slaves can be connected
Modbus/TCP Slave	GN-9481	16 Modbus/TCP Masters can be connected
	GN-9482/83	64 Modbus/TCP Masters can be connected
EtherCAT Slave	GN-9481/82/83	
Web-server	GN-9481	16 clients can be opened
	GN-9482/83	64 clients can be opened

* While using these features, can use up to a maximum number of sockets(GN-9481: 16, GN-9482/83: 64) at the same time.

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7.5.   GN-948X - LED Indicator
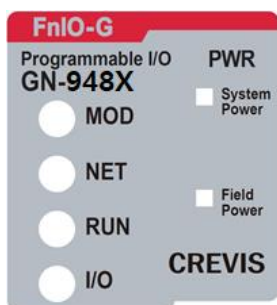
LED No.	LED Description	LED Color
MOD	Module Status	Green
NET	Network Status	Green
RUN	Custom	Green/Red
IOS	Expansion IO Status	Green/Red

7.5.1.   MOD (Module Status LED)

Status	LED is	To indicate
No Power	OFF	Power is not supplied to the unit.
Device Operational	Green	The unit is operating in normal condition.
Device in Standby	Blinking Green	The EEPROM parameter is not initialized yet. Serial Number is zero value (0x00000000)
IAP Mode	Toggling Green & Red	IAP Mode : Available for firmware download using FireFox.
Unrecoverable Fault	Red	The unit has occurred unrecoverable fault in self-testing. - Firmware fault

* The IP Address to access IAP web-server during IAP Mode: 192.168.100.10 (Recommended to use FireFox)

7.5.2.   NET (Network Status LED)

Status	LED is	To indicate	
Initialize	OFF	Non-Operating or Initialize	
Operate	Green	Operating	
	Blinking Green	Pre-Operating	LED ON : 200ms / LED OFF : 200ms
		Safe-Operating	LED ON : 200ms / LED OFF : 1s
Error	Red	Network Error	
Diagnostic	Blinking Red	Diagnostic Mode	

 *Blinking Green MOD & NET LED: BOOTP/DHCP is requesting for new IP address.

 (You can change the IP setting mode. Please refer to specification.)

7.5.3.   RUN (PLC Run/Stop Status LED)

Status	LED is	To indicate
Not programmed	OFF	The unit is not programmed or not powered.
Run	Green	PLC Run
Stop	Blinking Green	PLC Stop
Program Error	Blinking Red	PLC program error

7.5.4. I/O LED (Expansion Module Status LED)

Status	LED is	To indicate
Not Powered No Expansion Module	OFF	Device has no expansion module or may not be powered.
On-line, Do not Exchanging I/O	Blinking Green	I/O Communication is normal but does not exchange I/O data. (Passed the expansion module configuration)
Connection, Run Exchanging I/O	Green	Exchanging I/O data.
Connection Fault during Exchanging I/O	Blinking Red	One or more expansion module occurred in fault state. - Changed expansion module configuration. - Communication failure. - Overflowed Input/Output size.
Expansion Configuration Failed	Red	Failed to initialize expansion module. - Detect invalid expansion module ID. - Too many expansion modules. - Initial protocol failure. - Mismatch vendor code between adapter and I/O module.

7.5.5. Exception indication

To indicate	LED			
	MOD	NET	RUN	IOS
Program reset	-	-	RED/GREEN (Toggle every 0.25s)	-
Factory reset	RED/GREEN (Toggle every 0.25s)			
IO Watchdog error	RED	-	RED	-
CODESYS Task Watchdog error	-	-	RED	-
CODESYS License error	-	-	RED/GREEN (Toggle every 2s)	-
Heap memory over flow	RED	RED	-	-
Stack memory over flow or Assertion error	RED	-	-	-
Hard Fault	RED			

'-' : Current LED status

7.5.6. Field Power LED (Field Power Status LED)

Status	LED is	To indicate
Not supplied field power	OFF	Not supplied 24Vdc field power.
Supplied field power	Green	Supplied 24Vdc field power.

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7.5.7. RJ-45 Socket (1pcs)

Pin#	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

Shielded RJ-45 Socket

7.5.8. RS-232/RS 485 Port for MODBUS/RTU, Touch Panel or IO Guide
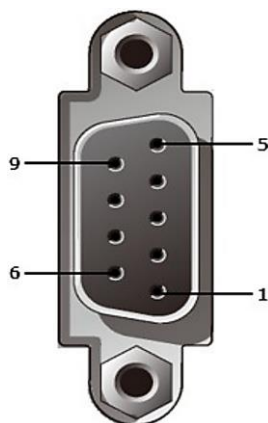
Pin#	Signal Name	Description
1	-	
2	TxD	RS232 TxD
3	RxD	RS232 RxD
4	-	
5	GND	RS232 GND
6	D+	RS485 D+
7	-	
8	D-	RS485 D-
9	/ISP	Low Active, Internal Pull-up

7.5.9. Toggle Switch and Push Button

Toggle Switch Status	Module is	Description
UP	RUN	PLC Run
DOWN	STOP	PLC Stop

Push Button	Module is	Description
Push and detach	Reset	PLC Reset and Stop
Push for 5sec and Power Reset	PLC Reset	Erase PLC user program and Retain memory
Push for 20sec and Power Reset	Factory Reset	Erase PLC user program and PLC parameter reset
Push hold and Power Reset	IAP mode	Firmware download via FireFox.

7.5.10. RJ-45 Socket (2pcs)
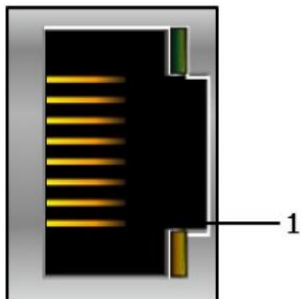
Shielded RJ-45 Socket

Pin#	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

7.5.11. EtherCAT Node Setting Switch

DIP Pole #	Description
1	Identification Value DIP bit#0
2	Identification Value DIP bit#1
3	Identification Value DIP bit#2
4	Identification Value DIP bit#3
5	Identification Value DIP bit#4
6	Identification Value DIP bit#5
7	Identification Value DIP bit#6
8	Identification Value DIP bit#7

8. M937x - Specification

8.1. General Specification

General specification	
UL System Power	Supply voltage : 24Vdc nominal, Class 2
System Power	Supply voltage : Class 2, 24Vdc nominal Supply voltage range : 15~28.8Vdc Protection : Output current limit / Reverse polarity protection
Power Dissipation	110mA typical @ 24Vdc
Current for I/O Module	Max 1.5A @ 5Vdc (If except for the NA, current for I/O module is about 1.4A)
Isolation	System power to internal logic : Non-isolation System power I/O driver : Isolation
UL Field Power	Supply voltage : 24Vdc nominal, Class 2
Field Power	Supply voltage : 24Vdc typical (Max.28.8Vdc) * Field Power Range is different depending on IO Module series. Refer to IO Module`s Specification.
Max. Current Field Power Contact	DC 10A Max
Wiring	0.205㎟ - 1.3㎟ (24-16 AWG)
Torque	0.8 Nm(7 lb-in)
Weight	179g
Module Size	54mm x 110mm x 75mm

8.2. Environment Specification

Environmental specification	
Operating Temperature	-25℃~60℃ (based on UL)
Storage Temperature	-40℃~85℃
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
Shock Operating	IEC 60068-2-27
Vibration Resistance	IEC 60068-2-6, 4g
Industrial Emissions	EN 61000-6-4/A11 : 2011
Industrial Immunity	EN 61000-6-2 : 2019
Installation Position	Vertical and horizontal installation is available.
Product Certifications	UL, ATEX, CE, UKCA, ABS, BV, CCS, DNV, KR, LR

8.3. Interface Specification

Programmable Specification			
Module Lists	**M9371**	**M9372**	**M9373**
Programming	CODESYS V3.5.17.3 with FW Rev 3.xxx CODESYS V3.5.11.3 with FW Rev 1.xxx, FW Rev 2.xxx		
Program Memory	512 Kbytes	16 Mbytes	
Data Memory	96 Kbytes	16 Mbytes	
	IO Input: %IW0 ~%IW2047 (2048 words) IO Output: %QW0 ~%QW2047 (2048 words) Memory: %MW0 ~ %MW8191 (8192 words)		
Non-Volatile Memory	4 Kbytes	12 Kbytes	
	Retain: 2 Kbytes Persistent: 2 Kbytes	Retain: 6 Kbytes Persistent: 6 Kbytes	
Run-Time System	Multiple PLC Tasks		
Program Languages	IEC 61131-3 (LD, IL, ST, FBD, SFC)		
MQTT [1]	O	O	
MQTT_Sparkplug B	X	O	
IIOT Library	X	X	
SNMP (Agent Only) [2]	O	O	
SNTP	O	O	
User management [3]	X	O	
OPC DA Server	X	O	
OPC UA Server & Client	X	O	
Online Change	X	O	
Source Upload/Download	X	O	
File system	X	O	
File transmit	X	O	
TFTP	X	O	
SQL4CODESYS	X	O	
Breakpoint	X	O	
Weather Forecast	X	O	
Web Visualization [4]	X	X	O
RTC [5]	Retain Time : < 15 day / Accuracy : < 2min/month Recommendation : Battery should be fully recharged at 25℃.		
Max. Task	10		
Max. Cycle Task	10		
Max. Status Task	10		
Process Time	0.0311us	0.1627usec	

1) MQTT does not support TLS.
2) Only the standard format "RFC1213-MIB" is provided.
3) Provide functionality in a limited form.
4) Web Visualization cannot be supported in Internet Explorer.

5) RTC (at 25℃)

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Battery charging time	Retain time (at 25℃)	*** RTC Warning
4 hours	> 2 day	There will be 2 operating problems when the battery is discharged.
12 hours	> 12 day	- Retain data will not be saved.
16 hours	> 15 day	- RTC data will not be stored and will be the initial value.

- Recommend charging for at least 16 hours when the battery is discharge.
- Retain time may vary depending on temperature and environment.
- The battery is one of components on PCB in the plastic housing.
  It means that it can't be checked visually but can be charged by supplying the voltage to the system power.

Interface Specification		
Adapter Type		Master & Slave Node (Modbus TCP, Modbus RTU)
Max. Expansion Module		63 Slots
Max. Data Size(Input+Output)		Max 128Byte each slot
Max. Nodes		Limited by Ethernet Specification
Baud rate		10/100Mbps, Auto-negotiation, Full Duplex
Ethernet Interface		RJ-45 socket * 2pcs
Ethernet Protocol		Modbus TCP, Modbus UDP, SNTP, SNMP DHCP/BOOTP, HTTP (Web-Server)
Max. Socket	M9371	UDP: 16, TCP: 16
	M9372/73	UDP: 16, TCP: 64
Serial Interface		RS232 : 1 port RS485 : 2 port
Serial Protocol		Modbus/RTU / Baud Rate : 2400~115200 bps (Default: 115200 bps)
Serial Port		RS232 for MODBUS/RTU, Touch Panel or IOGuidePro
Serial Fixed Configuration (RS232_Debug Connector)		Node : 1 Data bit : 8 Parity bit : No parity Baud Rate : 115200 Stop bit : 1
LED Indicator		1 Green/Red, Module Status (MOD) 1 Green/Red, Network Status (NET) 1 Green/Red, PLC Run/Stop Status (RUN) 1 Green/Red, Expansion I/O Module Status (IOS)

8.4.   Ethernet Connection Specification

Function*	Model	Max. number of concurrent communications
Web Visualization	M9373 only	One for each functions are available at the same time
ARTI (OPC-server)	M9372/73	
CODESYS link	M9371/72/73	
Network-variable	M9371/72/73	
Modbus/TCP Master	M9371	16 Modbus/TCP Slaves can be connected
	M9372/73	64 Modbus/TCP Slaves can be connected
Modbus/TCP Slave	M9371	16 Modbus/TCP Masters can be connected
	M9372/73	64 Modbus/TCP Masters can be connected
Web-server	M9371	16 clients can be opened
	M9372/73	64 clients can be opened

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* The maximum number of sockets (M9371: 16, M9372/73: 64) can be used at the same time.

Hot Swap
The slot exchange should be done one by one. If multiple slots should be exchanged, it must be done sequentially starting from the slot closest to Network Adapter.

8.5.   M937x - Wiring Diagram

Pin No.		Signal Description
0	SP	System Power, 24V
1	SP	System Power, 24V
2	SN	System Power, 0V(GND)
3	SN	System Power, 0V(GND)
4	NC	------------
5	NC	------------
6	PS	Primary Power Setting
7	PS	Primary Power Setting
8	FG	F.G
9	FG	F.G
10	FN	Field Power 0V (GND)
11	FN	Field Power 0V (GND)
12	FN	Field Power 0V (GND)
13	FN	Field Power 0V (GND)
14	FP	Field Power 24V
15	FP	Field Power 24V
16	FP	Field Power 24V
17	FP	Field Power 24V
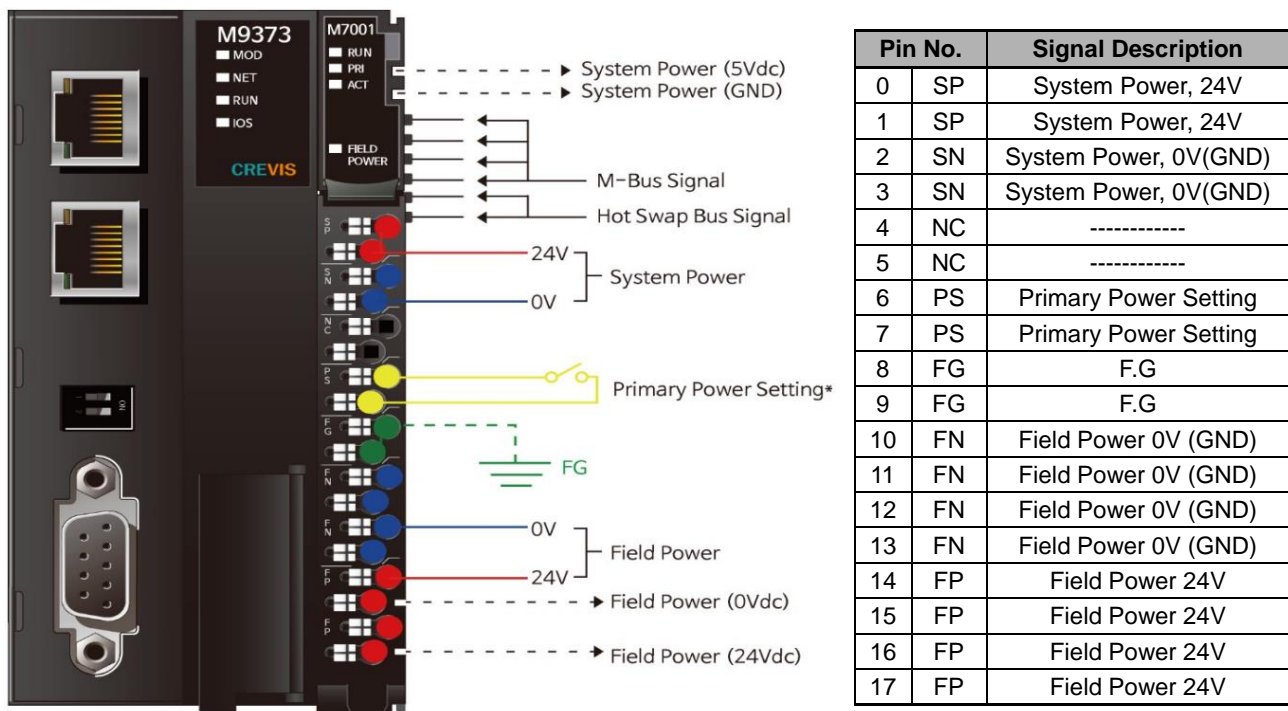
∗ **Primary Power Setting (P.S pin)** : Short the P.S pin to set one of the two M7001 as the primary power.

8.6.   M937x - LED Indicator
8.6.1.   LED Indicator
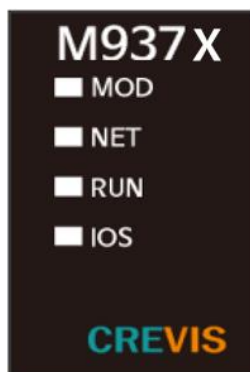
LED No.	LED Function / Description	LED Color
MOD	Module Status	Green/Red
NET	Network Status	Green/Red
RUN	PLC Status	Green/Red
IOS	Extension Module Status	Green/Red

8.6.2. MOD (Module Status LED)

Status	LED	Description
Not Powered	OFF	Power is not supplied to the unit.
Normal, Operational	Green	The unit is operating in normal condition.
Device in Standby	Blinking Green	The EEPROM parameter is not initialized yet. Serial Number is zero value (0x00000000)
IAP Mode*	Toggling Green & Red	Available for firmware download using FireFox.
Unrecoverable Fault	Red	The unit has occurred unrecoverable fault in self-testing. - Firmware fault

* The IP Address to access IAP web-server during IAP Mode: 192.168.100.10 (Recommendation to use FireFox)

8.6.3. NET (Network Status LED)

Status	LED	Description
Off-line	OFF	Network Offline.
On-line (Connect)	Green	On-line Mode and network is connected.
Error	Red	Network Error.
Diagnostic	Blinking Red	Diagnostic Mode.

*Blinking Green MOD & NET LED: it's the mode of Bootp or DHCP for new IP address.

(The Bootp or DHCP can be set as per the specification)

8.6.4. RUN (PLC Run/Stop Status LED)

Status	LED	Description
Not programmed	OFF	The unit is not programmed or not powered.
Run	Green	PLC program is running.
Stop	Blinking Green	PLC program is stop.
Firmware Fault	Red	The unit has occurred unrecoverable fault in self-testing.
Diagnostic	Blinking Red	PLC program and expansion I/O modules do not match.

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8.6.5. IOS LED (Expansion Module Status LED)

Status	LED	To indicate
No Expansion I/O	OFF	Device has no expansion module or may not be powered.
Do not Exchanging I/O	Blinking Green	I/O Communication is normal but does not exchange I/O data. (Passed the expansion module configuration)
Run Exchanging I/O	Green	Device has expansion modules.
Connection Fault during Exchanging I/O	Blinking Red	One or more expansion module occurred in a fault state. - Check the expanded module configuration. - Failed the expanded module communication. - Overflowed Input/Output size. (Enable Hot-swap)
Expansion Configuration Failed	Red	Failed to initialize expansion module - Detected invalid expansion module ID. - Overflowed Input / Output Size - Oversized expansion module - Initial protocol failure - Mismatch vendor code between adapter and I/O module. (Disable Hot-swap)

8.6.6. Exception indication

To indicate	LED			
	MOD	NET	RUN	IOS
Program reset	-	-	RED/GREEN (Toggle every 0.25s)	-
Factory reset	RED/GREEN (Toggle every 0.25s)			
IO Watchdog error	RED	-	RED	-
CODESYS Task Watchdog error	-	-	RED	-
CODESYS License error	-	-	RED/GREEN (Toggle every 2s)	-
Heap memory over flow	RED	RED	-	-
Stack memory over flow or Assertion error	RED	-	-	-
Hard Fault	RED			

 '-' : Current LED status

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8.6.7. Toggle Switch

Toggle Switch Status	Module is	Description
UP	RUN	PLC Run
DOWN	STOP	PLC Stop

8.6.8. Push Button

Push Button	Module is	Description
Push and detach	Reset	PLC Reset and Stop
Push for 5sec and Power Reset	PLC Reset	Erase PLC user program and Retain memory
Push for 20sec and Power Reset	Factory Reset	Erase PLC user program and PLC parameter reset
Push hold and Power Reset	IAP mode	Firmware download via FireFox.

9. ML9971 - Specification

9.1.   General Specification

General specification		
Power Dissipation	ML9971	60mA typical @ 24Vdc
	ML9972/73	50mA typical @ 24Vdc
UL System Power		Supply voltage: 24Vdc nominal, Class 2
System Power		Supply voltage: 24Vdc nominal Supply voltage range: 18 ~ 28.8Vdc Reverse polarity protection
UL Field Power		Supply voltage: 24Vdc nominal, Class 2
Field Power*		Supply voltage: 24Vdc typical (Max. 30Vdc)
Max. Current Field Power Contact		Max. DC 8A
Wiring		I/O Cable Max. 2.0mm2(AWG 14)
Torque		0.8 Nm(7 lb-in)
Current for Expansion Module		1.0A @ 5Vdc
Isolation		System power to internal logic : Non-isolation System power I/O driver : Isolation
Weight		84g
Module Size		17.5mm x 110mm x 75mm

9.2.   Environment Specification

Environmental specification	
Operating Temperature	-25℃~60℃（based on UL）
Storage Temperature	-40℃~85℃
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
Shock Operating	IEC 60068-2-27
Vibration Resistance	IEC 60068-2-6, 4g
Industrial Emissions	EN 61000-6-4/A11 : 2011
Industrial Immunity	EN 61000-6-2 : 2019
Installation Position	Vertical and horizontal installation is available.
Product Certifications	UL, CE, UKCA

* ML9971: To comply with the EMI, a ferrite core must be used for the DC power and each communication cable.

9.3. Interface Specification

Programmable Specification			
Module List	**ML9971**	**ML9972**	**ML9973**
Programming (CODESYS)	CODESYS V3.5.17.3 with FW Rev 3.xxx CODESYS V3.5.11.3 with FW Rev 1.xxx, FW Rev 2.xxx		
Program Memory	512 Kbytes	16 Mbytes	
Data Memory	96 Kbytes	16 Mbytes	
	IO Input: %IW0 ~%IW2047　　　　　(2048 words) IO Output: %QW0 ~%QW2047　　　　(2048 words) Memory: %MW0 ~ %MW8191　　　　(8192 words)		
Non-Volatile Memory	4 Kbytes	32 Kbytes	
	Retain: 2 Kbytes Persistent Retain: 2 Kbytes	Retain: 16 Kbytes Persistent Retain: 16 Kbytes	
Run-Time System	Multiple PLC Tasks		
Program Languages	IEC 61131-3 (LD, IL, ST, FBD, SFC)		
MQTT **1)**	O	O	
MQTT_Sparkplug B	X	O	
SSL/TLS	X	X	
User management **2)**	X	O	
IIOT Library	X	X	
SNMP (Agent Only) **3)**	X	O	
SNTP	O	O	
OPC DA Server	X	O	
OPC UA Server & Client	X	O	
Online Change	X	O	
Source Upload/Download	X	O	
File system	X	O	
File transmit	X	O	
TFTP	X	O	
SQL4CODESYS	X	O	
Breakpoint	X	O	
Weather Forecast	X	O	
Web Visualization **4)**	X	X	O
Max. Task	10		
Max. Cycle Task	10		
Max. Status Task	10		
Process Time	0.0186us	0.1648usec	
RTC **5)**	Retain Time : < 15 day / Accuracy : < 2min/month (Recommendation : Battery should be fully recharged at 25℃.		

1) MQTT does not support TLS.
2) Provide functionality in a limited form.
3) Only the standard format "RFC1213-MIB" is provided.

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4) Web Visualization can't be available with Internet Explorer.

5) RTC (at 25℃)

Battery charging time	Retain time at 25℃	*** RTC Warning
4 hours	> 2 day	There will be 2 operating problems when the battery is discharged.
12 hours	> 12 day	- Retain data will not be saved.
16 hours	> 15 day	- RTC data will not be stored and will be the initial value.

- Recommend charging for at least 16 hours when the battery is discharge.
- Retain time may vary depending on temperature and environment.
- The battery is one of components on PCB in the plastic housing.
 It means that it can't be checked visually but can be charged by supplying the voltage to the system power.

ML9971 Interface Specification	
Adapter Type	Master & Slave node (Modbus TCP)
Interface	RJ-45 socket * 2pcs
Baud rate	10/100Mbps, Auto-negotiation, Full Duplex
Ethernet Protocol	Modbus/TCP, Modbus/UDP, SNTP, HTTP (Web-Server), DHCP/BOOTP
Max. Socket	UDP: 10, TCP: 10

Indicator	4 LEDs
	  1 Green/Red, Module Status (MOD)
	  1 Green/Red, Network Status (NET)
	  1 Green/Red, PLC Run/Stop Status (RUN)
	  1 Green/Red, Expansion I/O Module Status (IOS)

ML9972/9973 Interface Specification	
Adapter Type	Master & Slave node (Modbus TCP, Modbus RTU)
Baud rate	10/100Mbps, Auto-negotiation, Full Duplex
Ethernet Interface	RJ-45 socket * 1pcs
Ethernet Protocol	Modbus/TCP, Modbus/UDP, SNTP, SNMP, DHCP/BOOTP HTTP (Web Visualization*, Web-Server), OPC-server
Max. Socket	UDP: 16, TCP: 64
Serial Interface	RJ-45 socket * 1pcs
Serial Protocol	Modbus RTU Baud Rate : 2400~115200 bps (Default: 115200 bps)

Indicator	4 LEDs
	  1 Green/Red, Module Status (MOD)
	  1 Green/Red, Network Status (NET)
	  1 Green/Red, PLC Run/Stop Status (RUN)
	  1 Green/Red, Expansion I/O Module Status (IOS)

9.4. ML997x - Ethernet connection specification

Function*	Model	Max. number of concurrent communications
Web Visualization	ML9973 only	One for each functions are available at the same time
ARTI (OPC-server)	ML9972/73	
CODESYS link	ML9971/72/73	
Network-variable	ML9972/73	
Modbus/TCP Master	ML9971	1 Modbus TCP Slaves can be connected
	ML9972/9973	64 Modbus TCP Slaves can be connected
Modbus/TCP Slave	ML9971	10 Modbus TCP Masters can be connected
	ML9972/9973	64 Modbus TCP Masters can be connected
Web-server	ML9971	10 clients can be opened
	ML9972/9973	64 clients can be opened

* The maximum number of sockets (ML9971: 10, ML9972/73: 64) can be used at the same time.

9.5. ML997x - Serial connection specification

Function	Model	Max. number of concurrent communications
Modbus RTU Master	ML9972/73	31 Modbus RTU Slaves can be connected

* Only for ML9972 and ML9973.

Hot Swap
The slot exchange should be done one by one. If multiple slots should be exchanged, it must be done sequentially starting from the slot closest to Network Adapter.

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9.6.   ML997x - Wiring Diagram
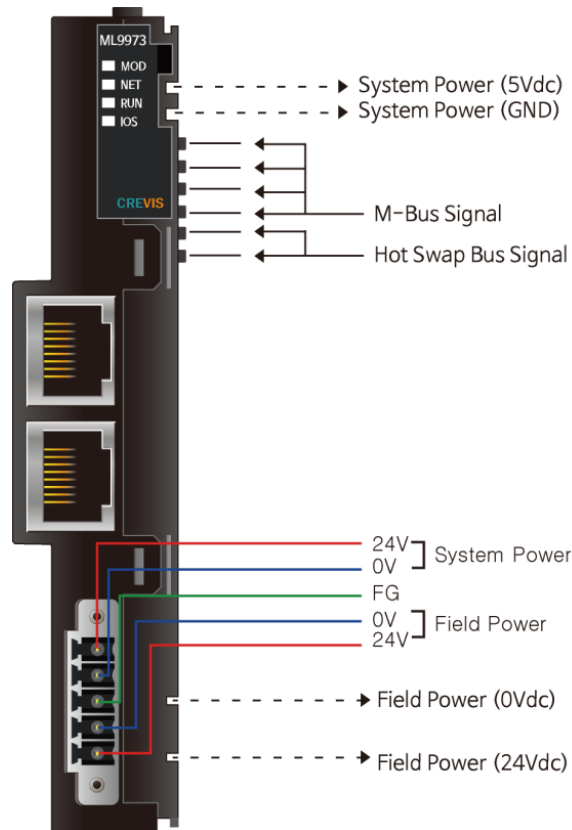
9.7.   ML997x - Power Description

Pin No.	Signal Description
1	System Power, 24V
2	System Power, Ground
3	F.G
4	Field Power, Ground
5	Field Power, 24V

* **Warning**
- The System Power and Field Power must be isolated from each other.
- System Power should use its own exclusive power supply.

9.8.   ML997x - LED Indicator

LED No.	LED Description	LED Color
MOD	Module Status	Green
NET	Network Status	Green
RUN	Custom	Green/Red
IOS	Expansion IO Status	Green/Red

9.8.1.   MOD (Module Status LED)

Status	LED is	To indicate
Not Powered	OFF	Power is not supplied to the unit.
Normal, Operational	Green	The unit is operating in normal condition.
IAP Mode*	Toggling Green & Red	Available for firmware download using FireFox.
Firmware Fault	Red	The unit has occurred unrecoverable fault in self-testing.
Recoverable Fault	Blinking Red	The unit has occurred recoverable fault in self-testing. - EEPROM checksum fault.

* The IP Address to access IAP web-server during IAP Mode: 192.168.100.10 (Recommended to use FireFox)

9.8.2.   NET (Network Status LED)

Status	LED is	To indicate
Not Powered	OFF	Network off-line.
Link	Green	Physically connected to the Ethernet port.

9.8.3.   RUN (PLC Run/Stop Status LED)

Status	LED is	To indicate
None PLC	OFF	Device has no program.
PLC Run	Green	PLC program is running.
PLC Stop	Blinking Green	PLC program stop.
Firmware Fault	Red	The unit has occurred unrecoverable fault in self-testing.
Memory Fault	Blinking Green and Red	Exceeded memory limits.
Diagnostic	Blinking Red	PLC program and expansion I/O modules do not match.

- If the error of a memory fault occurs, the program reset should proceed.

9.8.4. IOS LED (Expansion Module Status LED)

Status	LED is	To indicate
No Expansion I/O	OFF	Device has no expansion modules or not powered.
Have Expansion I/O	Green	Device has expansion modules.
Configuration Fault	Red	Replace expansion modules or fail to initialize. - Detect invalid expansion module ID. - Initial protocol failure. - Too many expansion modules. - Mismatch vendor code between adapter and expansion module. (Disable Hotswap)
Connection Fault	Blinking Red	One or more expansion module occurred in fault state. - Changed expansion module configuration. - Communication failure. - Mismatch vendor code between adapter and expansion module. (Enable Hotswap)

9.8.5. Exception indication

To indicate	LED			
	MOD	NET	RUN	IOS
Program reset	-	-	RED/GREEN (Toggle every 0.25s)	-
Factory reset	RED/GREEN (Toggle every 0.25s)			
IO Watchdog error	RED	-	RED	-
CODESYS Task Watchdog error	-	-	RED	-
CODESYS License error	-	-	RED/GREEN (Toggle every 2s)	-
Heap memory over flow	RED	RED	-	-
Stack memory over flow or Assertion error	RED	-	-	-
Hard Fault	RED			

'-' : Current LED status

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9.9.   Electrical Interface

9.9.1.   ML9971 RJ-45 Socket

- Ethernet Socket * 2pcs
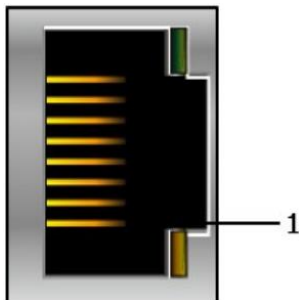
Ethernet Socket * 2pcs

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

9.9.2.   ML9972/9973 RJ-45 Socket

- Ethernet Socket * 1pcs + Serial Socket * 1pcs

Ethernet Socket * 1pcs

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	
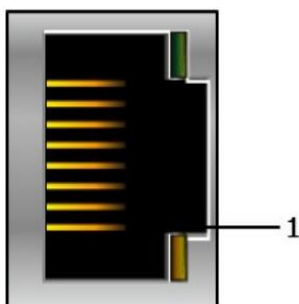
Serial Socket * 1pcs

RJ-45	Signal Name	Description
1	D+	RS485 D+
2	D-	RS485 D-
3	GND	
4	/ISP	/ISP
5	-	
6	GND	
7	TXD	RS232 TXD
8	RXD	RS232 RXD
Case	Shield	

9.9.3. Toggle Switch

Toggle Switch	Signal Name	Description
UP	RUN	PLC Run
DOWN	STOP	PLC Stop

9.9.4. Push Switch

Push Switch	Module is	Description
Push < 5sec	Stop State	Transition to PLC stop state.
Push > 5sec	PLC Reset	The PLC program and retain memory will be erased.
Push > 20sec	Factory Reset	The PLC program and parameters will be erased.
Push hold and Power Reset	IAP mode	Firmware download. (Recommended to use FireFox.)

9.9.5. Dip Switch

Dip Swtich		Description
1	2	
ON	ON	RS485 terminating resistor enabled (1 kΩ)
OFF	OFF	RS485 terminating resistor disabled

* 2 poles DIP Switches only for GL-9972 and GL-9973.

Dip Switch	Description
-	No function (Reserved)

10. G Series PIO (Programmable I/O) Functions

CREVIS IO Guide Pro is compatible with the PIO(GN-9371/2/3).
The basic parameter set-up and configuration for the PIO is available via the IO Guide Pro.
And user can set up the IP Address, RTC from the Webserver page,

10.1. Connection to IO Guide Pro by Modbus RTU *(RS-232 or RS-485)

(1) Installation program, 'IO Guide Pro Tool' downloaded by CREVIS Webpage (www.crevis.co.kr).
(2) Open the IO Guide and Click the 'New project' Icon.
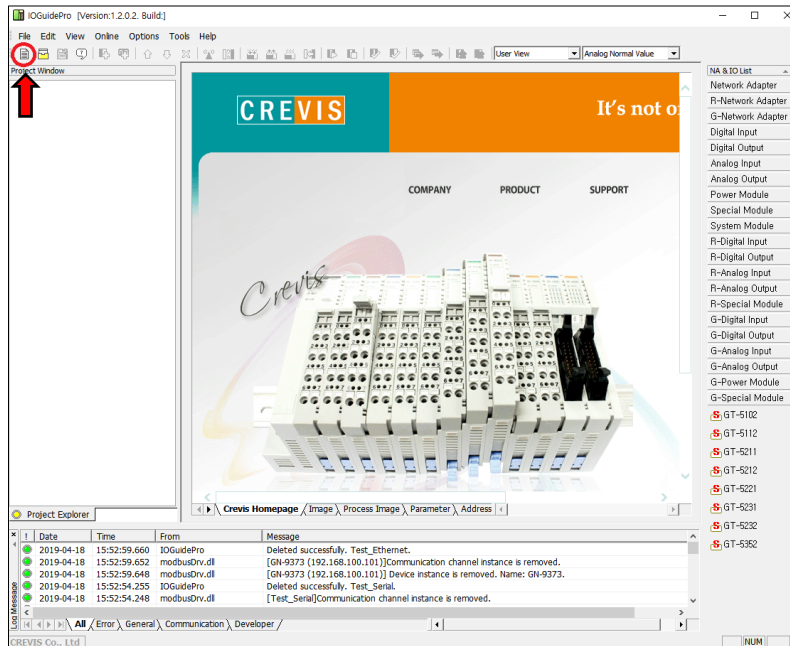
(3) Write the 'Project Name', Select the 'Bus Type' & the 'Location' and Click the 'OK'.
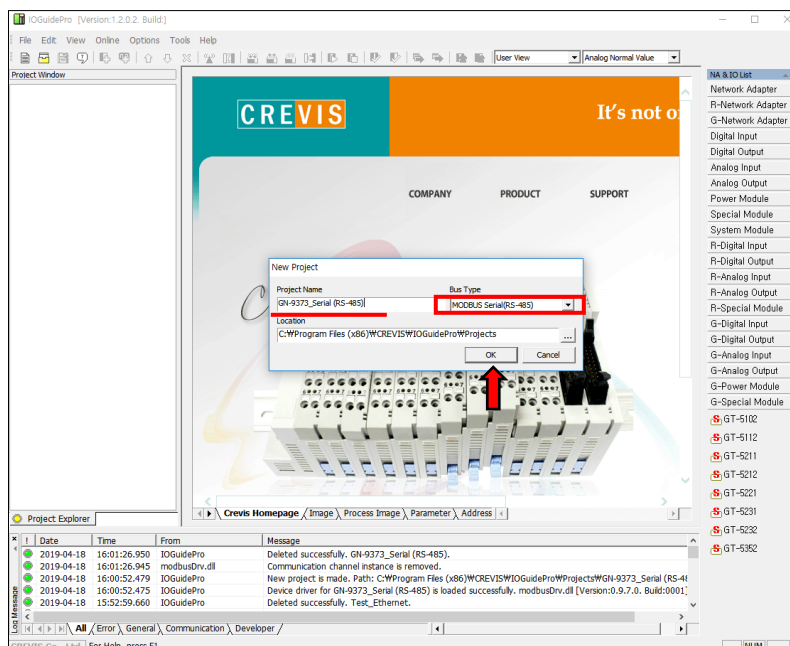
(4) After creating a project and Click the 'Automatic scan' Icon.
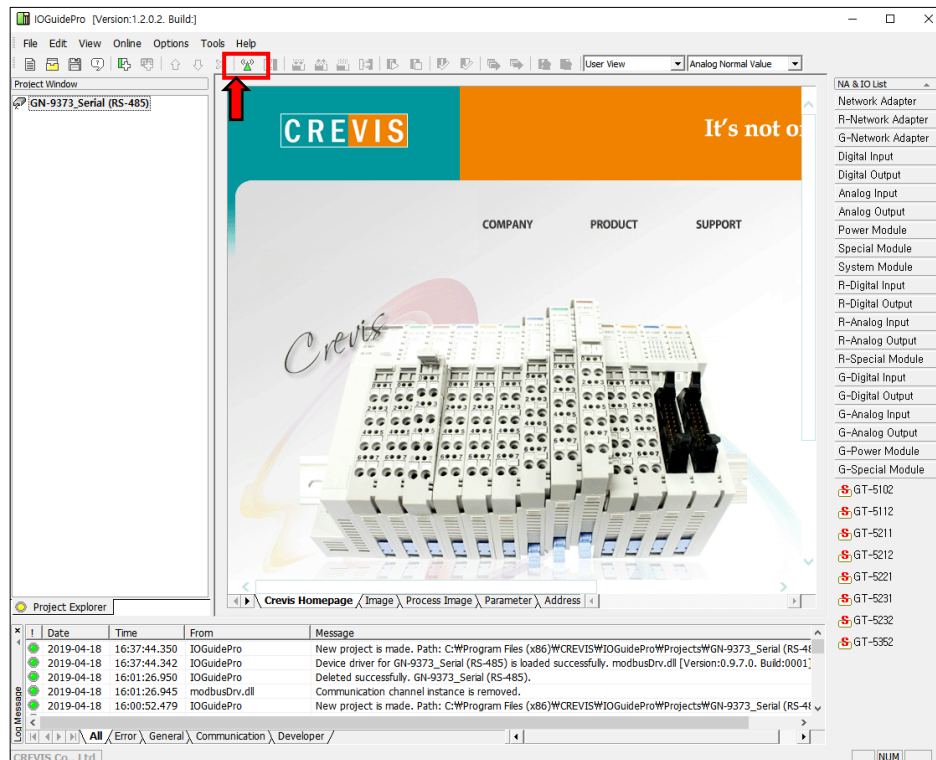
(5) Write the value(Port, Node, Baudrate), and Click the 'Scan' button.
(6) After the end to scan the network, Click the 'OK'.
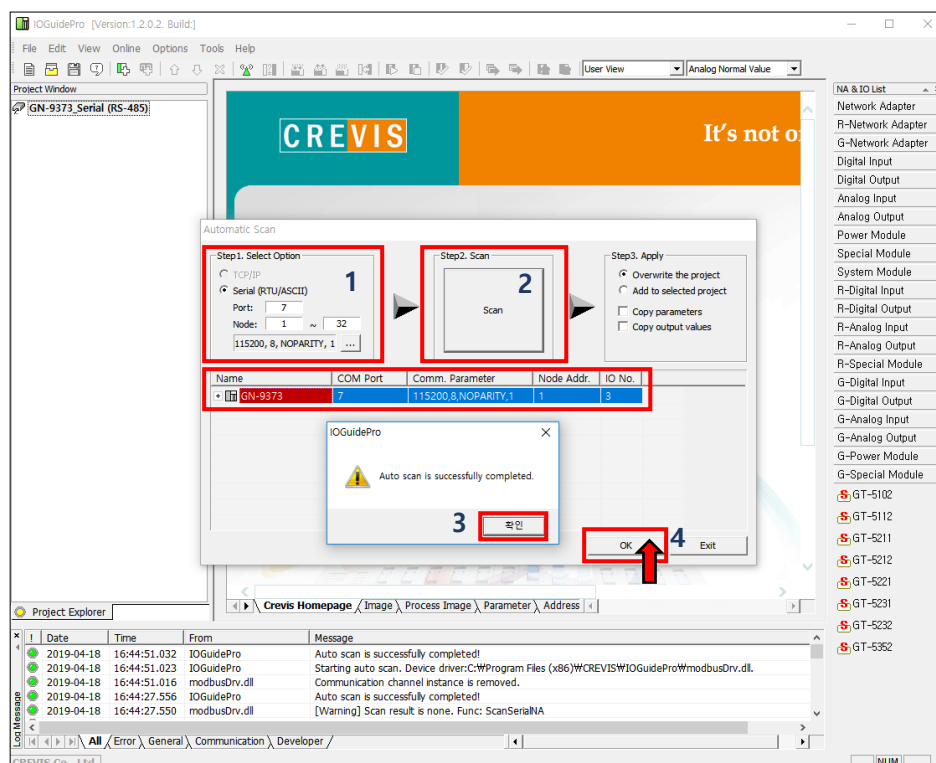
(7) Now ready to use the IO Guide Pro with RTU.
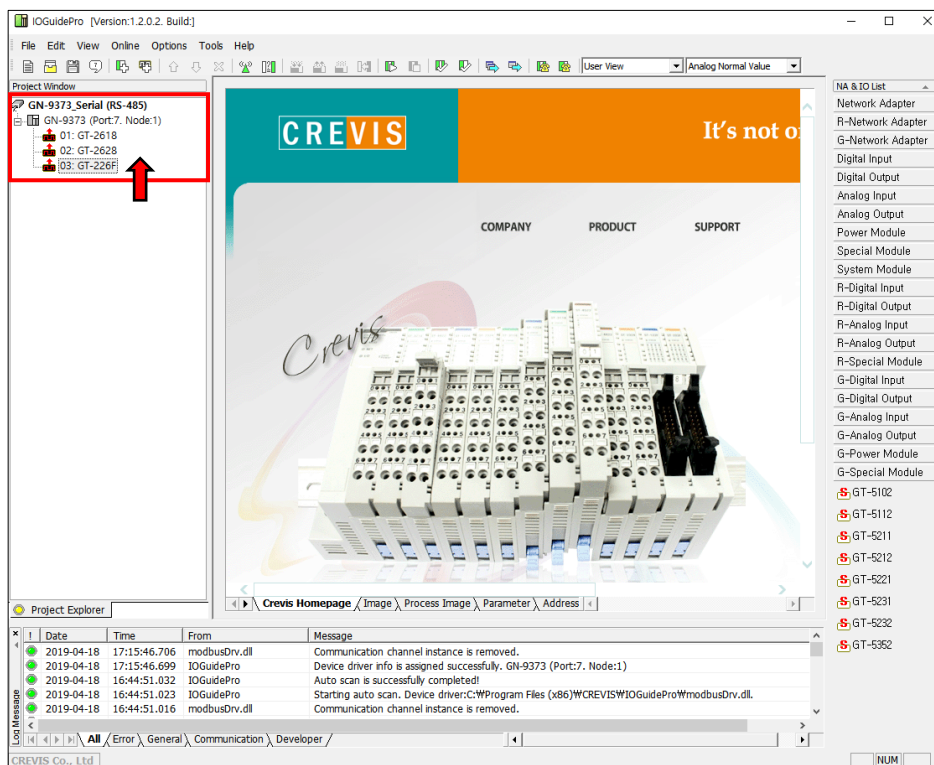
10.2. Connection to IO Guide Pro by Modbus TCP

(1) Open the IO Guide Pro Tool and Click the 'New project' Icon (Same as RTU).
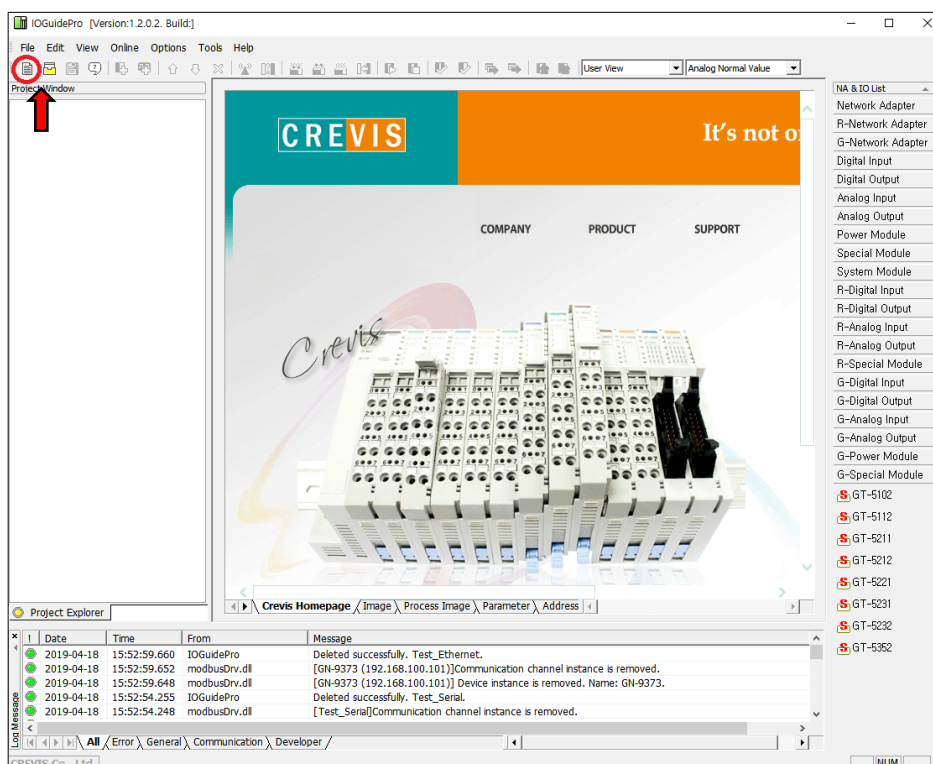
(2) Write the 'Project Name', Select the 'Bus Type' & the 'Location' and Click the 'OK'.
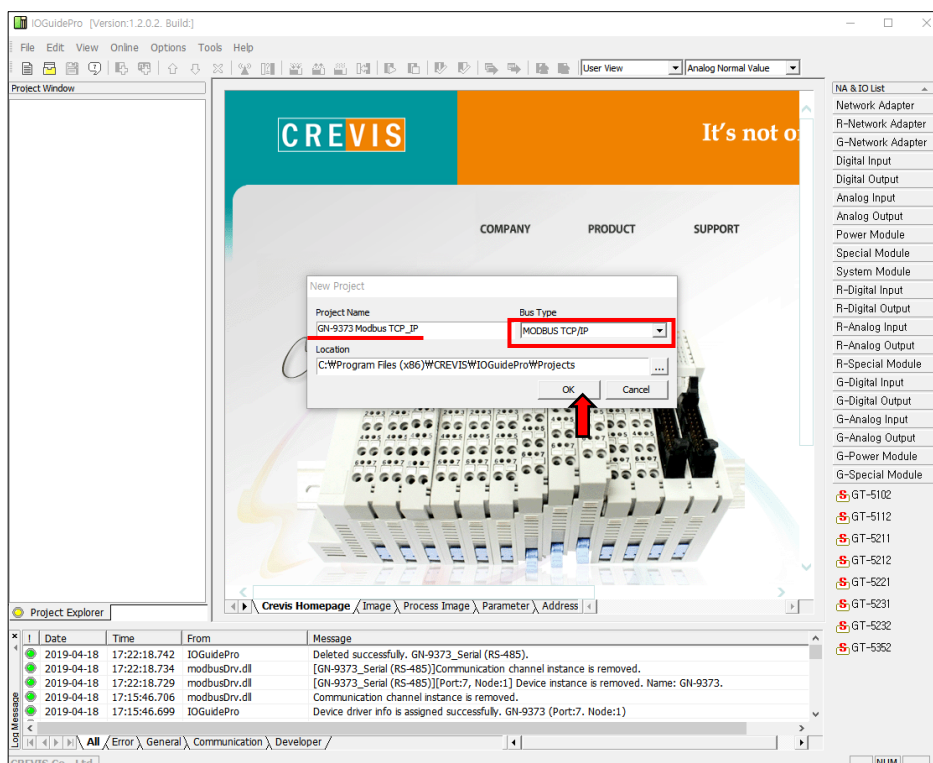
(3) After creating a project and click the 'Automatic Scan' Icon.
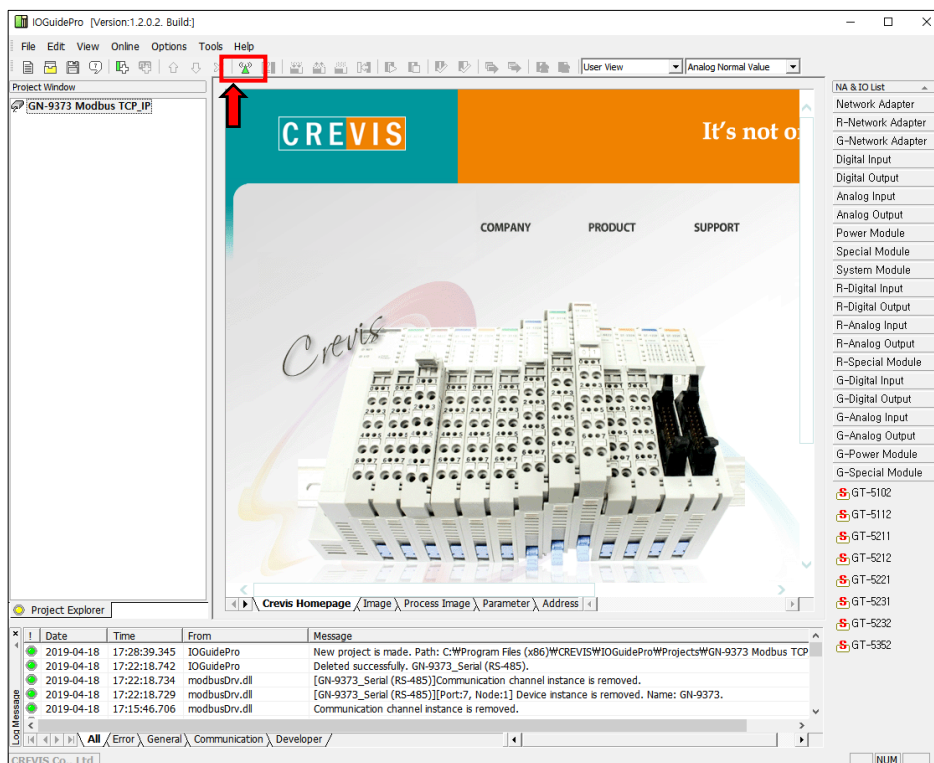
(2) Click the 'Scan' button.
(4) After the end to scan the network, Click the 'OK' button.
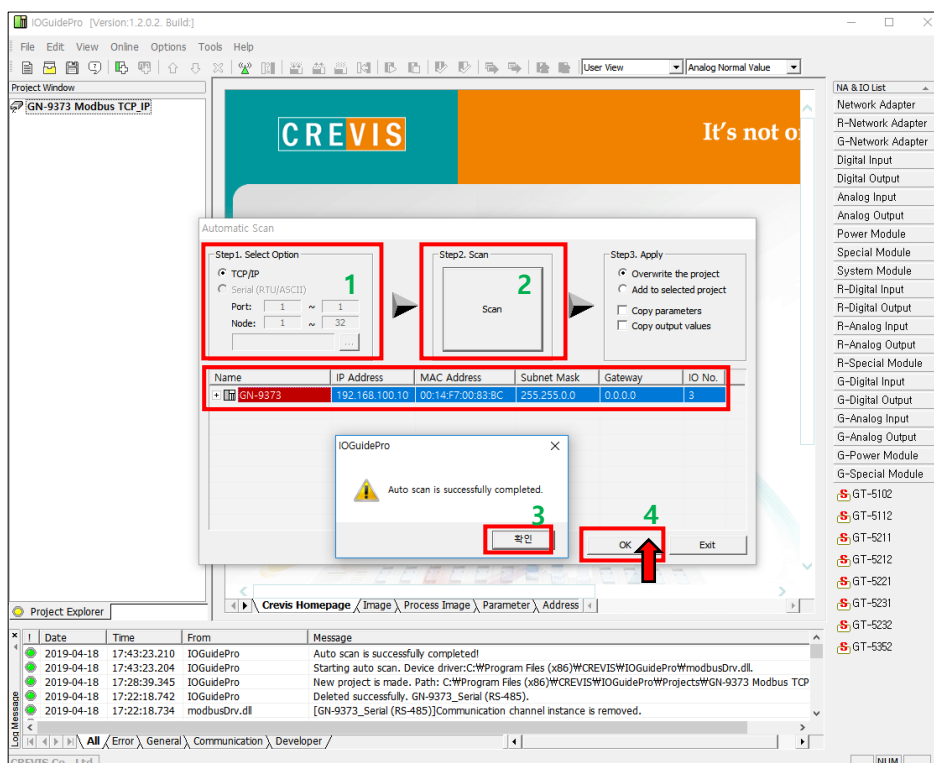
(5) Now ready to use the IO Guide Pro with Modbus TCP.
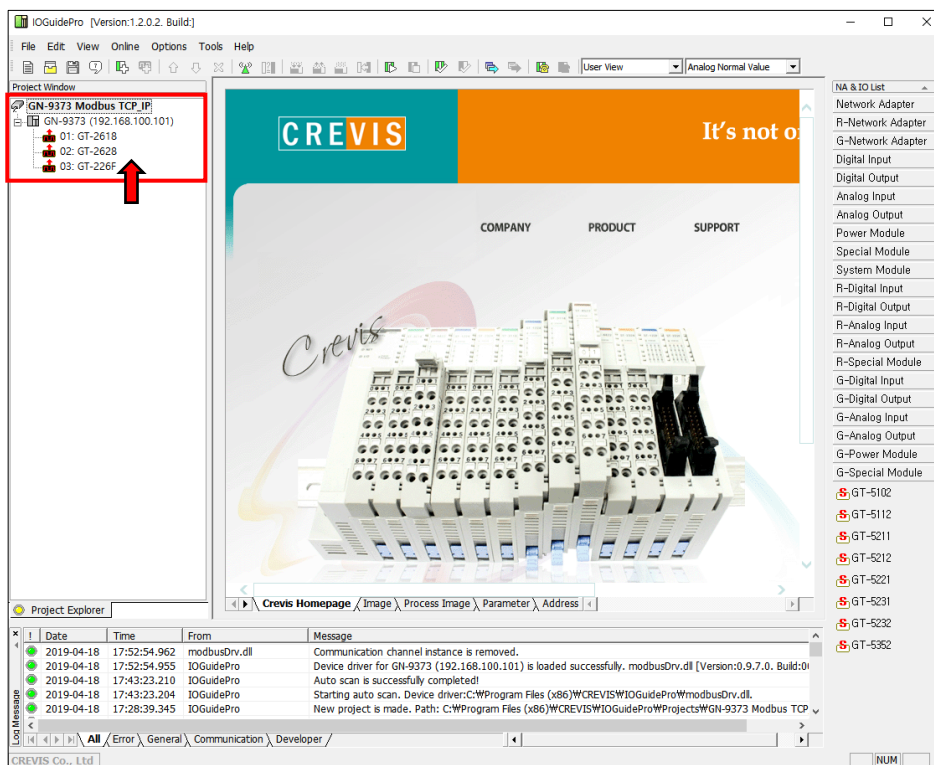
10.3. Confirmation of Network Information.

Network Condition about the IP Address, Subnet Mask, Gate Way, Mac Address of GN-9371/2/3 can be checked, or set up from the following process below by using the IO Guide Pro Tool under Modbus RTU, and Modbus TCP protocol types.

* IP Address : Also known as an "IP number" or simply an "IP," this is a code made up of numbers separated by three dots that identifies a particular computer on the Internet. Every computer, whether it be a Web server or the computer you're using right now, requires an IP address to connect to the Internet. IP addresses consist of four sets of numbers from 0 to 255, separated by three dots.

* Subnet Mask : A subnet mask is a number that defines a range of IP addresses that can be used in a network. (It is not something you wear on your head to keep subnets out.) Subnet masks are used to designate sub networks, or subnets, which are typically local networks LANs that are connected to the Internet. Systems within the same subnet can communicate directly with each other, while systems on different subnets must communicate through a router.

* Gate Way : A gateway is either hardware or software that acts as a bridge between two networks so that data can be transferred between a number of computers.

* Mac Address : A MAC address is a hardware identification number that uniquely identifies each device on a network. The MAC address is manufactured into every network card, such as an Ethernet card or Wi-Fi card, and therefore can't change.

(1) Run '[Crevis] -> [IOGuidePro] -> [Protocol Messenger] -> [Modbus]'
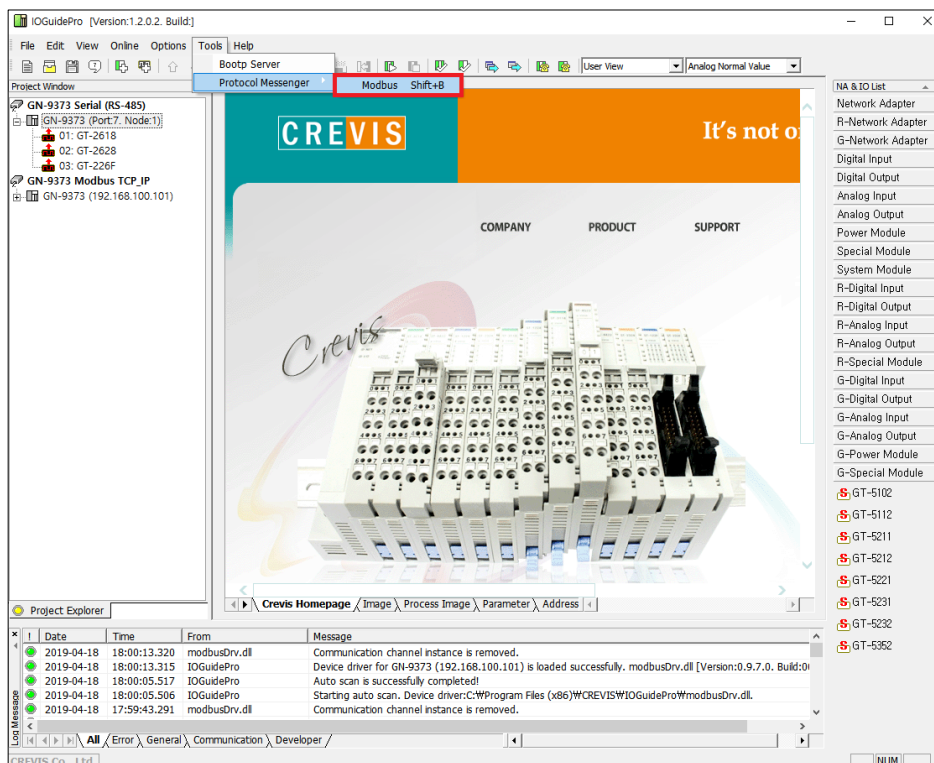
(2) Write the value of each.
   *Protocol : Modbus TCP, Modbus RTU
   *ComPort : User Port / Baudrate : 115200(default)
   *Address(Hex) : 1600 (IP Address Register)
                 : 1602 (IP Subnet Mask Register)
                 : 1604 (Gate way Register)
                 : 1610 (Mac Address Register)
   *Function(Dec) : 03, Read Holding Registers

(3) After clicking the 'send' button and confirm the necessary information.
   If you choose 'ByteDec', easier to see.

10.4. BOOTP / DHCP

'IP Address' setting is available for BOOTP / DHCP.

* BOOTP: short for Bootstrap Protocol, is a UDP network protocol used by a network client to obtain its IP address automatically. This is usually done in the bootstrap process of computers or operating systems running on them. The BOOTP server can assign the IP address from a pool of addresses to each client.

* DHCP: set of rules used by communications devices such as a computer, router or network adapter to allow the device to request and obtain an IP address from a server which has a list of addresses available for assignment.

(1) Run '[Crevis] -> [IOGuidePro] -> [Protocol Messenger] -> [Modbus]'
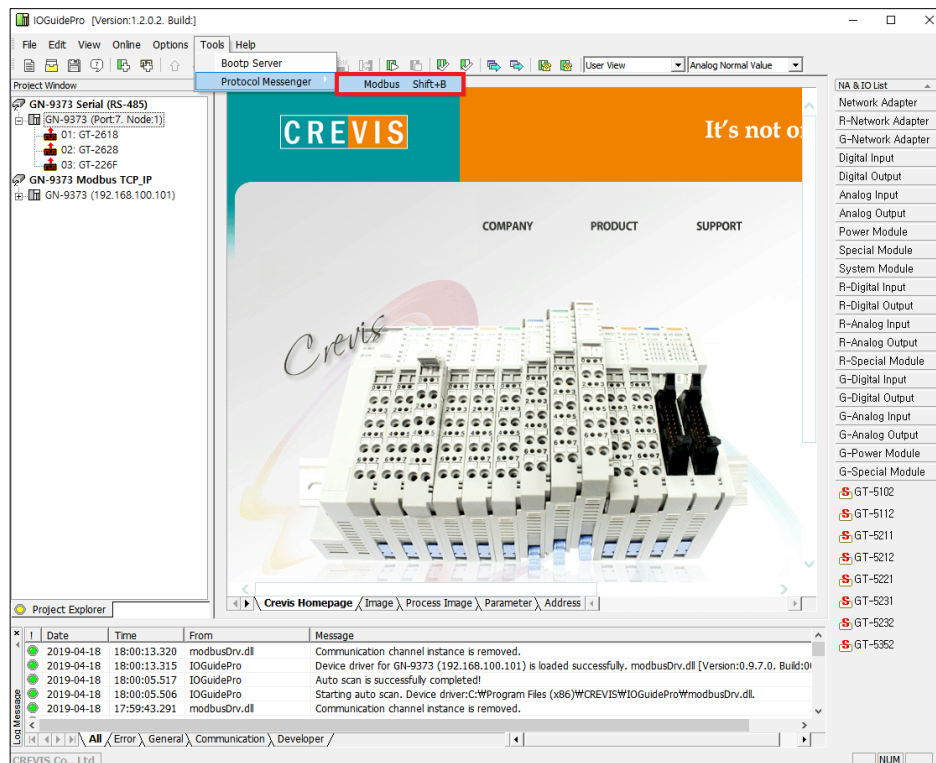
(1) Write the value of each.
*Protocol : ModbusTCP, Modbus RTU
*ComPort : User Port / Baudrate : 115200(default)
*Address(Hex) : 160B (IP Setting Method Register)
*Function(Dec) : 16, Write Multiple registers

(2) Write the register value and click the 'Send' button.
     *Not Use : 0000   /   *BootP Setting : 8000   /   *DHCP Setting : 8001

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10.5. Setup IP Address

User can assign the IP Address manually via the CREVIS Bootp Server in IO Guide Pro.
Default IP Address is 192.168.100.100

(1) Run '[Crevis] → [IOGuidePro] → [Bootp Server]'
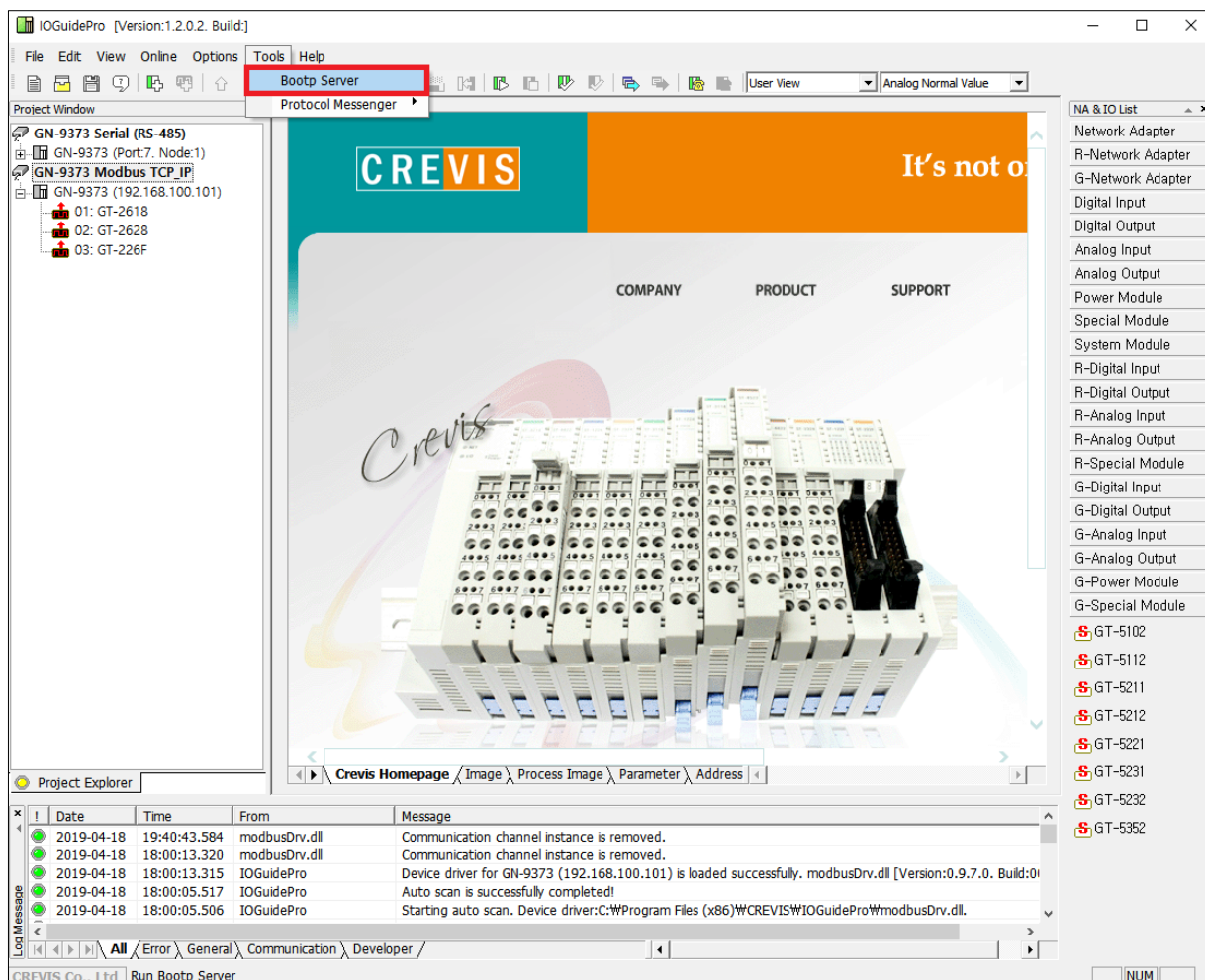
IMPORTANT	GN-9371/2/3 can support DHCP or Bootp. If DHCP server is working on the same network, Bootp is not available. In this case, IP set-up is only available from the DHCP server.

(2) Power on the GN-9371/2/3, and Click the 'Start Bootp' button.
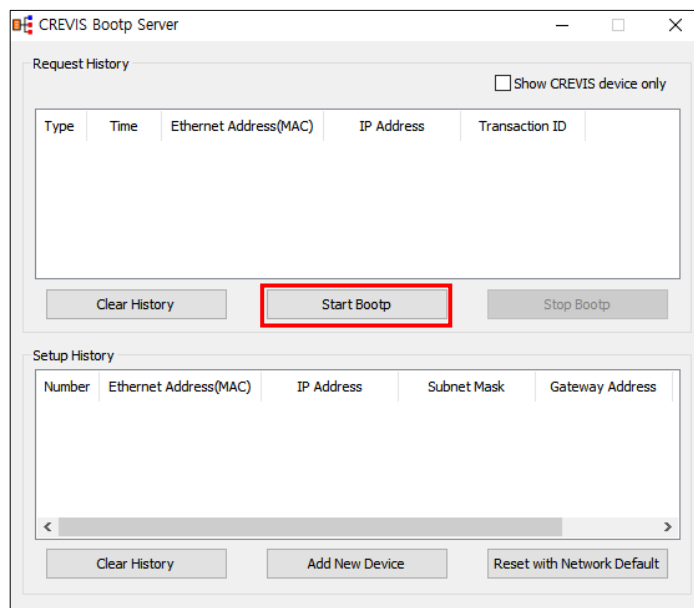
(3) Double Click 'MAC address of GN-9371/2/3'.
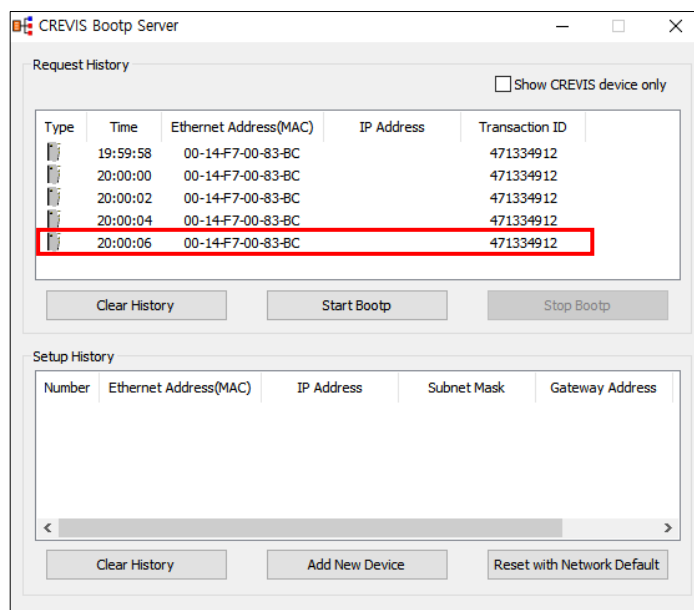
| IMPORTANT | Turn on the power of GN-9371/2/3, and Bootp server will retry to get the MAC address or IP address 2 times for 4 seconds. IP set-up can be available within the duration above from the Bootp server. |

(4) Set the IP, and click 'OK'.
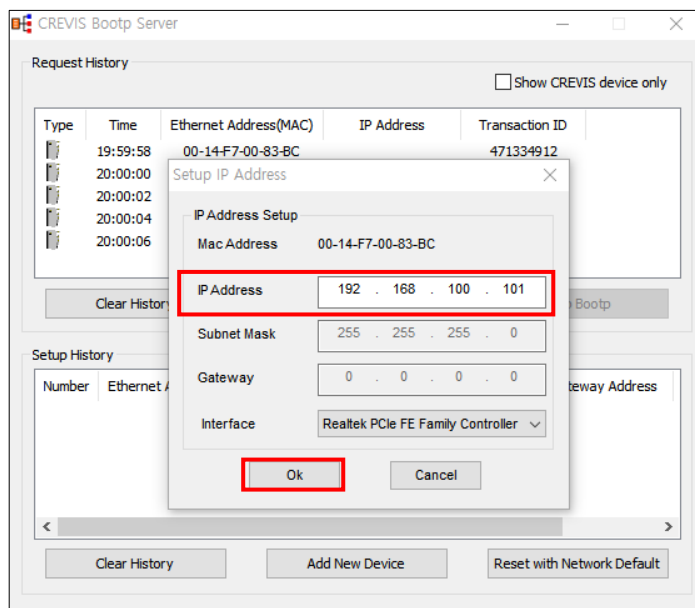
(5) Finish
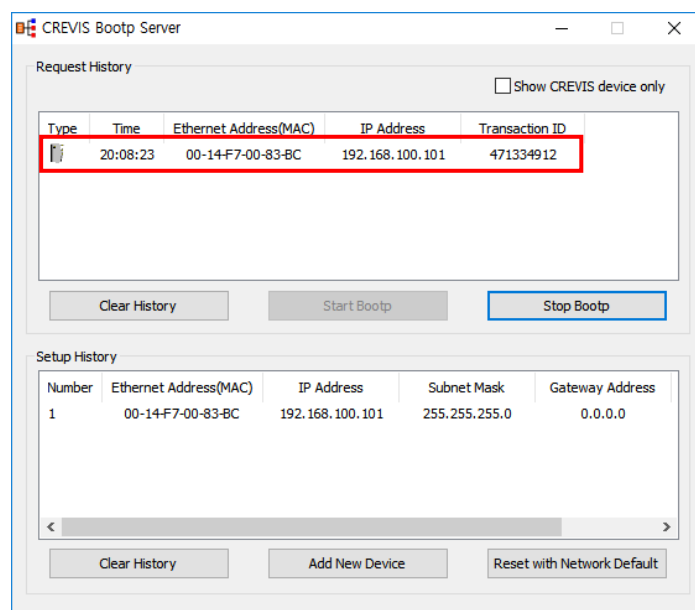
| IMPORTANT | Subnet Mask and Gateway is assigned automatically by the value that is set in the computer. |

10.6. Serial Communication Settings

Setting according to the each communication state is possible Because GN-9371/2/3 is available the RS232 and RS485 Serial Communications.

- Station Setting

The following illustration is an area of Register 0x160A address that can be used to set the code of Serial communication. High 1byte is the area of rs232, and Low 1byte is the area of rs485.

It is possible to set a maximum of 247 for each area. (default : 1)

	MSB															LSB
0x160A	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

RS232C Modbus station   RS485 Modbus station
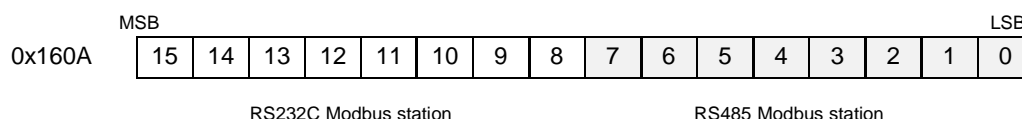
- RS232/ RS485 Communication setting

The options for the communication can be selected.
RS232 can be selected from the register address, "0x1606".
RS485 can be selected from the register address, "0x1608".

```
- 1 nibble : Data bit(0 : 8bit(default), 1 : 9bit)
- 2 nibble : Stop bit(0 : 1bit(default), 1 : 2bit)
- 3 nibble : Parity bit(0 : none(default), 1: even, 2 : odd)
- 4 nibble : Reserve
```

	MSB															LSB
0x1607	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

    Data bit   Stop bit   Parity bit   Reserve

RS232

	MSB															LSB
0x1609	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

    Data bit   Stop bit   Parity bit   Reserve
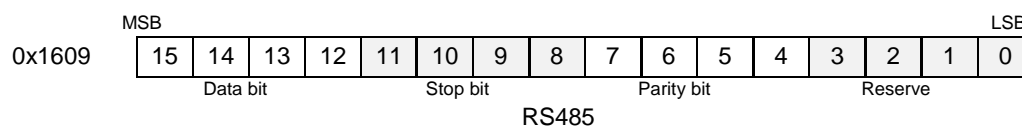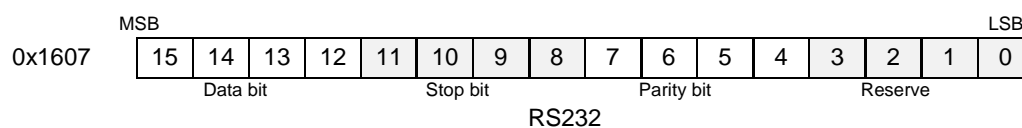
RS485

- Baud rate setting

The baud rate from 2400bps to 115200bps is supported.
RS232 can be selected from the register address, "0x1606".
RS485 can be selected from the register address, "0x1608".

```
0 : 115200(Default)      1 : 2400     2 : 4800    3 : 9600

4 : 19200     5 : 38400   6 : 57600   7 : 115200
```

(1) Run '[Crevis] -> [IOGuidePro] -> [Protocol Messenger] -> [Modbus]'

(2) Write the value of each.
*Protocol : Modbus RTU
*ComPort : User Port / Baud rate : 115200(default)
*Address(Hex) : 1606 (RS232 Baud rate Register)
                 : 1607 (RS232 Use bit Setting Register)
                 : 1608 (RS485 Baud rate Register)
                 : 1609 (RS485 Use bit Setting Register)
*Function(Dec) : When the value is write - 16, Write Multiple registers
                When the value is read - 03, Read Holding Registers

(3) confirm the necessary information.
*When the value is write   *When the value is read
 Write the desired value and click the Send button.   Click the Send button and confirm the value.

10.7. Memory Reset

Data field 0x55AA makes the remote device to restart with factory default setup of EEPROM.
*All expansion slot configuration parameters are cleared.

(1) Run '[Crevis] -> [IOGuidePro] -> [Protocol Messenger] -> [Modbus]'

(2) Write the value of each.
*Protocol : Modbus RTU
*ComPort : User Port / Baudrate : 115200(default)
*Address(Hex) : 0001 (Factory default setup)
*Length(Hex) : 0002
*Function(Dec) : When the value is write – 08, Diagnostics

(3) Write the register value and click the 'Send' button.
*Value : 0x55AA + "Sumcheck" – Program Reset

*Value : 0x55AA + 0xAB7B + "Sumcheck" – Factory Reset

(Please refer to 3.2.2 for Sumcheck (0x1006).

10.8. RTC(Real Time Clock) Function

A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time.   RTC information of GN-9371/72/73 is stored in address 0x1620 in the Register,
also can be read.

(1) Run '[Crevis] -> [IOGuidePro] -> [Protocol Messenger] -> [Modbus]'

(2) Write the value of each.
*Protocol : Modbus TCP, Modbus RTU
*ComPort : User Port / Baudrate : 115200(default)
*Address(Hex) : 1620 (RTC Register)
*Function(Dec) : When the value is write - 16, Write Multiple registers
                 : When the value is read - 03, Read Holding Registers

(3) confirm the necessary information.
*When the value is write   *When the value is read
 Write the desired value and click the Send button.   Click the Send button and confirm the value.

RTC can be checked & set as the followings;

(4) CODESYS
     It can check & change the current time.
     - 2021Y 01M 01D 00h 00m 00s
     - RTV value every 100ms
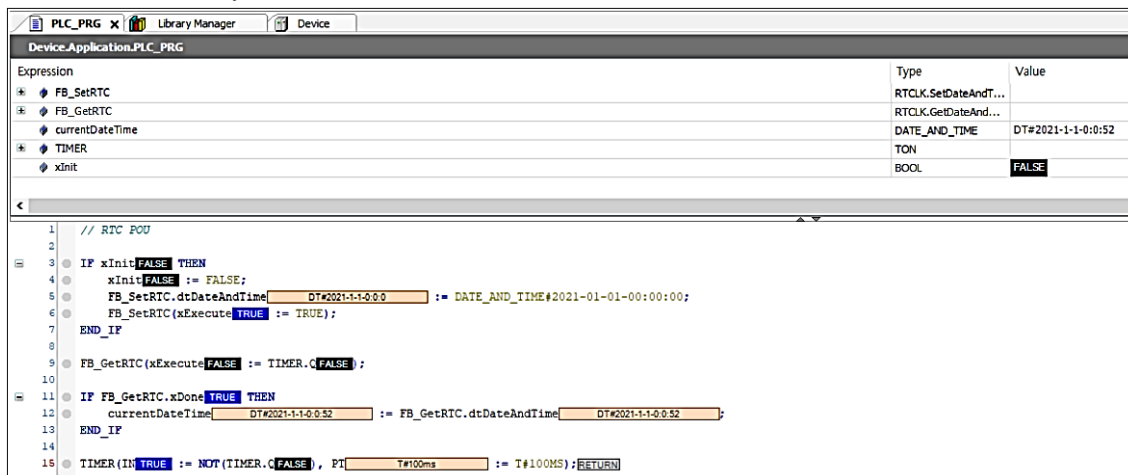
(5) Web-Server
     It can check & change the current time.

10.9. Webserver
(1)   Main page is showing various information for PIO status.
(2)   To access the webserver, IP Address/setup.htm (is required)
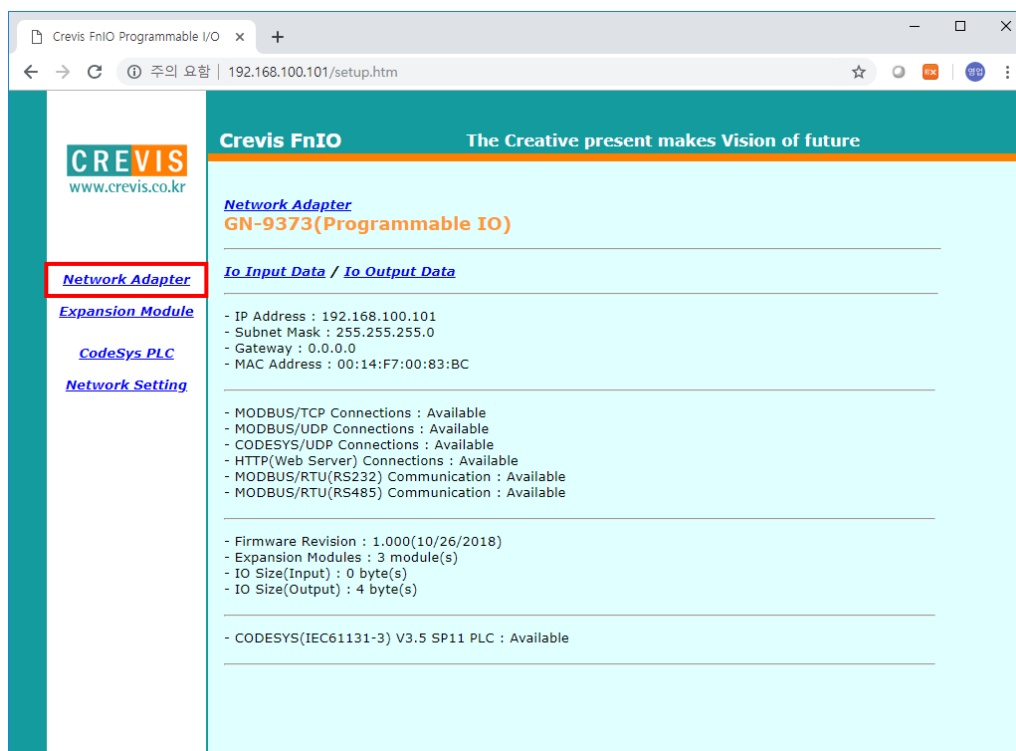
(3)   When you click the expansion menu, user can check the extension module status.
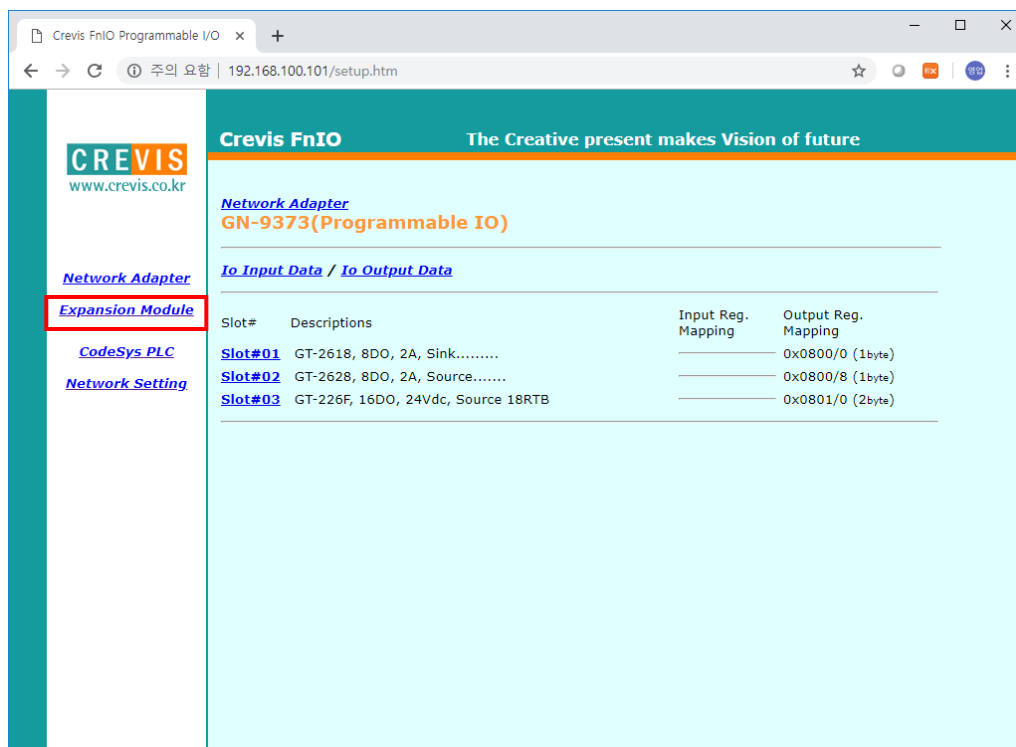
(4) User can easily change and set the RTC time. If you click the 'Get Time' button, the clock time from PC will be adapted to PIO.
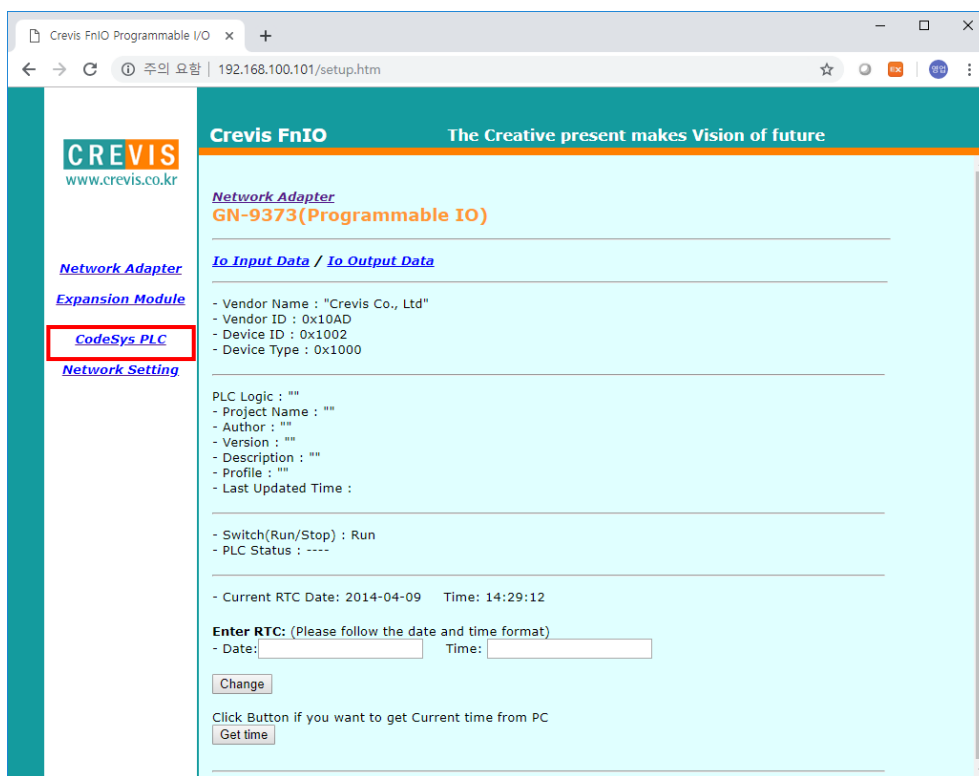
(5) Using the Network setting, user can set the IP/Subnet mask/Gateway.
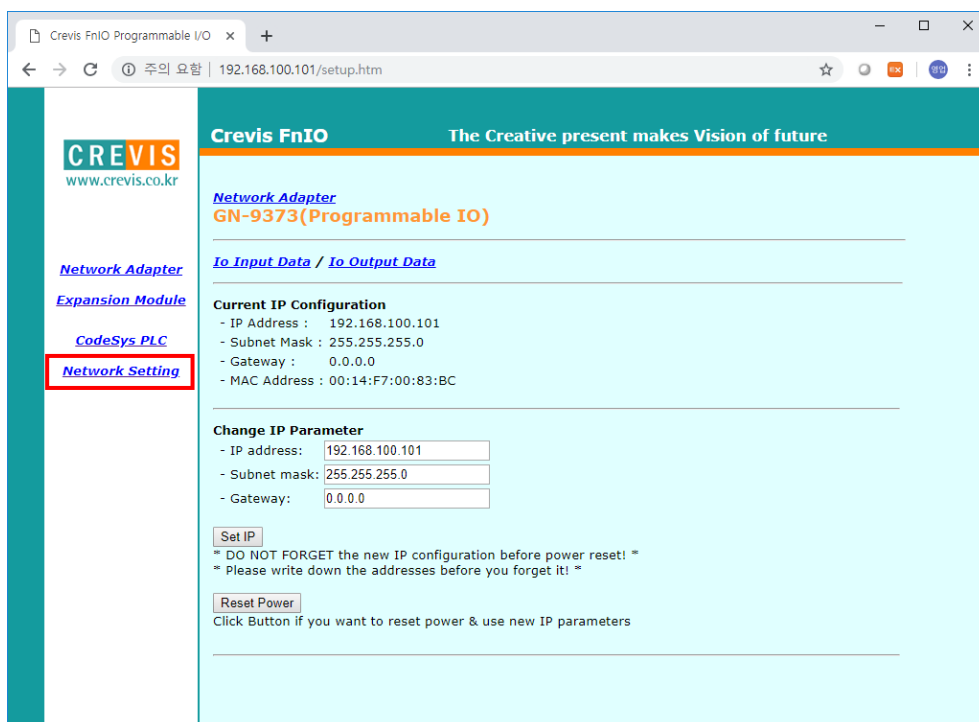
10.10.   IP Default Setting

When user forget the IP address, After power on the PIO and push the Reset switch in front of PIO.
The switch should be pushed for 20 seconds at least. PIO will be fall into the factory default mode.

All of PIO LED will blink in Green/Red.
The default IP setting is

IP address   192.168.100.100
Subnet Mask   255.255.255.0
Gateway   192.168.100.254

11.   Programing the PIO (CODESYS)

11.1. Download and Install the CODESYS

IMPORTANT	The CODESYS runtime version of 'V3.5 SP17 Patch3' is for FW Rev3.xxx The CODESYS runtime version of 'V3.5 SP11 Patch3' is for FW Rev1.xxx, 2.xxx, CODESYS runtime version should be used according to the FW Rev numbers. Except for the above version, any versions including the latest version will not be compatible with PIO. The library of V3.5.11.3 or V3.5.17.3 need to be used if user want to use the latest CODESYS runtime version.

The correct version can be downloaded via the website (https://store.codesys.com/en/codesys.html).

Version	.exe (self extracting) 32 bit	.exe (self extracting) 64 bit	.zip (uncompressed archive) 32 bit	.zip (uncompressed archive) 64 bit	Release Notes	Release date
3.5.17.30	3.5.17.30 32 bit (.exe)	3.5.17.30 64 bit (.exe)	3.5.17.30 32 bit (.zip)	3.5.17.30 64 bit (.zip)	-	25.01.2022
3.5.11.30	3.5.11.30 32 bit (.exe)	3.5.11.30 64 bit (.exe)	3.5.11.30 32 bit (.zip)	3.5.11.30 64 bit (.zip)	-	17.10.2017

11.2. The Basic Configuration CODESYS

11.2.1.　　Installation of XML

(1)　[Tools] → [Device Repository], Click 'PLCs' and select PIO Description
　　　(Download to CREVIS website),
　　　Install… Compressed file: <u>G-Series XML(CoDeSys)</u> / <u>CVS_G-Series_Rack.devdesc</u>
　　*Please check whether they are installed correctly or not.
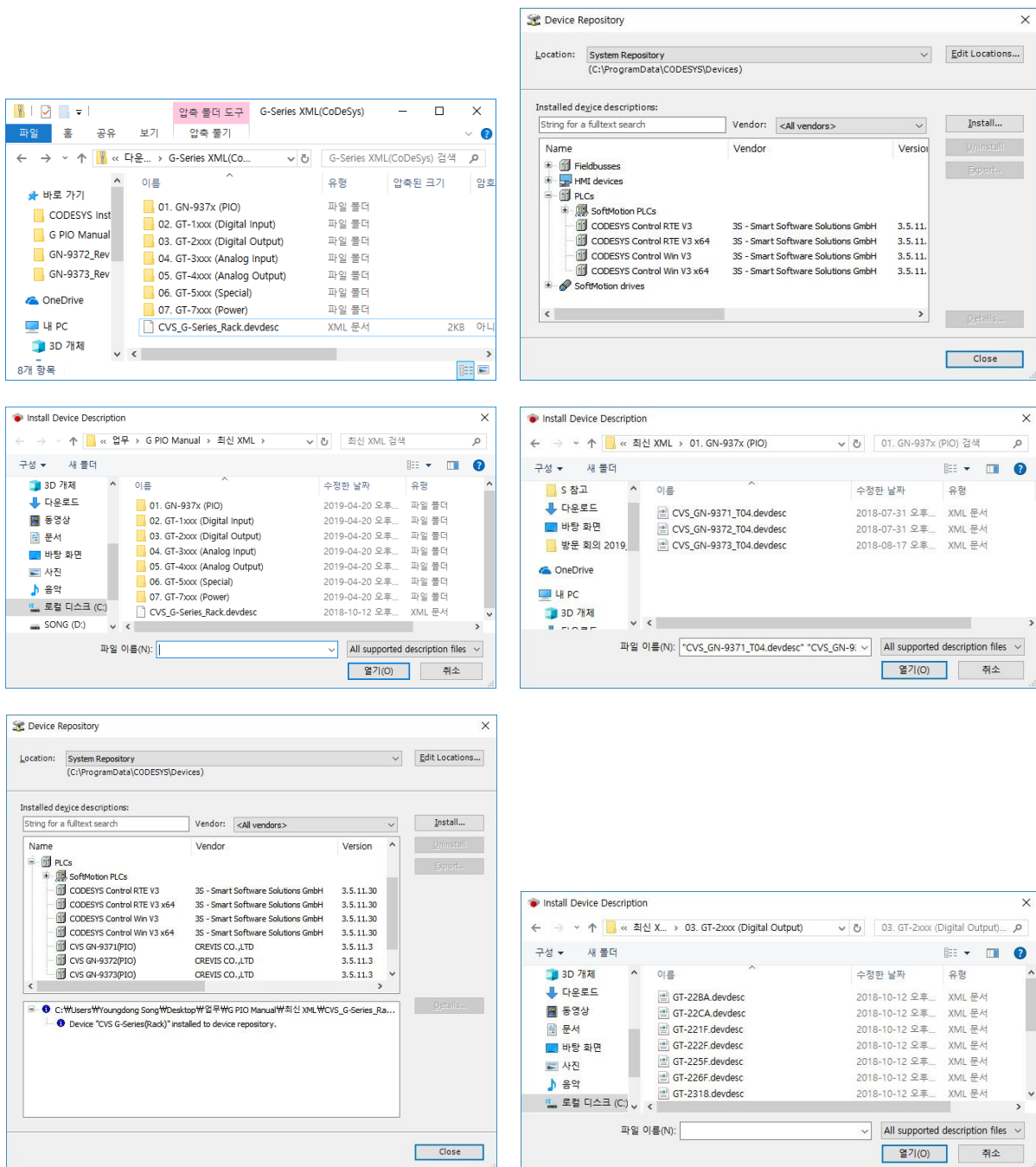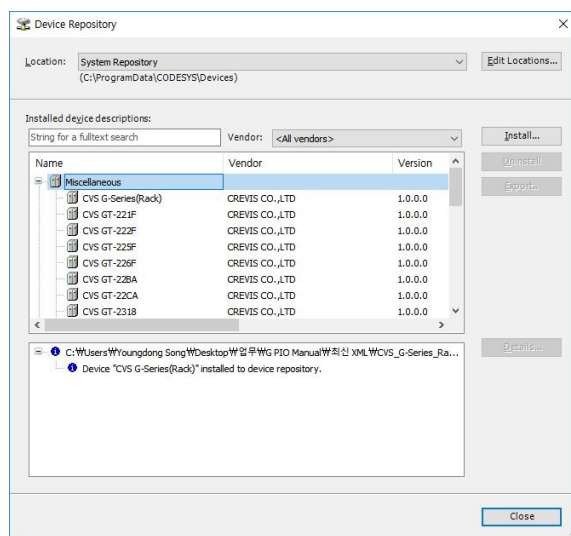
*Please check whether they are installed correctly or not.

11.2.2.   Created Project

(1) Run the CODESYS program.
(2) [File] → [New Project], select 'Standard project'. Write the Project Name & Location. Click 'OK'
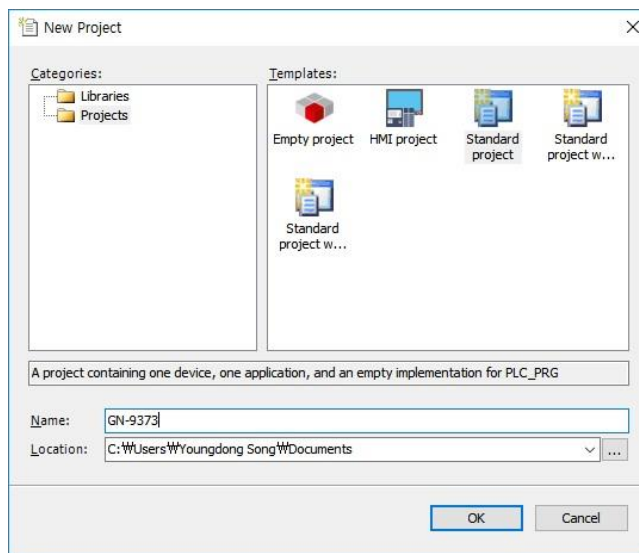
(3) Select Device : GN-9371/2/3, select the Programming Language.
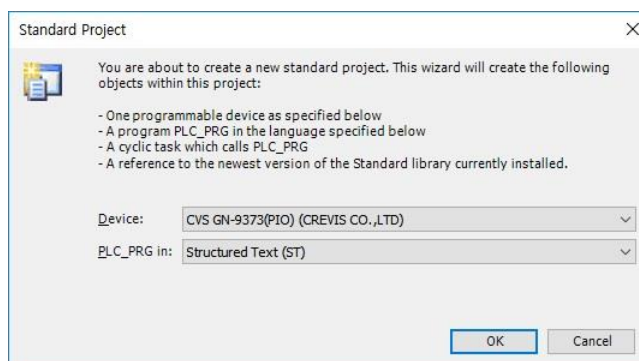
11.2.3. CODESYS User Interface
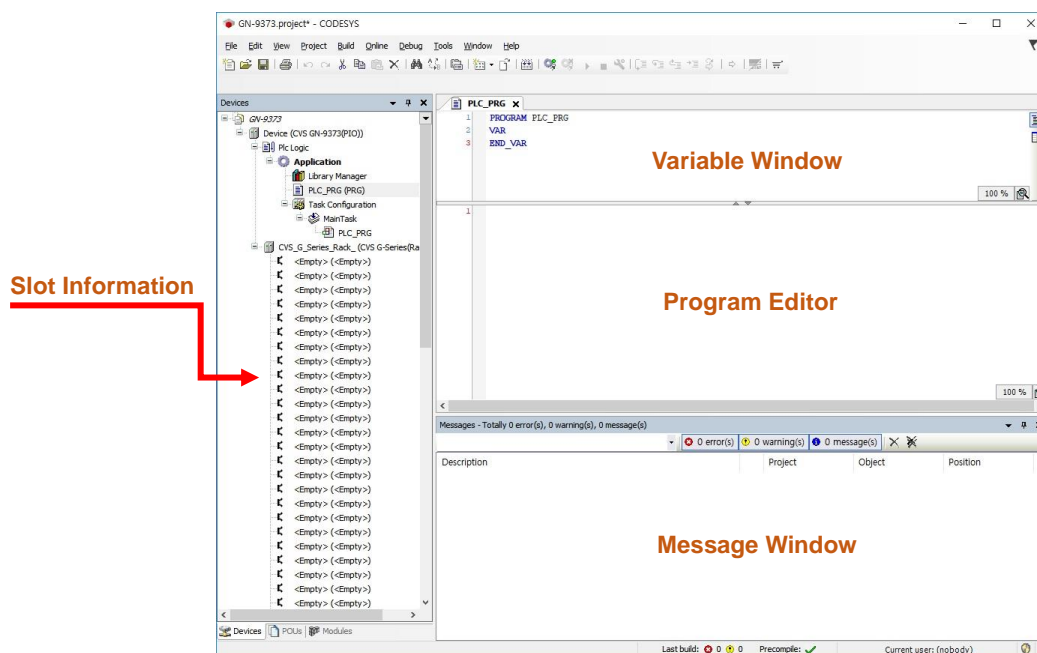
11.2.4. Setup I/O

(1) Additional Device
Click on the model you want to use, and click 'Plug Device'.
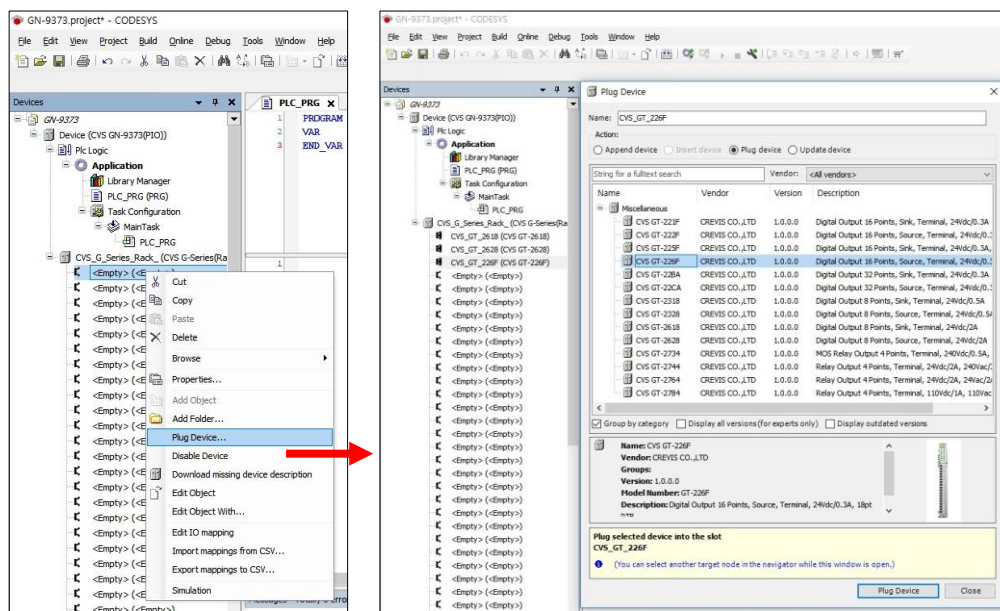
IMPORTANT	For the normal operation, you must select the module image in order through the CODESYS like the user configuration. Auto Scan is not supported.

(2) Setting Device Parameter and IO Mapping
Click IO → Right click → Click 'Edit object'.

•   Parameter setting
       Click 'Digital IOs Configuration'   *The setting unit of the parameter is bytes.
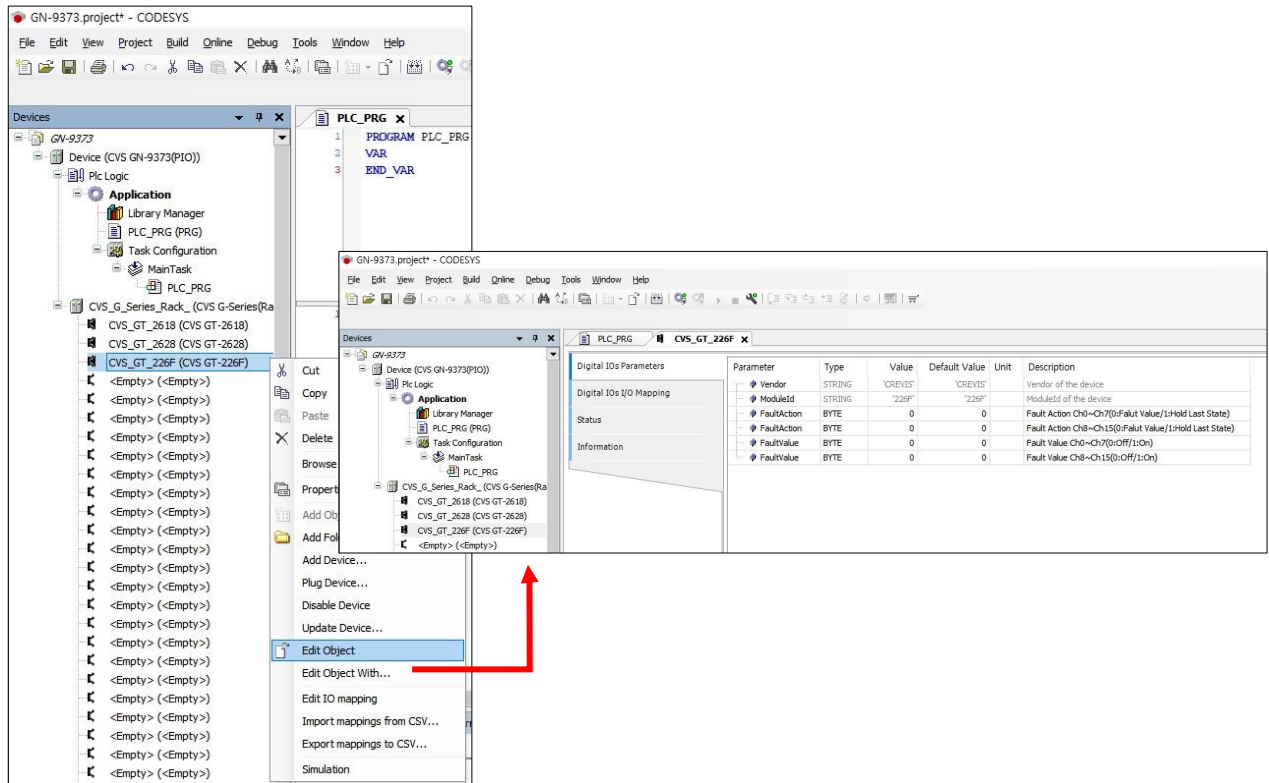
•   IO Mapping
       Click 'Digital IOs I/O Mapping'
       If there are no set values in the red square, you can program the variable area set by the address.
       If you use the variable set by the POU or GVL, you can use the variable area after deleting the
       variable in the address.
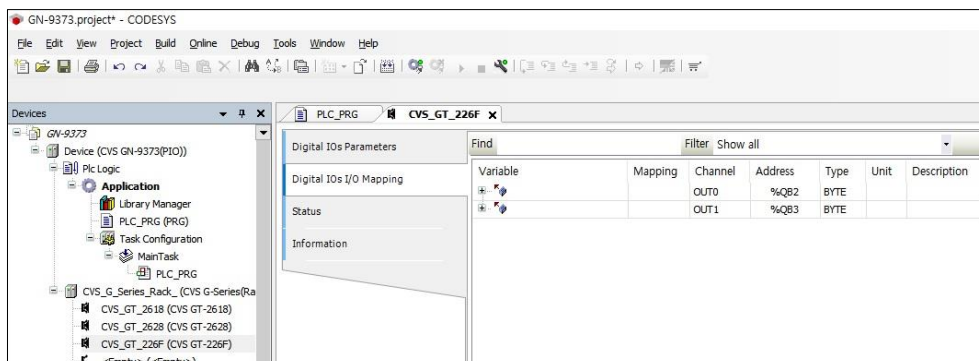
11.3. MODBUS TCP Setting

11.3.1.   TCP Master Setting

(1) Add Device
Click Device(GN-9371/2/3) → right click → Click 'Add Device…'.

(2) Add Ethernet Adapter
Click 'Fieldbus' → 'Ethernet Adapter' → 'Ethernet' and 'Add Device' Click.
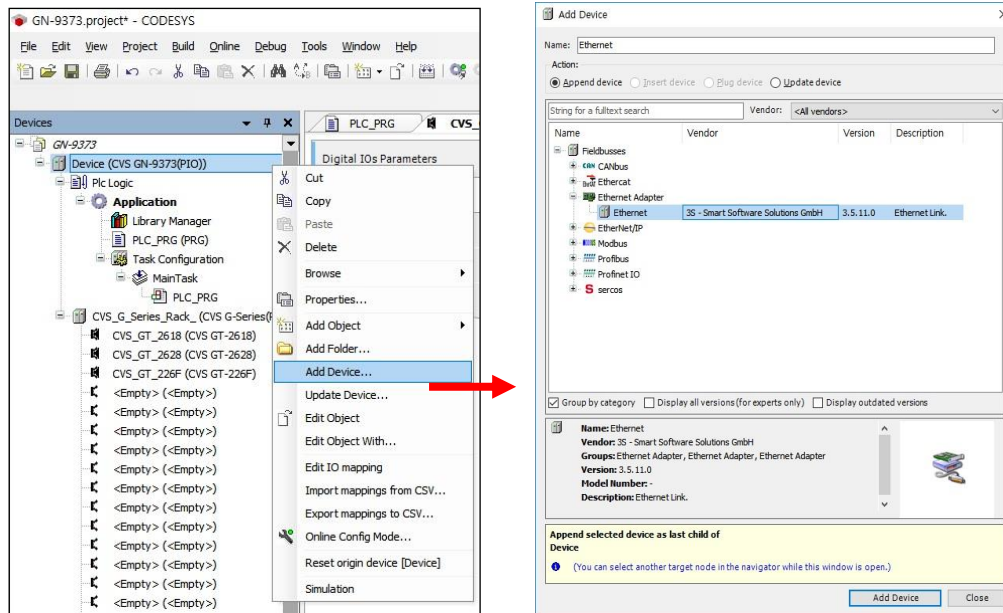
(3) Add Device after Selecting Ethernet and Add MODBUS TCP Master
Click Ethernet (Ethernet) → right click → Click 'Add Device'
Click 'Fieldbuses' → 'Modbus TCP Master' → 'Modbus TCP Master' and 'Add Device' Click.

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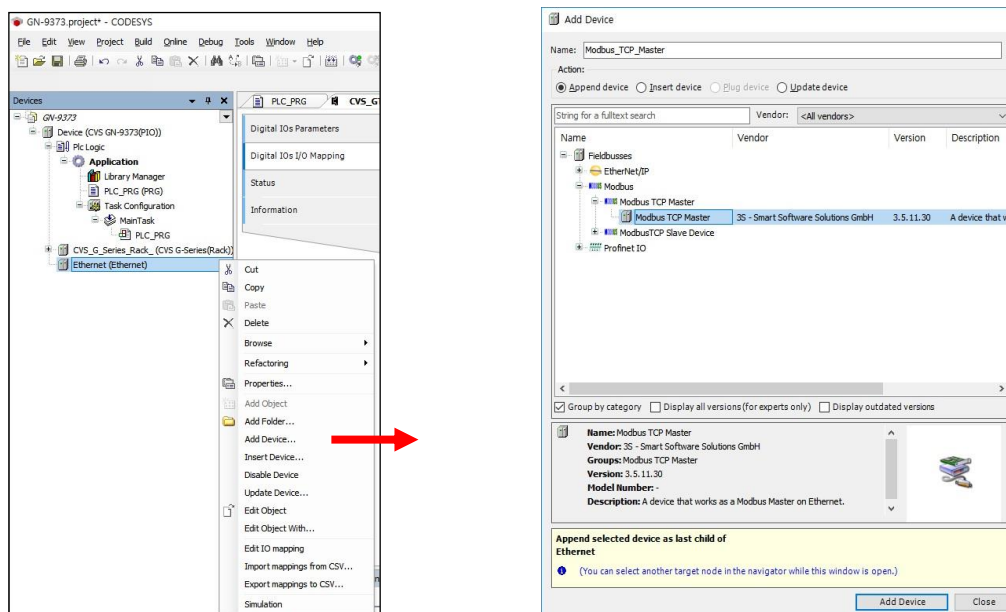
To use the continuously without disconnection, it should be checked the "auto-reconnect"
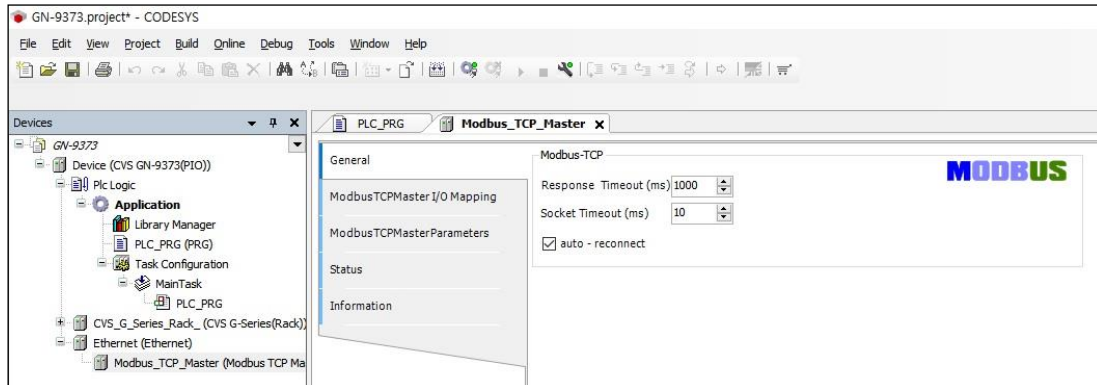
(4) Add Device after adding MODBUS TCP Master and Add Modbus TCP Slave
Click Modbus_TCP_Master → right click → Click 'Add Device'
Click 'Fieldbuses' → 'Modbus' → 'Modbus TCP Slave' → 'Modbus TCP Slave' and 'Add Device' Click.
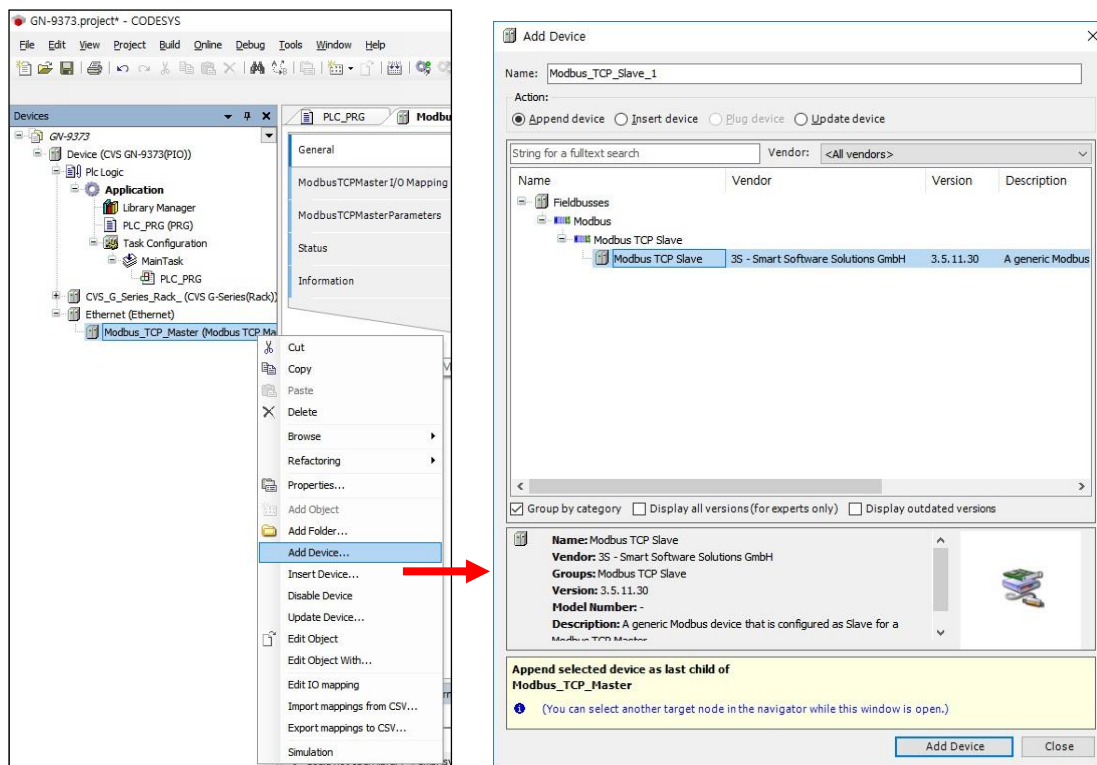
(5) Configuration the ModbusTCP Slave
Click 'Modbus_TCP_Slave'(Modbus TCP Slave)
Write Slave IP Address (GN-9371/2/3)
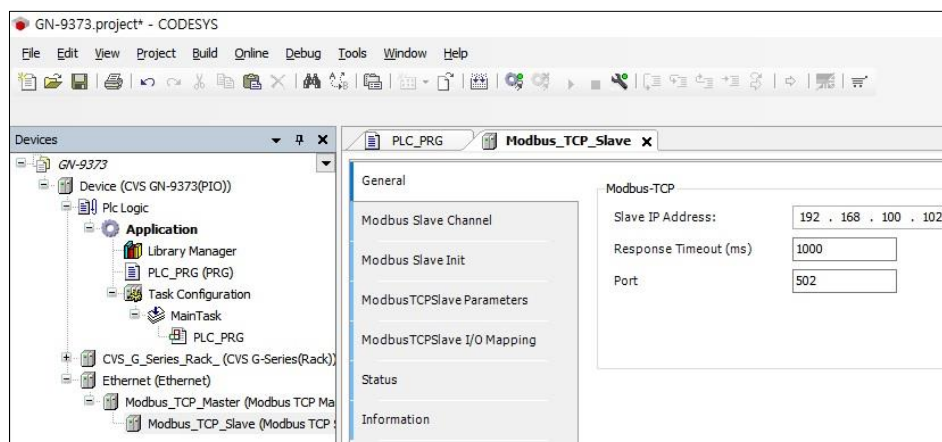
502 is a default value for the slave port. It means port 502 will be used for Modbus TPC slave.

But 502 port can be disabled by using the latest xml v3 and it means that other port number can be

used for the slave set-up instead of 502.

Click 'Modbus Slave Channel'
Add a channel of GN-9371/2/3 and Modify Cycle Time
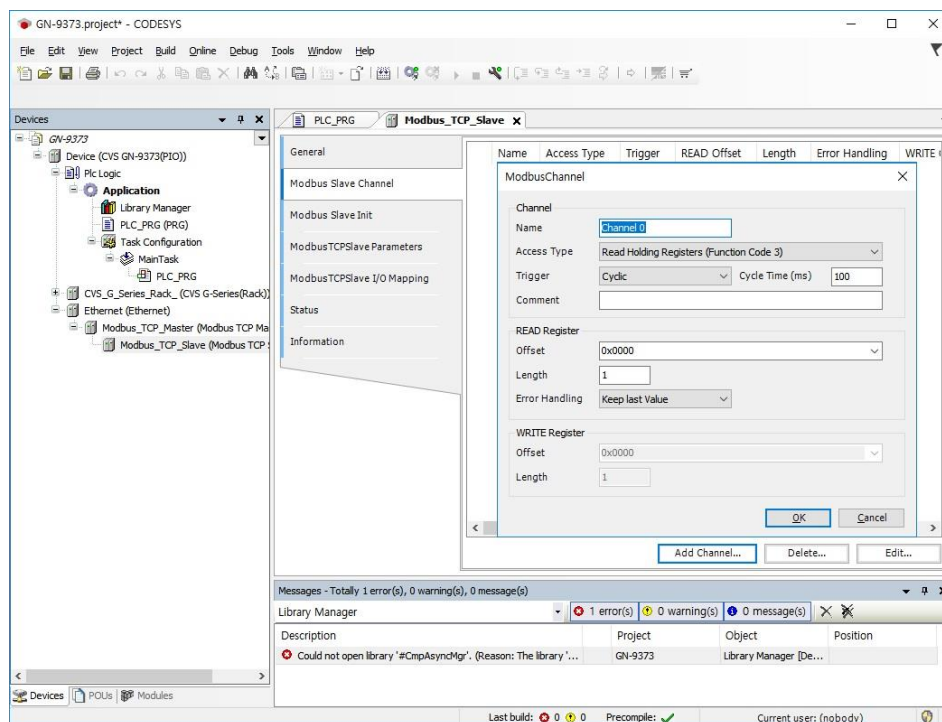
Default Cycle Time(ms) : 100ms.
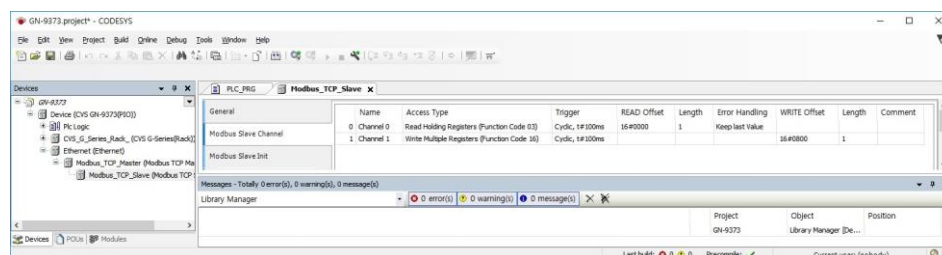
11.3.2.   TCP Slave Setting

(1) There's no special setting to use TCP Slave because it's based on the TCP Slave.

(2) Other masters will recognize GN-9371, 9372, 9373 from their IP address.

11.4. Network Variable
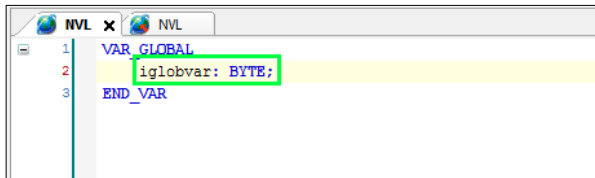
(1) Click 'Application' → Right click and click 'Add Object' → Click 'Network Variable List (Sender)'.
  _ You have to add one more devices in the devices tree._*

(2) Define the network properties of the sender GVL
  _ You have to select UDP as network type. / * List identifier and Node ID is the same concept._*
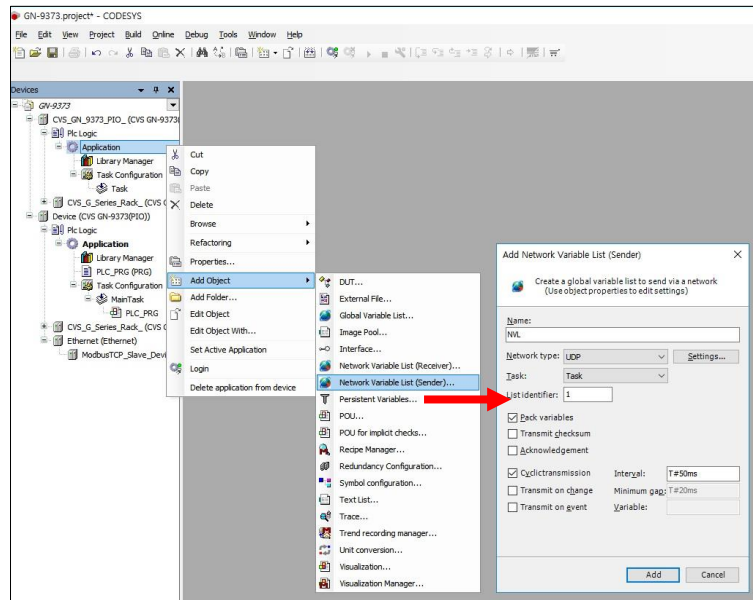
(3) Add a Global Network Variable List in the Receiver
  _ You find a selection list of all GVLs with network properties currently available in the project._*

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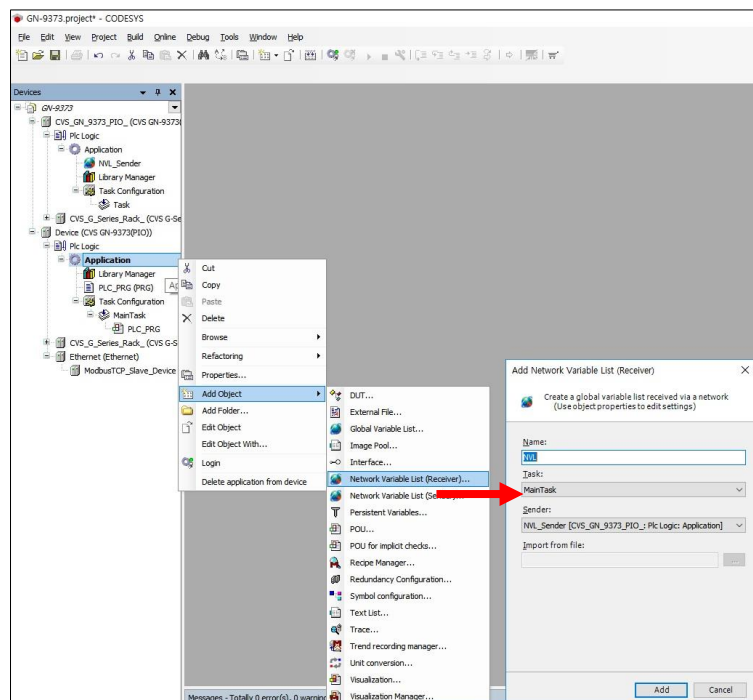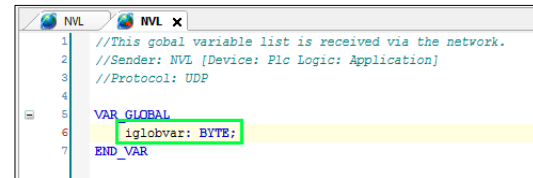
(4) Created by Global Variables.

```
NVL  x    NVL
  1   VAR_GLOBAL
  2       iglobvar: BYTE;
  3   END_VAR
```
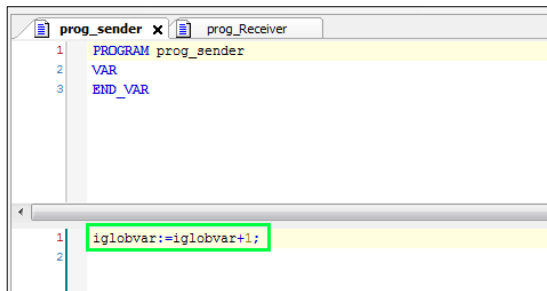
```
NVL     NVL  x
  1   //This gobal variable list is received via the network.
  2   //Sender: NVL [Device: Plc Logic: Application]
  3   //Protocol: UDP
  4
  5   VAR_GLOBAL
  6       iglobvar: BYTE;
  7   END_VAR
```

(5) It is possible to create a program using a global variable.
   -    in prog_sender in the sender application enter the following use of variable iglobvar.
   -    in prog_Receiver in the receiver application also use variable iglobvar.
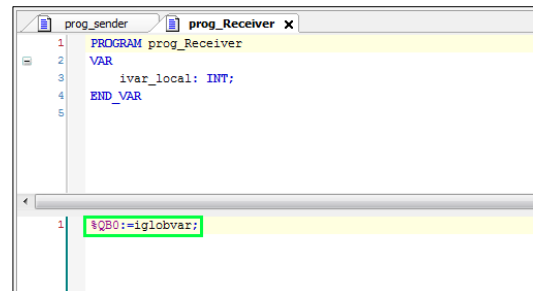
```
prog_sender  x    prog_Receiver
  1   PROGRAM prog_sender
  2   VAR
  3   END_VAR



  1   iglobvar:=iglobvar+1;
  2
```

```
prog_sender      prog_Receiver  x
  1   PROGRAM prog_Receiver
  2   VAR
  3       ivar_local: INT;
  4   END_VAR
  5



  1   %QB0:=iglobvar;
```

11.5. Download and Monitoring

(1) Communication Settings

•   Scan network(UDP)

[Device] → [Communication Settings], click 'Scan network'.
After completing the search, double click the Gateway icon to make it activated.

•   Add device(TCP)

[Device] → [Communication Settings], click 'Add device'.
After write the IP address and click 'OK' , double click the Gateway icon to make it activated.
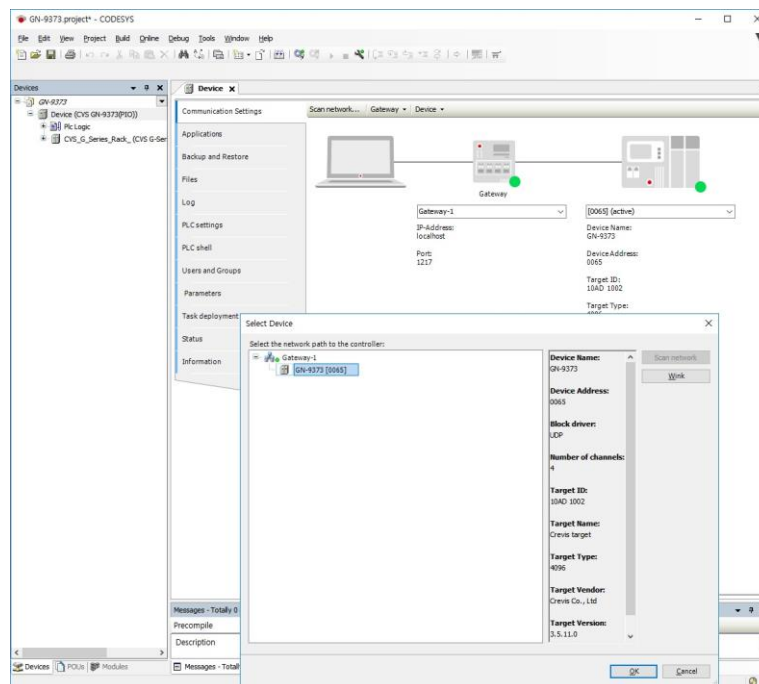
(2) Login

[Online] → [Login] → Download to Application → Entry into Monitoring Mode → [Debug] → [RUN]

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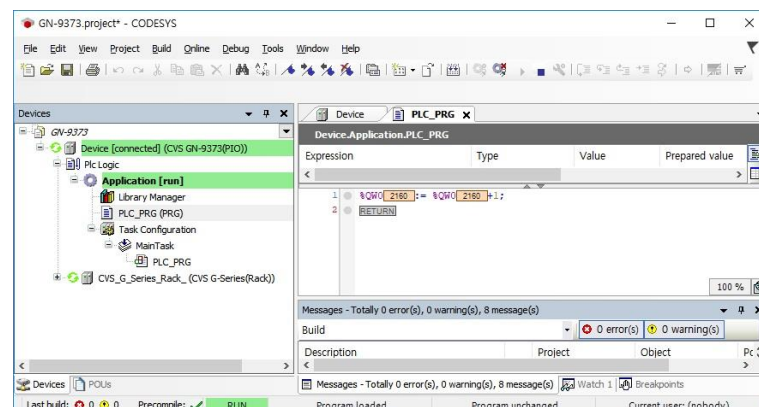
11.6. OPC Server

(1) Add Object for the Symbolic Configuration to Application Project
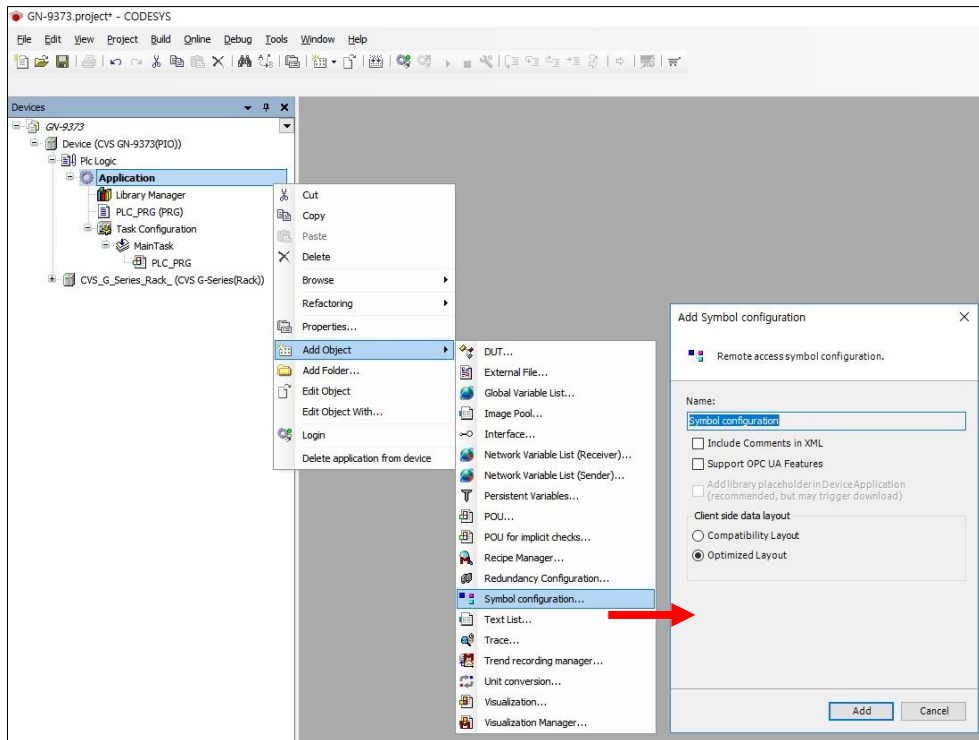
(2) Define the Symbolic variable to configure the OPC variable.
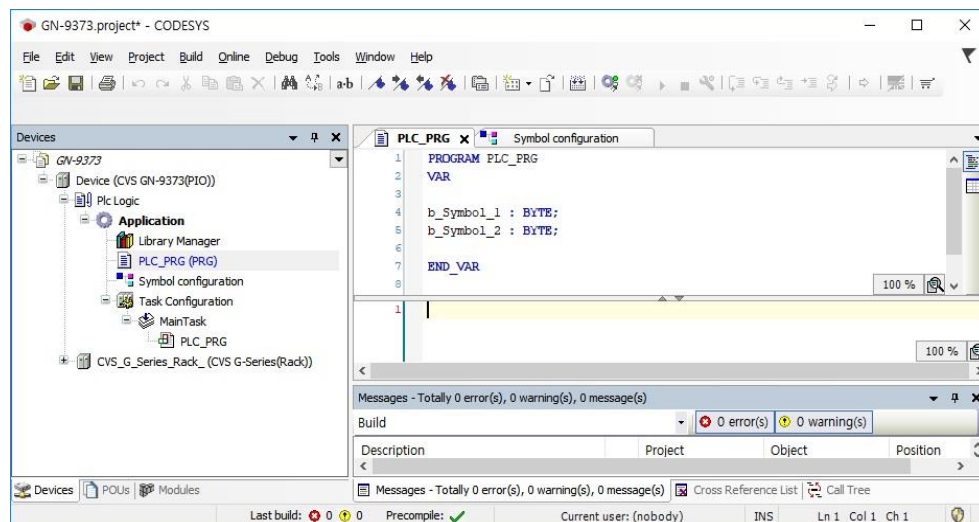
(3)　At the Symbol configuration screen, after click the "build" button, the defined variable will appear in order to activate the OPC server.
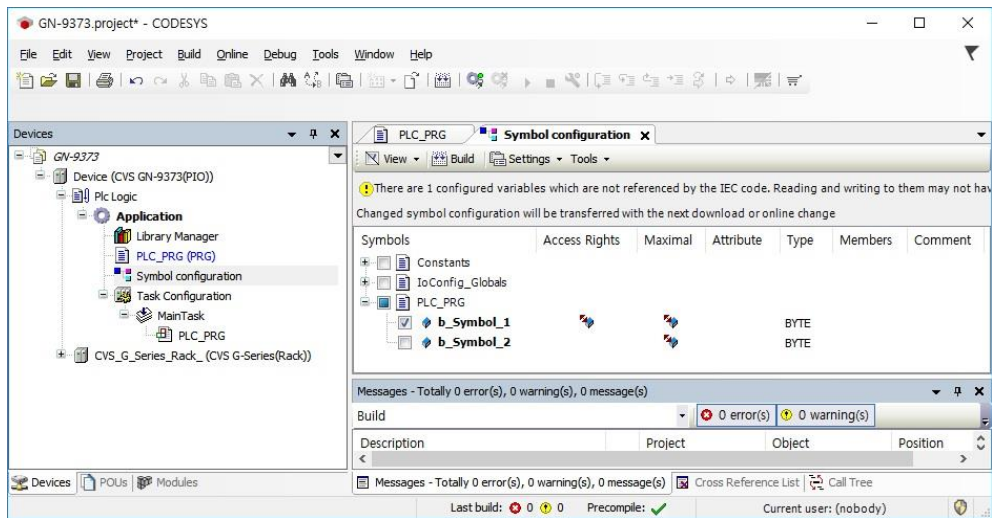
User can set this variable to be exposed to outside as OPC variable in use click the radio button on it.

(4)　In order to set the OPC configurator, user should know either Device address or IP address when it is used by TCP/IP mode. Click the Device so that user can choose the TCP/IP mode.
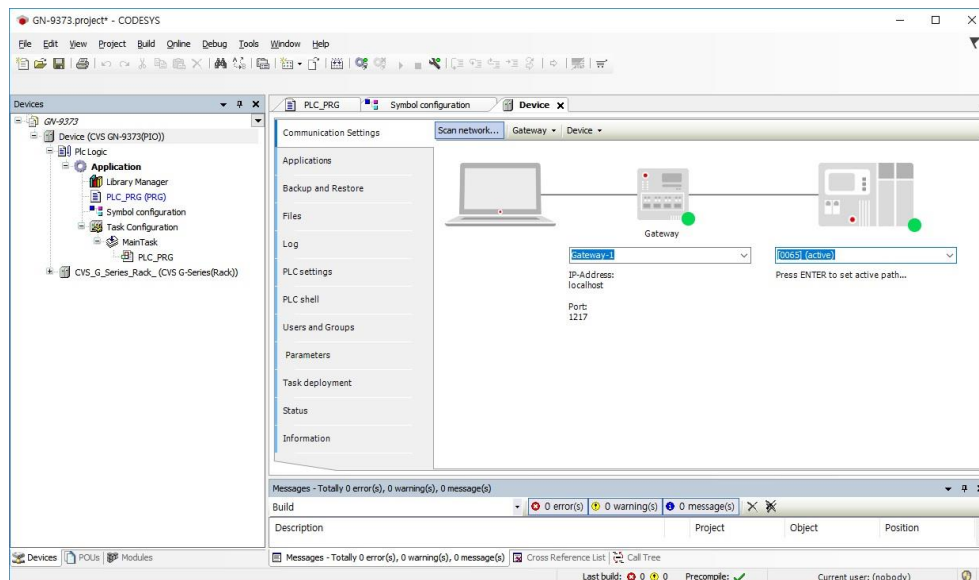
(5) To use the OPC server variable at outside of PIO, user should set the OPC configurator,
      Click the OPC configurator in the windows menu.
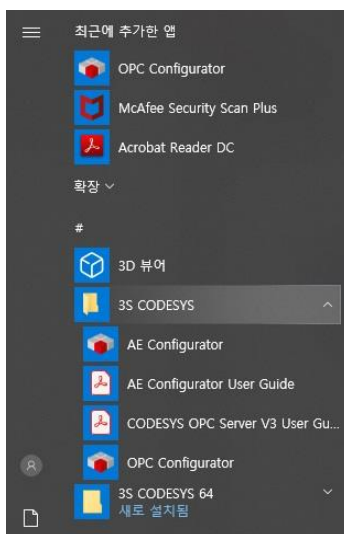
- OPC Configurator Tool: Supported by 32bits version of V3.5.SP11.3 & V3.5.17.3

- OPC Configurator Tool: Not Supported by 64bits version of V3.5.SP11.3 & V3.5.SP17.3.

(6) In OPC configurator, choose the "GATEWAY3" interface.
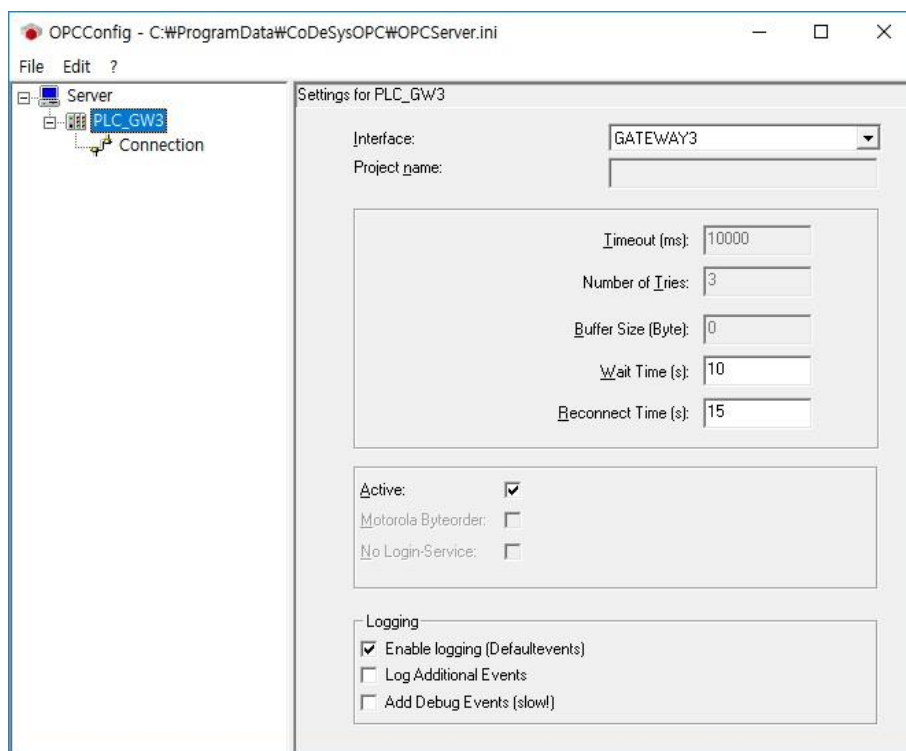
(7) At the Connection tap, click the Edit button. Input the PLC name. (*Refer the (4) section.)
Gateway IP address should be same as the PC IP address(gateway), the Port number should be 1217.

(8) TCP mode OPC configuration setting
If it is operated with TCP/IP mode, check the "Use TCP/IP blockdriver" tap and put the PLC IP address.
Set the PIO IP address into the PLC IP address. The PLC IP Port should be '11740'.
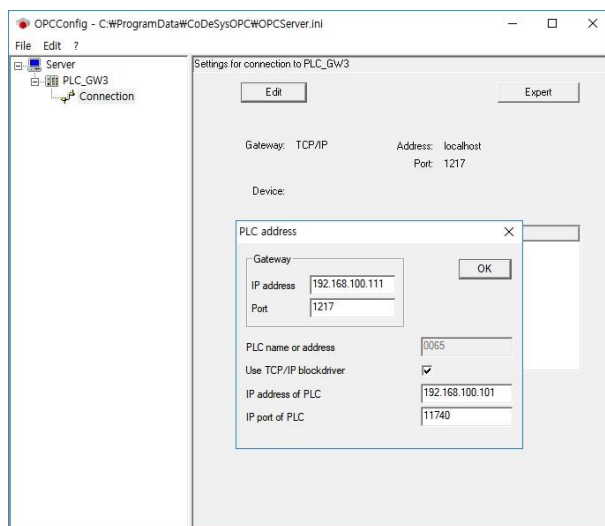
(9) Save and completion
After setting the all of OPC configurator stages, user should click the expert and save.
If it doesn`t work, OPC server will not be operated.
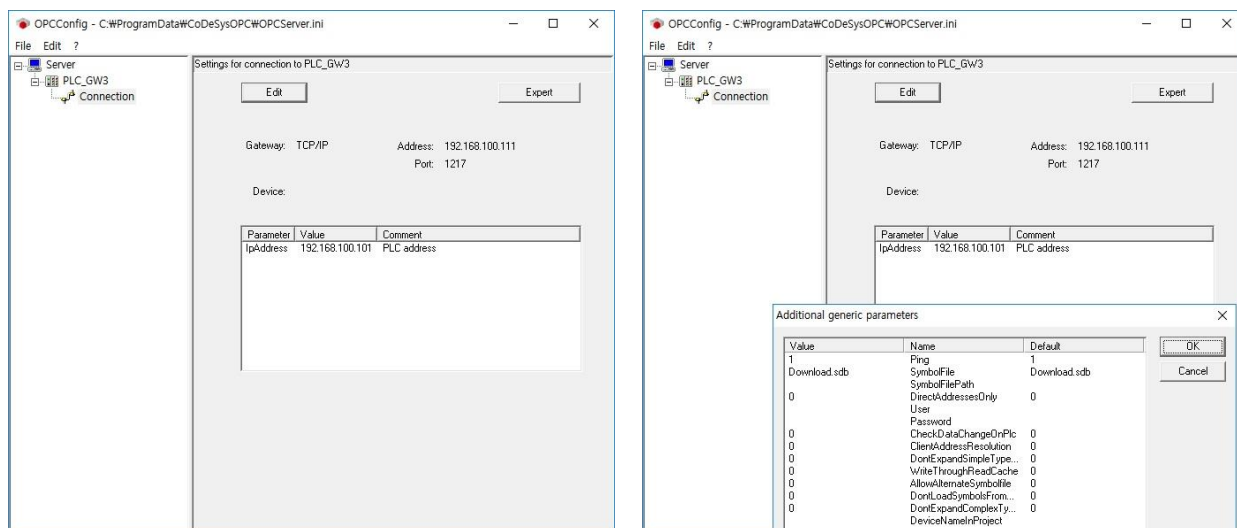
It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

11.7. MQTT Sparkplug B

MQTT Sparkplug B example is as the followings;

EoN Function Block's hostname [IP Address connected with PIO] and Build & Download
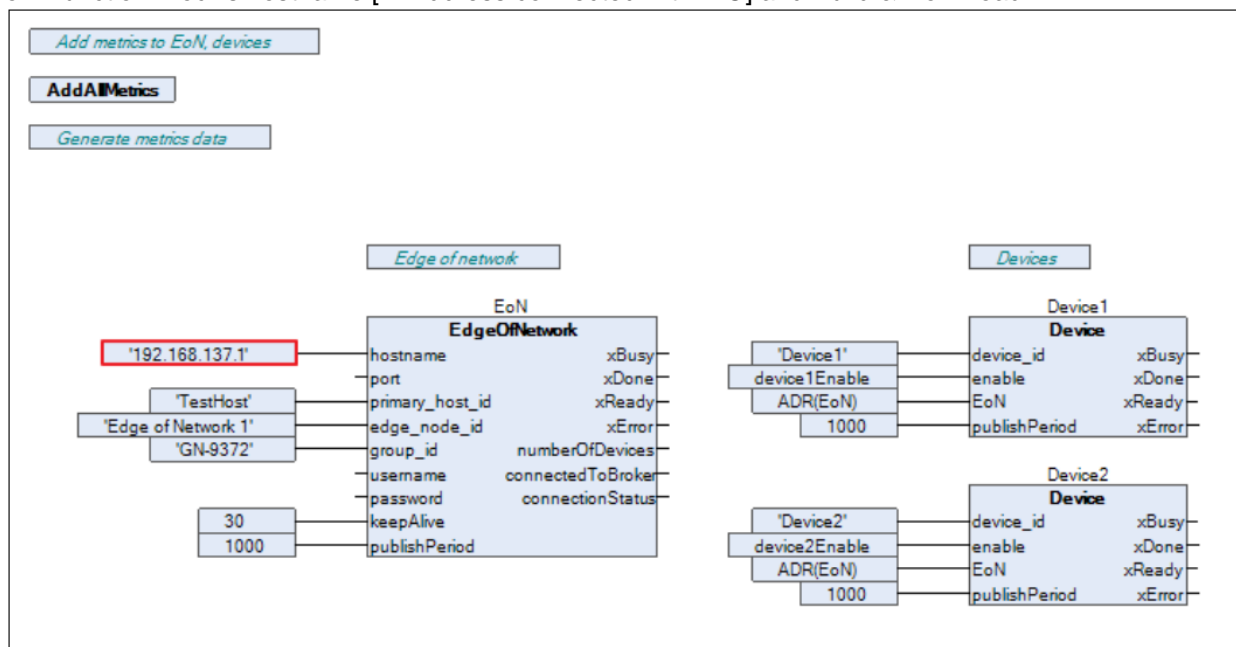
If EoN's xReady = True & connectedToBroker = True, MQTT broker connection is successful.
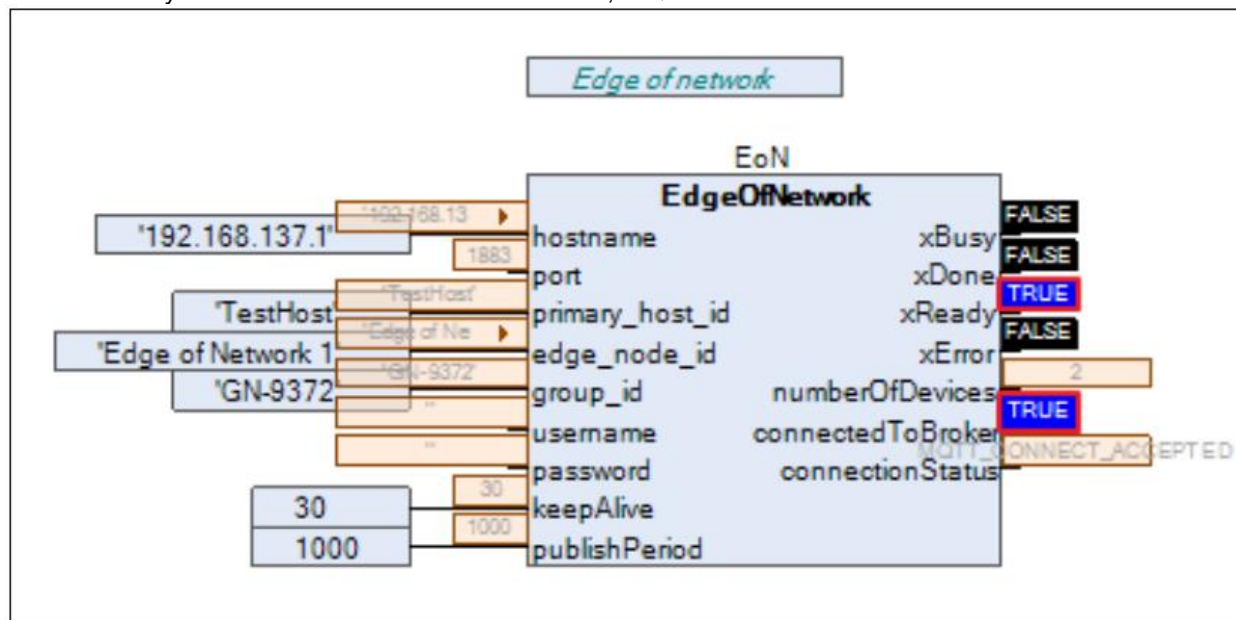
It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

11.8. Modbus RTU Master

(1) In order to use the Modbus RTU master function, user should set the Modbus Register 1614.

Address	Access	Type, Size	Description
0x1614(5652)*	Read	1word	Serial connection Method - 0x0000 : CREVIS Modbus/RTU(Default) - 0x8000 : RS232 Enable - 0x8001 : RS485 Enable - 0x8002 : RS232/RS485 Enable at same time *8000/ 01/ 02: CODESYS Function Block / RTU Master

* User can set the RS 232 or 485 by using IO Guide Pro or Modbus communication tool.

Address value	RS232C port	RS485 port
0x0000	Default (Modbus Slave)	Default (Modbus Slave)
0x8000	CODESYS Setting(RTU M/Serial com)*	Default (Modbus Slave)
0x8001	Default (Modbus Slave)	CODESYS Setting(RTU M/Serial com)*
0x8002	CODESYS Setting(RTU M/Serial com)*	CODESYS Setting(RTU M/Serial com)*

*RTU Master mode or Serial communication mode for example Barcode and so on.

(2) Add Device for Modbus COM from Modbus Serial Port at Device tree menu.
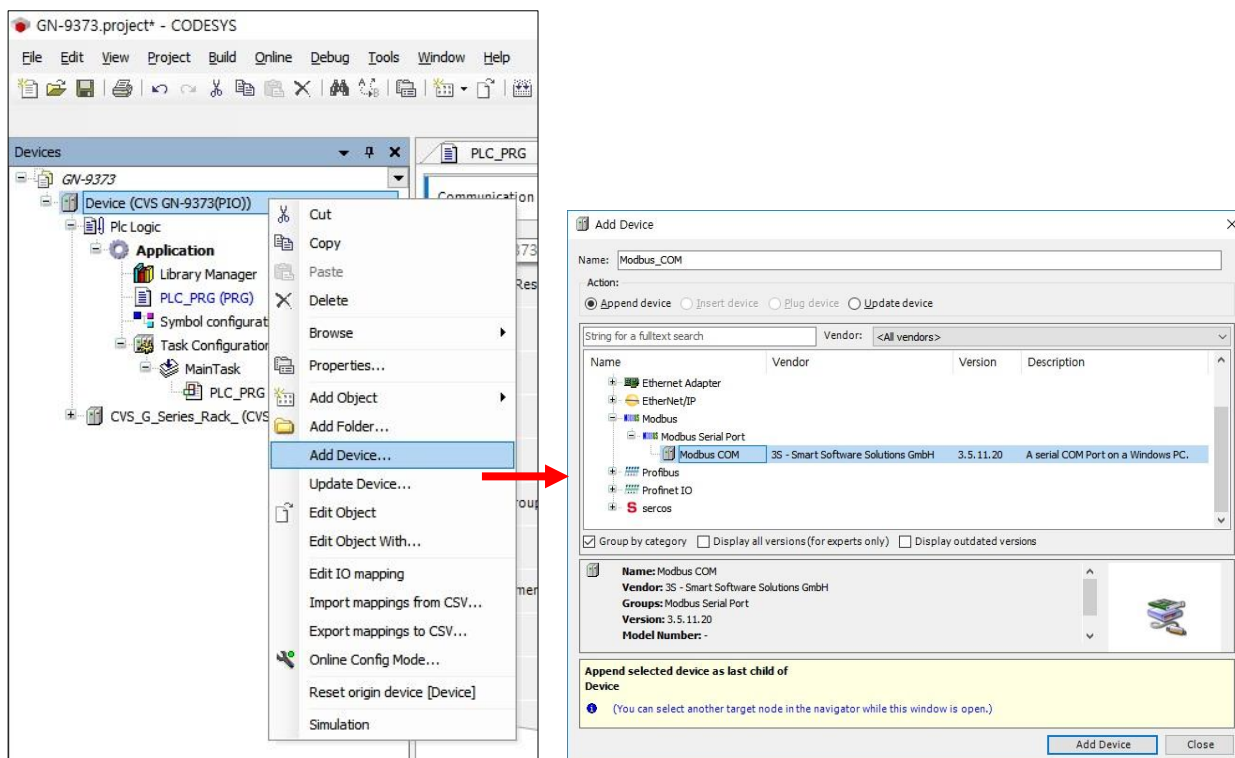
(3) Set the Master port number, Baud rate, parity, Data Bits, Stop Bit and so on in Modbus Com configuration tap. By choosing the COM port number, RTU type can be decided from CODESYS Tool. << COM Port 1: RS-232 Set-up available / COM Port 2: RS-485 Set-up available >>
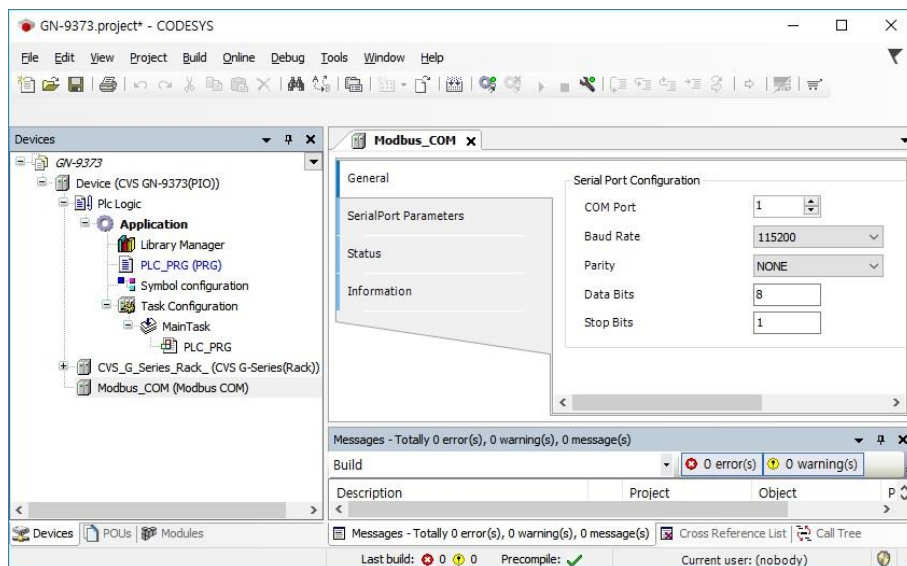
(4) Add Device for the Modbus_Master_COM_Port at the Modbus_COM tree menu.
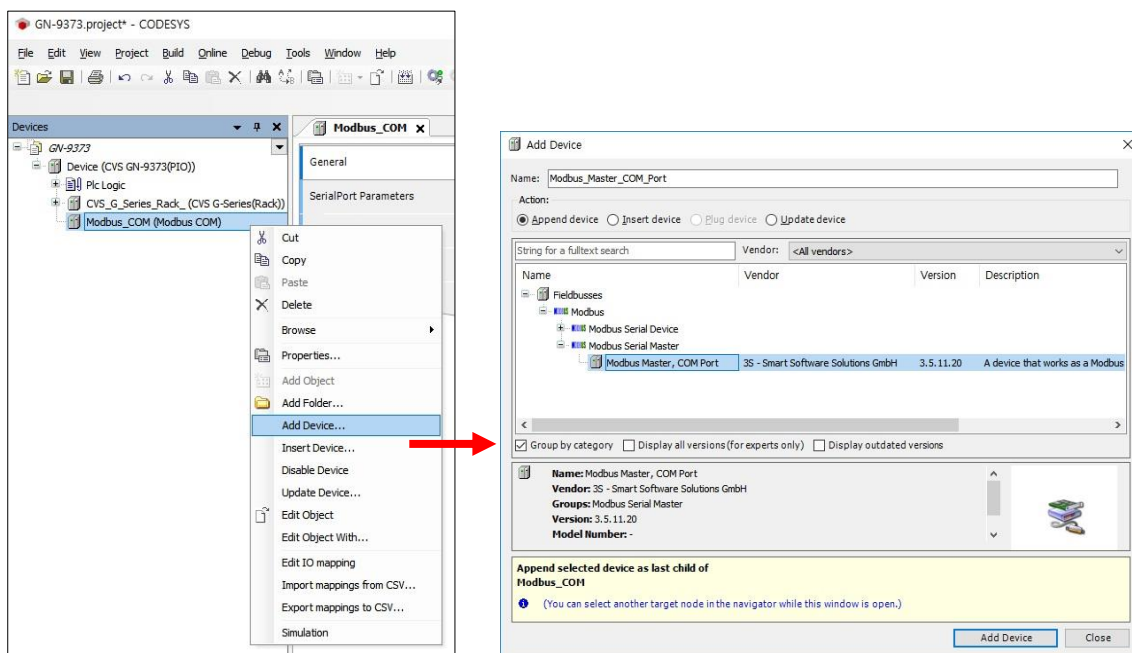
(5) Set the Response Timeout and Time between frames at the Modbus_Master_COM_Port configuration tap. (It does not support the ASCII mode in PIO)
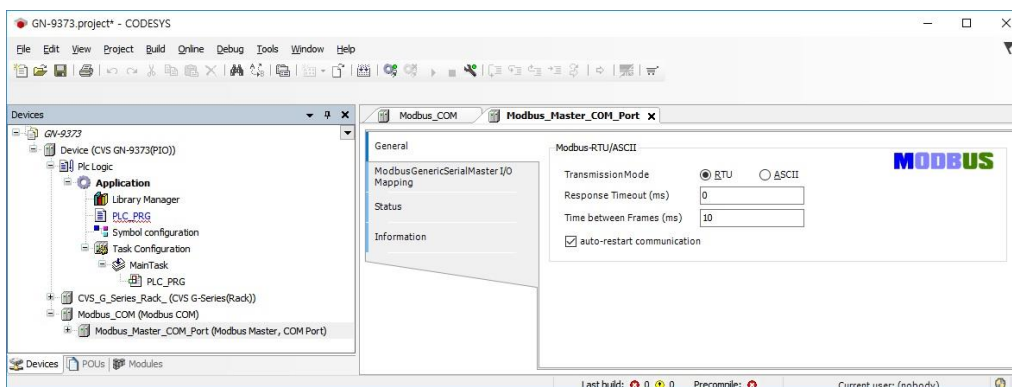
(6) Add the device of Modbus_Slave_COM_Port at the Modbus_Master_COM_Port tree menu.
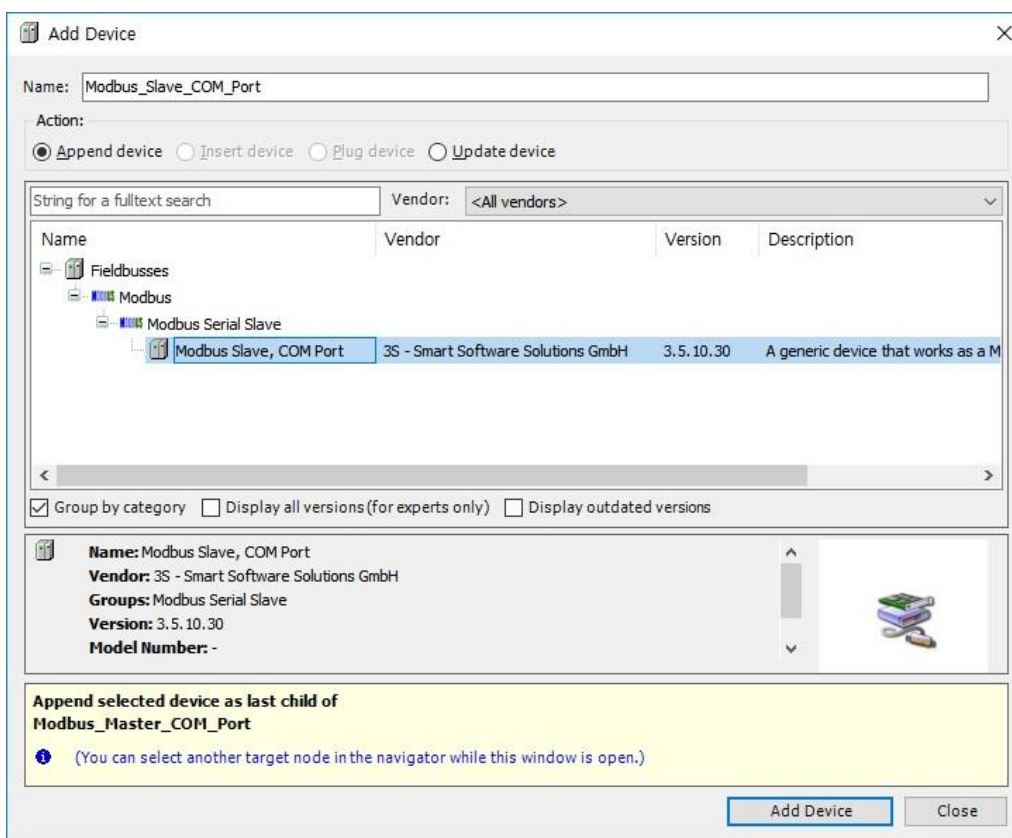
(7) Set the Slave Address Number and Response Timeout at the Modbus_Slave_COM_Port
       configuration tap.
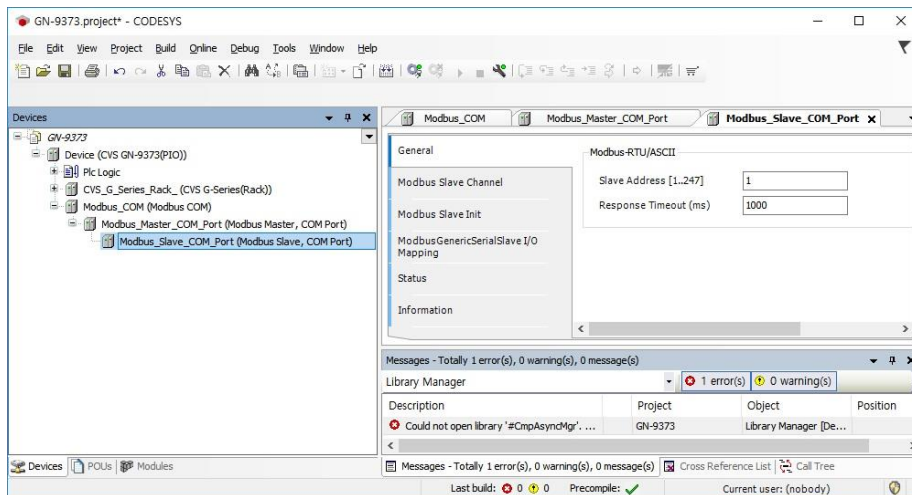
(8) At the Modbus Slave Channel Tap, user can set the Modbus Address.
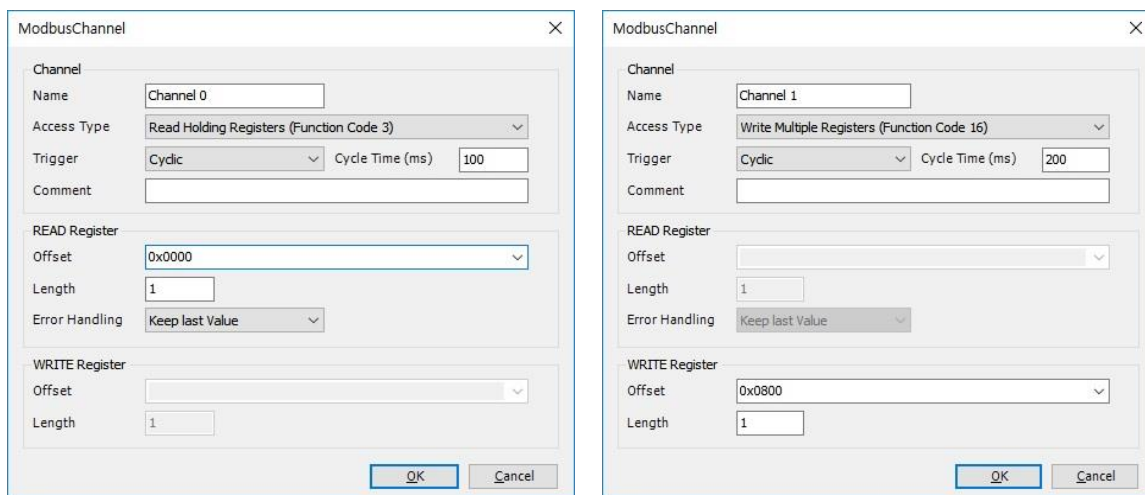
(9) Below is the address for Modbus Generic Serial Slave I/O Mapping.
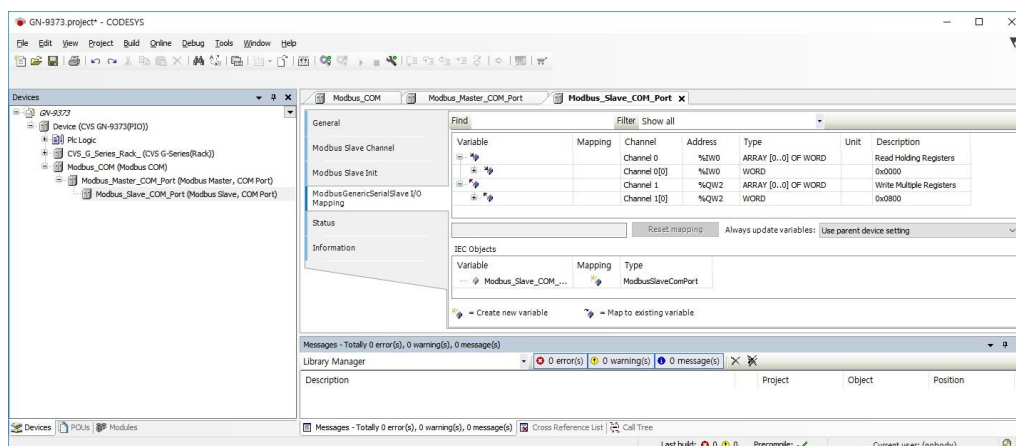
11.9. Web Visualization

(1) GN-9373, GN-9483, GL-9973, GL-9975, M9373, ML9973 can support Web Visualization.
(2) Add Web Visualization manager to Application project
(3) Set the Web Visualization option on the Web Visualization manager.
     User should set the Start Visualization path, and can set the visualization windows size.
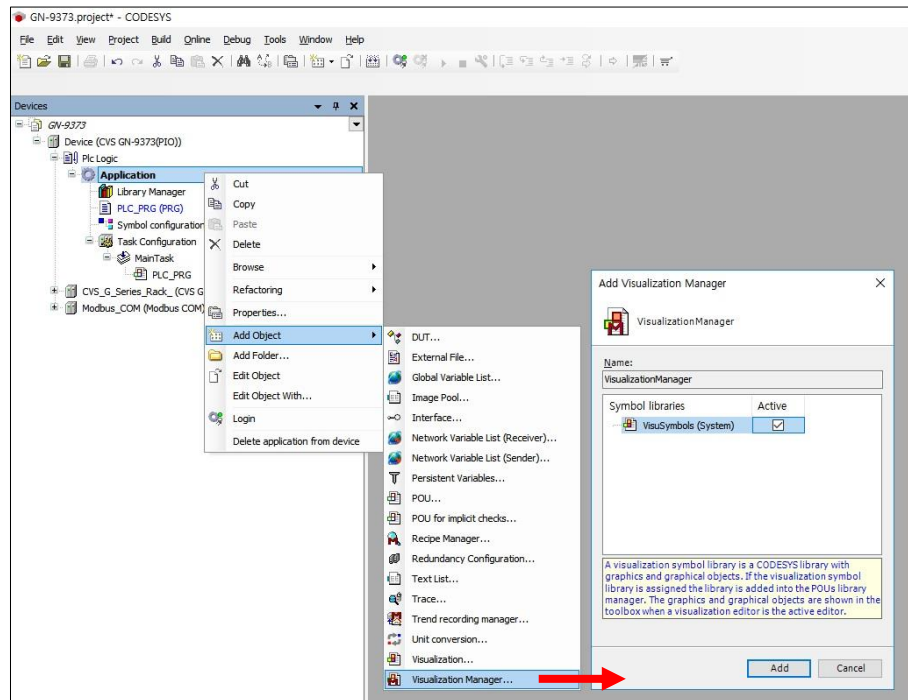
(4) Add the visualization object to Application project

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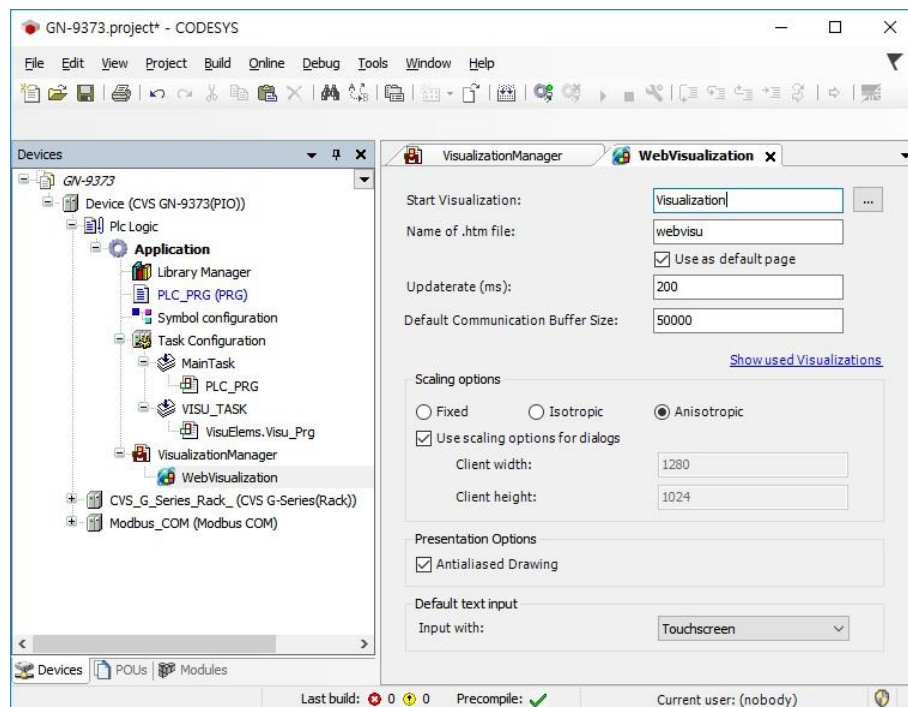
(5) Set the Visualization Manager should be 3.5.9.0.
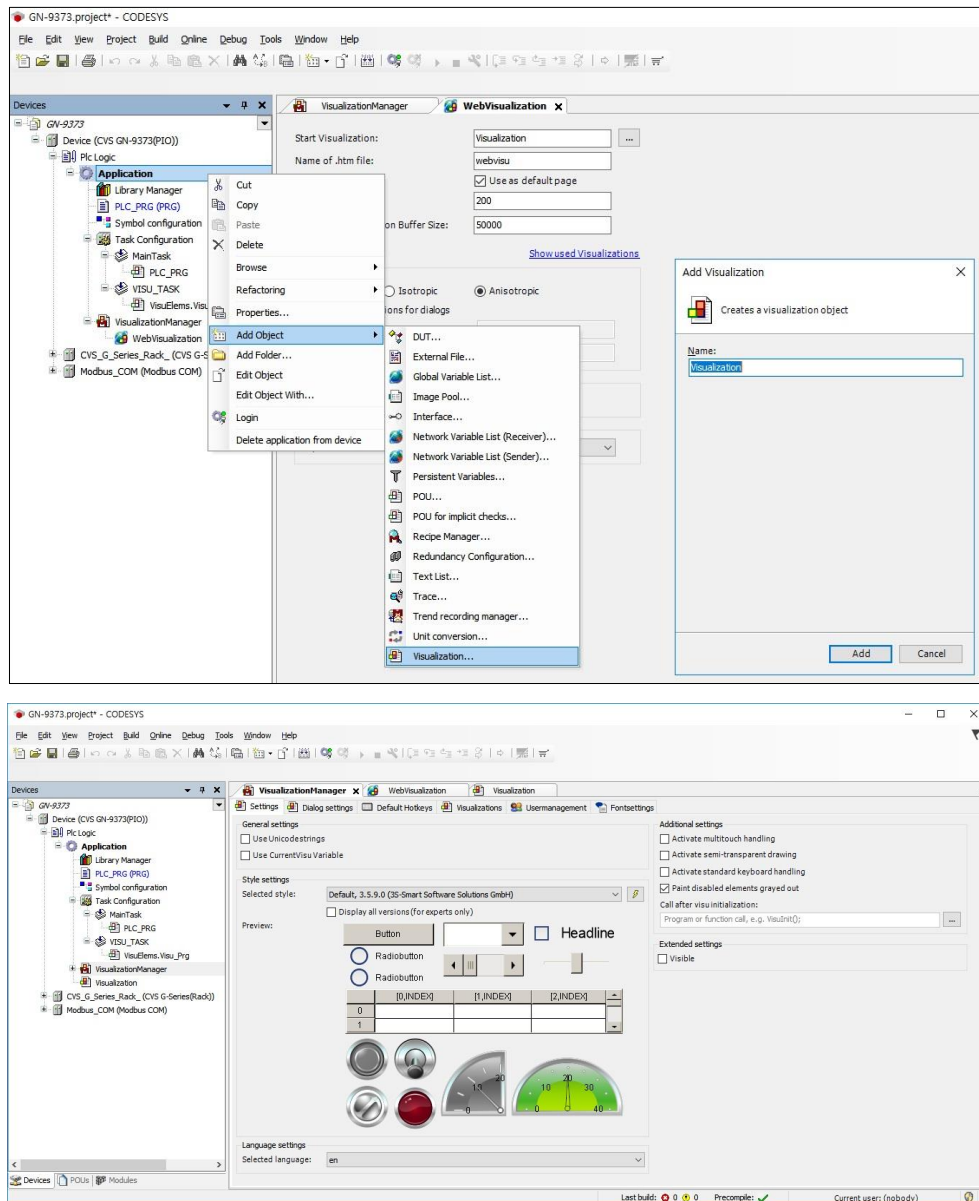
(6) Make the Web visualization page
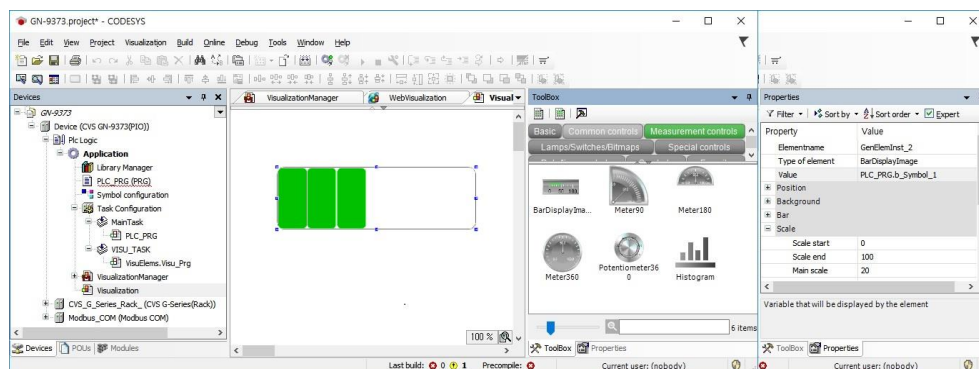
(7) Web visualization page on the Web Browser.
On the web browser, type the "IP address:8080/webvisu.htm" as like below.
It is recommended to use at Chrome and FireFox browser.
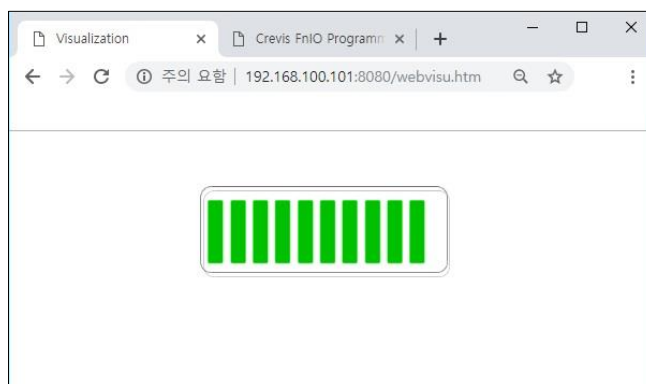
(8) The visualization editor opens after a double-click on a visualization object.
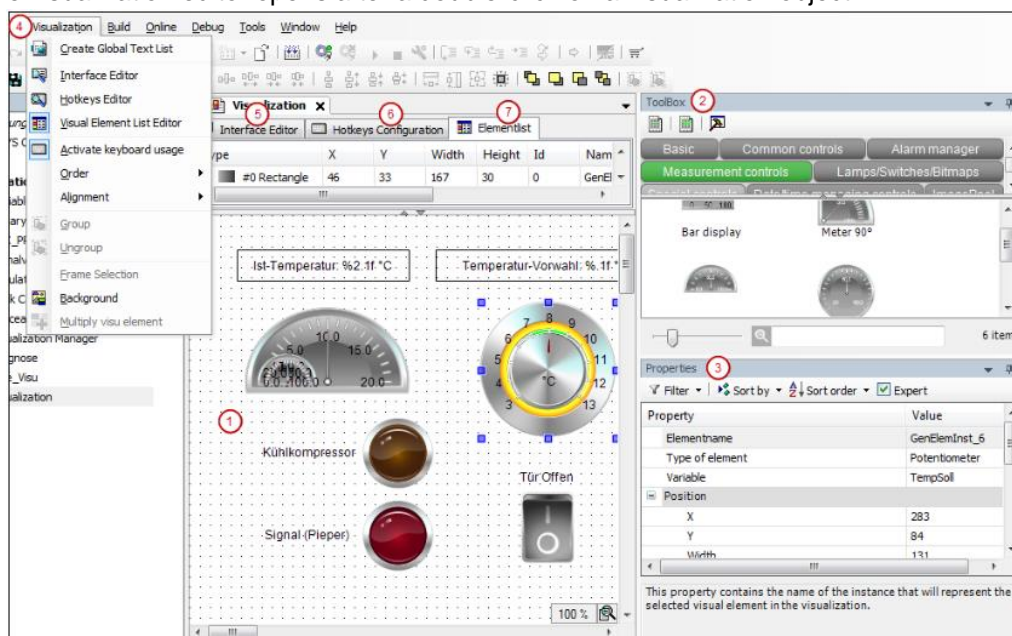
No.1 Graphical editor: this is where you create a visualization from the visualization elements that are provided in the view Tools.
No.2 View Tools: available visualization elements
No.3 View Properties: configuration editor for the visualization element currently selected in the editor area
No.4 Menu Visualization: commands for working in the visualization editor

Amongst other things, the menu Visualization contains commands for opening additional editors:

No.5 Interface Editor: declaration of variables via which the references of the visualization can be parameterized.
No. 6 Hotkeys Configuration: definition of shortcuts for inputs on the visualization in online mode.
No. 7 Element list: List of all elements used in the visualization, possibility to change their position on the z-axis.

12.   Connection – Link – UDP/TCP

UDP, TCP connection can be checked as the followings;

(1) UDP – Click 'scan network'.
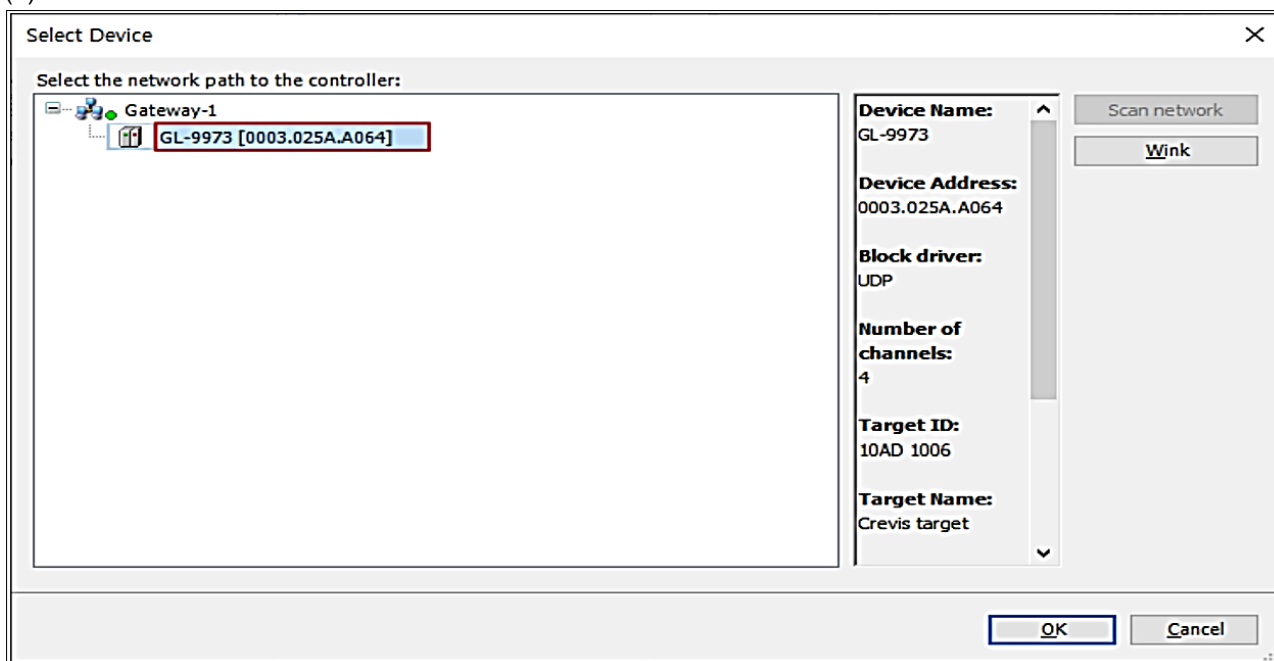
(2) TCP – Enter the target IP address.
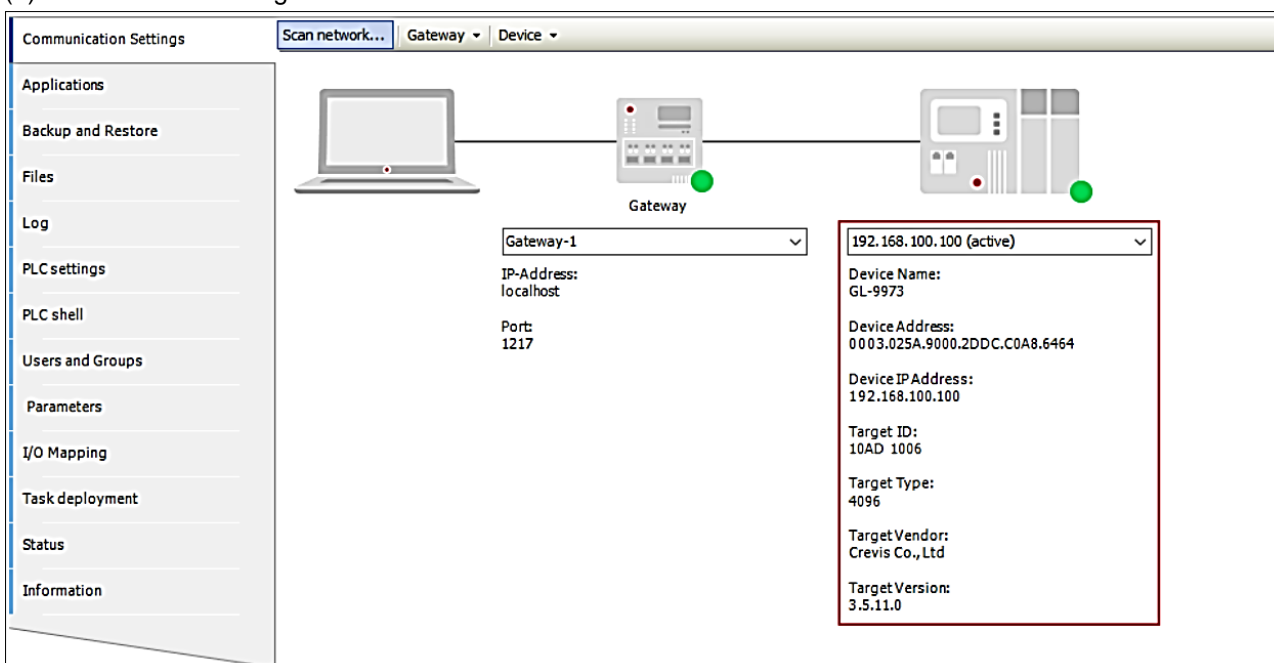
13. I/O Parameter Data Setting

I/O parameter data can change in CODESYS before downloading the program.

Parameter	Type	Current Value	Prepared Value	Value	Default Value	Unit	Description
◆ Vendor	STRING	'CREVIS'		'CREVIS'	'CREVIS'		Vendor of the device
◆ Module ID	STRING	'22CA'		'22CA'	'22CA'		Module ID of the device
◆ Fault Action(CH0~CH7)	BYTE	0		0	0		0:Falut value, 1:Hold last state
◆ Fault Action(CH8~CH15)	BYTE	0		0	0		0:Falut value, 1:Hold last state
◆ Fault Action(CH16~CH23)	BYTE	0		0	0		0:Falut value, 1:Hold last state
◆ Fault Action(CH24~CH31)	BYTE	0		0	0		0:Falut value, 1:Hold last state
◆ Fault value(CH0~CH7)	BYTE	1		1	0		0:OFF, 1:ON
◆ Fault value(CH8~CH15)	BYTE	0		0	0		0:OFF, 1:ON
◆ Fault value(CH16~CH23)	BYTE	1		1	0		0:OFF, 1:ON
◆ Fault value(CH4~CH31)	BYTE	0		0	0		0:OFF, 1:ON

14. File System

14.1. Source download and upload

In this tab of the generic device editor, you can transfer files between CODESYS (host) and the PLC. If the communication settings are correct and the PLC is online, then CODESYS establishes the connection automatically to the PLC for the duration of the file transfer.

Downloading Source Code to and from the PLC

CODESYS provides the capability of loading project source code to a PLC as a project archive.
User can then transfer this project archive back to the development system from the PLC as needed.
Requirement: The connection settings are configured for the affected controllers.

(1) Route: File -> Source download. User can download the project file to PIO.
(2) Click the Source Download menu in Comp. Select the your PIO and click Ok.
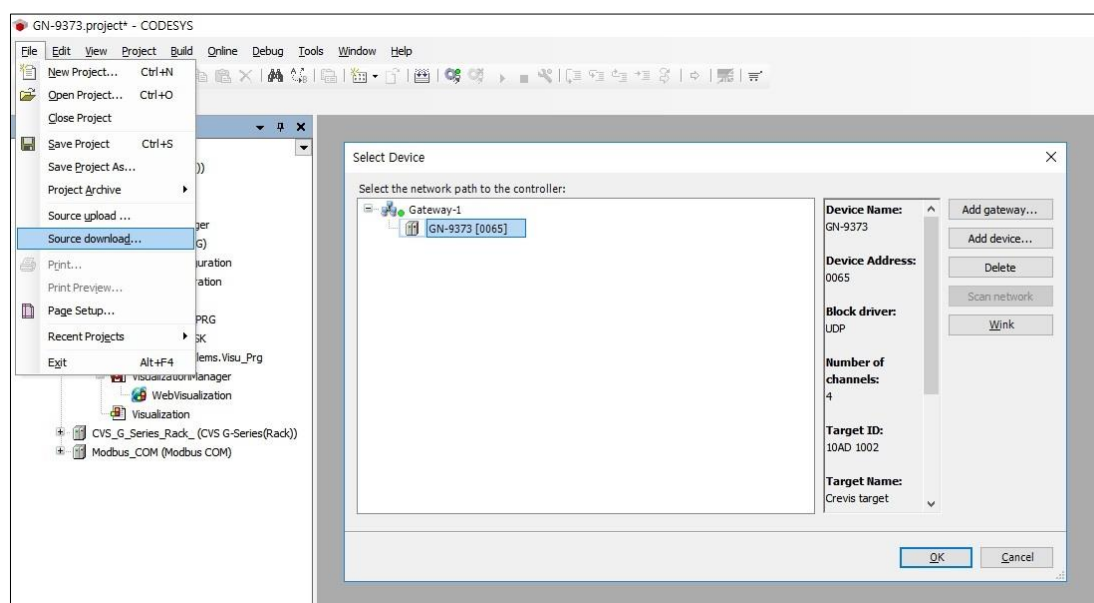
(3) When the Online mode, user can download the source file using the Source download to Connected device in Online pop up menu. After click this, it will be downloaded immediately.

(4) If user wand to extract the project file from the PIO, click the Source Upload menu in Comp. Select the activated PIO. Route: File -> Source upload
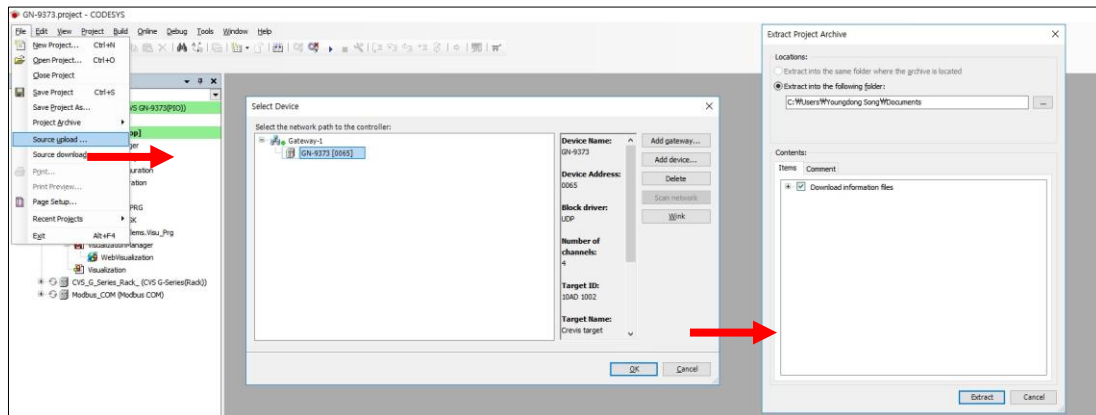
It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

15. SNTP

(1) Route: Device -> Parameters
(2) Enable the SNTP Service. IP Address of First SNTP Server : PC IP Address
(3) The current time will change in order to be same as the server time.
(Current Time can be checked on the web-server or CODESYS program.)
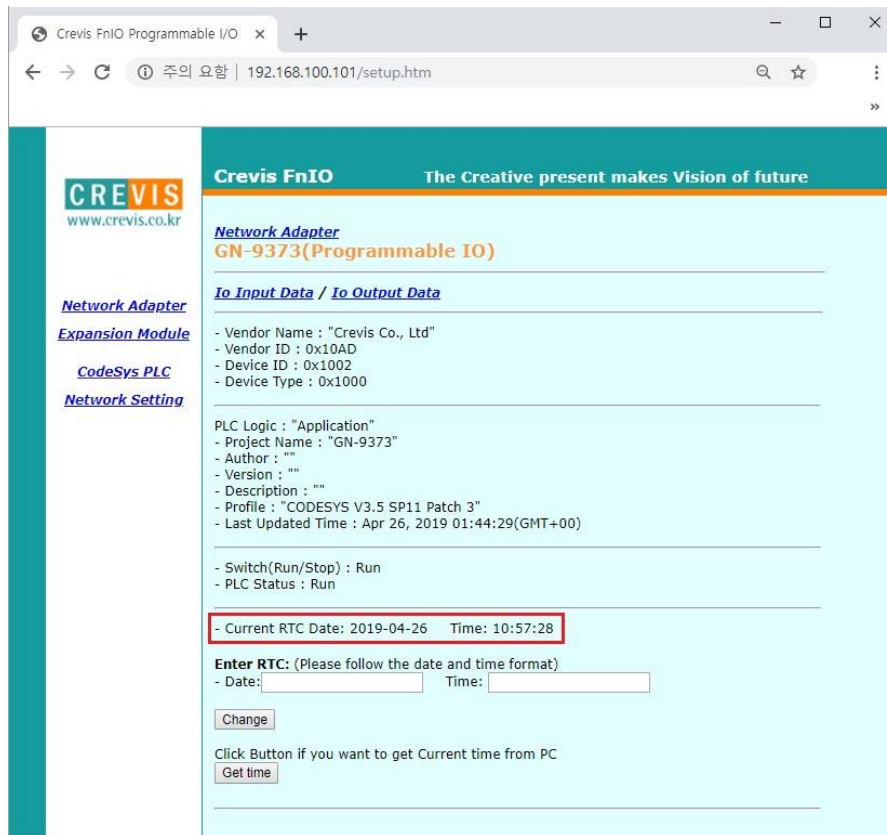
CREVIS

(4) Web Server

(5) CODESYS Program

16.   Event Log

User can view the PLC log in this tab of the generic device editor. It lists the events that were recorded on the target system. This concerns:

- Events during the startup and shutdown of the system (components loaded, with version)
- Application download and loading of the boot application
- Custom entries
- Log entries from I/O drivers
- Log entries from data sources

    (1) Route: Device' -> Log
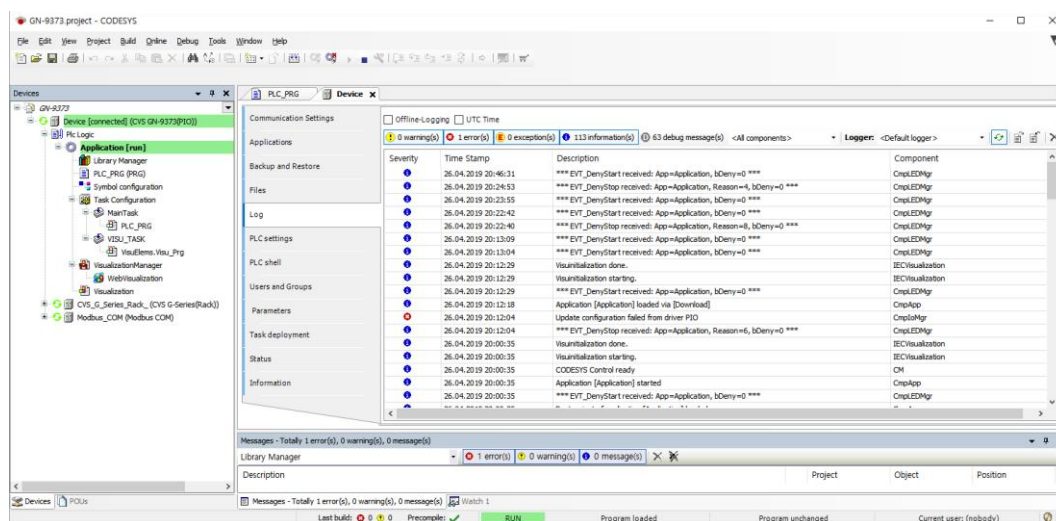
■ Boot Application

CODESYS generates the boot application automatically when an application is downloaded and transfers them to the PLC (Boot Application is not available with GN-9481, GN-9371, GL-9971, M9971, M9371).

■ Offline mode
  When generating and using a Boot Application in offline mode, the application name must also be included in the configuration file (*.cfg).

  ex) When using the 'MyApplication.app' and 'MyApplication.crc' files generated in offline mode,
     the application name must be included in the CODESYSControl.cfg file.

```
'CODESYSControl.cfg' file

[CmpApp]
Application.1=MyApplication
```

■ Application Information in the cfg File:
   - After a factory reset : Automatically generated as 'Application.'
   - After downloading : Automatically generated based on the application name in the file.
   - After a reset origin : Does not include Application information.

* When using the Boot Application in offline mode after a reset origin, the user needs to include the application name manually.

17.   **File Transfer**

In the generic Files tab of the device editor, user can transfer files between CODESYS (host) and the PLC.
If the communication settings are correct and the PLC is online, then CODESYS establishes the connection
automatically to the PLC for the duration of the file transfer. User can copy files to and from the local file system
and the controller. < Requirement: The vendor has unlocked the tab. In the device tree, the connection to the
controller is configured. The device is running. >

- (1)   Route: Device -> Files
- (2)   PC files can be stored to PIO, and stored files from PIO can be transferred to the PC
- (3)   Files will be stored to Program Memory (GN-9371: 512Kbytes / GN-9372, 9373: 16Mbytes)
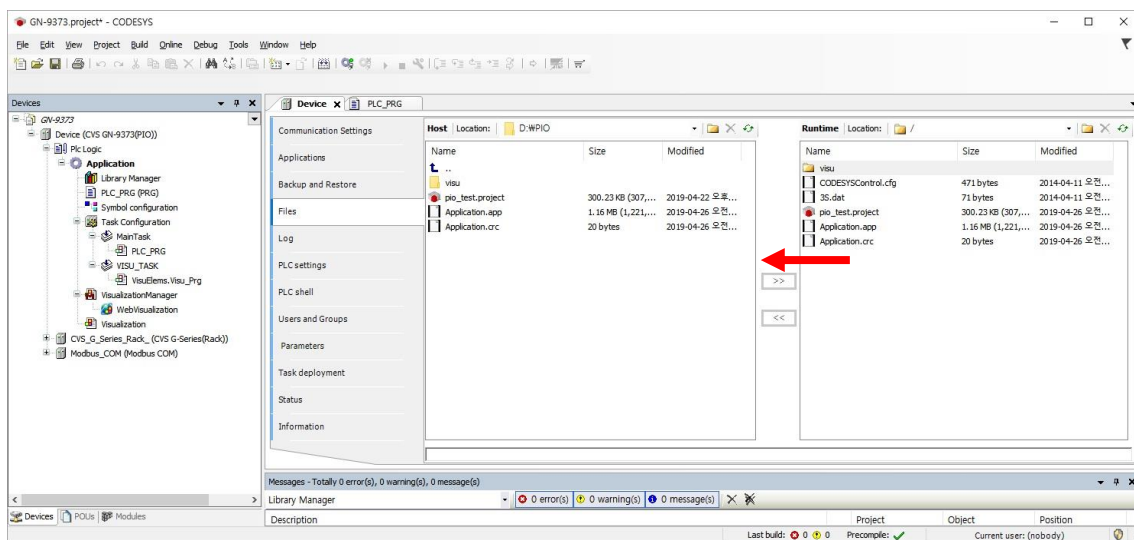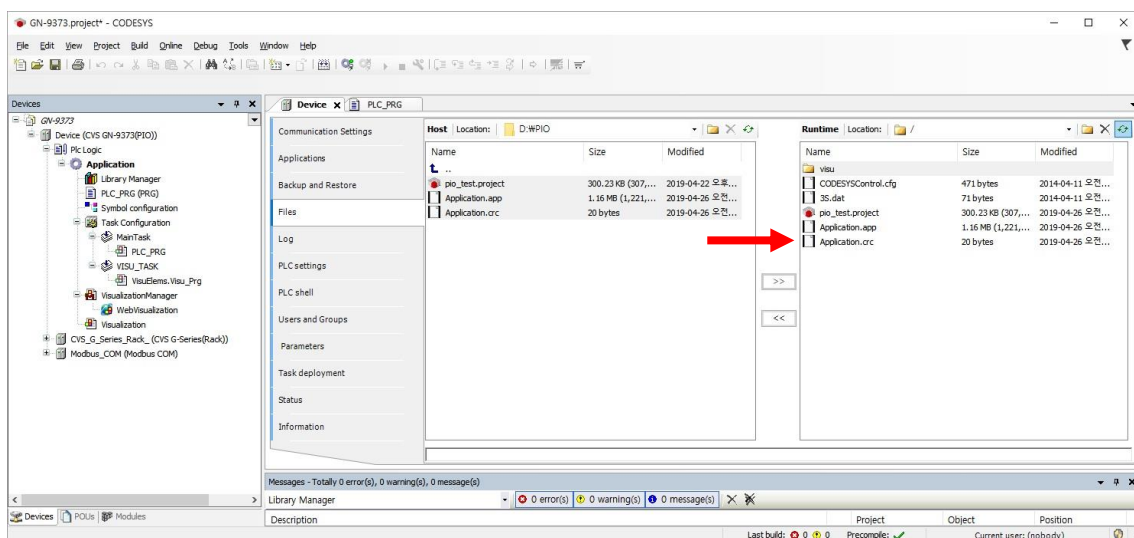
It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483,
M9372, M9373, ML9972, M9973.

18.   Recipe Manger

Use recipes to change or read recipes values for a specific set of variables (recipe definition) on the controller at the same time.

Users define the basic settings for recipes, such as save location and format, in the object Recipe Manager. Insert one or more recipe definitions below this object. A recipe definition comprises one or more recipes for the contained variable. The recipe consists of specific variable values.

User can save a recipe to a file or write directly from files to the PLC.

Recipes can be loaded via the CODESYS development interface, the visualization element, or the application program.

   (1) Route: Device -> Application -> Add Object -> Recipe Manager
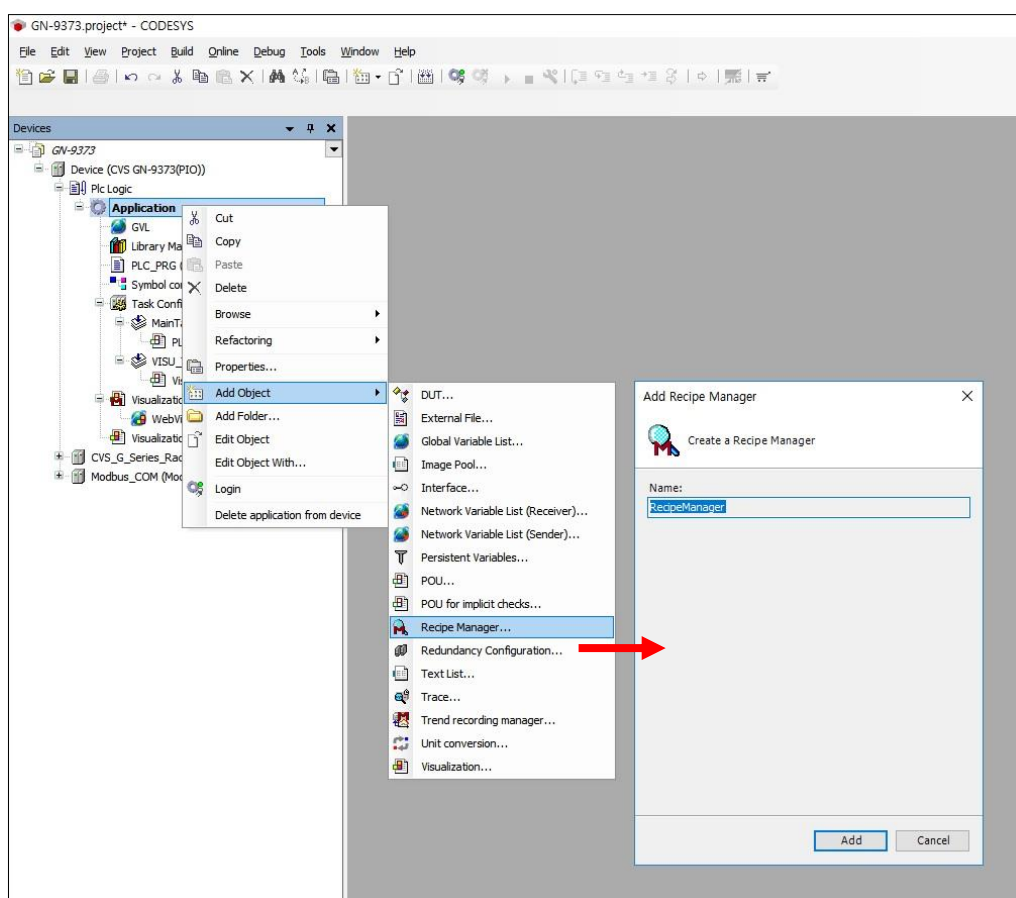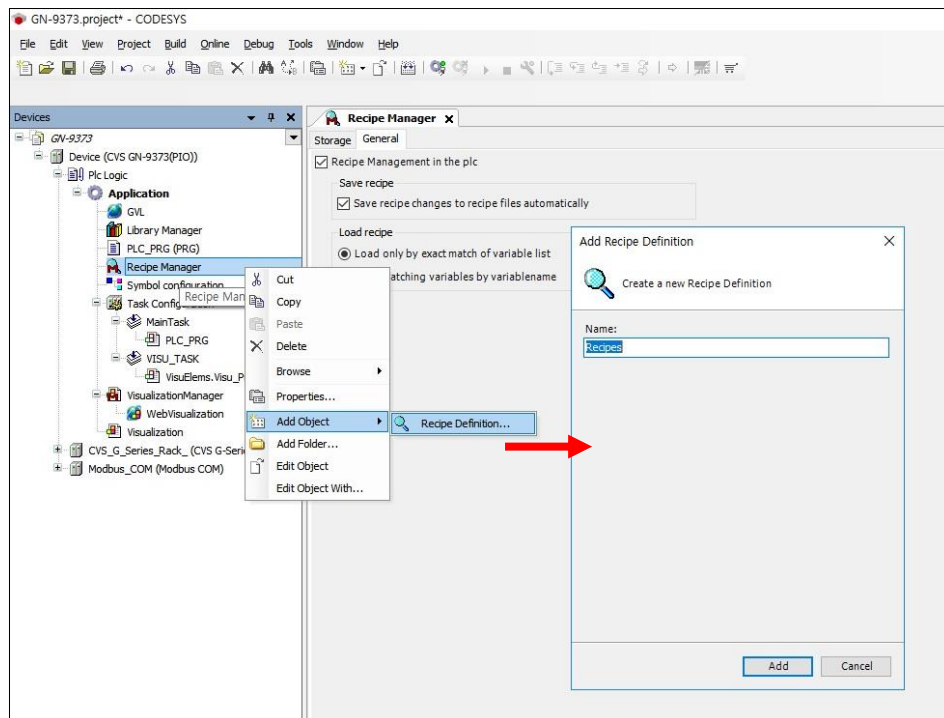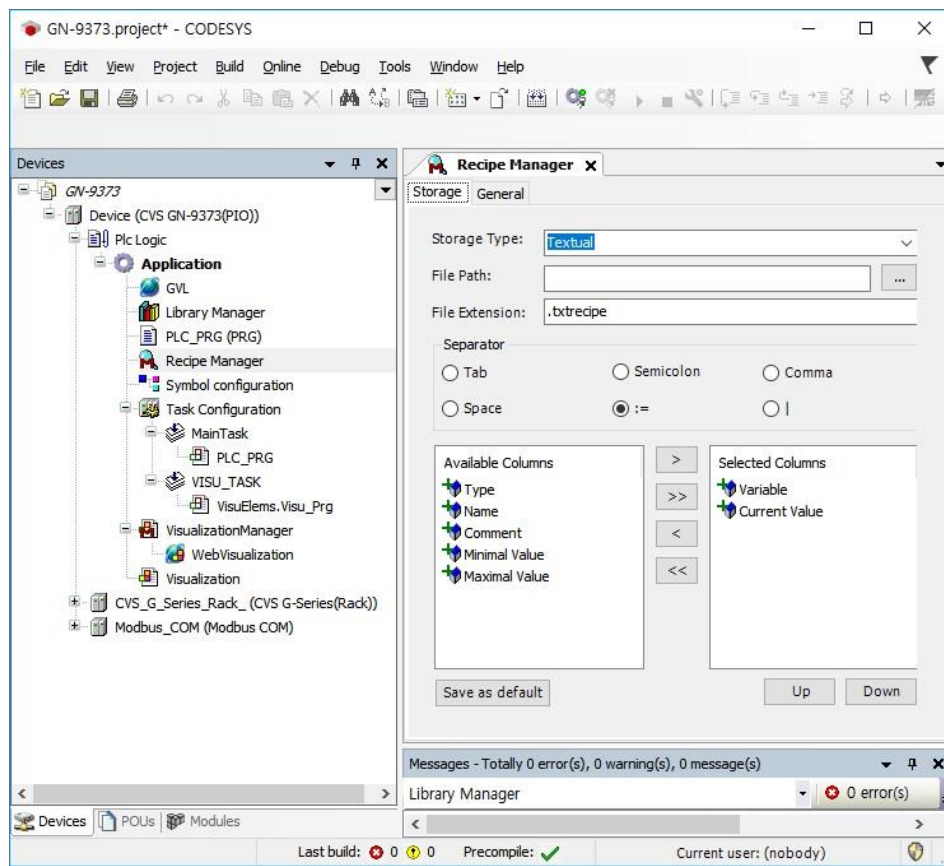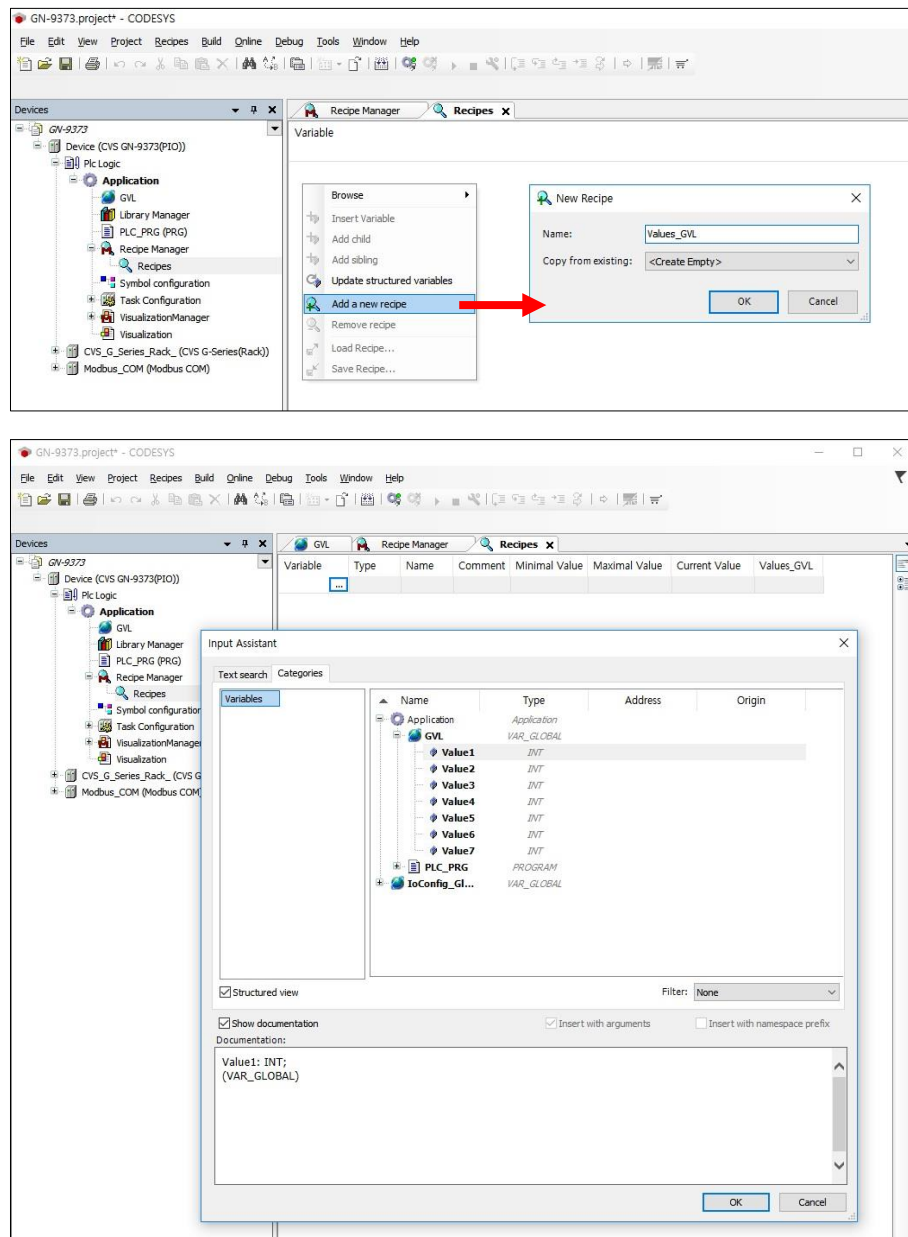
In the recipe definition (1), you define different value sets for the variables, which are termed recipes (2). User can toggle the display of the recipe definition between the flat list view (3) and the structured view (4). In the structured view, CODESYS groups variables according to structure.
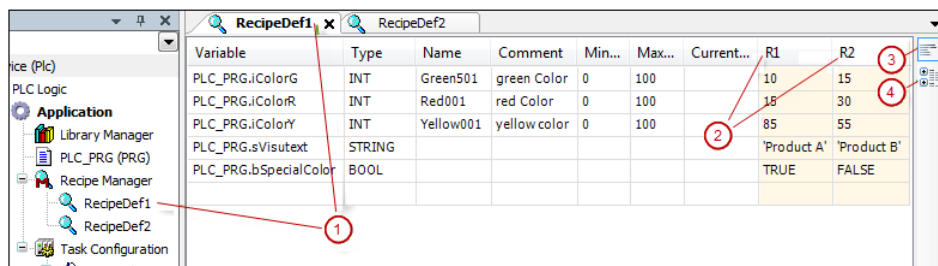
User can save the Recipe about their valued variables.

CREVIS
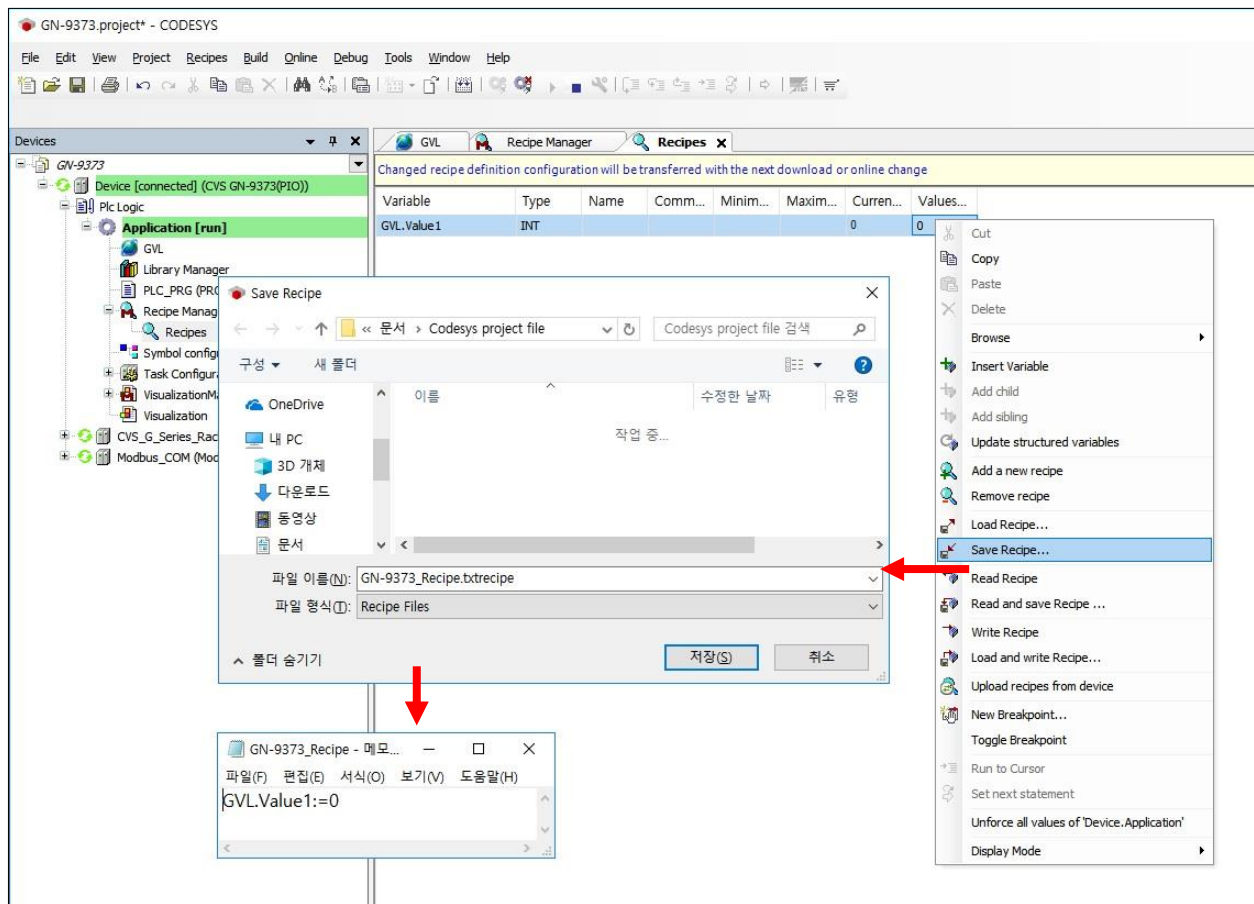
19. Trace Manager

A Trace makes it possible to record the value history of variables on the PLC — just like a digital sampling oscilloscope. When the application is in runtime mode with trace, all statements are executed first within the task cycle. Then, data recording starts with value storage including time stamps. These time stamps are relative and refer to the start time of the data recording. The data yields a discrete time signal and CODESYS displays its course in the trace editor.

(1) Route: Device -> Application -> Add Object -> Trace
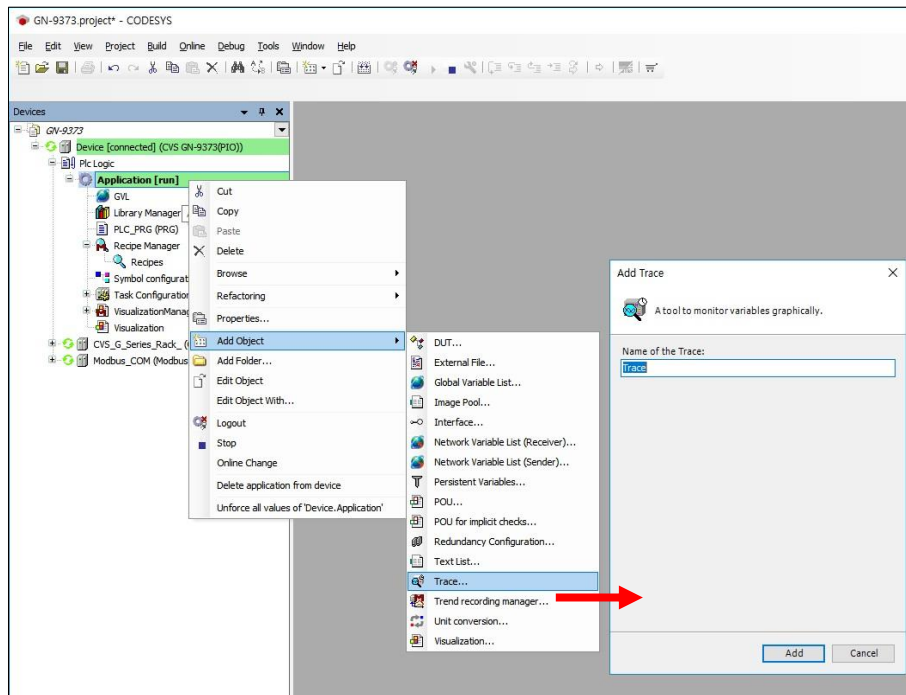
(2) Click 'Add variable' to select the variable, and make the input value visible.
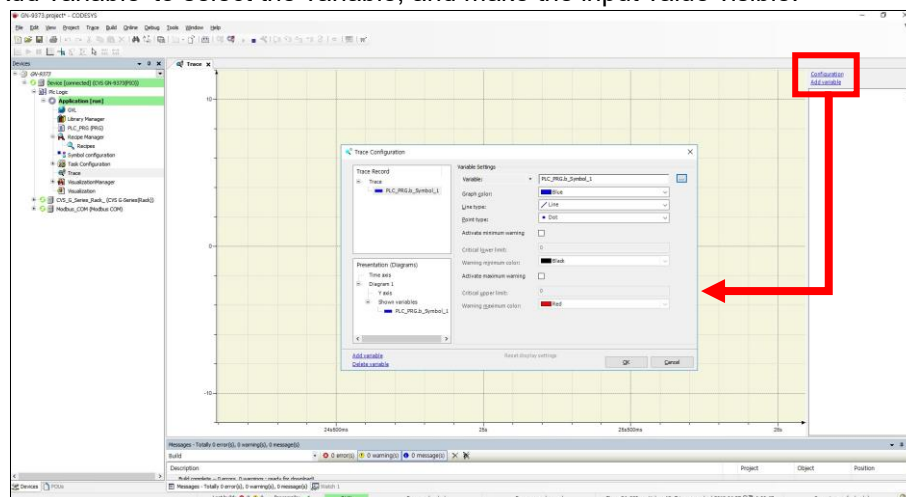
(3) After the 'Download Trace', user can see the simple graph under the valued variable.
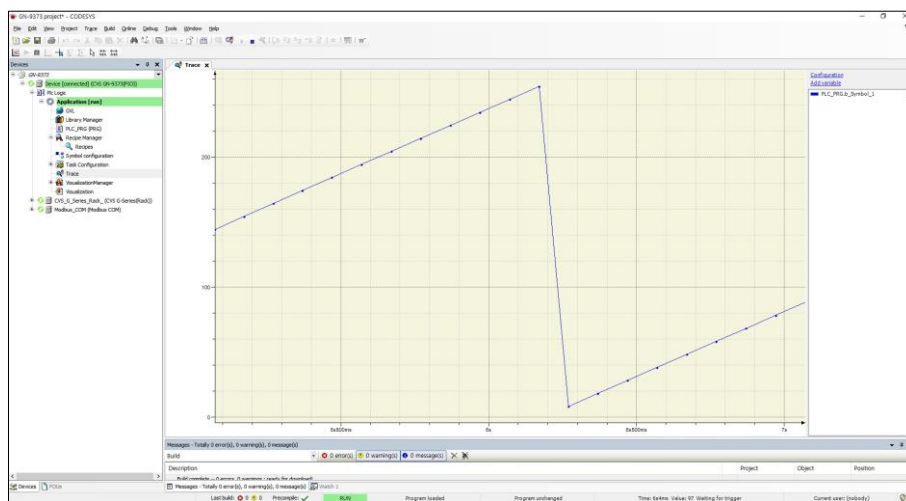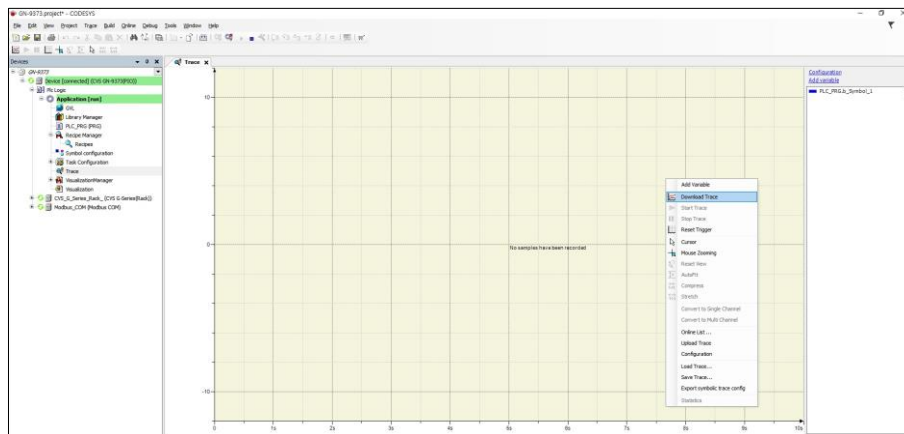
20.   Online Change

It is used to trigger an online change on the current application. When this is done, CODESYS re-downloads only the changed parts of an application which is already running on the controller.

The command is available in the context menu when an application is selected in the device tree.
As a result, you can perform an online change just for one application, even if that application is not currently "active".
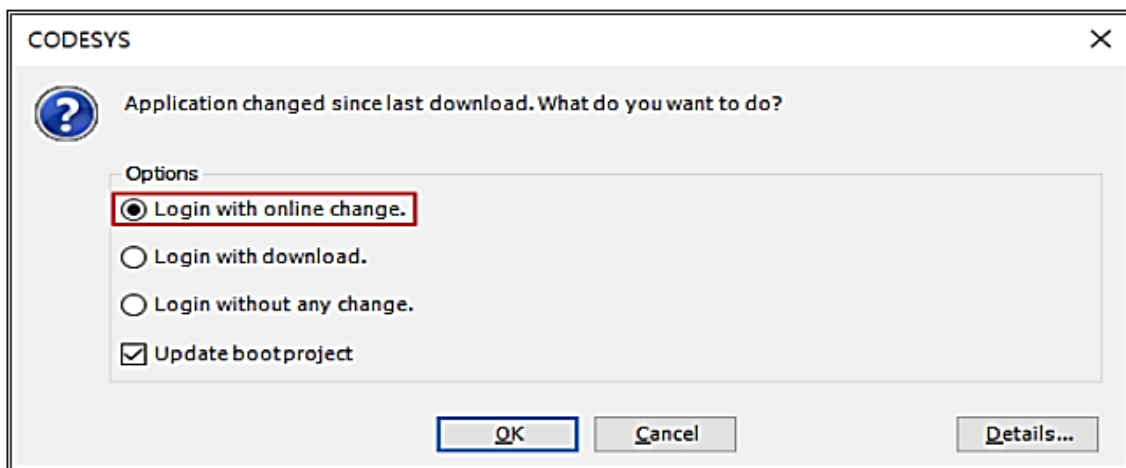
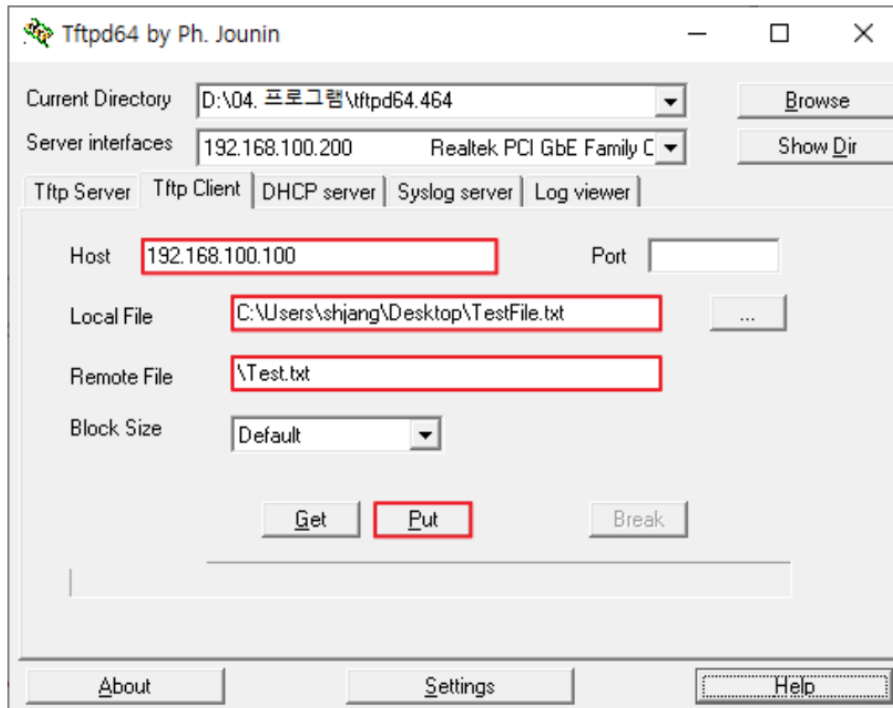It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

Caution
An online change modifies the running application program and does not cause a restart.
Make sure that the new application code still has the required effect on the controlled system.
Depending on the controlled plant, this could result in damage to the plant or the workpieces,
or injury or death of personnel.

Important
When an online change is performed, the application-specific initializations (example: homing) are not executed because the machine retains its status.
For this reason, the new program code may not have the intended effect.

Variables to pointers retain their value from the last cycle. When a pointer refers to a variable whose value was changed in an online change, the variable no longer yields the correct value.
Make sure that the pointers are re-assigned in each cycle.

After you have changed the "parent application", a "child application" is removed from the controller when an online change is performed.

21.   Breakpoints

Breakpoints are commonly used for debugging programs. User can set breakpoints at specific positions in the program to force an execution stop and to monitor variable values. You can also set data breakpoints to halt program execution when the value of a specific variable changes. CODESYS supports breakpoints in all IEC editors. The halt at a breakpoint or data breakpoint can be linked to additional conditions. You can also redefine breakpoints and data breakpoints as execution points where specific code is executed instead of stopping the program.

(1) Select the desired line and press F9 to set the brake point. Start by pressing F5.
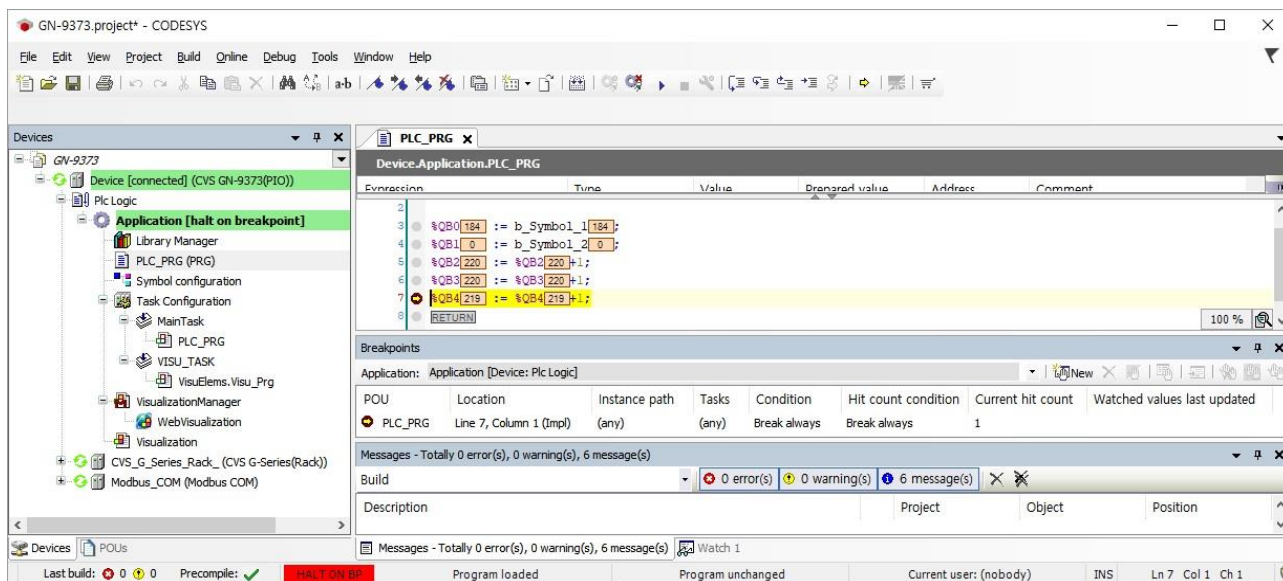
It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

22. TFTP

The file can be transferred from PC to PIO (& vice versa).

#1. PC to CODESYS - PIO

#2. CODESYS - PIO to PC
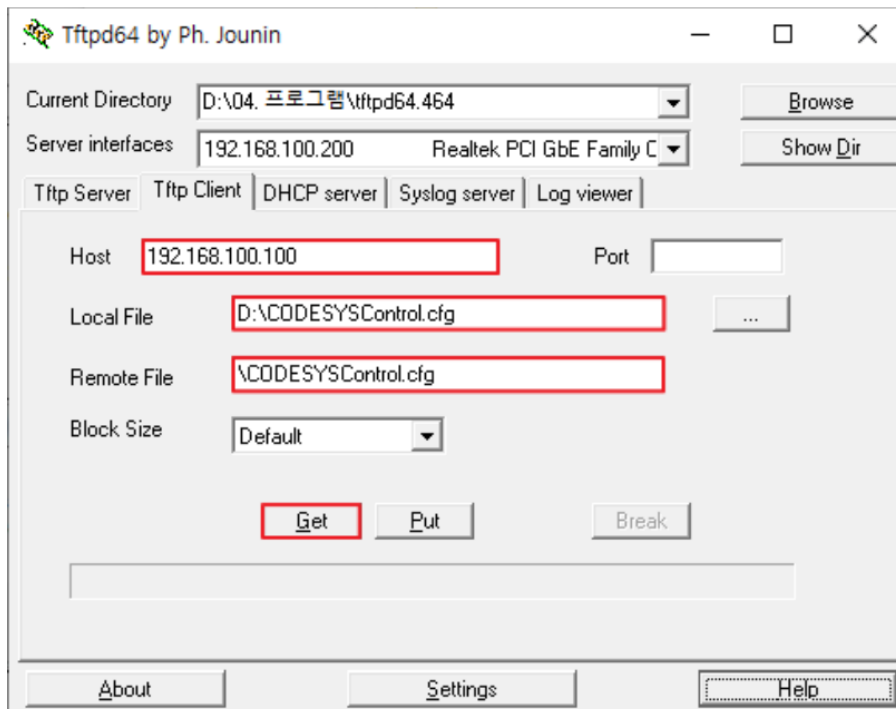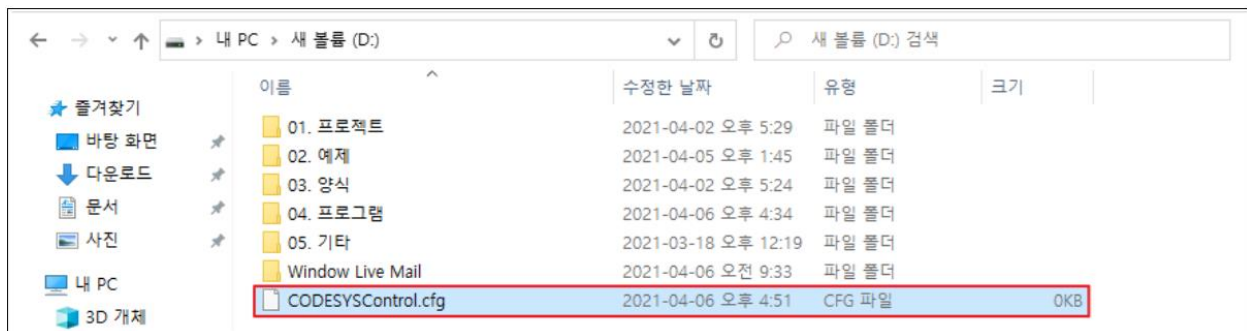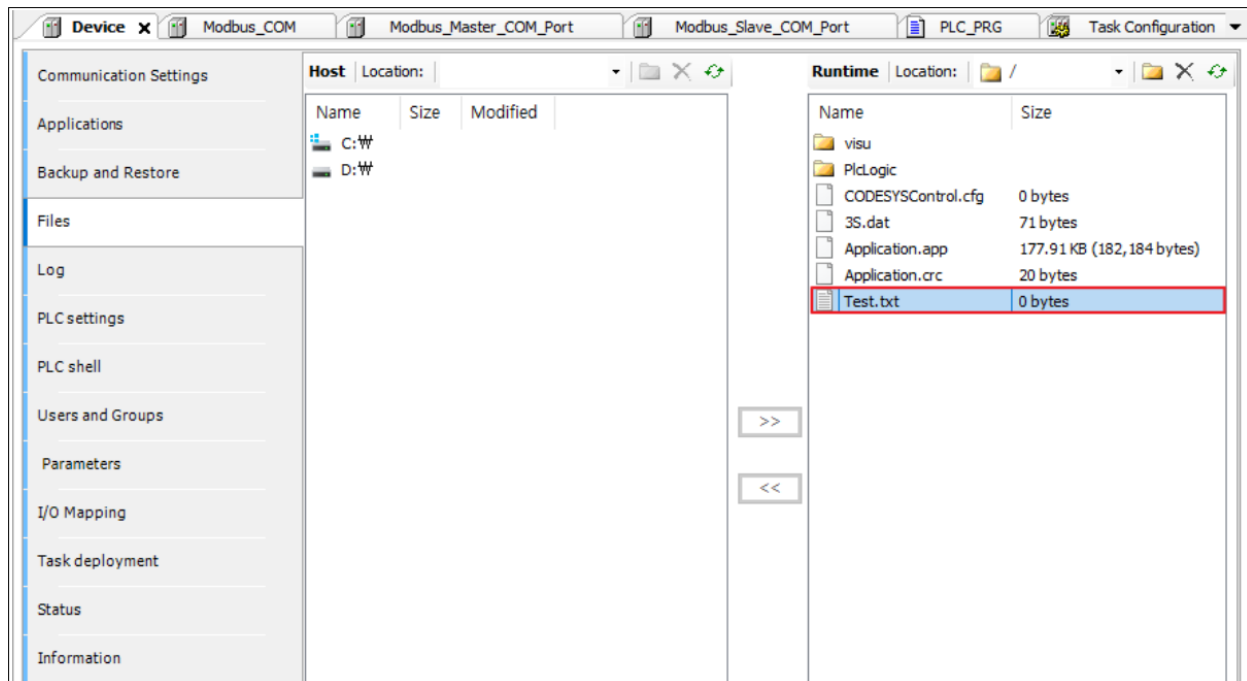
CREVIS

It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

23.   SQL4 CODESYS

(1) Create MS-SQL Database
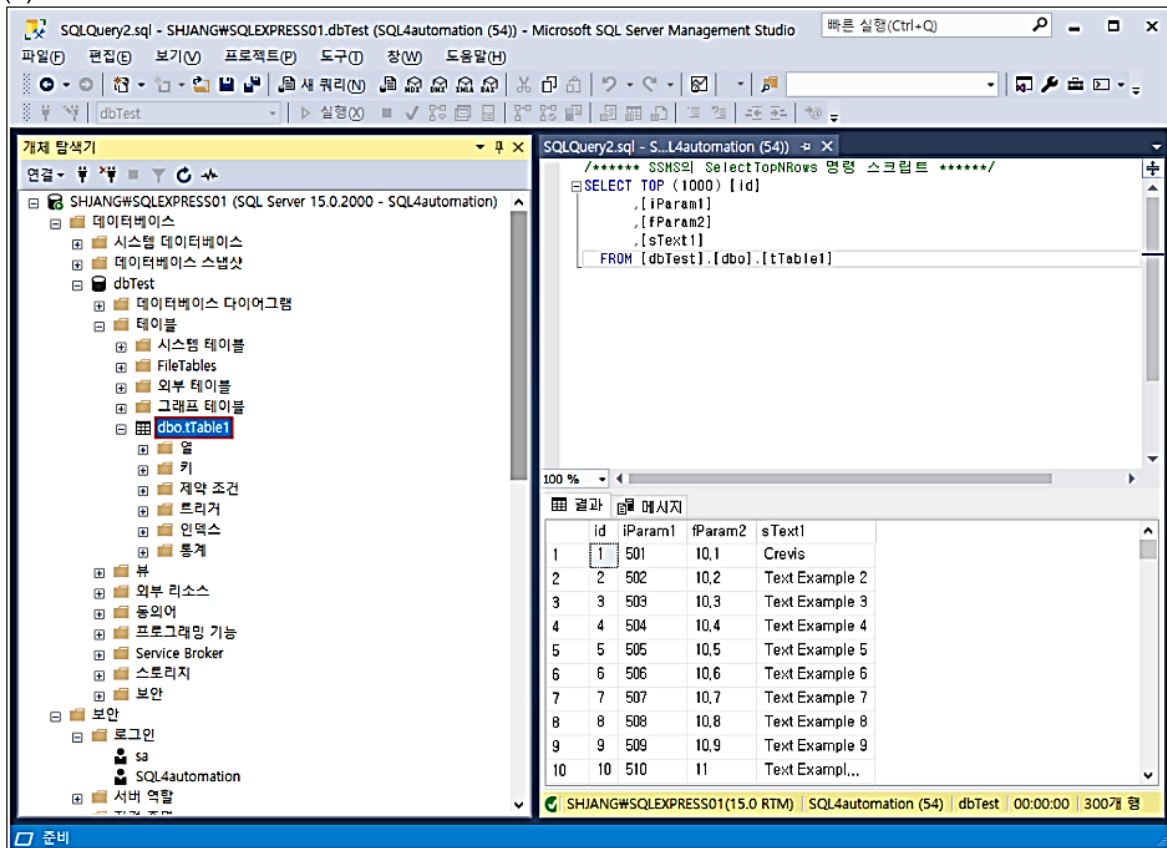
(2) Connect the target(GL-9973) and connector(PC, MS SQL Server) using S4AConfig Tool.
(Server IP : 192.168.100.200, Target IP : 192.168.100.100)
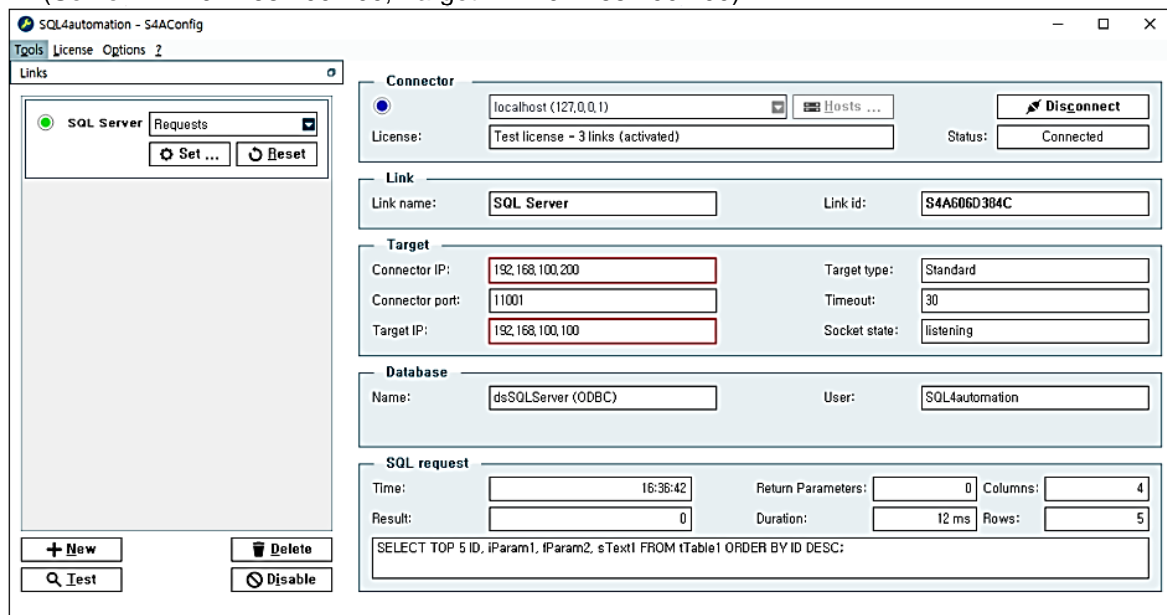
(3) Database SQL query succeed.
(SELECT TOP 5 ID, iParam1, fParam2, sText1 FROM tTable1 ORDER BY ID DESC;)

Expression	Type	Value
⊟ ◈ asData	ARRAY [0..(gvS4A.c...	
◈ asData[0, 0]	STRING(255)	'300'
◈ asData[0, 1]	STRING(255)	'800'
◈ asData[0, 2]	STRING(255)	'40'
◈ asData[0, 3]	STRING(255)	'Text Example 300'
◈ asData[1, 0]	STRING(255)	'299'
◈ asData[1, 1]	STRING(255)	'799'
◈ asData[1, 2]	STRING(255)	'39.9'
◈ asData[1, 3]	STRING(255)	'Text Example 299'
◈ asData[2, 0]	STRING(255)	'298'
◈ asData[2, 1]	STRING(255)	'798'
◈ asData[2, 2]	STRING(255)	'39.8'
◈ asData[2, 3]	STRING(255)	'Text Example 298'
◈ asData[3, 0]	STRING(255)	'297'
◈ asData[3, 1]	STRING(255)	'797'
◈ asData[3, 2]	STRING(255)	'39.7'
◈ asData[3, 3]	STRING(255)	'Text Example 297'
◈ asData[4, 0]	STRING(255)	'296'
◈ asData[4, 1]	STRING(255)	'796'
◈ asData[4, 2]	STRING(255)	'39.6'
◈ asData[4, 3]	STRING(255)	'Text Example 296'
◈ asData[5, 0]	STRING(255)	''
◈ asData[5, 1]	STRING(255)	''
◈ asData[5, 2]	STRING(255)	''
◈ asData[5, 3]	STRING(255)	''

Devices
- S4A_SQL4CODESYS_Sample
  - Device [connected] (CVS GL-9973(PIO))
    - Plc Logic
      - Application [run]
        - S4A migration functions
        - gvS4A
        - Library Manager
        - fbSqlExampleSCL (FB)
        - prgCritical (PRG)
        - prgUncritical (PRG)
        - Task Configuration
          - Task
            - prgCritical
          - Task_1
            - prgUncritical
  - CVS_G_Series_Rack_ (CVS G-Series(Rack)

fbSqlExampleSCL
Device.Application.prgCritical.inSqlExampleSCL

SQL Result

State: Success   Result: 0   Return Parameters: 0   Rows: 5   Columns: 4   ✔ Clear Result

Result Table

	ID	iParam1	fParam2	sText1
1	300	800	40	Text Example 300
2	299	799	39.9	Text Example 299
3	298	798	39.8	Text Example 298
4	297	797	39.7	Text Example 297
5	296	796	39.6	Text Example 296

It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

24. External Feature Library
24.1. Battery State of charge

※ RTC data or RETAIN data will not be saved if the battery is not charged enough.

```
LastBatteryStatus
        BOOL  xError
        ERROR eErrorID
```
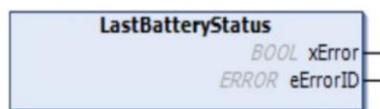
	NAME	Type	Comment
OUT	xError	BOOL	1. TRUE : Battery charging required 2. False : Battery charged
OUT	eErrorID	Error	(1) NO_Err : No Error (2) Reset_RTC (3) Reset_Retain (4) Reset_Rtc_And_Retain

(1) Code about Battery State

```
PROGRAM Battery
VAR
    Battery_FLAG : BOOL;
    Battery : ExtFeatures.LastBatteryStatus;
    Error : BOOL;
    ErrorCode : ExtFeatures.ERROR;
END_VAR

IF Battery_FLAG = TRUE THEN
    Battery();
    Error := Battery.xError;
    ErrorCode := Battery.eErrorID;
    Battery_FLAG := FALSE;
END_IF
```

(2) Result

※ IF xError : It means "True", so the battery should be charged through supplying the system power.

Battery	ExtFeatures.LastBat...				
xError	BOOL	TRUE			
eErrorID	ERROR	BATTERY_RESET_RTC_AND_RETAIN			
Error	BOOL	TRUE			
ErrorCode	ERROR	BATTERY_RESET_RTC_AND_RETAIN			

24.2. Read / Write Special Register (PIO Module Parameter Access)

※ The MODBUS Special Register Map listed in the specification can do "read / write" by programming logic through the library as the followings ;

(1) Read Special Register

```
                    ReadSpecialRegister
—| wAddress WORD              ARRAY [0..127] OF WORD  wBuffer |—
—| wSize WORD                           WORD  wRegSize |—
                                          ERROR  eErrorID |—
```

	NAME	Type	Comment
IN	wAddress	Word	Special Register Access Address
IN	wSize	Word	Access Size(Word)
IN	wBuffer	Word [64]	Buffers that perform reads
OUT	wRegSize	Word	Actual register size for that address(Word)
OUT	eErrorID	Error	(1) NO_Err : No Error (2) INVALID_ADDRESS : Incorrect address - Unsupported address (3) INVALID_SIZE : Incorrect access size

(2) Write Special Register

```
                    WriteSpecialRegister
—| wAddress WORD                         WORD  wRegSize |—
—| wSize WORD                            ERROR  eErrorID |—
—| wBuffer ARRAY [0..127] OF WORD
```

	NAME	Type	Comment
IN	wAddress	Word	Special Register Access Address
IN	wSize	Word	Access Size(Word)
IN	wBuffer	Word [64]	Buffers that perform Write
OUT	wRegSize	Word	Actual register size for that address(Word)
OUT	eErrorID	Error	(1) NO_Err : No Error (2) INVALID_ADDRESS : Incorrect address - Unsupported address (3) INVALID_SIZE : Incorrect access size

(3) Example to change Special Register

(3-1) Test to change the RS-232 Baud rate – 7 (115200)

Address	Access	Type, Size	Description
0x1600(5632)	Read	2words	IP Address. (ex : A8C0 6464 = 192.168.100.100)
0x1602(5634)	Read	2words	Subnet Mask. (ex : FFFF 0000 = 255.255.0.0)
0x1604(5636)	Read	2words	Gate way. (ex : A8C0 0100 = 192.168.0.1)
0x1606(5638)*	Read /Write	1word	RS-232C Baud rate. (2400bps~115200bps) - 0 : 115200 (default) - 1 : 2400 - 2 : 4800 - 3 : 9600 - 4 : 19200 - 5 : 38400 - 6 : 57600 - 7 : 115200

(3-2) Write Special Register sample logic

※ After setting the value, the login & download is required.

   - wAddress : Special Register Address = 16#1606
   - wSize : Special Register size = 1
   - wBuffer : buffer that perform write = 16#0007(115200)

```
(*================= Write Special Register =================*)
IF Write_Flag THEN
    Write.wAddress        := 16#1606;// special register address
    Write.wSize           := 1;          // word to write
    Write.wBuffer[0]      := 16#0007;
    Write();
    Write_Flag := FALSE;
END_IF
```

(3-3) Read Slot Parameter sample logic

※ Log-in is required in order to verify that the Write is successful

   - wAddress : Special Register Address = 16#1606
   - wSize : Special Register size = 1
   - wBuffer : buffer that perform Read

```
IF Read_Flag THEN                        wBuffer[0]  WORD    16#0007
    Read.wAddress    := 16#1606; // speci  wBuffer[1]  WORD    16#0000
    Read.wSize       := 1;       // word   wBuffer[2]  WORD    16#0000
    Read();
    Read_Flag        := FALSE;
END_IF
```

24.3. **Read / Write Slot Parameter**

※ **Causion** : Continuous writing the I/O parameter can cause problems in the I/O slot.
So it needs to be used only when required.

(1) Read Slot Parameter

```
                          ReadSlotParam
—bSlotAddress BYTE                        BYTE bParamSize—
—bSize BYTE                  ARRAY [0..254] OF BYTE bBuffer—
                                          ERROR eErrorID—
```

	NAME	Type	Comment
IN	bSlotAddress	Byte	Slot Address
IN	bSize	Byte	Access size (Byte)
OUT	bParamSize	Byte	Actual parameter size for that module (Byte)
OUT	bBuffer	Byte [255]	Buffers that perform reads
OUT	eErrorID	Error	(1) NO_Err : No Error (2) INVALID_ADDRESS : Incorrect slot address - 0 or Exceeded number of expansion slots (3) INVALID_SIZE : Incorrect parameter size - 0 or Excceded Parameter size

(2) Write Slot Parameter

```
                          WriteSlotParam
—bSlotAddress BYTE                        BYTE bParamSize—
—bOffset BYTE                            ERROR eErrorID—
—bSize BYTE
—bBuffer ARRAY [0..254] OF BYTE
```

	NAME	Type	Comment
IN	wAddress	Word	Slot Address
IN	bOffset	Byte	offset
IN	bSize	Byte	Access Size (Byte)
IN	bBuffer	Byte[255]	Buffer that perform writes
OUT	bParamSize	Byte	Actual parameter size for that module (Byte)
OUT	eErrorID	Error	(1) NO_Err : No Error (2) INVALID_ADDRESS : Incorrect slot address - 0 or Exceeded number of expansion slots (3) INVALID_SIZE : Incorrect parameter size - ((bSize or bSize+bOffset) > Parameter size of slot

(3) Example to access the extended I/O module parameter

6.2. GT-3924, GT-3944

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Ch#0 Command(H00 : 0~10V, H01 : 0~5V, H02 : -10~10V, H03 : -5~5V)							
1	Ch#1 Command(H00 : 0~10V, H01 : 0~5V, H02 : -10~10V, H03 : -5~5V)							
2	Ch#2 Command(H00 : 0~10V, H01 : 0~5V, H02 : -10~10V, H03 : -5~5V)							
3	Ch#3 Command(H00 : 0~10V, H01 : 0~5V, H02 : -10~10V, H03 : -5~5V)							
4	Filter Time(H00 : Default Filter(20), H01 : Fastest ~ H3E : Slowest)							
5	Reserve							

* ID_PARAMETER (6Byte)

(3-1) Create a WriteslotParam sample logic

※ After setting the value, the login & download is required.

- bSlotaddress : Slot Address : 1 (if first slot : 1 / if 10 th slot : 10)
- bSize : Data size of the parameters of the Module : 6
- boffset : offset : 0
- bBuffer[0] : Channel 0 Parameter Byte : H0(0~10V)
- bBuffer[1] : Channel 1 Parameter Byte : H1(0~5V)
- bBuffer[2] : Channel 2 Parameter Byte: H2(-10~10V)
- bBuffer[3] : Channel 3 Parameter Byte: H03(-5~5V)

```
================ Write Slot Parameter =================*)
Write_Flag THEN
WriteSlotParam.bSlotAddress := 1;// Slot Address (First Slot
WriteSlotParam.bSize        := 6;// number of bytes to write
WriteSlotParam.bOffset      := 0;// Offset
//(HEX 00 : 0~10V / H01 : 0~5V / H02 : -10~10V / H03 : -5 ~ 5
WriteSlotParam.bBuffer[0]   := 16#00;   // Parameter byte0
WriteSlotParam.bBuffer[1]   := 16#01;   // Parameter byte1
WriteSlotParam.bBuffer[2]   := 16#02;   // Parameter byte2
WriteSlotParam.bBuffer[3]   := 16#03;   // Parameter byte3
WriteSlotParam.bBuffer[4]   := 16#00;   // Parameter byte4
WriteSlotParam.bBuffer[5]   := 16#00;   // Parameter byte5
WriteSlotParam();
```

```
//(HEX 00 : 0~10V / H01 : 0~5V / H02 : -10~10V / H03 : -5 ~ 5V)
WriteSlotParam.bBuffer[0] 16#00 := 16#00;   // Parameter byte0
WriteSlotParam.bBuffer[1] 16#01 := 16#01;   // Parameter byte1
WriteSlotParam.bBuffer[2] 16#02 := 16#02;   // Parameter byte2
WriteSlotParam.bBuffer[3] 16#03 := 16#03;   // Parameter byte3
WriteSlotParam.bBuffer[4] 16#00 := 16#00;   // Parameter byte4
WriteSlotParam.bBuffer[5] 16#00 := 16#00;   // Parameter byte5
WriteSlotParam();
```

(3-2) Create a ReadslotParam sample logic

※ Log-in is required in order to verify that the Write is successful

- bsize : Set the parameter data size to read
- bSlotaddress : Slot Address(if first slot : 1 / if 10 th slot : 10)

```
{ ---------------- Read Slot Parameter -----------------
IF Read_Flag THEN
    MemUtils.memset(ADR(Read_Data[0]), 0, SIZEOF(Read_Data))

    ReadSlotParam.bSlotAddress := 1;    // Slot Address (Fir
    ReadSlotParam.bSize := 6;           // number of bytes !
    ReadSlotParam();

    MemUtils.SysMemCpy(ADR(Read_Data[0]),ADR(ReadSlotParam.k
    Read_Flag := FALSE;
END_IF
```

Read_Data[0]	BYTE	16#00
Read_Data[1]	BYTE	16#01
Read_Data[2]	BYTE	16#02
Read_Data[3]	BYTE	16#03
Read_Data[4]	BYTE	16#00
Read_Data[5]	BYTE	16#00

25.   User DB (ID / PW)

This command configures a new online user and adds this user to the administrator group.
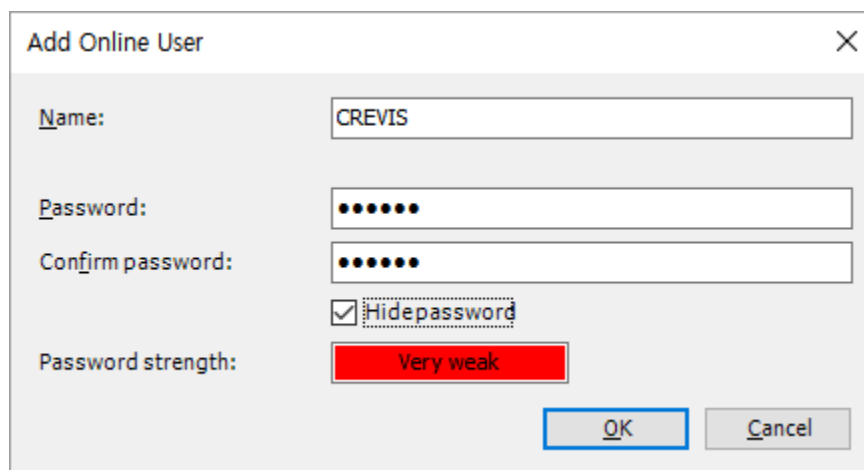
The application is in online mode, and the target system supports online user management.

This command opens the Add Online User dialog box where you define the login data of the new user.
Please use a strong password as follows:

- •   Password length >= 8 characters (best >= 12)
- •   Use uppercase and lowercase
- •   Include numbers
- •   Use special characters
- •   Do not use existing names or sequence of characters that are easy to guess
     (for example, "123", "abc", "qwerty")
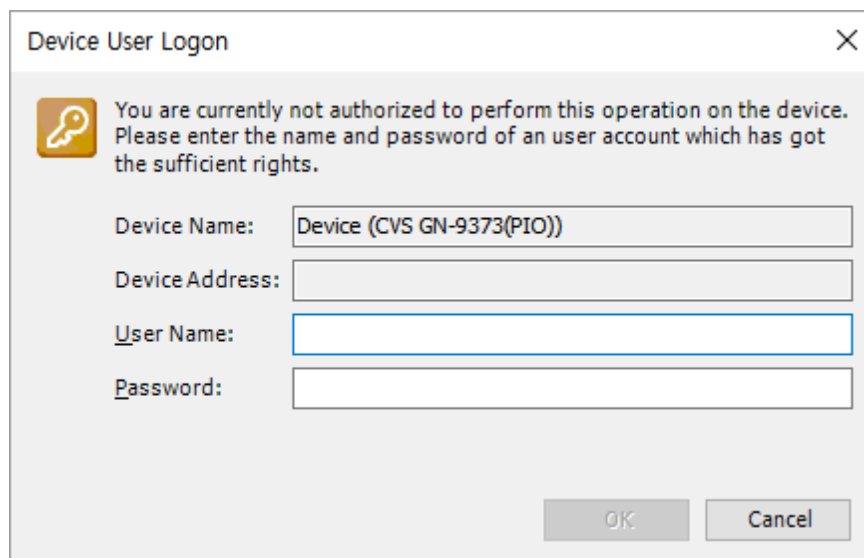
(1) Route: Online → Security → Add Online User

(2) The first time you run the project, you have to log in.

It can be available with GN-9372, GN-9373, GL-9972, GL-9973, GL-9974, GL-9975, GN-9482, GN-9483, M9372, M9373, ML9972, M9973.

26.   Upgrade Firmware

26.1. Using IAP over Ethernet

(1) Apply a power with pushing a reset button(Mod LED will blink Green/Red).
(2) Execute Firefox.(It is recommended to use Firefox)
(3) Connect to 192.168.100.10 and login (User ID :crevis / Password : crevis)
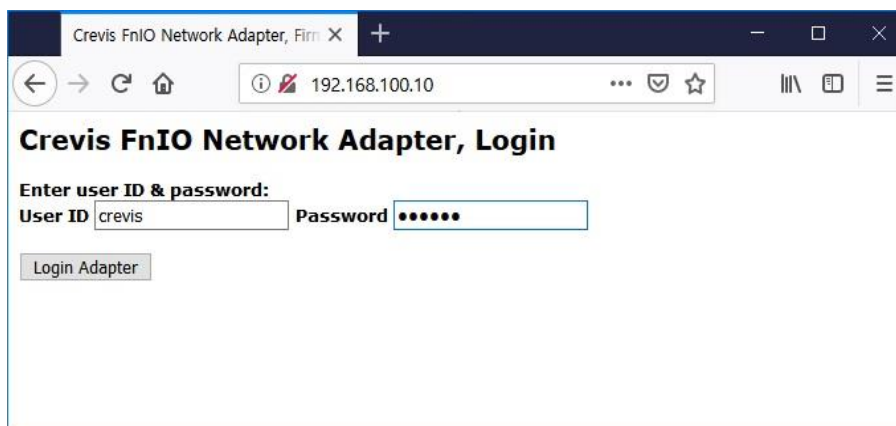
(4) Search the file to download using a search button.
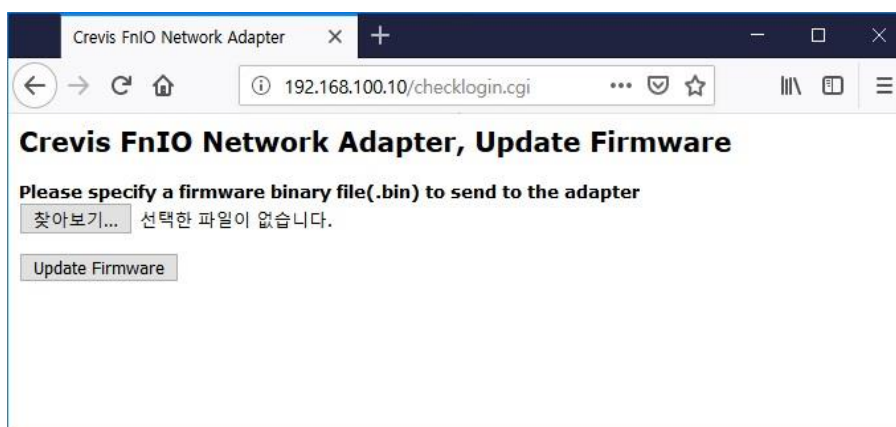
(5) Click a Upload Button.
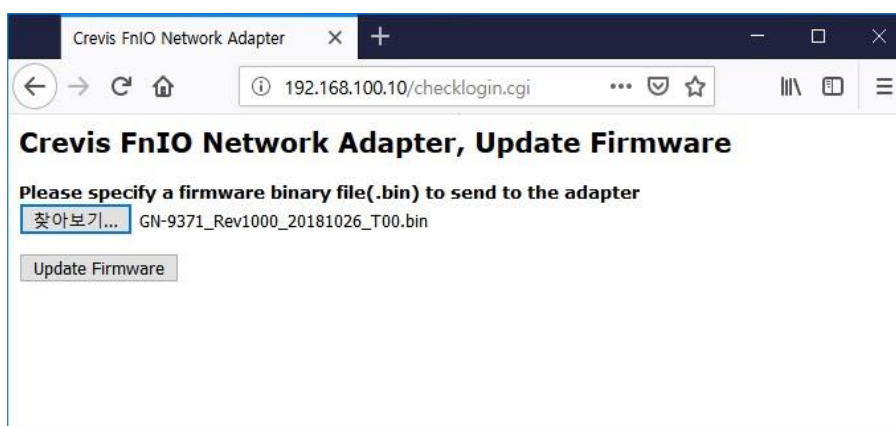
(6) If it finish, you can see a below message (File Upload Done!)
And click a 'Reset Adapter' button.
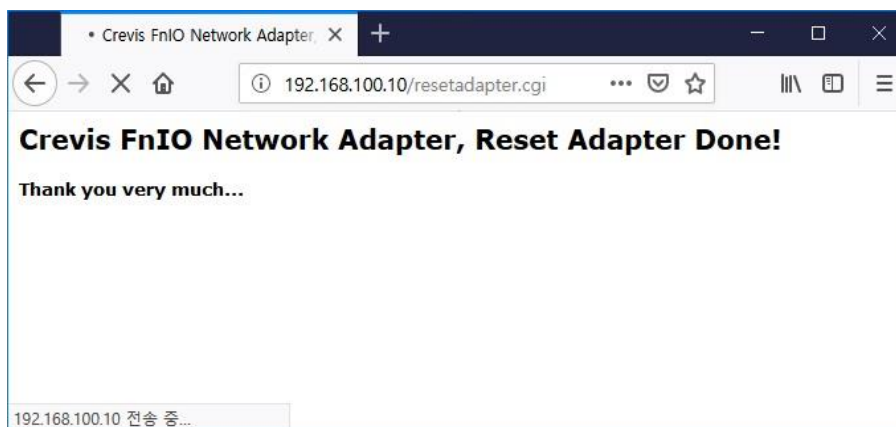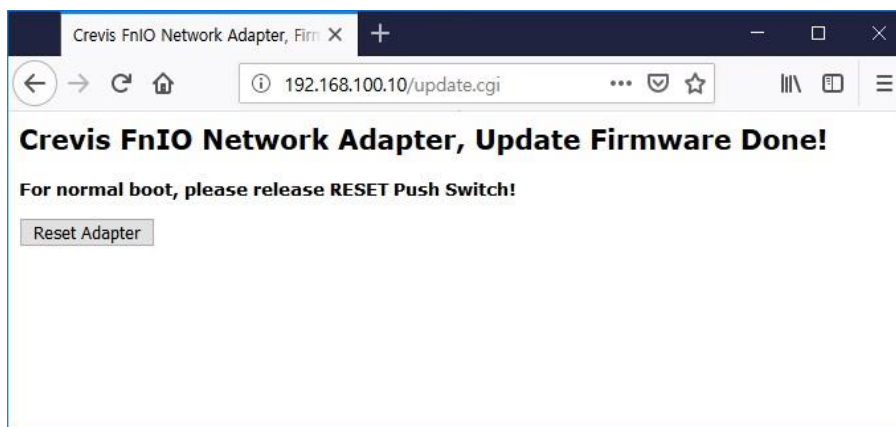
27. CPU Usage

CPU load can be checked as the followings; (and below is an example.)

    (1) PIO RTOS Task Scheduling

Main Tasks related to CPU Usage

PRIORITY	RTOS TASK	DESCIPTION
HIGH	CODESYS PLC	CODESYS Runtime System + PLC Logic (User PLC Program)
MID	IO SCAN	Communicate & Update with Expansion I/O Modules
LOW	OPC UA SERVER	OPC UA server

* Based on the priority of the task, lower-priority tasks will grant the CPU usage only after higher-priority tasks have utilized their required resources.

* CODESYS PLC > IO SCAN > OPC UA SERVER

    (2) CODESYS PLC TASK's CPU Usage

Items relate to PLC Logic

CODESYS_PLC (CPU Usage %)	Default CPU usage + (Remain CPU Usage / Interval * Cycle Time) = 30 + (70 / Interval * Cycle Time)

* The CPU Usage of 'CODESYS PLC TASK' is determined by the following : Default CPU Usage (CODESYS Runtime System) + Interval & Cycle Time in PLC Logic(User PLC Program).

* Default CPU Usage(CODESYS Runtime System) : All processes required for running CODESYS except the User PLC Program. It utilizes a fixed CPU usage of about 30%.

* All tests were conducted on F/W rev 3.003.

28.　Trouble Shooting

A.　How to diagnose by LED indicator

LED Status	Cause	Action
All LED turns off	- No power	- Check main power Cable
	- System power is not supplied.	- Contact Sales team and send module for repair.
MOD LED flashes green	- Failure of initialization EEPROM parameter.	- Contact Sales team and send module for repair.
MOD LED flashes red	- Excess of expansion slot - Excess of IO size - Wrong IO composition - Occurrence of EEPROM checksum error	- Use expansion slot up to 63. - Compose that IO total size is not excess. - Check composition I/O Module
MOD LED is red	- Wrong address ID - Occurrence critical error in firmware	- Contact Sales team and send module for repair.
I/O LED turns off	- Failure of realization expansion Module - None expansion Module	- Check connector status both NA series and expansion module.
I/O LED flashes red	-Failure of configuration baud rate	- Check communication cable with Master - Check power for master.
	-Failure of initialization I/O	- Use expansion slot up to 63. - Compose that IO total size is not excess.
		NA series notice unidentified expansion module ID. Check status of expansion module.
I/O LED is red	-Failure of exchanging I/O data	Check status of expansion IO connection.
RUN LED flashed Green	-PLC program stop	Check the toggle switch is up.
RUN LED flashed red	-Failure of Module Configuration	Check the module hardware and software configurations are the same.

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B. How to diagnose when device couldn't communicate network

Inspection of wrong or omission cable connection.
- Check status of cable connection for each node.
- Check that all color matches between connector and cable.
- Check wire omission.

Terminator resistor

- If terminator resistor is not installed, install terminator resistor
- Check location of terminator resistor

Configuration of Node address

- Check duplication node address.

Configuration of Master

- Check configuration of master
- Check whether to do download or don't
- Check composition is right
  Configuration of communication baud rate
  I/O size
  Configuration of each node

Ground and environment

- Check ground is contacted
- Check environment factor (temperature, humidity, etc.) is in less than regular limit

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APPENDIX A - MODBUS INTERFACE

A.1   MODBUS Interface Register / Bit Map

•   **Register Map**

Start Address	Read/Write	Description	Func. Code
0x0000 ~	Read	Process input image registers (Real Input Register)	4, 23
0x0800 ~	Read/Write	Process output image registers (Real Output Register)	3, 16, 23
0x1000 ~	Read	Adapter Identification special registers.	3, 4, 23
0x1020 ~	Read/Write	Adapter Watchdog, other time special register.	3, 4, 6, 16, 23
0x1100 ~	Read/Write	Adapter Information special registers.	3, 4, 6, 16, 23
0x2000 ~	Read/Write	Expansion Slot Information special registers.	3, 4, 6, 16, 23

   * The special register map must be accessed by read/write of every each address (one address).

•   **Bit Map**

Start Address	Read/Write	Description	Func. Code
0x0000 ~	Read	Process input image bits All input registers area is addressable by bit address. Size of input image bit is size of input image register * 16.	2
0x0800 ~	Read/Write	Process output image bits All output registers area is addressable by bit address. Size of output image bit is size of output image register * 16.	1, 5, 15

A.2   MODBUS Transmission Mode
Two different serial transmission modes are defined: The RTU mode and the ASCII mode. It defines the bit contents of message fields transmitted serially on the line. It determines how information is packed into the message fields and decoded.

A.2.1. RTU Transmission Mode
When devices communicate on a MODBUS serial line using the RTU (Remote Terminal Unit) mode, each 8–bit byte in a message contains two 4–bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode for the same baudrate. Each message must be transmitted in a continuous stream of characters.

Start	Address	Function	Data	CRC Check	End
≥ 3.5 chars	1 char	1 char	Up to 252 chars	2 chars	≥ 3.5 chars

A.2.2. ASCII Transmission Mode

When devices are setup to communicate on a MODBUS serial line using ASCII (American Standard Code for Information Interchange) mode, each 8–bit byte in a message is sent as two ASCII characters. This mode is used when the physical communication link or the capabilities of the device does not allow the conformance with RTU mode requirement regarding timers management.

Start	Address	Function	Data	CRC Check	End
1 char	2 chars	2 chars	Up to 252 chars	2 chars	2 chars CR,LF

A.3   Supported MODBUS Function Codes

Function Code	Function	Description	Unicast / Broadcast
1 (0x01)	Read Coils	Read output bit	Unicast
2 (0x02)	Read Discrete Inputs	Read input bit	Unicast
3 (0x03)	Read Holding Registers	Read output word	Unicast
4 (0x04)	Read Input Registers	Read input word	Unicast
5 (0x05)	Write Single Coil	Write one bit output	Unicast / Broadcast
6 (0x06)	Write Single Register	Write one word output	Unicast / Broadcast
8 (0x08)	Diagnostics (Serial Line only)	Read diagnostic register	Unicast
15 (0x0F)	Write Multiple Coils	Write a number of output bits	Unicast / Broadcast
16 (0x10)	Write Multiple registers	Write a number of output words	Unicast / Broadcast
23 (0x17)	Read / Write Multiple register	Read a number of input words / Write a number of output words	Unicast

-    Refer to MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1a

A.3.1. 1 (0x01) Read Coils

This function code is used to read from 1 to 2000 contiguous status of coils in a remote device. The Request PDU specifies the starting address, i.e. the address of the first coil specified, and the number of coils. In the PDU Coils are addressed starting at zero. Therefore coils numbered 1-16 are addressed as 0-15. The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1= ON and 0= OFF.

•   **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x01	0x01
Starting Address Hi	0x10	0x10
Starting Address Lo	0x00	0x00
Quantity of Outputs Hi	0x00	0x00
Quantity of Outputs Lo	0x0A	0x0A
Error Check (CRC/LRC)	-	0xB8, 0xAB
End of Frame	-	t1-t2-t3

• **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x01	0x01
Byte Count	0x02	0x02
Output Status	0x55	0x55
Output Status	0x02	0x02
Error Check (CRC/LRC)	-	0x8F, 0x6D
End of Frame	-	t1-t2-t3

* In case of address 0x1015~0x1000 output bit value: 00000010_01010101.

A.3.2. 2 (0x02) Read Discrete Inputs
This function code is used to read from 1 to 2000 contiguous status of discrete inputs in a remote device. The Request PDU specifies the starting address, i.e. the address of the first input specified, and the number of inputs. In the PDU Discrete Inputs are addressed starting at zero. Therefore Discrete inputs numbered 1-16 are addressed as 0-15. The discrete inputs in the response message are packed as one input per bit of the data field.
Status is indicated as 1= ON; 0= OFF.

• **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x02	0x02
Starting Address Hi	0x00	0x00
Starting Address Lo	0x00	0x00
Quantity of Inputs Hi	0x00	0x00
Quantity of Inputs Lo	0x0A	0x0A
Error Check (CRC/LRC)	-	0xF8, 0x6B
End of Frame	-	t1-t2-t3

• **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x02	0x02
Byte Count	0x02	0x02
Input Status	0x80	0x80
Input Status	0x00	0x00
Error Check (CRC/LRC)	-	0x50, 0x78
End of Frame	-	t1-t2-t3

- In case of address 0x0015~0x0000 output bit value: 00000000_10000000.

A.3.3. 3 (0x03) Read Holding Registers

This function code is used to read the contents of a contiguous block of holding registers in a remote device. The Request PDU specifies the starting register address and the number of registers. The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

•   **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x03	0x03
Starting Address Hi	0x08	0x08
Starting Address Lo	0x00	0x00
Quantity of Register Hi	0x00	0x00
Quantity of Register Lo	0x02	0x02
Error Check (CRC/LRC)	-	0xC6, 0x0D
End of Frame	-	t1-t2-t3

•   **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x03	0x03
Byte Count	0x04	0x04
Output Register #0 Hi	0x11	0x11
Output Register #0 Lo	0x22	0x22
Output Register #1 Hi	0x33	0x33
Output Register #1 Lo	0x44	0x44
Error Check (CRC/LRC)	-	0x2D, 0xC6
End of Frame	-	t1-t2-t3

-    In case of address 0x0800, 0x0801 output register value: 0x1122, 0x3344.

A.3.4. 4 (0x04) Read Input Registers
This function code is used to read from 1 to approx. 125 contiguous input registers in a remote device. The Request PDU specifies the starting register address and the number of registers. The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

- **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x04	0x04
Starting Address Hi	0x00	0x00
Starting Address Lo	0x00	0x00
Quantity of Register Hi	0x00	0x00
Quantity of Register Lo	0x02	0x02
Error Check (CRC/LRC)	-	0x71, 0xAD
End of Frame	-	t1-t2-t3

- **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x04	0x04
Byte Count	0x04	0x04
Input Register #0 Hi	0x00	0x00
Input Register #0 Lo	0x80	0x80
Input Register #1 Hi	0x00	0x00
Input Register #1 Lo	0x00	0x00
Error Check (CRC/LRC)	-	0x9C, 0x6C
End of Frame	-	t1-t2-t3

- In case of address 0x0000, 0x0001 input register value: 0x0080, 0x0000.

A.3.5. 5 (0x05) Write Single Coil
This function code is used to write a single output to either ON or OFF in a remote device. The
requested ON/OFF state is specified by a constant in the request data field. A value of FF 00 hex
requests the output to be ON. A value of 00 00 requests it to be OFF. All other values are illegal and will
not affect the output.

• **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x05	0x05
Starting Address Hi	0x10	0x10
Starting Address Lo	0x01	0x01
Quantity of Outputs Hi	0xFF	0xFF
Quantity of Outputs Lo	0x00	0x00
Error Check (CRC/LRC)	-	0xD9, 0x5C
End of Frame	-	t1-t2-t3

• **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x05	0x05
Output Address Hi	0x10	0x10
Output Address Lo	0x01	0x01
Output Value Hi	0xFF	0xFF
Output Value Lo	0x00	0x00
Error Check (CRC/LRC)	-	0xD9, 0x5C
End of Frame	-	t1-t2-t3

- Output bit of address 0x1001 turns ON.

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A.3.6. 6 (0x06) Write Single Register
This function code is used to write a single holding register in a remote device. Therefore register numbered 1 is addressed as 0. The normal response is an echo of the request, returned after the register contents have been written.

- **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x06	0x06
Starting Address Hi	0x08	0x08
Starting Address Lo	0x00	0x00
Quantity of Outputs Hi	0x11	0x11
Quantity of Outputs Lo	0x22	0x22
Error Check (CRC/LRC)	-	0x07, 0x85
End of Frame	-	t1-t2-t3

- **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x06	0x06
Output Address Hi	0x08	0x08
Output Address Lo	0x00	0x00
Output Value Hi	0x11	0x11
Output Value Lo	0x22	0x22
Error Check (CRC/LRC)	-	0x07, 0x85
End of Frame	-	t1-t2-t3

- In case of address 0x0800 outputs register value: 0x0000 changes to 0x1122.

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A.3.7. 8 (0x08) Diagnostics

MODBUS function code 08 provides a series of tests for checking the communication system between a client (Master) device and a server (Slave), or for checking various internal error conditions within a server.

The function uses a two–byte sub-function code field in the query to define the type of test to be performed. The server echoes both the function code and sub-function code in a normal response.

Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.

- **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x08	0x08
Sub-Function Hi	0x00	0x00
Sub-Function Lo	0x00	0x00
Data Hi	0x11	0x11
Data Lo	0x22	0x22
Error Check (CRC/LRC)	-	0x6C, 0x24
End of Frame	-	t1-t2-t3

- **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x08	0x08
Sub-Function Hi	0x00	0x00
Sub-Function Lo	0x00	0x00
Data Hi	0x11	0x11
Data Lo	0x22	0x22
Error Check (CRC/LRC)	-	0x6C, 0x24
End of Frame	-	t1-t2-t3

✓ **Sub-function 0x0000(0) Return Query Data**

The data passed in the request data field is to be returned (looped back) in the response.

The entire response message should be identical to the request.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0000(0)	Any	Echo Request Data	

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✓ **Sub-function 0x0001(1) Restart Communications Option**
The remote device could be initialized and restarted, and all of its communications event counters are cleared. Especially, data field 0x55AA makes the remote device to restart with factory default setup of EEPROM.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0001(1)	0x0000, 0xFF00	Echo Request Data	Reset
0x0001(1)	0x55AA + sumcheck	Echo Request Data	Program Reset[1]
0x0001(1)	0x55AA+0xAB7B+sumcheck[3]	Echo Request Data	Factory Reset[1] [2]

1) PLC program will be deleted.
2) IP address, Subnet Mask, Gateway, RS232, RS485 setting and Bootp/DHCP all modes will be the default value based on the factory setting.
3) Refer the A.4.2 sumcheck(0x1006)

✓ **Sub-function 0x000A(10) Clear Counters and Diagnostic Register**
The goal is to clear all counters and the diagnostic register. Counters are also cleared upon power−up.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000A(10)	0x0000	Echo Request Data	

✓ **Sub-function 0x000B(11) Return Bus Message Count**
The response data field returns the quantity of messages that the remote device has detected on the communications system since its last restart, clear counters operation, or power−up.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000B(11)	0x0000	Total Message Count	

✓ **Sub-function 0x000D(13) Return Bus Exception Error Count**
The response data field returns the quantity of MODBUS exception responses returned by the remote device since its last restart, clear counters operation, or power−up.
Exception responses are described and listed in section 6.2.11.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000D(13)	0x0000	Exception Error Count	

✓ **Sub-function 0x000E(14) Return Slave Message Count**
The response data field returns the quantity of messages addressed to the remote device, or broadcast, that the remote device has processed since its last restart, clear counters operation, or power−up.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000E(14)	0x0000	Slave Message Count	

✓ **Sub-function 0x000F(15) Return Slave No Response Count**
The response data field returns the quantity of messages addressed to the remote device for which it has returned no response (neither a normal response nor an exception response), since its last restart, clear counters operation, or power−up.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000F(15)	0x0000	Slave No Response Count	

✓ **Sub-function 0x0064(100) Return Slave MODBUS, Extension module Status**
The response data field returns the status of MODBUS and Extension module addressed to the remote device.

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This status values are identical with status 1word of input process image. Refer to 5.3.1.

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0064(100)	0x0000	MODBUS, Extension module Status	Same as status 1word

A.3.8. 15 (0x0F) Write Multiple Coils
This function code is used to force each coil in a sequence of coils to either ON or OFF in a remote device. The Request PDU specifies the coil references to be forced. Coils are addressed starting at zero. A logical '1' in a bit position of the field requests the corresponding output to be ON. A logical '0' requests it to be OFF.
The normal response returns the function code, starting address, and quantity of coils forced.

- **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x0F	0x0F
Starting Address Hi	0x10	0x10
Starting Address Lo	0x00	0x00
Quantity of Outputs Hi	0x00	0x00
Quantity of Outputs Lo	0x0A	0x0A
Byte Count	0x02	0x02
Output Value #0	0x55	0x55
Output Value #1	0x01	0x01
Error Check (CRC/LRC)	-	0x21, 0XC9
End of Frame	-	t1-t2-t3

- **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x0F	0x0F
Starting Address Hi	0x10	0x10
Starting Address Lo	0x00	0x00
Quantity of Outputs Hi	0x00	0x00
Quantity of Outputs Lo	0x0A	0x0A
Error Check (CRC/LRC)	-	0xD1, 0x6A
End of Frame	-	t1-t2-t3

- In case of address 0x1015~0x1000 output bit value: 00000000_00000000 changes to 00000001_01010101.

A.3.9. 16 (0x10) Write Multiple Registers
This function code is used to write a block of contiguous registers (1 to approx. 120 registers) in a remote device.
The requested written values are specified in the request data field. Data is packed as two bytes per register.
The normal response returns the function code, starting address, and quantity of registers written.

- **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x0F	0x0F
Starting Address Hi	0x08	0x08
Starting Address Lo	0x00	0x00
Quantity of Registers Hi	0x00	0x00
Quantity of Registers Lo	0x02	0x02
Byte Count	0x04	0x04
Register Value #0 Hi	0x11	0x11
Register Value #0 Lo	0x22	0x22
Register Value #1 Hi	0x33	0x33
Register Value #1 Lo	0x44	0x44
Error Check (CRC/LRC)	-	0x3B, 0x12
End of Frame	-	t1-t2-t3

- **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x0F	0x0F
Starting Address Hi	0x08	0x08
Starting Address Lo	0x00	0x00
Quantity of Outputs Hi	0x00	0x00
Quantity of Outputs Lo	0x02	0x02
Error Check (CRC/LRC)	-	0x43, 0xCE
End of Frame	-	t1-t2-t3

- In case of address 0x0800, 0x0801 output register value: 0x0000, 0x0000 changes to 0x1122, 0x3344.

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A.3.10. 23 (0x17) Read/Write Multiple Registers

This function code performs a combination of one read operation and one write operation in a single MODBUS transaction. The write operation is performed before the read. The request specifies the starting address and number of holding registers to be read as well as the starting address, number of holding registers, and the data to be written. The byte count specifies the number of bytes to follow in the write data field.

The normal response contains the data from the group of registers that were read. The byte count field specifies the quantity of bytes to follow in the read data field.

• **Request**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x17	0x17
Read Starting Address Hi	0x08	0x08
Read Starting Address Lo	0x00	0x00
Quantity of Read Hi	0x00	0x00
Quantity of Read Lo	0x02	0x02
Write Starting Address Hi	0x08	0x08
Write Starting Address Lo	0x00	0x00
Quantity of Write Hi	0x00	0x00
Quantity of Write Lo	0x02	0x02
Byte Count	0x04	0x04
Write Reg. Value #0 Hi	0x11	0x11
Write Reg. Value #0 Lo	0x22	0x22
Write Reg. Value #1 Hi	0x33	0x33
Write Reg. Value #1 Lo	0x44	0x44
Error Check (CRC/LRC)	-	0x88, 0x3F
End of Frame	-	t1-t2-t3

• **Response**

Field name	Example	RTU
Start of Frame	-	t1-t2-t3
Slave Address	0x07	0x07
Function Code	0x17	0x17
Byte Count	0x04	0x04
Write Reg. Value #0 Hi	0x11	0x11
Write Reg. Value #0 Lo	0x22	0x22
Write Reg. Value #1 Hi	0x33	0x33
Write Reg. Value #1 Lo	0x44	0x44
Error Check (CRC/LRC)	-	0x2E, 0xD2
End of Frame	-	t1-t2-t3

- In case of address 0x0800, 0x0801 output register value: 0x0000, 0x0000 changes to 0x1122, 0x3344.

A.4   MODBUS Special Register Map

The special register map can be accessed by function code 3, 4, 6 and 16. Also the special register map must be accessed by read/write of every each address (one address).

A.4.1. Adapter Register Mapping

Address	IEC Address	Contents
0x0000~0x07FF	%IW0~%IW2047	2048 words Input and Internal memory (Area is write-protected)
0x0800~0x0FFF	%QW0~%QW2047	2048 words Output and Internal memory (Area is write-enabled)
0x1000~0x1FFF	-	Special Function Register (PIO Information)
0x2000~0x2FFF	-	Special Function Register (Slot Information)
0x4000~0x5FFF	%MW0~%MW8191	2048 words Internal memory (Area is write-enabled)

A.4.2. Adapter Identification Special Register (0x1000, 4096)

Address	Access	Type, Size	Description
0x1000(4096)	Read	1 word	Vendor ID = 0x02E5(741), Crevis. Co., Ltd.
0x1001(4097)	Read	1 word	Device Type = 0x000C, Network Adapter
0x1002(4098)	Read	1 word	Product Code = 0x9100(GN-9371) / 0x9110(GN-9372) / 0x9120(GN-9373)
0x1003(4099)	Read	1 word	Firmware revision, if 0x0101, revision 1.001
0x1005(4101)	Read	String up to 34bytes	Product name string First 1word is length of valid character string Example) response as following "00 1D 52 4E 2D 39 32 32 32 2C 50 72 6F 66 69 62 75 73 20 41 64 61 70 74 65 72 2C 52 42 55 53 00 00 000" Valid character size = 0x0017 =29 characters "GN-9372(PIO)"
0x1006(4102)	Read	1 word	Sum check of EEPROM
0x1010(4112)	Read	2 words	Firmware release date
0x101E(4126)	Read	15words	Composite Id of following address 0xA8C0(Lo_IP Addr),0x3264(Hi_IP Addr),0xFFFF(Lo_NetMask), 0x00FF(Hi_NetMask),0xA8C0(GateWay),0xFE64(GateWay), 0x1400(MacAddr),0x00F7(MacAddr),0xBA83(MacAddr), 0x02E5(VendorCode),0x000C(DeviceType), 0x9120(ProductCode), 0x0200(FW_Rev), 0x0420(FW_ReleasData), 0x2018(FW_ReleasYear)

* String Type consists of valid string length (first 1word) and array of characters.

A.4.4. Adapter Information Special Register (0x1100, 4352)

| Address	Access	Type, Size	Description
0x1102(4354)	Read	1word	Start address of input image word register. =0x0000
0x1103(4355)	Read	1word	Start address of output image word register. =0x0800
0x1104(4356)	Read	1word	Size of input image word register.
0x1105(4357)	Read	1word	Size of output image word register.
0x1106(4358)	Read	1word	Start address of input image bit. = 0x0000
0x1107(4359)	Read	1word	Start address of output image bit. =0x1000
0x1108(4360)	Read	1word	Size of input image bit.
0x1109(4361)	Read	1word	Size of output image bit.
0x110D(4365)	Read/Write	1word	Field Power On/OFF, Run/Stop Switch, Reset Switch *Field Power On : 0x8010 / Field Power Off : 0x0000 *Stop : 0x0000 / Run : 0x0001 / Reset Switch : 0x0002 ex) 0x8013 : Field Power On + Run + Reset Switch ON
0x110E(4366)	Read	Up to 64 words	Expansion slot's GT-number If the PIO is connected with GT-222F and GT-123F, then 0x222F 0x123F
0x1110(4368)	Read	1word	Number of expansion slot
0x1113(4371)	Read	Up to 64 words	Expansion slot Module Id. Refer to Appendix A.1 Product List. First 1word is adapter's module id.
0x111E(4382)	Read	1word	Reserved. Adapter IO identification vendor code.

* After the system is reset, the new "Set Value" action is applied.
* If the slot location is changed, set default value automatically (all expansion slots are live).

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A.4.5. Adapter Setting Special Register (0x1600, 5632)

Address	Access	Type, Size	Description
0x1600(5632)	Read	2words	IP Address. (ex : C0A8 6464 = 192.168.100.100)
0x1602(5634)	Read	2words	Subnet Mask. (ex : FFFF FF00 = 255.255.255.0)
0x1604(5636)	Read	2words	Gate way. (ex : C0A8 0001 = 192.168.0.1)
0x1606(5638)	Read/Write	1word	RS-232 Baudrate. (2400bps~115200bps) 0 : 115200(Default) 1 : 2400 2 : 4800 3 : 9600 4 : 19200 5 : 38400 6 : 57600 7 : 115200
0x1607(5639)	Read/Write	1word	RS-232 Setting. - 1 nibble : Data bit(0 : 8bit(default), 1 : 9bit) - 2 nibble : Stop bit(0 : 1bit(default), 1 : 2bit) - 3 nibble : Parity bit(0 : none(default), 1: odd, 2 : even) - 4 nibble : Reserve
0x1608(5640)	Read/Write	1word	RS-485 Baudrate. (2400bps~115200bps) 0 : 115200(Default) 1 : 2400 2 : 4800 3 : 9600 4 : 19200 5 : 38400 6 : 57600 7 : 115200
0x1609(5641)	Read/Write	1word	RS-485 Setting. - 1 nibble : Data bit(0 : 8bit(default), 1 : 9bit) - 2 nibble : Stop bit(0 : 1bit(default), 1 : 2bit) - 3 nibble : Parity bit(0 : none(default), 1: odd, 2 : even) - 4 nibble : Reserve
0x160A(5642)	Read/Write	1word	MODBUS Station. - High 1byte : Station No. of RS-232C (default : 1) - Low 1byte : Station No. of RS-485 (default : 1)
0x160B(5643)	Read/Write	1word	IP Setting Method. - Not Use : 0x0000 - BootP : 0x8000 (default) - DHCP : 0x8001
0x1610(5648)	Read	3words	Mac Address (ex : 0014 F700 0101 = 00.14.F7.00.01.01)
0x1614(5652)*	Read/Write	1word	Serial connection Method - 0x0000 : CREVIS Modbus/RTU(Default) - 0x8000 : RS232 Enable for CODESYS Function block - 0x8001 : RS485 Enable for CODESYS Function block - 0x8002 : RS232/RS485 Enable at the same time for CODESYS Function block / RTU Master
0x1620(5664)	Read/Write	4words	RTC - 1 word : 00ss (ss : sec) - 2 word : hhmm (hh : hour, mm : min) - 3 word : mmdd (mm : month, dd : day) - 4 word : yyyy (yyyy : year) (ex : 0010 0F28 0317 07E0 = 2016 - 03.23 - 15:40 - 16)

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*RS-232C/485 Setting : This description for 0x1607/0x1609 register with bit.
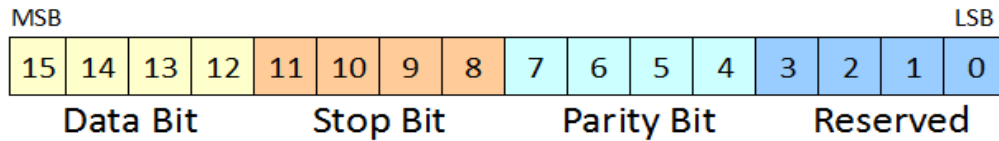
**Modbus Station : This description for 0x160A register with bit.
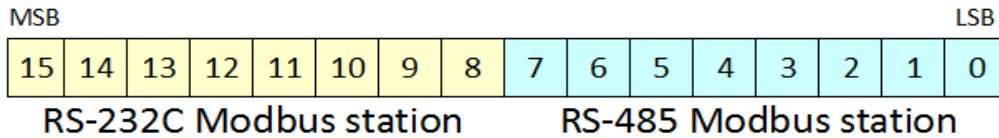
A.4.6. Expansion Slot Information Special Register (0x2000, 8192)
Each expansion slot has 0x20(32) address offset and same information structure.

Slot#1	0x2000(8192)~0x201F(8223)	Slot#2	0x2020(8224)~0x203F(8255)
Slot#3	0x2040(8256)~0x205F(8287)	Slot#4	0x2060(8288)~0x207F(8319)
Slot#5	0x2080(8320)~0x209F(8351)	Slot#6	0x20A0(8352)~0x20BF(8383)
Slot#7	0x20C0(8384)~0x20DF(8415)	Slot#8	0x20E0(8416)~0x20FF(8447)
Slot#9	0x2100(8448)~0x211F(8479)	Slot#10	0x2120(8480)~0x213F(8511)
Slot#11	0x2140(8512)~0x215F(8543)	Slot#12	0x2160(8544)~0x217F(8575)
Slot#13	0x2180(8576)~0x219F(8607)	Slot#14	0x21A0(8608)~0x21BF(8639)
Slot#15	0x21C0(8640)~0x21DF(8671)	Slot#16	0x21E0(8672)~0x21FF(8703)
Slot#17	0x2200(8704)~0x221F(8735)	Slot#18	0x2220(8736)~0x223F(8767)
Slot#19	0x2240(8768)~0x225F(8799)	Slot#20	0x2260(8800)~0x227F(8831)
Slot#21	0x2280(8832)~0x229F(8863)	Slot#22	0x22A0(8864)~0x22BF(8895)
Slot#23	0x22C0(8896)~0x22DF(8927)	Slot#24	0x22E0(8928)~0x22FF(8959)
Slot#25	0x2300(8960)~0x231F(8991)	Slot#26	0x2320(8992)~0x233F(9023)
Slot#27	0x2340(9024)~0x235F(9055)	Slot#28	0x2360(9056)~0x237F(9087)
Slot#29	0x2380(9088)~0x239F(9119)	Slot#30	0x23A0(9120)~0x23BF(9151)
Slot#31	0x23C0(9152)~0x23DF(9183)	Slot#32	0x23E0(9184)~0x23FF(9215)
Slot#33	0x2400(9216)~0x241F(9247)	Slot#34	0x2420(9248)~0x243F(9279)
Slot#35	0x2440(9280)~0x245F(9311)	Slot#36	0x2460(9312)~0x247F(9343)
Slot#37	0x2480(9344)~0x249F(9375)	Slot#38	0x24A0(9376)~0x24BF(9407)
Slot#39	0x24C0(9408)~0x24DF(9439)	Slot#40	0x24E0(9440)~0x24FF(9471)
Slot#41	0x2500(9472)~0x251F(9503)	Slot#42	0x2520(9504)~0x253F(9535)
Slot#43	0x2540(9536)~0x255F(9567)	Slot#44	0x2560(9568)~0x257F(9599)
Slot#45	0x2580(9600)~0x259F(9631)	Slot#46	0x25A0(9632)~0x25BF(9663)
Slot#47	0x25C0(9664)~0x25DF(9695)	Slot#48	0x25E0(9696)~0x25FF(9727)
Slot#49	0x2600(9728)~0x261F(9759)	Slot#50	0x2620(9760)~0x263F(9791)
Slot#51	0x2640(9792)~0x265F(9823)	Slot#52	0x2660(9824)~0x267F(9855)
Slot#53	0x2680(9856)~0x269F(9887)	Slot#54	0x26A0(9888)~0x26BF(9919)
Slot#55	0x26C0(9920)~0x26DF(9951)	Slot#56	0x26E0(9952)~0x26FF(9983)
Slot#57	0x2700(9984)~0x271F(10015)	Slot#58	0x2720(10016)~0x273F(10047)
Slot#59	0x2740(10048)~0x275F(10079)	Slot#60	0x2760(10080)~0x277F(10111)
Slot#61	0x2780(10112)~0x279F(10143)	Slot#62	0x27A0(10144)~0x27BF(10175)
Slot#63	0x27C0(10176)~0x27DF(10207)		

Address Offset	Expansion Slot#1	Expansion Slot#2	Expansion Slot#3	……..	Expansion Slot#62	Expansion Slot#63
+ 0x00(+0)	0x2000(8192)	0x2020(8224)	0x2040(8256)	…….	0x27A0(9120)	0x27C0(9152)
+ 0x01(+1)	0x2001(8193)	0x2021(8225)	0x2041(8257)	…….	0x27A1(9121)	0x27C1(9153)
+ 0x02(+2)	0x2002(8194)	0x2022(8226)	0x2042(8258)	…….	0x27A2(9122)	0x27C2(9154)
+ 0x03(+3)	0x2003(8195)	0x2023(8227)	0x2043(8259)	…….	0x27A3(9123)	0x27C3(9155)
+ 0x04(+4)	0x2004(8196)	0x2024(8228)	0x2044(8260)	…….	0x27A4(9124)	0x27C4(9156)
+ 0x05(+5)	0x2005(8197)	0x2025(8229)	0x2045(8261)	…….	0x27A5(9125)	0x27C5(9157)
+ 0x06(+6)	0x2006(8198)	0x2026(8230)	0x2046(8262)	…….	0x27A6(9126)	0x27C6(9158)
+ 0x07(+7)	0x2007(8199)	0x2027(8231)	0x2047(8263)	…….	0x27A7(9127)	0x27C7(9159)
+ 0x08(+8)	0x2008(8200)	0x2028(8232)	0x2048(8264)	…….	0x27A8(9128)	0x27C8(9160)
+ 0x09(+9)	0x2009(8201)	0x2029(8233)	0x2049(8265)	…….	0x27A9(9129)	0x27C9(9161)
+ 0x0A(+10)	0x200A(8202)	0x202A(8234)	0x204A(8266)	…….	0x27AA(9130)	0x27CA(9162)
+ 0x0B(+11)	0x200B(8203)	0x202B(8235)	0x204B(8267)	…….	0x27AB(9131)	0x27CB(9163)
+ 0x0C(+12)	0x200C(8204)	0x202C(8236)	0x204C(8268)	…….	0x27AC(9132)	0x27CC(9164)
+ 0x0D(+13)	0x200D(8205)	0x202D(8237)	0x204D(8269)	…….	0x27AD(9133)	0x27CD(9165)
+ 0x0E(+14)	0x200E(8206)	0x202E(8238)	0x204E(8270)	…….	0x27AE(9134)	0x27CE(9166)
+ 0x0F(+15)	0x200F(8207)	0x202F(8239)	0x204F(8271)	…….	0x27AF(9135)	0x27CF(9167)
+ 0x10(+16)	0x2010(8208)	0x2030(8240)	0x2050(8272)	…….	0x27B0(9136)	0x27D0(9168)
+ 0x11(+17)	0x2011(8209)	0x2031(8241)	0x2051(8273)	…….	0x27B1(9137)	0x27D1(9169)
+ 0x12(+18)	0x2012(8210)	0x2032(8242)	0x2052(8274)	…….	0x27B2(9138)	0x27D2(9170)
+ 0x13(+19)	0x2013(8211)	0x2033(8243)	0x2053(8275)	…….	0x27B3(9139)	0x27D3(9171)
+ 0x14(+20)	0x2014(8212)	0x2034(8244)	0x2054(8276)	…….	0x27B4(9140)	0x27D4(9172)
+ 0x15(+21)	0x2015(8213)	0x2035(8245)	0x2055(8277)	…….	0x27B5(9141)	0x27D5(9173)
+ 0x16(+22)	0x2016(8214)	0x2036(8246)	0x2056(8278)	…….	0x27B6(9142)	0x27D6(9174)
+ 0x17(+23)	0x2017(8215)	0x2037(8247)	0x2057(8279)	…….	0x27B7(9143)	0x27D7(9175)
+ 0x18(+24)	0x2018(8216)	0x2038(8248)	0x2058(8280)	…….	0x27B8(9144)	0x27D8(9176)
+ 0x19(+25)	0x2018(8217)	0x2038(8249)	0x2058(8281)	…….	0x27B9(9145)	0x27D9(9177)
+ 0x1A(+26)	0x201A(8218)	0x203A(8250)	0x205A(8282)	…….	0x27BA(9146)	0x27DA(9178)
+ 0x1B(+27)	0x201B(8219)	0x203B(8251)	0x205B(8283)	…….	0x27BB(9147)	0x27DB(9179)
+ 0x1C(+28)	0x201C(8220)	0x203C(8252)	0x205C(8284)	…….	0x27BC(9148)	0x27DC(9180)
+ 0x1D(+29)	0x201D(8221)	0x203D(8253)	0x205D(8285)	…….	0x27BD(9149)	0x27DD(9181)
+ 0x1E(+30)	0x201E(8222)	0x203E(8254)	0x205E(8286)	…….	0x27BE(9150)	0x27DE(9182)
+ 0x1F(+31)	0x201F(8223)	0x203F(8255)	0x205F(8287)	…….	0x23BF(9151)	0x27DF(9183)

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Address Offset	Access	Type, Size	Description
+ 0x00(+0)	Read	1word	Slot module id. Refer to Appendix A.1 Product List.
+ 0x02(+2) **	Read	1word	Input start register address of input image word this slot.
+ 0x03(+3) **	Read	1word	Input word's bit offset of input image word this slot.
+ 0x04(+4) **	Read	1word	Output start register address of output image word this slot.
+ 0x05(+5) **	Read	1word	Output word's bit offset of output image word this slot.
+ 0x06(+6) **	Read	1word	Input bit start address of input image bit this slot.
+ 0x07(+7) **	Read	1word	Output bit start address of output image bit this slot.
+ 0x08(+8) **	Read	1word	Size of input bit this slot
+ 0x09(+9) **	Read	1word	Size of output bit this slot
+ 0x0A(+10)**	Read	n words	Read input data this slot
+ 0x0B(+11)**	Read/Write	n words	Read/write output data this slot
+ 0x0E(+14)	Read	1word	GT-number, if GT-22CA, returns 0x22CA
+ 0x0F(+15)	Read	String Up to 72bytes	First 1word is length of valid character string. If GT-22CA, returns "00 1C 47 54 2D 32 32 43 41 2C 20 33 32 44 4F 2C 20 32 34 56 64 63 2C 20 53 6F 75 72 63 65 " Valid character size = 0x001E =30 characters, "GT-22CA, 32DO, 24Vdc, Source"
+ 0x10(+16)	Read	1word	Size of configuration parameter byte
+ 0x11(+17)**	Read/Write	n words	Read/write Configuration parameter data, up to 8byte. ***
+ 0x17(+23)	Read	1word	Firmware Revision
+ 0x18(+24)	Read	1word	Expansion Module Revision
+ 0x19(+25)	Read	2word	Firmware release data

*   After the system is reset, the new "Set Value" action is applied.

**   Nothing of output, input, and memory or configuration parameter corresponding slot returns Exception 02.

*** Slot Configuration parameter saved by internal EEPROM during power cycle until slot position changed.

*** All of output modules and special modules have the slot configuration parameter data. Refer to Document.
    (FnIO_Configuration_Parameter_Memory_Register_Rev1.01)

• **IO Data Code Format (1 word)**

Item	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0	Word
Field	Output IO code								Input IO code								
Field	Date Type		Data Length						Date Type		Data Length						
Example)																	
ST-3214	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0x0084
ST-1224	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0x00C4
ST-1228	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0x0041
ST-4123	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0x8200
ST-221F	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0x4200
ST-2324	1	1	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0xC4C4

Input/output Data Type: 0 0: No I/O Data / 0 1: Byte Data / 1 0: Word Data / 1 1: Bit Data

Input/output Data Length: 0 0 0 0 0 0 0: 0 Bit/Byte/Word / 0 0 0 0 0 0 1: 1 Bit/Byte/Word / 0 0 0 0 0 1 0: 2 Bit/Byte/Word
               0 0 0 0 0 1 1: 3 Bit/Byte/Word / 0 0 0 0 0 1 1: 3 Bit/Byte/Word

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A.5   Example

A.5.1. Example of Input Process Image(Input Register) Map

Input image data depends on slot position and expansion slot data type. Input process image data is only ordered by expansion slot position when input image mode is uncompressed (mode 0, 2). But, when input image mode is compressed (mode 1, 3), input process image data is ordered by expansion slot position and slot data type. Input process image mode can be set by special register 0x1114(4372). Refer to 6.3.3.

- **For example slot configuration**

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete input
#2	8-discrete input
#3	4-analog input
#4	16-discrete input
#5	4-discrete input
#6	8-discrete input
#7	4-discrete input
#8	4-analog input

- **Input Process Image Mode#0** (Status(1word) + Uncompressed Input Processing Data)

Status (1word)

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	0	0	0	0	0	0	0	FP	Internal protocol Status						
0x0001	Discrete In 8pts (Slot#2)								Empty, Always 0				Discrete In 4pts (Slot#1)			
0x0002	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0003	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0004	Analog Input Ch2 high byte (Slot#3)								Analog Input Ch2 low byte (Slot#3)							
0x0005	Analog Input Ch3 high byte (Slot#3)								Analog Input Ch3 low byte (Slot#3)							
0x0006	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0007	Discrete In 8pts (Slot#6)								Empty, Always 0				Discrete In 4pts (Slot#5)			
0x0008	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0				Discrete In 4pts (Slot#7)			
0x0009	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0010	Analog Input Ch2 low byte (Slot#8)								Analog Input Ch1 high byte (Slot#8)							
0x0011	Analog Input Ch3 low byte (Slot#8)								Analog Input Ch2 high byte (Slot#8)							
0x0012									Analog Input Ch3 high byte (Slot#8)							

✓ **Expansion Module Status :**

0: Normal Operation   1: Internal protocol Standby
2: Internal protocol Communication Fault   3: Slot Configuration Failed
4: No Expansion Slot

✓ **FP (Field Power) :**

0: 24Vdc Field Power On.   1: 24Vdc Field Power Off

✓ **EW (MODBUS Error Watchdog) :**

0: No Error Watchdog   1: Error Watchdog once more since its last restart, clear counters operation, or power-up.

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- **Input Process Image Mode#1** (Status(1word) + Compressed Input Processing Data)

Status (1word)

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	0	0	0	0	0	0	0	FP	Internal protocol Status						
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Analog Input Ch2 high byte (Slot#3)								Analog Input Ch2 low byte (Slot#3)							
0x0004	Analog Input Ch3 high byte (Slot#3)								Analog Input Ch3 low byte (Slot#3)							
0x0005	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0006	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0007	Analog Input Ch2 high byte (Slot#8)								Analog Input Ch2 low byte (Slot#8)							
0x0008	Analog Input Ch3 high byte (Slot#8)								Analog Input Ch3 low byte (Slot#8)							
0x0009	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0010	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0011					Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

✓ **Input Assembly Priority :**
1) Analog Input Data (Word type)
2) 8 or 16 points Discrete Input Data (Byte type)
3) 4 points Input Data (Bit type)
4) 2 points Input Data (Bit type)

- **Input Process Image Mode#2** (Uncompressed Input Processing Data without Status), Default Input Image

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Discrete In 8pts (Slot#2)								Empty, Always 0				Discrete In 4pts (Slot#1)			
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Analog Input Ch2 high byte (Slot#3)								Analog Input Ch2 low byte (Slot#3)							
0x0004	Analog Input Ch3 high byte (Slot#3)								Analog Input Ch3 low byte (Slot#3)							
0x0005	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0006	Discrete In 8pts (Slot#6)								Empty, Always 0				Discrete In 4pts (Slot#5)			
0x0007	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0				Discrete In 4pts (Slot#7)			
0x0008	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0009	Analog Input Ch2 low byte (Slot#8)								Analog Input Ch1 high byte (Slot#8)							
0x0010	Analog Input Ch3 low byte (Slot#8)								Analog Input Ch2 high byte (Slot#8)							
0x0011									Analog Input Ch3 high byte (Slot#8)							

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• **Input Process Image Mode#3** (Compressed Input Processing Data without Status)

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0001	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0002	Analog Input Ch2 high byte (Slot#3)								Analog Input Ch2 low byte (Slot#3)							
0x0003	Analog Input Ch3 high byte (Slot#3)								Analog Input Ch3 low byte (Slot#3)							
0x0004	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0005	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0006	Analog Input Ch2 high byte (Slot#8)								Analog Input Ch2 low byte (Slot#8)							
0x0007	Analog Input Ch3 high byte (Slot#8)								Analog Input Ch3 low byte (Slot#8)							
0x0008	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0009	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0010					Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

* S-Series uses the byte-oriented register mapping.

* Size of input image bit is size of input image register *16.

✓ **Input Assembly Priority :**
1) Analog Input Data (Word type)
2) 8 or 16 points Discrete Input Data (Byte type)
3) 4 points Input Data (Bit type)
4) 2 points Input Data (Bit type)

A.5.2. Example of Output Process Image(Output Register) Map

Output image data depends on slot position and expansion slot data type. Output process image data is only ordered by expansion slot position when output image mode is uncompressed (mode 0). But, when output image mode is compressed (mode 1), output process image data is ordered by expansion slot position and slot data type.

Output process image mode can be set by special register 0x1115(4373). Refer to 6.3.3.

- **For example slot configuration**

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete output
#2	8-discrete output
#3	4-analog output
#4	16-discrete output
#5	4-discrete output
#6	8-discrete output
#7	4-analog output
#8	4-discrete output

- **Output Process Image Mode#0** (Uncompressed Output Processing Data), **default output image**

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Discrete out 8pts (Slot#2)								Empty, Don't care				Discrete out 4pts (Slot#1)			
0x0801	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0802	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0803	Analog out Ch2 high byte (Slot#3)								Analog out Ch2 low byte (Slot#3)							
0x0804	Analog out Ch3 high byte (Slot#3)								Analog out Ch3 low byte (Slot#3)							
0x0805	Discrete out high 8pts (Slot#4)								Discrete out low 8pts (Slot#4)							
0x0806	Discrete out 8pts (Slot#6)								Empty, Don't care				Discrete out 4pts (Slot#5)			
0x0807	Analog out Ch0 high byte (Slot#7)								Analog out Ch0 low byte (Slot#7)							
0x0808	Analog out Ch1 high byte (Slot#7)								Analog out Ch1 low byte (Slot#7)							
0x0809	Analog out Ch2 high byte (Slot#7)								Analog out Ch2 low byte (Slot#7)							
0x0810	Analog out Ch3 high byte (Slot#7)								Analog out Ch3 low byte (Slot#7)							
0x0811	Empty, Don't care								Empty, Don't care				Discrete out 4pts (Slot#8)			

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- **Output Process Image Mode#1** (Compressed Output Processing Data)

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0801	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0802	Analog out Ch2 high byte (Slot#3)								Analog out Ch2 low byte (Slot#3)							
0x0803	Analog out Ch3 high byte (Slot#3)								Analog out Ch3 low byte (Slot#3)							
0x0804	Analog out Ch0 high byte (Slot#7)								Analog out Ch0 low byte (Slot#7)							
0x0805	Analog out Ch1 high byte (Slot#7)								Analog out Ch1 low byte (Slot#7)							
0x0806	Analog out Ch2 high byte (Slot#7)								Analog out Ch2 low byte (Slot#7)							
0x0807	Analog out Ch3 high byte (Slot#7)								Analog out Ch3 low byte (Slot#7)							
0x0808	Discrete out low 8pts (Slot#4)								Discrete out 8pts (Slot#2)							
0x0809	Discrete out 8pts (Slot#6)								Discrete out high 8pts (Slot#4)							
0x0810	Empty, Don't care				Discrete out 4pts (Slot#8)				Discrete out 4pts (Slot#5)				Discrete out 4pts (Slot#1)			

* S-Series uses the byte-oriented register mapping.
* Size of input image bit is size of input image register *16.

✓ **Output Assembly Priority :**
   1) Analog Output Data (Word type)
   2) 8 or 16 points Discrete Output Data (Byte type)
   3) 4 points Output Data (Bit type)
   4) 2 points Output Data (Bit type)

A.6   MODBUS Reference

MODBUS Reference Documents
          http://www.Modbus.org

MODBUS Tools
          http://www.Modbustools.com,   MODBUS poll
          http://www.win-tech.com,   MODSCAN32

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APPENDIX B - Product List

No.	Module Lists	Description	ID (Hex)
1	GT-1138	DI 8 PTs, Universal (Sink or Source), 3.3Vdc / 5Vdc, 10RTB	1138
2	GT-1238	DI 8 PTs, Universal (Sink or Source), 24Vdc, 10RTB	1238
3	GT-1258	DI 8PTs, Proximity Sensor Type, 24Vdc, 18RTB (Detecting Open/Short/On-Off States)	1258
4	GT-1278	DI 8 PTs, Sink, 24Vdc, 6mA, 24Vdc, 18RTB (proximity sensor type)	1278
5	GT-1288	DI 8 PTs, Source, 24Vdc, 6mA, 3wire supporting 4 PTs, 0Vdc/ 4 PTs, 24Vdc, 18RTB	1288
6	GT-121F	DI 16 PTs, Sink, 24Vdc, 20P Connector	121F
7	GT-122F	DI 16 PTs, Source, 24Vdc, 20P Connector	122F
8	GT-123F	DI 16 PTs, Universal (Sink or Source), 24Vdc, 20P Connector	123F
9	GT-12DF	DI 16 PTs, Universal (Sink or Source), 24Vdc, 18RTB	12DF
10	GT-12FA	DI 32 PTs, Universal (Sink or Source), 24Vdc, 40P Connector	12FA
11	GT-127F	DI 16 PTs, Sink, 24Vdc, 6mA, 24Vdc, 18RTB (proximity sensor type)	127F
12	GT-1358	DI 8 PTs, Sink, 24Vdc, 3wire supporting 4 PTs 0Vdc/ 4 PTs 24Vdc, 18RTB	1358
13	GT-1368	DI 8 PTs, Source, 24Vdc, 3wire supporting 4 PTs 0Vdc/ 4 PTs 24Vdc, 18RTB	1368
14	GT-1428	DI 8 PTs Sink, DO 8 PTs Source, Diagnostic, 24Vdc/0.5A, 18RTB	1428
15	GT-15DF	DI 16 PTs, Universal, 12Vdc, 18RTB	15DF
16	GT-1658	DI 8PTs, Proximity Sensor Type, 8.2Vdc, 18RTB (Detecting Open/Short/On-Off States)	1658
17	GT-1B7F	DI Sink, DO Source, selecting Input or Output for each 16 PTs, 24Vdc, 0.3A, 18RTB	1B7F
18	GT-1B8F	DI Source, DO Sink, selecting Input or Output for each 16 PTs, 24Vdc, 0.3A, 18RTB	1B8F
19	GT-1C18	DI Sink, DO Source, Combination, 16 PTs, 5Vdc, 18RTB	1C18
20	GT-1604	DI 4 PTs, 24Vac, 10RTB	1604
21	GT-1704	DI 4 PTs, 48Vac, 10RTB	1704
22	GT-1804	DI 4 PTs, 120Vac, 10RTB	1804
23	GT-1904	DI 4 PTs, 240Vac, 10RTB	1904
24	GT-1E7F	DI Sink, DO Source, selecting Input or Output for each 16 PTs, 24Vdc, ERNI Connector	1E7F
25	GT-1E8F	DI Source, DO Sink, selecting Input or Output for each 16 PTs, 24Vdc, ERNI Connector	1E8F
26	GT-1EBA	DI 16 PTs, Sink / DO 16 PTs, Source, 24Vdc, ERNI Connector	1EBA
27	GT-1ECA	DI 16 PTs, Source / DO 16 PTs, Sink, 24Vdc, ERNI Connector	1ECA
28	GT-1E1A	DI 32 PTs, Sink, 24Vdc, ERNI Connector	1E1A
29	GT-1E2A	DI 32 PTs, Source, 24Vdc, ERNI Connector	1E2A
30	GT-2318	DO 8 PTs, Sink, 24Vdc/0.5A, 10RTB	2318
31	GT-2338	DO 8 PTs, Sink, 24Vdc/2.0A, 10RTB (non short circuit protection)	2338
32	GT-2328	DO 8 PTs, Source, 24Vdc/0.5A, 10RTB	2328
33	GT-2348	DO 8 PTs, Source, 24Vdc/2.0A, 10RTB (non short circuit protection)	2348
34	GT-2358	DO 8 PTs, Sink, 24Vdc/0.5A, Multi-Com, 18RTB (Max. 4A)	2358
35	GT-2368	DO 8 PTs, Source, 24Vdc/0.5A, Multi-Com, 18RTB (Max. 4A)	2368
36	GT-2378	DO 8 PTs, Sink, 24Vdc/2.0A, Multi-Com, 18RTB	2378

37	GT-2388	DO 8 PTs, Source, 24Vdc/2.0A, Multi-Com, 18RTB	2388
38	GT-221F	DO 16 PTs, Sink, 24Vdc/0.3A, 20P Connector	221F
39	GT-223F	DO 16 PTs, Sink, 24Vdc/0.3A, 20P Connector (non short circuit protection)	223F
40	GT-222F	DO 16 PTs, Source, 24Vdc/0.3A, 20P Connector	222F
41	GT-224F	DO 16 PTs, Source, 24Vdc/0.3A, 20P Connector (non short circuit protection)	224F
42	GT-225F	DO 16 PTs, Sink, 24Vdc/0.3A, 18RTB	225F
43	GT-227F	DO 16 PTs, Sink, 24Vdc/2.0A, 18RTB (non short circuit protection)	227F
44	GT-226F	DO 16 PTs, Source, 24Vdc/0.3A, 18RTB	226F
45	GT-228F	DO 16 PTs, Source, 24Vdc/2.0A, 18RTB (non short circuit protection)	228F
46	GT-22BA	DO 32 PTs, Sink, 24Vdc/0.3A, 40P Connector	22BA
47	GT-22DA	DO 32 PTs, Sink, 24Vdc/0.3A, 40P Connector (non short circuit protection)	22DA
48	GT-22CA	DO 32 PTs, Source, 24Vdc/0.3A, 40P Connector	22CA
49	GT-22EA	DO 32 PTs, Source, 24Vdc/0.3A, 40P Connector (non short circuit protection)	22EA
50	GT-2418	DO 8 PTs, Sink, Diagnostic, 24Vdc/0.5A, 18RTB	2418
51	GT-2428	DO 8 PTs, Source, Diagnostic, 24Vdc/0.5A, 18RTB	2428
52	GT-2438	DO 8 PTs, Sink, Diagnostic, 24Vdc/2.0A, 18RTB (non short circuit protection)	2438
53	GT-2448	DO 8 PTs, Source, Diagnostic, 24Vdc/2.0A, 18RTB (non short circuit protection)	2448
54	GT-2618	DO 8 PTs, Sink, 24Vdc/2A, 10RTB	2618
55	GT-2628	DO 8 PTs, Source, 24Vdc/2A, 10RTB	2628
56	GT-2734	MOS Relay, 4 PTs, 240Vdc/ac, 0.5A, 10RTB (Solid State Relay)	2734
57	GT-2738	MOS Relay, 8 PTs, 240Vdc/ac, 0.5A, 18RTB (Solid State Relay)	2738
58	GT-2744	Relay Output 4 PTs, 24Vdc/2A, 240Vac/2A, 10RTB	2744
59	GT-2764	MOS Relay, 4 PTs, 24Vdc/ac, 2A, 10RTB (Solid State Relay)	2764
60	GT-2768	MOS Relay, 8 PTs, 24Vdc/ac, 2A, 18RTB (Solid State Relay)	2768
61	GT-2784	MOS Relay, 4 PTs, 110Vdc/ac, 1A, 10RTB	2784
62	GT-2788	MOS Relay, 8 PTs, 110Vdc/ac, 1A, 18RTB	2788
63	GT-2E1A	DO 32 PTs, Sink, 24Vdc/0.3A, ERNI Connector (Max. 6A)	2E1A
64	GT-2E2A	DO 32 PTs, Source, 24Vdc/0.3A, ERNI Connector (Max. 6A)	2E2A
65	GT-2E3A	DO 32 PTs, Sink, 24Vdc/0.3A, ERNI Connector (Max. 6A / non short circuit protection)	2E3A
66	GT-3002	Load Cell, Strain Guage, 2 CHs, -150~150mV, 24Bits, 18RTB	3002
67	GT-3102	Load Cell, Strain Guage, 2 CHs, -150~150mV, 24Bits / 0.1g/Kg/Ton-32Bits presentation , 18RTB	3102
68	GT-3114	AI 4 CHs, 0~20, 4~20mA, 12Bits, 10RTB	3114
69	GT-3154	AI 4 CHs, 0~20, 4~20mA, 16Bits, 10RTB	3154
70	GT-3118	AI 8 CHs, 0~20, 4~20mA, 12Bits, 10RTB	3118
71	GT-3158	AI 8 CHs, 0~20, 4~20mA, 16Bits, 10RTB	3158
72	GT-311F	AI 16 CHs, 0~20, 4~20mA, 12Bits, 20P Connector	311F
73	GT-315F	AI 16 CHs, 0~20, 4~20mA, 16Bits, 20P Connector	315F
74	GT-317F	AI 16 CHs, 0~20, 4~20mA, 12Bits, 18RTB	317F
75	GT-319F	AI 16 CHs, 0~20, 4~20mA, 16Bits, 18RTB	319F
76	GT-3424	AI 4 CHs, 0~10, 0~5, 1~5Vdc, 12Bits, 10RTB	3424
77	GT-3464	AI 4 CHs, 0~10, 0~5, 1~5Vdc, 16Bits, 10RTB	3464
78	GT-3428	AI 8 CHs, 0~10, 0~5, 1~5Vdc, 12Bits, 10RTB	3428

79	GT-3468	AI 8 CHs, 0~10, 0~5, 1~5Vdc, 16Bits, 10RTB	3468
80	GT-342F	AI 16 CHs, 0~10, 0~5, 1~5Vdc, 12Bits, 20P Connector	342F
81	GT-346F	AI 16 CHs, 0~10, 0~5, 1~5Vdc, 16Bits, 20P Connector	346F
82	GT-347F	AI 16 CHs, 0~10, 0~5, 1~5Vdc, 12Bits, 18RTB	347F
83	GT-349F	AI 16 CHs, 0~10, 0~5, 1~5Vdc, 16Bits, 18RTB	349F
84	GT-3704	AI 4 CHs, RTD, Resistance Input, 10RTB	3704
85	GT-3708	AI 8 CHs, RTD, Resistance Input, 20P Connector	3708
86	GT-3714	AI 4 CHs, Temperature Controller, RTD Input, SSR Output, 20P Connector	3714
87	GT-3734	AI 4 CHs, Temperature Controller, RTD Input, Current Output, 20P Connector	3734
88	GT-3744	AI 4 CHs, 4-Wire RTD/Resistance Input, 18RTB	3744
89	GT-3758	AI 8 CHs, NTC/Resistance Input, 18RTB	3758
90	GT-3788	AI 8 CHs, RTD/Resistance Input, 18RTB	3788
91	GT-3804	AI 4 CHs, Thermocouple, K/J/T/B/R/S/E/N/L/U/C/D/ Types' Sensor, 10RTB	3804
92	GT-3808	AI 8 CHs, Thermocouple, K/J/T/B/R/S/E/N/L/U/C/D/ Types' Sensor, 20P Connector	3808
93	GT-3814	AI 4 CHs, Thermocouple, Temperature Controller, TC Input, SSR Output, 20P Connector	3814
94	GT-3834	AI 4 CHs, Thermocouple, Temperature Controller, TC Input, Current Output, 20P Connector	3834
95	GT-3888	AI 8 CHs, Thermocouple, K/J/T/B/R/S/E/N/L/U/C/D/ Types' Sensor, 18RTB	3888
96	GT-3901	3-Phase, AC Measurement, Lx-Ly 500Vac/1A, 1CHs, 10RTB	3901
97	GT-3911	3-Phase, AC Measurement, Lx-Ly 500Vac/5A, 1CHs, 10RTB	3911
98	GT-3914	Differential Type, 4 CHs, 0~20, 4~20, ±20mA, 12Bits, 10RTB	3914
99	GT-3934	Differential Type, 4 CHs, 0~20, 4~20, ±20mA, 16Bits, 10RTB	3934
100	GT-3918	Differential Type, 8 CHs, 0~20, 4~20, ±20mA, 12Bits, 18RTB	3918
101	GT-3938	Differential Type, 8 CHs, 0~20, 4~20, ±20mA, 16Bits, 18RTB	3938
102	GT-3924	Differential Type, 4 CHs, 0~5, 0~10, ±5, ±10Vdc, 12Bits, 10RTB	3924
103	GT-3944	Differential Type, 4 CHs, 0~5, 0~10, ±5, ±10Vdc, 16Bits, 10RTB	3944
104	GT-3928	Differential Type, 8 CHs, 0~5, 0~10, ±5, ±10Vdc, 12Bits, 18RTB	3928
105	GT-3948	Differential Type, 8 CHs, 0~5, 0~10, ±5, ±10Vdc, 16Bits, 18RTB	3948
106	GT-3C74	AI 4 CHs, AO 4 CHs, 0~10VDC, 12Bits, 18RTB	3C74
107	GT-3C94	AI 4 CHs, AO 4 CHs, 0~10VDC, 16Bits, 18RTB	3C94
108	GT-3C78	AI 8 CHs, AO 8 CHs, 0~10VDC, 12Bits, 18RTB	3C78
109	GT-3C98	AI 8 CHs, AO 8 CHs, 0~10VDC, 16Bits, 18RTB	3C98
110	GT-4114	AO 4 CHs, 0~20mA, 12Bits, 10RTB	4114
111	GT-4154	AO 4 CHs, 0~20mA, 16Bits, 10RTB	4154
112	GT-4118	AO 8 CHs, 0~20mA, 12Bits, 10RTB	4118
113	GT-4158	AO 8 CHs, 0~20mA, 16Bits, 10RTB	4158
114	GT-4214	AO 4 CHs, 4~20mA, 12Bits, 10RTB	4214
115	GT-4254	AO 4 CHs, 4~20mA, 16Bits, 10RTB	4254
116	GT-4218	AO 8 CHs, 4~20mA, 12Bits, 10RTB	4218
117	GT-4258	AO 8 CHs, 4~20mA, 16Bits, 10RTB	4258
118	GT-4314	AO 4 CHs, 4~20mA, 12Bits, 18RTB (550ohm)	4314
119	GT-4334	AO 4 CHs, 4~20mA, 12Bits, 18RTB (750ohm)	4334
120	GT-4354	AO 4 CHs, 4~20mA, 16Bits, 18RTB (550ohm)	4354

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121	GT-4374	AO 4 CHs, 4~20mA, 16Bits, 18RTB (750ohm)	4374
122	GT-4424	AO 4 CHs, 0~10Vdc, 12Bits, 10RTB	4424
123	GT-4464	AO 4 CHs, 0~10Vdc, 16Bits, 10RTB	4464
124	GT-4428	AO 8 CHs, 0~10Vdc, 12Bits, 10RTB	4428
125	GT-4468	AO 8 CHs, 0~10Vdc, 16Bits, 10RTB	4468
126	GT-442F	AO 16 CHs, 0~10Vdc, 12Bits, 20P Connector	442F
127	GT-446F	AO 16 CHs, 0~10Vdc, 16Bits, 20P Connector	446F
128	GT-447F	AO 16 CHs, 0~10Vdc, 12Bits, 18RTB	447F
129	GT-449F	AO 16 CHs, 0~10Vdc, 16Bits, 18RTB	449F
130	GT-4524	AO 4 CHs, ±10Vdc, 12Bits, 10RTB	4524
131	GT-4564	AO 4 CHs, ±10Vdc, 16Bits, 10RTB	4564
132	GT-5102	High Speed Counter, 2CHs, 5Vdc, Encoder Input, 10RTB	5102
133	GT-5112	High Speed Counter, 2CHs, 24Vdc, Encoder Input, 10RTB	5112
134	GT-5114	High Speed Counter, 4CHs, 24Vdc, Encoder Input, 10RTB	5114
135	GT-5122	High Speed Counter, 2CHs, 5Vdc, 24Vdc, Counting Mode, Gate Function Mode, 18RTB	5122
136	GT-5132	High Speed Counter, 2CHs, 24Vdc, Encoder Input, 10RTB	5132
137	GT-5142	High Speed Counter, 2CHs, 5~24Vdc, Encoder Input, 18RTB	5142
138	GT-5211	Serial Interface, RS 232, 1 CH, RTS/CTS, Full Duplex Type, 10RTB	5211
139	GT-5212	Serial Interface, RS 232, 2 CHs, Full Duplex Type, 10RTB	5212
140	GT-5221	Serial Interface, RS 422, 1 CH, Full Duplex Type, 10RTB	5221
141	GT-5231	Serial Interface, RS 485, 1 CH, Half Duplex Type, 10RTB	5231
142	GT-5232	Serial Interface, RS 485, 2 CHs, Half Duplex Type, 10RTB	5232
143	GT-5352	Synchronous Serial Interface Input, 2 CHs, 10RTB	5352
144	GT-5422	PWM Output, 2CHs, 2.0A/24Vdc, Push-pull, 18RTB	5422
145	GT-5424	PWM Output, 4CHs, 2.0A/24Vdc, Push-pull, 18RTB	5424
146	GT-5442	PWM Output, 2CHs, 0.5A/24Vdc, Source, 18RTB	5442
147	GT-5444	PWM Output, 4CHs, 0.5A/24Vdc, Source, 18RTB	5444
148	GT-5521	2-Phase Bipolar Stepping Motor Driver, 24Vdc/1A, 10RTB	5521
149	GT-5642	Pulse Output, 2CHs, 0.5A/24Vdc, Source, 18RTB	5642
150	GT-5652	Pulse Output, 2CHs, RS422 (Differential), 18RTB	5652
151	GT-5758	DI 8 PTs, PTC-Thermistor, 18RTB	5758
152	GT-5904	IO Link, 4CHs	5904
153	GT-5914	Hart Master, 4CHs, 4-20mA, current input	5914
154	GT-7408	Potential Distributor, 8 CHs, Shield, 10 RTB, ID Type	7408
155	GT-7508	Potential Distributor, 8 CHs, 0Vdc, 10 RTB, ID Type	7508
156	GT-7511	Expansion Power, System/Field Power, Input 24Vdc, Output 5Vdc, 1A, 10 RTB, ID Type	7511
157	GT-7518	Potential Distributor, 10 CHs, 24Vdc, 10 RTB, ID Type	7518
158	GT-7588	Potential Distributor, 5 CHs, 24Vdc / 5 CHs, 0Vdc, 10 RTB, ID Type	7588
159	GT-7641	Field Power Distribution, 24Vdc, 10 RTB, ID Type	7641
160	GT-7151	Noise Filter Module, 18RTB, None ID Type	7151
161	GT-7851	Noise Filter Module, 18RTB, ID Type	7851

No.	Module Lists	Description	ID (Hex)
1	M15DF-FP	16 Channels, Universal Input Terminal, 12Vdc,18RTB	15DF
2	M1B7F-FP	Selectable I/O, DI Sink or DO Source, Total 16points, 24Vdc	1B7F
3	M1B8F-FP	Selectable I/O, DI Source or DO Sink, Total 16points, 24Vdc	1B8F
4	M1278-FP	DI 8 Points, Sink, 24Vdc, 6mA, 18RTB	1278
5	M1C18-FP	Combination I/O, DI Sink 8 points and DO Source 8 points, 5V DC	1C18
6	M12DF-FP	DI 16 Points, Universal (Sink or Source), 24Vdc, 18RTB	12DF
7	M1418-FP	DI 8 Points, Sink, 24Vdc, 18RTB, Diagnostic	1418
8	M1428-FP	DI 8 Points, Source, 24Vdc, 18RTB, Diagnostic	1428
9	M1808-FP	DI 8 Points, 120Vac, 18RTB	1808
10	M1908-FP	DI 8 Points, 240Vac, 18RTB	1908
11	M225F-FP	DO 16 Points, Sink, 24Vdc/0.3A, 18RTB	225F
12	M226F-FP	DO 16 Points, Source, 24Vdc/0.3A, 18RTB	226F
13	M227F-FP	DO 16 Points, Sink, 24Vdc/0.3A, 18RTB	227F
14	M228F-FP	DO 16 Points, Source, 24Vdc/0.3A, 18RTB	228F
15	M2618-FP	DO 8 Points, Sink, 24Vdc/2A, 18RTB	2618
16	M2628-FP	DO 8 Points, Source, 24Vdc/2A, 18RTB	2628
17	M2418-FP	DO 8 Points, Sink, 24Vdc, 18RTB, Diagnostic	2418
18	M2428-FP	DO 8 Points, Source, 24Vdc, 18RTB, Diagnostic	2428
19	M2438-FP	DO 8 Points, Sink, 24Vdc, 18RTB, Diagnostic(non short circuit protection)	2438
20	M2448-FP	DO 8 Points, Source, 24Vdc, 18RTB, Diagnostic(non short circuit protection)	2448
21	M2738-FP	MOS Relay, 8 Points, 240Vdc/ac, 0.5A, 18RTB	2738
22	M2768-FP	MOS Relay, 8 Points, 24Vdc/ac, 2A, 18RTB	2768
23	M2788-FP	MOS Relay, 8 Points, 120Vdc/ac, 1A, 18RTB	2788
24	M2744-FP	Relay Output 4 Points, 24Vdc/2A, 240Vac/2A, 18RTB	2744
25	M2774-FP	Form C, Relay Output 4 Points, 24Vdc/2A, 240Vac/2A, 18RTB	2774
26	M3C24-FP	AI, Differential type, 4 Channels, AO, 4 Channels, 0~5, 0~10, +/-5, +/-10Vdc, 12Bits, 18RTB	3C24
27	M3C44-FP	AI, Differential type, 4 Channels, AO, 4 Channels, 0~5, 0~10, +/-5, +/-10Vdc, 14Bits, 18RTB	3C44
28	M3C64-FP	AI, Differential type, 4 Channels, AO, 4 Channels, 0~5, 0~10, +/-5, +/-10Vdc, 16Bits, 18RTB	3C64
29	M3C28-FP	AI 8 Channels, AO 8 Channels, 0~10V, 0~5V, 1~5V, 12Bits, 18RTB	3C28
30	M3C48-FP	AI 8 Channels, AO 8 Channels, 0~10V, 0~5V, 1~5V, 14Bits, 18RTB	3C48
31	M3C68-FP	AI 8 Channels, AO 8 Channels, 0~10V, 0~5V, 1~5V, 16Bits, 18RTB	3C68
32	M317F-FP	AI, 16 Channels, 0~20, 4~20mA, 12Bits, 18RTB	317F
33	M319F-FP	AI, 16 Channels, 0~20, 4~20mA, 16Bits, 18RTB	319F
34	M347F-FP	AI, 16 Channels, 0~10, 0~5, 1~5Vdc, 12Bits, 18RTB	347F
35	M349F-FP	AI, 16 Channels, 0~10, 0~5, 1~5Vdc, 16Bits, 18RTB	349F
36	M3744-FP	AI, 4 Channels, RTD / Resistance Input, 18RTB	3744
37	M3708-FP	AI, 8 Channels, RTD / Resistance Input, 18RTB	3708
38	M3808-FP	AI, 8 Channels, Thermocouple / mV Input, 18RTB	3808
39	M3901-FP	3Phase, AC Measurement, Lx-Ly 500Vac/1A	3901
40	M3918-FP	AI, Differential type, 8 Channels, 0~20, 4~20, +/-20mA, 12Bits, 18RTB	3918

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41	M3938-FP	AI, Differential type, 8 Channels, 0~20, 4~20, +/-20mA, 16Bits, 18RTB	3938
42	M3928-FP	AI, Differential type, 8 Channels, 0~5, 0~10, +/-5, +/-10Vdc, 12Bits, 18RTB	3928
43	M3948-FP	AI, Differential type, 8 Channels, 0~5, 0~10, +/-5, +/-10Vdc, 16Bits, 18RTB	3948
44	M4118-FP	AO, 8 Channels, 0~20mA, 12Bits, 18RTB	4118
45	M4158-FP	AO, 8 Channels, 0~20mA, 16Bits, 18RTB	4158
46	M4218-FP	AO, 8 Channels, 4~20mA, 12Bits, 18RTB	4218
47	M4258-FP	AO, 8 Channels, 4~20mA, 16Bits, 18RTB	4258
48	M4428-FP	AO, 8 Channels, 0~10Vdc, 12Bits, 18RTB	4428
49	M4468-FP	AO, 8 Channels, 0~10Vdc, 16Bits, 18RTB	4468
50	M4314-FP	4 Channels , Current Output, 4~20mA, 550ohm, 12bit	4314
51	M4334-FP	4 Channels , Current Output, 4~20mA, 750ohm, 12bit	4334
52	M4354-FP	4 Channels , Current Output, 4~20mA, 550ohm, 16bit	4354
53	M4374-FP	4 Channels , Current Output, 4~20mA, 750ohm, 16bit	4374
54	M5112-FP	High speed counter, 2Cannels, 5/24Vdc, 18RTB	5112
55	M5212-FP	RS 232 Serial Interface, 2 Channels, Full Duplex Type, 18RTB	5212
56	M5222-FP	RS 422 Serial Interface, 2 Channels, Full Duplex Type, 18RTB	5222
57	M5232-FP	RS 485 Serial Interface, 2 Channels, Half Duplex Type, 18RTB	5232
58	M5352-FP	Synchronous Serial Interface Input, 2 Channels, 18RTB	5352
59	M5442-FP	PWM, 2 Channels, 0.5A/24Vdc, Source, 18RTB	5442
60	M5444-FP	PWM, 4 Channels, 0.5A/24Vdc, Source, 18RTB	5444
61	M5642-FP	Pulse Output, 2 Channels, 0.5A/24Vdc, Source, 18RTB	5642
62	M5652-FP	2 Channel Differential Output. RS422, 18RTB	5652
63	M5522-FP	Stepper Module, 2 Channels, 18RTB	5522
64	M5914-FP	HART Master, 4 Channels, Current Input, 4~20mA, 16bits, 18RTB	5914
65	M7001-FP	System, Field Distribution Module (1byte)	7001
66	M7002-FP	System, Field Distribution Module (None data Size)	7002

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APPENDIX C – HMI connection example

C.1   Beijer HMI Master- PLC Slave(TCP)

Set the HMI connect and PIO with same network system by LAN.
PIO can support the Modbus TCP slave communication, separately CODESYS Modbus TCP master/slave function. This function can be available for the connection IO guide pro connection, HMI connection and so on.
The Modbus TCP slave will be access to CODESYS address directly for as below address.
This address can be access able at Modbus RTU slave as well.

| Address	IEC Address	Contents
0x0000~0x07FF	%IW0~%IW2047	2048 words Input and Internal memory (Area is write-protected)
0x0800~0x0FFF	%QW0~%QW2047	2048 words Output and Internal memory (Area is write-enabled)
0x1000~0x1FFF	-	Special Function Register (PIO Information)
0x2000~0x2FFF	-	Special Function Register (Slot Information)
0x4000~0x5FFF	%MW0~%MW8191	8192 words Internal memory (Area is write-enabled)

Set the HMI for the Modbus Master system.
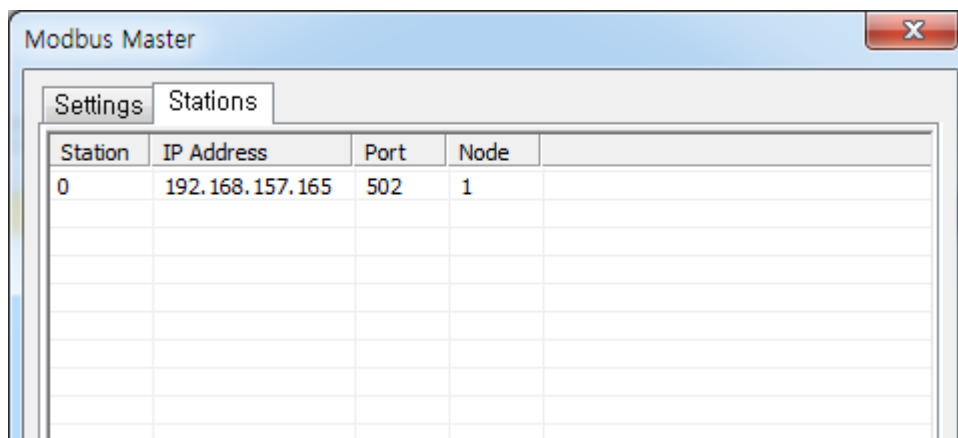It could be different for depends on the HMI system.
In this example, it is set by Modcon Modbus Master for HMI
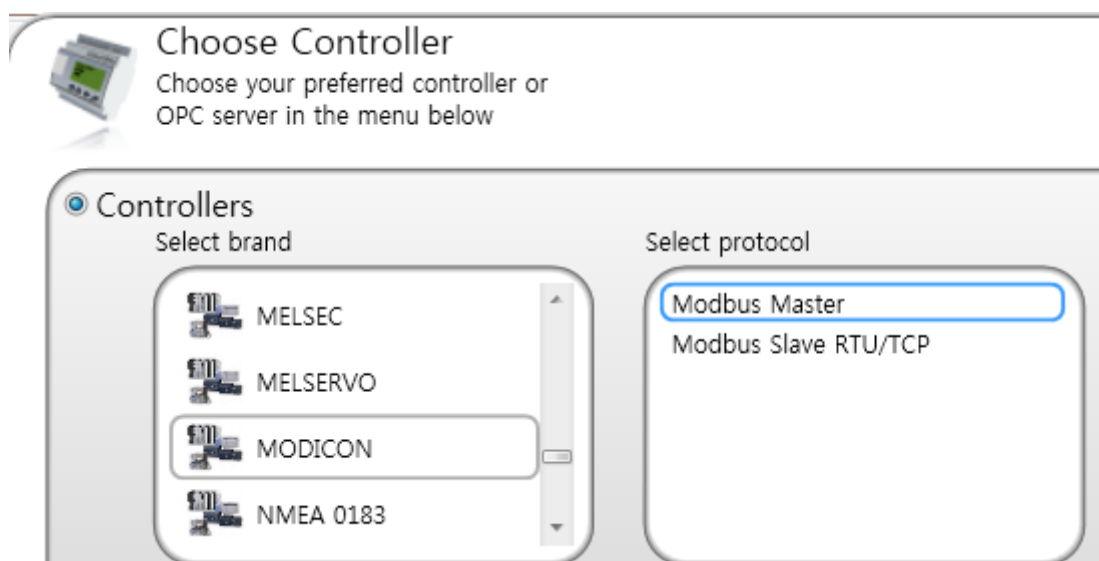
Set the Hexadecimal address system and address.
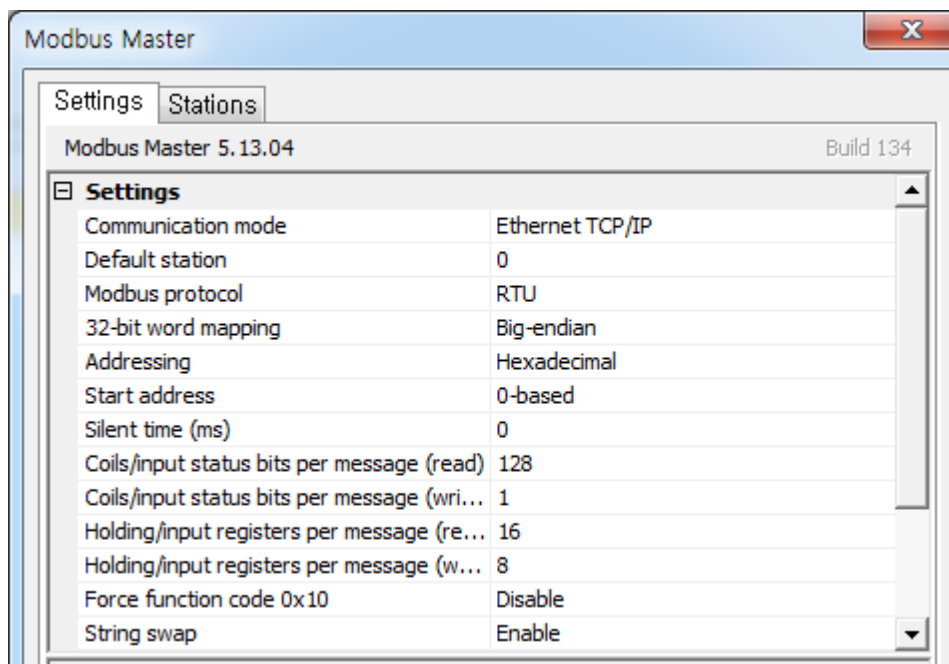
Set the station IP address for PIO(Slave).

Read the 30000 address for the PIO slave input address.
Read/Write the 40800 for the PIO slave output address.

Tag			Controllers		
Name	Data Type	Access Right	Data Type	TCP ▼	RTU
ModBusTCP_Output	DEFAULT	Read	INT16	40800	
ModBusTCP_Input	DEFAULT	Read	INT16	30000	
ModBusRTU_Input	DEFAULT	Read	INT16		30000
ModBusRTU_Output	DEFAULT	Read	INT16		40800

## C.2   Beijer HMI Master- PLC Slave(RTU)

Connect the PIO with HMI using the serial cable.
PIO can support the RS232 and RS485 port simultaneously.

HMI should be supported the RS232 or RS485 for Modbus RTU master.
PIO can support the Modbus RTU slave only. Not supported the master mode.

It does not need to set into the PIO for the Modbus RTU slave mode.
The Modbus RTU slave will be access to CODESYS address directly for as below address.

Address	IEC Address	Contents
0x0000~0x07FF	%IW0~%IW2047	2048 words Input and Internal memory (Area is write-protected)
0x0800~0x0FFF	%QW0~%QW2047	2048 words Output and Internal memory (Area is write-enabled)
0x1000~0x1FFF	-	Special Function Register (PIO Information)
0x2000~0x2FFF	-	Special Function Register (Slot Information)
0x4000~0x5FFF	%MW0~%MW8191	8192 words Internal memory (Area is write-enabled)

Set the HMI for the Modbus Master system.
Set the Hexadecimal address system and address.
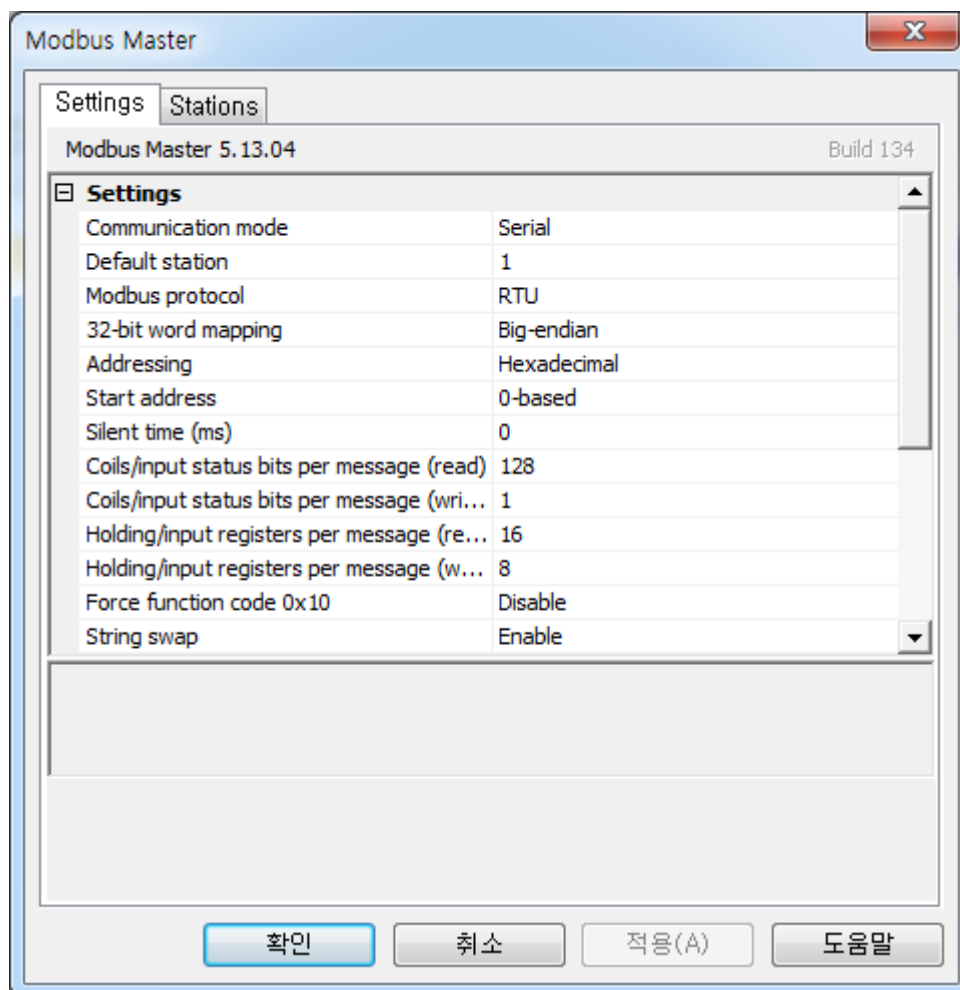
Default Baud rate is 115200, set the COM port in HMI.
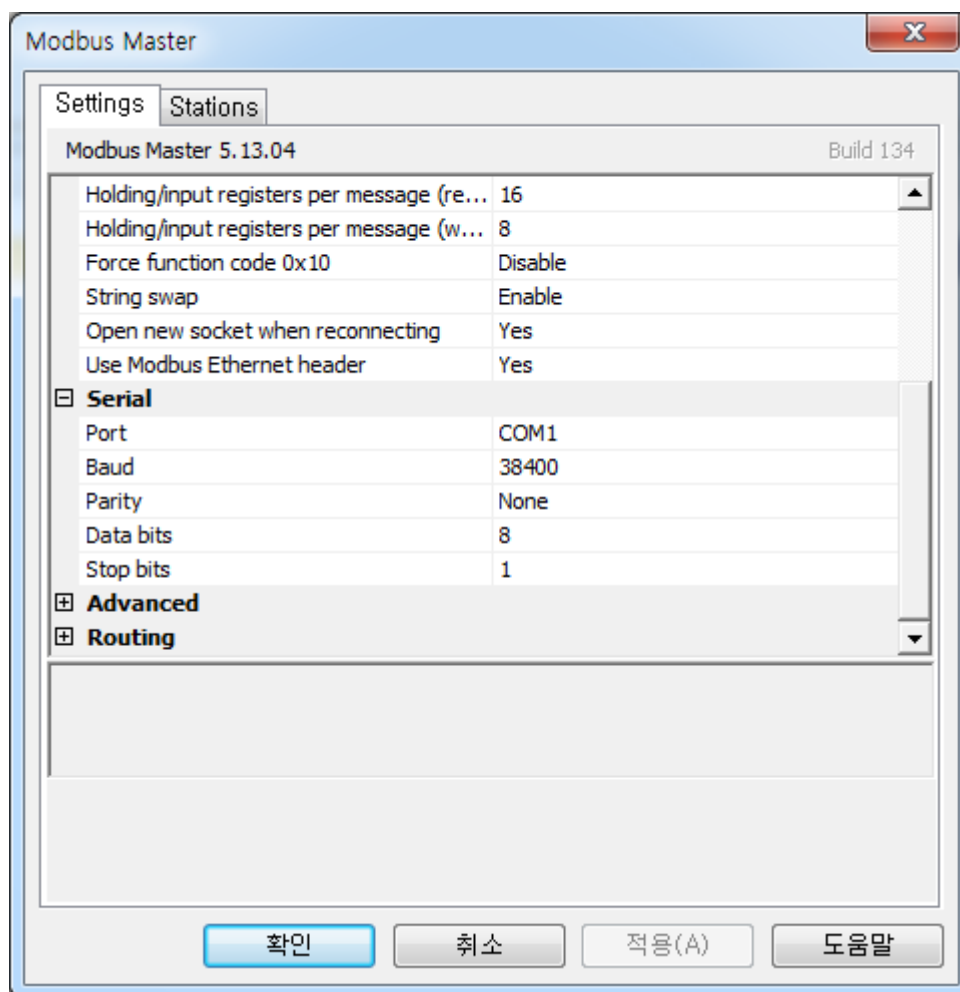
Read the 30000 address for the PIO slave input address.
Read/Write the 40800 for the PIO slave output address.
It is same as other CREVIS Modbus slave system address.

Tag			Controllers		
Name	Data Type	Access Right	Data Type	TCP	RTU ▲
ModBusTCP	DEFAULT	Read	INT16	30000	
ModBusTCP_Input	DEFAULT	Read	INT16	40000	
❯ ModBusRTU_Input	DEFAULT	Read	INT16		30000
ModBusRTU_Output	DEFAULT	Read	INT16		40800

These example are for using Beijer TXA series.
In other HMI systems, it could be another way to use.
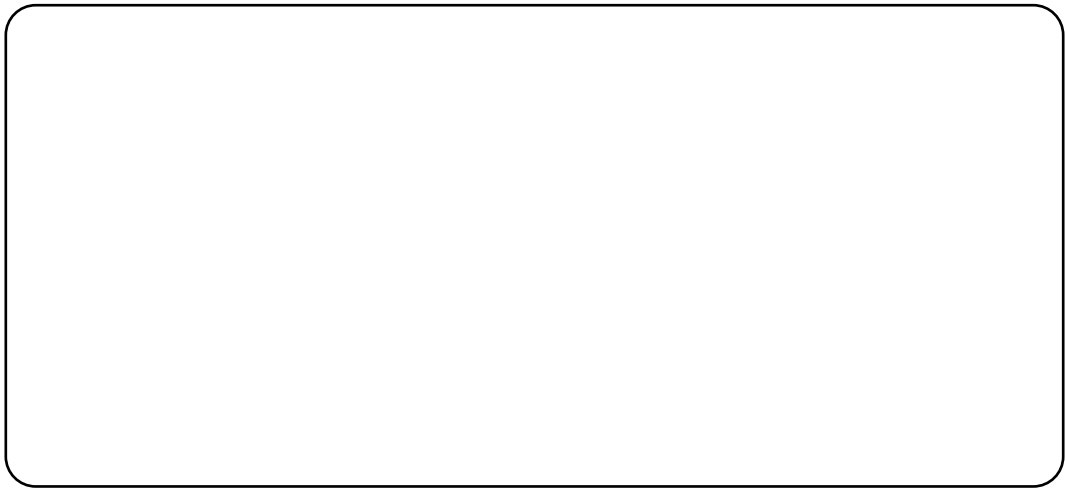
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