

Operating CFW900 in an EtherCAT[®] network using TwinCAT[®] automation software

CFW900

Application Note

CFW900-CECAT-N EtherCAT Application Note

CFW900

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SUMMARY OF REVISIONS

The information below describes the reviews made in this manual.

Version	Revision	Description
-	R00	First Edition.

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1 ABOUT THIS DOCUMENT

The purpose of this application note is to provide practical instructions on configuring CFW900 frequency converter for operation in an EtherCAT network using PC-based TwinCAT 3 automation software.

This document is meant for trained personnel working with the described equipment and EtherCAT networks, and requires basic knowledge of automation and programmable logic controllers, in particular about Beckhoff® TwinCAT 3 software.

1.1 REFERENCE DOCUMENTS

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

Document / Tool	Version	Author
CFW900 User's Manual	10008985516 / 02	WEG
CFW900 Programming Manual	10008985492 / 03 (1.08.xx)	WEG
CFW900 Anybus User's Guide	10011171364 / 00	WEG
TwinCAT Automation Software	3.X	BECKHOFF
WPS	3.00	WEG

1.2 DISCLAIMER

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EtherCAT® is a registered trademark of Beckhoff Automation GmbH.

TwinCAT® is a registered trademark of Beckhoff Automation GmbH.

Windows® is a registered trademark of Microsoft Corporation.

1.4 ARCHITECTURE

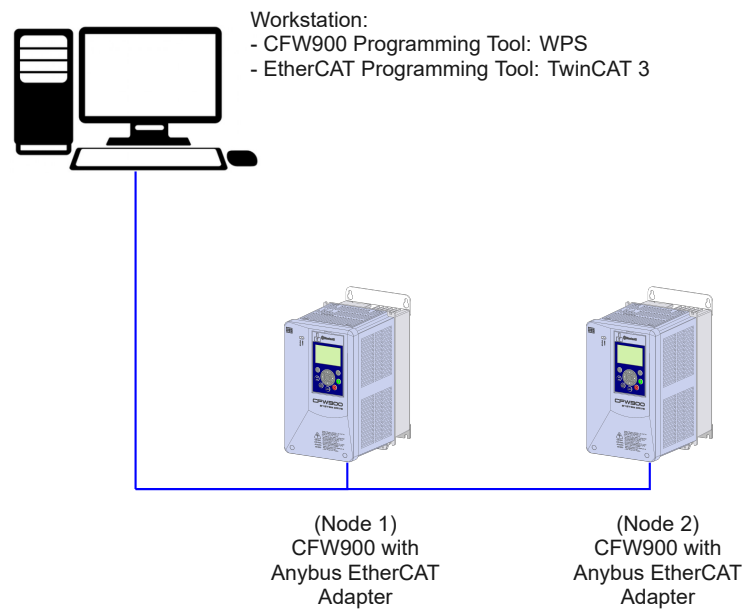


Figure 1.1: Network components

1.5 CFW900

- Equipment: CFW900 version 1.08.0X
- Programming tool: WPS version 3.00

1.6 PC

- Programming tool:
 - Beckhoff TwinCAT 3

1.7 PASSIVE COMPONENTS

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

2 IP ADDRESS AND NETWORK CONFIGURATION

Due to the way EtherCAT was designed, IP addresses are not mandatory. TwinCAT automation software uses a different mechanism to address the devices on the network. However, if IP routing is required, for features such as Ethernet over EtherCAT (EoE), then each node on the network must have a unique IP address. Considering this scenario, one could have the following settings:

- Subnet mask: 255.255.255.0
- IP addresses: each device must have a different IP address
 - Workstation: 192.168.0.83
 - CFW900 (node 1): 192.168.0.10 (as described in item 3)
 - CFW900 (node 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:

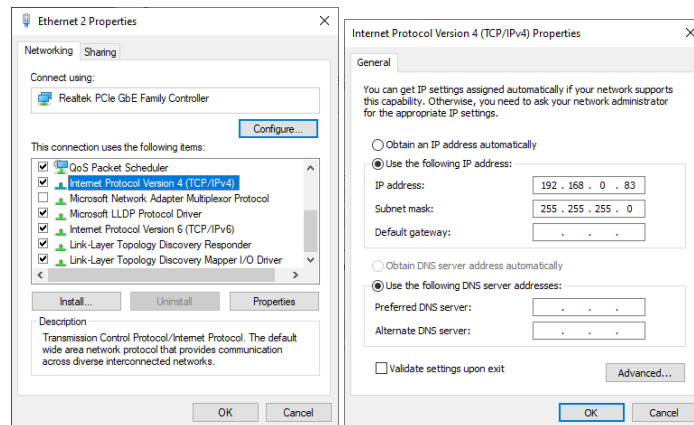


Figure 2.1: PC IP Address Configuration

2.2 TWINCAT IP ADDRESS CONFIGURATION

User do not need to explicitly set IP address for TwinCAT software. But when creating a new project, one of the first actions is to select the Ethernet interface that is going to be used. Figure below shows Device 3, a local PC Ethernet card which is connected to the EtherCAT devices:

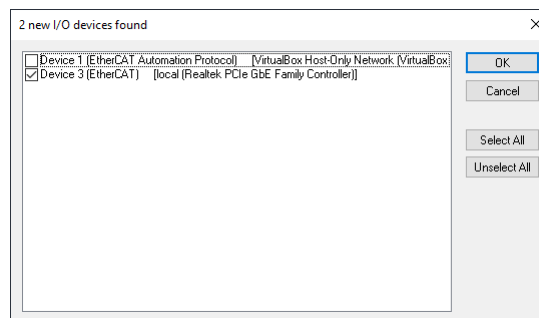


Figure 2.2: TwinCAT Ethernet Interface Selection

3 DRIVE CONFIGURATION - CFW900

This section describes the main configurations for operating the CFW900 frequency converter in an EtherCAT network. Some of these parameters are only available if CFW900-CECAT-N accessory is properly installed.

Refer to the CFW900 programming manual for the necessary configurations related to other device functions, like motor configuration, protections, etc.

3.1 ANYBUS INTERFACE

For this application, the following configurations have been done via keypad:

- C9.7.8 Anybus - IP Address Settings: **0** (Parameters)
- C9.7.9 Anybus - IP Address: 192.168.0.**10** and 192.168.0.**11**
- C9.7.10 Anybus - CIDR Subnet: 255.255.255.0
- C9.7.11 Anybus - Gateway: 0.0.0.0



NOTE!

After changing these configurations, the equipment must be turned off and on again.

3.2 LOCAL/REMOTE

CFW900 has three operating modes: Local (via HMI), Remote 1 (R1) and Remote 2 (R2). For each operating mode, it is necessary to define the source that it will be used to control the drive. For this application, the following control sources have been defined:

- Local: Keypad disable
- R1: Anybus
- R2: Not used
- R1/R2 selection: Not used. Commands not coming from R1 will be ignored by the drive

Based on this, the following configurations have been programmed:

- C4.1.1 Command mode: Remote 1
- C4.1.3 HMI LOC/REM Key: Disable
- C4.2.1.1 General Enable: Anybus
- C4.2.1.2 Run/Stop: Anybus
- C4.2.1.3 Direction of Rotation: Anybus
- C4.3.1.2.1 Speed Ref. Source - Remote 1 Mode: Anybus

3.3 COMMUNICATION ERROR

For CFW900, 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

DRIVE CONFIGURATION - CFW900

For both situations, CFW900 will indicate A129 or F229 (Anybus Module Offline). It is important to define the action CFW900 will take in case of communication error. If CFW900 was running the motor via network command, CFW900 should also perform a general disable. Based on this, the following configurations have been programmed:

- C9.1.1.2 Master Offline Alarm Action: 2 (General Disable)

3.4 I/O DATA CONFIGURATION

CFW900 has a set of parameters where it is possible to program any device data to be exchanged with network master. The last chapter of Anybus User's Guide provides the entire list of parameters available for that.

Parameter	Description	Range of values	Decimal places	Data type	Net Id	Size	Qty mapped words
S3.8.6.2	Sensor 2	-100.0 to 250.0 °C	1	INT	9122	s16bit	1
S3.8.6.3	Sensor 3	-100.0 to 250.0 °C	1	INT	9123	s16bit	1
S3.8.6.4	Sensor 4	-100.0 to 250.0 °C	1	INT	9124	s16bit	1
S3.8.6.5	Sensor 5	-100.0 to 250.0 °C	1	INT	9125	s16bit	1
S3.8.6.6	Sensor 6	-100.0 to 250.0 °C	1	INT	9126	s16bit	1
S4 Status/Functional Safety							
S4.1	Status	0 = Not used 1 = STO 2 = Operational 3 = Programming 4 = SS1-t 5 = Fault		USINT	90	enum	1
S4.2	SS1-t Delay Time	0 to 999 s	0	UINT	92	16bit	1
S5 Status/Communications							
S5.1	Status and Commands						
S5.1.1	Status Word 1	Bit 0 = STO Bit 1 = Run Command Bit 2 = Local Bit 3 = Not used Bit 4 = No Quick Stop Bit 5 = 2nd Ramp Bit 6 = Config. Mode Bit 7 = Alarm Bit 8 = Running Bit 9 = Enabled Bit 10 = Reverse Bit 11 = JOG Bit 12 = Remote 2 Bit 13 = Undervoltage Bit 14 = Not used Bit 15 = Fault		WORD	680	16bit	1
S5.1.2	Speed	-200.00 to 200.00 %	2	INT	681	s16bit	1
S5.1.3	Status Word 2	Bit 0 = Self-tuning		WORD	690	16bit	1

Figure 3.1: List of available data described in CFW900-CECAT-N User's Guide

Always refer to that chapter to select the data (Net Id and Qty mapped words) needed according to the application. For this example, CFW900 (node 1) will exchange the following I/O data:

Mapped Inputs	Net Id	Size	Qty Mapped Words
S5.1.1 Status and Commands Status Word 1	680	16bit	1
S5.1.2 Status and Commands Speed	681	16bit	1
S2.3.1 Inverter Output Current	3	16bit	1
S2.3.5 Inverter Output Power	10	16bit	1
TOTAL			4 Words (8 Bytes)

Mapped Outputs	Net Id	Size	Qty Mapped Words
S5.6.3 Anybus Control Word	660	16bit	1
S5.6.4 Anybus Speed Reference	661	16bit	1
TOTAL			2 Words (4 Bytes)

Based on this sequence, appropriate values for drive parameters are set as below.

Data read configuration (Slave → Master):

- C9.7.1 Anybus Readings 1st Word: 1
- C9.7.2 Anybus Readings Quantity: 4
- C9.2.1.1 Reading Data Word #1: 3 (Inverter Output Current)
- C9.2.1.2 Reading Data Word #2: 10 (Inverter Output Power)

Data write configuration (Master → Slave):

- C9.7.3 Anybus Writings 1st Word: 1
- C9.7.4 Anybus Writings Quantity: 2

And CFW900 (node 2) will exchange I/O data below¹:

Mapped Inputs	Net Id	Size	Qty Mapped Words
S5.1.1 Status and Commands Status Word 1	680	16bit	1
S5.1.2 Status and Commands Speed	681	16bit	1
TOTAL			2 Words (4 Bytes)

Mapped Outputs	Net Id	Size	Qty Mapped Words
S5.6.3 Anybus Control Word	660	16bit	1
S5.6.4 Anybus Speed Reference	661	16bit	1
TOTAL			2 Words (4 Bytes)

The same applies for CFW900 (node 2).

Data read configuration (Slave → Master):

- C9.7.1 Anybus Readings 1st Word: 1
- C9.7.2 Anybus Readings Quantity: 2

Data write configuration (Master → Slave):

- C9.7.3 Anybus Writings 1st Word: 1
- C9.7.4 Anybus Writings Quantity: 2

¹Remember that the first 2 words for input (680 and 681) and output (660 and 661) are fixed.

4 CONTROLLER CONFIGURATION - TWINCAT

TwinCAT is the only engineering tool required to configure an EtherCAT network and operate devices on it. The following sections show how to create a project, put CFW900 online, read and write process data and send acyclic commands to access equipment parameters.

4.1 REGISTER ESI FILE

The TwinCAT EtherCAT Master requires the device description files of all EtherCAT devices for configuration. These device descriptions are called ESI files (EtherCAT Slave Information) in XML format.

To register the ESI file for CFW900², copy it into the TwinCAT installation directory, typically “C:\TwinCAT\3.1\Config\Io\EtherCAT”.

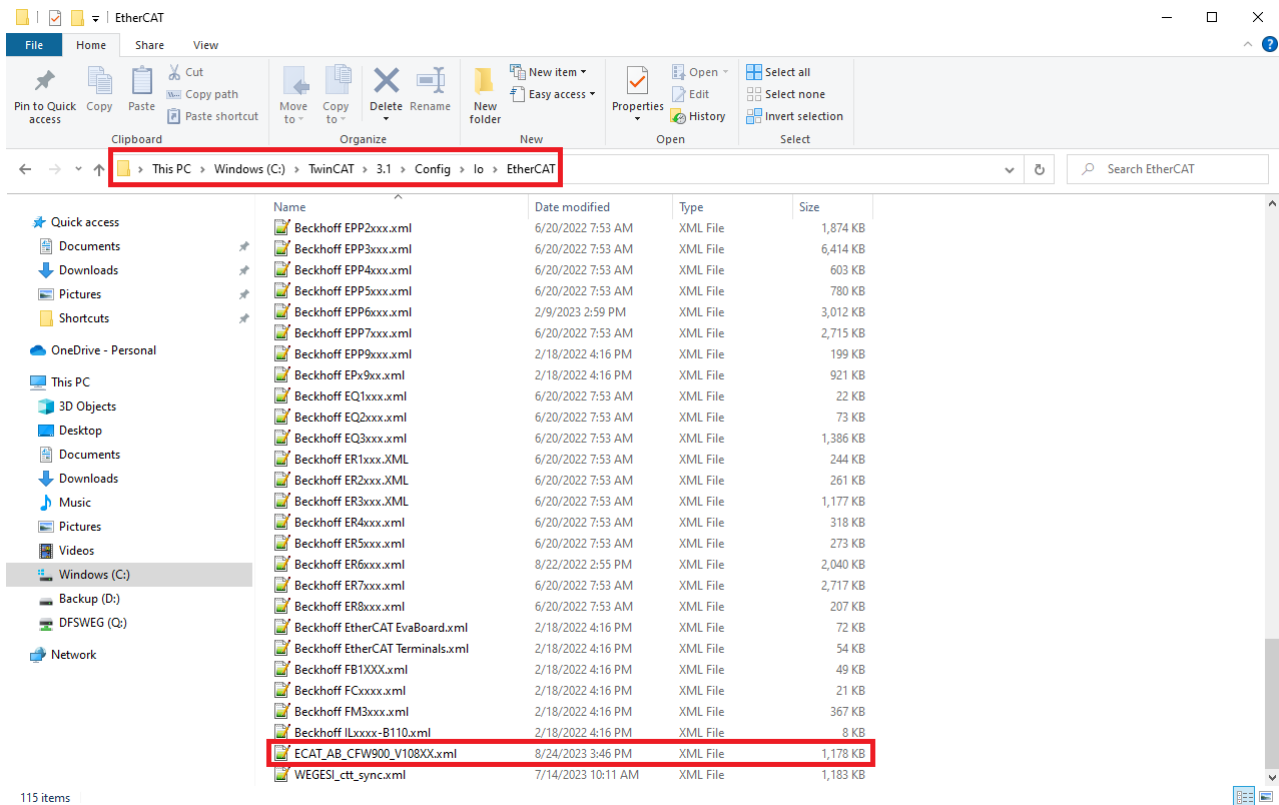


Figure 4.1: Registering CFW900 ESI file

²ECAT_AB_CFW900_V108XX.xml is available for download from WEG website.

4.2 CREATE A PROJECT

Open TwinCAT and click “New TwinCAT Project...” to create a new project.

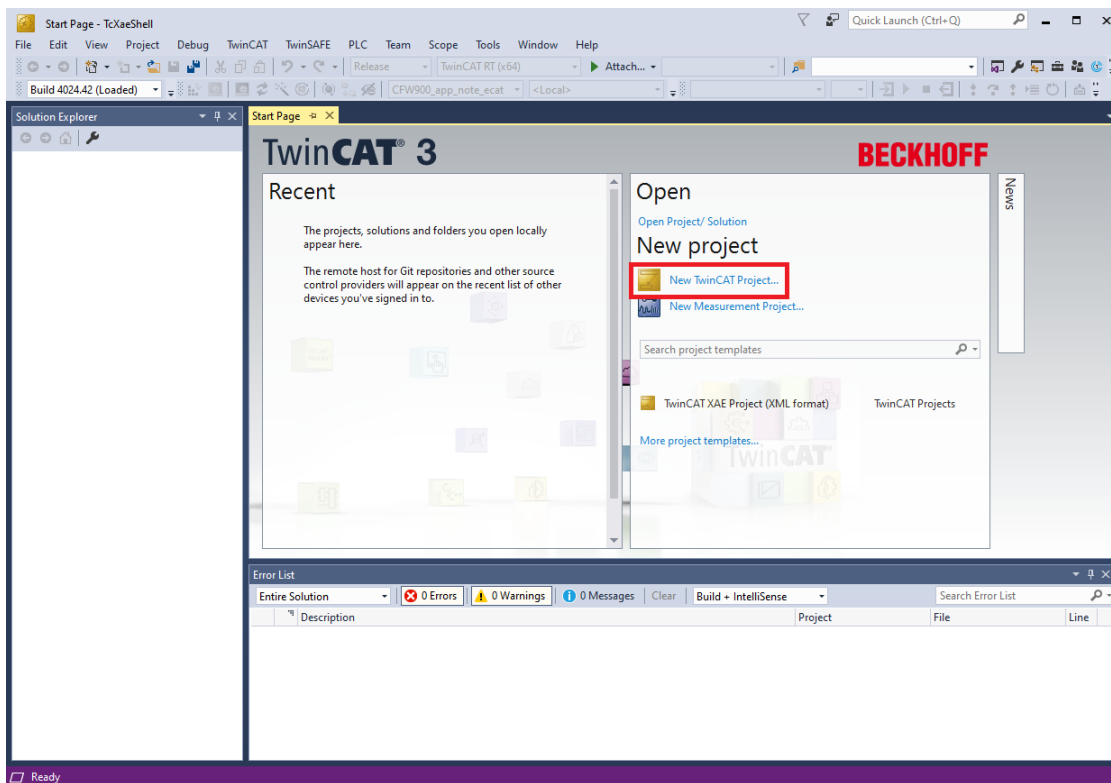


Figure 4.2: TwinCAT main window

Provide a name for the project and click Ok.

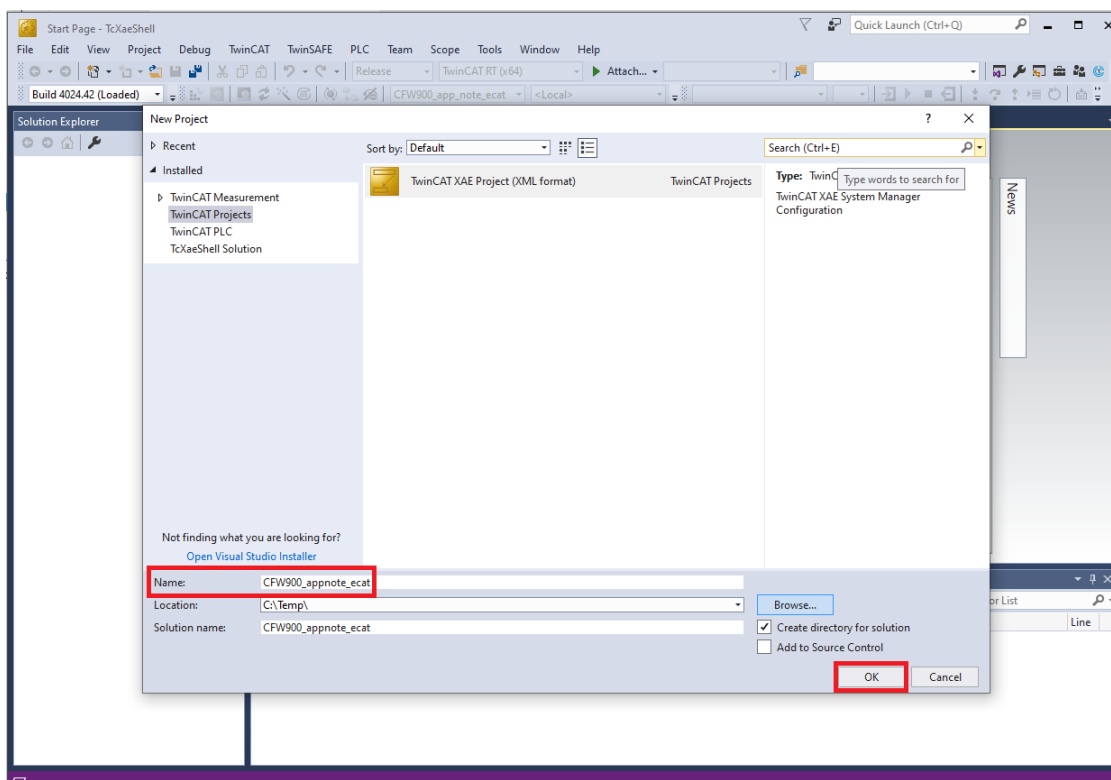


Figure 4.3: Creating a new project

Click in the menu under **TwinCAT > EtherCAT Devices** on **Reload Device Description**.

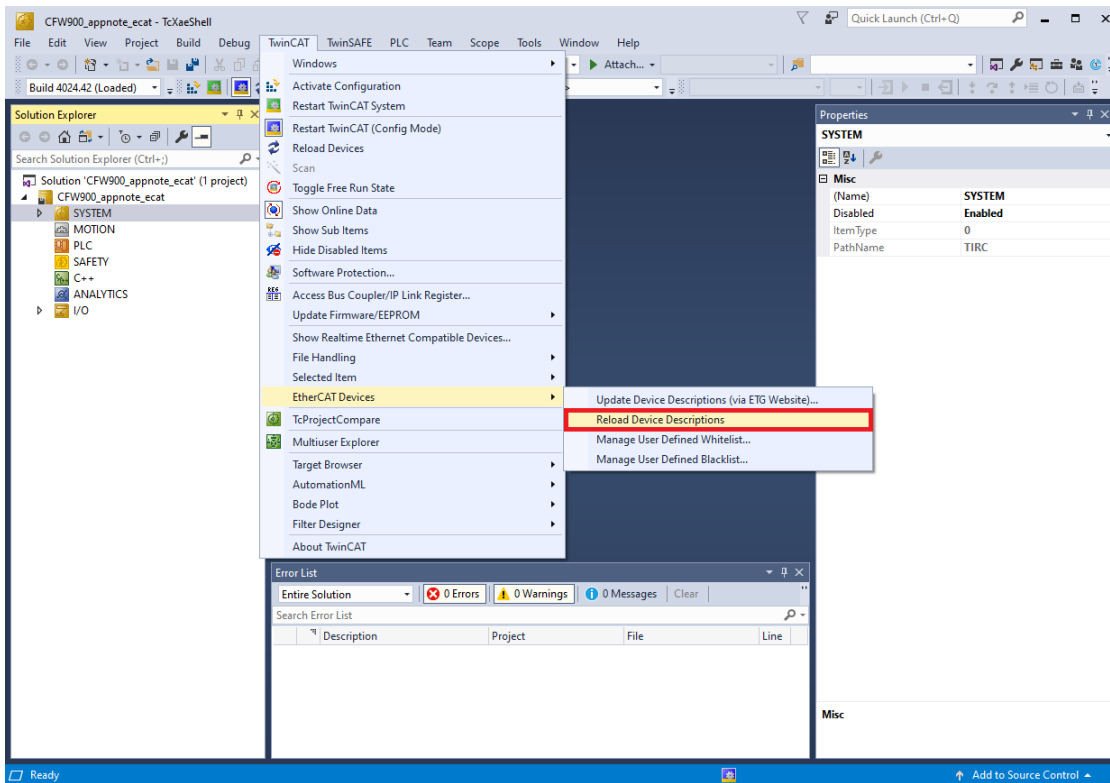


Figure 4.4: Re-read ESI files into TwinCAT

In the **Solution Explorer** window, in the left hand side, click in **I/O**, then right-click in **Devices** and select **Scan**.

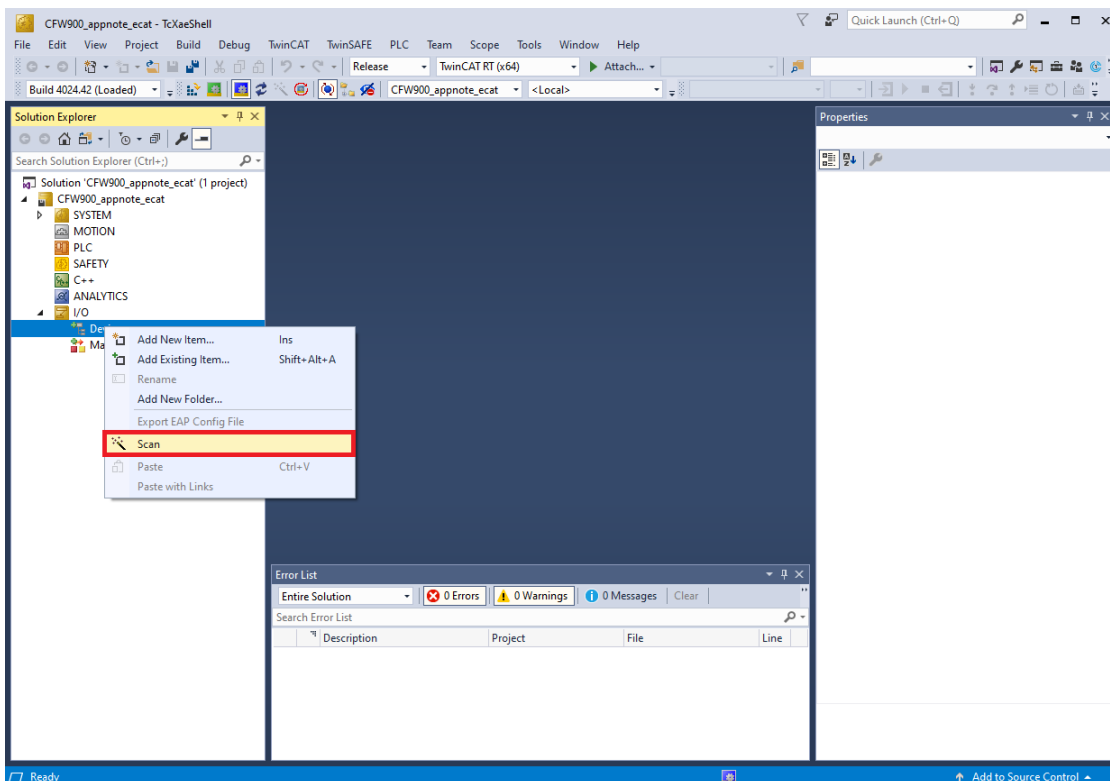


Figure 4.5: Trigger scan

CONTROLLER CONFIGURATION - TWINCAT

Select **Device 3** which corresponds to the PC Ethernet interface that is connected to the EtherCAT devices downstream. This setting might be different depending on the computer being used, so make sure to tick the right **Device**.

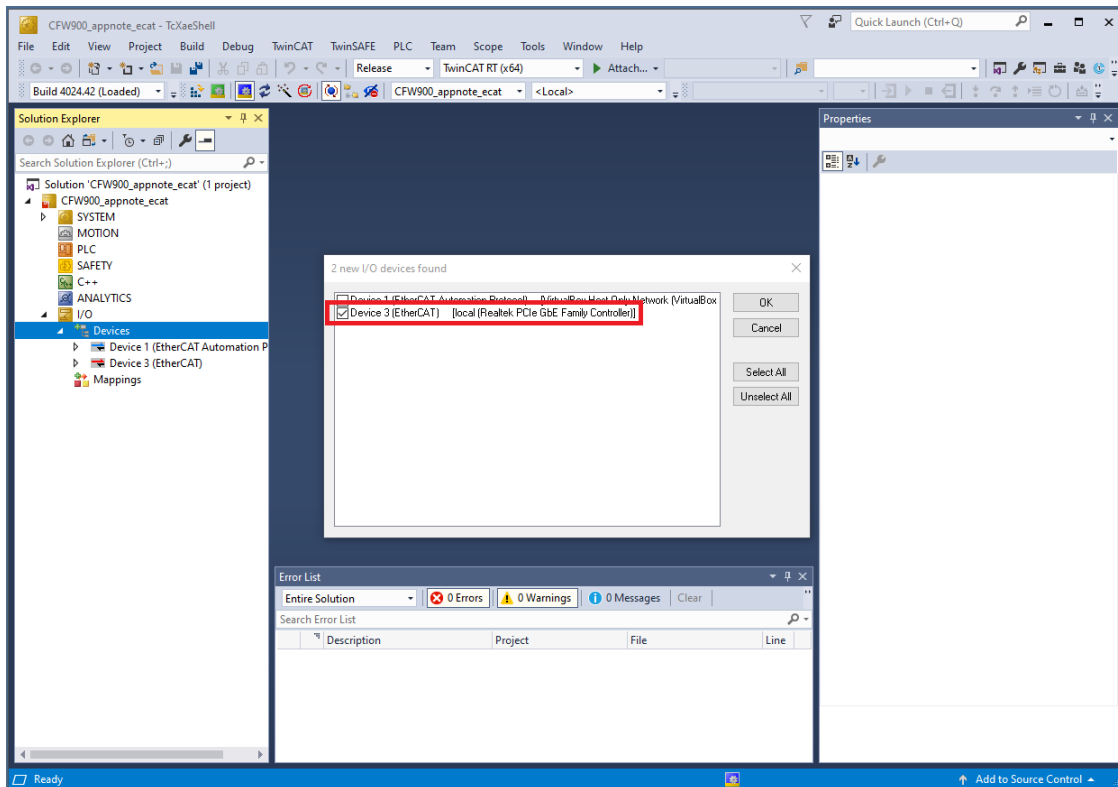


Figure 4.6: Select Ethernet interface

Click **Yes** button to start the **Scan for boxes** and then again in the next screen to **Activate Free Run**.

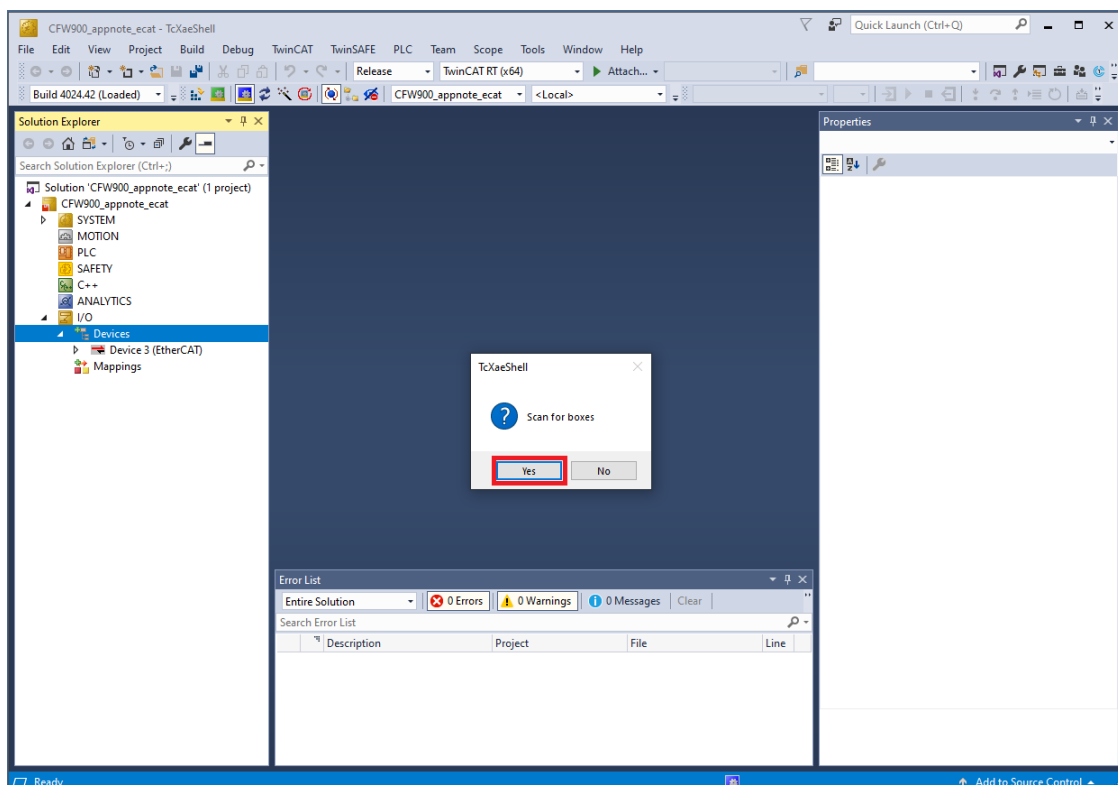


Figure 4.7: Search network for devices

At this point, all EtherCAT devices found in the network should appear in the **Solution Explorer** window. In this example, both drives CFW900 are found, labeled as Box 1 (CFW900 Anybus-CC) and Box 2 (CFW900 Anybus-CC).

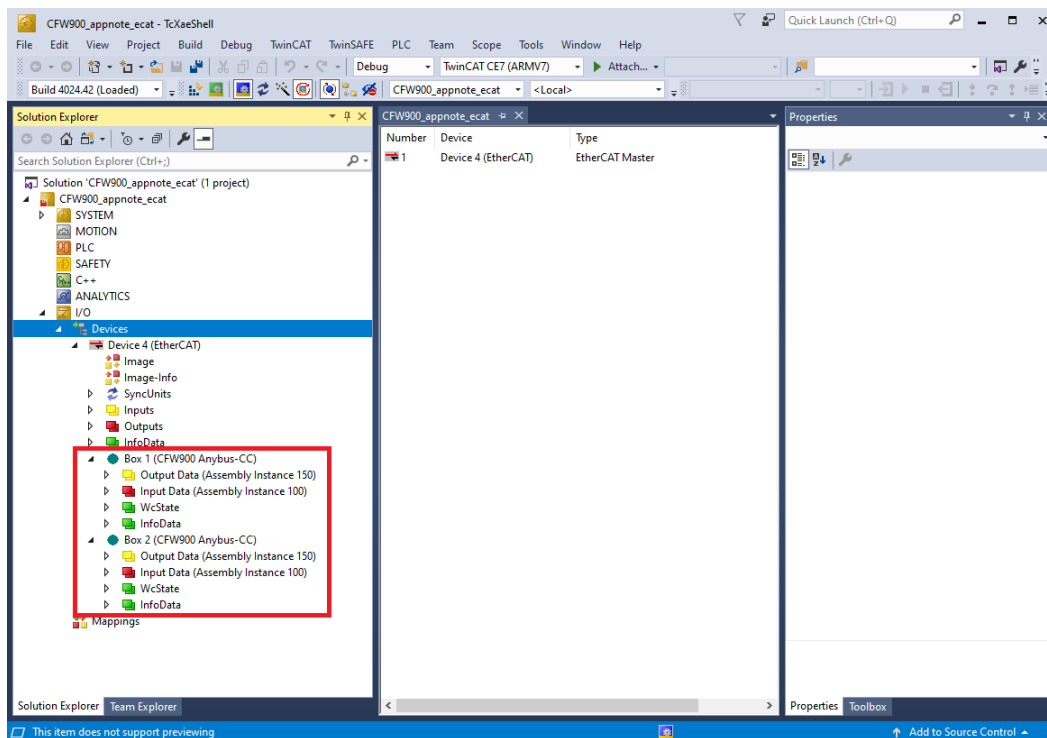


Figure 4.8: List of devices found

CONTROLLER CONFIGURATION - TWINCAT

Note the number of words set for both CFW900 (section 3.4) appear here as **SubIndex**. The sequence also remains the same.

For Box 1 (CFW900 Anybus) we have the following:

- **Output Data:** SubIndex 001 = 680, SubIndex 002 = 681, SubIndex 003 = 3, SubIndex 004 = 10
- **Input Data:** SubIndex 001 = 660, SubIndex 002 = 661

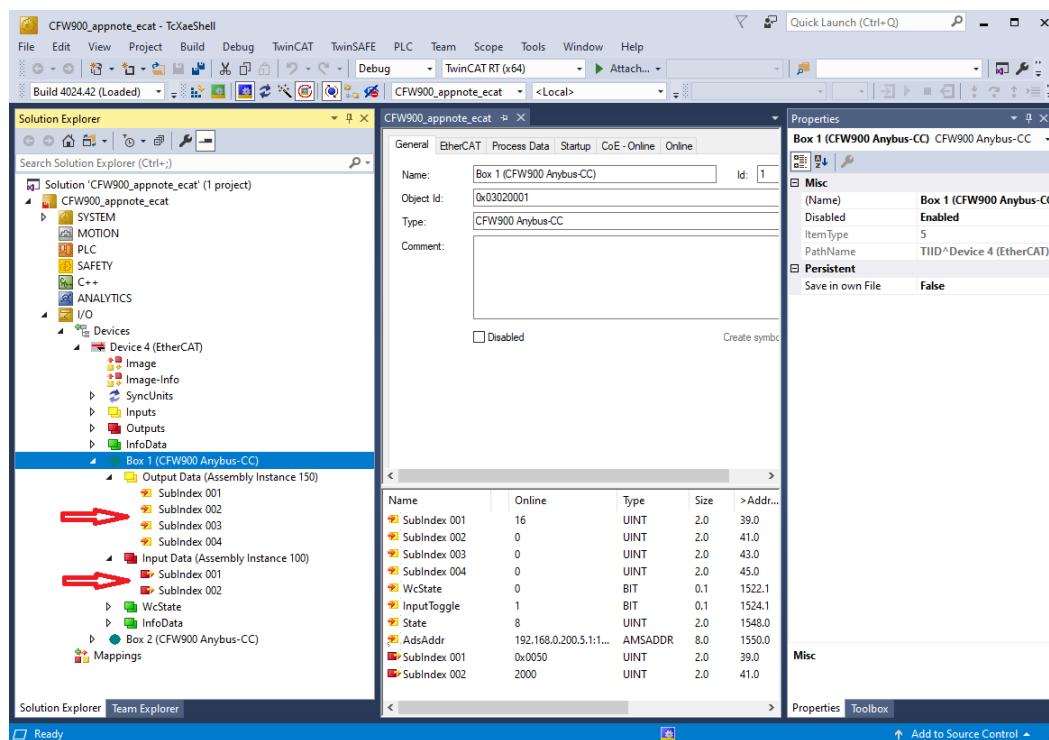


Figure 4.9: CFW900 node 1 I/O data

And Box 2 (CFW900 Anybus):

- **Output Data:** SubIndex 001 = 680, SubIndex 002 = 681
- **Input Data:** SubIndex 001 = 660, SubIndex 002 = 661

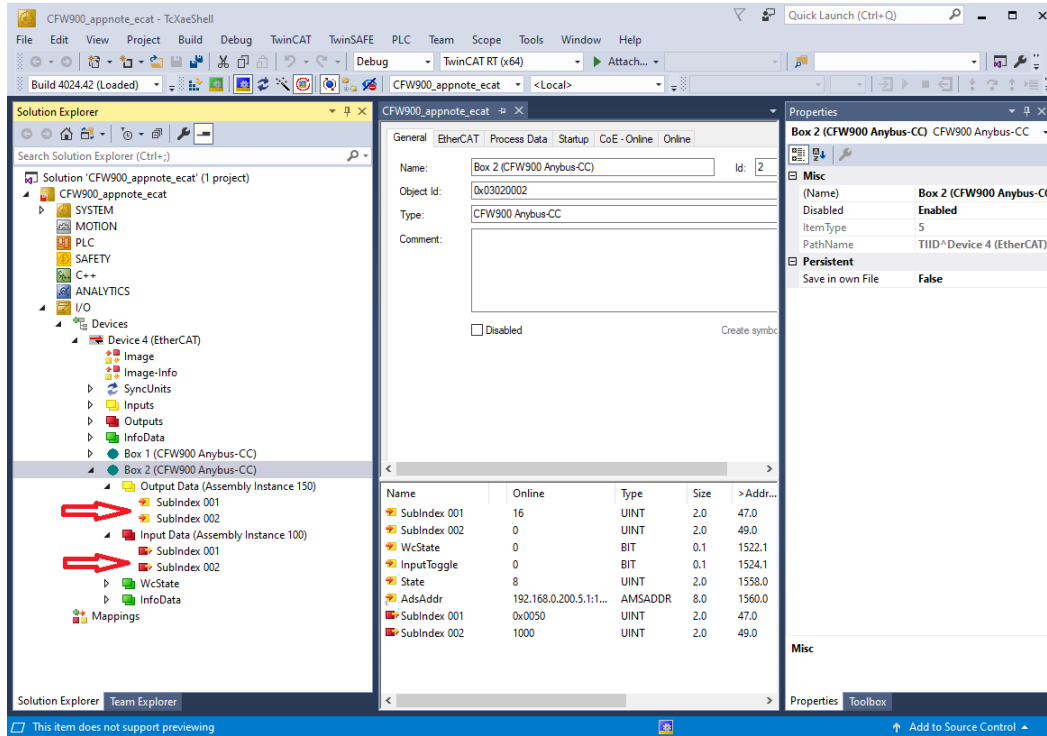


Figure 4.10: CFW900 node 2 I/O data

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

Clicking in Box 1 (CFW900 Anybus-CC) it is possible to check input and write output data directly in the controller memory.

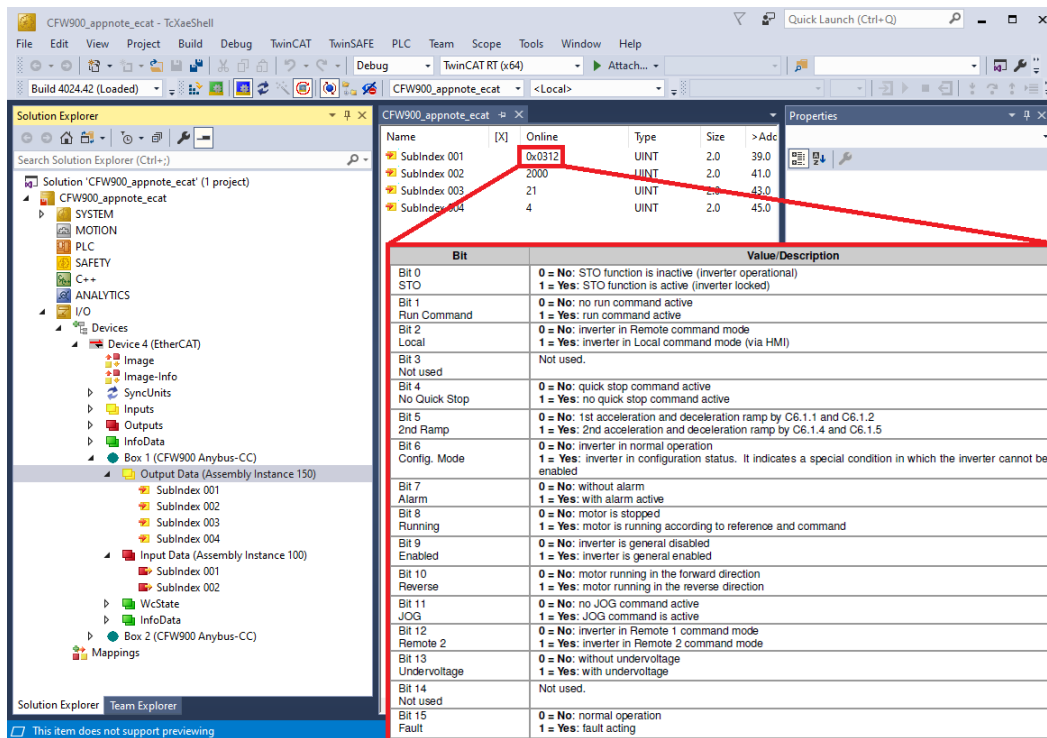


Figure 5.1: Highlighting Status Word 1 as described in CFW900 EtherCAT documentation

For inputs, as described in the section 3.4, one can read the following information:

■ Output Data

SubIndex 001: 680, value 0x0312 hexadecimal (binary 0000 0011 0001 0010).

- Bit 1 = 1 (run command).
- Bit 4 = 1 (no quick stop).
- Bit 8 = 1 (running).
- Bit 9 = 1 (enabled).
- Bit 12 = 0 (R1 command mode).

SubIndex 002: 681, value 2000 (motor speed actual value = 20.00%).

SubIndex 003: 3, value 21 (motor current actual value = 2.1 A).

SubIndex 004: 10, value 4 (motor output power value = 0.04 kW).

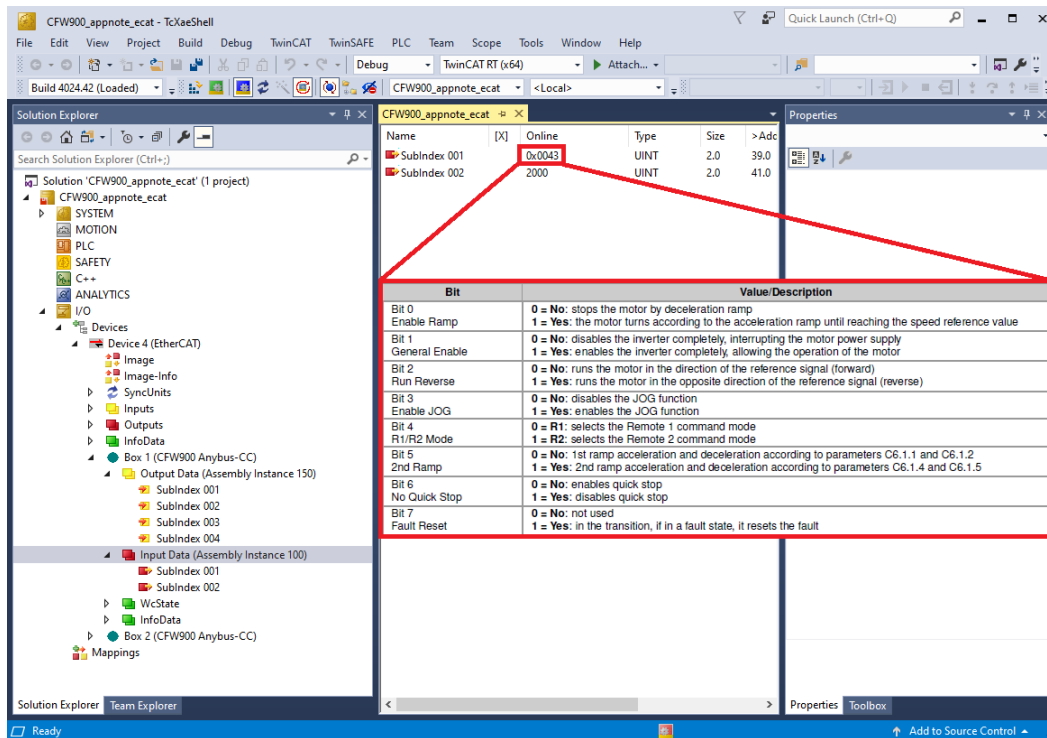


Figure 5.2: Highlighting Control Word 1 as described in CFW900 EtherCAT documentation

For outputs, we have the following:

■ Input Data

SubIndex 001: 660, value 0x0043 hexadecimal (binary 0000 0000 0001 0011).

- Bit 0 = 1 (enable ramp).
- Bit 1 = 1 (general enable).
- Bit 4 = 0 (R1 command mode).
- Bit 6 = 1 (no quick stop).

SubIndex 002: 661, value 2000 (motor speed reference = 20.00%).

5.2 ACYCLIC REQUESTS

Besides monitoring status and writing control data, it is possible to access and change any device parameter selecting **CoE - Online** tab and double-clicking in any parameter. For example, to change C6.1.1 Speed Control Ramps Acceleration Time, just find it in the list, change the value and click Ok button.

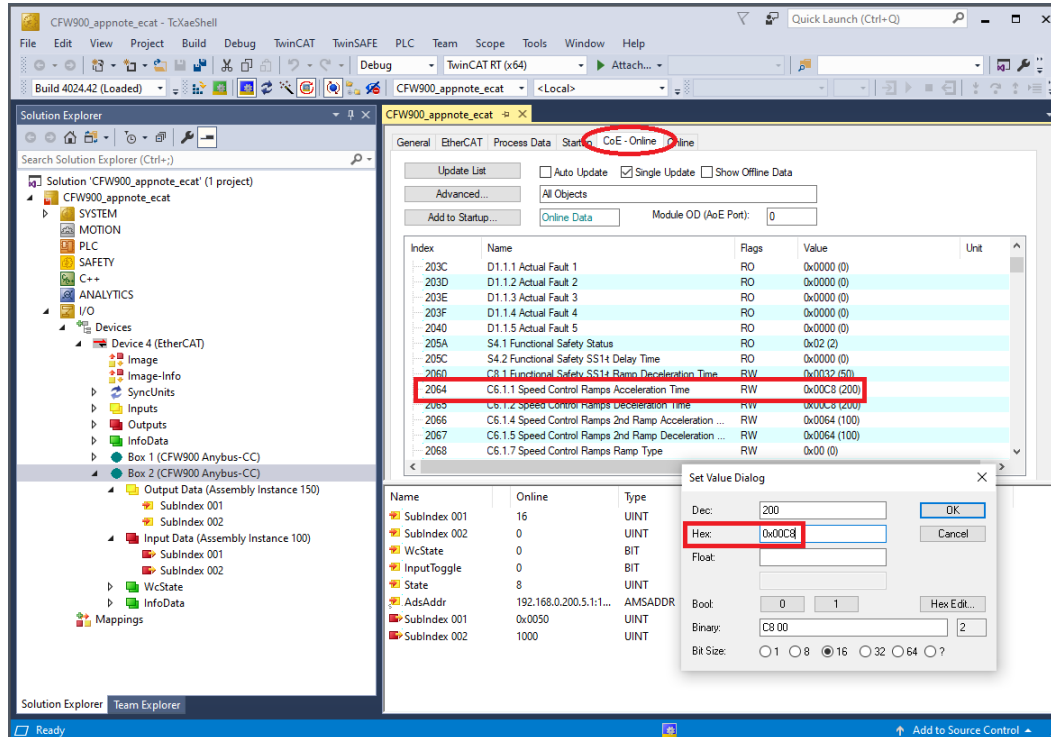


Figure 5.3: Changing acyclically a drive's parameter



WEG Drives & Controls - Automation LTDA.
Jaraguá do Sul - SC - Brazil
Phone 55 (47) 3276-4000 - Fax 55 (47) 3276-4020
São Paulo - SP - Brazil
Phone 55 (11) 5053-2300 - Fax 55 (11) 5052-4212
automacao@weg.net
www.weg.net