PowerXL™

DX-NET-MODBUSTCP-2
Field bus connection
for Variable Frequency Drives DA1

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Original Operating Instructions
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original German manual.

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Production: René Wiegand
Translation: globaldocs GmbH

Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The applicable national accident prevention and safety regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  - Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
  - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
  - Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

Table of contents

0 About this Manual

0.1 Target group

This manual describes the Modbus/TCP connection DX-NET-MODBUSTCP-2 for the variable frequency drives of the DA1 device series.

It is aimed at experienced drive specialists and automation technicians. Extensive knowledge regarding the MODBUS-TCP fieldbus and programming of a MODBUS-TCP master are assumed. In addition, readers must be familiar with how to use the DA1 variable frequency drive.

Please read this manual carefully before installing and operating the Modbus/TCP connection.

We assume that you have a good knowledge of engineering fundamentals, and that you are familiar with handling electrical systems and machines, as well as with reading technical drawings.

To make it easier to understand some of the images included in this manual, the housing and other safety-relevant parts have been left out.
The components described here must be used only with a properly fitted housing and all necessary safety-relevant parts.

Please follow the notes in the IL040004ZU instruction leaflet.

All the specifications in this manual refer to the hardware and software versions documented in it.

More information on the series described here can be found on the Internet under:
www.eaton.eu/powerxl

0.2 Writing conventions

Symbols used in this manual have the following meanings:

▶ Indicates instructions to be followed.

0.2.1 Hazard warnings of material damages

NOTICE

Warns about the possibility of material damage.

0.2.2 Hazard warnings of personal injury

CAUTION

Warns of the possibility of hazardous situations that may possibly cause slight injury.

WARNING

Warns of the possibility of hazardous situations that could result in serious injury or even death.

DANGER

Warns of hazardous situations that result in serious injury or death.

0.2.3 Tips

Indicates useful tips.

0.3 Abbreviations and Symbols

The following abbreviations are used in this manual:

CW	Command
DS	Default setting
EMC	Electromagnetic compatibility
FB	Field bus
FS	Frame Size
GND	Ground (0 V potential)
LED	Light Emitting Diode (LED)
LSB	Least significant bit
Modbus/TCP	Ethernet Industrial Protocol
MSB	Most significant bit
PC	Personal Computer
PNU	Parameter number
PD	Process Data
PLC	Programmable logic controller
SW	Status Word
UL	Underwriters Laboratories

0.4 Units

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système International d'Unités) units. For the purpose of the equipment's UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

Table 1: Unit conversion examples

Designation	SI value	Imperial unit	Conversion value	US-American designation
Length	25.4 mm	1 in ('')	0.0394	inch
Power	0.7457 kW	1 HP = 1.014 PS	1.341	horsepower
Moment of torque	0.113 Nm	1 lbf in	8.851	pound-force inches
Temperature	-17.222 °C (T_C)	1 °F (T_F)	$T_F = T_C \times 9/5 + 32$	Fahrenheit
Rotational speed	1 min^{-1}	1 rpm	1	Revolutions per minute
Weight	0.4536 kg	1 lb	2.205	pound
Flow rate	1.698 m^3/min	1 cfm	0.5889	cubic feed per minute

1 Device series

1.1 Checking the Delivery

Before opening the package, please check the nameplate on it to make sure that you received the correct connection.

Your fieldbus connection was carefully packaged and handed over for shipment. The devices should be shipped only in their original packaging with suitable transportation materials. Please observe the labels and instructions on the packaging and for handling the unpacked device.

▶ Open the packaging with adequate tools and inspect the contents immediately after receipt in order to ensure that they are complete and undamaged.

The packaging must contain the following parts:

- A fieldbus connection DX-NET-MODBUSTCP-2,
- the instruction leaflet IL040004ZU.

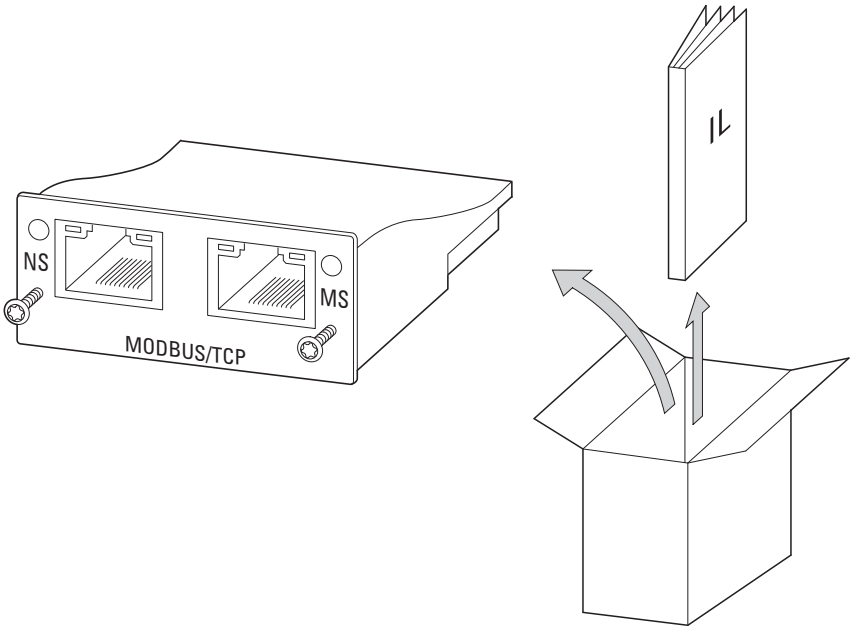


Figure 1: Equipment supplied with fieldbus connection DX-NET-MODBUSTCP-2

1.2 Key to part numbers

The catalog number selection and the part no. for the DX-NET-… field bus connection card have the following syntax:

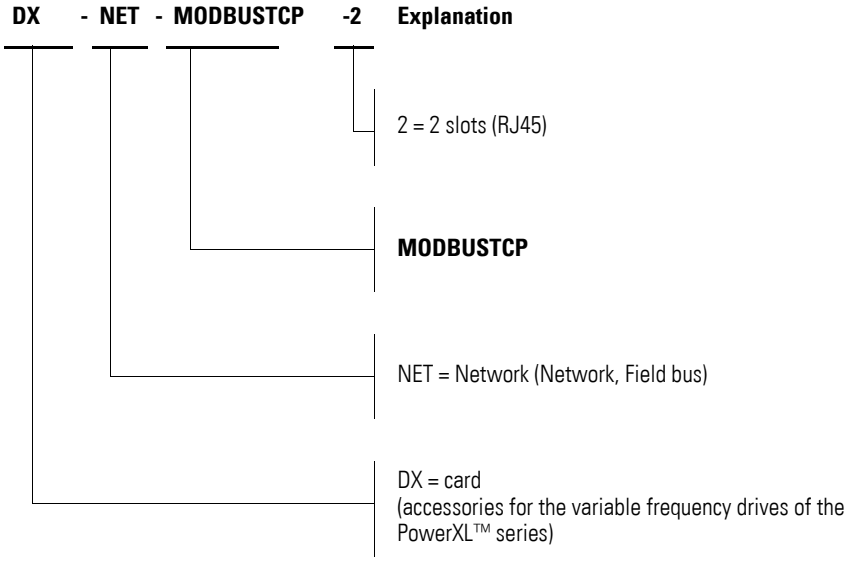


Figure 2: Catalog number selection of field bus interface card DX-NET-…

1.3 General rated operational data

Technical Data	Symbol	Unit	Value
General			
Standards			meets the requirements of the EN 50178 (standard for electrical safety)
Production quality			RoHS, ISO 9001
Ambient conditions			
Operation temperature	ϑ	°C	-40 (no hoarfrost) up to +70
Storage temperature	ϑ	°C	-40 - +85
Climatic proofing	p_w	%	< 95, relative humidity, no condensation permitted
Installation altitude	H	m	max. 1000
Vibration	g	m/s^2	5 – according to IEC 68-2-6; 10 – 500 Hz; 0.35 mm
Modbus/TCP connections			
Interface			RJ45 plug
Data transfer			10/100 MBit/s full duplex/half duplex/ Automatic baud rate detection
Transfer cable			Twisted two-pair balanced cable (screened)
Communication protocol			
Modbus/TCP			Modbus/TCP Server Max. 256 Byte input data Max. 256 Byte output data
Baud rate		MBit/s	10/100

1.4 Designation at DX-NET-MODBUSTCP-2

The following drawing shows the DX-NET-MODBUSTCP-2 fieldbus connection for Modbus/TCP with two RJ45 ports.

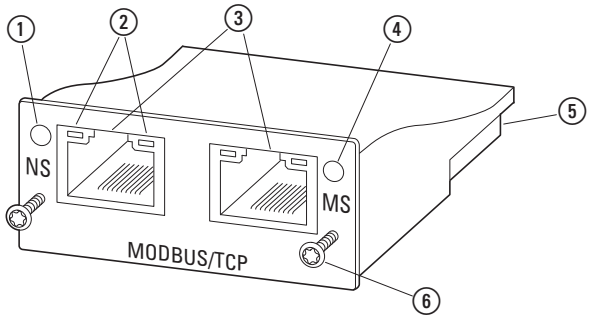


Figure 3: Designations at DX-NET-MODBUSTCP-2

① Network status LED (NS)
② LINK/Activity-LED
③ RJ45 sockets
④ Module status LED (MS)
⑤ 50-pole adapter extension
⑥ Screws for securing DA1 variable frequency drive

1.5 Proper use

The DX-NET-MODBUSTCP-2 fieldbus connection is an electrical piece of equipment that can be used to control DA1 variable frequency drives and connect them to a standard Modbus/TCP field bus system. It is intended to be installed in a machine or assembled with other components into a machine or system. It makes it possible for DA1 series variable frequency drives to be integrated as server (slave) into Modbus/TCP field bus systems.

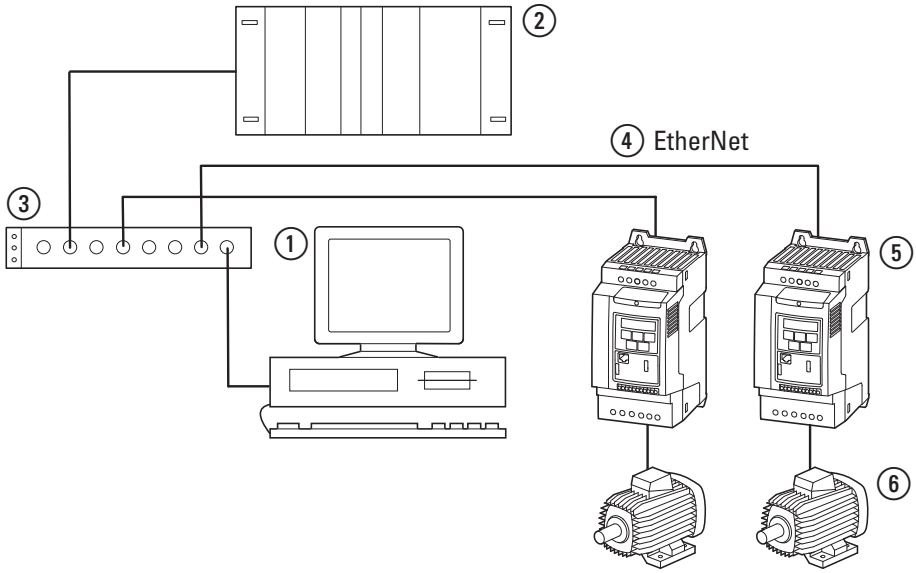


Figure 4: How the DX-NET-MODBUSTCP-2 fieldbus connection can be integrated into a EtherNet/ network

① PC
② Head-end controller (client)
③ Switch
④ Ethernet cable
⑤ Variable frequency drive DA1 with DX-NET-MODBUSTCP-2 connection
⑥ Motor(s)

→ The DX-NET-MODBUSTCP-2 fieldbus connection is not a household appliance, but rather a component intended exclusively for use in commercial applications.

→ Observe the technical data and connection requirements described in this manual.
Any other usage constitutes improper use.

1.6 Maintenance and inspection

The DX-NET-MODBUSTCP-2 fieldbus connection will not require any maintenance if the general rated operational data (→ Page 9), as well as all Modbus-specific technical data, is adhered to. However, external factors can influence the components's lifespan and function. Because of this, we recommend inspecting the devices on a regular basis and carrying out the following maintenance activities at the specified intervals.

Table 2: Recommended maintenance

Maintenance measures	Maintenance interval
Check the filter in the control panel doors (see the manufacturer's specifications)	6 - 24 months (depending on the environment)
Check the tightening torques of the control signal terminals	regularly
Check connection terminals and all metallic surfaces for corrosion	6 - 24 months (depending on the environment)

The DX-NET-MODBUSTCP-2 fieldbus connection has not been designed in such a way as to make it possible to replace or repair it. If the card is damaged by external influences, repair is not possible.

1.7 Storage

If the fieldbus connection is stored before use, suitable ambient conditions must be ensured at the site of storage:

- Storage temperature: -40 - +85 °C,
- Relative average air humidity: < 95 %, no condensation permitted.

1.8 Service and warranty

Contact your local sales partner if you have a problem with your Eaton fieldbus connection.
When you call, have following data ready:

- the exact part no. (= DX-NET-MODBUSTCP-2),
- the date of purchase,
- a detailed description of the problem which has occurred with the DX-NET-MODBUSTCP-2 fieldbus connection.

Information concerning the guarantee can be found in the Terms and Conditions Eaton Industries GmbH.

24-hour hotline: +49 (0) 180 5 223 822
e-mail: AfterSalesEGBonn@Eaton.com

1.9 Disposal

The DX-NET-MODBUSTCP-2 fieldbus connection can be disposed of as electrical waste in accordance with the currently applicable national regulations. Dispose of the device according to the applicable environmental laws and provisions for the disposal of electrical or electronic devices.

2 Engineering

2.1 Modbus/TCP

The Modbus/TCP protocol is an application protocol – belonging to layer 7 of the OSI Reference Model – that can be used to establish and run client/server communications between nodes in different bus systems and networks.

The Modbus/TCP protocol is based on the general principle behind TCP/IP networks: All data and parameters are defined in the payload data of a TCP/IP frame. What is referred to as an "MBAP header" is then added to the start of the message (MBAP stands for "ModBus Application Protocol"). Finally, the data is accessed using special function codes.

Communications between Modbus stations are based on the client/server model: The client (a PLC, for example) begins by transmitting a request to the server using function codes. The server then responds to this request and returns the requested data to the client.

Modbus communications always require a master and one or more slaves. The master always initiates communications, i.e., it establishes a connection to the slaves and uses them to send requests.
This means that the slaves are unable to start communications on their own, and instead are limited to responding to requests from the master once they have executed the corresponding functions.

Each TCP/IP network can have multiple masters, in which case communications will continue to work as described above.

The number of cards on a Modbus/TCP system is virtually unlimited.

2.2 LED indicators

The module's LED indicators are used to indicate operating and network statuses, making quick diagnostics possible.

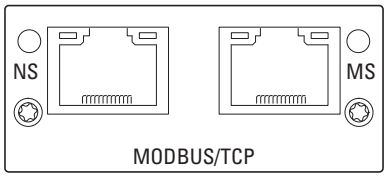


Figure 5: NS and MS LED indicators

2.2.1 NS (Network status)

The network status LED (NS) is used to indicate network statuses.

LED status	Description
off	No supply voltage or no IP address
green illuminating	Connection to Modbus/TCP network established
green flashing	online, but no communication
illuminated red	Error detected (e.g., same IP address assigned twice)
red flashing	Fault detected (e.g., connection request timeout)

2.2.2 MS (Module Status)

The module status LED (MS) is used to indicate the Modbus/TCP module's status.

LED status	Description
off	No supply voltage or device not turned on
green illuminating	Connection to Modbus/TCP client established
illuminated red	Fatal error detected[1)] (EXCEPTION-State)
red flashing	A reversible error has occurred[1)] (IP Address Conflict)

1) Reversible errors can be reset by means of a reset or by power cycling the supply voltage (turning it off and then back on). In contrast, fatal errors can only be reset by power cycling the supply voltage or by changing the hardware configuration while the supply voltage is off, as the case may be.

2.2.3 LINK/Activity-LED

The LINK/Activity LED is used to indicate communications statuses.

LED status	Description
off	No communications or port not connected
green illuminating	Communications established (100 Mbit/s), port connected
green flashing	Data transfer active (100 Mbit/s)
illuminated yellow	Communication established (10 Mbit/s)
yellow flashing	Data transfer active (10 Mbit/s)

3 Installation

3.1 Introduction

This chapter provides a description of the mounting and the electrical connection for the fieldbus connection DX-NET-MODBUSTCP-2.

→ While installing and/or mounting the field bus connection, cover all ventilation slots in order to ensure that no foreign bodies can enter the device.

→ Perform all installation work with the specified tools and without the use of excessive force.

In the case of DA1 variable frequency drives, the way in which the DX-NET-MODBUSTCP-2 fieldbus connection needs to be installed will depend on the corresponding variable frequency drive's size.

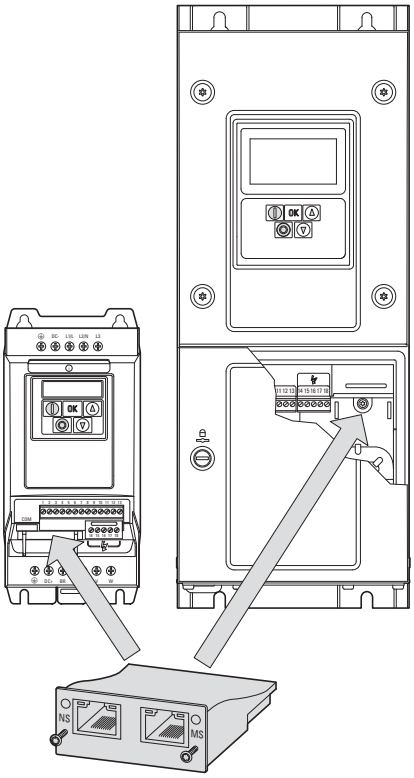


Figure 6: Flush mounting of fieldbus connection

In the case of DA1 variable frequency drives with sizes FS2 and FS3, the fieldbus connection will need to be plugged into the variable frequency drive from below.

In the case of sizes FS4 and up, the fieldbus connection will need to be mounted on the right side, underneath the variable frequency drive's front enclosure cover.

3.2 Notes on the documentation

Documents containing installation instructions:

- IL4020010Z instruction leaflet for DA1 variable frequency drive in size FS2 and FS3
- IL4020011Z instruction leaflet for DA1 variable frequency drive from size FS4

These documents are also available as PDF files on the Eaton Internet website.

www.eaton.eu → **Customer Support → Download Center – Documentation**

To find them quickly, please enter the corresponding number (e.g., 4020010Z) into the **Quick Search** field.

3.3 Notes on the mechanical surface mounting

DANGER

Make sure that the equipment is fully de-energized when performing the handling and installation work required to mechanically set up and install the fieldbus connection.

→ When installing the DX-NET-MODBUSTCP fieldbus connection in devices with a size of FS4 or greater, it will be necessary to open the DA1 variable frequency drive's housing. We recommend that this mounting work be carried out before electrically installing the variable frequency drive.

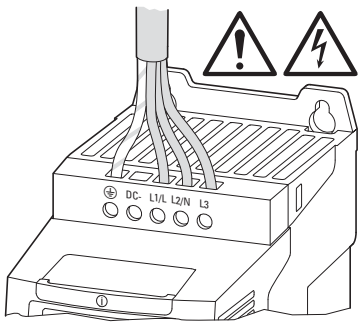


Figure 7: Make sure that the equipment is de-energized when performing installation work

3.4 Mounting for frame sizes FS2 and FS3

In the case of DA1 variable frequency drives with sizes FS2 and FS3, the DX-NET-MODBUSTCP-2 fieldbus connection needs to be installed on the bottom of the variable frequency drive. To do this, use a flat-blade screwdriver to lift off the cover at the marked cutout (without forcing it) and then remove the cover by hand.

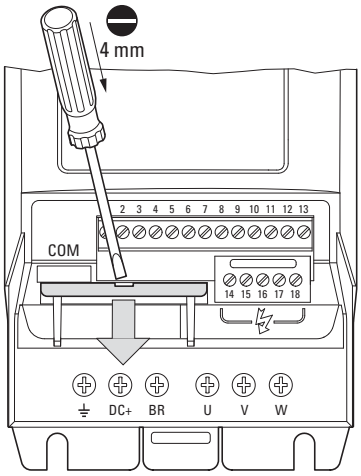


Figure 8: Opening the interface cover

> *NOTICE*
>
> Do not insert tools or other objects into the opened variable frequency drive.
> Ensure that foreign bodies do not enter the opened housing wall.

After doing so, you can insert the connection and secure it with the two screws.

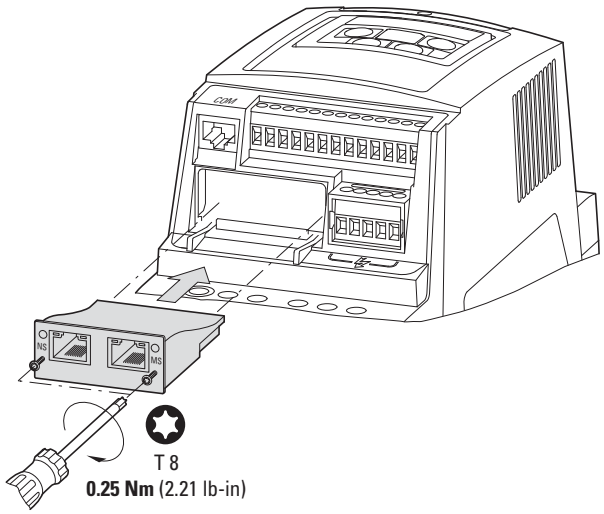


Figure 9: Inserting the fieldbus connection

3.5 Mounting from construction size FS4

When working with DA1 variable frequency drives of size FS4 or larger, the DX-NET-MODBUSTCP-2 fieldbus connection must be installed inside the variable frequency drive. To do so, use a standard screwdriver to turn the two screws on the front cover 90°. Then proceed to remove the cover.

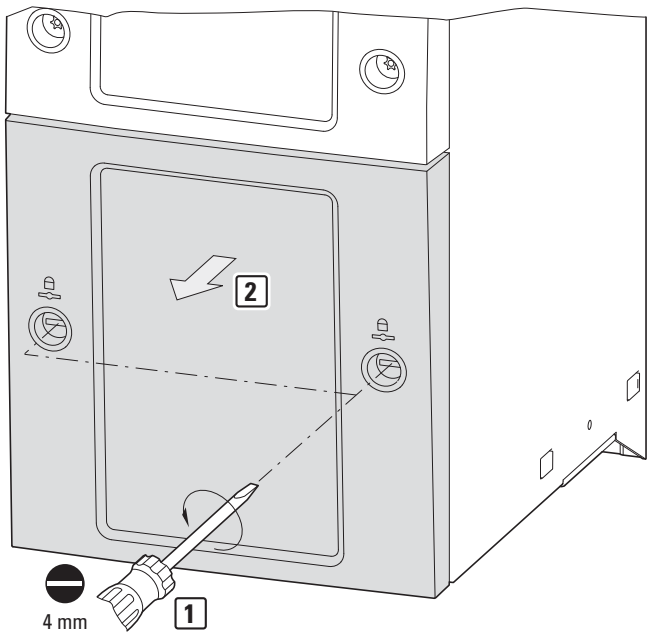


Figure 10:Opening the enclosure of DA1 variable frequency drives with size FS4 and up

NOTICE

Do not insert tools or other objects into the opened variable frequency drive.
Ensure that foreign bodies do not enter the opened housing wall.

After doing so, you can insert the connection on the right-hand side and use the screws to secure it.

Then put the cover back on and use the two screws (turn them 90°) to secure it.

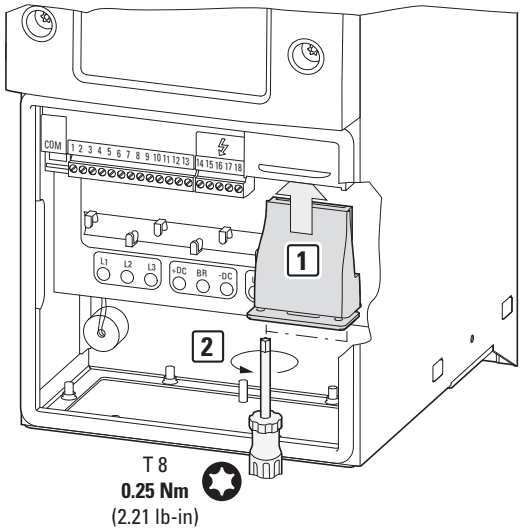
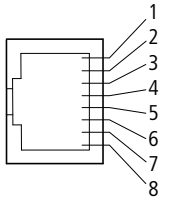


Figure 11:Inserting the fieldbus connection

3.6 Installing the fieldbus connection

An RJ45 plug is used in order to establish a connection to the Modbus/TCP field bus.

Generally, connection cables with RJ45 plugs for Modbus/TCP are available as standard ready-for-use cables. They can also be prepared individually. This will require the connections shown below (pinout).



Pin	Meaning
1	TD+
2	TD-
3	RD+
4	To GND via RC circuit
5	To GND via RC circuit
6	RD-
7	To GND via RC circuit
8	To GND via RC circuit

Figure 12:RJ45 plug pinout

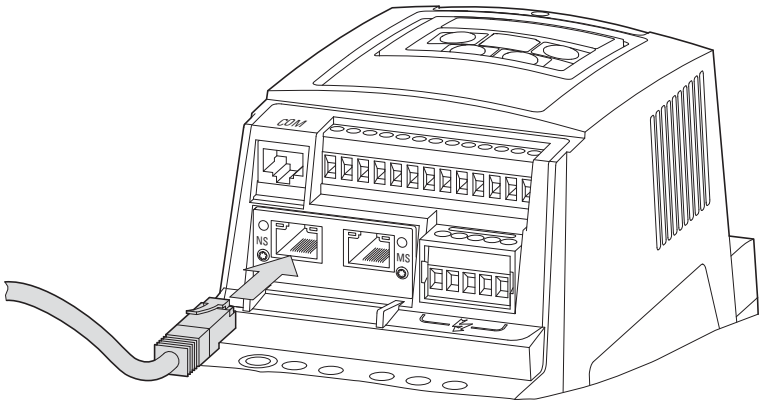


Figure 13:Connecting the RJ45 plug

3.7 Install field bus

Never lay the cable of a field bus system directly parallel to the energy carrying cables.

When installing the connection, make sure that the control and signal cables (0 - 10 V, 4 - 20 mA, 24 V DC, etc.), as well as the field bus system's connection cables, are not routed directly parallel to mains connection or motor connection cables conveying power.

With parallel cable routing, the clearances between control, signal and field bus cables ② and energy-carrying mains and motor cables ① must be greater than 30 cm. Cables should always intersect at right angles.

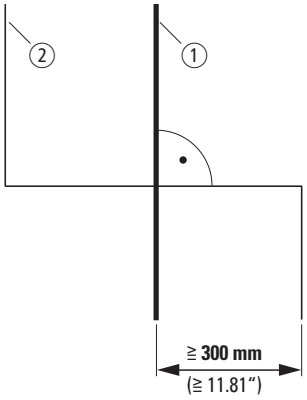


Figure 14:Cable routing for Modbus/TCP ② and mains/motor cables ①

If the system requires a parallel routing in cable ducts, a partition must be installed between the field bus cable ② and the mains and motor cable ①, in order to prevent electromagnetic interference on the field bus.

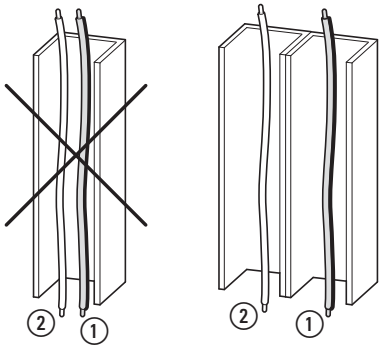


Figure 15:Separate routing in the cable duct

① Mains and motor connection cable
② Modbus cable

In all cases only use approved EtherNet cables.

4 Commissioning

4.1 DA1 variable frequency drives

→ First of all complete all measures for commissioning the DA1 variable frequency drive as described in the respective manual MN04020005Z-DE.

→ Check the settings and installations for the connection to the Modbus/TCP field bus system which are described in this manual.

NOTICE

Make sure that there is no danger in starting the motor. Disconnect the driven machine if there is a danger in an incorrect operating state.

→ For communications, parameter P12 (drive control) must be set as follows in the DA1 variable frequency drive: P12 = 4.

For detailed information on how to configure parameters, please refer to manual MN04020005Z-EN.

4.2 Protocol description

The Modbus protocol defines a simple protocol data unit (PDU) that is independent of the underlying communication layers. When the Modbus protocol is mapped on specific bus systems or networks, additional fields are added to the corresponding application data unit (ADU). This Modbus ADU is built by the client that initiates Modbus communications. Meanwhile, the function code indicates to the server which type of data access is required. The Modbus protocol defines the format for client requests. The "function code" field in a Modbus frame is coded in a single byte: Valid codes go from 1 to 255 in decimal notation, with numbers 128 to 255 being reserved for error messages.

When a client sends a message to the server, the function code defines the type of command that needs to be executed. Function code 0 is not permitted. To have multiple commands be executed, sub-function codes can be added to certain function codes. In addition, the data field in messages sent from a client to a server contains information that the server needs in order to process the corresponding command. This information can include, for example, bit and register addresses, the number of commands that have to be processed, and the number of data bytes in the data field.

In certain requests, the data field may have a value of 0, or there may not be a data field to begin with. In these cases, this means that the server does not require any additional information and that the function code alone defines the command that needs to be executed. If the server processes the client's request without any errors, the server's response frame will contain the requested data. If, on the other hand, there is an error, the response frame's data field will contain an exception code that the client will interpret based on the relevant application.

4.2.1 Data model

The Modbus data model draws a distinction between four basic data types:

Table 3: Modbus data types

Data type	Object type	Access	Explanation
Discrete Inputs	Bit	Read	This type of data can be provided by an I/O system
Coils	Bit	Read/Write	This type of data can be modified/written by an application program.
Input Registers	16 bit (Word)	Read	This type of data can be provided by an I/O system
Holding Registers	16 bit (Word)	Read/Write	This type of data can be modified/written by an application program.

A maximum of 65,536 data blocks can be implemented for each of these data types. In addition, the read and write operations for this data can be used to process multiple consecutive data blocks. The maximum permissible data length will depend on the function code being used. Finally, all data transmitted via Modbus (bits, registers) must be stored in the Modbus device's application memory.

4.2.2 Structure of the master request

4.2.2.1 Addressing

In Modbus/TCP, Modbus messages do not use the device address for individual slave addressing. Instead, they use the IP address in the TCP packet.

Modbus/TCP devices are addressed both with a MAC address and with IP addresses. Each device will have a MAC address that is unique worldwide and that consists of an Ethernet address with a length of six bytes. The first three bytes specify the manufacturer-specific ID, while the other three bytes specify the device‘s serial number.

→ To find the MAC address for a device, check its nameplate. The DHCP function will be enabled by default.

By assigning an IP address to it, the variable frequency drive can be integrated into a Modbus/TCP environment. The corresponding parameters will then be configured fully automatically by the higher-level master.

→ The IP address can be configured with a network tool (e.g., RSLogix 5000 or HMS IPconfig).

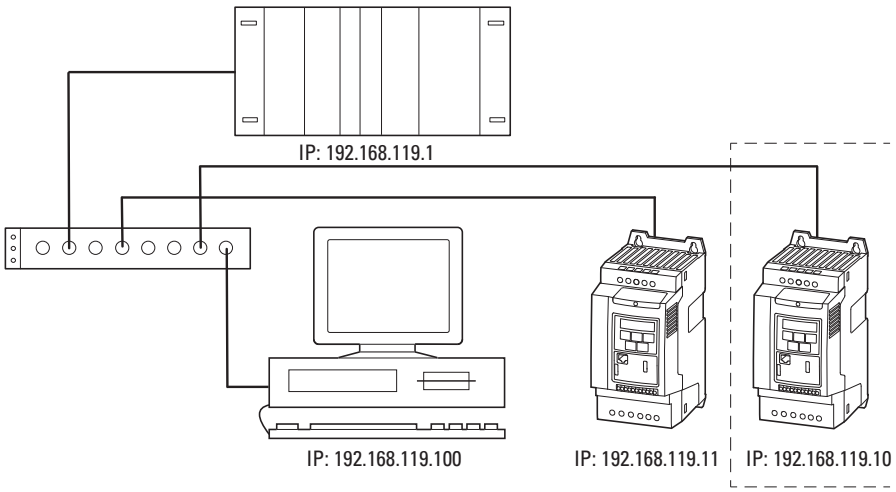


Figure 16:IP addressing

Number of devices

Since TCP uses IP addresses instead of Modbus addresses, the number of devices that can be used in the corresponding Modbus network is virtually unlimited. However, the maximum cable length that can be used without repeaters is limited to 100 meters.

4.2.2.2 Function code

The function code defines the type of message. The following actions can be performed in the case of DA1 variable frequency drives:

Function code [hex]	Designation	Description
03	Read Holding Registers	Reading of the holding registers (process data, parameters, configuration) in the slave. A master request enables up to 11 registers to be read.
06	Write Single Register	Writing of a holding register in the slave. With a general telegram (Broadcast) the appropriate holding registers are written in all slaves. The register is read back for comparison.
23	Read and Write Multiple Registers	Used to read from and write to multiple registers simultaneously

4.3 Operation

4.3.1 Process data input

The input process data is used to control the DA1 variable frequency drive.

Command – Register 0

The information in the command is used to control the DA1 variable frequency drive.

PNU	Description	
	Value = 0	**Value = 1**
0	stop	Operation
1	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
2	No action	Fault Reset
3	No action	free run-down
4	Not used	
5	No action	Quick stop (ramp)
6	No action	Fixed frequency 1 (FF1)
7	No action	Overwrite setpoint value with 0
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

Setpoint value – Register 1

The permissible values fall within a range of P1-02 (minimum frequency) to P1-01 (maximum frequency). This value will be scaled with a factor of 0.1 in the application.

Process data input 3 – Register 2

Configured with parameter P5-14.

The following settings can also be modified during operation:

Value	Description	DS
Field bus module PDI-3 input	0 = Torque limit / reference 1 = User PID reference register 2 = User register 3	0

Process data input 4 – Register 3

Configured with parameter P5-13.

The following settings can also be modified during operation:

Value	Description	DS
Field bus module PDI-4 input	0 = Ramp control field bus 1 = User register 4	0

Process data output

Status and fault word - Register 256

Device status and fault message information is provided in the status word (bit 0 to bit 7) and fault word (bit 8 to bit 15).

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB															LSB
Fault Messages								Device status							

Status Word

Bit	Description	
	Value = 0	Value = 1
0	Drive not ready	ready for operation (READY)
1	stop	Operation (RUN)
2	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
3	no error	Fault detected (FAULT)
4	Acceleration ramp	Frequency actual value equals setpoint input
5	–	Zero speed
6	Speed control deactivated	Speed control activated
7	STO not triggered	STO triggered

Fault word

Failure code [hex]	Value shown on display	Meaning
00	no-fit	Stop, ready for operation
01	OI-b	Braking chopper overcurrent
02	OL-br	Braking resistance overload
03	O-I	• Overcurrent at variable frequency drive output • Motor overload • Overtemperature on variable frequency drive (heat sink)
04	I.t-trp	Motor, thermal overload
05	SAFE -1	Short-circuit at safety circuit input

Failure code [hex]	Value shown on display	Meaning
06	O Volts	Overvoltage (DC link)
07	V-volts	undervoltage (DC link)
08	O-t	Overtemperature (heat sink)
09	V-t	Undertemperature (heat sink)
0A	P-dEf	Default settings, parameters have been loaded
0B	E-trip	External fault message
0C	SC-ObS	Error, OP bus
0D	FLt-dc	Excessively large voltage waves in DC link
0E	P-LOSS	Phase failure (mains side)
0F	h O-I	Overcurrent at variable frequency drive output
10	th-Flt	Thermistor fault, internal (heat sink)
11	dAtA-F	EEPROM checksum fault
12	4-20F	Analog input: • Out-of-range value • Wire breakage (4 mA monitoring)
13	dAtA- E	Error in internal memory
14	V-dEF	User-definable factory parameters have been loaded
15	F-Ptc	Excessive overtemperature, motor PTC
16	FAN-F	Fault, internal fan
17	O-hEAt	Excessively high ambient air temperature
18	O-torq	Maximum torque limit exceeded
19	V-torq	Output torque too low
1A	Out-F	Fault at variable frequency drive output
1D	SAFE-2	Short-circuit at safety circuit input
1D	Enc-01	Encoder, communication lost
1F	Enc-02	Encoder, speed error
20	Enc-03	Encoder, wrong PPRs set
21	Enc-04	Encoder, channel A fault
22	Enc-05	Encoder, channel B fault
23	Enc-06	Encoder, channel A and B fault
24	Enc-07	Encoder, RS485 data channel error
25	Enc-08	Encoder, I/O communications loss
26	Enc-09	Encoder, incorrect type
27	Enc-10	Encoder
28	AtF-01	Motor stator resistance fluctuating between phases
29	AtF-02	The motor's stator resistance too high
2B	AtF-03	Motor inductance too low
2B	AtF-04	Motor inductance too high
2C	AtF-05	The motor parameters do not match the motor

Failure code [hex]	Value shown on display	Meaning
32	SC-FO1	Fault: Modbus communication loss error
33	SC-F02	Fault: CANopen communication loss error
34	SC-F03	Communications with field bus module disconnected
35	SC-F04	Loss of communications (I/O cards)
3C	OF-01	Connection to add-on card lost
3D	OF-02	Add-on card in unknown state
46	PLC-01	Unsupported PLC function
47	PLC-02	PLC program too big
48	PLC-03	Division by 0
49	PLC-04	Lower limit value is higher than upper limit value

Actual value – Register 253

The variable frequency drive's actual value falls within a value range of 0 to P1-01 (maximum frequency). This value will be scaled with a factor of 0.1 in the application.

Process data output 3 – Register 258

Configured with parameter P5-12.

The following settings can also be modified during operation:

Value	Description	DS
Field bus module PDO-3 output	0 = Output current 1 = Output power 2 = DI status 3 = AI2 signal level 4 = Heat sink temperature 5 = User register 1 6 = User register 2 7 = P0-80	0

Process data output 4 – Register 259

Configured with parameter P5-08.

The following settings can also be modified during operation:

Value	Description	DS
Field bus module PDO-4 output	0 = Motor torque 1 = Output power 2 = DI status 3 = AI2 signal level 4 = Heat sink temperature	0

4.4 mode parameter

The abbreviations used in the parameter lists below have the following meaning:

PNU	Parameter number
ID	Identification number of the parameter
RUN	Access rights to the parameters during operation (RUN): / = Modification permissible - = Modification only possible in STOP
ro | rw	Parameter read and write permissions via a fieldbus connection: ro = read only rw = read and write (read and write)
Value	Setting of the parameter
DS	Default setting: (P1.1 = 1) base parameter

Manual

PNU	ID	Access right		Value	Description		DS
		RUN	ro | rw				
①				②	③		④

PC Software

PNU	Description	Value	Range	Default	Visible
①	③	②		④	

Figure 17:How the parameters are shown in the manual and in the software

PNU	ID	Access right		Designation	Value range	DS	Value that must be configured
		RUN	ro | rw				
P1-12	112	–	rw	Control level	0 = Control signal terminals (I/O) 1 = Keypad (KEYPAD FWD) 2 = Keypad (KEYPAD FWD/REV) 3 = PID control 4 = Field bus system (Modbus/TCP, Modbus RTU etc.) 5 = Slave mode 6 = field bus CANopen	0	4

The Baud rate will automatically be set to match the master.

4.4.1 Application example

The example below illustrates how to commission a DA1 variable frequency drive via Modbus/TCP when using an EATON XV100 controller.

Before commissioning the DA1 variable frequency drive, the PLC needs to be set up correctly. The head-end controller (PLC) will establish the connection to the DA1 variable frequency drive and handle all communications as the master.

The CODESYS software is used to configure all the necessary settings:

→ The software can be downloaded from the Internet at:

http://eaton-automation.com -> Downloads -> Software -> XSoft-CoDeSys-2.

→ These instructions use the CODESYS "ModbusTCP.Lib" library to control and configure the DA1 variable frequency drive.

After installing CODESYS, please download the "Modbus.Lib" library from the EATON website and store the file in the project directory.

The following configuration is required in order to connect the PLC correctly:

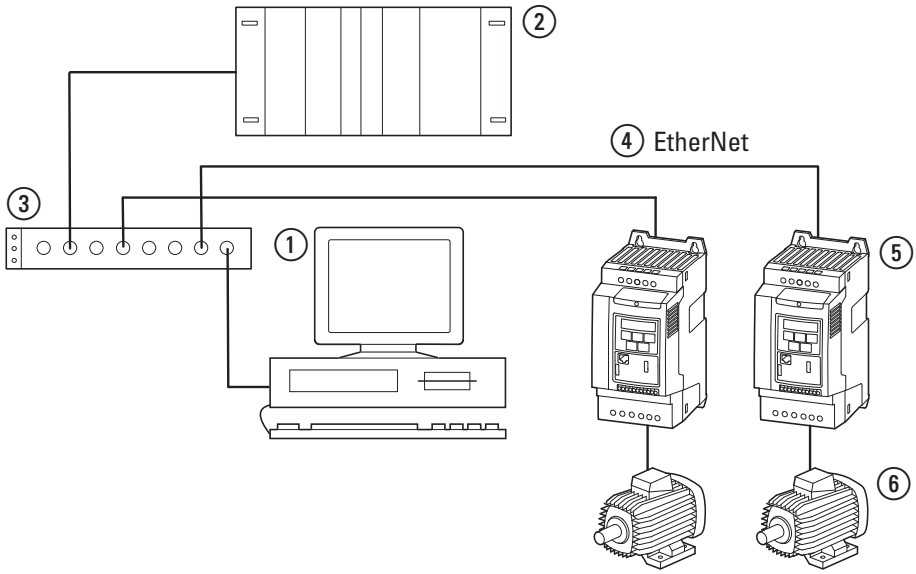


Figure 18:Engineering

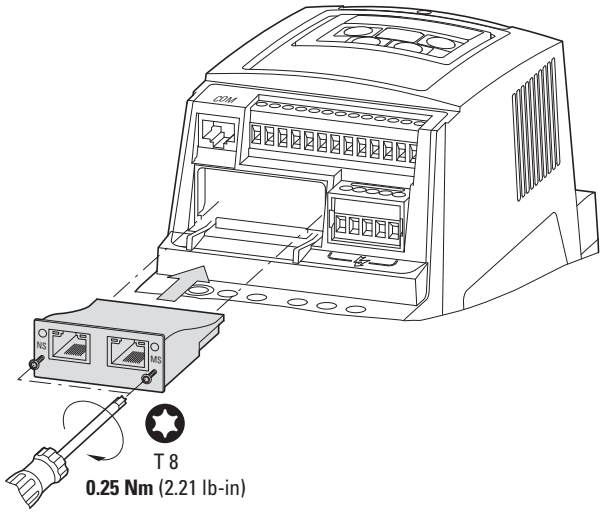
① PC (with configuration module and xSoft CODESYS software)
② Head-end controller (XV100)
③ Ethernet Switch
④ Ethernet cable
⑤ DA1 variable frequency drive with DX-NET-MODBUSTCP-2 configuration module
⑥ Motor

4.4.2 Configuring the IP address for the DX-NET-MODBUSTCP-2 module

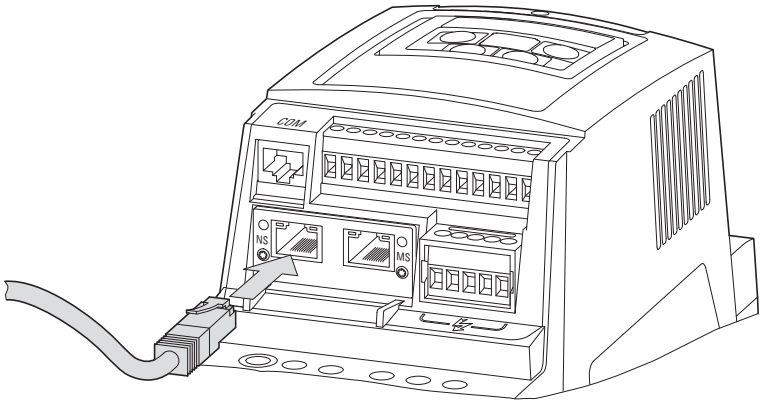
The IP address is configured using the IPconfig program.

→ The IPconfig software can be downloaded free of charge from the Internet at:
www.anybus.com → **Support**
Select **Tools** from the drop-down menu.

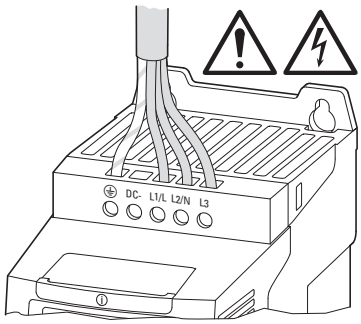
▶ Plug the module into the variable frequency drive.



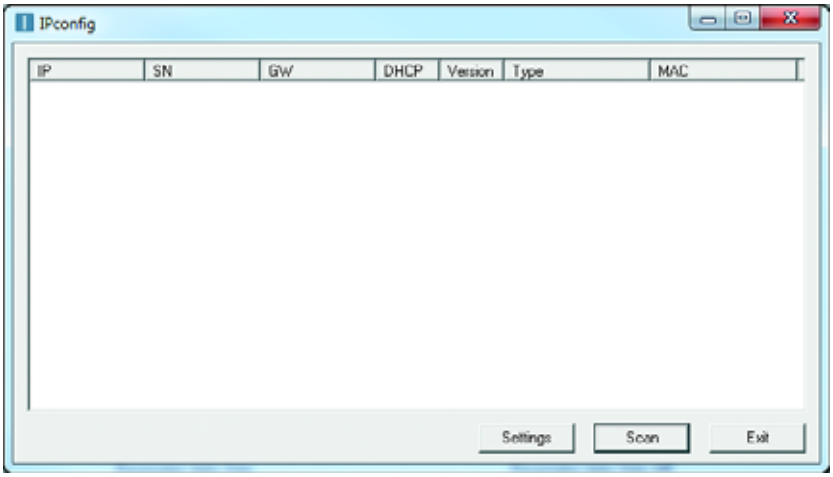
▶ Connect the variable frequency drive and the computer to the network.



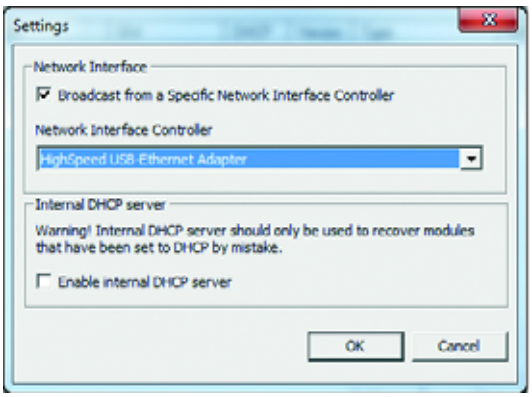
▶ Switch on the variable frequency drive.



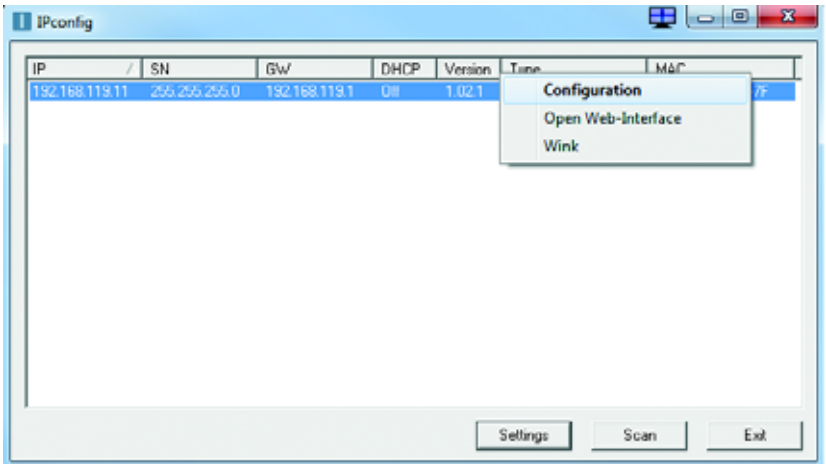
▶ Open the IPconfig program and click on **Settings**.



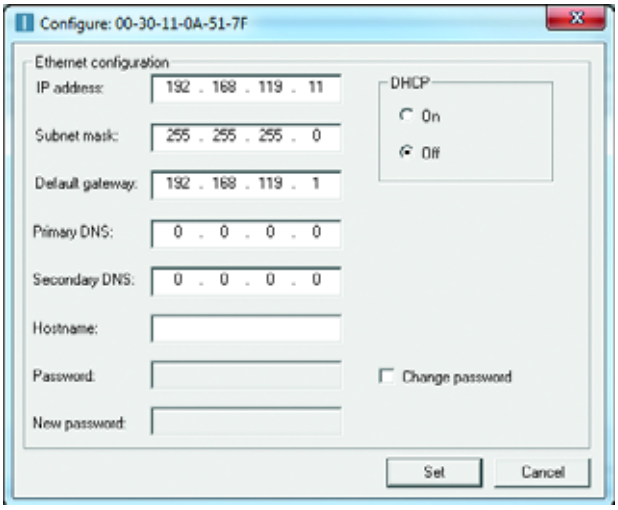
▶ Select the right computer network adapter from the **Network Interface Controller** drop-down menu and confirm by clicking on **OK**.



▶ Right-click on the line for the module and select the **Configuration** option from the context menu in order to assign the module an IP address.



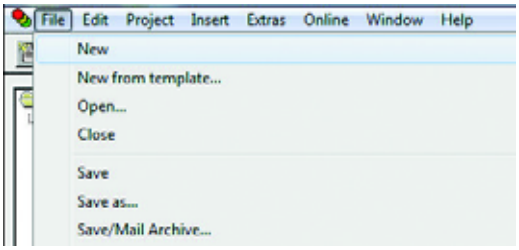
▶ Now set an IP address. Confirm with **OK**.



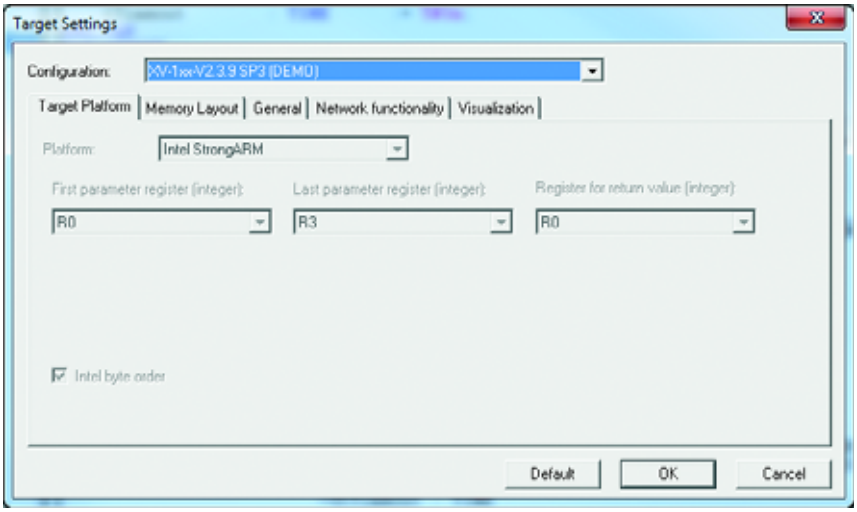
4.4.3 PLC Configuration

Once you have downloaded the CODESYS software, follow the configuration steps below in order to commission the PLC connection.

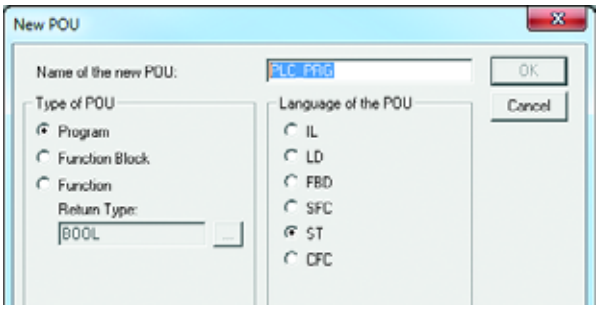
▶ Open CODESYS and select the target system by clicking on **File ▶ New**.



▶ Use the Configuration drop-down menu in the **Target Settings** dialog box to select the right controller type (VX100 in this example). Then click on **OK**.

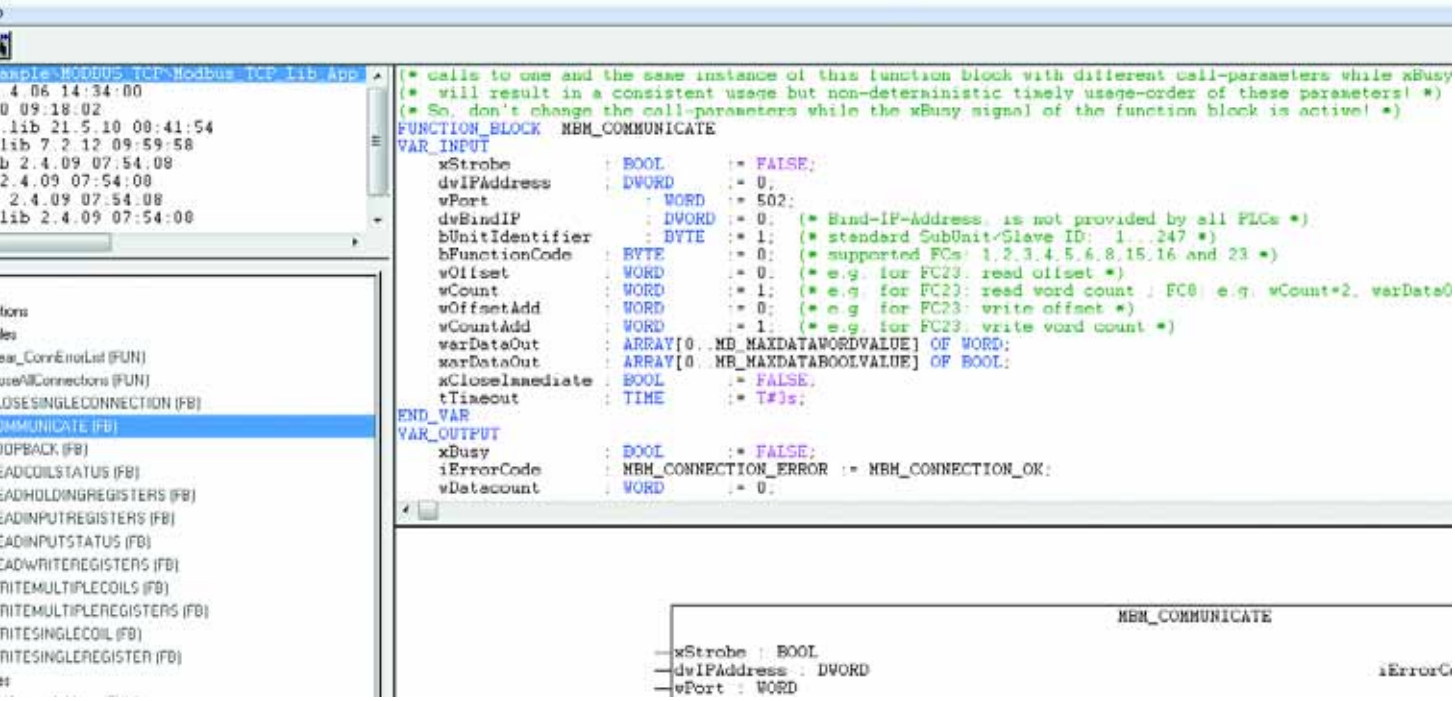


▶ Now, in the **New POU** dialog box, select the **Program** option under **Type of POU** and then select a language for the block. Then, enter a name (**Name of the new POU**) for the program. Once you are done, click on **OK**.

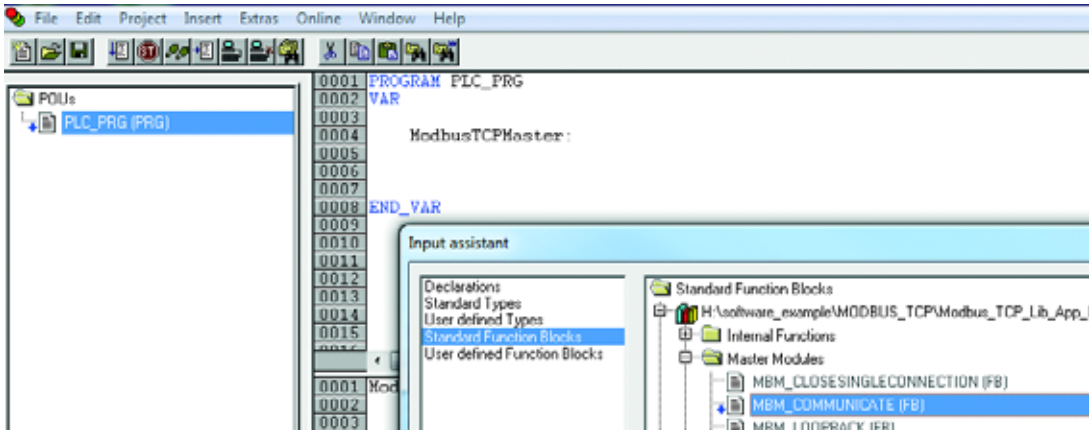


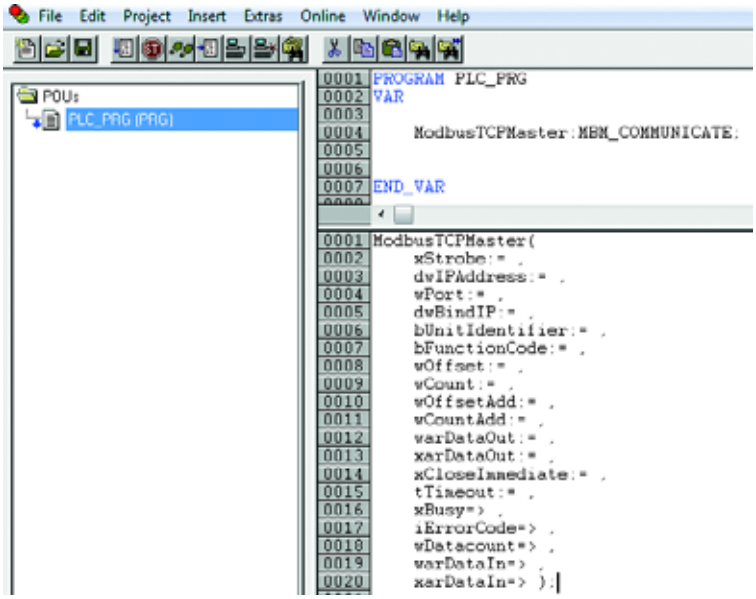
▶ Now add the **ModBusTCP.lib** Modbus library:

To do so, click on: **Resources ▶ Library Manager ▶ Insert ▶ Additional Library…**



▶ Now, in the main program, open the **MBM_COMMUNICATE** Modbus/ TCP block.





Following is a table that explains what each of the inputs and outputs in **MBM_COMMUNICATE** means:

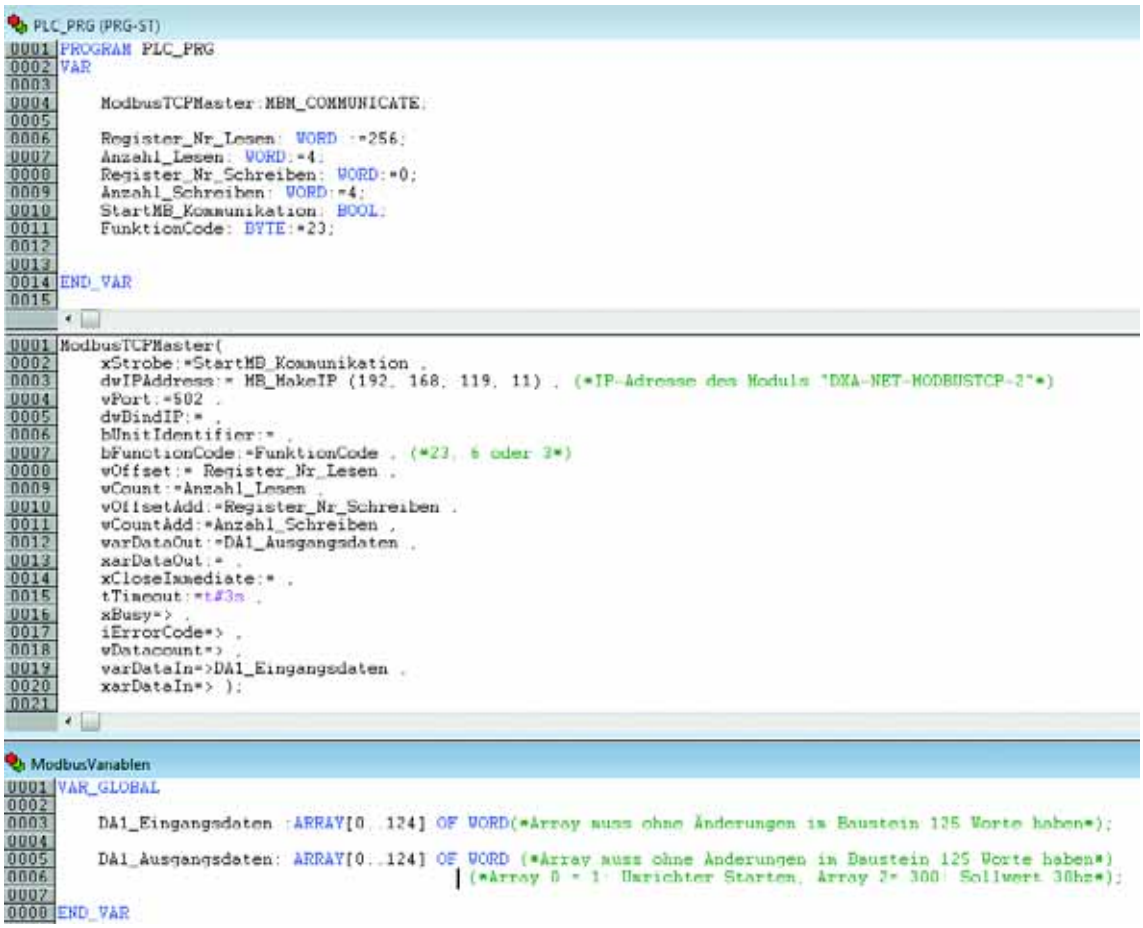
Table 4: Inputs and outputs MBM_COMMUNICATE

Inputs/outputs	Description
Inputs	
xStrobe	A rising edge will start the function block
dwIPAddress	IP address in DWORD format
wPort	Port that can be used to reach the slave
dwBindIP	Makes it possible to establish connections using an alternative IP interface
bUnitIdentifier	Unique slave number within a range of 1 to 247 (for when multiple slaves can be reached at a single IP address, for instance)
bFunctioncode	Function code Modbus
wOffset	First value that should be processed (for all function codes)
wCount	Number of values that should be processed (FCs 1, 2, 3, 4, 8, 15, 16, 23)
wOffsetAdd	FC 23: Offset for write operation
wCountAdd	FC 23: Number of write operations
warDataOut	Register values for write access (FCs 6, 8, 16, 23)
xarDataOut	Output values for write access (FCs 5, 15)
xCloseImmediate	Used to terminate the IP connection immediately after data transfers
tTimeout	Maximum time for waiting for a response to arrive
Outputs	
xBusy	The function block is still busy (because a slave response has not yet arrived, for example)
iErrorCode	Failure code Should be queried only after the function block's xBusy output has been set back to FALSE.
wDatacount	Amount of data being returned
warDataIn	Returned register values
xardataIn	Returned input/output values

Now fill out the block with the following data:

- Use the MakeIP function block to set the module's IP address (separated by commas)
- The default port address should be 502
- Specify function code 23 for read and write operations
- Use **StartMB_Kommunikation** to activate the block
- The timeout should be 3 s
- Register 0: start signal; register 1 (300 = 30 Hz): setpoint
- Status information should be read using registers 256 to 259

Declare the variable frequency drive's input and output data in the global variables. Use **varDataOut** and **varDataIn** for this purpose.



```
PLC_PRG (PRG-ST)
PROGRAM PLC_PRG
VAR

    ModbusTCPMaster:MBM_COMMUNICATE;

    Register_Nr_Lesen: WORD :=256;
    Anzahl_Lesen: WORD:=4;
    Register_Nr_Schreiben: WORD:=0;
    Anzahl_Schreiben: WORD:=4;
    StartMB_Kommunikation: BOOL;
    FunktionCode: BYTE:=23;


END_VAR

ModbusTCPMaster(
    xStrobe:=StartMB_Kommunikation ,
    dwIPAddress:= MB_MakeIP (192, 168, 119, 11) , (*IP-Adresse des Moduls "DXA-NET-MODBUSTCP-2"*)
    wPort:=502 ,
    dwBindIP:= ,
    bUnitIdentifier:= ,
    bFunctionCode:=FunktionCode , (*23, 6 oder 3*)
    wOffset:= Register_Nr_Lesen ,
    wCount:=Anzahl_Lesen ,
    wOffsetAdd:=Register_Nr_Schreiben ,
    wCountAdd:=Anzahl_Schreiben ,
    varDataOut:=DA1_Ausgangsdaten ,
    xarDataOut:= ,
    xCloseImmediate:= ,
    tTimeout:=t#3s ,
    xBusy=> ,
    iErrorCode=> ,
    wDatacount=> ,
    varDataIn=>DA1_Eingangsdaten ,
    xarDataIn=> );
```

```
ModbusVariablen
VAR_GLOBAL

    DA1_Eingangsdaten :ARRAY[0..124] OF WORD(*Array muss ohne Änderungen im Baustein 125 Worte haben*);

    DA1_Ausgangsdaten: ARRAY[0..124] OF WORD (*Array muss ohne Änderungen im Baustein 125 Worte haben*)
                                        (*Array 0 = 1: Umrichter Starten, Array 7= 300: Sollwert 30hz*);

END_VAR
```

- ▶ Connect all devices.
- ▶ Now log in: **Online** menu → **Log in**

Accessing the drive parameters

The DA1 variable frequency drive's parameter data can be accessed using register numbers.

There are specific Modbus registers available for receiving the requested data. The following table shows the corresponding register numbers:

Table 5: Register

No.	Description		Access right	ADI number	Register
1		Process Input Data	w	1	0 - 3
2		Process Output Data	ro	2	256 - 259
3	Drive ID		ro	9	536
4	Drive Type		ro	10	537
5	Control part software		ro	11	538
6	Control section checksum		ro	12	539
7	Software power section		ro	13	540
8	Power section checksum		ro	14	541
9	Serial number 1		ro	15	542
10	Serial number 2		ro	16	543
11	Serial number 3		ro	17	544
12	Serial number 4		ro	18	545
13	P1-01	Maximum frequency / maximum speed	rw	101	628
14	P1-02	Minimum frequency / minimum speed	rw	102	629
15	P1-03	Acceleration time (acc1)	rw	103	630
16	P1-04	Deceleration time (dec1)	rw	104	631
17	P1-05	Stop Function	rw	105	632
18	P1-06	Energy optimization	rw	106	633
19	P1-07	Motor, rated operating voltage	rw	107	634
20	P1-08	Motor, rated operational current	rw	108	635
21	P1-09	Motor, rated frequency	rw	109	636
22	P1-10	Motor, rated speed	rw	110	637
23	P1-11	Output voltage at zero frequency	rw	111	638
24	P1-12	Control level	rw	112	639
25	P1-13	Digital input, function	rw	113	640
26	P1-14	Parameter range access code (dependent on P2-40 and P6-30)	rw	114	641
27	P2-01	Fixed frequency FF1 / speed 1	rw	201	728
28	P2-02	Fixed frequency FF2 / speed 2	rw	202	729
29	P2-03	Fixed frequency FF3 / speed 3	rw	203	730
30	P2-04	Fixed frequency FF4 / speed 4	rw	204	731
31	P2-05	Fixed frequency FF5 / speed 5	rw	205	732

No.	Description		Access right	ADI number	Register
32	P2-06	Fixed frequency FF6 / speed 6	rw	206	733
33	P2-07	Fixed frequency FF7 / speed 7	rw	207	734
34	P2-08	Fixed frequency FF8 / speed 8	rw	208	735
35	P2-09	Frequency jump 1, bandwidth	rw	209	736
36	P2-10	Frequency skip 1, center	rw	210	737
37	P2-11	AO1 signal (Analog Output)	rw	211	738
38	P2-12	AO1, signal range	rw	212	739
39	P2-13	AO2 signal (Analog Output)	rw	213	740
40	P2-14	AO2, signal range	rw	214	741
41	P2-15	RO1 Signal (Relay 1 Output)	rw	215	742
42	P2-16	AO1 / RO1 upper limit	rw	216	743
43	P2-17	AO1 / RO1 lower limit	rw	217	744
44	P2-18	RO2 Signal (Relay Output)	rw	218	745
45	P2-19	AO2 / RO2 upper limit	rw	219	746
46	P2-20	AO2 / RO2 lower limit	rw	220	747
47	P2-21	Scaling factor for value	rw	221	748
48	P2-22	Scaled display value	rw	222	749
49	P2-23	Holding time for speed of zero	rw	223	750
50	P2-24	Pulse frequency	rw	224	751
51	P2-25	Quick stop deceleration ramp time	rw	225	752
52	P2-26	Motor flying restart circuit	rw	226	753
53	P2-27	Standby mode delay time	rw	227	754
54	P2-28	Slave speed scaling	rw	228	755
55	P2-29	Slave speed scaling factor	rw	229	756
56	P2-30	AI1, Signal range	rw	230	757
57	P2-31	AI1 scaling factor	rw	231	758
58	P2-32	AI1 offset	rw	232	759
59	P2-33	AI2, Signal range	rw	233	760
60	P2-34	AI2 scaling factor	rw	234	761
61	P2-35	AI2 offset	rw	235	762
62	P2-36	REAF, Start function with automatic restart, control signal terminals	rw	236	763
63	P2-37	REAF, start function with automatic restart,	rw	237	764
64	P2-38	Response in the event of a power failure	rw	238	765
65	P2-39	Parameter access lock	rw	239	766
66	P2-40	Access codes - menu level 2	rw	240	767
67	P3-01	PID controllers, P amplification	rw	301	828
68	P3-02	PID controller, I time constant	rw	302	829

No.	Description		Access right	ADI number	Register
69	P3-03	PID controller, D time constant	rw	303	830
70	P3-04	PID controller, control deviation	rw	304	831
71	P3-05	PID controller, setpoint source	rw	305	832
72	P3-06	PID controller, digital reference value	rw	306	833
73	P3-07	PID controller, actual value limiting, maximum	rw	307	834
74	P3-08	PID controller, actual value limiting, minimum	rw	308	835
75	P3-09	PID controller, actual value limiting	rw	309	836
76	P3-10	PID controller, actual value (PV)	rw	310	837
77	P3-11	Maximum PID error for enabling the ramps	rw	311	838
78	P3-12	PID feedback display scaling factor	rw	312	839
79	P3-13	PID feedback wake up level	rw	313	840
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81	P3-15	Reserved	-	315	842
82	P3-16	Reserved	-	316	843
83	P3-17	Reserved	-	317	844
84	P3-18	PID reset control	rw	318	845
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88	P4-04	Speed controller integral time	rw	404	931
89	P4-05	Motor power factor (cos φ)	rw	405	932
90	P4-06	Torque setpoint/limit	rw	406	933
91	P4-07	Maximum torque (motor)	rw	407	934
92	P4-08	Minimum torque	rw	408	935
93	P4-09	Maximum torque (generator)	rw	409	936
94	P4-10	V/Hz characteristic curve modification voltage	rw	410	937
95	P4-11	V/Hz characteristic curve modification frequency	rw	411	938
96	P5-01	Inverter Slave Adress	rw	501	1028
97	P5-02	CANopen baud rate	rw	502	1029
98	P5-03	Modbus RTU Baud rate	rw	503	1030
99	P5-04	Modbus RTU data format – Parity type	rw	504	1031
100	P5-05	Timeout – Communications dropout	rw	505	1032
101	P5-06	Response in the event of a communications dropout	rw	506	1033
102	P5-07	Ramp via field bus	rw	507	1034
103	P5-08	Field bus module PDO-4 output	rw	508	1035

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105	P5-10	Reserved	-	510	1037
106	P5-11	Reserved	-	511	1038
107	P5-12	Field bus module PDO-3 output	rw	512	1039
108	P5-13	Field bus module PDI-4 input	rw	513	1040
109	P5-14	Field bus module PDI-3 input	rw	514	1041
110	P6-01	Firmware upgrade enable	rw	601	1128
111	P6-02	Auto temperature management	rw	602	1129
112	P6-03	Auto-reset waiting time	rw	603	1130
113	P6-04	Relay hysteresis band	rw	604	1131
114	P6-05	Enable incremental encoder feedback	rw	605	1132
115	P6-06	Incremental encoder scale	rw	606	1133
116	P6-07	Maximum speed error	rw	607	1134
117	P6-08	Input frequency at maximum speed	rw	608	1135
118	P6-09	Droop speed	rw	609	1136
119	P6-10	PLC function enable	rw	610	1137
120	P6-11	Speed holding time in the event of an enable signal	rw	611	1138
121	P6-12	Speed holding time in the event of a disable signal	rw	612	1139
122	P6-13	Motor brake opening time	rw	613	1140
123	P6-14	Motor brake engagement delay	rw	614	1141
124	P6-15	Minimum torque for brake opening	rw	615	1142
125	P6-16	Minimum torque time limit	rw	616	1143
126	P6-17	Maximum torque time limit	rw	617	1144
127	P6-18	Voltage for DC injection braking	rw	618	1145
128	P6-19	Brake resistor value	rw	619	1146
129	P6-20	Brake resistor power	rw	620	1147
130	P6-21	Braking chopper cycle in the event of excessively low temperature	rw	621	1148
131	P6-22	Reset fan run-time	rw	622	1149
132	P6-23	kWh meter reset	rw	623	1150
133	P6-24	Service interval	rw	624	1151
134	P6-25	Service interval reset	rw	625	1152
135	P6-26	AO1 - scaling	rw	626	1153
136	P6-27	AO1 - offset	rw	627	1154
137	P6-28	Display index P0-80	rw	628	1155
138	P6-29	Save parameters as default	rw	629	1156
139	P6-30	Access code for menu level 3	rw	630	1157

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140	P7-01	Motor stator resistance	rw	701	1228
141	P7-02	Rotor resistance	rw	702	1229
142	P7-03	Motor leakage inductance (d)	rw	703	1230
143	P7-04	Motor magnetizing current	rw	704	1231
144	P7-05	Motor leakage factor	rw	705	1232
145	P7-06	Motor leakage inductance (q)	rw	706	1233
146	P7-07	Advanced generator control	rw	707	1234
147	P7-08	Enable, motor parameter adaptation	rw	708	1235
148	P7-09	Overvoltage current limit	rw	709	1236
149	P7-10	Load inertia factor	rw	710	1237
150	P7-11	Minimum PWM pulse width	rw	711	1238
151	P7-12	Magnetizing time at the U/f method	rw	712	1239
152	P7-13	Rotational speed controller D gain	rw	713	1240
153	P7-14	Torque boost	rw	714	1241
154	P7-15	Maximum frequency limit for torque boost	rw	715	1242
155	P7-16	Enable, signal injection	rw	716	1243
156	P7-17	Signal injection level	rw	717	1244
157	P8-01	Second acceleration time (acc2)	rw	801	1328
158	P8-02	Transition frequency (acc1 - acc2)	rw	802	1329
159	P8-03	Third acceleration time (acc3)	rw	803	1330
160	P8-04	Transition frequency (acc2 - acc3)	rw	804	1331
161	P8-05	Fourth acceleration time (acc4)	rw	805	1332
162	P8-06	Transition frequency (acc3 - acc4)	rw	806	1333
163	P8-07	Fourth deceleration time (dec4)	rw	807	1334
164	P8-08	Transition frequency (dec3 - dec4)	rw	808	1335
165	P8-09	Third deceleration time (dec3)	rw	809	1336
166	P8-10	Transition frequency (dec2 - dec3)	rw	810	1337
167	P8-11	Second deceleration time (dec2)	rw	811	1338
168	P8-12	Transition frequency (dec1 - dec2)	rw	812	1339
169	P8-13	Ramp selection when there is a preset speed	rw	813	1340
170	P9-01	Control source - enable	rw	901	1428
171	P9-02	Control source - quick stop	rw	902	1429
172	P9-03	Control source - start signal 1 (FWD)	rw	903	1430
173	P9-04	Control source – start signal 2 (REV)	rw	904	1431
174	P9-05	Control source - Stay-put function	rw	905	1432
175	P9-06	Control source - enable (REV)	rw	906	1433
176	P9-07	Control source - reset	rw	907	1434

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177	P9-08	Control source – external fault	rw	908	1435
178	P9-09	Control source - terminal control	rw	909	1436
179	P9-10	Source - Speed 1	rw	910	1437
180	P9-11	Source - speed 2	rw	911	1438
181	P9-12	Source - speed 3	rw	912	1439
182	P9-13	Source - speed 4	rw	913	1440
183	P9-14	Source - speed 5	rw	914	1441
184	P9-15	Source - speed 6	rw	915	1442
185	P9-16	Source - speed 7	rw	916	1443
186	P9-17	Source - speed 8	rw	917	1444
187	P9-18	Speed - input 0	rw	918	1445
188	P9-19	Speed - input 1	rw	919	1446
189	P9-20	Speed - input 2	rw	920	1447
190	P9-21	Fixed frequency 0	rw	921	1448
191	P9-22	Fixed frequency 1	rw	922	1449
192	P9-23	Fixed frequency 2	rw	923	1450
193	P9-24	Acceleration ramp input 0	rw	924	1451
194	P9-25	Acceleration ramp input 1	rw	925	1452
195	P9-26	Deceleration time input 0	rw	926	1453
196	P9-27	Deceleration time input 1	rw	927	1454
197	P9-28	Control source - Up-pushbutton	rw	928	1455
198	P9-29	Control source - Down-pushbutton	rw	929	1456
199	P9-30	FWD limit switch	rw	930	1457
200	P9-31	REV limit switch	rw	931	1458
201	P9-32	Reserved	-	932	1459
202	P9-33	Source - analog output (AO) 1	rw	933	1460
203	P9-34	Source - analog output (AO) 2	rw	934	1461
204	P9-35	Control source - Relay 1	rw	935	1462
205	P9-36	Control source - Relay 2	rw	936	1463
206	P9-37	Control source - scaling	rw	937	1464
207	P9-38	Source - PID setpoint value	rw	938	1465
208	P9-39	Source - PID feedback	rw	939	1466
209	P9-40	Source - torque control reference	rw	940	1467
210	P9-41	Function choices - Relay output 3, 4, 5	rw	941	1468
211	DI 1		ro	1001	1528
212	DI 2		ro	1002	1529
213	DI 3		ro	1003	1530

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214	DI 4	ro	1004	1531
215	DI 5	ro	1005	1532
216	DI 6	ro	1006	1533
217	DI 7	ro	1007	1534
218	DI 8	ro	1008	1535
219	AO 1	ro	1009	1536
220	AO 2	ro	1010	1537
221	DO 1	ro	1011	1538
222	DO 2	ro	1012	1539
223	DO 3	ro	1013	1540
224	DO 4	ro	1014	1541
225	DO 5	ro	1015	1542
226	User register 1	rw	1017	1544
227	User register 2	rw	1018	1545
228	User register 3	rw	1019	1546
229	User register 4	rw	1020	1547
230	User register 5	rw	1021	1548
231	User register 6	rw	1022	1549
232	User register 7	rw	1023	1550
233	User register 8	rw	1024	1551
234	User register 9	rw	1025	1552
235	User register 10	rw	1026	1553
236	User register 11	rw	1027	1554
237	User register 12	rw	1028	1555
238	User register 13	rw	1029	1556
239	User register 14	rw	1030	1557
240	User register 15	rw	1031	1558
241	User AO 1	rw	1032	1559
242	User AO 2	rw	1033	1560
243	User RO 1	rw	1036	1563
244	User RO 2	rw	1037	1564
245	User RO 3	rw	1038	1565
246	User RO 4	rw	1039	1566
247	User RO 5	rw	1040	1567
248	User, scaling value	rw	1041	1568
249	User, decimal scaling	rw	1042	1569
250	User, speed reference	rw	1043	1570
251	User, torque deference	rw	1044	1571

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252	Field bus / User ramp	rw	1045	1572
253	Scope index 1 / 2	rw	1046	1573
254	Scope index 3 / 4	rw	1047	1574
255	24hour timer	rw	1048	1575
256	User display Ctrl	rw	1049	1576
257	User display value	rw	1050	1577
258	AI 1 (Q12)	ro	1061	1588
259	AI 1 (%)	ro	1062	1589
260	AI 2 (Q12)	ro	1063	1590
261	AI 2 (%)	ro	1064	1591
262	DI status	ro	1065	1592
263	Speed reference	ro	1066	1593
264	Value, digital potentiometer	ro	1067	1594
265	Field bus speed reference	ro	1068	1595
266	Master speed reference	ro	1069	1596
267	Slave speed reference	ro	1070	1597
268	Frequency on speed reference input	ro	1071	1598
269	Torque reference (Q12)	ro	1072	1599
270	Torque reference (%)	ro	1073	1600
271	Master torque reference (Q12)	ro	1074	1601
272	Field bus torque reference (Q12)	ro	1075	1602
273	PID user reference (Q12)	ro	1076	1603
274	PID user return value (Q12)	ro	1077	1604
275	PID controller reference (Q12)	ro	1078	1605
276	PID controller feedback value (Q12)	ro	1079	1606
277	PID controller output (Q12)	ro	1080	1607
278	Motor, velocity	ro	1081	1608
279	Motor, current	ro	1082	1609
280	Motor, torque	ro	1083	1610
281	Motor, power	ro	1084	1611
282	PID controller starting speed	ro	1085	1612
283	DC- voltage	ro	1086	1613
284	Unit Temperature	ro	1087	1614
285	PCB controle temperature	ro	1088	1615
286	Drive scaling value 1	ro	1089	1616
287	Drive scaling value 2	ro	1090	1617
288	Motor, torque (%)	ro	1091	1618
289	Expansion, IO input status	ro	1093	1620

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290	ID, Plug-in module	ro	1096	1623
291	ID, field bus boards	ro	1097	1624
292	Scope channel 1 data	ro	1101	1628
293	Scope channel 2 data	ro	1102	1629
294	Scope channel 3 data	ro	1103	1630
295	Scope channel 4 data	ro	1104	1631
296	OLED language number	ro	1105	1632
297	OLED version	ro	1106	1633
298	power section	ro	1107	1634
299	Service time	ro	1128	1655
300	Fan speed	ro	1129	1656
301	User kWh meter	ro	1130	1657
302	User, MWh meter	ro	1131	1658
303	Complete, KWh meter	ro	1132	1659
304	Complete, MWh meter	ro	1133	1660
305	Total, operating hours meter	ro	1134	1661
306	Total, min/sec operating time counter	ro	1135	1662
307	User, hours-run meter	ro	1136	1663
308	User, min/sec operating time counter	ro	1137	1664

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