

# Operating CFW-11 in an EtherNet/IP<sup>®</sup> network using Rockwell ControlLogix<sup>™</sup> PLC

## CFW-11

### Application Note

# **ETHERNET-2P-05 EtherNet/IP Application Note**

**CFW-11**

Document: 10011687887

Revision: 00

Publication Date: 12/2023

## SUMMARY OF REVISIONS

The information below describes the reviews made in this manual.

Version	Revision	Description
-	R00	First Edition.

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## 1 DESCRIPTION

This application note is intended to provide a description of how to program a CFW-11 frequency converter to communicate in EtherNet/IP network using Rockwell ControlLogix PLC.

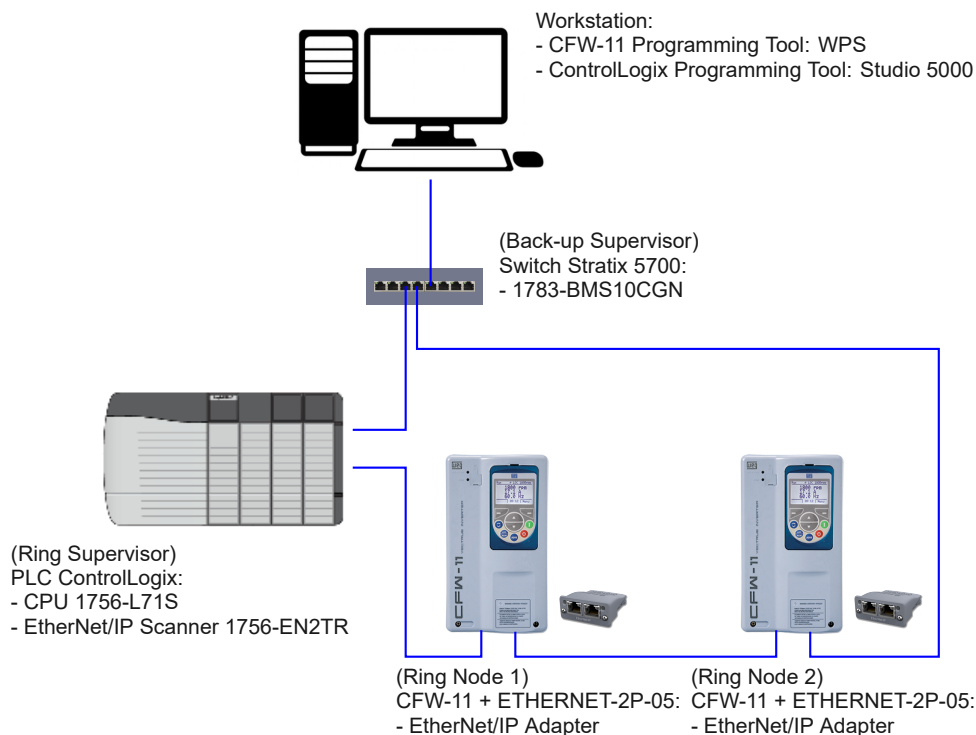
This document is meant for trained personnel working with the described equipment and EtherNet/IP network installation, besides a good knowledge of automation and programmable logic controllers, in particular about Rockwell Automation software.

### 1.1 REFERENCE DOCUMENTS

This application note was developed based on the following documents and tools:

Document / Tool	Version	Source
CFW-11 Frequency Inverter Programming Manual	10004274148 / 03 (7.0x)	WEG
CFW-11 Anybus-CC User's Manual	0899.5750 / 08	WEG
Media Planning and Installation Manual - EtherNet/IP	PUB00148R0	ODVA
Using Device Level Ring (DLR) with EtherNet/IP	PUB00316R2	ODVA
RSNetWorx™ for EtherNet/IP	28.01	Rockwell Automation
Studio 5000® PLC Programming Software	34.00	Rockwell Automation
WPS	3.00	WEG

### 1.2 ARCHITECTURE



**Figure 1.1:** Network components

### 1.3 CFW-11

- Equipment: CFW-11 version 7.0X.
- Accessory: ETHERNET-2P-05.
- Programming tool: WPS version 3.00.

## DESCRIPTION

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### 1.4 CONTROLLOGIX

- CPU: 1756-L71S version 34.011
- EtherNet/IP Scanner: 1756-EN2TR version 11.003
- Programming tools:
  - RSNetWorx For EtherNet/IP version 28.01
  - Studio 5000 Logix Designer version 34.00

### 1.5 STRATIX 5700

- Managed Switch: 1783-BMS10CGN

### 1.6 PASSIVE NETWORK COMPONENTS

For passive network components - cables, ethernet switch - we recommend using certified components for industrial applications. Please refer to the product documentation for information about the proper network installation.

## 2 IP ADDRESS AND NETWORK CONFIGURATION

To allow communication among the devices, they need to have a compatible IP address configuration. It means the IP address must be in the same range, according to network mask. For this example, we will use the following IP addresses:

- Subnet mask: 255.255.255.0
- IP addresses: each device must have a different IP address.
  - Workstation: 192.168.0.20
  - ControlLogix: 192.168.0.71
  - Stratix® 5700: 192.168.0.66
  - CFW-11 (1): 192.168.0.10 (as described at item 3).
  - CFW-11 (2): 192.168.0.11

### 2.1 PC IP ADDRESS CONFIGURATION

To configure this option on Windows platform, go to “Network Connections” and select “Properties” of the applicable Ethernet interface:

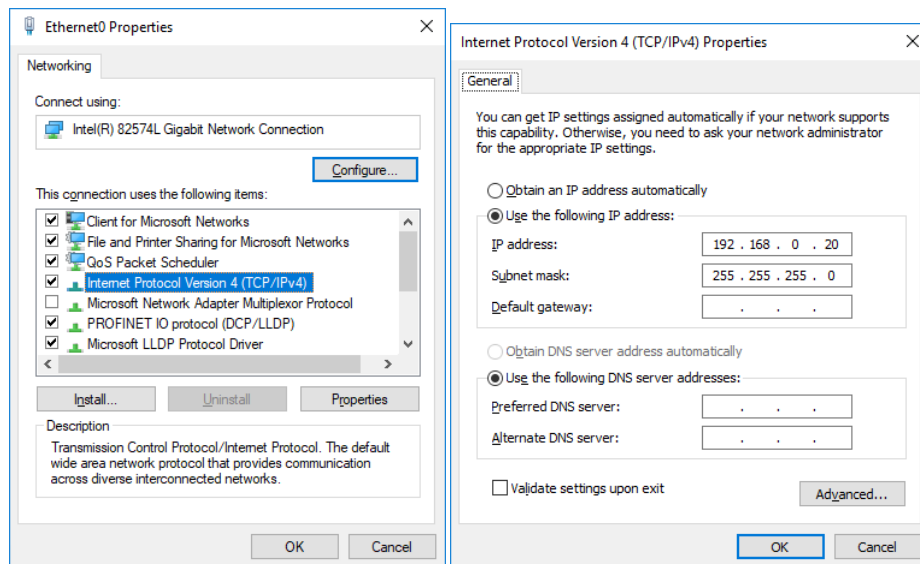
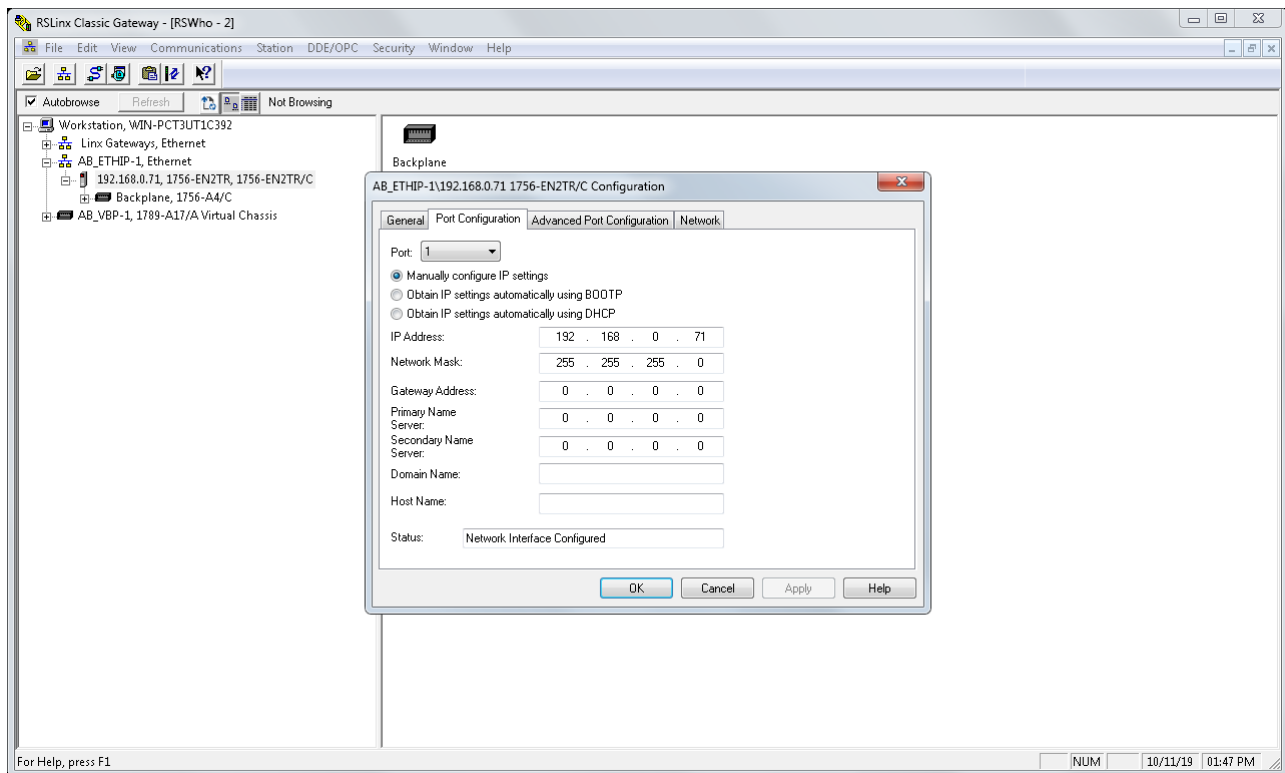


Figure 2.1: PC IP Address Configuration

### 2.2 CONTROLLOGIX IP ADDRESS CONFIGURATION

User can set IP address for ControlLogix using Rockwell configuration tools. Check ControlLogix documentation to obtain information about how to perform this configuration.

## IP ADDRESS AND NETWORK CONFIGURATION



**Figure 2.2:** ControlLogix IP Address Configuration



### 3 SERVER CONFIGURATION - CFW-11

This section describes the main configurations for operating the CFW-11 frequency converter in an EtherNet/IP network for Ring Node 1 and 2.

Refer to the CFW-11 programming manual for the necessary configurations related to other device functions, like motor configuration, protections, etc.

#### 3.1 ETHERNET INTERFACE

For this application, the following configurations have been done via keypad to allow Ethernet communication to WPS:

- P0843 IP Address Config: **0** (Parameters).
- P0844 ... P0847 IP Address: 192.168.0.**10** and 192.168.0.**11**.
- P0848 CIDR Sub-net: 255.255.255.0.
- P0849 ... P0852 Gateway: 0.0.0.0.

When communication configuration is done, it is also possible to create a WPS configuration and connect to it via Ethernet, to access the parameter list and configuration wizards:

Pa...	Description	Offline	Online	Minimum	Maximum	Factory settings	Unit	Type
P0836	Phase S Rect 1 Temper	0.0		-20.0	150.0	0.0	°C	INT
P0837	Phase T Rect 1 Temper	0.0		-20.0	150.0	0.0	°C	INT
P0840	Anybus Status	0: Setup		0: Setup		0: Setup		WO...
P0841	Eth:Baud rate	0: Auto		0: Auto		0: Auto		WO...
P0842	Eth:ModbusTCP timeout	0.0		0.0	65.5	0.0		WO...
P0843	Eth:IP Address Config	1: DHCP		0: Parameters		1: DHCP		WO...
P0844	Eth:IP Address 1	192		0	255	192		WO...
P0845	Eth:IP Address 2	168		0	255	168		WO...
P0846	Eth:IP Address 3	0		0	255	0		WO...
P0847	Eth:IP Address 4	10		0	255	10		WO...
P0848	Eth:CIDR Sub-net	24		1	31	24		WO...
P0849	Eth:Gateway 1	0		0	255	0		WO...
P0850	Eth:Gateway 2	0		0	255	0		WO...
P0851	Eth:Gateway 3	0		0	255	0		WO...
P0852	Eth:Gateway 4	0		0	255	0		WO...
P0853	Station Name	0		0	255	0		WO...
P0854	Compatible mode	0: Modbus WEG		0: Modbus WEG		0: Modbus WEG		WO...
P0918	Profibus Address	1		1	126	1		WO...
P0922	Profibus Teleg. Sel.	1: Std. Teleg. 1		1: Std. Teleg. 1	9: Telegram 107	1: Std. Teleg. 1		WO...
P0944	Fault Message Counter	0		0	65535	0		WO...
P0947	Fault Number	0		0	65535	0		WO...
P0963	Profibus Baud Rate	0: 9.6 kbit/s		0: 9.6 kbit/s		0: 9.6 kbit/s		WO...
P0964	Drive Unit Ident.	0		0	65535	0		WO...
P0965	Profile Ident. Number	0		0	65535	0		WO...
P0967	Control Word 1	<input type="checkbox"/> ON <input type="checkbox"/> No Coast Stop <input type="checkbox"/> No Quick Stop <input type="checkbox"/> Enable Oper. <input type="checkbox"/> Enable Ramp <input type="checkbox"/> Enable Setpt. <input type="checkbox"/> Fault Ack. <input type="checkbox"/> Jog 1 <input type="checkbox"/> Control by PLC <input type="checkbox"/> Rdy Switch On <input type="checkbox"/> Rdy to Operate <input type="checkbox"/> Done Enabled	<input type="checkbox"/> ON <input type="checkbox"/> No Coast Stop <input type="checkbox"/> No Quick Stop <input type="checkbox"/> Enable Oper. <input type="checkbox"/> Enable Ramp <input type="checkbox"/> Enable Setpt. <input type="checkbox"/> Fault Ack. <input type="checkbox"/> Jog 1 <input type="checkbox"/> Control by PLC <input type="checkbox"/> Rdy Switch On <input type="checkbox"/> Rdy to Operate <input type="checkbox"/> Done Enabled	0	65535	0		WO...

Figure 3.1: WPS - Parameter list

#### 3.2 LOCAL/REMOTE

CFW-11 has two operation modes: local and remote. For each operation mode, it is necessary to define the source that it will use to receive commands, like start/stop, fault reset. For this application, considering accessory installed, the following control sources have been defined:

- Local: keypad will control CFW-11 in local mode.
- Remote: ETHERNET-2P-05 will control CFW-11 in remote mode.

## SERVER CONFIGURATION - CFW-11

- Local/Remote transition: the definition if the device is in local or remote mode will be controlled by ETHERNET-2P-05 commands (remote mode at power on).

Based on this, the following configurations have been programmed:

- P0220 LOC/REM Selection Src: Anybus-CC REM.
- P0222 REM Reference Sel: Anybus-CC.
- P0226 REM FWD/REV Sel: Anybus-CC FWD.
- P0027 REM Run/Stop Sel: Anybus-CC.
- P0228 REM JOG Selection: Anybus-CC.

### 3.3 COMMUNICATION ERROR

For CFW-11, the following events lead to error indication:

- When cyclic communication is active and it is interrupted.
- When cyclic communication is active and master is in "Run" mode, and then it goes to "Idle" mode.

For both situations, CFW-11 will indicate A147 ou F247 (EtherNet/IP Communication Offline). It is important to define the action CFW-11 will take in case of communication error. If CFW-11 was running the motor via network command, CFW-11 should also perform a general disable. Based on this, the following configurations have been programmed:

- P0313 Comm. Error Action: 2 (General Disable).

### 3.4 I/O DATA CONFIGURATION

CFW-11 has a set of configurations where it is possible to define any device data to exchange with network master. Programming manual describing the entire list of device data that can be programmed to I/O Data.

Parameter	Function	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Pag.
P0590	Energy Sav. Min. Sp	0 to 18000 rpm	600 (525) rpm		V/F Vector	53	14-31
P0591	Energy Sav Histeresis	0 to 30 %	10 %		V/F Vector	53	14-31
P0600	Firmware Update	0 = Off 1 = VFD -> MemCard 2 = MemCard -> VFD	0 = Off		CFG	06	7-6
P0613	Firmware Revision	-32768 to 32767			RO	09	18-10
P0614	PLD Revision	-32768 to 32767			RO	09	18-11
P0662	Detection peak amp.	0 to 100 %	30 %		VW/PM PM	05, 55, 94	12-15
P0678	Enc. Spin Check	0 to 200 rpm	0 rpm		PM	45	17-19
P0680	Logical Status	Bit 0 = STO Bit 1 = Not Used Bit 2 = Fire Mode Bit 3 = Not Used Bit 4 = Quick Stop ON Bit 5 = 2 <sup>nd</sup> Ramp Bit 6 = Config. Mode Bit 7 = Alarm Bit 8 = Running Bit 9 = Enabled Bit 10 = Forward Bit 11 = JOG Bit 12 = Remote Bit 13 = Subvoltage Bit 14 = Automatic (PID) Bit 15 = Fault	-		RO	09, 111	19-6

Figure 3.2: List of available data described in ETHERNET-2P-05 Programming Manual

- Assembly instances: 100/150 (Manufacturer Specific Profile).
- Read parameters: no additional read parameters will be included to read area.
- Write parameters: no additional write parameters will be included to write area.

So the following parameters must be programmed:

- P0727 - Anybus I/O Words: 2.

For each application, it is necessary define the data to communicate between CFW-11 and ControlLogix. For this application, CFW-11 will transfer the following I/O data with network master:

Mapped Inputs	Parameter	Size	Qty Mapped Words
P0680 - Logical Status	680	16bit	1
P0681 - Speed in 13 bits	681	16bit	1
TOTAL			2 Words (4 Bytes)

Mapped Outputs	Parameter	Size	Qty Mapped Words
P0686 - Anybus-CC Control	686	16bit	1
P0687 - Anybus-CC Speed Ref.	687	16bit	1
TOTAL			2 Words (4 Bytes)

Based on this sequence of data for communication, the following configurations have been programmed:

Data read configuration (Input Words):

- Anybus Read Word #1: 680 (Logical Status).
- Anybus Read Word #2: 681 (Speed in 13 bits).

Data write configuration (Output Words):

- Anybus Write Word #1: 686 (Anybus-CC Control).
- Anybus Write Word #2: 687 (Anybus-CC Speed Ref.).

## 4 MASTER CONFIGURATION - CONTROLLOGIX

Use Rockwell software to configure and program ControlLogix to communicate with CFW-11. The main steps are described below.

### 4.1 RSNETWORX FOR ETHERNET/IP

#### 4.1.1 Register EDS File

Use EDS Wizard to register EDS file for CFW-11.

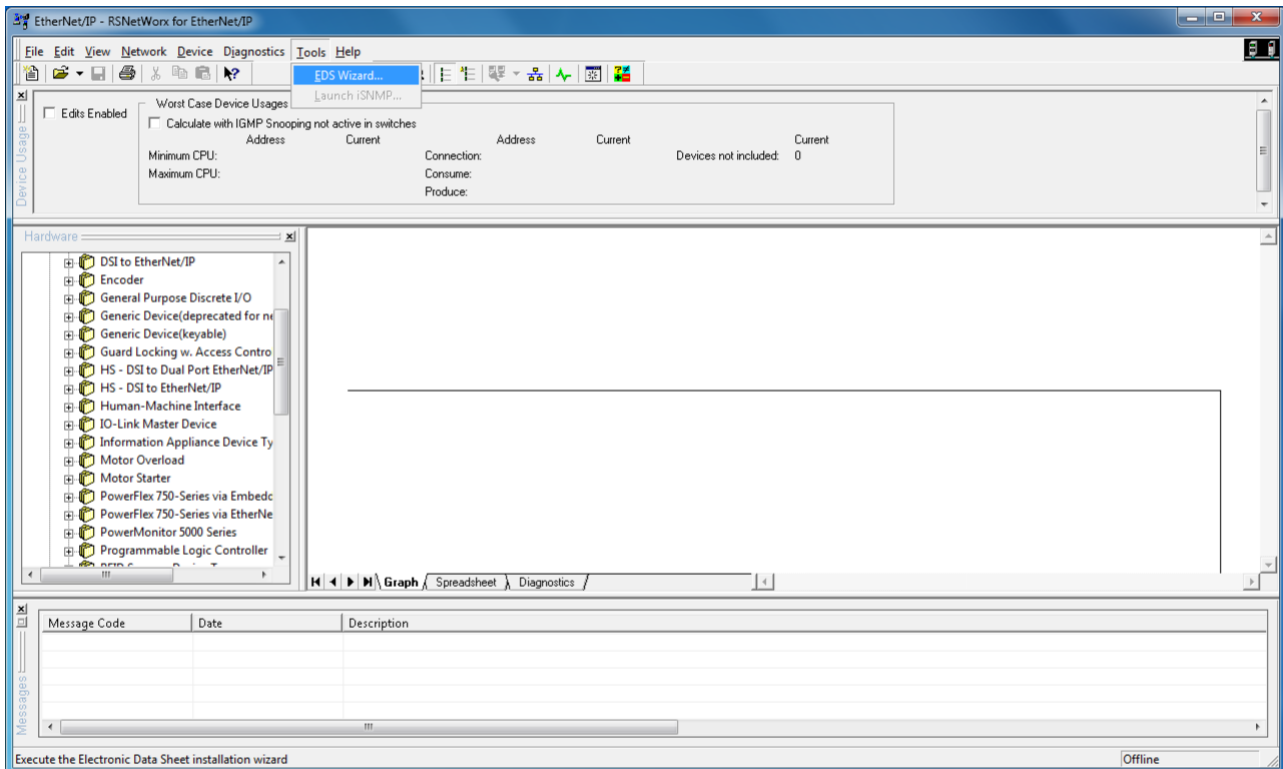
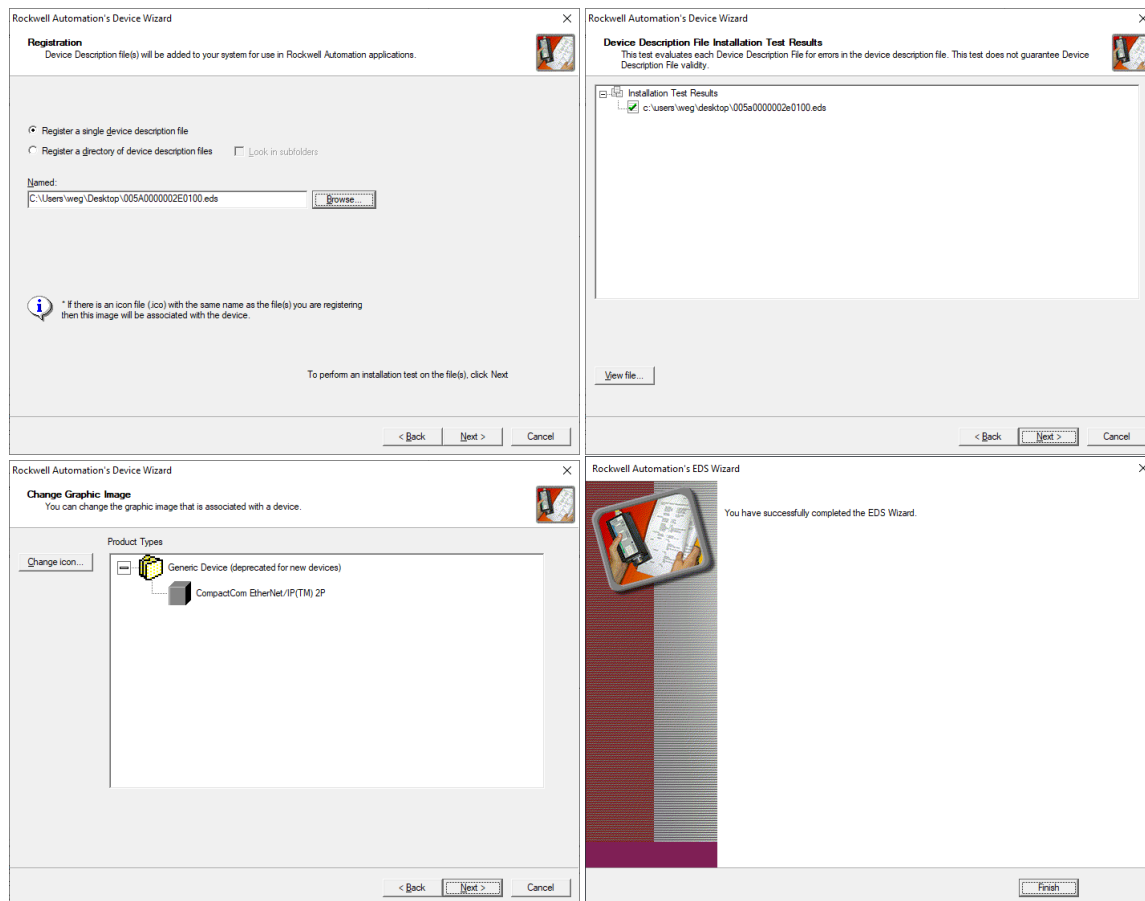


Figure 4.1: RSNetWorx For EtherNet/IP



**Figure 4.2: RSNetWorx - Register EDS File**

### 4.1.2 Scan Devices

With devices connected, it is possible to scan the network to find active nodes for communication. For this example, EtherNet/IP scanner (1756-EN2TR) is present in address 192.168.0.71. It is possible to save this configuration and link it during ControlLogix configuration.

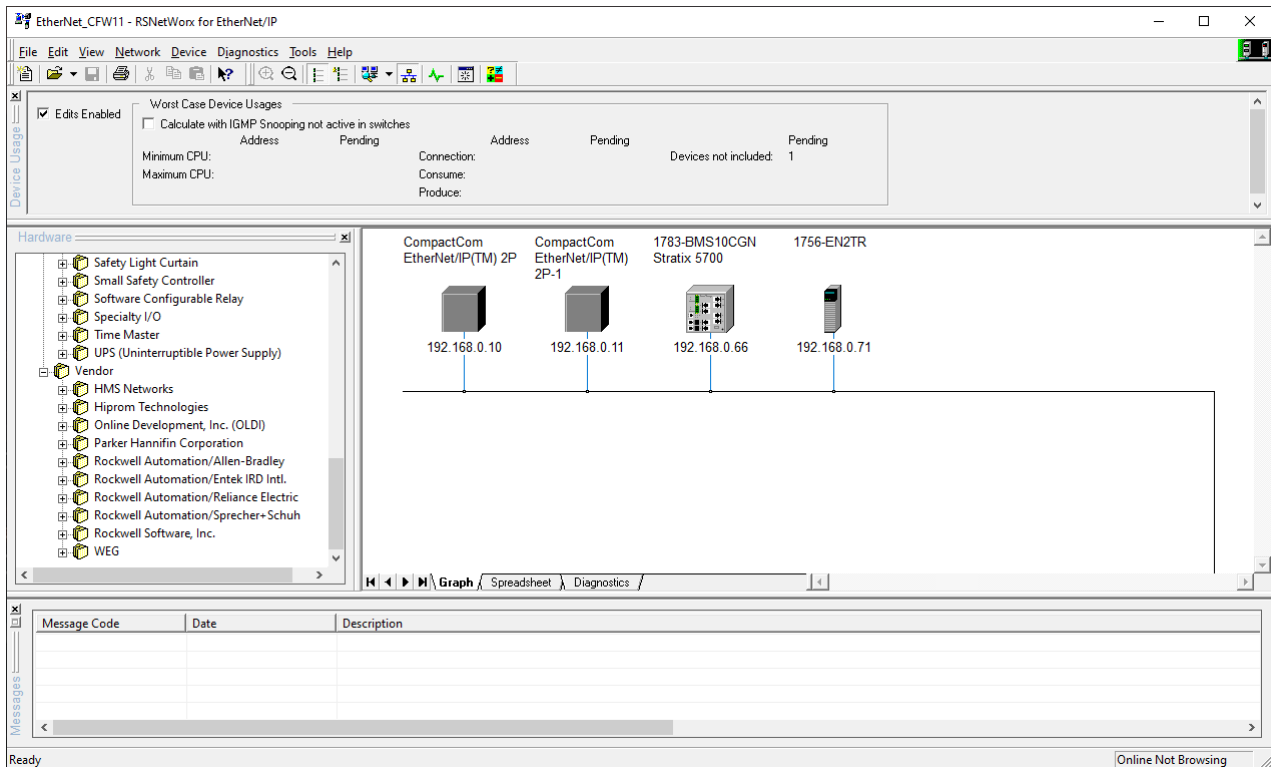


Figure 4.3: RSNetWorx for EtherNet/IP - Online Identification

## 4.2 STUDIO 5000 LOGIX DESIGNER

Open Studio Rockwell 5000 software and create a new project. Select ControlLogix CPU, chassis and EtherNet/IP scanner, according to available hardware and firmware version.

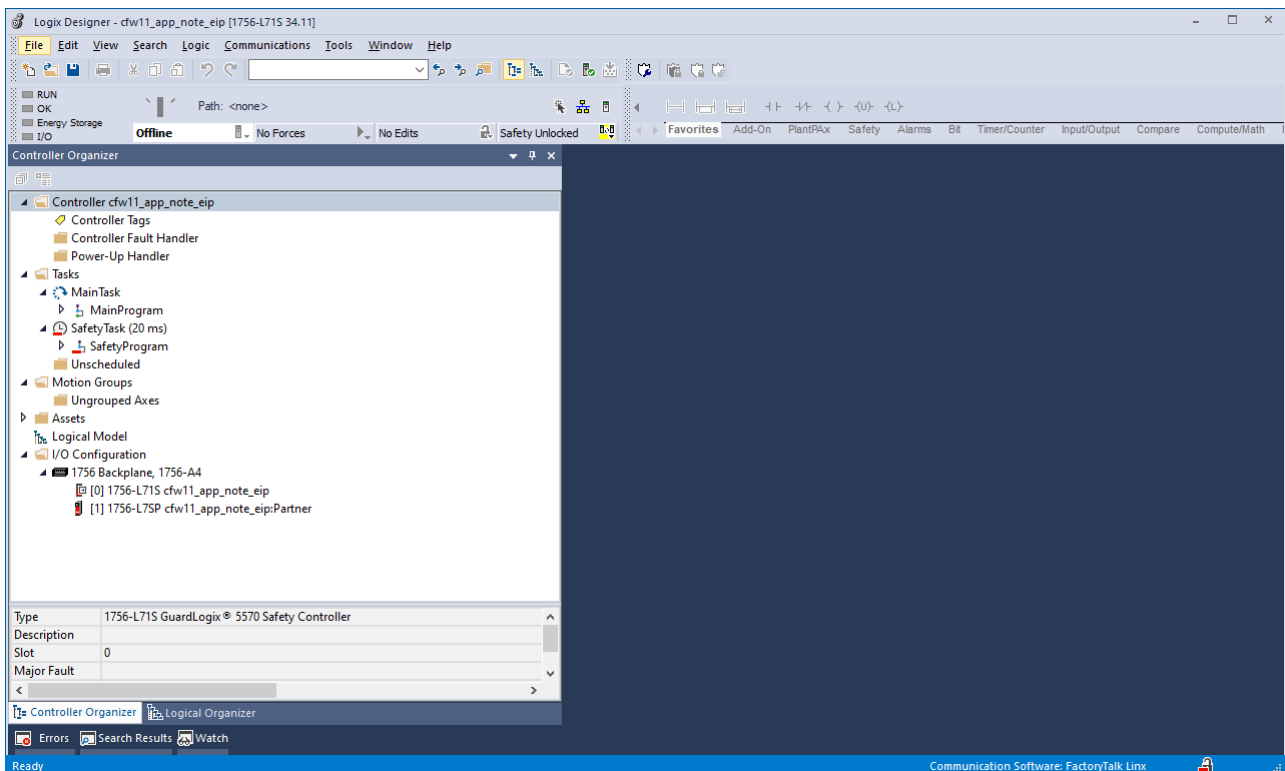


Figure 4.4: Studio 5000 Logix Designer - Create New Project

## 4.2.1 Add New Module for Control Logix

Create a new scanner module for Ethernet interface and configure, as programmed in item 2.2.

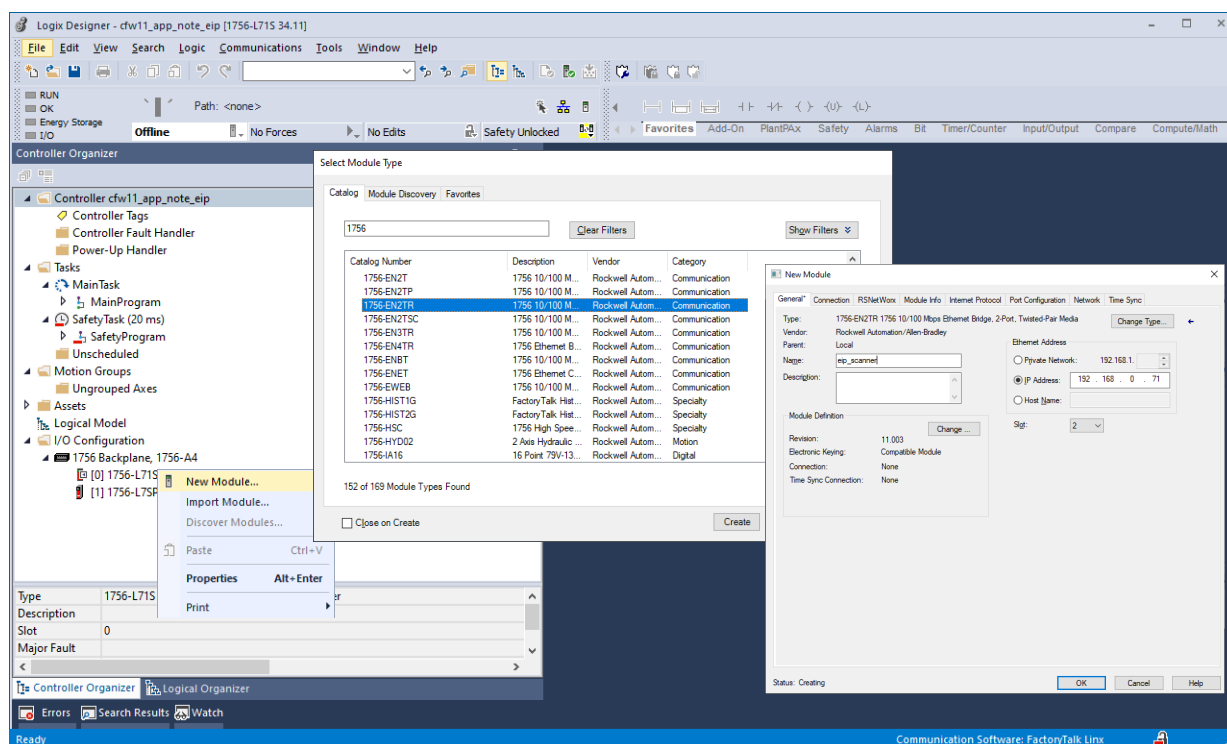
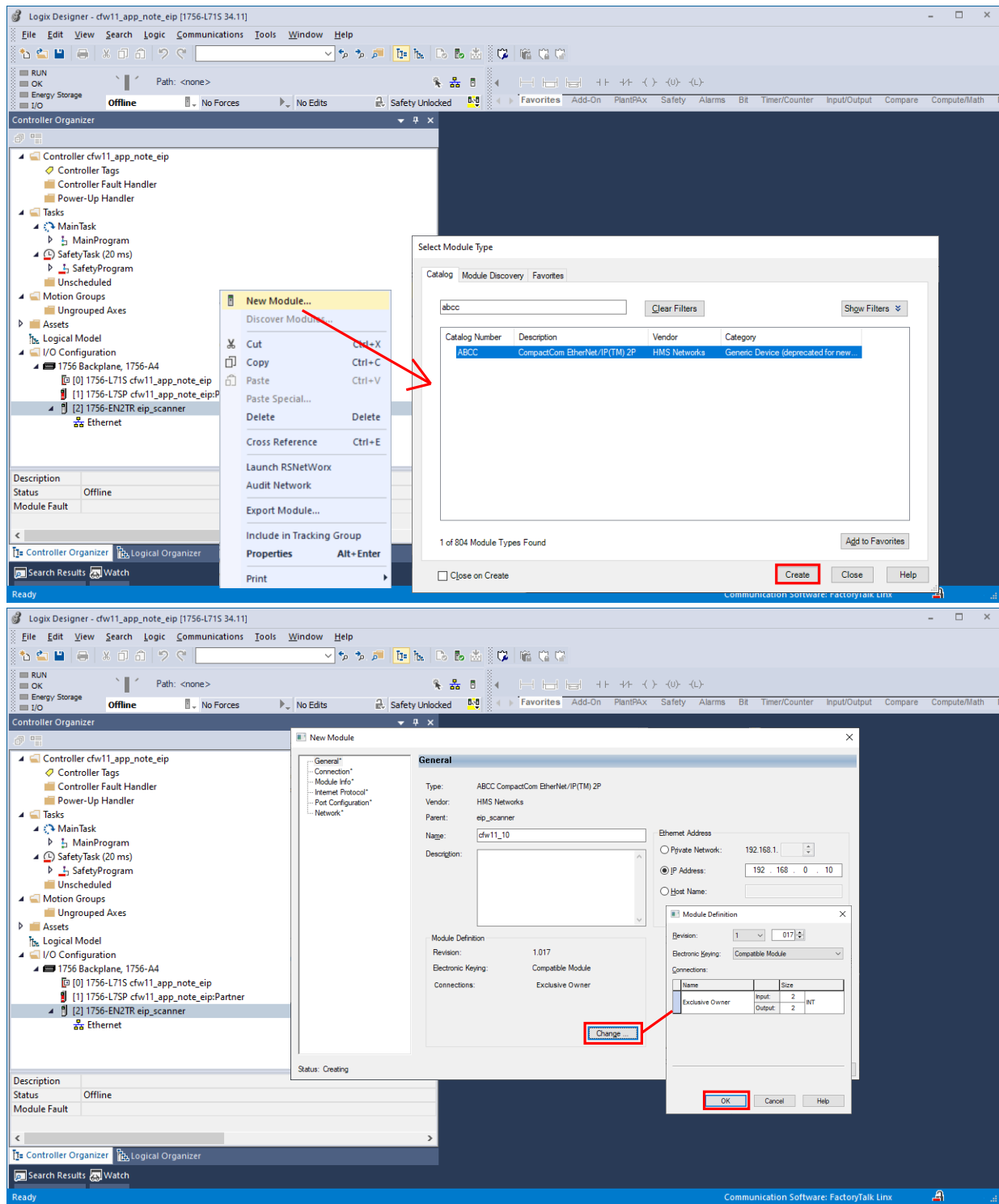


Figure 4.5: Studio 5000 Logix Designer - Add New EtherNet/IP Module

## 4.2.2 Add New Module for CFW-11

Create a new CFW-11 module for Ethernet interface, and configure the instance and I/O size, as programmed in item 3.4.



**Figure 4.6:** Studio 5000 Logix Designer - Add New CFW-11 Module

For this example, CFW-11 will communicate 2 input words and 2 output words. Status and control data will follow the manufacturer specific profile. This must match the same configuration programmed in drive parameters.

## 4.2.3 Download and Monitor Configuration

With module created, device data should be available at Controller Tags. Using these tags, it is possible to view and edit online device I/O data, as well as creating a ladder logic to control and monitor the device.

Once the configuration is finished, download it to PLC in order to monitor CFW-11 I/O data.



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## 5 CONTROL AND MONITORING

Once network configuration is done, it is possible to control and monitor the device. The main steps are described below.

### 5.1 VIEW AND EDIT READ AND WRITE DATA

In online mode, at controller tags, it is possible to check input and write output data directly in controller memory.

Name	Value	Force Mask	Style	Data Type	Class	Description
cfw11_10:l	{...}	{...}	{...}	_005A:ABCC_76270E8...	Standard	
cfw11_10:l.Con...	0		Decimal	BOOL	Standard	
cfw11_10:l.Data	{...}	{...}	Hex	INT[2]	Standard	
cfw11_10:l.Da...	16#1702		Hex	INT	Standard	
cfw11_10:l.Da...	16#1000		Hex	INT	Standard	
cfw11_10:0	{...}	{...}	{...}	_005A:ABCC_7377BD...	Standard	
cfw11_10:0.Da...	{...}	{...}	Hex	INT[2]	Standard	
cfw11_10:0.D...	16#0017		Hex	INT	Standard	
cfw11_10:0.D...	16#1000		Hex	INT	Standard	
cfw11_11:l	{...}	{...}	{...}	_005A:ABCC_76270E8...	Standard	
cfw11_11:l.Con...	0		Decimal	BOOL	Standard	
cfw11_11:l.Da...	{...}	{...}	Hex	INT[2]	Standard	

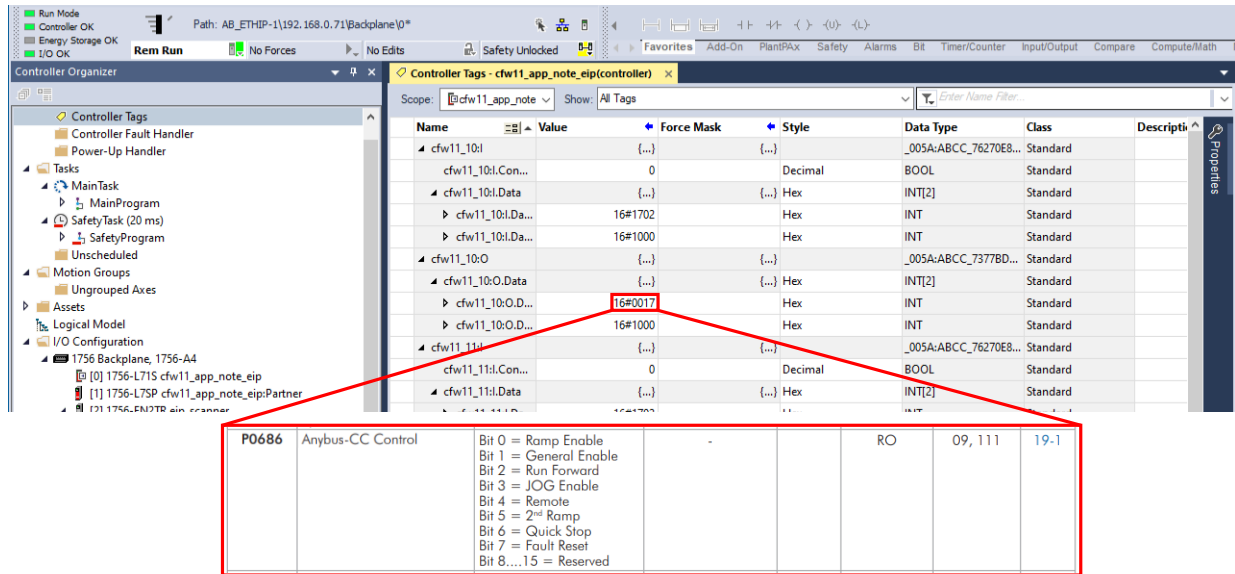
  

Address	Variable Name	Bit	Bit Description	Force	Mask	Style	Data Type	Class	Description
P0680	Logical Status	Bit 0	STO				RO	09, 111	19-6
		Bit 1	Not Used						
		Bit 2	Fire Mode						
		Bit 3	Not Used						
		Bit 4	Quick Stop ON						
		Bit 5	2nd Ramp						
		Bit 6	Config. Mode						
		Bit 7	Alarm						
		Bit 8	Running						
		Bit 9	Enabled						
		Bit 10	Forward						
		Bit 11	JOG						
		Bit 12	Remote						
		Bit 13	Subvoltage						
		Bit 14	Automatic (PID)						
		Bit 15	Fault						

Figure 5.1: Read data, with highlight to the status word as described in CFW-11 EtherNet/IP documentation

For inputs, as described at item 3.4, it is programmed to read the following information:

- CFW-11\_10:l1.Data[0]: 680, value 0x1702 hexadecimal (binary 0001 0111 0000 0010).
  - Bit 1 = 1 (internal use).
  - Bit 8 = 1 (running).
  - Bit 9 = 1 (enabled).
  - Bit 10 = 1 (forward).
  - Bit 12 = 1 (remote).
- CFW-11\_10:l1.Data[1]: 681, value 0x1000 (motor speed actual value = 30.0Hz).



**Figure 5.2:** Write data, with highlight to the command word as described in CFW-11 EtherNet/IP documentation

For output, as described at item 3.4, it is programmed to write the following information:

- CFW-11\_10:O1.Data[0]: 686, value 0x0017 hexadecimal (binary 0000 0000 0001 0111).
  - Bit 0 = 1 (ramp enable).
  - Bit 1 = 1 (general enable).
  - Bit 2 = 1 (run forward).
  - Bit 4 = 1 (remote).
- CFW-11\_10:O1.Data[1]: 687, value 0x1000 (motor speed reference = 30.0Hz).

These tags can be used during PLC program to create a logic in order to monitor and control devices.

## 5.2 ACYCLIC REQUESTS

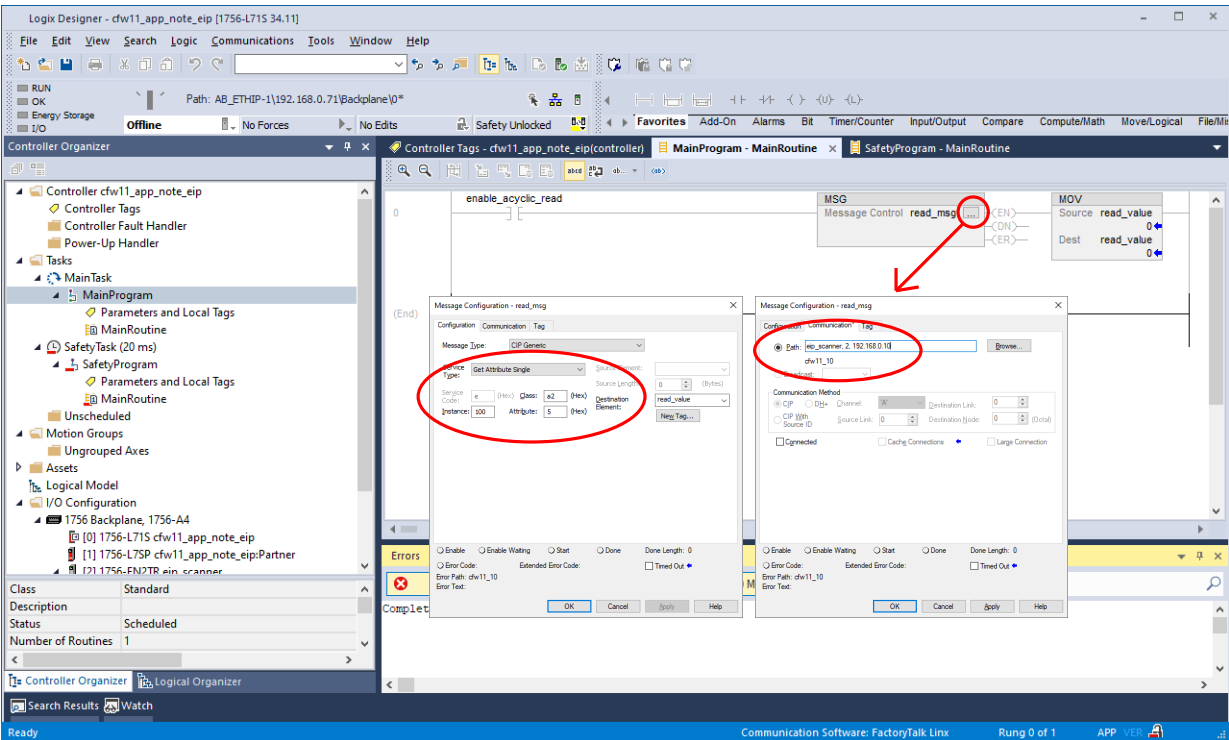
Besides monitoring status data and writing control data, it is possible to create acyclic requests to access other device parameters. For this example, we will read the value of P0100 - Acceleration Time.

Parameter	Class	Instance	Attribute
P0001	162 (A2h)	1	5
P0002	162 (A2h)	2	5
P0003	162 (A2h)	3	5
⋮	⋮	⋮	⋮
P0400	162 (A2h)	400	5
⋮	⋮	⋮	⋮

**Figure 5.3:** CFW-11 Ethernet documentation describing CIP path for acyclic access

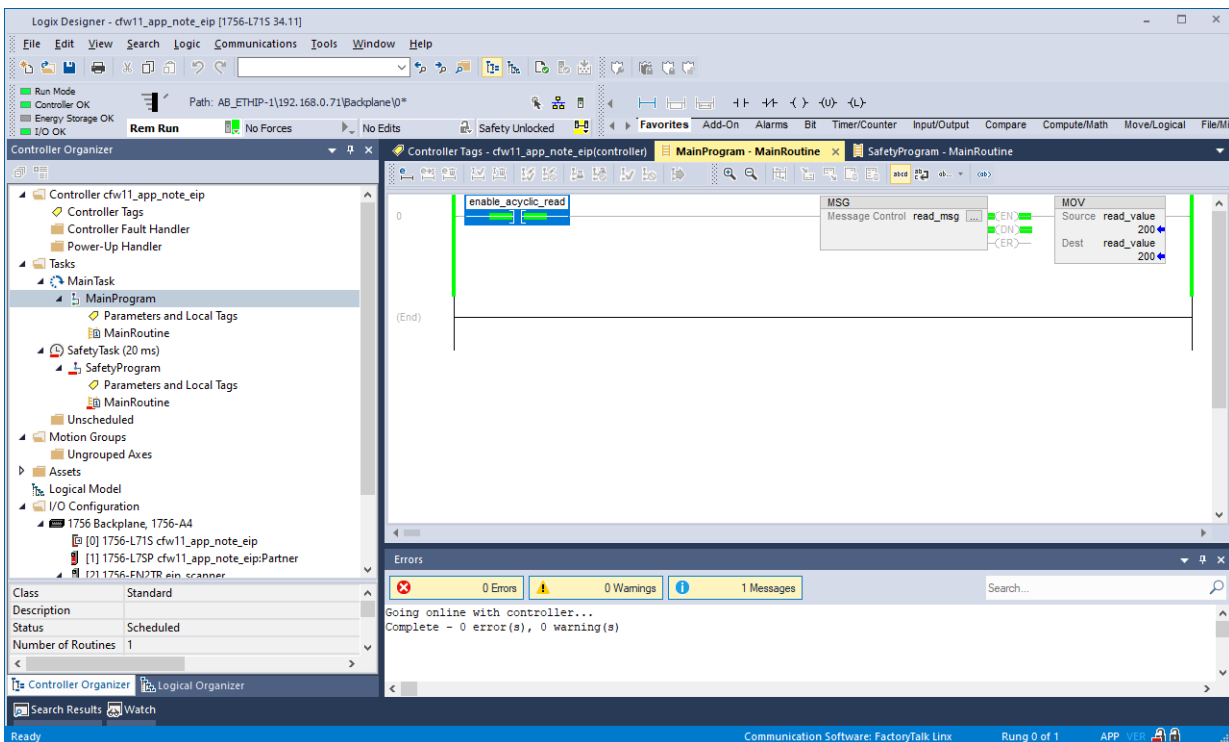
Configure Service, Class, Instance and Attribute to address desired parameter, it is necessary to program the following values:

- Service “Get Attribute Single” to read parameter.
- Class 162 (A2 hex)
- Instance 100
- Attribute 5 (05 hex)



**Figure 5.4: Program MSG instruction**

Once defined the information for acyclic access, design a program using PLC's ladder language. A "MSG" instruction will be used to send such request. In online mode, it is possible to enable the block to send an acyclic request to read the parameter value.



**Figure 5.5: Enable MSG Instruction**

## 6 NETWORK REDUNDANCY

Each ring node supports two EtherNet/IP ports. Therefore, each ring or supervisor node has a embedded Ethernet switch. Note, the CFW-11 is an announced-based ring node.

Figure 1.1 shows a topology of a DLR ring. The application includes CFW-11 frequency converter, PLC, managed switch and a workstation for network configuration. The following configurations have been done via CIP for ring supervisor and back-up supervisor:

Ring Supervisor:

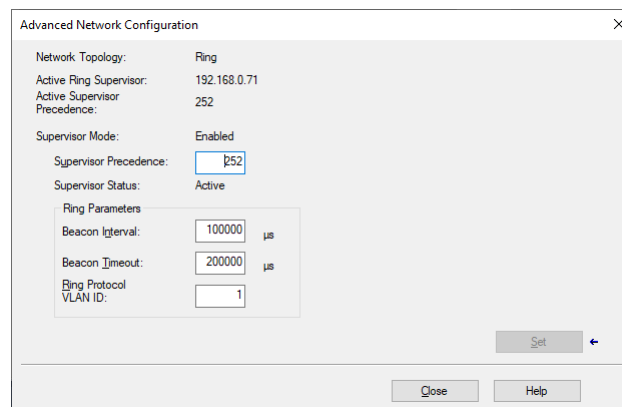
- Precedence: **252**.
- Beacon Interval: **100000**  $\mu$ s.
- Beacon Timeout: **200000**  $\mu$ s.
- VLAN ID: **1**.

Back-up Supervisor:

- Precedence: **250**.
- Beacon Interval: **100000**  $\mu$ s.
- Beacon Timeout: **200000**  $\mu$ s.
- VLAN ID: **1**.

### 6.1 RING SUPERVISOR SETTINGS

Ring Supervisor configuration in Studio 5000.



**Figure 6.1:** Studio 5000 Logix Designer - Ring Supervisor Configuration

With the devices online and arranged according to the diagram in Figure 1.1, the ring will go into Normal state.

## NETWORK REDUNDANCY

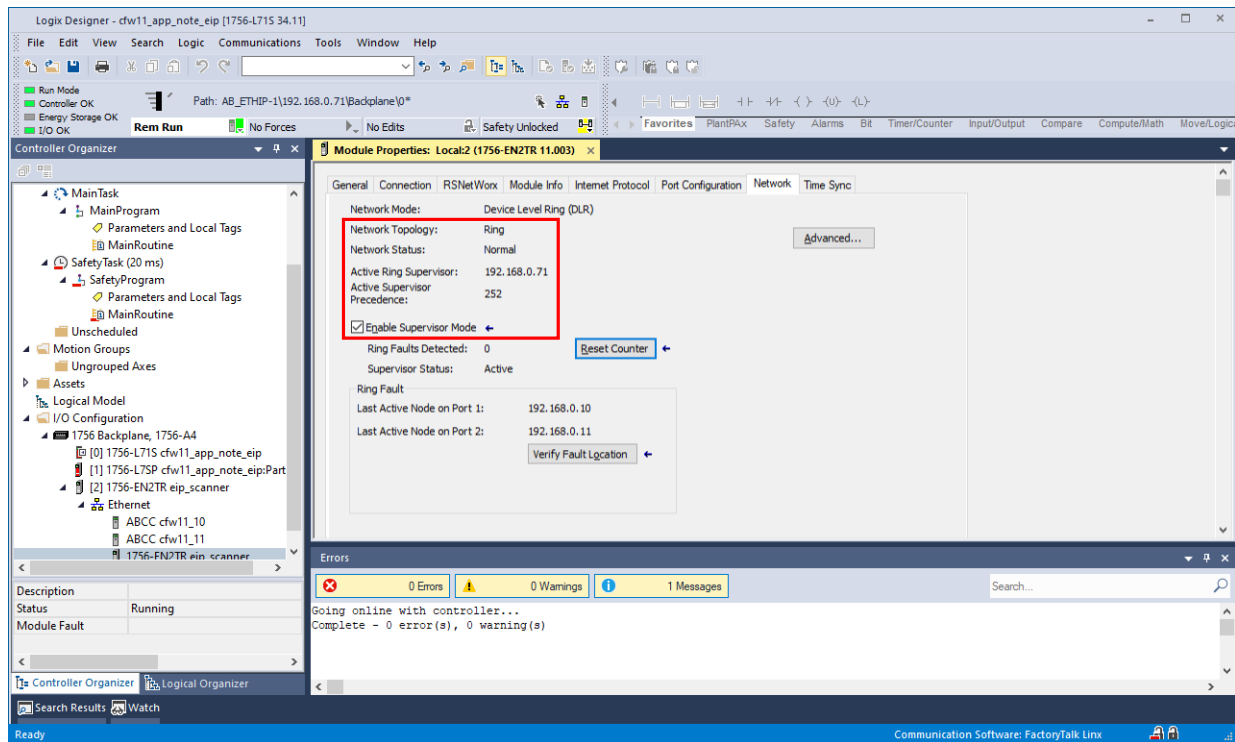


Figure 6.2: Studio 5000 Logix Designer - Ring Supervisor in Normal State

When pulling out one of the network cables, the ring will go into Fault state.

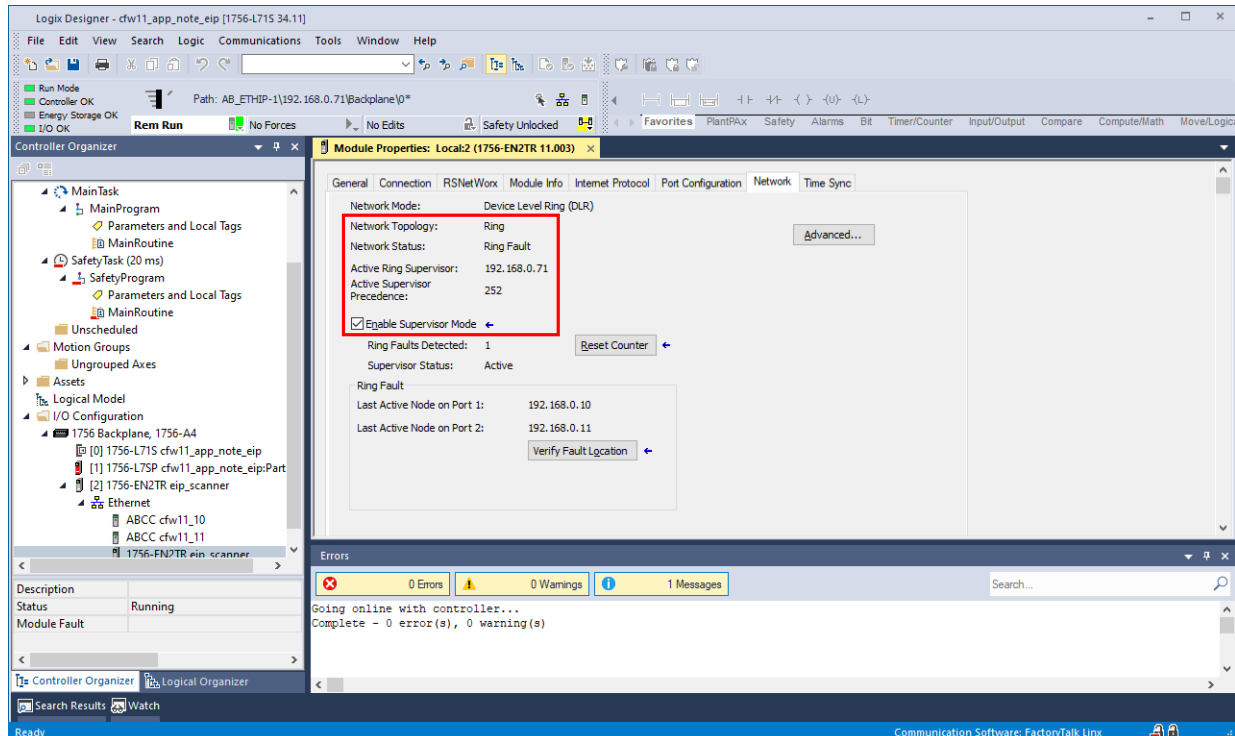


Figure 6.3: Studio 5000 Logix Designer - Ring Supervisor in Fault State

By disabling the Supervisor Mode of the Ring Supervisor, the Back-up supervisor will take over.

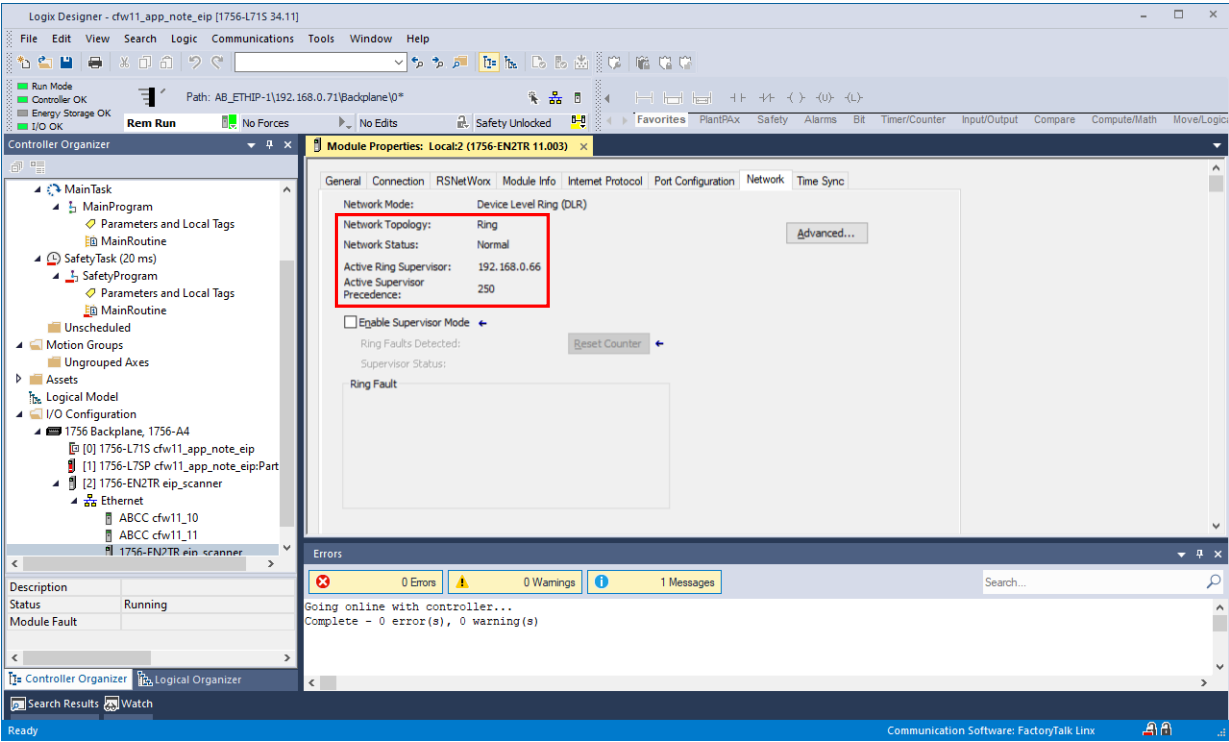


Figure 6.4: Studio 5000 Logix Designer - Back-up Supervisor



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