LXM32M

Modbus-TCP module
Fieldbus manual

V1.01, 01.2012

Modbus

0198441113843, V1.01, 01.2012

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Schneider Electric

Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

Hand this manual and all other pertinent product documentation over to all users of the product.

Carefully read and observe all safety instructions and the chapter "Before you begin - safety information".

Some products are not available in all countries.
For information on the availability of products, please consult the catalog.

Subject to technical modifications without notice.

All details provided are technical data which do not constitute warranted qualities.

Most of the product designations are registered trademarks of their respective owners, even if this is not explicitly indicated.

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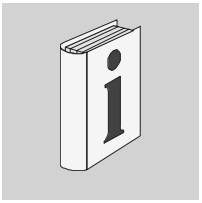
About this manual



This manual applies to the module Modbus TCP for the product LXM32M, module identification ETH.

The information provided in this manual supplements the product manual.

Source manuals

The latest versions of the manuals can be downloaded from the Internet at:

http://www.schneider-electric.com

Source CAD data

For easier engineering, CAD data (EPLAN macros or drawings) are available for download from the Internet at:

http://www.schneider-electric.com

Corrections and suggestions

We always try to further optimize our manuals. We welcome your suggestions and corrections.

Please get in touch with us by e-mail:
techcomm@schneider-electric.com.

Work steps

If work steps must be performed consecutively, this sequence of steps is represented as follows:

- ■ Special prerequisites for the following work steps
- ▸ Step 1
- ◃ Specific response to this work step
- ▸ Step 2

If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.

Unless otherwise stated, the individual steps must be performed in the specified sequence.

Making work easier

Information on making work easier is highlighted by this symbol:

Sections highlighted this way provide supplementary information on making work easier.

Parameters

In text sections, parameters are shown with the parameter name, for example `_IO_act`. A list of the parameters can be found in the product manual in the chapter Parameters.

SI units

SI units are the original values. Converted units are shown in brackets behind the original value; they may be rounded.

Example:
Minimum conductor cross section: 1.5 mm^2 (AWG 14)

Inverted signals

Inverted signals are represented by an overline, for example $\overline{\texttt{STO\_A}}$ or $\overline{\texttt{STO\_B}}$.

Glossary

Explanations of special technical terms and abbreviations.

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Index List of keywords with references to the corresponding page numbers.

Further reading

User Association http://www.modbus.org

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1 Introduction

1

Different products with a Modbus TCP interface can be operated in the same fieldbus. Modbus TCP provides a common basis for interchanging commands and data between the network devices.

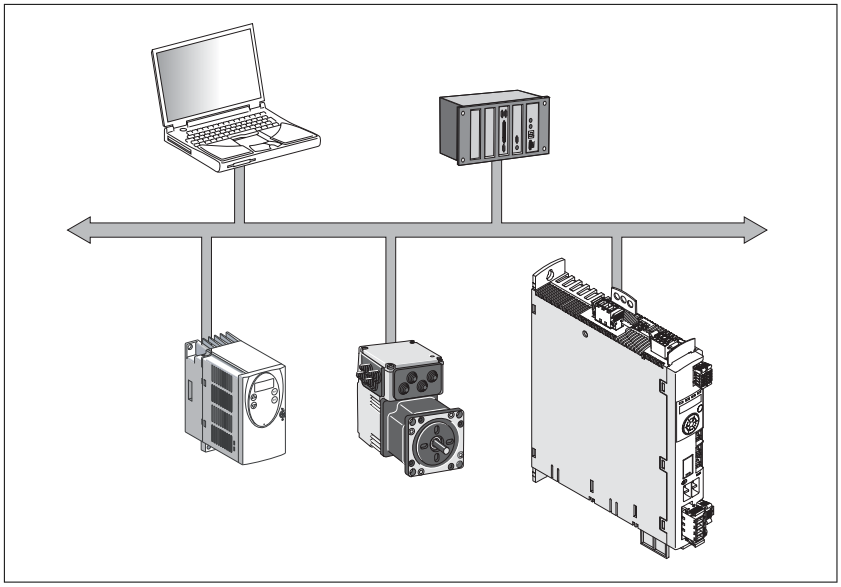

Figure 1: Fieldbus products on the network

Features The product supports the following functions via Modbus TCP:

- Automatic IP address assignment via BOOTP or DHCP
- Automatically obtaining configuration data via the FDR (Fast Device Replacement) service
- Commissioning via commissioning software
- Diagnostics and configuration via integrated web server
- Reading and writing parameters
- Controlling the drive
- Monitoring inputs and outputs
- Diagnostics and monitoring functions

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2 Before you begin - safety information

2

2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

2.2 Intended use

The functions described in this manual are only intended for use with the basic product; you must read and understand the appropriate product manual.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design).

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

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2.3 Hazard categories

Safety instructions to the user are highlighted by safety alert symbols in the manual. In addition, labels with symbols and/or instructions are attached to the product that alert you to potential hazards.

Depending on the seriousness of the hazard, the safety instructions are divided into 4 hazard categories.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

CAUTION

CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. **can result** in equipment damage).

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2.4 Basic information

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines. [1)]
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death or serious injury.

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control” and to NEMA ICS 7.1 (latest edition), “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems”.

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2.5 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

In the area of drive systems, this includes, but is not limited to, terms such as "safety function", "safe state", "fault", "fault reset", "failure", "error", "error message", "warning", "warning message", etc.

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"
- IEC 61784 series: "Industrial communication networks - Profiles"
- IEC 61508 series: "Functional safety of electrical/electronic/ programmable electronic safety-related systems"

Also see the glossary at the end of this manual.

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3 Basics

3

3.1 Modbus TCP technology

3.1.1 Function principle

Modbus TCP is an Ethernet fieldbus. Modbus TCP describes the transmission of the Modbus protocol via the Ethernet interface and the TCP/IP transport and network layers.

The Modbus TCP client (master) connects to the Modbus TCP server (slave). Once the connection is established, the client sends Modbus requests to the server. These requests are processed by the server. The result is returned to the client as a Modbus response.

The Modbus TCP services are identical to the Modbus RTU services.

3.1.2 Bus topology

Star and tree topologies can be used. It is possible to use hubs or switches. In the case of high bus loads with many devices, it is recommended to use a switches.

The maximum length of a segment is 100 m. A segment consists of devices and hubs. A network can be subdivided into several segments by means of gateways or switches. Short cables and a star topology are recommended to achieve a fast bus cycle.

The transmission rate is 10 or 100 MBit/s in half-duplex mode. If switches are used, transmission is also possible in full duplex mode.

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3.1.3 Client / server model

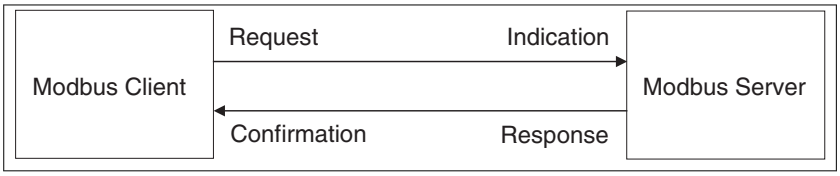

Figure 2: Client / server model

The Modbus messaging service implements client/server communication between devices connected by means of a TCP/IP network. Modbus TCP does not use an object dictionary.

The client/server model is based on 4 types of messages:

- **Request**: Message sent by the client to initiate a transaction.
- **Indication**: Request as received by the server.
- **Response**: Response message to the request sent by the server.
- **Confirmation**: Response as received by the client.

A communication cycle consists of the request from the client (request from the fieldbus master) and a response from the server (response from the fieldbus slave). Modbus request and Modbus response have the same structure. If an error occurs on receipt of the Modbus request or if the slave cannot execute the action, the slave sends an error message in the Modbus response.

The product analyzes the Modus requests received. Depending on the Modbus request, the product triggers actions or provides requested data.

3.1.4 Network service SNMP

The Internet community has developed the SNMP standard "Simple Network Management Protocol" to support the management of different network devices by means of a single system.

The Network Management System can exchange data with SNMP devices. The tasks of the network management system comprise monitoring, control and configuration of network components as well as error detection and error messaging.

SNMP agent ConneXview

The product supports SNMP version 1.0. An SNMP agent must be used to monitor a network with SNMP. Schneider Electric offers the tool ConneXview for such purposes.

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3.2 Modbus TCP protocol

The Modbus protocol defines a so-called Modbus PDU (Protocol Data Unit) which is independent of the underlying communication layers. This Modbus PDU consists of the fields "Function Code" and "Data". Depending on the mapping to the different network protocols, the Modbus PDU is extended by additional fields in the so-called Modbus ADU (Application Data Unit). The Modbus PDU and the Modbus ADU constitute the Modbus message, also referred to as "Frame".

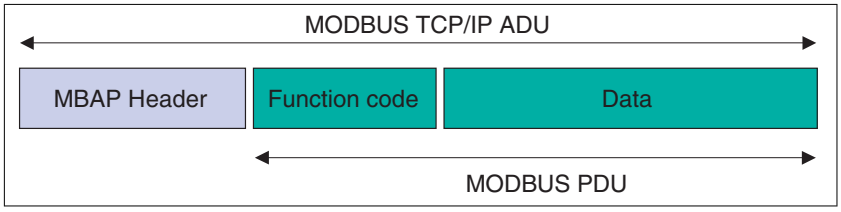

Figure 3: Structure of a Modbus message

The "Function Code" of a message specified the Modbus service to be triggered. The "Data" field can contain additional information, depending on the "Function Code".

Due to the encapsulation of "Function Code" and "Data" in the Modbus PDU, the Modbus services and the object model can be the same in the case of all Modbus versions.

In the case of a "Function Code" for which the "Data" field in the Modbus PDU has a fixed length, the "Function Code" is sufficient.

In the case of a "Function Code" for which the "Data" field in the Modbus request or the Modbus response has a variable amount of data, the "Data" field contains a byte counter.

The maximum size of a Modbus ADU is 260 bytes. The size of an embedded Modbus PDU is 253 bytes.

NOTE: The fields are encoded in Big Endian format (highest-value byte first).

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3.2.1 MBAP header

The MBAP header contains the information allowing the recipient to uniquely identify a message. This is even possible if a message is split into several packets for transmission.

Explicit and implicit length rules as well as the use of a CRC-32 error check code (on Ethernet) results in an infinitesimal chance of undetected corruption to a request or response message.

Design The MBAP header has a length of 7 bytes and contains the following fields:

Field	Length	Description
Transaction Identifier	2 bytes	Identification of a Modbus request or Modbus response.
Protocol Identifier	2 bytes	Value 0 means Modbus protocol.
Length	2 bytes	Number of bytes to follow.
Unit Identifier	1 byte	Identification of a slave connected to another bus via a serial line.

- **Transaction Identifier**

  The field "Transaction Identifier" is used for "Pairing". The server copies the "Transaction Identifier" of the Modbus request to the Modbus response.
- **Protocol Identifier**

  The field "Protocol Identifier" is used to identify the protocol. The Modbus protocol is identified by the value 0.
- **Length**

  The "Length" field is a byte counter for the following fields ("Unit Identifier", "Function Code" and "Data").
- **Unit Identifier**

  The field "Unit Identifier" is used to identify the server in the slave.

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3.3 Modbus TCP communication

3.3.1 Connection management

Establishing of a connection

The Modbus TCP server allows for TCP connections via the default port 502. A client can establish a new connection via this port. If the client is to exchange data with a remote server, a new client connection via remote port 502 must be established.

Modbus data transfer

A Modbus request is sent via a suitable, open connection. This TCP connection is found using the IP address of the remote device. The connection remains open for all Modbus communication. Up to 8 simultaneous connections are possible.

As described in the next chapter, a Modbus client can initialize several Modbus transactions without having to wait for the previous transaction to be finished.

Closing a connection

After the Modbus communication between the client and a server is finished, the client causes the connection used to be closed.

The server does not close the connection under normal circumstances.

However, when errors occur and in special cases, the server closes the connection, for example:

- Communication errors
- Communication inactivity
- Maximum number of connections reached

The product can manage up to 8 TCP connections. If an attempt is made to establish a further connection beyond this maximum, the oldest unused connection is closed. If it is impossible to close the oldest unused connection, the new connection is refused.

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3.3.2 Modbus response to a Modbus request

The Modus server generates a Modbus response after having processed a Modbus request.

Depending on the type of processing, two types of Modbus responses are possible:

- Positive Modbus response
  - The "Function Code" in the Modbus response corresponds to the "Function Code" in the Modbus request.
- Negative Modbus response
  - The client receives pertinent information on error detection during processing;
  - The "Function Code" in Modbus response corresponds to the "Function Code" in the Modbus request + 80_h.
  - The "Exception Code" indicates the cause of the error.

If a syntactically incorrect Modbus PDU (Protocol Data Unit) is transmitted, the connection is terminated. In the case of other other error, a negative Modbus response is sent.

Exception Code	Name	Description
01	Illegal Function Code	The "Function Code" is unknown to the server.
02	Illegal Data Address	Depends on the Modbus request
03	Illegal Data Value	Depends on the Modbus request
04	Server Failure	The server was unable to properly terminate processing.
05	Acknowledge	The server has accepted the Modbus request. However, the execution takes a relatively long time. The server therefore only returns an acknowledgement confirming receipt of the service request.
06	Server Busy	The server was unable to accept the Modbus request. It is the responsibility of the application on the client to determine whether and when to re-send the request.
0A	Gateway Problem	The gateway path is unavailable.
0B	Gateway Problem	The targeted device does not respond. The gateway generates this error.

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3.3.3 Reading and writing parameters

Parameters are processed as 32 bit values. 16 bit values must also be processed as 32 bit values. Two consecutive 16 bit parameters must be read or written to process a 16 bit parameter. The first Modbus address must be specified.

If several consecutive parameters are to be processed, a single Modbus command with the corresponding Modbus address and the length indication is sufficient.

NOTE: This does not apply to reading and writing parameters with addresses in the range from 17408 (4400_h) to 17663 ($44FF_h$). In this range, only a single parameter can be addressed with one Modbus command.

Example Reading the parameter `CTRL1_KPp` "Position controller P gain" Modbus address 4614

When the parameter `CTRL1_KPp` with the Modbus parameter address 4614 and length 2 is read, the two parameter addresses 4614 and 4615 are read. Result:

Address	Value
4614	0000_h
4615	$00C8_h$

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3.3.4 I/O scanning to "Drive Profile Lexium"

I/O scanning is used for cyclic interchange of data between master and slave.

I/O scanning must be configured on the master. The master can use 2 different approaches for of I/O scanning:

- "Function Code" 23 (17_h), Read-Write Mulitple Registers
- "Function Code" 3 (03_h), Read Multiple Registers and "Function Code" 16 (10_h), Write Multiple Registers

  NOTE: The read value is 0 until the first write command is executed.

Settings

The following setting must be made on the master before you can use I/O scanning:

- The "Unit Identifier" is 255.
- The Modbus parameter address is 0.
- The data length is 13.

  In addition, you can use up to 3 mappable parameters. If these parameters are used, the data length changes to 15, 17 or 19.

The Modbus addresses for I/O scanning do not differ from the addresses for normal Modbus access.

Output - Input

Output and input refer to the direction of data transmission from the perspective of the master.

- Output: Commands from the master to the slave
- Input: Status messages from the slave to the master

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3.3.4.1 I/O scanning Output

The table below shows the structure of the cyclic data for the commands from the master to the product. See the product manual for a description of the parameters.

Byte	Meaning	Data type	Parameter address
0 ... 7	ParCh	-	Parameter channel
8 ... 9	dmControl	INT	-
10 ... 13	RefA32	DINT	-
14 ... 17	RefB32	DINT	-
18 ... 21	Ramp_v_acc	DINT	Parameter `Ramp_v_acc` Modbus 1556
22 ... 25	Ramp_v_dec	DINT	Parameter `Ramp_v_dec` Modbus 1558
26 ... 29	EthOptMapOut1	DINT	Parameter `EthOptMapOut1` Modbus 17500
30 ... 33	EthOptMapOut2	DINT	Parameter `EthOptMapOut2` Modbus 17502
34 ... 37	EthOptMapOut3	DINT	Parameter `EthOptMapOut3` Modbus 17504

ParCh Parameters can be read or written via "ParCh", see chapter "3.3.4.3 Parameter channel".

dmControl The word "dmControl" is used to set the operating state and the operating mode.

See chapters "6.1.2 Changing the operating state" and "6.2.2 Starting and changing an operating mode" for a detailed description of the bits.

RefA32, RefB32 The two double words "RefA32" and "RefB32" are used to set two values for the operating mode. The meaning depends on the operating mode; it is described in the chapters on the individual operating modes.

Ramp_v_acc / Ramp_v_dec The double words "Ramp_v_acc" and "Ramp_v_dec" are used to set the acceleration and the deceleration. They correspond to the parameters of the same name. See the product manual for a description.

EthOptMapOut1 ... EthOptMapOut3 The double words EthOptMapOut1 ... EthOptMapOut3 contain selectable parameters, see chapter "5.7.3 Setting the mapping for I/O scanning".

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3.3.4.2 I/O scanning Input

The table below shows the structure of the cyclic data for the status messages from the product to the master. See the product manual for a description of the parameters.

Byte	Meaning	Data type	Parameter address
0 ... 7	ParCh	-	Parameter channel
8 ... 9	driveStat	INT	-
10 ... 11	mfStat	INT	-
12 ... 13	motionStat	INT	-
14 ... 15	driveInput	INT	-
16 ... 19	_p_act	DINT	Parameter `_p_act` Modbus 7706
20 ... 23	_v_act	DINT	Parameter `_v_act` Modbus 7744
24 ... 25	_I_act	INT	Parameter `_I_act` Modbus 7686
26 ... 29	EthOptMapInp1	DINT	Parameter `EthOptMapInp1` Modbus 17512
30 ... 33	EthOptMapInp2	DINT	Parameter `EthOptMapInp2` Modbus 17514
34 ... 37	EthOptMapInp3	DINT	Parameter `EthOptMapInp3` Modbus 17516

ParCh Parameters can be read or written via "ParCh", see chapter "3.3.4.3 Parameter channel".

driveStat The current operating state is indicated with the "driveStat" word.

For a detailed description of the bits, see chapter "6.1.1 Indication of the operating state".

mfStat The word "mfStat" is used to indicate the current operating mode.

For a detailed description of the bits, see chapter "6.2.1 Indicating and monitoring the operating mode".

motionStat The word "motionStat" is used to provide information on the motor and profile generator.

bit	Meaning
0 ... 5	Reserved
6	MOTZ: Motor at a standstill
7	MOTP: Motor movement in positive direction
8	MOTN: Motor movement in negative direction
9	PWIN: Motor within position window
10	Reserved
11	TAR0: Profile generator at standstill
12	DEC: Profile generator decelerates
13	ACC: Profile generator accelerates
14	CNST: Profile generator moves at constant velocity
15	Reserved

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driveInput The word "driveInput" is used to indicate the status of the digital signal inputs.

bit	Signal	Factory setting
0	DI0	Signal input function Freely Available
1	DI1	Signal input function Reference Switch (REF)
2	DI2	Signal input function Positive Limit Switch (LIMP)
3	DI3	Signal input function Negative Limit Switch (LIMN)
4	DI4	Signal input function Freely Available
5	DI5	Signal input function Freely Available
6 ... 15	-	Reserved

_p_act The double word "_p_act" indicates the actual position. The value corresponds to the parameter `_p_act`.

_v_act The double word "_v_act" indicates the actual velocity. The value corresponds to the parameter `_v_act`.

_I_act The word "_I_act" is used to provide information on the total motor current. The value corresponds to the parameter `_I_act`.

EthOptMapInp1 ... EthOptMapInp3 The double words EthOptMapInp1 ... EthOptMapInp3 contain selectable parameters. The product manual provides descriptions of the parameters EthOptMapInp1 ... EthOptMapInp3 which explain parameter mapping.

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3.3.4.3 Parameter channel

The master can request a parameter value from the slave or change a parameter value via the parameter channel. Each parameter can be uniquely addressed via the index and subindex.

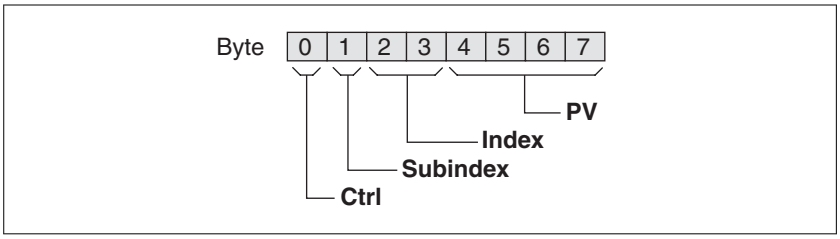

Figure 4: Parameter channel

Ctrl Byte "Ctrl" contains the request to read or write a parameter.

The transmit data contains the information whether a parameter is to be read or written. The receive data contains the information whether the read request or the write request were successful.

Transmit data:

Ctrl	**Function**
02_h	No request
12_h	Read request
22_h	Write request (word)
32_h	Write request (double word)

Receive data:

Ctrl	**Function**
02_h	Request not yet completed
12_h	Read request or write request successfully completed (word)
22_h	Read request or write request successfully completed (double word)
72_h	Error message

Only one request can be processed at a time. The slave provides the response until the master sends a new request. If a response includes parameter values, the slave responds with the current value in the case of a repetition.

NOTE: Read requests are only executed by the slave if the value changes from 02_h to 12_h. Write requests requests are only executed by the slave if the value changes from 02_h to 22_h or to 32_h.

Subindex The byte "Subindex" must be set to the value 00_h.

Index The word "Index" contains the parameter address.

See the product manual for a list of the parameters.

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PV

The double word "PV" contains the parameter value.

In the case of a read request, the value in the transmit data has no significance. The receive data contains the parameter value.

In the case of a write request, the transmit data contains the value to be written to the parameter. The receive data contains the parameter value.

If a read request or a write request were not successful, the double word "PV" contains the error number of the error.

Example: Reading a parameter

In the example, the program number of the product is read from the parameter `_prgNoDEV`. The parameter `_prgNoDEV` has the parameter address 258 (01_h 02_h).

The parameter value read has the decimal value 91200 which corresponds to 01_h 64_h 40_h.

Transmit data:

Ctrl	Subindex	Index	PV
12_h	00_h	01_h 02_h	00_h 00_h 00_h 00_h

Receive data:

Ctrl	Subindex	Index	PV
22_h	00_h	01_h 02_h	00_h 01_h 64_h 40_h

Example: Writing of an invalid parameter

In this example, the value of a non-existent parameter is to be changed. The parameter has the parameter address 101 (00_h 65_h). The value of the parameters is to be changed to 222 (DE_h).

Before the slave can accept a new request, the value 02_h must first be transmitted in byte "Ctrl".

Since the slave cannot address the parameter, a synchronous error message is transmitted with the receive data. Byte "Ctrl" is set to 72_h. Double word "PV" is set to the error number (error number 1101_h: Parameter does not exist).

Transmit data:

Ctrl	Subindex	Index	PV
32_h	00_h	00_h 65_h	00_h 00_h 00_h DE_h

Receive data:

Ctrl	Subindex	Index	PV
72_h	00_h	00_h 65_h	00_h 00_h 11_h 01_h

See the product manual for information on the error numbers.

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3.4 Modbus services - "Function Code"

The table below provides an overview of the available Modbus services:

"Function Code"	Meaning under Modbus	Meaning from device perspective
3	Read Multiple Registers	Reading a parameter
8	Diagnostics	Diagnostics
16	Write Multiple Registers	Writing a parameter
23	Read/Write Multiple Registers	Reading and writing parameters
43 Subcode14	Read Device Identification	–
90	UMAS File Transfer (Upload)	–

3.4.1 "Function Code" 3 (Read Multiple Registers)

This "Function Code" 3 (Read Multiple Registers) allows you to read several consecutive parameters, starting at any address.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	3 = 03_h	Read Multiple Registers
Starting Address	2	(various)	Address of the first parameter to be read
Quantity Of Registers	2	2 * n	Number of 16 bit values to be read (1 parameter has the value 2 since a parameter consists of a 32 bit value)

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	3 = 03_h	Read Multiple Registers
Byte Count	1	4 * n	Number of data bytes
Registers Value	4 * n	(various)	Parameter values

Structure of the negative Modbus response

Field	Bytes	Value	Meaning
Function Code	1	$03_h + 80_h = 83_h$	Read Multiple Registers
Exception Code	1	01_h ... 04_h	See chapter "3.3.2 Modbus response to a Modbus request"

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3.4.2 "Function Code" 8 (Diagnostics)

This "Function Code" 8 (Diagnostics) allows you to read diagnostics data of the slave.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	8 = 08_h	Diagnostics
Sub-function Code	2	(various)	Diagnostics function
Data	2	(various)	Data (depending on diagnostics function)

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	8 = 08_h	Diagnostics
Sub-function Code	2	(various)	Diagnostics function
Data	2	(various)	Diagnostics data

Structure of the negative Modbus response

Field	Bytes	Value	Meaning
Function Code	1	$08_h + 80_h = 88_h$	Diagnostics
Exception Code	1	01_h ... 04_h	See chapter "3.3.2 Modbus response to a Modbus request"

Sub-function Code The following diagnostics functions are available:

Sub-function Code		Diagnostics function
00	Return Query Data	Return request as a response
01	Restart Communication Option	Re-initialize the communication port
02	Return Diagnostic Register	Return the error number in the case of synchronous errors
03	(reserved)	–
04	Force Listen Only Mode	Force "Listen Only" mode
05 ... 09	(reserved)	–
10	Clear Counters and Diagnostic Register	Clear all statistical counters
11	Return Bus Message Count	Return number of detected "Bus Message"s
12	Return Bus Communication Error Count	Return number of detected "Bus Communication Error"s
13	Return Bus Exception Error Count	Return number of detected "Bus Exception Error"s
14 ... 15	(reserved)	–
16	Return Slave NAK Count	Return number of detected "Slave Not-Acknowledged"s
17	Return Slave Busy Count	Return number of detected "Slave Busy"s
18	Return Bus Char Overrun Count	Return number of detected "Bus Char Overrun"s
>18	(reserved)	–

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3.4.3 "Function Code" 16 (Write Multiple Registers)

This "Function Code" 16 (Write Multiple Registers) allows you to write several consecutive parameters, starting at any address.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	16 = 10_h	Write Multiple Registers
Starting Address	2	(various)	Address of the first parameter to be written
Quantity Of Registers	2	2 * m	Number of 16 bit values to be written (1 parameter has the value 2 since a parameter consists of a 32 bit value)
Byte Count	1	4 * m	Number of data bytes
Registers Value	2 * m	(various)	Parameter values

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	16 = 10_h	Write Multiple Registers
Starting Address	2	(various)	Corresponds to the Modbus request
Quantity Of Registers	2	2 * m	Corresponds to the Modbus request

Structure of the negative Modbus response

Field	Bytes	Value	Meaning
Function Code	1	10_h + 80_h = 90_h	Write Multiple Registers
Exception Code	1	01_h ... 04_h	See chapter "3.3.2 Modbus response to a Modbus request"

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3.4.4 "Function Code" 23 (ReadWrite Multiple Registers)

This "Function Code" 23 (ReadWrite Multiple Registers) allows you to read and write several consecutive parameters, starting at any address.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	23 = 17_h	Read/Write Multiple Registers
Read Starting Address	2	(various)	Address of the first parameter to be read
Quantity To Read	2	2 * n	Number of 16 bit values to be read (1 parameter has the value 2 since a parameter consists of a 32 bit value)
Write Starting Address	2	(various)	Address of the first parameter to be written
Quantity To Write	2	2 * m	Number of 16 bit values to be written (1 parameter has the value 2 since a parameter consists of a 32 bit value)
Write Byte Count	1	4 * m	Number of data bytes
Write Registers Value	4 * m	(various)	Parameter values

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	23 = 17_h	Read/Write Multiple Registers
Byte Count	1	2 * n	Number of data bytes
Read Registers Value	2 * n	(various)	Parameter values

Structure of the negative Modbus response

Field	Bytes	Value	Meaning
Function Code	1	$17_h + 80_h = 97_h$	Read/Write Multiple Registers
Exception Code	1	01_h ... 04_h	See chapter "3.3.2 Modbus response to a Modbus request"

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3.4.5 "Function Code" 43 (Encapsulated Interface Transport)

This "Function Code" 43 / 14 (Read Device Identification) allows you to read device-specific data.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	43 = $2B_h$	Encapsulated Interface Transport
Modbus Encapsulated Interface Type	1	14 = $0E_h$	Fixed value 14 (Read Device Identification)
Read Device ID Code	1	01	Read all objects
Object ID	1	0x00	Object ID

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	43 = $2B_h$	Encapsulated Interface Transport
Modbus Encapsulated Interface Type	1	14 = $0E_h$	Fixed value 14 (Read Device Identification)
Read Device ID Code	1	01	Corresponds to the Modbus request
Conformity Level	1	02	Fixed value
More Follows	1	00	Fixed value
Next Object ID	1	00	Fixed value
Number Of Objects	1	03	Number of objects
Object ID	1		Object ID, see table
Object Length	1		Object length
Object Value		(various)	Object data (various)

Structure of the negative Modbus response

Field	Bytes	Value	Meaning
Function Code	1	$2B_h + 80_h = AB_h$	Encapsulated Interface Transport
Exception Code	1	01_h ... 04_h	See chapter "3.3.2 Modbus response to a Modbus request"

Object ID The following object IDs are available:

Object ID	Object name	Value
00_h	vendor name	Manufacturer name
01_h	product code	„xxxxxxxxxxx“ (see type code)
03_h	revision	"Vxx.yyy" (e.g. "V02.001")

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3.4.6 Examples

3.4.6.1 Example of "Function Code" 3

Reading an error memory entry. Since the Modbus addresses of the parameters of an error memory entry are contiguous (ascending order), a single Modbus request is sufficient.

Parameters `_ERR_number (15362)`, `_ERR_class (15364)`, `_ERR_time (15366)` and `_ERR_qual (15368)`.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	3	Read Multiple Registers
Starting Address	2	15362 ($3C02_h$)	Address of the first parameter to be read
Quantity Of Registers	2	8	Number of the 16 bit values to be read = 8

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	3	Read Multiple Registers
Byte Count	1	16	Number of bytes: 8 bytes of data
Registers Value	16	32 bit value 32 bit value 32 bit value 32 bit value	`_ERR_number`, 15362 (error number) `_ERR_class`, 15364 (error class) `_ERR_time`, 15366 (error time) `_ERR_qual`, 15368 (error qualifier)

3.4.6.2 Example of "Function Code" 16

Writing of the software limit switches. Since these parameters also have consecutive addresses, a single Modbus request is sufficient:

Parameters `MON_swLimP (1544)` and `MON_swLimN (1546)`.

Modbus request Structure of the Modbus request:

Field	Bytes	Value	Meaning
Function Code	1	16	Write Multiple Registers
Starting Address	2	1544 (608_h)	Address of the first parameter to be written
Quantity Of Registers	2	4	Number of parameters = 4 (8 bytes of data)
Byte Count	1	8	Number of bytes: 8 bytes of data
Registers Value	8	32 bit value 32 bit value	`MON_swLimP`, 1544 `MON_swLimN`, 1546

Modbus response Structure of the positive Modbus response:

Field	Bytes	Value	Meaning
Function Code	1	16	Write Multiple Registers
Starting Address	2	1544 (608_h)	Address of the parameter
Quantity Of Registers	2	4	Number of parameters = 4 (8 bytes of data)

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4 Installation

4

⚠ WARNING

SIGNAL AND DEVICE INTERFERENCE

Signal interference can cause unexpected responses of the device.

- Install the wiring in accordance with the EMC requirements.
- Verify compliance with the EMC requirements.

Failure to follow these instructions can result in death, serious injury or equipment damage.

4.1 Installation of the module

CAUTION

DESTRUCTION DUE TO ESD

Electrostatic discharge (ESD) can cause immediate or later destruction of the module or the device.

- Use suitable ESD measures (IEC 61340-5-2) when handling the module.
- Do not touch any internal components.

Failure to follow these instructions can result in equipment damage.

▸ Install the module according to the instructions in the product manual.

Description	Order no.
Fieldbus module EtherNet/IP (module identification ETH) with 2 x RJ45 connection. For EtherNet/IP and Modbus-TCP	VW3A3616

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4.2 Electrical installation

Cable specifications

Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	8 * 0.25 mm² (8 * AWG 22)
Maximum cable length:	100 m
Special features:	-

- Note the pertinent information on equipotential bonding conductors in the product manual.
- Use pre-assembled cables to reduce the risk of wiring errors.

Pin assignment

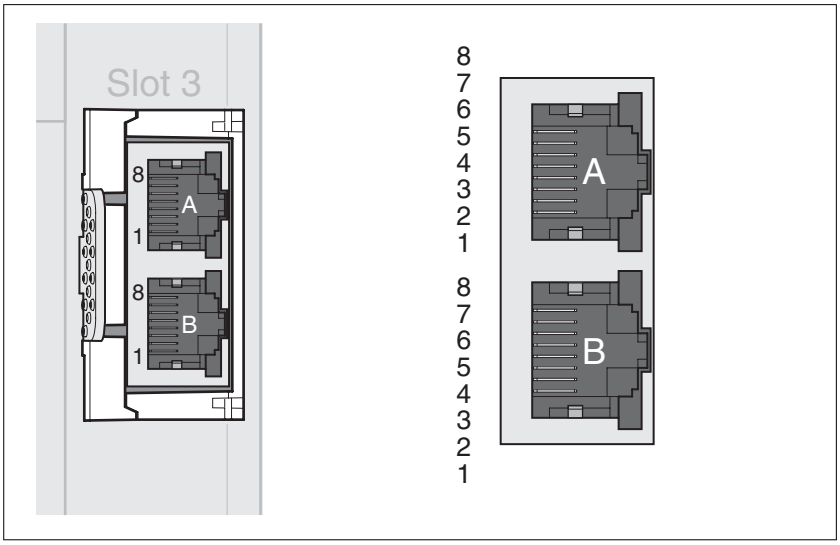

Figure 5: Pin assignment

Pin	Signal	Meaning
1	Tx+	Ethernet transmit signal +
2	Tx-	Ethernet transmit signal -
3	Rx+	Ethernet receive signal +
4	-	-
5	-	-
6	Rx-	Ethernet receive signal -
7	-	-
8	-	-

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5 Commissioning

5

⚠ WARNING

LOSS OF CONTROL

The product is unable to detect an interruption of the network link if connection monitoring is not active.

- Verify that connection monitoring is on.
- The shorter the time for monitoring, the faster the detection of the interruption.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

UNINTENDED OPERATION

- Do not write values to reserved parameters.
- Do not write values to parameters unless you fully understand the function.
- Run initial tests without coupled loads.
- Verify the use of the word sequence with fieldbus communication.
- Do not establish a fieldbus connection unless you have fully understood the communication principles.
- Only start the system if there are no persons or obstructions in the hazardous area.

Failure to follow these instructions can result in death, serious injury or equipment damage.

5.1 Commissioning the device

For installation in the network, the device must first be properly installed (mechanically and electrically) and commissioned.

▸ Commission the device as per product manual.

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5.2 "First Setup"

A "First Setup" is required when the controller supply is switched on for the first time or after the factory settings have been restored.

Switching on the device

- The power stage supply is switched off.
- ▸ Disconnect the product from the the fieldbus during commissioning in order to avoid conflicts by simultaneous access.
- ▸ Switch on the controller supply.
- ◃ The device goes through an initialization routine, all LEDs are tested, all segments of the 7-segment display and the status LEDs light up.

After the initialization, the fieldbus interface must be configured. The product is configured via the integrated HMI or the commissioning software.

First Setup via HMI

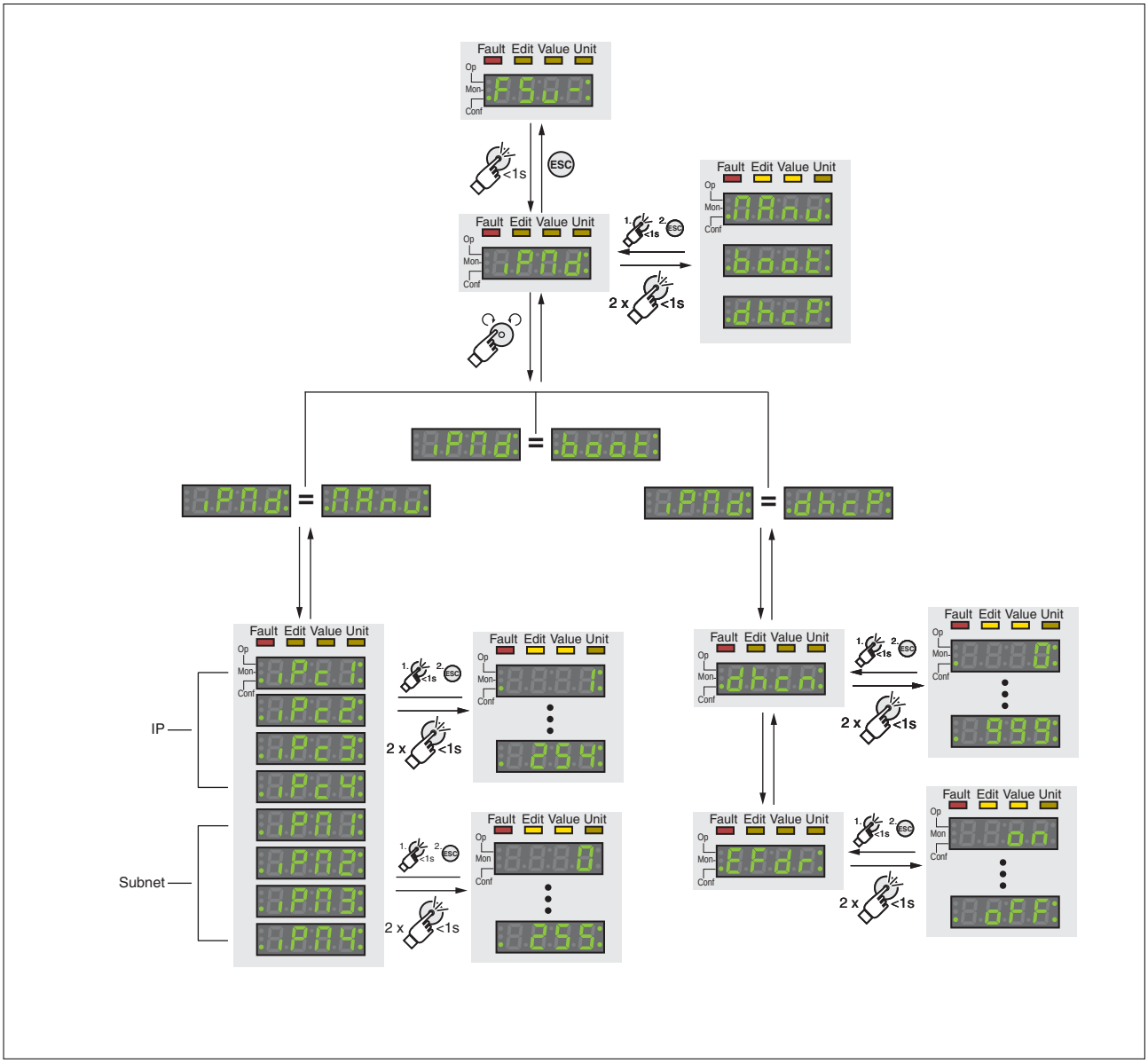

Figure 6: First Setup via the integrated HMI

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Type of network address assignment

- Select the type of network address assignment.

  The type of network address assignment is set via the parameter `EthIpMode` (, PMd).

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthIpMode` ConF → CoM- ConF → FSu- , PMd	Type of obtaining IP address **0 / Manual / MAnu** : Manual **1 / BOOTP / boot** : BOOTP **2 / DHCP / dhcP** : DHCP When selecting DHCP, also set the parameter EthFdrEnable to ON or OFF, depending on whether or not your DHCP server supports FDR. Changed settings become active immediately.	- 0 2 2	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:5h Modbus 17418 Profibus 17418 CIP 168.1.5

5.2.1 Manual assignment of the network address

- `EthIpMode` has been set to Manual (MAnu).
- Set the network addresses consisting of the IP address and the subnet mask.

  The IP address is set via the parameters `EthIPmodule1` ... `EthIPmodule4`. The subnet mask is set via the parameters `EthIPmask1` ... `EthIPmask4`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthIPmodule1 CONF → CON- CONF → FSU- , PC 1	IP address Ethernet module, byte 1 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:7$_h$ Modbus 17422 Profibus 17422 CIP 168.1.7
EthIPmodule2 CONF → CON- CONF → FSU- , PC2	IP address Ethernet module, byte 2 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:8$_h$ Modbus 17424 Profibus 17424 CIP 168.1.8
EthIPmodule3 CONF → CON- CONF → FSU- , PC3	IP address Ethernet module, byte 3 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:9$_h$ Modbus 17426 Profibus 17426 CIP 168.1.9
EthIPmodule4 CONF → CON- CONF → FSU- , PC4	IP address Ethernet module, byte 4 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:A$_h$ Modbus 17428 Profibus 17428 CIP 168.1.10
EthIPmask1 CONF → CON- CONF → FSU- , PM 1	IP address subnet mask, byte 1 Changed settings become active the next time the product is switched on.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:B$_h$ Modbus 17430 Profibus 17430 CIP 168.1.11
EthIPmask2 CONF → CON- CONF → FSU- , PM2	IP address subnet mask, byte 2 Changed settings become active the next time the product is switched on.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:C$_h$ Modbus 17432 Profibus 17432 CIP 168.1.12
EthIPmask3 CONF → CON- CONF → FSU- , PM3	IP address subnet mask, byte 3 Changed settings become active the next time the product is switched on.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:D$_h$ Modbus 17434 Profibus 17434 CIP 168.1.13
EthIPmask4 CONF → CON- CONF → FSU- , PM4	IP address subnet mask, byte 4 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:E$_h$ Modbus 17436 Profibus 17436 CIP 168.1.14

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5.2.2 Assignment of the network address via BOOTP

- `EthIpMode` has been set to BOOTP (`boot`).
- ▸ Verify that an accessible BOOTP server is available on the network.

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5.2.3 Assignment of the network address via DHCP

- `EthIpMode` has been set to DHCP (dhcP).
- Verify that an accessible DHCP server is available on the network.
- Set a number that is unique in the network via dhcn.
  NOTE: This setting is only required if you want to use an FDR server.

  The number is entered at the 13th, 14th and 15th digit of the device name.
  Example: LEXIUM_SERVO**001**

  In the commissioning software, the full device name can be displayed and changed.
- Activate the FDR service via EFdr.

  See chapter "6.3.3 FDR service (Fast Device Replacement)" for additional information on the FDR service.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`EthFdrEnable` ConF → CoM- ConF → FSu- EFdr	FDR service **0 / Off / oFF** : FDR service disabled **1 / On / on** : FDR service enabled Enable Ethernet service "Fast Device Replacement" (FDR). If FDR is enabled, the DHCP server must support FDR, otherwise no IP address can be obtained via DHCP.	- 0 0 1	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:40h Modbus 17536 Profibus 17536 CIP 168.1.64

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5.3 Setting the transmission rate

The parameter `EthRateSet` lets you set the transmission rate.

- Set the desired transmission rate with the parameter `EthRateSet`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthRateSet`	Transmission rate setting **0 / Autodetect**: Autodetect **1 / 10 Mbps Full**: 10 Mbps full duplex **2 / 10 Mbps Half**: 10 Mbps half duplex **3 / 100 Mbps Full**: 100 Mbps full duplex **4 / 100 Mbps Half**: 100 Mbps half duplex Changed settings become active immediately.	- 0 0 4	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2$_h$ Modbus 17412 Profibus 17412 CIP 168.1.2

5.4 Setting the protocol

The protocol is set by means of the parameter `EthMode`.

- Set the parameter `EthMode` to "Modbus TCP".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus

`EthMode`
`ConF → CoM-`
`EtMd`
	Protocol
	0 / Modbus TCP / MtCP : Modbus TCP I/O scanning is enabled
	1 / EtherNet/IP / Et, P : EtherNet/IP communication is enabled
	NOTE: Modbus TCP parameter access is possible irrespective of the selected setting.
	Changed settings become active the next time the product is switched on.
		-
		0
		1
		1
			UINT16
			UINT16
			UINT16
			UINT16
			R/W
			per.
			-
				CANopen 3044:1$_h$
				Modbus 17410
				Profibus 17410
				CIP 168.1.1

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5.5 Setting the gateway

The IP address of the gateway is set by means of the parameters `EthIPgate1` ... `EthIPgate4`.

- Set the IP address of the gateway with the parameters `EthIPgate1` ... `EthIPgate4`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthIPgate1` CONF → CON- , PG 1	IP address gateway, byte 1 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:F_h Modbus 17438 Profibus 17438 CIP 168.1.15
`EthIPgate2` CONF → CON- , PG2	IP address gateway, byte 2 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:10_h Modbus 17440 Profibus 17440 CIP 168.1.16
`EthIPgate3` CONF → CON- , PG3	IP address gateway, byte 3 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:11_h Modbus 17442 Profibus 17442 CIP 168.1.17
`EthIPgate4` CONF → CON- , PG4	IP address gateway, byte 4 Changed settings become active the next time the product is switched on.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:12_h Modbus 17444 Profibus 17444 CIP 168.1.18

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5.6 Master with Word Swap

The IP address of a master with Word Swap is set by means of the parameters `EthMbIPswap1` ... `EthMbIPswap4`.

You may not set an IP for a master without Word Swap.

- Check whether or not the master uses Word Swap.
- If the master uses Word Swap, set the IP address of the master with the parameters `EthMbIPswap1` ... `EthMbIPswap4`.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`EthMbIPswap1`	IP address of master for Modbus word swap, byte 1 IP address of a Modbus master device. For this master, the word order is swapped to "Low word first", instead of the default "High word first". High word first -> Modicon Quantum Low word first -> Premium, HMI (Schneider Electric) Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:50h Modbus 17568 Profibus 17568 CIP 168.1.80
`EthMbIPswap2`	IP address of master for Modbus word swap, byte 2 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:51h Modbus 17570 Profibus 17570 CIP 168.1.81
`EthMbIPswap3`	IP address of master for Modbus word swap, byte 3 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:52h Modbus 17572 Profibus 17572 CIP 168.1.82
`EthMbIPswap4`	IP address of master for Modbus word swap, byte 4 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:53h Modbus 17574 Profibus 17574 CIP 168.1.83

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5.7 Setting I/O-Scanning

5.7.1 Activating I/O scanning

I/O scanning is activated/deactivated by means of the parameter `EthMbScanner`.

- If you do not want to use I/O scanning, set the parameter `EthMbScanner` to "Off".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthMbScanner`	Modbus TCP I/O scanning **0 / Off**: Modbus TCP I/O scanning off **1 / On**: Modbus TCP I/O scanning on I/O scanning only works if the parameter EthMode is set to Modbus TCP. Changed settings become active immediately.	- 0 1 1	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:28$_h$ Modbus 17488 Profibus 17488 CIP 168.1.40

5.7.2 Setting the master for I/O scanning

Entering the IP address of a master reserves I/O scanning for this master. This means that no other master on the network can perform I/O scanning.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION DUE TO UNLIMITED ACCESS

If the IP addresses are not set correctly, any network device may control the system or access by the master may be blocked.

- Verify that you have set the correct master IP address.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The IP address of the master for I/O scanning is set by means of the parameters `EthIPmaster1` ... `EthIPmaster4`.

- Set the IP address of the master for I/O scanning with the parameters `EthIPmaster1` ... `EthIPmaster4`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthIPmaster1	IP address master, byte 1 IP address of the master that is permitted to perform Modbus TCP I/O scanning. If set to 0.0.0.0 (default), any master can perform I/O scanning. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:29$_h$ Modbus 17490 Profibus 17490 CIP 168.1.41
EthIPmaster2	IP address master, byte 2 Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2A$_h$ Modbus 17492 Profibus 17492 CIP 168.1.42
EthIPmaster3	IP address master, byte 3 Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2B$_h$ Modbus 17494 Profibus 17494 CIP 168.1.43
EthIPmaster4	IP address master, byte 4 Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2C$_h$ Modbus 17496 Profibus 17496 CIP 168.1.44

5.7.3 Setting the mapping for I/O scanning

The input mapping is set by means of the parameters EthOptMapInp1 ... EthOptMapInp3.

The output mapping is set by means of the parameters EthOptMapOut1 ... EthOptMapOut3.

- Set the desired mapping values with the parameters EthOptMapInp1 ... EthOptMapInp3 and EthOptMapOut1 ... EthOptMapOut3.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthOptMapInp1	Optionally mapped input parameter 1 (drive to PLC) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (drive to PLC). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:34$_h$ Modbus 17512 Profibus 17512 CIP 168.1.52
EthOptMapInp2	Optionally mapped input parameter 2 (drive to PLC) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (drive to PLC). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:35$_h$ Modbus 17514 Profibus 17514 CIP 168.1.53
EthOptMapInp3	Optionally mapped input parameter 3 (drive to PLC) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (drive to PLC). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:36$_h$ Modbus 17516 Profibus 17516 CIP 168.1.54
EthOptMapOut1	Optionally mapped output parameter 1 (PLC to drive) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (PLC to drive). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2E$_h$ Modbus 17500 Profibus 17500 CIP 168.1.46
EthOptMapOut2	Optionally mapped output parameter 2 (PLC to drive) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (PLC to drive). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2F$_h$ Modbus 17502 Profibus 17502 CIP 168.1.47
EthOptMapOut3	Optionally mapped output parameter 3 (PLC to drive) Modbus address of parameter which is optionally mapped to Ethernet/IP assembly or Modbus TCP I/O scanner data (PLC to drive). Changed settings become active immediately.	- - 0 -	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:30$_h$ Modbus 17504 Profibus 17504 CIP 168.1.48

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5.7.4 Setting communication monitoring for I/O scanning

⚠ WARNING

LOSS OF CONTROL

The product is unable to detect an interruption of the network link if connection monitoring is not active.

- Verify that connection monitoring is on.
- The shorter the time for monitoring, the faster the detection of the interruption.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Communication monitoring for I/O scanning is set by means of the parameter `EthMbScanTimeout`.

▸ Set communication monitoring for I/O scanning with the parameter `EthMbScanTimeout`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthMbScanTimeout`	Modbus TCP I/O scanning timeout Communication monitoring timeout for Modbus TCP. Value 0: Timeout monitoring disabled In increments of 0.1 s. Changed settings become active immediately.	s 0.0 2.0 60.0	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:2D$_h$ Modbus 17498 Profibus 17498 CIP 168.1.45

5.8 Setting the web server

The web server is activated or deactivated by means of the parameter `EthWebserver`.

▸ If you do not want to use the web server, set the parameter `EthWebserver` to "Off".

See chapter "6.3.1 Web server" for additional information on the web server.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`EthWebserver`	Ethernet webserver **0 / Off**: Ethernet webserver off **1 / On**: Ethernet webserver on Changed settings become active the next time the product is switched on.	- 0 1 1	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:6$_h$ Modbus 17420 Profibus 17420 CIP 168.1.6

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6 Operation

6

⚠ WARNING

UNINTENDED OPERATION

- Do not write values to reserved parameters.
- Do not write values to parameters unless you fully understand the function.
- Run initial tests without coupled loads.
- Verify the use of the word sequence with fieldbus communication.
- Do not establish a fieldbus connection unless you have fully understood the communication principles.
- Only start the system if there are no persons or obstructions in the hazardous area.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The chapter "Operation" describes the basic operating states, operating modes and functions of the product.

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6.1 Operating states

6.1.1 Indication of the operating state

The current operating state is indicated with the "driveStat" word.

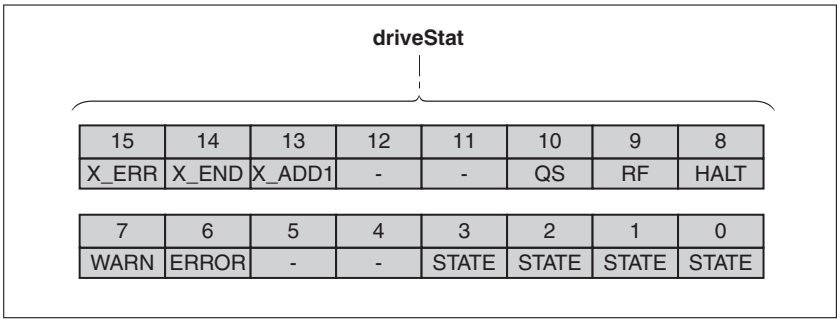

Figure 7: Structure of driveStat

Bit	Name	Meaning
0 ... 3	STATE	Current operating state (binary coded)
4 ... 5	-	Reserved
6	ERROR	An error has occurred (error classes 1 ... 3)
7	WARN	A warning has occurred (error class 0)
8	HALT	"Halt" is active
9	RF	Homing valid
10	QS	"Quick Stop" is active
11 ... 12	-	Reserved
13	X_ADD1	Operating mode-specific information
14	X_END	Operating mode terminated
15	X_ERR	Operating mode terminated with error

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6.1.2 Changing the operating state

Bits 8 ... 15 of the word "dmControl" are used to set the operating state.

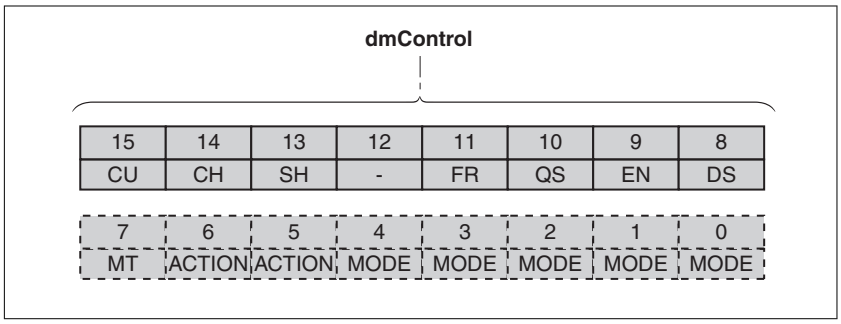

Figure 8: Structure dmControl bits 8 ... 15

Bit	Name	Meaning	Operating state
8	DS	Disable power stage	**6** Operation Enabled -> **4** Ready To Switch On
9	EN	Enable power stage	**4** Ready To Switch On -> **6** Operation Enabled
10	QS	Executing a "Quick Stop"	**6** Operation Enabled -> **7** Quick Stop Active
11	FR	Execute "Fault Reset"	**7** Quick Stop Active -> **6** Operation Enabled **9** Fault -> **4** Ready To Switch On
12	-	Reserved	Reserved
13	SH	Execute "Halt"	**6** Operation Enabled
14	CH	Clear "Halt"	**6** Operation Enabled
15	CU	Resume operating mode interrupted by "Halt"	**6** Operation Enabled

In the case of an access, the bits respond to a 0->1 change to trigger the corresponding function.

If a request for changing the operating state is not successful, this request is ignored. There is no error response.

Ambivalent bit combinations are treated in accordance with the following priority list (highest priority bit 8, lowest priority bit 14 and bit 15):

- Bit 8 (disable power stage) prior to bit 9 (enable power stage)
- Bit 10 ("Quick Stop") prior to bit 11 ("Fault Reset")
- Bit 13 (execute "Halt") prior to bit 14 (clear "Halt") and bit 15 (resume operating mode interrupted by "Halt")

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6.2 Operating modes

6.2.1 Indicating and monitoring the operating mode

The word "mfStat" is used to indicate the current operating mode.

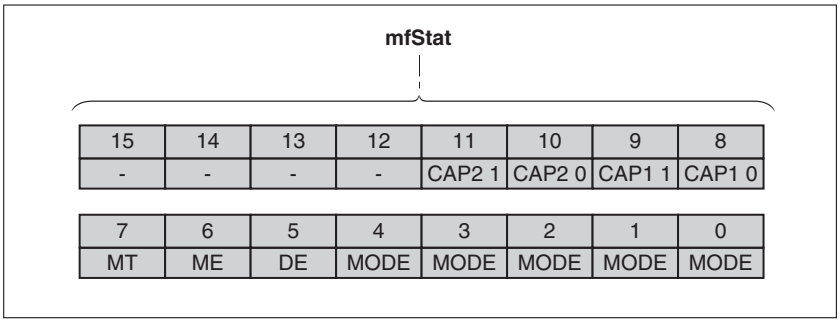

Figure 9: Structure mfStat

Bit	Name	Description
0 ... 4	MODE	Indicates the current operating mode Value 01_h: Profile Position Value 03_h: Profile Velocity Value 04_h: Profile Torque Value 06_h: Homing Value $1F_h$: Jog Value $1E_h$: Electronic Gear Value $1D_h$: Motion Sequence
5	DE	The "DE" bit relates to parameters that are independent of "Mode Toggle" (MT). The "DE" bit is set if a data value in the process data channel is invalid.
6	ME	The "ME" bit relates to parameters that are dependent on "Mode Toggle" (MT). The "ME" bit is set if a request from a master (starting an operating mode) was rejected.
7	MT	Handshake via "Mode Toggle"
8 ... 9	CAP1	Bit 0 and bit 1 of parameter `_Cap1Count`
10 ... 11	CAP2	Bit 0 and bit 1 of parameter `_Cap2Count`
12 ... 15	-	Reserved

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6.2.2 Starting and changing an operating mode

Bits 0 ... 7 in the word "dmControl" are used to set the operating mode.

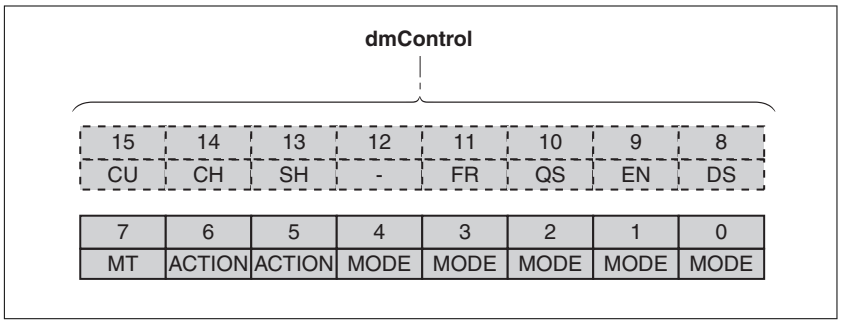

Figure 10: Structure dmControl bits 0 ... 7

Bit	Name	Description
0 ... 4	MODE	Operating mode Value 01_h: Profile Position Value 03_h: Profile Velocity Value 04_h: Profile Torque Value 06_h: Homing Value $1F_h$: Jog Value $1E_h$: Electronic Gear Value $1D_h$: Motion Sequence
5 ... 6	ACTION	Operating mode-dependent
7	MT	Handshake via Mode Toggle

The operating modes can be changed during operation. For this purpose, the current process must be completed or explicitly canceled. The motor must be at a standstill.

The master must enter the following values to activate an operating mode or to change reference values:

- Reference values, depending on desired operating mode
- Operating mode in "dmControl", bits 0 ... 4 (MODE).
- Action for this operating mode in bit 5 and bit 6 (ACTION)
- Toggle bit 7 (MT)

The following chapters describe the possible operating modes, functions and the corresponding reference values.

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6.2.3 Overview of operating modes

The table below provides an overview of the operating modes.
Detailed information can be found on the following pages.

Operating mode	Method	dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
Jog		$1F_h$	Value 0: No movement Value 1: Slow movement in positive direction Value 2: Slow movement in negative direction Value 5: Fast movement in positive direction Value 6: Fast movement in negative direction	-
Electronic Gear	Position synchronization without compensation movement	$1E_h$	As `GEARdenom`	As `GEARnum`
	Position synchronization with compensation movement	$3E_h$	As `GEARdenom`	As `GEARnum`
	Velocity synchronization	$5E_h$	As `GEARdenom`	As `GEARnum`
Profile Torque		24_h	As `PTtq_target`	As `RAMP_tq_slope`
Profile Velocity		23_h	As `PVv_target`	-
Profile Position	Absolute	01_h	As `PPv_target`	As `PPp_target`
	Relative with reference to the currently set target position	21_h	As `PPv_target`	As `PPp_target`
	Relative with reference to the current motor position	41_h	As `PPv_target`	As `PPp_target`
Homing	Position setting	06_h	-	As `HMp_setP`
	Reference movement	26_h	As `HMmethod`	-
Motion Sequence	Start sequence	$1D_h$	Data set number	Value 1: Use data set number
	Start individual data set	$3D_h$	Data set number	-

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6.2.4 Operating mode Jog

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
$1F_h$	Value 0: No movement Value 1: Slow movement in positive direction Value 2: Slow movement in negative direction Value 5: Fast movement in positive direction Value 6: Fast movement in negative direction	-

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	Reserved
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Value 0 RefA
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.5 Operating mode Electronic Gear

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

Method	dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
Position synchronization without compensation movement	$1E_h$	As GEARdenom	As GEARnum
Position synchronization with compensation movement	$3E_h$	As GEARdenom	As GEARnum
Velocity synchronization	$5E_h$	As GEARdenom	As GEARnum

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	1: Reference velocity reached [1)]
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

1) Only with method Velocity synchronization and with active velocity window.

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.6 Operating mode Profile Torque

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
24_h	As `PTtq_target`	As `RAMP_tq_slope`

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	0: Target torque not reached 1: Target torque reached
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.7 Operating mode Profile Velocity

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
23_h	As `PVv_target`	-

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	0: Target velocity not reached 1: Target velocity reached
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.8 Operating mode Profile Position

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

Method	dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
Absolute	01_h	As `PPv_target`	As `PPp_target`
Relative with reference to the currently set target position	21_h	As `PPv_target`	As `PPp_target`
Relative with reference to the current motor position	41_h	As `PPv_target`	As `PPp_target`

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	0: Target position not reached 1: Target position reached
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Target position reached
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.9 Operating mode Homing

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

Method	dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
Position setting	06_h	-	As `HMp_setP`
Reference movement	26_h	As `HMmethod`	-

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	Reserved
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Homing successful
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.2.10 Operating mode Motion Sequence

Starting the operating mode

The operating mode is set and started in the process data channel with the transmit data (master to slave).

Method	dmControl Bits 0 ... 6 MODE+ACTION	Reference value RefA32	Reference value RefB32
Start sequence	$1D_h$	Data set number	Value 1: Use data set number
Start individual data set	$3D_h$	Data set number	-

Status information

The word "driveStat" provides information on the operating mode.

Bit	Name	Meaning
13	X_ADD1	1: End of a sequence
14	X_END	0: Operating mode started 1: Operating mode terminated
15	X_ERR	0: No error 1: Error

Terminating the operating mode

The operating mode is terminated when the motor is at a standstill and one of the following conditions is met:

- Individual data set terminated
- Individual data set of a sequence terminated (waiting for transition condition to be fulfilled)
- Sequence terminated
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by an error

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6.3 Extended settings

6.3.1 Web server

Functions The product features an integrated web server.

The web server offers the following features:

- Display status information
- Display and change parameters
- Display and change network settings
- Display and change Modbus TCP settings
- Display and change EtherNet/IP settings
- Display and change settings for the FDR service
- Display network statistics
- User-specific adaptation of the website
  See chapter "6.3.2 FTP server"

6.3.1.1 Setting the web server

The web server is activated or deactivated by means of the parameter `EthWebserver`.

▶ If you do not want to use the web server, set the parameter `EthWebserver` to "Off".

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`EthWebserver`	Ethernet webserver **0 / Off**: Ethernet webserver off **1 / On**: Ethernet webserver on Changed settings become active the next time the product is switched on.	- 0 1 1	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:6$_h$ Modbus 17420 Profibus 17420 CIP 168.1.6

6.3.1.2 Accessing the web server

The web server of the product can be accessed via a Web browser.

■ The product must have a valid IP address.
▶ Start an Internet browser.
▶ Enter the IP address of the product in the address bar.
▶ Enter "USER" as the username and the password (uppercase).

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6.3.1.3 User interface

Structure of the web server user interface:

Figure 11: User interface of the web server

(1) Main menu
(2) Submenu
(3) Content

Main menu	Submenu	Content
Home	English	Homepage
Documentation	-	Link to website www.schneider-electric.com
Monitoring	Drive monitor	Status information
	Drive parameter	Display and change parameters
Network Setup	Network parameters	Network settings
	Modbus scanner	Modbus settings
	Eth/IP scanner	EtherNet/IP settings
	Fast device replacement	FDR service settings
	Administration	Change web server passwords
Diagnostics	TCP/IP statistics	Information on TCP/IP
	Modbus statistics	Information on Modbus
	Ethernet IP statistics	Information on EtherNet/IP

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6.3.2 FTP server

Functions

The product features an integrated FTP server.

The FTP server lets you upload a CFG file and a JPG file to modify the content and appearance of the web server.

The following items can be modified:

- Product Name
- Link under "Documentation..."
- Product image (picture on the start page)

6.3.2.1 Accessing the FTP server

The FTP server of the product can be accessed via an FTP client.

- The product must have a valid IP address.
- ▸ Start an FTP client.
- ▸ Enter the IP address of the product when prompted for a "Host/ Server" .
- ▸ Enter "USER" as the username and the password (uppercase).

6.3.2.2 User-specific adaptation of the website

You can upload a CFG file and a JPG file to modify the content and appearance of the web server.

CFG file

File name of the CFG file: http.cfg

The CFG file has the following structure:

```
[ProductName]
Lexium 32 by MyCompany

[ProductLink]
http://www.my-company.com

[ProductImageName]
mypic.jpg
```

JPG file

The JPG file replaces the product image (picture on the start page).

The file name of the JPG file must match the file name specified in the CFG file.

NOTE: The entire file name is case-sensitive (even the extension JPG).

Uploading files

- ▸ Connect via an FTP client.
- ▸ Save the CFG file at the top level.
- ▸ Create a folder "html".
- ▸ Below the "html" folder, create an "images" folder.
- ▸ Save the JPG file in the "images" folder.
- ▸ Switch the product off and on.

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6.3.3 FDR service (Fast Device Replacement)

The FDR service uses standard DHCP and TFTP (Trivial File Transfer Protocol) technologies to simplify maintenance of Ethernet devices.

For example, the FDR service is used to replace a defective device by a new device. The service allows for detection, configuration and automatic start of the new device without complex manual user interaction.

The main steps:

- A defective device that uses the FDR service is removed.
- The new device that is pre-configured with the "DeviceName" of the defective device is installed in the network.
- The FDR server which can be a Quantum- or Premium-SPS PLC Ethernet module detects the new device, configures it with its IP address and transmits the configuration parameters.
- The replacement device checks the parameters for compatibility.

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7 Diagnostics and troubleshooting

7

7.1 Fieldbus communication error diagnostics

Connections for fieldbus mode

If the product cannot be addressed via the fieldbus, first check the connections. The product manual contains the technical data of the device and information on network and device installation. Check the following:

- $24V_{dc}$ power supply
- Power connections to the device
- Fieldbus cable and fieldbus wiring

You can also use the commissioning software for troubleshooting.

Fieldbus function test

If the connections are correct, check the settings for the fieldbus addresses. After correct configuration of the transmission data, test fieldbus mode.

- ▸ In addition to the master, activate a bus monitor that, as a passive device, displays messages.
- ▸ Switch the supply voltage off and on.
- ▸ Observe the network messages that are generated briefly after the supply voltage is switched on. A bus monitor can be used to record the elapsed time between messages and the relevant information in the messages.

Addressing, parameterization

If it is impossible to connect to a device, check the following:

- ▸ Addressing

  Each network device must have a unique IP address.

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7.2 Status LEDs

The status of the module is indicated by four LEDs.

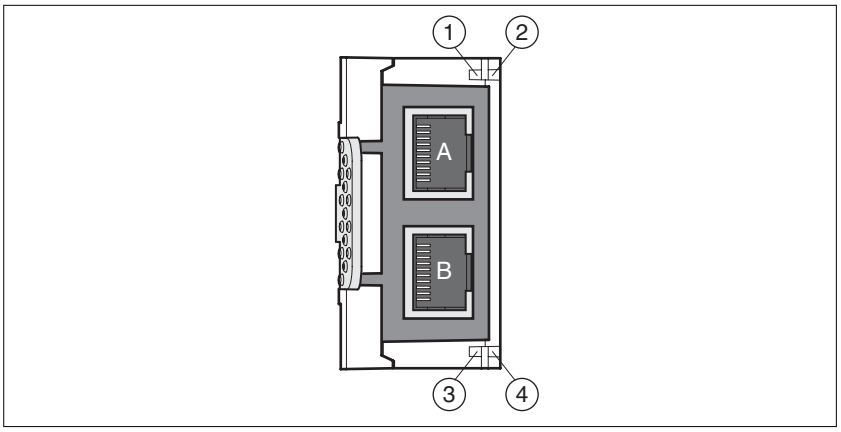

Figure 12: Overview of the LEDs at the module

(1) Network activity interface A
(2) Module status
(3) Network activity interface B
(4) Network status

NOTE: The meaning of the flash signals depends on the selected protocol.

- Check whether the protocol is set to "EtherNet/IP" or "Modbus TCP".

Network activity LED 1 and LED 3

The table below shows the meaning of the flashing signals for network activity.

Color	Status	Meaning
-	Off	No connection
Green	On	Connection with 100 [MB/s]
Yellow	On	Connection with 10 [MB/s]
Green	Flashing	Activity with 100 [MB/s]
Yellow	Flashing	Activity with 10 [MB/s]

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Module status LED 2 The table below shows the meaning of the flashing signals for the module status.

Color	LED	Meaning for EtherNet/IP [1]	Meaning for Modbus TCP [1]
-	Off	No power supply	No IP address or no power supply
Green/yellow	Flashing	Start-up	Start-up
Green	On	Ready for operation	Ready for operation
Green	Flashing	Module is not configured or scanner is Idle	Not ready (no connection, ...)
Red	Flashing	Recoverable error	Recoverable error
Red	On	Irrecoverable error	Irrecoverable error

1) Depends on the selected protocol (parameter `EthMode`)

Network status LED 4 The table below shows the meaning of the flashing signals for the network status.

Color	LED	Meaning for EtherNet/IP [1]	Meaning for Modbus TCP [1]
-	Off	No IP address or no power supply	No IP address or no power supply
Green/yellow	Flashing	Start-up	Start-up
Green	On	Connected	At least 1 port is connected and the IP address has been set
Green	Flashing 3 times	-	No connection, IP address has been set
Green	Flashing 4 times	-	IP address conflict
Green	Flashing 5 times	-	BOOTP or DHCP active
Green	Flashing	No connection	-
Red	Flashing	Timeout	-
Red	On	IP address conflict	-

1) Depends on the selected protocol (parameter `EthMode`)

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7.3 Error indication

The last cause of error and the last 10 error messages are stored. You can display the last 10 error messages using the commissioning software and the fieldbus.

Asynchronous errors

Asynchronous errors are triggered by internal monitoring (for example, temperature) or by external monitoring (for example, limit switch). An error response is initiated if an asynchronous error occurs.

Asynchronous errors are indicated in the following way:

- Transition to operating state **7** Quick Stop Active or to operating state **9** Fault.
- Information in the words "driveStat", "mfStat", "motionStat" and "driveInput" during I/O scanning, see chapter "3.3.4.2 I/O scanning Input"
- Error number is written to parameter `_LastError`

The parameters `_LastError` or `_LastWarning` can be used in the input mapping for I/O scanning. This way, error numbers are easy to read out.

Modbus response

Depending on the type of processing, two types of Modbus responses are possible:

- Positive Modbus response
  - The "Function Code" in the Modbus response corresponds to the "Function Code" in the Modbus request.
- Negative Modbus response
  - The client receives pertinent information on error detection during processing;
  - The "Function Code" in Modbus response corresponds to the "Function Code" in the Modbus request + 80_h.
  - The "Exception Code" indicates the cause of the error.

If a syntactically incorrect Modbus PDU (Protocol Data Unit) is transmitted, the connection is terminated. In the case of other other error, a negative Modbus response is sent.

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Exception Code	Name	Description
01	Illegal Function Code	The "Function Code" is unknown to the server.
02	Illegal Data Address	Depends on the Modbus request
03	Illegal Data Value	Depends on the Modbus request
04	Server Failure	The server was unable to properly terminate processing.
05	Acknowledge	The server has accepted the Modbus request. However, the execution takes a relatively long time. The server therefore only returns an acknowledgement confirming receipt of the service request.
06	Server Busy	The server was unable to accept the Modbus request. It is the responsibility of the application on the client to determine whether and when to re-send the request.
0A	Gateway Problem	The gateway path is unavailable.
0B	Gateway Problem	The targeted device does not respond. The gateway generates this error.

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8 Accessories and spare parts

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8.1 Cables

Description	Order no.
2 m, 2 x RJ45, shielded twisted pair cable	490NTW00002
5 m, 2 x RJ45, shielded twisted pair cable	490NTW00005
12 m, 2 x RJ45, shielded twisted pair cable	490NTW00012
2 m, 2 x RJ45, shielded twisted pair cable with UL and CSA 22.1 certification	490NTW00002U
5 m, 2 x RJ45, shielded twisted pair cable with UL and CSA 22.1 certification	490NTW00005U
12 m, 2 x RJ45, shielded twisted pair cable with UL and CSA 22.1 certification	490NTW00012U

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9 Glossary

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9.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

9.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

9.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559*10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.45359237	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.59237	/ 28.34952	/ 14593.9	/ 1000	-

9.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	-

9.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

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9.1.5 Rotation

	min^{-1} (RPM)	**rad/s**	**deg./s**
min^{-1} (RPM)	-	* π / 30	* 6
rad/s	* 30 / π	-	* 57.295
deg./s	/ 6	/ 57.295	-

9.1.6 Torque

	lb·in	**lb·ft**	**oz·in**	**Nm**	**kp·m**	**kp·cm**	**dyne·cm**
lb·in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^6$
lb·ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^6$
oz·in	/ 16	/ 192	-	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	-	* 0.101972	* 10.1972	* $10*10^6$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	-	* 100	* $98.066*10^6$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	-	* $0.9806*10^6$
dyne·cm	/ $1.129*10^6$	/ $13.558*10^6$	/ 70615.5	/ $10*10^6$	/ $98.066*10^6$	/ $0.9806*10^6$	-

9.1.7 Moment of inertia

	lb·in^2	**lb·ft^2**	**kg·m^2**	**kg·cm^2**	**kp·cm·s^2**	**oz·in^2**
lb·in^2	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb·ft^2	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg·m^2	* 3417.16	/ 0.04214	-	* $10*10^3$	* 10.1972	* 54674
kg·cm^2	* 0.341716	/ 421.4	/ $10*10^3$	-	/ 980.665	* 5.46
kp·cm·s^2	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz·in^2	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

9.1.8 Temperature

	°F	**°C**	**K**
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273.15
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

9.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm^2	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm^2	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

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9.2 Terms and Abbreviations

See chapter "2.5 Standards and terminology" for information on the pertinent standards on which many terms are based. Some terms and abbreviations may have specific meanings with regard to the standards.

CIP **C**ommon **I**ndustrial **P**rotocol, general specification for communication between fieldbus devices.

Client First transmitter, then recipient of fieldbus messages in the client-server relationship. Starts transmission with a transmission to the server; the reference point is the server object dictionary.

DOM **D**ate **o**f **m**anufacturing: The nameplate of the product shows the date of manufacture in the format DD.MM.YY or in the format DD.MM.YYYY. Example:
31.12.09 corresponds to December 31, 2009
31.12.2009 corresponds to December 31, 2009

Error Discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.

Error class Classification of errors into groups. The different error classes allow for specific responses to errors, for example by severity.

Factory setting Factory settings when the product is shipped

Fatal error In the case of fatal error, the product is no longer able to control the motor so that the power stage must be immediately disabled.

Fault Fault is a state that can be caused by an error. Further information can be found in the pertinent standards such as IEC 61800-7, ODVA Common Industrial Protocol (CIP).

Fault reset A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.

Input Output and input refer to the direction of data transmission from the perspective of the master. Input: Status messages from the slave to the master, see also Output.

Master Active bus device that controls the data traffic on the network.

Output Output and input refer to the direction of data transmission from the perspective of the master. Output: Commands from the master to the slave, see also Input.

Parameter Device data and values that can be read and set (to a certain extent) by the user.

Persistent Indicates whether the value of the parameter remains in the memory after the device is switched off.

Quick Stop The Quick Stop function can be used for fast deceleration of a movement in the case of an error or via a command.

User-defined unit Unit whose reference to motor movement can be determined by the user via parameters.

Warning If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning does not cause a transition of the operating state.

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