PowerXL™

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

EtherCAT®

EATON

Powering Business Worldwide

Emergency On Call Service
Please call your local representative:
http://www.eaton.eu/aftersales
or
Hotline of the After Sales Service:
+49 (0) 180 5 223822 (de, en)
AfterSalesEGBonn@eaton.com

For customers in US/Canada contact:

EatonCare Customer Support Center

Call the EatonCare Support Center if you need assistance with placing an order, stock availability or proof of shipment, expediting an existing order, emergency shipments, product price information, returns other than warranty returns, and information on local distributors or sales offices.

Voice: 877-ETN-CARE (386-2273) (8:00 a.m. – 6:00 p.m. EST)
After-Hours Emergency: 800-543-7038 (6:00 p.m. – 8:00 a.m. EST)

Drives Technical Resource Center

Voice: 877-ETN-CARE (386-2273) option 2, option 6
(8:00 a.m. – 5:00 p.m. Central Time U.S. [UTC-6])
email: TRCDrives@Eaton.com
www.eaton.com/drives

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.

1st published 2014, edition date 01/14

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 (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 EtherCAT connection DX-NET-ETHERCAT-2 for the variable frequency drives of the DA1 device series.

→ EtherCAT® (EtherCAT = Ethernet for Controller and Automation Technology) is a registered trademark and patented technology, licensed from Beckhoff Automation GmbH.

It is aimed at experienced drive specialists and automation technicians. A thorough knowledge of the EtherCAT field bus system and the programming of a EtherCAT master is required. Knowledge of handling the DA1 variable frequency drive is also required.

Please read this manual carefully before installing and operating the EtherCAT 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.com/moeller → **Support**

→ More information on EtherCAT can be found on the website of the EtherCAT Technology Group:

www.ethercat.org

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:

ADI	Application Data Instance
CIP	Common Industrial Protocol
CoE	CANopen over EtherCAT
CW	Command
EMC	Electromagnetic compatibility
ESC	EtherCAT Slave Controller
EtherCAT	Ethernet for Controller and Automation Technology
ETG	EtherCAT Technology Group
FB	Field bus
FMMU	Fieldbus Memory Management Unit
FS	Frame Size
GND	Ground (0 V potential)
LED	Light Emitting Diode (LED)
LSB	Least significant bit
MAC	Medium Access Controller
MSB	Most significant bit
NIC	Network Interface Card
PC	Personal Computer
PDI	Process Data Interface
PNU	Parameter number
PD	Process Data
PLC	Programmable logic controller
SW	Status Word
UL	Underwriters Laboratories

0.4 Units of measurement

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

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-ETHERCAT-2,
- the instruction leaflet IL040004ZU.

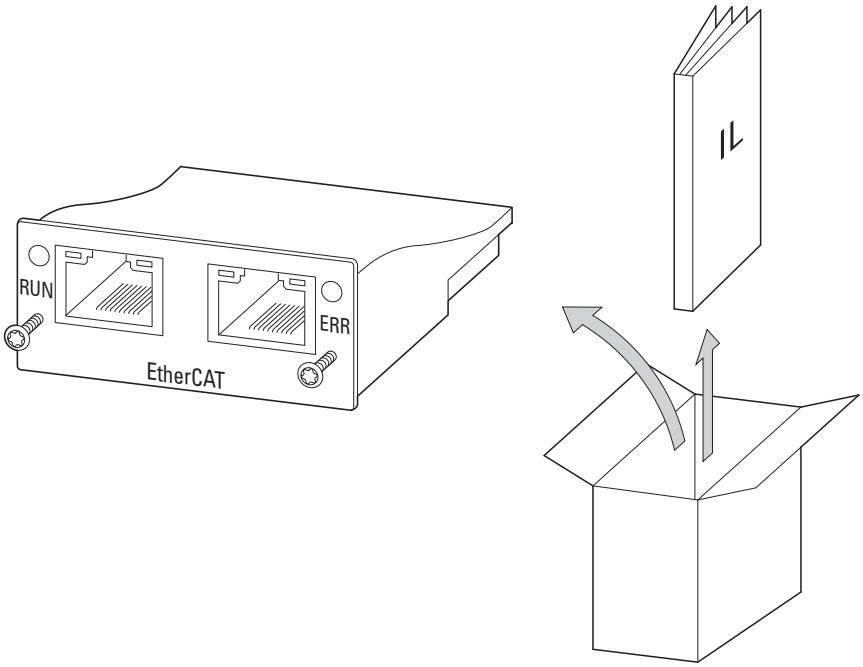


Figure 1: Equipment supplied with fieldbus connection DX-NET-ETHERCAT-2

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:

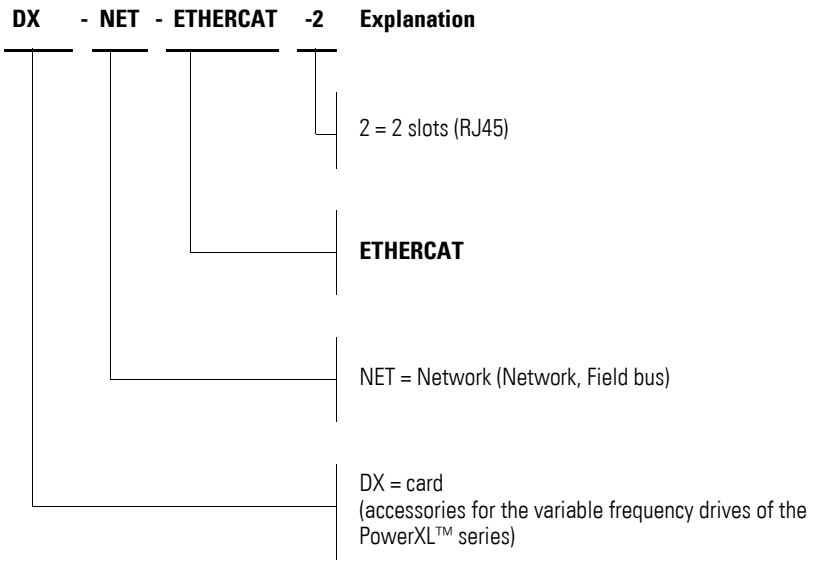


Figure 2: Catalog number selection of field bus interface card DX-NET-…

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
EtherCAT connections			
interface			RJ45 plug
data transfer			100 Mbit/s full-duplex
Transfer cable			Twisted two-pair balanced cable (screened)
Communication protocol			
EtherCAT			IEEE 802.3 according to DS301 CANopen over EtherCAT
Baud rate		MBit/s	100

1.4 Features

DX-NET-ETHERCAT-2 supports the following functions and specifications:

- CANopen over EtherCAT (CoE),
- plug-in connection RJ45
- DS301 conformity,
- isolated EtherCAT interface
- Network ID changes
- star and linear topology,
- EMCY support,
- Access to up to 16,383 ADIs, in the form of vendor-specific objects, through the network,
- Up to 256 I/O bytes in each direction (fast cyclic),
- up to 127 slave cards,
- device description file as xml-file.

1.5 Designation at DX-NET-ETHERCAT-2

The following drawing shows the DX-NET-ETHERCAT-2 fieldbus connection for EtherCAT with two RJ45 ports.

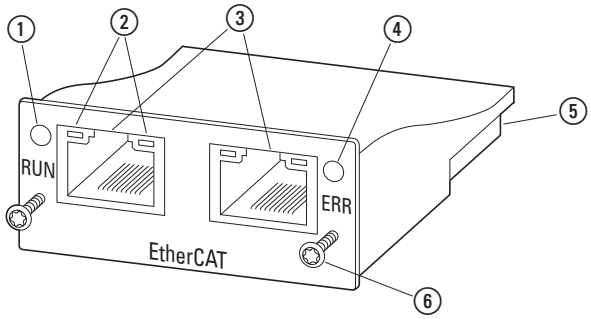


Figure 3: Designations at DX-NET-ETHERCAT-2

① RUN LED
② LINK/Activity-LEDs
③ EtherCAT port 1 and port 2
④ LED ERROR
⑤ 50-pole adapter extension
⑥ Screws for securing DA1 variable frequency drive

1.6 Proper use

The DX-NET-ETHERCAT-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 EtherCAT 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 slaves into EtherCAT field bus systems.

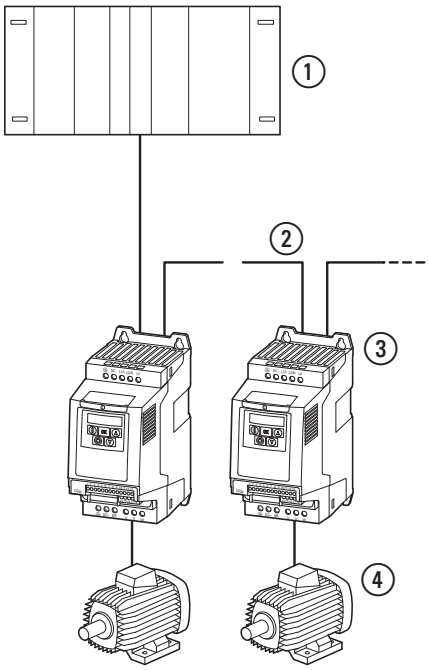


Figure 4: How the DX-NET-ETHERCAT-2 fieldbus connection can be integrated into a EtherCAT network

① Head-end controller (master)
② EtherCAT cable
③ Variable frequency drive DA1 with DX-NET-ETHERCAT-2 connection
④ Motor(s)

The EtherCAT cable coming from the master needs to be plugged into the IN RJ45 socket. The outgoing connection from the DX-NET-ETHERCAT-2 module needs to be connected using the OUT socket.

Simply leave the OUT socket on the last device (variable frequency drive) alone. A bus termination resistor is not necessary.

→ The DX-NET-ETHERCAT-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.

1.7 Maintenance and inspection

The DX-NET-ETHERCAT-2 fieldbus connection will not require any maintenance if the general rated operational data (→ Page 9), as well as all EtherCAT-specific technical data, is adhered to. However, external factors can influence the components's lifespan and function. We therefore recommend that the devices are checked regularly and the following maintenance measures are carried out 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-ETHERCAT-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.

1.8 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.

1.9 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-ETHERCAT-2),
- the date of purchase,
- a detailed description of the problem which has occurred with the DX-NET-ETHERCAT-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

1.10 Disposal

The DX-NET-ETHERCAT-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 EtherCAT

EtherCAT (Ethernet for Control Automation Technology) is an industrial Ethernet system that uses standard frames and the physical layers defined in the IEEE 802.3 series of Ethernet standards. It was developed by Beckhoff Automation GmbH.

EtherCAT is normally used for applications in which I/O data and parameters need to be transmitted quickly.

In EtherCAT systems, the master is the only node in a segment that is allowed to actively send EtherCAT frames. All other nodes simply forward the frames. The last node in the segment will detect an open port and send the frame back to the master.

The DX-NET-ETHERCAT-2 EtherCAT module works as a slave within the EtherCAT network to which it is connected. The module contains the entire EtherCAT protocol stack, including the CANopen-over-EtherCAT application functions defined in DS301. By using EtherCAT, a bus topology containing several hundred nodes can be implemented. In fact, the network's size is virtually unlimited.

2.2 LED indicators

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

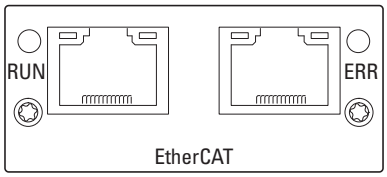


figure 5: RUN, ERR, and Link/Activity (Port 1, Port 2) LED indicators

2.2.1 LED status display

The following LED are included:

LED	Description
1	RUN LED
2	LED ERROR
3	Link/Activity (Port 1)
4	Link/Activity (Port 2)

2.2.2 RUN LED

The RUN LED is used to indicate CoE communications statuses.

LED status	Designation	Description
off	Init	no communication or power supply
Green illuminating	Operational	Communications have been fully established (parameter transmission)
Green flashing	Pre-operational	Parameter communications have been established, but process data communications have not
green single flash	Safe operational	Limited communications
Red flashing	Fatal Event	Fatal error

2.2.3 LED ERR

The ERR LED indicates the EtherCAT communications error status.

LED status	Designation	description
off	No Error	no error or device switched off
illuminated red	Application controller failure	EtherCAT status was exited (EXCEPTION)
Red flashing	Invalid Configuration	Configuration not OK
rot double flash	Application watchdog timeout	SyncManager Watchdog Time

2.2.4 LEDs Link/Activity

The LINK/Activity LED are used to indicate EtherCAT communications statuses.

LED status	Designation	Description
off	No link	The EtherCAT cable is not connected or no power is being supplied
Green illuminating	Link sensed, no activity	A connection has been established, but no data is being transferred
Green flashing	Link sensed, activity detected	A connection has been established, data is being transferred

3 Installation

3.1 Introduction

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

→ While installing and/or mounting the fieldbus 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-ETHERCAT-2 fieldbus connection needs to be installed will depend on the corresponding variable frequency drive's size.

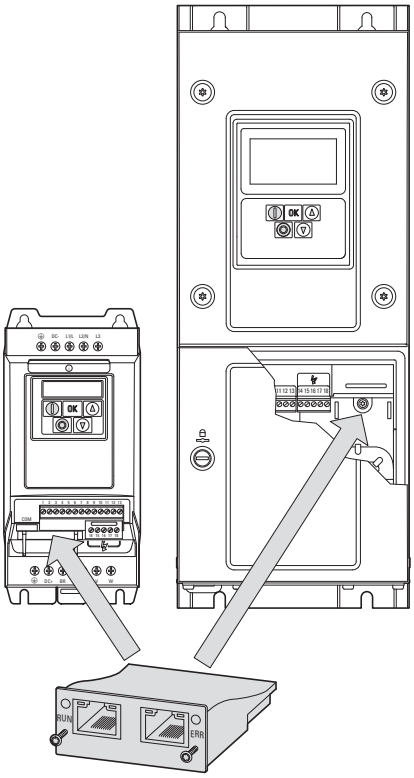


Figure 6: Flush mounting of fieldbus connection

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. They can be quickly located at

www.eaton.com/moeller → Support

by entering the document number as the search term.

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-ETHERCAT-2 fieldbus connection, it will be necessary to open the DA1 variable frequency drive's enclosure. We recommend that this mounting work be carried out before the electrical installation of the variable frequency drive.

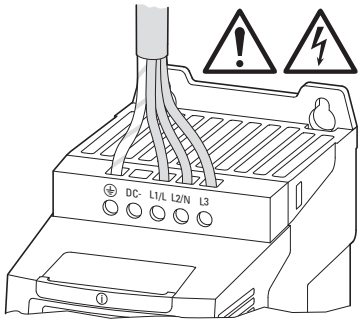


Figure 7: Make sure that the equipment is de-energized when performing installation work

3.4 Mounting for frame sizes FS2 and FS3

In the case of DA1 variable frequency drives with sizes FS2 and FS3, the NET-ETHERCAT-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.

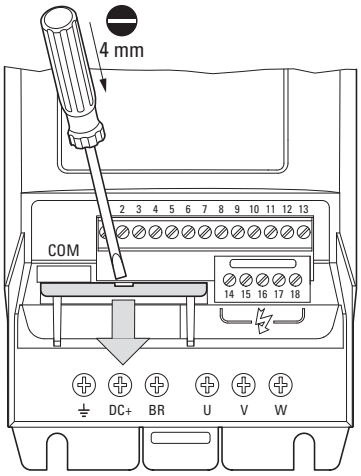


Figure 8: Opening the interface cover

> *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.

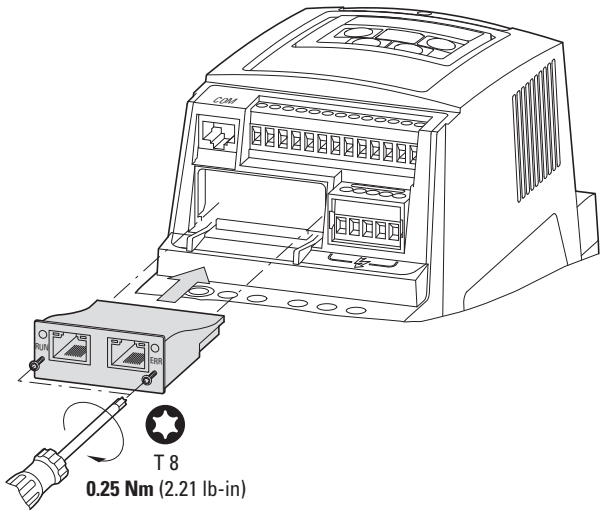


Figure 9: Inserting the fieldbus connection

3.5 Mounting from construction size FS4

When working with DA1 variable frequency drives of size FS4 or larger, the DX-NET-ETHERCAT-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.

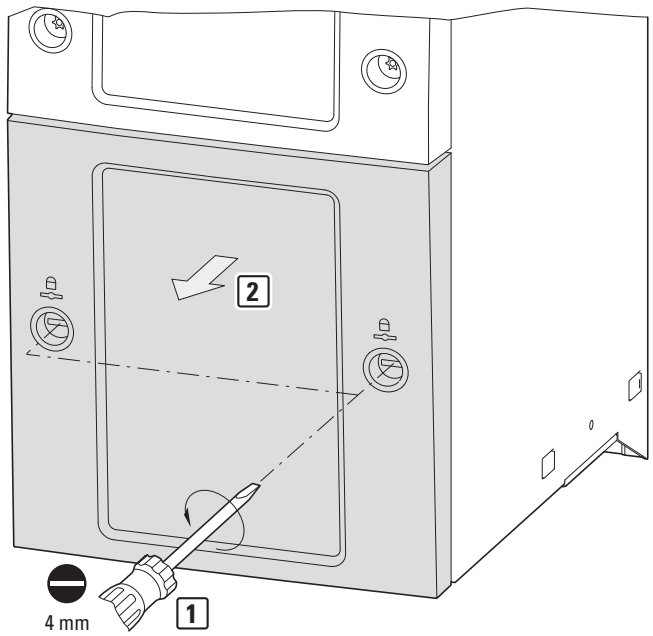


Figure 10: Opening the enclosure of DA1 variable frequency drives with size FS4 and up

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.

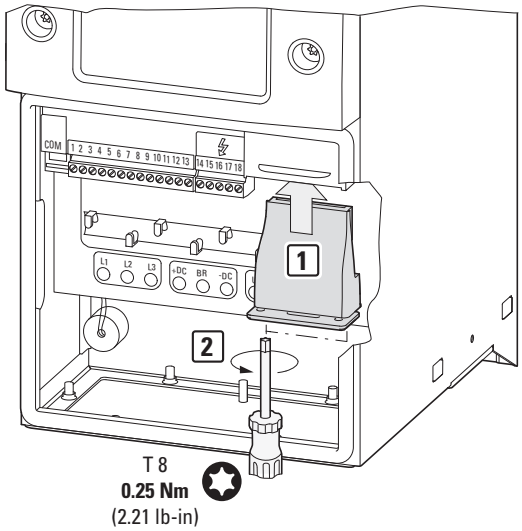
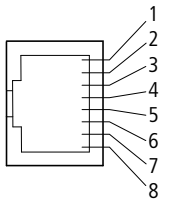


Figure 11: Inserting the fieldbus connection

3.6 Installing the fieldbus connection

An RJ45 plug is used in order to establish a connection to the EtherCAT field bus.

Generally, connection cables with RJ45 plugs for ETHERCAT 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

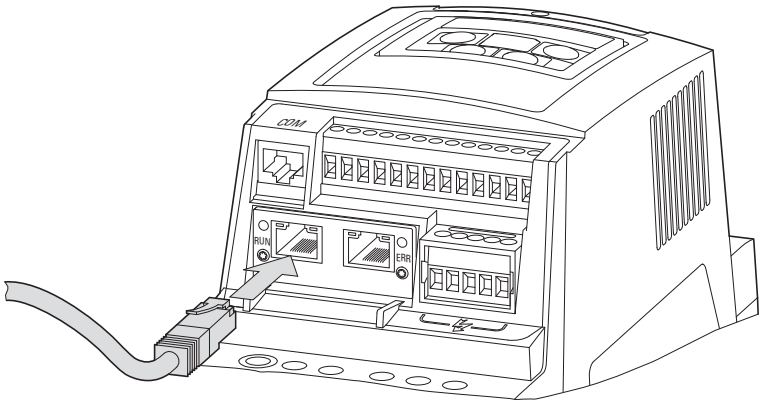


Figure 13: Connecting the RJ45 plug

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 VDC, etc.), as well as the field bus system's (EtherCAT) 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.

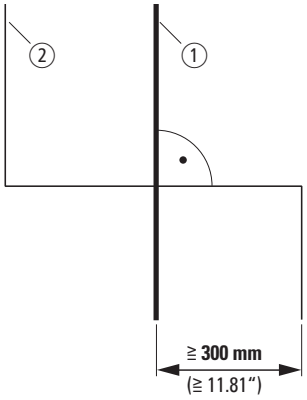


Figure 14: Routing cables for EtherCAT ② and mains/motor cables ①

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.

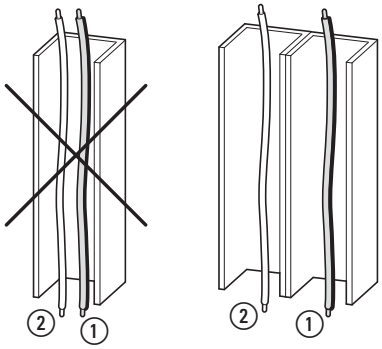


Figure 15: Separate routing in the cable duct

① Mains and motor connection cable
② EtherCAT cable

→ In all cases only use approved EtherCAT 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-EN.

Check the settings and installations for the connection to the EtherCAT 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 ESI file

ESI files (ESI = EtherCAT Slave Interface) are XML files that are used to define the properties of EtherCAT nodes. In order to be able to connect a DA1 variable frequency drive to an EtherCAT network, you will require the corresponding ESI file.

The ESI file can be found on the CD-ROM and on the Internet at:

www.eaton.com/moeller → **Downloads**

The ESI file contains the following information:

- Manufacturer,
- name,
- part no.,
- version number,
- protocol used,
- configuration data.

4.3 Addressing

Addresses are assigned according to the physical order of the devices on the ring. Please note that you will not need to assign any addresses manually, as the master will automatically do so (head-end controller).

4.4 Bus termination resistor

EtherCAT networks do not require bus termination resistors. When the last node on a network is reached, EtherCAT will automatically detect that there are no further nodes (loopback function).

4.5 Engineering the module

The following instructions explain how to configure the communication module with a DA1 variable frequency drive.

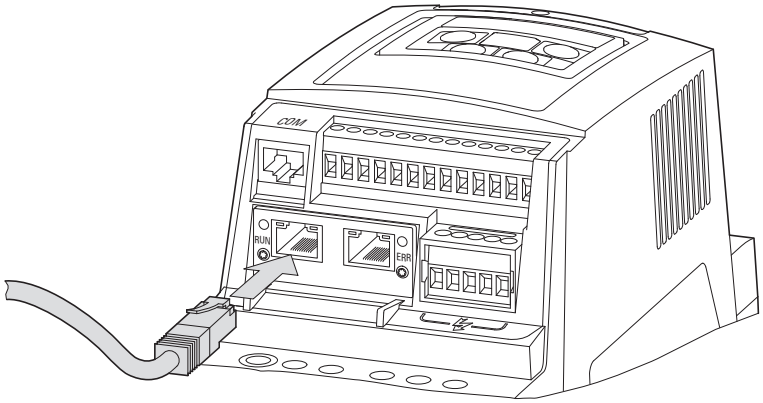


Figure 16:RJ45 plug connection

▶ Connect the device to the EtherCAT environment.
You will need the following components to do so:
- Head-end controller
- Computer (for programming and configuration purposes)
- Variable frequency drive DA1 with DX-NET-ETHERCAT-2 connection

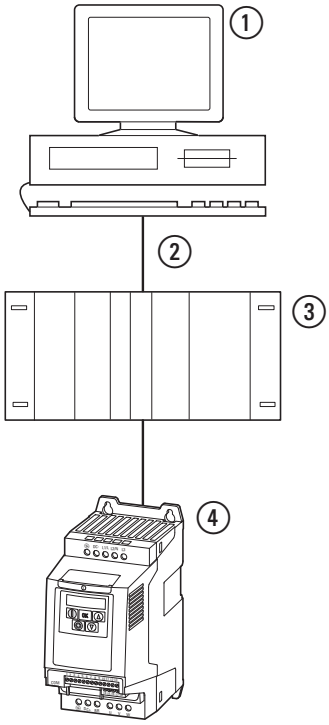
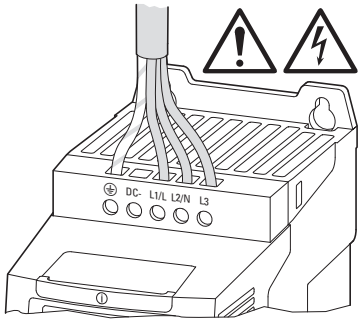


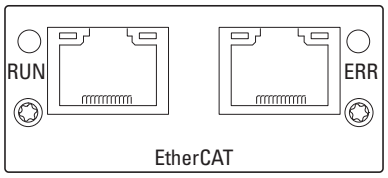
Figure 17:Engineering

① PC (with configuration tool)
② Head-end controller (master) with EtherCAT interface
③ EtherCAT cable
④ Variable frequency drive DA1 with DX-NET-ETHERCAT-2 connection

- Switch the device on (turn on the power supply!).



- Now configure the project. (For information on a detailed configuration, please consult the manual provided by the PLC's manufacturer.)
- Check the LED indicators.
  The head-end controller must recognize the device address and the module must light up green (→ Section 2.2, "LED indicators").



4.6 EtherCAT principle

The EtherCAT protocol is specifically optimized for the transmission of process data and uses Ethernet as its transmission medium. The EtherCAT protocol also has its own EtherType, meaning that EtherCAT data can be transported directly inside standard Ethernet frames. In fact, this transmission method will always be selected if all bus nodes are found on the same subnet.

An EtherCAT frame can be made up of multiple subframes. Each one of these subframes will serve a specific memory area in the logical process image, which in turn can have a maximum size of 4 GB. The data sequence will be independent of the physical order of the nodes on the network. Unlike the method normally used with other Ethernet systems, Ethernet data packets in EtherCAT networks are not received at every single node in order to be interpreted and then have the process data be copied. Instead, output data is taken from the frame and input data is added to it in a single run through the EtherCAT network. More specifically, the slaves on the network will take any data meant for them as the frame passes through them. Likewise, they will insert input data into the frame as it passes through. This process only delays frames by a few nanoseconds. Since an Ethernet frame will include the data for a large number of nodes both in the transmission and reception directions, this means that the payload data content will increase to more than 90 %. Used in conjunction with 100BASE-TX's full-duplex mode, this method makes it possible to achieve effective data rates of almost 200 Mbit/s.

4.7 CoE protocol

The EtherCAT fieldbus system uses the CoE (CANopen over EtherCAT) transmission protocol.

Meanwhile, user protocols are tunneled through an EtherCAT data channel. By using the CoE protocol, EtherCAT provides the exact same communication mechanisms that are available through CANopen (e.g., object dictionary, PDO mapping, and SDOs). In addition, the network management mechanisms are similar. This means that it is relatively easy to implement EtherCAT on devices equipped with CANopen, as a large part of the CANopen firmware can be reused directly.

When using the CoE protocol, two transfer methods are used for the various CANopen transfer methods:

- **Mailbox frame protocol** for transmitting acyclic data
- **Process data frame protocol** for transmitting cyclic data

The mailbox frame protocol is used to transmit the SDOs defined in CANopen. In EtherCAT systems, these SDOs are transmitted in SDO frames. Meanwhile, the process data frame protocol is used to transmit the PDOs defined in CANopen for transferring cyclic data. In EtherCAT systems, these PDOs are transmitted in PDO frames. This means that PDOs and SDOs can be used the same way they are used with the CANopen communications protocol.

4.8 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

Access rights are not shown in the drivesConnect PC software.

Manual

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

PC Software

PNU	Description	Value	Range	Default	Visible
①	③	②		④	

Figure 18:How the parameters are shown in the manual and in the software

PNU	ID	Access right RUN	Access right ro | rw	Designation	Value range	DS	Value that must be configured
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 (PROFINET-2, Modbus RTU, etc.) 5 = Slave mode 6 = field bus CANopen	0	4

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

4.9 Data Types

Table 3 lists the data types used in EtherCAT.

Table 3: EtherCAT data types

Name	Description	Range	
		Minimum	Max Length
UNSIGNED8	8-bit unsigned integer (b7 to b0)	0	255
UNSIGNED16	16-bit unsigned integer (b15 to b0)	0	65535
UNSIGNED32	32-bit unsigned integer (b31 to b0)	0	4294967295
INTEGER8	8-bit signed integer (b7 to b0)	-128	127
INTEGER16	16-bit signed integer (b15 to b0)	-32768	32767
INTEGER32	32-bit signed integer (b31 to b0)	-2147483648	2147483647
RECORD	Data structure with fixed number of any types	–	–
STRING	Character string (e.g. „EATON“)	–	–

4.10 Operation

4.10.1 Cyclic data

Process data field

Master → Slave TPDO	CW	REF	PDI 3	PDI 4
Slave → Master RPTO	SW	ACT	PDO 3	PDO 4

The length of each data unit is 1 word.

Description of data content

Byte	Meaning	Explanation
CW	Control word	Command
SW	Status word	Status Word
REF	Reference Value	Setpoint value
ACT	Actual Value	Actual value
PDO	Process Data Out	Process data output
PDI	Process Data In	Process data input

Command

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	

4.10.2 PDO-based cyclic communications

Each module has both a transmit PDO (TPDO) and a receive PDO (RPDO) available. RPDOs are sent from master to slave (e.g.: control word, setpoint value). TPDOS, meanwhile, transport process input data (e.g., variable frequency drive status information) from slave to master.

TPDOs and RPDOs have up to 254 SDOs available for mapping.

Setpoint value

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 (PDI 3)

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 (PDI 4)

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

Status word

The status word (consisting of any error messages and the device status) provides information regarding the device status and any error messages.

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

Device status

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	Not used	

Error messages

Failure code [hex]	Value shown on display	Meaning
00	no-FAt	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
06	O Volts	Overvoltage (DC link)
07	U-volts	undervoltage (DC link)
08	O-t	Overtemperature (heat sink)
09	U-t	Undertemperature (heat sink)
0A	P-dEF	Default settings, parameters have been loaded
0B	E-trIP	External error 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, built-in (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	U-dEF	User-definable factory parameters have been loaded

Failure code [hex]	Value shown on display	Meaning
15	F-PtC	Excessive overtemperature, motor PTC
16	FAn-F	Fault, internal fan
17	O-hEAt	Excessively high ambient air temperature
18	O-tor9	Maximum torque limit exceeded
19	U-tor9	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, RS-485 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 is 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
32	SC-F01	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

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 (PDO 3)

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 (PDO 4)

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

4.11 SyncManager

In order to make it possible to integrate CANopen objects into the EtherCAT protocol, EtherCAT systems feature what is referred to as a SyncManager. This feature implements a series of Sync channels. All objects are sent to the EtherCAT bus via these Sync channels.

In contrast to CANopen, EtherCAT makes it necessary to additionally map SDOs and PDOs to Sync channels. SyncManager objects are available for this purpose. Sync channels are permanently assigned to individual transfer methods, i.e., users cannot change the transfer method for a channel.

- Sync channel 0: mailbox frame protocol for incoming SDOs (from master to slave)
- Sync channel 1: mailbox frame protocol for outgoing SDOs (from slave to master)
- Sync channel 2: process data frame protocol for incoming PDOs (from master to slave)
- Sync channel 3: process data frame protocol for outgoing PDOs (from slave to master)

The individual PDOs are configured using receive PDOs and transmit PDOs. The Sync channels and the PDOs can only be set and configured in the "Pre-Operational" state.

4.12 CoE communication objects

The standard object dictionary is implemented as specified in communication profile DS 301. Table 4 provides an overview of the communication objects that are compatible with CANopen. These parameters are supported by the DX-NET-ETHERCAT-2 module.

Table 4: Communication objects

Index	Object name	Sub index	Description	Type	Access type	Meaning
1000_{hex}	Device type	00_{hex}	Device type	U32	ro	Device type
1001_{hex}	Error register	00_{hex}	Error Register	U8	ro	Error Register (See diagnostics object 02_{hex})
1003_{hex}	Pre-defined error field	00_{hex}	Number of errors	U8	rw	
		01_{hex} - 05_{hex}	Error field	U32	ro	
1008_{hex}	Manufacturer device name	00hex	Manufacturer device name	String	ro	Component designation (see EtherCAT object $F5_{hex}$)
1009_{hex}	Manufacturer hardware version	00_{hex}	Manufacturer hardware version	String	ro	Hardware version See object $F5_{hex}$
1011_{hex}	Restore parameters	00_{hex}	Largest sub index supported	U8	ro	-
		01_{hex}	Restore all default parameters	U32	rw	Restore all parameters
1018_{hex}	Identity Object	00_{hex}	Number of entries	U8	ro	Configuration of entries
		01_{hex}	Vendor ID	U32	ro	These entries are managed by EtherCAT object $F5_{hex}$
		02_{hex}	Product Code	U32	ro	
		03_{hex}	Revision Number	U32	ro	
		04_{hex}	Serial Number	U32	ro	
1600_{hex}	Receive PDO Mapping	00_{hex}	Number of mapped application objects in PDO	U8	ro	Number of mappings for PDOs (0 - 254)
		01_{hex}	Mapped object 1	U32	ro	–
		02_{hex}	Mapped object 2	U32	ro	–
		…	…	U32	ro	–
		NN_{hex}	Mapped Object NN	U32	ro	–
$1A00_{hex}$	Transmit PDO Mapping	00_{hex}	Number of mapped application objects in PDO	U8	ro	Number of mappings for PDOs (0 - 254)
		01_{hex}	Mapped object 1	U32	ro	–
		02_{hex}	Mapped object 2	U32	ro	–
		…	…	U32	ro	–
		NN_{hex}	Mapped Object NN	U32	ro	–
$1C00_{hex}$	SyncManager Communication Type	00_{hex}	Number of entries	U8	ro	Configuration of Sync channels.
		01_{hex}	Mailbox wr	U8	ro	–
		02_{hex}	Mailbox rd	U8	ro	–
		03_{hex}	Process Data out	U8	ro	–
		04hex	Process Data in	U8	ro	–
$1C12_{hex}$	SyncManager Rx PDO Assign	00_{hex}	Number of Assigned PDOs	U8	ro	Assignment between Sync channel and a PDO
		01_{hex}	Assigned PDO	U16	ro	assigned PDO

Index	Object name	Sub index	Description	Type	Access type	Meaning
$1C13_{hex}$	SyncManager Tx PDO Assign	00_{hex}	Number of Assigned PDOs	U8	ro	Assignment between Sync channel and a PDO
		01_{hex}	Assigned PDO	U16	ro	Assigned PDO
$1C32_{hex}$	SM ouput parameter	00_{hex}	Number of entries	U8	ro	–
		01_{hex}	Sync Mode	U16	ro	–
$1C33_{hex}$	SM input Parameter	00_{hex}	Number of entries	U8	ro	–
		01_{hex}	Sync Mode	U16	ro	–

4.12.1 Diagnostics object 02_{hex}

This object defines a standardized method for handling host application events and diagnostics.

Instance attributes

Name	Access	Type	Value
Severity	Get	UINT8	–
Event Code	Get	UINT8	–
NW specific extension	Get	UINT8	CANopen specific EMCY code

If a fault occurs in the DA1 variable frequency drive, the corresponding diagnostic data will be forwarded through the module. An emergency message will be used to generate a message and transmit it to the EtherCAT bus.

The transfer appears as follows:

1. A new entry (diagnostics) is created in object 1003_{hex} (pre-defined error field) as follows:

High Byte (UNIT32)		Low Byte
Not used	Event Code	00_{hex}

2. The corresponding bit information is written to the error register (object 1001_{hex} assignment).

3. The EMCY object is sent to the network with the following information:

Byte 0	Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
00_{hex}	Event Code	Error Register 1001_{hex}	Vendor-specific information (not used)				

Bytes 0 and 1 will be replaced with the value in attribute 3.

EtherCAT CoE emergency frames are used to transfer error messages between master and slave. More specifically, CoE emergency frames are used directly to transfer the EMCY messages defined in CANopen.

4.12.2 Network object 03_{hex}

This object contains general information about the network (e.g. type of network, data format).

	Name	Access	Type	Value
1	Type of network	ro	UINT8	0087_{hex}
2	Type of network String	ro	String	"EtherCAT"
3	Data Format	ro	ENUM	00_{hex}
4	Parameter Data	ro	BOOLE	True
5	PDO - Write	ro	UINT16	PDO size currently being written
6	PDO - Read	ro	UINT16	PDO size currently being read
7	Exception - Information	ro	UINT8	Additional information when the module throws an exception: 01: data type not available 02: Error message for GET_INSTANCE_NUMBER_BY_ORDER 03: Error message for GET_ATTRIBUTE "Highest Instance Number" 04: Error message for GET_ATTRIBUTE "Number of Instances" 05: "Highest instance number is lower than the number of instances" implementation error

4.12.3 Network configuration object (04hex)

This object contains network configuration parameters that can be configured by the user.

A reset command for this object will reset all instances to their default values.

Object attributes (instance 0)

	Name	Access	Type	Value
1	Name	ro	String	"Network configuration"
2	Revision	ro	UINT8	01_{hex}
3	Number of instances	ro	UINT16	0001_{hex}
4	Highest Instance Number	ro	UINT16	0003_{hex}

Instance attributes (Instance 3 Device ID)

	Name	Access	Type	Value
1	Name	ro	String	"Device ID"
2	data type	ro	UINT8	05_{hex}
3	Number of elements	ro	UINT8	01_{hex}
4	Highest Instance Number	ro	UINT8	07_{hex}
5	&Value	ro	UINT6	1 - 65353

4.12.4 Object $F5_{hex}$

Object $F5_{hex}$ implements EtherCAT-specific settings in the host application; it contains manufacturer information.

Object attributes

	Name	Access	Type	Value	Meaning
1	Name	Get	String	"EtherCAT"	Property Name
2	Revision	Get	UINT8	01_{hex}	Revision
3	Number of Instances	Get	UINT16	0001_{hex}	Number of instances
4	Highest Instance No.	Get	UINT16	0001_{hex}	Highest Instance Number

Instance attributes

	Name	Access	Type	Value	Meaning
1	Vendor ID	Get	UINT32	000001CB	
2	Product Code	Get	UINT32	169127	
3	Major revision	Get	UINT16	1	
4	Minor revision	Get	UINT16	0	
5	Serial Number	Get	UINT32	169127	
6	Manufacturer Device Name	Get	String	"EATON"	Name of manufacturer
7	Manufacturer Hardware Version	Get	String	1.20	Manufacturer hardware version

4.12.5 Application Data (ADI)

ADIs can be accessed through the network using a vendor-specific object range (2001_{hex} - $5FFF_{hex}$).

The SDO information protocols allow the node to retrieve the name and data type of an ADI.

Read and write access to the drive parameters is provided by the SDO services.

The SDO protocols allow the node to retrieve the name and data type of the ADI.

4.12.5.1 Acyclic Parameter

In order to configure and diagnose nodes, acyclic communications can be used to access the variables available to the network. The mailbox frame is used for acyclic data transfers. The SDO services make it possible to have read and write access to the drive parameters.

4.12.6 List of parameters

Table 5: Parameter Data

ADI order	Description		Access right	ADI number	Index
9	Variable frequency drive ID		ro	9	2009hex
10	Variable frequency drive part no.		ro	10	200Ahex
11	Control section software		ro	11	200Bhex
12	Control section checksum		ro	12	200Chex
13	Software power section		ro	13	200Dhex
14	Power section checksum		ro	14	200Ehex
15	Serial number 1		ro	15	200Fhex
16	Serial number 2		ro	16	2010hex
17	Serial number 3		ro	17	2011hex
18	Serial number 4		ro	18	2012hex
21	P1-01	Maximum frequency / maximum speed	rw	101	2065hex
22	P1-02	Minimum frequency / minimum speed	rw	102	2066hex
23	P1-03	Acceleration time (acc1)	rw	103	2067hex
24	P1-04	Deceleration time (dec1)	rw	104	2068hex
25	P1-05	Stop Function	rw	105	2069hex
26	P1-06	Energy optimization	rw	106	206Ahex
27	P1-07	Motor, rated operating voltage	rw	107	206Bhex
28	P1-08	Motor, rated operational current	rw	108	206Chex
29	P1-09	Motor, rated frequency	rw	109	206Dhex
30	P1-10	Motor, rated speed	rw	110	206Ehex
31	P1-11	Output voltage at zero frequency	rw	111	206Fhex
32	P1-12	Control level	rw	112	2070hex
33	P1-13	Digital input, function	rw	113	2071hex
34	P1-14	Parameter range access code (depends on P2-40 and P6-30)	rw	114	2072hex
46	P2-01	Fixed frequency FF1 / speed 1	rw	201	20C9hex
47	P2-02	Fixed frequency FF2 / speed 2	rw	202	20CAhex
48	P2-03	Fixed frequency FF3 / speed 3	rw	203	20CBhex
49	P2-04	Fixed frequency FF4 / speed 4	rw	204	20CChex
50	P2-05	Fixed frequency FF5 / speed 5	rw	205	20CDhex
51	P2-06	Fixed frequency FF6 / speed 6	rw	206	20CEhex
52	P2-07	Fixed frequency FF7 / speed 7	rw	207	20CFhex
53	P2-08	Fixed frequency FF8 / speed 8	rw	208	20D0hex
54	P2-09	Frequency jump 1, bandwidth	rw	209	20D1hex
55	P2-10	Frequency skip 1, center	rw	210	20D2hex
56	P2-11	AO1 signal (Analog Output)	rw	211	20D3hex
57	P2-12	AO1, signal range	rw	212	20D4hex
58	P2-13	AO2 signal (Analog Output)	rw	213	20D5hex

ADI order	Description		Access right	ADI number	Index
59	P2-14	AO2, signal range	rw	214	20D6hex
60	P2-15	RO1 Signal (Relay 1 Output)	rw	215	20D7hex
61	P2-16	AO1 / RO1 upper limit	rw	216	20D8hex
62	P2-17	AO1 / RO1 lower limit	rw	217	20D9hex
63	P2-18	RO2 Signal (Relay Output)	rw	218	20DAhex
64	P2-19	AO2 / RO2 upper limit	rw	219	20DBhex
65	P2-20	AO2 / RO2 lower limit	rw	220	20DChex
66	P2-21	Scaling factor for value	rw	221	20DDhex
67	P2-22	Scaled display value	rw	222	20DEhex
68	P2-23	Holding time for speed of zero	rw	223	20DFhex
69	P2-24	Pulse frequency	rw	224	20E0hex
70	P2-25	Quick stop deceleration ramp time	rw	225	20E1hex
71	P2-26	Flying restart circuit	rw	226	20E2hex
72	P2-27	Standby mode delay time	rw	227	20E3hex
73	P2-28	Slave speed scaling	rw	228	20E4hex
74	P2-29	Slave speed scaling factor	rw	229	20E5hex
75	P2-30	AI1, Signal range	rw	230	20E6hex
76	P2-31	AI1 scaling factor	rw	231	20E7hex
77	P2-32	AI1 offset	rw	232	20E8hex
78	P2-33	AI2, Signal range	rw	233	20E9hex
79	P2-34	AI2, scaling factor	rw	234	20EAhex
80	P2-35	AI2, Offset	rw	235	20EBhex
81	P2-36	REAF, Start function with automatic restart, control signal terminals	rw	236	20EChex
82	P2-37	REAF, start function with automatic restart	rw	237	20EDhex
83	P2-38	Response in the event of a power failure	rw	238	20EEhex
84	P2-39	Parameter access lock	rw	239	20EFhex
85	P2-40	Access codes - menu level 2	rw	240	20F0hex
86	P3-01	PID controllers, P amplification	rw	301	
87	P3-02	PID controller, I time constant	rw	302	212Dhex
88	P3-03	PID controller, D time constant	rw	303	212Ehex
89	P3-04	PID controller, control deviation	rw	304	212Fhex
90	P3-05	PID controller, setpoint source	rw	305	2130hex
91	P3-06	PID controller, digital reference value	rw	306	2131hex
92	P3-07	PID controller, actual value limiting, maximum	rw	307	2132hex
93	P3-08	PID controller, actual value limiting, minimum	rw	308	2133hex
94	P3-09	PID controller, actual value limiting	rw	309	2134hex
95	P3-10	PID controller, actual value (PV)	rw	310	2135hex
96	P3-11	Maximum PID error for enabling the ramps	rw	311	2136hex
97	P3-12	PID feedback display scaling factor	rw	312	2137hex

ADI order	Description		Access right	ADI number	Index
98	P3-13	PID feedback wake up level	rw	313	2138hex
99	P3-14	Reserved	-	314	2139hex
100	P3-15	Reserved	-	315	213Ahex
101	P3-16	Reserved	-	316	213Bhex
102	P3-17	Reserved	-	317	213Chex
103	P3-18	PID reset control	rw	318	213Dhex
106	P4-01	Motor control mode selection	rw	401	2191hex
107	P4-02	Auto-tune enable	rw	402	2192hex
108	P4-03	Rotational speed controller P gain	rw	403	2193hex
109	P4-04	Speed controller integral time	rw	404	2194hex
110	P4-05	Motor Power Factor (cosφ)	rw	405	2195hex
111	P4-06	Torque setpoint/limit	rw	406	2196hex
112	P4-07	Maximum torque (motor)	rw	407	2197hex
113	P4-08	Minimum torque	rw	408	2198hex
114	P4-09	Maximum torque (generator)	rw	409	2199hex
115	P4-10	V/Hz characteristic curve modification voltage	rw	410	219Ahex
116	P4-11	V/Hz characteristic curve modification frequency	rw	411	219Bhex
126	P5-01	Inverter Slave Adress	rw	501	21F5hex
127	P5-02	CANopen baud rate	rw	502	21F6hex
128	P5-03	Modbus RTU Baud rate	rw	503	21F7hex
129	P5-04	Modbus RTU data format – Parity type	rw	504	21F8hex
130	P5-05	Timeout at communications dropout	rw	505	21F9hex
131	P5-06	Response in the event of a communications dropout	rw	506	21FAhex
132	P5-07	Ramp via field bus	rw	507	21FBhex
133	P5-08	Field bus module PDO-4 output	rw	508	21FChex
134	P5-09	reserved	-	509	21FDhex
135	P5-10	reserved	-	510	21FEhex
136	P5-11	reserved	-	511	21FFhex
137	P5-12	Field bus module, PDO-3 output	rw	512	2200hex
138	P5-13	Field bus module, PDI-4 input	rw	513	2201hex
139	P5-14	Field bus module, PDI-3 input	rw	514	2202hex
146	P6-01	Firmware upgrade enable	rw	601	2259hex
147	P6-02	Auto temperature management	rw	602	225Ahex
148	P6-03	Auto-reset waiting time	rw	603	225Bhex
149	P6-04	Relay hysteresis band	rw	604	225Chex
150	P6-05	Enable incremental encoder feedback	rw	605	225Dhex
151	P6-06	Incremental encoder scale	rw	606	225Ehex
152	P6-07	Maximum speed error	rw	607	225Fhex
153	P6-08	Input frequency at maximum speed	rw	608	2260hex

ADI order	Description		Access right	ADI number	Index
154	P6-09	Droop speed	rw	609	2261hex
155	P6-10	PLC function enable	rw	610	2262hex
156	P6-11	Speed holding time in the event of an enable signal	rw	611	2263hex
157	P6-12	Speed holding time in the event of a disable signal	rw	612	2264hex
158	P6-13	Motor brake opening time	rw	613	2265hex
159	P6-14	Motor brake engagement delay	rw	614	2266hex
160	P6-15	Minimum torque for brake opening	rw	615	2267hex
161	P6-16	Minimum torque time limit	rw	616	2268hex
162	P6-17	Maximum torque time limit	rw	617	2269hex
163	P6-18	Voltage for DC injection braking	rw	618	226Ahex
164	P6-19	Brake resistor value	rw	619	226Bhex
165	P6-20	Brake resistor power	rw	620	226Chex
166	P6-21	Braking chopper cycle in the event of excessively low temperature	rw	621	226Dhex
167	P6-22	Reset fan run-time	rw	622	226Ehex
168	P6-23	kWh meter reset	rw	623	226Fhex
169	P6-24	Service interval	rw	624	2270hex
170	P6-25	Service interval reset	rw	625	2271hex
171	P6-26	AO1, scaling	rw	626	2272hex
172	P6-27	AO1, Offset	rw	627	2273hex
173	P6-28	Display index P0-80	rw	628	2274hex
174	P6-29	Save parameters as default	rw	629	2275hex
175	P6-30	Access code for menu level 3	rw	630	2276hex
176	P7-01	Motor stator resistance	rw	701	22BDhex
177	P7-02	Rotor resistance	rw	702	22BEhex
178	P7-03	Motor leakage inductance (d)	rw	703	22BFhex
179	P7-04	Motor magnetizing current	rw	704	22C0hex
180	P7-05	Motor leakage factor	rw	705	22C1hex
181	P7-06	Motor leakage inductance (q)	rw	706	22C2hex
182	P7-07	Advanced generator control	rw	707	22C3hex
183	P7-08	Enable, motor parameter adaptation	rw	708	22C4hex
184	P7-09	Overvoltage current limit	rw	709	22C5hex
185	P7-10	Load inertia factor	rw	710	22C6hex
186	P7-11	Minimum PWM pulse width	rw	711	22C7hex
187	P7-12	Magnetizing time at the U/f method	rw	712	22C8hex
188	P7-13	Rotational speed controller D gain	rw	713	22C9hex
189	P7-14	Torque boost	rw	714	22CAhex
190	P7-15	Maximum frequency limit for torque boost	rw	715	22CBhex
191	P7-16	Enable, signal injection	rw	716	22CChex
192	P7-17	Signal injection level	rw	717	22CDhex

ADI order	Description		Access right	ADI number	Index
196	P8-01	Second acceleration time (acc2)	rw	801	2321hex
197	P8-02	Transition frequency (acc1 - acc2)	rw	802	2322hex
198	P8-03	Third acceleration time (acc3)	rw	803	2323hex
199	P8-04	Transition frequency (acc2 - acc3)	rw	804	2324hex
200	P8-05	Fourth acceleration time (acc4)	rw	805	2325hex
201	P8-06	Transition frequency (acc3 - acc4)	rw	806	2326hex
202	P8-07	Fourth deceleration time (dec4)	rw	807	2327hex
203	P8-08	Transition frequency (dec3 - dec4)	rw	808	2328hex
204	P8-09	Third deceleration time (dec3)	rw	809	2329hex
205	P8-10	Transition frequency (dec2 - dec3)	rw	810	232Ahex
206	P8-11	Second deceleration time (dec2)	rw	811	232Bhex
207	P8-12	Transition frequency (dec1 - dec2)	rw	812	232Chex
208	P8-13	Ramp selection when there is a preset speed	rw	813	232Dhex
216	P9-01	Control source - enable	rw	901	2385hex
217	P9-02	Control source - quick stop	rw	902	2386hex
218	P9-03	Control source - start signal 1 (FWD)	rw	903	2387hex
219	P9-04	Control source – start signal 2 (REV)	rw	904	2388hex
220	P9-05	Control source - Stay-put function	rw	905	2389hex
221	P9-06	Control source - enable (REV)	rw	906	238Ahex
222	P9-07	Control source - reset	rw	907	238Bhex
223	P9-08	Control source – external fault	rw	908	238Chex
224	P9-09	Control source - terminal control	rw	909	238Dhex
225	P9-10	Source - Speed 1	rw	910	238Ehex
226	P9-11	Source - speed 2	rw	911	238Fhex
227	P9-12	Source - speed 3	rw	912	2390hex
228	P9-13	Source - speed 4	rw	913	2391hex
229	P9-14	Source - speed 5	rw	914	2392hex
230	P9-15	Source - speed 6	rw	915	2393hex
231	P9-16	Source - speed 7	rw	916	2394hex
232	P9-17	Source - speed 8	rw	917	2395hex
233	P9-18	Speed - input 0	rw	918	2396hex
234	P9-19	Speed - input 1	rw	919	2397hex
235	P9-20	Speed - input 2	rw	920	2398hex
236	P9-21	Fixed frequency 0	rw	921	2399hex
237	P9-22	Fixed frequency 1	rw	922	239Ahex
238	P9-23	Fixed frequency 2	rw	923	239Bhex
239	P9-24	Acceleration ramp input 0	rw	924	239Chex
240	P9-25	Acceleration ramp input 1	rw	925	239Dhex
241	P9-26	Deceleration time input 0	rw	926	239Ehex

ADI order	Description		Access right	ADI number	Index
242	P9-27	Deceleration time input 1	rw	927	239Fhex
243	P9-28	Control source - Up-pushbutton	rw	928	23A0hex
244	P9-29	Control source - Down-pushbutton	rw	929	23A1hex
245	P9-30	FWD limit switch	rw	930	23A2hex
246	P9-31	REV limit switch	rw	931	23A3hex
247	P9-32	reserved	-	932	23A4hex
248	P9-33	Source - analog output (AO) 1	rw	933	23A5hex
249	P9-34	Source - analog output (AO) 2	rw	934	23A6hex
250	P9-35	Control source - Relay 1	rw	935	23A7hex
251	P9-36	Control source - Relay 2	rw	936	23A8hex
252	P9-37	Control source - scaling	rw	937	23A9hex
253	P9-38	Source - PID setpoint value	rw	938	23AAhex
254	P9-39	Source - PID feedback	rw	939	23ABhex
255	P9-40	Source - torque control reference	rw	940	23AChex
256	P9-41	Function choices - Relay output 3, 4, 5	rw	941	23ADhex
266	DI 1		ro	1001	23E9hex
267	DI 2		ro	1002	23EAhex
268	DI 3		ro	1003	23EBhex
269	DI 4		ro	1004	23EChex
270	DI 5		ro	1005	23EDhex
271	DI 6		ro	1006	23EEhex
272	DI 7		ro	1007	23EFhex
273	DI 8		ro	1008	23F0hex
274	AO 1		ro	1009	23F1hex
275	AO 2		ro	1010	23F2hex
276	DO 1		ro	1011	23F3hex
277	DO 2		ro	1012	23F4hex
278	DO 3		ro	1013	23F5hex
279	DO 4		ro	1014	23F6hex
280	DO 5		ro	1015	23F7hex
282	User register 1		rw	1017	23F9hex
283	User register 2		rw	1018	23FAhex
284	User register 3		rw	1019	23FBhex
285	User register 4		rw	1020	23FChex
286	User register 5		rw	1021	23FDhex
287	User register 6		rw	1022	23FEhex
288	User register 7		rw	1023	23FFhex
289	User register 8		rw	1024	2400hex
290	User register 9		rw	1025	2401hex

ADI order	Description	Access right	ADI number	Index
291	User register 10	rw	1026	2402hex
292	User register 11	rw	1027	2403hex
293	User register 12	rw	1028	2404hex
294	User register 13	rw	1029	2405hex
295	User register 14	rw	1030	2406hex
296	User register 15	rw	1031	2407hex
297	User AO 1	rw	1032	2408hex
298	User AO 2	rw	1033	2409hex
301	User RO 1	rw	1036	240Chex
302	User RO 2	rw	1037	240Dhex
303	User RO 3	rw	1038	240Ehex
304	User RO 4	rw	1039	240Fhex
305	User RO 5	rw	1040	2410hex
306	User, scaling value	rw	1041	2411hex
307	User, decimal scaling	rw	1042	2412hex
308	User, speed reference	rw	1043	2413hex
309	User, torque deference	rw	1044	2414hex
310	Field bus / User ramp	rw	1045	2415hex
311	Scope index 1 / 2	rw	1046	2416hex
312	Scope index 3 / 4	rw	1047	2417hex
313	24hour timer	rw	1048	2418hex
314	User display Ctrl	rw	1049	2419hex
315	User display value	rw	1050	241Ahex
326	AI 1 (Q12)	ro	1061	2425hex
327	AI 1 (%)	ro	1062	2426hex
328	AI 2 (Q12)	ro	1063	2427hex
329	AI 2 (%)	ro	1064	2428hex
330	DI status	ro	1065	2429hex
331	Speed reference	ro	1066	242Ahex
332	Value, digital potentiometer	ro	1067	242Bhex
333	Field bus speed reference	ro	1068	242Chex
334	Master speed reference	ro	1069	242Dhex
335	Slave speed reference	ro	1070	242Ehex
336	Frequency on speed reference input	ro	1071	242Fhex
337	Torque reference (Q12)	ro	1072	2430hex
338	Torque reference (%)	ro	1073	2431hex
339	Master torque reference (Q12)	ro	1074	2432hex
340	Field bus torque reference (Q12)	ro	1075	2433hex
341	PID user reference (Q12)	ro	1076	2434hex

ADI order	Description	Access right	ADI number	Index
342	PID user return value (Q12)	ro	1077	2435hex
343	PID controller reference (Q12)	ro	1078	2436hex
344	PID controller feedback value (Q12)	ro	1079	2437hex
345	PID controller output (Q12)	ro	1080	2438hex
346	Motor, velocity	ro	1081	2439hex
347	Motor, current	ro	1082	243Ahex
348	Motor, torque	ro	1083	243Bhex
349	Motor, power	ro	1084	243Chex
350	PID controller starting speed	ro	1085	243Dhex
351	DC voltage	ro	1086	243Ehex
352	Unit Temperature	ro	1087	243Fhex
353	PCB controle temperature	ro	1088	2440hex
354	Drive scaling value 1	ro	1089	2441hex
355	Drive scaling value 2	ro	1090	2442hex
356	Motor, torque (%)	ro	1091	2443hex
358	Expansion, IO input status	ro	1093	2445hex
361	ID, Plug-in module	ro	1096	2448hex
362	ID, field bus boards	ro	1097	2449hex
366	Scope channel 1 data	ro	1101	244Dhex
367	Scope channel 2 data	ro	1102	244Ehex
368	Scope channel 3 data	ro	1103	244Fhex
369	Scope channel 4 data	ro	1104	2450hex
370	OLED language number	ro	1105	2451hex
371	OLED version	ro	1106	2452hex
372	power section	ro	1107	2453hex
393	Service time	ro	1128	2468hex
394	Fan speed	ro	1129	2469hex
395	User kWh meter	ro	1130	246Ahex
396	User, MWh meter	ro	1131	246Bhex
397	Complete, KWh meter	ro	1132	246Chex
398	Complete, MWh meter	ro	1133	246Dhex
399	Total, operating hours meter	ro	1134	246Ehex
400	Total, operating minutes/seconds meter	ro	1135	246Fhex
401	User, hours-run meter	ro	1136	2470hex
402	User, operating minutes/seconds meter	ro	1137	2471hex

Alphabetical index

P

R

S

U

V

W