Operation on Modbus TCP network using PLC300

CFW320-CETH

Application Note







CFW320-CETH Modbus TCP Application Note

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1 DESCRIPTION

This application note is intended to provide a description of how to program a CFW320 frequency converter with accessory CFW320-CETH to communicate in Modbus TCP network using PLC300.

This document is meant for trained personnel working with the described equipment and Modbus TCP network installation, besides a good knowledge of automation and programmable logic controllers, in particular about WPS software.

1.1 REFERENCE DOCUMENTS

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

Document	Version	Source
CFW320 User's Manual	10008951055 / 00	WEG
Micro Mini Drives Programming Manual	10006257370 / 02	WEG
CFW320 Ethernet User's Guide	10009156409 / 00	WEG
PLC300 Modbus TCP user's manual	10002233461 / 00	WEG
WPS	3.00	WEG

1.2 ARCHITECTURE



Figure 1.1: Network components for this application

1.3 CFW320

- Equipment: CFW320 version 1.00.
- Accessory: CFW320-CETH version 1.01.
- Programming tool: WPS version 3.00.

1.4 PLC300

- CPU: PLC300HP version 4.13.
- Programming tool: WPS version 3.00.



1.5 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 an compatible IP address configuration. It means the IP address must be at the same range, according to network mask. For this example, we will use the following IP addresses:

- Static IP (not DHCP)
- Subnet mask: 255.255.255.0
- IP addresses: each device must have a different IP address.

```
PC: 192.168.0.2
PLC300: 192.168.0.10
CFW320: 192.168.0.11 (as described in Chapter 3 SERVER CONFIGURATION - CFW320 on page 8).
```

2.1 PC IP ADDRESS CONFIGURATION

To configure this options at Windows platform, go to "Network Connections" and open "Properties" of the desired Ethernet interface:

🎚 Local Area Connection Properties	Internet Protocol Version / (TCP/IDvd) Properties
Networking	General
Connect using:	Vou can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings. Qbtain an IP address automatically O Uge the following IP address: IP address: IP address: IP address: Subhet mask: 255.255.255.00
Install. Uninstall Properties Description Transmission Control Protocol/Internet Protocol. The default wide are network protocol that provides communication across diverse interconnected networks.	Default gateway: Obtain DNS server address automatically Outge the following DNS server addresses: Preferred DNS server: Alkernate DNS server: Validate settings upon exit
OK Cancel	OK Cancel

Figure 2.1: PC IP Address Configuration

2.2 PLC300 IP ADDRESS CONFIGURATION

The IP address for PLC300 can be set via SETUP menu using PLC300 keypad. This can also be done using the Setup Configuration tool in WPS.



Figure 2.2: PLC300 IP Address Configuration



3 SERVER CONFIGURATION - CFW320

This section describes the main configurations for CFW320 frequency converter operation with accessory CFW320-CETH in Modbus TCP network. Some of the described configurations are only available if CFW320-CETH accessory is properly installed.

Refer to the CFW320 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:

- P850 IP Address Config: **0** (Parameters).
- P851 ... P854 IP Address: 192.168.0.11.
- P855 CIDR: 24 (255.255.255.0).
- P856 ... P859 Gateway: 0.0.0.0.



NOTE!

After changing these configurations, for the modification to be effective, the equipment must be turned off and then turned on again.

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:

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cfw320_modbustcp_app_note	Parameters								
- CFW320 (CFW320 v1.0X 380 - 48	🔅 🖶 🗮 HMI							-	-
🖨 🔄 Parameter	😥 🧱 Frequency Inverter Identification	P Description	Offline	Online	Minimum	Maximum	Factory settings	Unit	t T 🚷
Parameters	😥 🧱 Command and References	P000 Access to Parameters	1		0	9999	1		UINT ,
Program	🗉 🗮 Motor Control	P001 Speed Reference	0		0	9999	0		UINT
Diagnostic		P002 Output Speed (Motor)	0		0	9999	0		UINT
A Carlos Wizarde	Eaulte and Alarme	P003 Motor Current	0.0		0.0	100.0	0.0	A	UINT
P P C300 (P C300 v4.13)	Pead	P004 DC Link Voltage	0		0	828	0	V	UINT
PEC300 (PEC300 V4.13)	Read	P005 Output Frequency (Motor)	0.0		0.0	400.0	0.0	Hz	UINT
	Communication	P006 Inverter Status	0: Ready		0: Ready	8: Fire Mode	0: Ready		UINT
	🗈 🚍 SoftPLC	P007 Output Voltage	0		0	480	0	V	UINT
		P009 Motor Torque	0.0		-200.0	200.0	0.0	%	INT
		P011 Power Factor	0.00		0.00	1.00	0.00		UINT
		P012 DI8 to DI1 Status	D12 D13 D14 D15 D16 D17 D18	DI2 DI3 DI4 DI5 DI6 DI7 DI8	0	255	0		UINT
		P013 DO4 to DO1 Status	DO1 DO2 DO3 DO4	DO1 DO2 DO3 DO4	0	15	0		UINT
		P014 AO1 Value	0.0		0.0	100.0	0.0	%	INT
		P015 AO2 Value	0.0		0.0	100.0	0.0	%	INT
		P018 AI1 Value	0.0		-100.0	100.0	0.0	%	INT
		P019 AI2 Value	0.0		-100.0	100.0	0.0	%	INT
		P020 Potentiometer Signal Value	0.0		-100.0	100.0	0.0	%	INT
		P022 FI Value in Hz	0		0	3000	0	Hz	UINT
		P023 Main SW Version	1.00		0.00	99.99	1.00		UINT
		P024 IO Acces. SW Version	0.00		0.00	99.99	0.00		UINT
		P025 Comm. Acces. SW Version	0.00		0.00	99.99	0.00		UINT
		P027 Config. Acces. IO	0: Without Access		0: Without Access		0: Without Access		UINT
		P028 Config. Comm. Acces.	0: Without Access		0: Without Access		0: Without Access		UINT
		P029 Power HW Configuration	0: Not identified		0: Not identified		0: Not identified		UINT
		P030 Module Temperature	0.0		-200.0	200.0	0.0	°C	INT
< >		P037 Motor Overload Ixt	0.0		0.0	100.0	0.0	0/n	LIINT

Figure 3.1: WPS - Parameter list

3.2 LOCAL/REMOTE

CFW320 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 CFW320-CETH accessory installed, the following control sources have been defined:



- Local: keypad will control CFW320 in local mode.
- Remote: CFW320-CETH will control CFW320 in remote mode.
- Local/Remote transition: the definition if the device is in local or remote mode will be controlled by CFW320-CETH commands (remote mode at power on).

Based on this, the following configurations have been programmed:

- P220 LOC/REM Selection Source: CO/DN/DP/ETH (REM). 0
- P222 REM Reference Selection: CO/DN/DP/ETH. 2
- P227 REM Run/Stop Selection: CO/DN/DP/ETH.
- P226 REM FWD/REV Selection: CO/DN/DP/ETH (FWD).
- P228 REM JOG Selection: CO/DN/DP/ETH.



Figure 3.2: WPS - Local/Remote configuration

3.3 COMMUNICATION ERROR

It is important to define the action CFW320 will take in case of communication error. For this application, a communication error will be detected based on Modbus TCP Timeout of 5.0 seconds - if device stops receiving Modbus TCP telegrams for a period longer than 5.0 seconds, it will indicate an alarm. If CFW320 was running the motor via network command, CFW320 should also perform a general disable.

Based on this, the following configurations have been programmed:

- P868 MBTCP Timeout: 5.0s.
- P313 Action for Communic. Error: 2 (General Disable).

4 CLIENT CONFIGURATION - PLC300

To configure and program PLC300 to communicate with CFW320, use WPS software. The main steps are described below.

4.1 CREATE WPS RESOURCE

Add a new resource for the PLC300 to the WPS Configuration. We will use this configuration to develop a ladder logic to send and receive Modbus TCP Client requests to CFW320.

Communication configuration	Communication mana	ger
···· Device	Host:	localhost
···· Information	Port:	34502
Password Password Memory areas	Device Preset: Physical layer: Configuration IP address: TCP port: Unit ID:	PLC300 USB Serial (over USB) 192.168.0.10 502 255 Timeout: 500 Telegram size: 40
	Current connection: Status:	Ethernet/Modbus-TCP/192.168.0.10:502/@255#0#0#5000#40 Test Communication Manager online. Device online. [WEG, PLC300, V4.13]

Figure 4.1: WPS - Add new resource

4.2 DATA ACCESS DEFINITION

For this application, CFW320 will exchange the following data with PLC300:

CFW320 Parameters to Read	Holding Register Address	Size
P680 Logical Status	680	16bit
P681 13-Bit Speed	681	16bit

CFW320 Parameters to Write	Holding Register Address	Size
P684 CO/DN/DP/ETH Control	684	16bit
P685 CO/DN/DP/ETH Speed Ref	685	16bit

After choosing the data, we will create PLC300 memory variables to link with these parameters.



These variables have been created as global variables, to use along the program:

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	Tag	Size	Datatype	At	Address	Bit	Initial Value	Comment	Modbus		
	CFW320_STATUS	0	WORD	%IW	2000		0		6000		
	CFW320_SPEED	0	WORD	%IW	2002		0		6001		
	CFW320_CONTROL	0	WORD	%QW	2004		0		6002		
	CFW320_SPEED_REF	0	WORD	%QW	2006		0		6003		
	₿										
	e.										
< >	GLOBAL LOCAL										
🗗 🔃 Notifications 🐻 Output				WE	G CFW320-CETH V1.01	localhost:34502	Ethernet/Modbus-TCP	/192.168.0.11:5	502/@254#0#	0#5000	#40 🔘

Figure 4.2: WPS - Create Variables

4.3 CONFIGURE CLIENT TO READ/WRITE SERVER DATA

PLC300 uses ladder logic to create and send Modbus TCP requests. There are ladder functions to send read and write Modbus TCP requests, where it is possible to program the IP address, unit ID, port, function code and registers to access.

According to defined in Section 4.2 DATA ACCESS DEFINITION on page 10, it was programmed one ladder function to read data from CFW320, and other ladder function to write data to CFW320, with the following configuration:

CFW320 Modbus TCP Server configuration:

IP: 192.168.0.11; TCP Port: 502; Unit ID: 255;

Read Words:

Modbus Function: 03 - Read Holding Registers;

Initial data address: 680 (Holding Register 680);

Number of data: 2 registers (Logical Status and Motor Speed);

Write Words:

Modbus Function: 16 - Write Multiple Registers;

Initial data address: 684 (Holding Register 684);

Number of data: 2 registers (Control Word and Speed Reference);



Figure 4.3: Ladder Logic to Read/Write Sever Data

The read and write commands are only transmitted in a positive transition of the "Execute" input. So, it is necessary to create a logic to control this transition, and repeat it cyclically in order to keep transmitting data constantly. For this example, a timer function using "POLL_INTERVAL" variable, set to 1000ms, is the default time interval for triggering new requests.

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	Q	STATUS_READ	0	BOOL	0			
		STATUS_READ_ERROR	0	BOOL	0			1
		WRITE_COMMAND	0	BOOL	0			
		COMMAND_WRITE_ERROR	0	BOOL	0		~	·
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🗗 🕕 Notifications 1 Dutput								

Figure 4.4: Logic for Timer Interval

4.4 DOWNLOAD AND MONITOR CONFIGURATION

Once the configuration is finished, download it to PLC from the WPS software. Go to the "Download Resource" option under the "Online" menu. When PLC300 is running the program, it is possible to monitor the ladder to view requests result.



Figure 4.5: Online Monitoring

5 CONTROL AND MONITORING

Once network configuration is done, use WPS to access device data. The main steps are described below.

5.1 VIEW AND EDIT READ AND WRITE DATA

Under the "Configurations" tab, right-click "cfw320_modbustcp_app_note/PLC300/Diagnostic/Monitoring Variable" and add a new file. Click at the plus sign, select the GLOBAL variables and press OK to add them to the monitoring file.

cope Group Lado	ler File			
GLOBAL V *AII * V *A	1.			
earch Anywhere ~				
Variable	Data Type	Group	Ladder	
CAN_BAUDRATE - CAN interface baud rate	BYTE	GLOBAL_SYSTEM	GLOBAL	- L.
CAN_BUS_OFF_COUNTER - Detected buss off error counter	WORD	GLOBAL_SYSTEM	GLOBAL	
CAN_BUS_POWER - CAN bus power supply	BOOL	GLOBAL_SYSTEM	GLOBAL	
CAN_OVERRUN_COUNTER - Lost (overrun) CAN telegram count	er WORD	GLOBAL_SYSTEM	GLOBAL	
CAN_RX_COUNTER - Received CAN telegram counter	WORD	GLOBAL_SYSTEM	GLOBAL	_
CAN_STATUS - CAN interface status	BYTE	GLOBAL_SYSTEM	GLOBAL	
CAN_TX_COUNTER - Transmitted CAN telegram counter	WORD	GLOBAL_SYSTEM	GLOBAL	
FW320_CONTROL	WORD	GLOBAL_NETWORK	GLOBAL	
FW320_READ_DATA[0]	WORD	GLOBAL	GLOBAL	
FW320_READ_DATA[1]	WORD	GLOBAL	GLOBAL	
FW320_SPEED	WORD	GLOBAL_NETWORK	GLOBAL	
FW320_SPEED_REF	WORD	GLOBAL_NETWORK	GLOBAL	
CFW320_STATUS	WORD	GLOBAL_NETWORK	GLOBAL	
FW320_WRITE_DATA[0]	WORD	GLOBAL	GLOBAL	
FW320_WRITE_DATA[1]	WORD	GLOBAL	GLOBAL	
CLEAR_ENC_ALARM - Clear encoder fault alarm	BOOL	GLOBAL_SYSTEM	GLOBAL	
COUNT_TASK10_DISABLE - Disable count task 10	BOOL	GLOBAL_SYSTEM	GLOBAL	

Figure 5.1: Monitoring Variable file

It is now possible to check input and write output data directly at controller memory.

W320 ×						4
Variable	Datatype	User		Monitoring	View as	Status
a 🖃 🔤 Global Variables						
CFW320_STATUS	WORD	0		1011100000010	Binary	ОК
CFW320_SPEED	WORD	0		2049	Decimal	ОК
CFW320_CONTROL	WORD	0		10111	Binary	ОК
CFW320_SPEED_REF	WORD	0		2048	Decimal	ОК
	/					
				Table 4.2: P680 bits fu	unction	
		Bit		Val	lue/Description	
	Bit 0 Rese	erved	-			
	Bit 1	0	0: there was no	Run command		
	Bit 2	Command	0: fire Mode fun	ction inactive		
	Fire I	Mode	1: fire Mode fun	ction active		
	Rese	arved	-			
	Blt 5 2nd	Ramp	0: 1 st accelerati 1: 2 nd accelerat	on and deceleration ramp by F Ion and deceleration ramp by I	2100 and P101 P102 and P103	
	Bit 6 Cont	lg. Mode	0: Inverter opera 1: Inverter In co because It has p	ating in normal conditions nfiguration state. It indicates a parameterization incompatibility	a special condition in which the inve	ter cannot be enabled,
	Bit 7 Alor	n	0: Inverter is not	In alarm state		
	Bit 8 Runr	ning	0: motor is stop 1: inverter is run	ped ning according to reference ar	nd command	
	Blt 9 Enab	bled	0: Inverter Is dis 1: Inverter Is ena	abled abled and ready to run the mot	tor	
	Blt 1 Fow	0 ard	0: motor is runn 1: motor is runn	Ing in the reverse direction Ing in the forward direction		
	Blt 1 JOG	1	0: JOG function 1: JOG function	Inactive active		
	Blt 1 Rem	2 ote	0: Inverter In Lo 1: Inverter In Re	cal mode mote mode		
	Blt 1 Subv	3 /oltage	0: no undervolta 1: with undervol	ige tage		
	Blt 1 Rese	4 erved	-			
	Bit 1 Fault	5	0: Inverter Is not 1: some fault re	In fault state gistered by the inverter		

Figure 5.2: Read data, with highlight to the status word as described at CFW320 Modbus TCP documentation

For inputs, as described in Section 4.2 DATA ACCESS DEFINITION on page 10, it is programmed to read the following information:



- Bit 1 = 1 (run command).
- Bit 8 = 1 (running).
- Bit 9 = 1 (enabled).
- Bit 10 = 1 (forward direction).
- Bit 12 = 1 (at remote mode).
- CFW320_SPEED: value 2049 ($\approx 1/4$ motor nominal speed).

Status
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Table 4.3: P684 bits function		
Bit	Value/Description	
Bit 0	0: stops the motor by deceleration ramp	
Ramp Enable	1: run the motor according to the acceleration ramp until reaching the speed reference value	
Blt 1	0: disables the Inverter, Interrupting the power supply to the motor	
General Enable	1: enables the Inverter, allowing the operation of the motor	
Blt 2 Run Forward	 run the motor in the opposite direction of the reference signal (reverse) run the motor in the direction of the reference signal (forward) 	
Bit 3	0: disable JOG function	
JOG Enable	1: enable JOG function	
Blt 4	0: Inverter goes Into Local mode	
Remote	1: Inverter goes Into Remote mode	
Blt 5	0: acceleration and deceleration ramp by P100 and P101	
2nd Ramp	1: acceleration and deceleration ramp by P102 and P103	
Blt 6 Reserved	•	
Blt 7	0: no function	
Fault Reset	1: If In fault state, reset the fault	
Bit 8 15 Reserved	-	

Figure 5.3: Write data, with highlight to the command word as described at CFW320 Modbus TCP documentation

For output, as described in Section 4.2 DATA ACCESS DEFINITION on page 10, it is programmed to write the following information:

- CFW320_CONTROL: value 23 decimal (binary 0000 0000 0001 0111).
 - Bit 0 = 1 (ramp enable).
 - Bit 1 = 1 (general enable).
 - Bit 2 = 1 (run forward).
 - Bit 4 = 1 (remote).

• CFW320_SPEED_REF: value 2048 (\approx 1/4 motor nominal speed).

5.2 LADDER LOGIC FOR ADDITIONAL DATA TRANSFER

Besides monitoring status data and writing control data, it is possible to create any other request to access server data.





Figure 5.4: Additional message configuration



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