LXM32M

Module EtherNet/IP
Fieldbus manual

V1.02, 12.2009

EtherNet/IP™

0198441113802, V1.02, 12.2009

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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.

0198441113802, V1.02, 12.2009

Table of contents

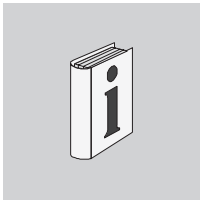
0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

About this manual



This manual applies to the module EtherNet/IP for LXM32M.

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 EPLAN Macros

For easier engineering, macro files and product master data 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.

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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 $\overline{\text{STO\_A}}$ or $\overline{\text{STO\_B}}$.

Glossary Explanations of special technical terms and abbreviations.

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

Further reading

Recommended literature for further reading

Reference documents

- The CIP Networks Library
  Volume 1
  Common Industrial Protocol
- The CIP Networks Library
  Volume 3
  DeviceNet Adaption of CIP
- DeviceNet terms of Usage Agreement

  http://www.odva.org

User Association **O**pen **D**eviceNet **V**endor **A**ssociation (ODVA)

http://www.odva.org

0198441113802, V1.02, 12.2009

1 Introduction

1

EtherNet/IP is a fieldbus based on TCP and UDP. EtherNet/IP extends Ethernet by an advanced industrial protocol (CIP, Common Industrial Protocol) as an application layer for automation applications - this way, Ethernet is excellently suited for industrial control . Products from different manufacturers can be networked without the need for special interface adaptation. The majority of the required network components correspond to the Ethernet components used in the PC world.

1.1 Fieldbus devices on the EtherNet/IP network

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

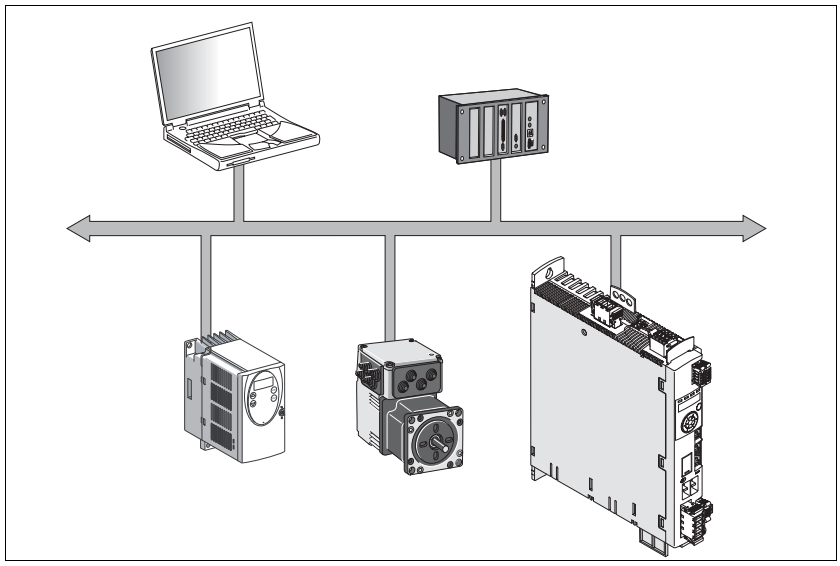

Figure 1.1 Fieldbus products on the network

Features The product supports the following functions via EtherNet/IP:

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

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

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

⚠ DANGER

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

When the system is started, the drives are usually out of the operator's view and cannot be visually monitored.

- Only start the system if there are no persons in the hazardous area.

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

⚠ 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 the 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 for Construction 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 EtherNet/IP technology

EtherNet/IP devices are based on the same technology as devices on Ethernet networks in the computer world. For many applications, components from the existing company network can be used. However, it is recommended to use industrial switches for time-critical applications. This manual is not intended to convey basic knowledge, for example in terms of network topology, data security or address assignment.

3.1.1 Data security

The larger the network into which the product is integrated, the greater the risk of unauthorized external access. The operator of the local network must take appropriate measures to prevent unauthorized access. Contact your network administrator prior to commissioning the product.

3.1.2 Basics

The ODVA is in charge of the specifications for the EtherNet/IP network and EtherNet/IP data terminal equipment. For more information on the ODVA see:

http://www.odva.org

Number of nodes

The number of nodes in an EtherNet/IP network is theoretically unlimited; it depends on the subnet size and on whether or not a CIP router is used. For example, 254 nodes are possible in a class C subnet.

Cable length

The maximum cable length is 100 m between EtherNet/IP terminal points and 90 m between infrastructure components. However, interference in industrial environments may require you to use shorter cables.

Drive profiles

The product supports the following drive profiles:

- "Drive Profile Lexium"

See chapter 6 "Operation" for a description of the corresponding operating modes.

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Communication means The product supports the following communication means:

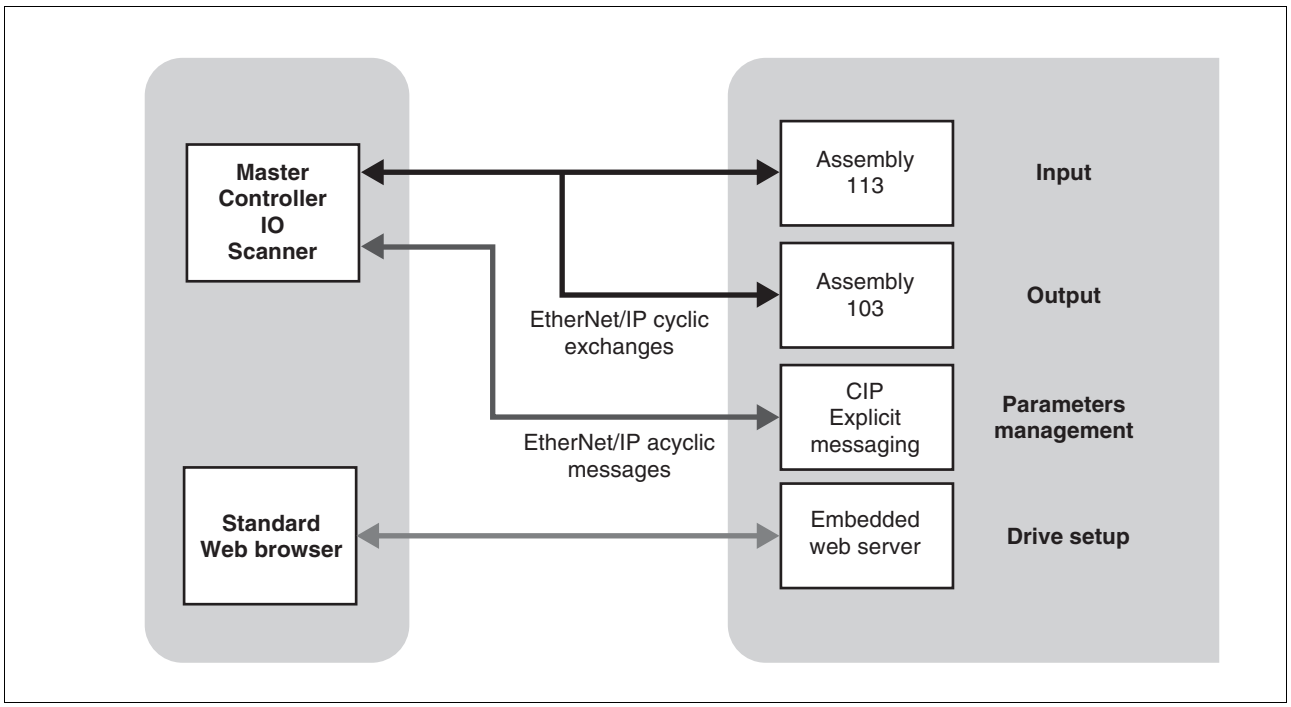

Figure 3.1 Overview of communication means

- Class 1 connections via assemblies:
  - Maximum number of connections: 4
  - Supported actual packet intervals (API): 2 ... 3200 ms
  - Supported connection types product to PLC (Target to Originator): point-to-point, Multicast
  - Supported connection types PLC to product (Originator to Target): point-to-point
  - Supported triggers: cyclic, state transition
- Class 3 connections via Explicit Messages:
  - Maximum number of connections: 16
  - Supported actual packet intervals (API): 10 ... 10000 ms
  - Supported connection types product to PLC (Target to Originator): point-to-point
  - Supported connection types PLC to product (Originator to Target): point-to-point

The product identifies itself as CIP "Generic Device" (Device Type = 0_h).

Data link layer The EtherNet/IP data link layer uses the transmission mechanisms as per IEEE 802.3 Standard Ethernet specification (edition 2002). This makes it possible to use a wide selection of available Ethernet components.

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Physical layer

Industrial EtherNet/IP specifies minimum requirements in terms of ambient conditions, cabling and connectors, based on IEC, ANSI, TIA and EIA standards.

The connectors required for Industrial EtherNet/IP include M12-4 connectors, D-coded. Use shielded or unshielded CAT5e or CAT6 cables for Industrial EtherNet/IP.

Copper media may be used only for distances up to 100 m.

Terms: Object class, instance, attribute, service

The EtherNet/IP approach is object-oriented. CIP defines object classes; one or more instances (objects) can be derived from such object classes. The attributes of an object class or the instance derived from it contain the various parameters. Services are actions that are possible with these attributes.

Example

Class	Instance	Attribute	Attribute value	Service
Motor data	Motor_1	MaxSpeed	4000 min^{-1}	Get
Motor data	Motor_2	MaxSpeed	3000 min^{-1}	Get

CIP object model

The following object classes from the CIP object model are available:

Object class	Class ID	Instance ID
Identity Object	1 (01_h)	1
Message Router Object	2 (02_h)	1
Assembly Object	4 (04_h)	103 = Output Assembly, consuming 113 = Input Assembly, producing
Connection Manager Object	6 (06_h)	1= Explicit Message
Vendor-specific objects	101 ... 163 (65_h ... $A3_h$)	1
TCP/IP Object	245 ($F5_h$)	1
Ethernet Link Object	246 ($F6_h$)	2

The vendor-specific class IDs 101 to 163 correspond to the object dictionary (class ID = object group + 100). The attributes of a class correspond to the subindex entry within the object group.

Communication model

EtherNet/IP uses the producer-consumer communication model. All nodes check the bus as to whether a data packet with the Identifier they support is available. Data packets that are sent by producers can only be received by the consumers of these packets.

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Groups of connections

EtherNet/IP is a connection-oriented network. Connections must be established and managed between two nodes. There are 4 connection groups with different priorities:

Group 1	Top-priority process data (highest priority)
Group 2	For simple master-slave connections
Group 3	For Explicit Messages
Group 4	Reserved group (lowest priority)

Electronic Data Sheet

An EDS file is a file in ASCII format. This file contains device-specific and vendor-specific descriptions of all parameters for a device. The EDS file also contains the fieldbus-specific communication parameters. The EDS file is required for commissioning.

3.1.3 Encapsulation

EtherNet/IP is based entirely on existing TCP/IP and UDP/IP technologies that are used without any modification. TCP/IP is used for the transmission of Explicit Messages while UDP/IP is used for I/O Messaging.

3.1.4 Messaging and message types

EtherNet/IP uses two types of messaging: Explicity Messaging and Implicit (I/O data) Messaging.

EtherNet/IP defines several message types for communication. The product described here uses the "Explicit Message" and "I/O Message" message types.

Explicit Messages

Explicit Messaging connections are point-to-point connections between two network nodes that are used for transactions of the type request - response. These connections are used to address parts of a device which are accessible via the network. The data field of Explicit Messages contains both protocol data and application-specific commands.

I/O messages

I/O Messages, also referred to as Implicit Messages, are transmitted via UDP/IP. I/O Message connections are often established as One-to-Many relationships in the producer-consumer Multicast model of EtherNet/IP. The data fields of I/O Messages contain no protocol information, but only time-critical I/O data. I/O Messages are a lot smaller than Explicit Messages, thus allowing for much faster processing. These messages are used to to transport application-specific I/O data over the network at regular intervals. The meaning of the data is pre-defined at the time the connection is established. I/O Messages can contain so-called Assemblies of several parameters that can be transmitted with a single message. The parameters for configuring EtherNet/IP communication are described in chapter5 "Commissioning".

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Command processing: Transmit data and receive data

The master sends a command to the drive system (slave) to execute a motion command, activate functions or request information from the slave. The slave executes the command and acknowledges it with a response message that may contain an error message if an error occurred.

The master device can send new commands as soon as it has received acknowledgement concerning the current command. Acknowledgement information and error messages are included in the transmitted data in bit-coded form.

The master must then continuously monitor for completion of the processing command by evaluating the acknowledgment from the slave. I/O messages are a special case. I/O messages are not acknowledged from the slave.

3.1.5 Data structure

The data frame with transmit and receive data and all byte, word and double-word values is shown in hexadecimal notation. Hexadecimal values are indicated as such by means of an "h" behind the numerical value, for example, "31_h", decimal values have no special identification. Note the different counting format of bits (0 ... 7, right to left) and bytes (0 ... xx, left to right)

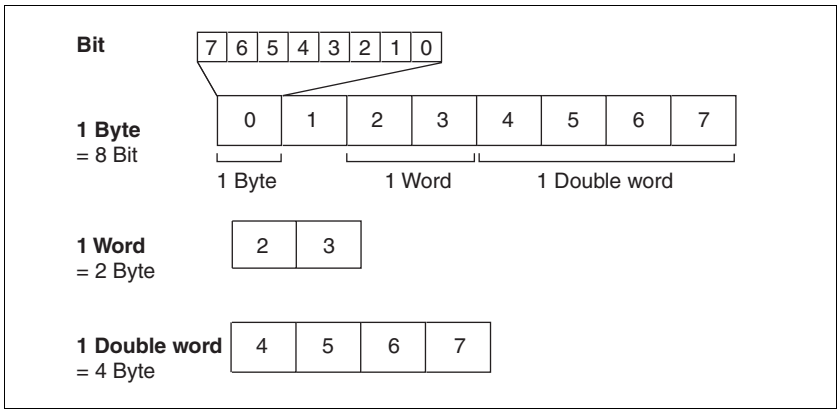

Figure 3.2 Data structure

3.1.6 Communication via Explicit Message

An Explicit Message (EtherNet/IP-specific or vendor-specific) is used to read or write an individual parameter. See the product manual for an overview of all parameters.

The parameter is accessed by means of Class.Instance.Attribute as per CIP.

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3.1.7 Communication via I/O Messages

An I/O Message is used for realtime exchange of process data. I/O messages lend themselves for motion commands. Transmission is very fast because the data is sent without administration data and a transmission acknowledgement from the recipient is not required.

The master can control the operating states of the slave by means of I/O Message, for example, enable and disable the power stage, trigger a "Quick Stop", reset errors and activate operating modes.

Changing operating states and activating operating modes must be done separately. An operating mode can usually only be activated if the operating state is already "Operation Enabled".

A new operating mode can only be activated when the motor is at a standstill.

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

Assembly

I/O Messages contain a collection (Assembly) of different parameters that are transmitted with a single message.

The following Assemblies are defined for EtherNet/IP:

- Output Assembly, instance 103
- Input Assembly, instance 113

Polled I/O Connection

The Assemblies are used in a Polled I/O Connection . A Polled I/O Connection is initiated by the master with a Poll Command. The Slave responds with a Poll Response.

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3.1.8 "Drive Profile Lexium" assemblies

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

3.1.8.1 Output Assembly, instance 103

The table below shows the memory image for Output Assembly data. See the product manual for a description of the parameters.

Byte	Meaning	Data type	Parameter address CIP
0 ... 3	PCTRLms	DINT	Implicit parameter channel
4 ... 7	PVms	DINT	
8 ... 9	dmControl	INT	-
10 ... 13	RefA32	DINT	-
14 ... 17	RefB32	DINT	-
18 ... 21	Ramp_v_act	DINT	CIP 131.1.6
22 ... 25	Ramp_v_dec	DINT	CIP 106.1.11
26 ... 29	EthOptMapOut1	DINT	CIP 168.1.46
30 ... 33	EthOptMapOut2	DINT	CIP 168.1.47
34 ... 37	EthOptMapOut3	DINT	CIP 168.1.48

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 double word is used to set the second value for the operating mode. The meaning depends on the operating mode; it is described in the chapters on the individual operating modes.

Ramp_v_act / Ramp_v_dec

The double words "Ramp_v_act" 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 ... EthOptMapOut 3

The double words EthOptMapOut1 ... EthOptMapOut3 contain selectable parameters. The product manual provides descriptions of the parameters EthOptMapOut1 ... EthOptMapOut3 which explain parameter mapping.

0198441113802, V1.02, 12.2009

3.1.8.2 Input Assembly, instance 113

The table below shows the memory image for Input Assembly data. See the product manual for a description of the parameters.

Byte	Meaning	Data type	Parameter address CIP
0 ... 3	PCTRLsm	DINT	Implicit parameter channel
4 ... 7	PVsm	DINT	
8 ... 9	driveStat	INT	-
10 ... 11	mfStat	INT	-
12 ... 13	motionStat	INT	-
14 ... 15	driveInput	INT	-
16 ... 19	_p_act	DINT	CIP 130.1.26
20 ... 23	_v_act	DINT	CIP 130.1.32
24 ... 25	_I_act	INT	CIP 130.1.3
26 ... 29	EthOptMapInp1	DINT	CIP 168.1.52
30 ... 33	EthOptMapInp2	DINT	CIP 168.1.53
34 ... 37	EthOptMapInp3	DINT	CIP 168.1.54

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

0198441113802, V1.02, 12.2009

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" is used to provide information on the current motor position. The value corresponds to the parameter _p_act.

_v_act The double word "_v_act" is used to provide information on the current velocity. The value corresponds to the parameter _v_act.

_I_act The word "_I_act" is used to provide information on the current 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.

0198441113802, V1.02, 12.2009

3.2 Handshake with the "Mode Toggle" bit

Availability Handshake with the "Mode Toggle" bit is only available with the "Drive Profile Lexium".

Mode Toggle Synchronized processing can be carried out with the transmit data in byte "modeCtrl" bit "Mode Toggle" and the receive data in byte "modeStat" bit "Mode Error" and bit "Mode Toggle". Synchronized processing means that the master waits for feedback messages from the slave so it can respond appropriately.

Example 1: Positioning The master starts a positioning movement. At points in time t_1, t_2 ..., the master checks the responses from the slave. It waits for the end of positioning. The end is identified by bit "x_end" = 1.

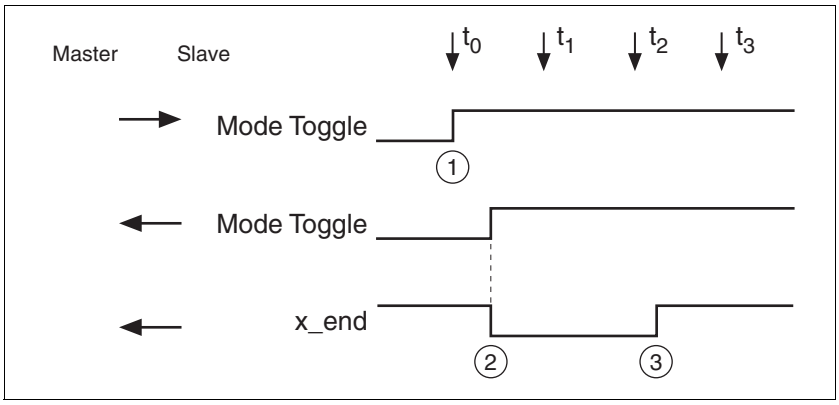

Figure 3.3 Mode Toggle Handshake

(1) Master starts positioning with "Mode Toggle" = 1
(2) Slave signals that positioning is running with "Mode Toggle" = 1; at the same time "x_end" = 0
(3) Slave signals end of positioning with "x_end" = 1

Example 2: Short-time positioning The master starts a positioning movement that will only take a very short time. The duration is shorter than the request cycle of the master. At point in time t_1 the movement is already complete. Bit "x_end" does not allow the master to detect whether the movement is already complete or has not yet been started. However, it can identify this with the "Mode Toggle" bit.

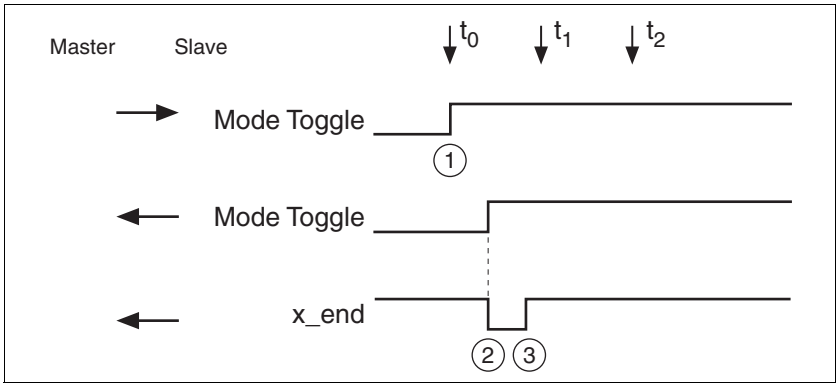

Figure 3.4 Mode Toggle Handshake, short movement

(1) Master starts positioning with "Mode Toggle" = 1
(2) Slave signals that positioning is running with "Mode Toggle" = 1; at the same time "x_end" = 0
(3) Slave signals end of positioning with "x_end" = 1

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4 Installation

4

⚠ WARNING

SIGNAL AND DEVICE INTERFERENCE

Signal interference can cause unexpected responses of 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.
EtherNet/IP fieldbus module with 2 x RJ45 connection. For EtherNet/IP and Ethernet Modbus/TCP.	VW3A3616

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4.2 Electrical installation

Cable specifications

- ▶ Use equipotential bonding conductors.
- ▶ Use pre-assembled cables to reduce the risk of wiring errors.
- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.

Pin assignment

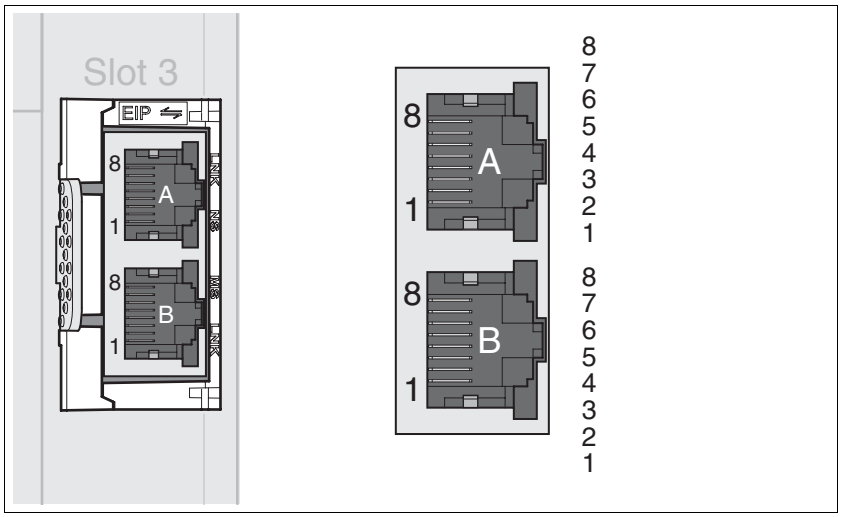

Figure 4.1 Pin assignment

Pin	Signal	Meaning
1	Tx+	Ethernet transmit line +
2	Tx-	Ethernet transmit line -
3	Rx+	Ethernet receive line +
4	-	-
5	-	-
6	Rx-	Ethernet receive line -
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 that the system is free and ready for the movement before changing parameters.
- Verify the use of the word sequence with fieldbus communication.
- Do not establish a fieldbus connection unless you have fully understood the communication principles.

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

Using the library considerably facilitates controlling the device. The library is available for download from the Internet.
http://www.schneider-electric.com

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. This prepares the device for operation in the network.

0198441113802, V1.02, 12.2009

5.2 "First Setup"

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

Switching on the device

- The power stage supply voltage 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 voltage.
- ◁ The device goes through an initialization routine, all LEDs are tested, all segments of the 7-segment display and the 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

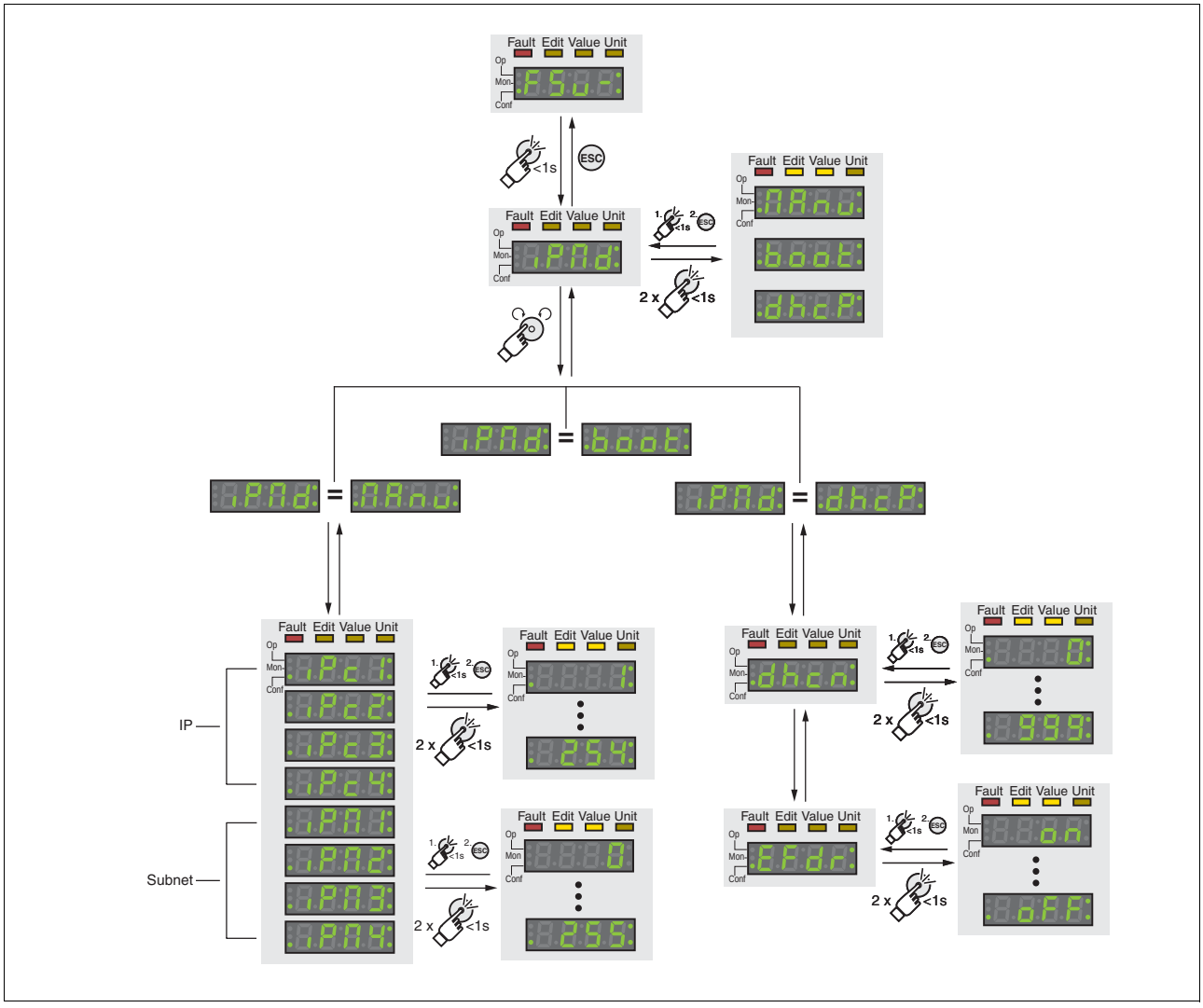

Figure 5.1 First Setup via the integrated HMI

- ▶ Select the type of network address assignment.

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

0198441113802, V1.02, 12.2009

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 3044:5$_h$ Modbus 17418 Profibus 17418 CIP 168.1.5
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 3044:40$_h$ Modbus 17536 Profibus 17536 CIP 168.1.64

Manually

- ■ 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.

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 → COM- CONF → FSU- , Pc 1	IP address Ethernet module, byte 1 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:7$_h$ Modbus 17422 Profibus 17422 CIP 168.1.7
EthIPmodule2 CONF → COM- CONF → FSU- , Pc2	IP address Ethernet module, byte 2 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:8$_h$ Modbus 17424 Profibus 17424 CIP 168.1.8
EthIPmodule3 CONF → COM- CONF → FSU- , Pc3	IP address Ethernet module, byte 3 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:9$_h$ Modbus 17426 Profibus 17426 CIP 168.1.9

0198441113802, V1.02, 12.2009

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthIPmodule4 CONF → CAN- CONF → FSU- , PC4	IP address Ethernet module, byte 4 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:A_h Modbus 17428 Profibus 17428 CIP 168.1.10
EthIPmask1 CONF → CAN- CONF → FSU- , PM1	IP address subnet mask, byte 1 Changed settings become active immediately.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:B_h Modbus 17430 Profibus 17430 CIP 168.1.11
EthIPmask2 CONF → CAN- CONF → FSU- , PM2	IP address subnet mask, byte 2 Changed settings become active immediately.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:C_h Modbus 17432 Profibus 17432 CIP 168.1.12
EthIPmask3 CONF → CAN- CONF → FSU- , PM3	IP address subnet mask, byte 3 Changed settings become active immediately.	- 0 255 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:D_h Modbus 17434 Profibus 17434 CIP 168.1.13
EthIPmask4 CONF → CAN- CONF → FSU- , PM4	IP address subnet mask, byte 4 Changed settings become active immediately.	- 0 0 255	UINT16 UINT16 UINT16 UINT16 R/W per. -	CANopen 3044:E_h Modbus 17436 Profibus 17436 CIP 168.1.14

BOOTP

- EthIpMode has been set to BOOTP (boot).

▶ Verify that an accessible BOOTP server is available on the network.

DHCP

- EthIpMode has been set to DHCP (dhcP).

▶ Verify that an accessible DHCP server is available on the network.

▶ Set a unique device name.

The second part of the device name (dhcn) can be set via the HMI. The adjustable range is from 0 to 999.

In the commissioning software, the device name can be displayed and changed under "Device Information".

Restarting the device

A restart of the device is required for the changes to become effective. After the restart, the device is ready for operation. The device is in the operating mode Jog.

0198441113802, V1.02, 12.2009

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 that the system is free and ready for the movement before changing parameters.
- Verify the use of the word sequence with fieldbus communication.
- Do not establish a fieldbus connection unless you have fully understood the communication principles.

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.

Using the library considerably facilitates controlling the device. The library is available for download from the Internet.
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6.1 Operating states

6.1.1 Indication of the operating state

Fieldbus: with "driveStat"

In the process data channel, status information is transmitted via the receive data (slave to master).

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

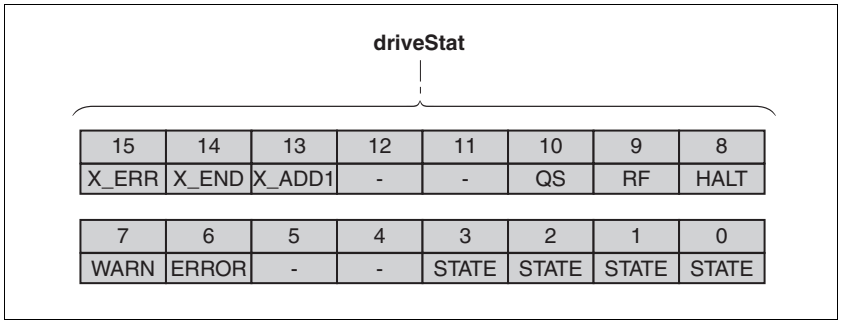

Figure 6.1 Structure of driveStat

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-dependent
14	X_END	Operating mode terminated
15	X_ERR	Operating mode terminated with error

0198441113802, V1.02, 12.2009

6.1.2 Changing the operating state

Fieldbus: with "dmControl"

In the process data channel, transmit data (master to slave) is used to make settings to the slave.

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

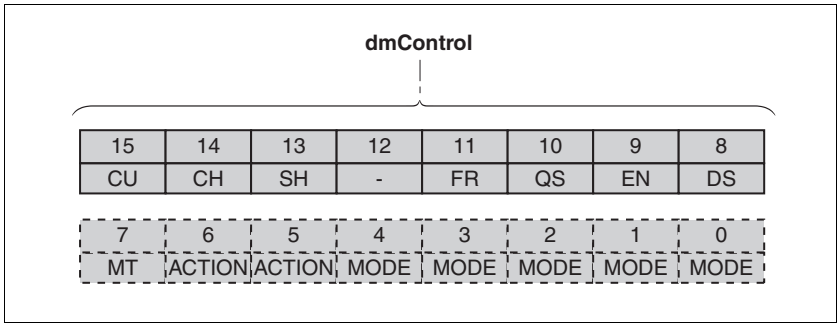

Figure 6.2 Structure dmControl bits 8 ... 15

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")

0198441113802, V1.02, 12.2009

6.2 Operating modes

6.2.1 Indicating and monitoring the operating mode

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

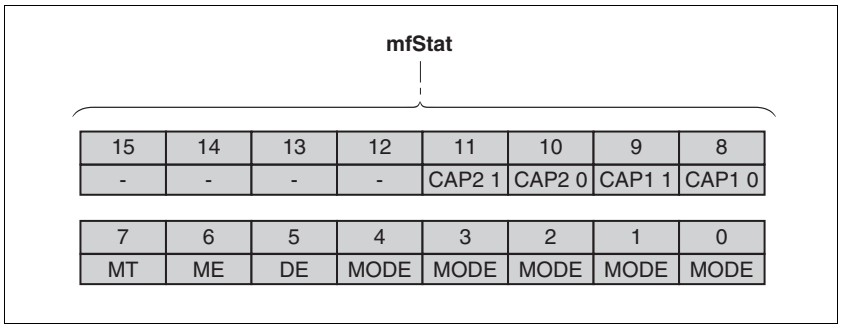

Figure 6.3 Structure mfStat

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

0198441113802, V1.02, 12.2009

6.2.2 Starting and changing an operating mode

Fieldbus: with "dmControl"

In the process data channel, transmit data (master to slave) is used to make settings to the slave.

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

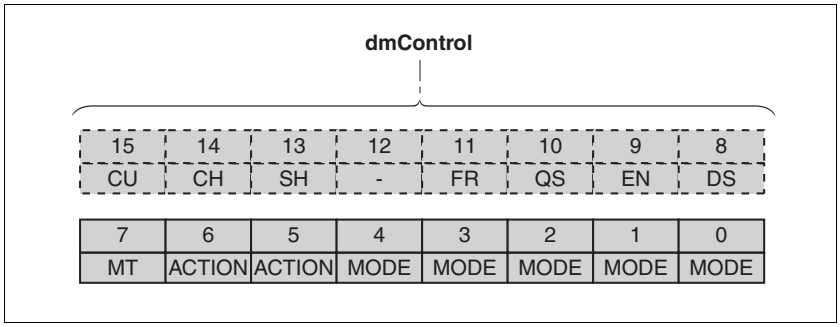

Figure 6.4 Structure dmControl bits 0 ... 7

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.

0198441113802, V1.02, 12.2009

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		$1F_h$	As JOGactivate	-
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	-

0198441113802, V1.02, 12.2009

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 3: Fast movement in positive direction Value 3: 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

0198441113802, V1.02, 12.2009

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

0198441113802, V1.02, 12.2009

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

0198441113802, V1.02, 12.2009

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

0198441113802, V1.02, 12.2009

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

0198441113802, V1.02, 12.2009

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

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

7 Diagnostics and troubleshooting

7

7.1 Fieldbus communication error diagnostics

A properly operating fieldbus is essential for evaluating operating and error messages.

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
- Network connection to the device

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 that knows the product via the EDS file and addressing, 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 address.

▶ Parameterization

"Vendor ID" and "Product Code" must match the values stored in the EDS file.

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7.2 Status LEDs

The status of the module is indicated by the LEDs described below.

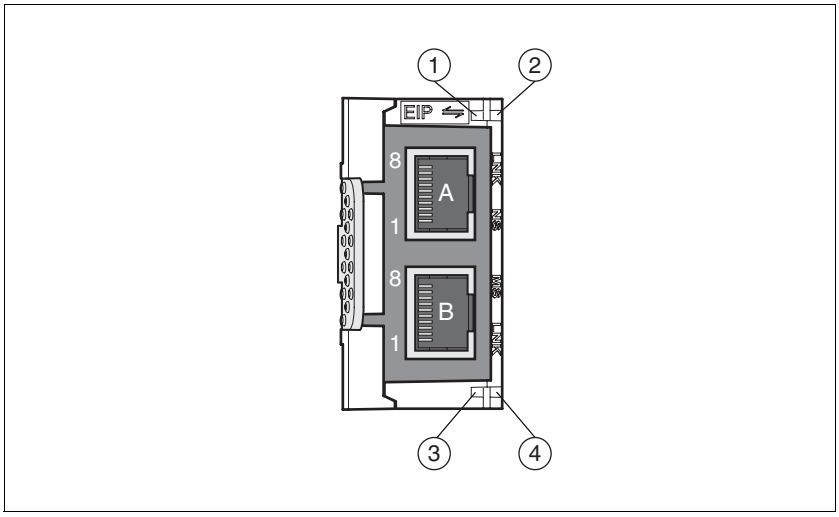

Figure 7.1 Overview of the LEDs at the EtherNet/IP module

(1) Connection 1
(2) Module status
(3) Connection 1
(4) Network status

The table below shows the meaning of the flashing signals of the Link Activity LEDs (1) (3).

Color	LED	Meaning
-	Off	No connection
GN	On	Connection with 100 MB/s
YE	On	Connection with 10 MB/s
GN/YE	Flashing	Activity with 100 MB/s

The table below shows the meaning of the flashing signals of the module status LED (2).

Color	LED	Meaning
-	Off	No power supply
GN/YE	Flashing	Start-up
GN	On	Ready for operation
GN	Flashing	Module not configured
RD	Flashing	Recoverable error
RD	On	Irrecoverable error

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The table below shows the meaning of the flashing signals of the network status LED (4).

Color	LED	Meaning
-	Off	No IP address. No power supply
GN/RD	Flashing	Start-up
GN	On	Connection
GN	Flashing	No connection
RD	Flashing	Timeout
RD	On	IP address conflict

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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.

For a description of all error numbers, see the product manual.

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 word "driveStat"
- Error number is written to parameter `_LastError`

Synchronous errors

Synchronous errors occur as direct errors in response to a fieldbus command. They comprise, for instance:

- Error during execution of an action command or control command
- Parameter value outside the permissible value range
- Invalid action command or control command during processing
- Access to unknown parameter

For a detailed description of the synchronous errors, see chapter 7.3.1 "Synchronous errors".

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7.3.1 Synchronous errors

Explicit Error Response

If an Explicit Request message cannot be processed by the slave, the master receives an error message in the associated Explicit Response. This response message contains 2 bytes:

- General Error Code
- Additional Error Code

Errors can be read with object 100.1.1. If the general error code has the value =$1F_h$, the field "additional error code" contains vendor-specific error numbers in coded form.

Response during I/O connection

The slave responds to an incorrect I/O command in the next I/O response by setting bit 6 (ME) in the word "mfStat". This does not interrupt the current process. To determine the cause of the error, the master can read the error number with the object 100.1.1.

The error indication is reset when the next valid data assembly is transmitted.

Table of general error codes

The error codes that can be contained in the "General Error Code" field are listed in the following table:

Error code	Name	Meaning
00_h	Success	The service was successfully executed by the specified object.
05_h	Path destination unknown	The path refers to an object class, an instance or a structure element that is unknown or not contained in the processing node. Path processing is terminated if an error is detected that is due to an unknown path destination.
09_h	Invalid attribute value	Invalid attribute data was detected
$0C_h$	Object state conflict	The object cannot execute the requested service in its current mode/state
$0E_h$	Attribute not settable	A request to change an attribute that cannot be set was received.
$0F_h$	Privilege violation	Checking of an authorization/privilege has not been successful.
10_h	Device state conflict	The requested service cannot be executed in the current mode/state of the device.
13_h	Not enough data	The service did not deliver enough data to execute the specified operation.
14_h	Attribute not supported	The attribute specified in the request is not supported
15_h	Too much data	The service delivered more data than expected
$1F_h$	Vendor specific error	A vendor-specific error was detected. The vendor-specific error code can be read with object 100.1.1. The vendor-specific error codes can be found in the product manual.

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

8 Object dictionary

8

This chapter describes the communication parameters supported by the product.

The following classes are supported:

- Identity Object (class 1)
- Message Router Object (class 2)
- Assembly Object (class 5)
- Connection Manager Object (class 6)
- TCP/IP Interface Object (class 245)
- Ethernet Link Object (class 246)

Acronyms

NV: Persistent (Non-Volatile)
V: Not persistent (Volatile)
RO: Read Only
RW: Read Write

Vendor-specific objects

The vendor-specific objects (parameters) are described in the product manual.

Structure of the address of an object:
Class.Instance.Attribute

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8.1 Identity Object (class 1)

The object contains the identification data of the product.

8.1.1 Services

ID	Name	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute

8.1.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	$00\ 01_h$	Revision
2	Get (NV-RO)	Max instance	UINT	$00\ 01_h$	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Number of instances	UINT	$00\ 01_h$	Number of instances
4	Get (NV-RO)	Optional attribute list	-	-	-
6	Get (NV-RO)	Max ID of class attributes	UINT	$00\ 07_h$	Greatest currently existing attribute number of a class
7	Get (NV-RO)	Max ID of instance attributes	UINT	$00\ 07_h$	Greatest currently existing attribute number of an instance derived from this class

8.1.3 Instance attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Vendor ID	UINT	243 (F3h)	Unique vendor number
2	Get (NV-RO)	Device type	UINT	0 (Generic Device)	Device family
3	Get (NV-RO)	Product code	UINT	$0A04_h$	Unique device type
4	Get (NV-RO)	Revision	STRUCT: USINT USINT	-	Revision of module
5	Get (NV-RO)	Status	WORD	-	Summarized device status
6	Get (NV-RO)	Serial number	UDINT	-	CIP serial number
7	Get (NV-RO)	Product name	SHORT_STRING	Lexium 32	Device name in text form

0198441113802, V1.02, 12.2009

8.2 Message Router Object (class 2)

8.2.1 Services

ID	Name	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute

8.2.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	00 01_h	Revision
2	Get (NV-RO)	Max instance	UINT	00 01_h	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Number of instances	UINT	00 01_h	Number of instances
4	Get (NV-RO)	Optional attribute list	-	2.3	List of optional instance attributes utilized in an object class implementation
6	Get (NV-RO)	Max ID of class attributes	UINT	00 07_h	Greatest currently existing attribute number of a class
7	Get (NV-RO)	Max ID of instance attributes	UINT	00 03_h	Greatest currently existing attribute number of an instance derived from this class

8.2.3 Instance attributes

ID	Access	Name	Data type	Values	Description
2	Get (NV-RO)	Number available	UINT	00 10_h	Maximum connections
3	Get (NV-RO)	Number active	UINT	-	Number of the currently active system connection to this object.

0198441113802, V1.02, 12.2009

8.3 Assembly Object (class 4)

An Assembly object is a container that contains one or more attributes of other objects. This way, multiple attributes can be transmitted from a slave or to a slave simultaneously with a single connection.

- Output Assemblies are commands from the network to the device.
- Input Assemblies are status messages from the device to the network.

The following instances of the object Assembly are implemented in the device:

ID	Type	Name	Number of bytes
103	EtherNet/IP Output Assemby, consuming	Vendor-dependent extended profile	38
113	EtherNet/IP Input Assemby, producing	Vendor-dependent extended profile	38

8.3.1 Services

ID	Name	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute

8.3.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	$00\ 02_h$	Revision
2	Get (NV-RO)	Max instance	UINT	$00\ C7_h$	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Number of instances	UINT	$00\ 04_h$	Number of instances
6	Get (NV-RO)	Max ID of class attributes	UINT	$00\ 07_h$	Greatest currently existing attribute number of a class
7	Get (NV-RO)	Max ID of instance attributes	UINT	$00\ 04_h$	Greatest currently existing attribute number of an instance derived from this class

8.3.3 Instance attributes

ID	Access	Name	Data type	Values	Description
3	Get (NV-RO)	Data	Array USINT	See 3.1.8 ""Drive Profile Lexium" assemblies"	Data of module
4	Get (NV-RO)	Size	UINT	38	Data size of instance

0198441113802, V1.02, 12.2009

8.4 Connection Manager Object (class 6)

The Connection Manager object allocates and manages the internal resources associated with both I/O- and Explicit Messaging connections.

8.4.1 Services

ID	Name	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute
54_h	Forward_Open	Opens a connection, maximum data size 511 bytes.
$4E_h$	Forward_Close	Closes a connection

8.4.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	00 01_h	Revision
2	Get (NV-RO)	Max instance	UINT	00 01_h	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Number of instances	UINT	00 01_h	Number of instances
4	Get (NV-RO)	Optional attribute list	-	1,2,3,4,5,6,7,8	List of optional instance attributes utilized in an object class implementation
6	Get (NV-RO)	Max ID of class attributes	UINT	00 07_h	Greatest currently existing attribute number of a class
7	Get (NV-RO)	Max ID of instance attributes	UINT	00 08_h	Greatest currently existing attribute number of an instance derived from this class

0198441113802, V1.02, 12.2009

8.4.3 Instance attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Open Requests	UINT	-	Number of the received Forward Open Service Request
2	Get (NV-RO)	Open Format Rejects	UINT	-	Number of the rejected Forward Open Service Request (incorrect format)
3	Get (NV-RO)	Open Resource Rejects	UINT	-	Number of the rejected Forward Open Service Request (busy)
4	Get (NV-RO)	Open Other Rejects	UINT	-	Number of the rejected Forward Open Service Request (other reason)
5	Get (NV-RO)	Close Requests	UINT	-	Number of the received Forward Open Service Request
6	Get (NV-RO)	Close Format Rejects	UINT	-	Number of the rejected Forward Close Service Request (incorrect format)
7	Get (NV-RO)	Close Other Rejects	UINT	-	Number of the rejected Forward Close Service Request (busy)
8	Get (NV-RO)	Connection Timeouts	UINT	-	Number of the rejected Forward Close Service Request (other reason)

0198441113802, V1.02, 12.2009

8.5 TCP/IP Interface Object (class 245)

The object TCP/IP Interface provides a mechanism to configure a device's TCP/IP network interface. Configurable items include the device's IP address, network mask and gateway address.

The object maintains link-specific counters and status information for a Ethernet 802.3 communication interface.

8.5.1 Services

ID	Access	Description
01_h	Get_Attribute_All	Returns a predefined listing of this object's attributes.
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute.
02_h	Set_Attribute_All	Modifies all settable attributes
10_h	Set_Attribute_Single	Modifies a single attribute.

8.5.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	$00\ 01_h$	Revision
2	Get (NV-RO)	Max Instance	UINT	$00\ 01_h$	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Number of Instance	UINT	$00\ 01_h$	Number of instances
4	Get (NV-RO)	Optional attribute list	-	8.9	List of optional instance attributes utilized in an object class implementation
5	Get (NV-RO)	Optional service list	-	-	-
6	Get (NV-RO)	Maximum ID Number Class Attributes	UINT	$00\ 07_h$	The attribute ID number of the last class attribute of the class definition implemented in the device
7	Get (NV-RO)	Maximum ID Number Instance Attributes	UINT	$00\ 09_h$	The attribute ID number of the last instance attribute of the class definition implemented in the device

0198441113802, V1.02, 12.2009

8.5.3 Instance attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Interface status	DWORD	See Kapitel „Status“, Seite 8-59.	Status of the interface
2	Get (NV-RO)	Configuration capability	DWORD	00 00 00 15_h	Obtaining configuration via BOOTP or DHCP
3	Get (NV-RO)	Configuration control	DWORD	-	0 - Configuration via non-volatile memory 1 - Configuration via BOOTP 2 - Configuration via DHCP/FDR
4	Get (NV-RO)	Physical Link Object	DWORD	-	Path to physical link object
		Path size	UINT	00 02_h	2 words
		Path	Padded EPATH	20 F6 24 01h	Ethernet Link object, instance 1 (logical segments identifying the physical link object)
5	Get (NV-RO)	Interface Configuration	-	-	TCP/IP network interface configuration
		IP Address	UDINT	-	IP address of the device
		Network Mask	UDINT	-	Network mask of the device
		Gateway Address	UDINT	-	Default gateway address
		Name Server	UDINT	-	Primary name server
		Name Server 2	UDINT	-	Secondary name server
		Domain Name	STRING	-	Default domain name
6	Get (NV-RO)	Host name	STRING	-	Host name
8	Get (NV-RO)	TTL Value	USINT	1	TTL values for EtherNet/IP Multicast packets
9	Get (NV-RO)	Mcast Config	-	-	Address configuration IP Multicast
		Alloc Control	USINT	0	0 - Standard algorithm for calculation the Multicast address 1 - Multicast address is assigned on the basis of the values of Mcast and Mcast Start Addr
		Reserved	USINT	0	-
		Num Mcast	UINT	4	Number of Multicast addresses assigned to EtherNet/IP
		Mcast Start	USINT	-	Multicast address at which the assignment starts

0198441113802, V1.02, 12.2009

8.5.4 Status

bit	Name	Description	Implementation
0 ... 3	Interface Configuration Status	Returns the interface status 1 - The interface attribute contains a valid configuration.	Return value 1
4	Mcast Pending	Indicates a pending change of the configuration of the TTL value or the Mcast Config attribute. This bit is set as soon as the TTL value or the Mcast Config attribute are changed; it is deleted during a re-start of the device.	Returns the status of the TTL and Mcast configuration.
5 ... 31	Reserved	Reserved	Reserved

8.5.5 Return values of various configuration possibilities

bit	Name	Description	Implementation
0	BOOTP client	1 - Network configuration could be obtained via BOOTP.	Return value 1
1	DNS Client	1 - Host names could be resolved via a DNS server.	Return value 0
2	DHCP client	1 - Network configuration could be obtained via DHCP.	Return value 1
3	DHCP-DNS update	1 - The product could send its host name in a DHCP request.	Return value 0
4	Configuration adjustable	1 - The interface configuration attribute is adjustable. Some devices such as a PC workstation do not allow such a configuration via the TCP/IP interface object.	Return value 1
5 ... 31	000	000	Return value 0

0198441113802, V1.02, 12.2009

8.6 Ethernet Link Object (class 246)

The Ethernet Link object maintains link-specific counters and status information for a Ethernet 802.3 communication interface.

Each device supports exactly one instance of the object for each Ethernet IEEE 802.3 communication interface on the module.

A request to access instance 1 of the object refers to the instance associated with the communication interface via which the request was received.

8.6.1 Services

ID	Name	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute

ID	Access	Description
01_h	Get_Attribute_All	Returns a predefined listing of this objects attributes
$0E_h$	Get_Attribute_Single	Returns the contents of the specified attribute
$4C_h$	Get_and_Clear	Get and then Clear the specified attribute (interface counters or media)

8.6.2 Class attributes

ID	Access	Name	Data type	Values	Description
1	Get (NV-RO)	Revision	UINT	$00\ 03_h$	Revision
2	Get (NV-RO)	Max Instance	UINT	$00\ 02_h$	Greatest currently existing instance number of an object derived from this class
3	Get (NV-RO)	Num Instance	UINT	$00\ 02_h$	Number of instances
6	Get (NV-RO)	Max Class Attributes	UINT	$00\ 07_h$	Greatest currently existing attribute number of a class
7	Get (NV-RO)	Max Instance Attributes	UINT	$00\ 0A_h$	Greatest currently existing attribute number of an instance derived from this class

0198441113802, V1.02, 12.2009

8.6.3 Instance attributes

ID	Access	Name	Data type	Values	Description	
1	Get	Interface Speed	UDINT	0A 00 00 00_h = 10 64 00 00 00_h = 100	Currently used interface speed	
2	Get	Interface flags	DWORD	-	0	Link status
					11	Half/full duplex
					2 ... 4	Interface Status flags
					5	Manual setting / requires reset
					6	Local Hardware error
					All other bits are reserved and set to 0.	
3	Get	Physical Address	ARRAY OF 6 USINTs	MAC address	MAC layer address	
4	Get		UINT			
5	Get		UINT			
6	Get		UINT			
7	Get		UINT	00 02_h	MAC layer address	
10	Get		UINT	"Top" or "Bottom"	Connection designation	

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

9 Accessories and spare parts

9

9.1 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

0198441113802, V1.02, 12.2009

0198441113802, V1.02, 12.2009

10 Glossary

10

10.1 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

10.1.1 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	-

10.1.2 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	-

10.1.3 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	/ $9.807*10^{-3}$	* $100*10^{3}$	-

10.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

0198441113802, V1.02, 12.2009

10.1.5 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	-

10.1.6 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	/ $10*10^6$	/ $98.066*10^6$	/ $0.9806*10^6$	-

10.1.7 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	-

10.1.8 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	-

10.1.9 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

0198441113802, V1.02, 12.2009

10.2 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.

Assembly Various attributes are combined in one single data packet. Client and server know the structure of the packets. See also Explicit Message.

Attribute A single value of an object (in a network device) that can be read or written over the network. (see Class - Instance - Object - Attribute)

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

COS **C**hange **O**f **S**tate: special I/O connection in which data is only transmitted when changes occur.

Class DeviceNet and EtherNet/IP describes the behavior of a network node in so-called object classes. A class defines the behavior of (related) objects and consists of attributes and so-called services to work with these attributes (read/write)
for example: class vehicles, object car, attribute fuel level, service fill (see Class - Instance - Object - Attribute)

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.

EDS (**E**lectronic **D**ata **S**heet); contains the specific properties of a product.

Error Discrepancy between a computed, observed or measured 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 Direction of data flow from the network perspective: data packet/status message from device, see also Output

Instance An actual object that is derived from a specific class. (see Class - Instance - Object - Attribute)

MAC ID Node address (MAC=Media Access Control); a unique address in the entire network.

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

ODVA **O**pen **D**eviceNet **V**endor **A**ssociation.
User organization for DeviceNet and EtherNet/IP standards.

0198441113802, V1.02, 12.2009

Object	An object is a member of a specific class. The object 'bicycle' is a member of the class 'vehicles'. The object 'car' is a member of the class 'vehicles'. (see Class - Instance - Object - Attribute)
Object dictionary	List of all parameters, values and functions available in the device. Each entry is uniquely referenced via index (16 bit) and subindex (8 bit).
Output	Direction of data flow from the network perspective: data packet/command to a device, 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	Function which can be used for fast deceleration of the motor via a command or in the event of an error.
Scanner	Bus device that, as a master unit, controls all data transmission via the bus. Corresponds to the master.
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 is not an error and does not cause a transition of the operating state.

0198441113802, V1.02, 12.2009

11 Index

11

0198441113802, V1.02, 12.2009

F

G

H

I

J

L

M

N

O

0198441113802, V1.02, 12.2009

P

Q

R

S

T

U

0198441113802, V1.02, 12.2009

W

0198441113802, V1.02, 12.2009