LXM32M

EtherCAT Module

Fieldbus manual

05/2018

EtherCAT®

0198441113868.04

www.schneider-electric.com

Schneider Electric™

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

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

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

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. 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 modifying the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

The qualified person must be able to detect possible hazards that may arise from parameterization, modifying parameter values and generally from mechanical, electrical, or electronic equipment.

The qualified person must be familiar with the standards, provisions, and regulations for the prevention of industrial accidents, which they must observe when designing and implementing the system.

INTENDED USE

The products described or affected by this document are, along with software, accessories and options, servo-drive systems for three-phase servo motors. The products are intended for industrial use according to the instructions, directions, examples and safety information contained in the present user guide and other supporting documentation.

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 products, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety-related measures must be implemented.

Since the products are used as components in an overall machine or process, you must ensure the safety of persons by means of the design of this overall machine or process.

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

Any use other than the use explicitly permitted as described herein is prohibited and may result in unanticipated hazards.

About the Book

At a Glance

Document Scope

The information provided in this manual supplements the product manual of the drive LXM32M.

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

Validity Note

This manual applies to the module EtherCAT for the product LXM32M, module identification ECT.

For product compliance and environmental information (RoHS, REACH, PEP, EOLI, etc.), go to *www.schneider-electric.com/green-premium*.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the reference or product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
LXM32M - EtherCAT module - Fieldbus manual (this manual)	*0198441113868 (eng)* *0198441113869 (fre)* *0198441113867 (ger)*
Lexium 32M - Servo Drive - User Guide	*0198441113767 (eng)* *0198441113768 (fre)* *0198441113766 (ger)* *0198441113770 (spa)* *0198441113769 (ita)* *0198441113771 (chi)*

You can download these technical publications and other technical information from our website at *http://www.schneider-electric.com/en/download*.

Product Related Information

⚠ WARNING

LOSS OF CONTROL

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

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

[1] For 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” or their equivalent governing your particular location.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
EN 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2008	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 1088:2008 ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2006	Safety of machinery - Emergency stop - Principles for design
EN/IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2008	Digital data communication for measurement and control: Functional safety field buses.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Chapter 1
Introduction

Fieldbus Devices on the EtherCAT Network

General

EtherCAT is an Ethernet-based fieldbus system. The technology is standardized as per the international standards IEC 61158 and IEC 61784 as well as ISO 15745-4.

EtherCAT is a real-time Ethernet system that lends itself for use in cycle-synchronous motion control applications.

EtherCAT® is a registered trademark and patented technology, licenced by Beckhoff Automation GmbH, Germany.

Features

Fieldbus protocol	EtherCAT
Physical interface	1 x RJ45 (X1, IN) 1 x RJ45 (X2, OUT)
Transmission rate	100 Mbit/s
Status indication	2 x LED Link/Activity 1 x LED Network RUN 1 x LED Network ERROR
Addressing methods	Position addressing Node addressing Logical addressing Second address
Communication profile	CoE (CANopen over EtherCAT) EoE (Ethernet over EtherCAT)[1)]
Synchronization methods	DC synchronous (Distributed Clock, Jitter <1 µs) SM synchronous (SyncManager)
Communication cycle time	0.25 ms ... 20 ms (0.25 ms increments)
Input shift time	0 ms ... x (0.25 ms increments) x = Set communication cycle time minus 0.25 ms
CiA 402 operating modes	Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode Profile Position Profile Velocity Profile Torque Homing
Vendor-specific operating modes	Jog Electronic Gear Motion Sequence
Certification Assigned Vendor ID Test Report Number EtherCAT Test Center	EtherCAT Conformance Test 0x800005A 0x800005A_002 (Family device test) Beckhoff Automation GmbH, Nuremberg, Germany
(1) With firmware version of the drive ≥V01.26 and firmware version of the EtherCAT module ≥V01.12.	

Chapter 2
Installation

Installation of the Module

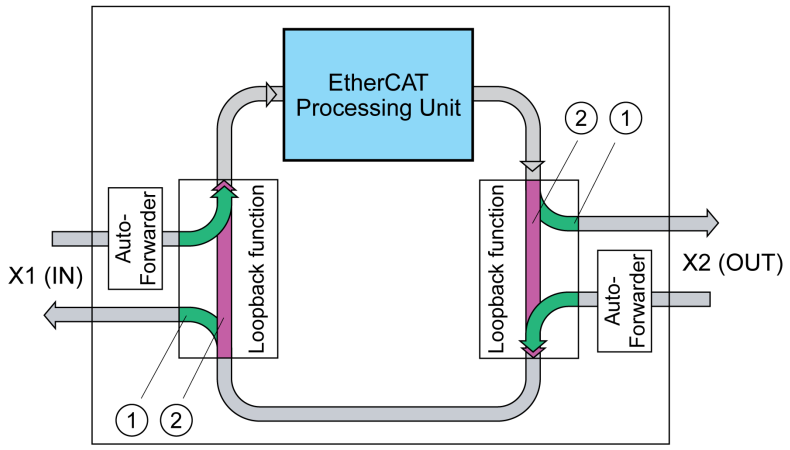
Mechanical Installation

Electrostatic discharge (ESD) may permanently damage the module either immediately or over time.

NOTICE
EQUIPMENT DAMAGE DUE TO ESD ● Use suitable ESD measures (for example, ESD gloves) when handling the module. ● Do not touch internal components. **Failure to follow these instructions can result in equipment damage.**

Install the module according to the instructions in the product manual of the drive.

Topology



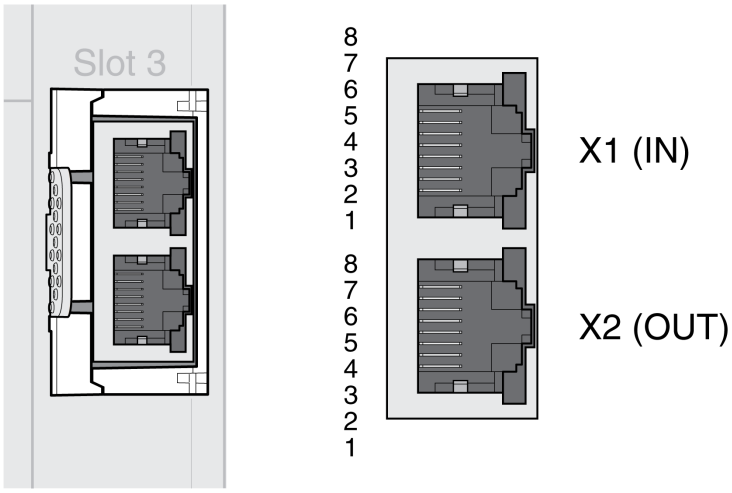
1 Port open
2 Port closed

Cable Specifications

Category:	Cat 5e
Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	8 * 0.25 mm^2 (8 * AWG 22)
Maximum cable length:	100 m (328 ft)
Special features:	Connector RJ45, no crossover cable

Note the pertinent information on equipotential bonding conductors in the product manual.

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	-	-

Chapter 3
Commissioning

What Is in This Chapter?

This chapter contains the following topics:

Preparation

This chapter describes how to commission the product.

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

⚠ WARNING

LOSS OF CONTROL

- Ensure that connection monitoring is enabled.
- Set the shortest, practical monitoring time cycles to detect communication interruptions as quickly as possible.

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only start the system if there are no persons or obstructions in the zone of 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 correct word order for 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.

Required Components

The following is required for commissioning:

- Commissioning software “Lexium32 DTM Library” *http://www.schneider-electric.com/en/download/document/Lexium_DTM_Library/*
- Fieldbus converter for the commissioning software for connection via the commissioning interface
- XML file (EtherCAT Slave Information) *http://www.schneider-electric.com/en/download/document/Lexium_32M_EtherCAT_XML_file/*
- Product manual LXM32M and fieldbus manual LXM32M EtherCAT

Add the Product as an NC Axis in the Beckhoff TwinCAT Software

TwinCAT

The product is added to the fieldbus using the Beckhoff TwinCAT software.

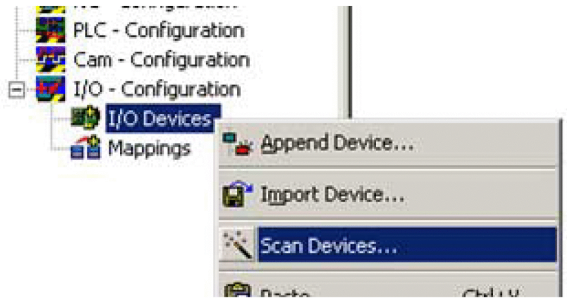
The following TwinCAT functions are supported:

- TwinCAT-Systeme PLC, NC PTP, NC I and CNC
- TwinCAT libraries using TcMc.lib or TcMc2.lib
- TwinCAT homing methods Plc CAM and Software Sync

Adding the Product to TwinCAT

Add the XML file to TwinCAT.

Scan the EtherCAT network to automatically add the product the TwinCAT.



Add the product to the NC configuration.

Settings

Setting the Process Data

4 predefined RxPDOs and 4 predefined TxPDOs are available.

Depending on the selected operating mode, one of the predefined RxPDOs and one of the predefined TxPDOs can be used:

Operating mode	Suitable PDO
Cyclic Synchronous Position	First Predefined PDO
Cyclic Synchronous Velocity	Second Predefined PDO
Cyclic Synchronous Torque	Third Predefined PDO
Any type of switch between: Cyclic Synchronous Position Cyclic Synchronous Velocity Cyclic Synchronous Torque	Fourth Predefined PDO

Only a single predefined RxPDO and only a single predefined TxPDO can be used simultaneously.

The PDOs can be adapted as required. A maximum of 10 parameters are possible per RxPDO and TxPDO.

Setting the Process Data of the First Predefined PDO

The first PDO is suitable for the operating mode Cyclic Synchronous Position.

Structure RxPDO 1600_h

Index	Parameter name (DS402 name)
$6040:0_h$	`DCOMcontrol` (Control word)
$607A:0_h$	`PPp_target` (Target position)
$3008:11_h$	`IO_DQ_set`

Structure TxPDO $1A00_h$

Index	Parameter name (DS402 name)
$6041:0_h$	`_DCOMstatus` (Status word)
$6064:0_h$	`_p_act` (Position actual value)
$603F:0_h$	`_LastError` (Error code)
$3008:1_h$	`_IO_act`

Setting the Process Data of the Second Predefined PDO

The second PDO is suitable for the operating mode Cyclic Synchronous Velocity.

Structure RxPDO 1601_h

Index	Parameter name (DS402 name)
$6040:0_h$	`DCOMcontrol` (Control word)
$60FF:0_h$	`PVv_target` (Target velocity)
$3008:11_h$	`IO_DQ_set`

Structure TxPDO $1A01_h$

Index	Parameter name (DS402 name)
$6041:0_h$	`_DCOMstatus` (Status word)
$6064:0_h$	`_p_act` (Position actual value)
$603F:0_h$	`_LastError` (Error code)
$3008:1_h$	`_IO_act`

Setting the Process Data of the Third Predefined PDO

The third PDO is suitable for the operating mode Cyclic Synchronous Torque.

Structure RxPDO 1602_h

Index	Parameter name (DS402 name)
$6040:0_h$	`DCOMcontrol` (Control word)
$6071:0_h$	`PTtq_target` (Target torque)
$3008:11_h$	`IO_DQ_set`

Structure TxPDO $1A02_h$

Index	Parameter name (DS402 name)
$6041:0_h$	`_DCOMstatus` (Status word)
$6064:0_h$	`_p_act` (Position actual value)
$6077:0_h$	`_tq_act` (Torque actual value)
$603F:0_h$	`_LastError` (Error code)
$3008:1_h$	`_IO_act`

Setting the Process Data of the Fourth Predefined PDO

The fourth predefined PDO is suitable for the operating modes Cyclic Synchronous Position, Cyclic Synchronous Velocity and Cyclic Synchronous Torque. You can switch between the operating modes as required.

Structure RxPDO 1603_h

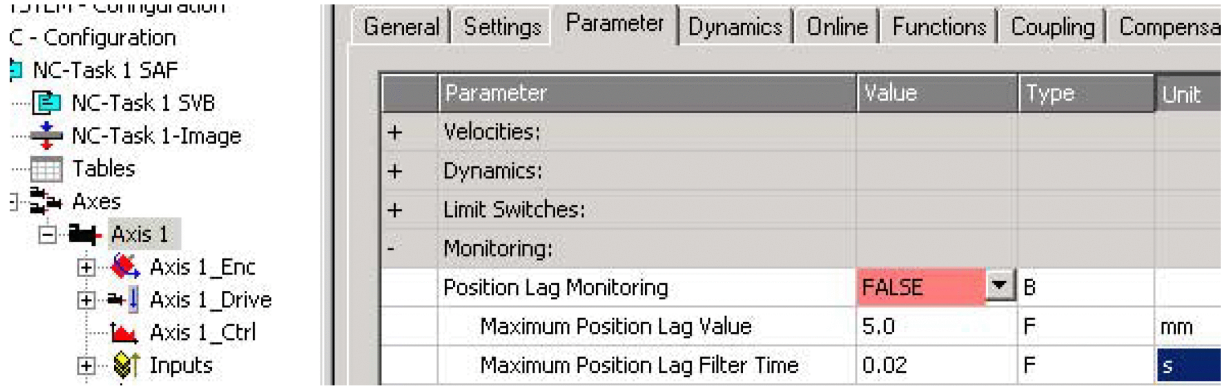
Index	Parameter name (DS402 name)
$6040:0_h$	`DCOMcontrol` (Control word)
$6060:0_h$	`DCOMopmode` (Mode of operation)
$607A:0_h$	`PPp_target` (Target position)
$60FF:0_h$	`PVv_target` (Target velocity)
$6071:0_h$	`PTtq_target` (Target torque)
$3008:11_h$	`IO_DQ_set`

Structure TxPDO $1A03_h$

Index	Parameter name (DS402 name)
$6041:0_h$	`_DCOMstatus` (Status word)
$6061:0_h$	`_DCOMopmd_act` (Mode of operation display)
$6064:0_h$	`_p_act` (Position actual value)
$60F4:0_h$	`_p_dif` (Following error actual value)
$6077:0_h$	`_tq_act` (Torque actual value)
$603F:0_h$	`_LastError` (Error code)
$3008:1_h$	`_IO_act`

Setting Monitoring of the Position Deviation of Operating Mode Cyclic Synchronous Position

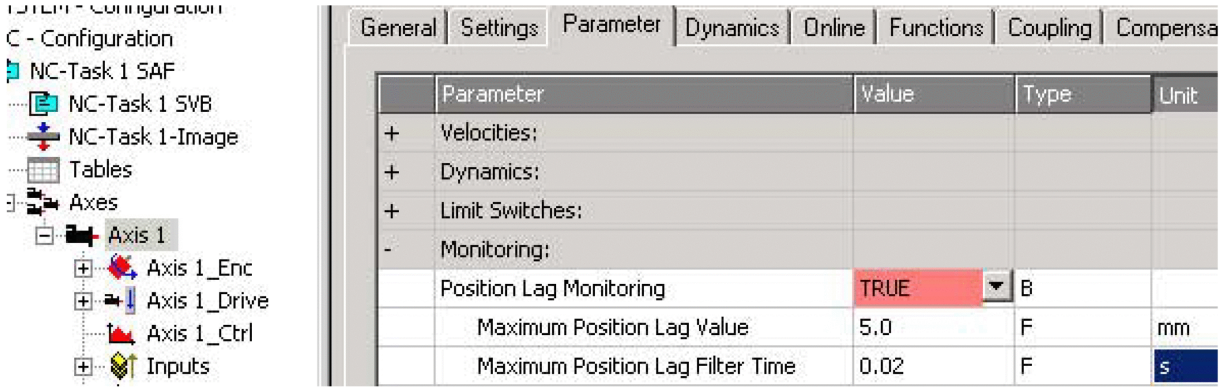
Monitoring of the position deviation must be deactivated for the operating mode Cyclic Synchronous Position since the position deviation is monitored in the drive.



- If you use the operating mode Cyclic Synchronous Position, set "Position Lag Monitoring" to "FALSE".

Setting Monitoring of the Position Deviation of Operating Mode Cyclic Synchronous Velocity

Monitoring of the position deviation must be activated for the operating mode Cyclic Synchronous Velocity.



- If you use the operating mode Cyclic Synchronous Velocity, set "Position Lag Monitoring" to "TRUE".

Setting Monitoring of the Position Deviation of Operating Mode Cyclic Synchronous Torque

Monitoring of the position deviation depends on the application for the operating mode Cyclic Synchronous Torque.

Setting the Scaling Factor

The scaling factor must be set.

Formula: Scaling factor = 1 / (position scaling in the product / mechanical system)

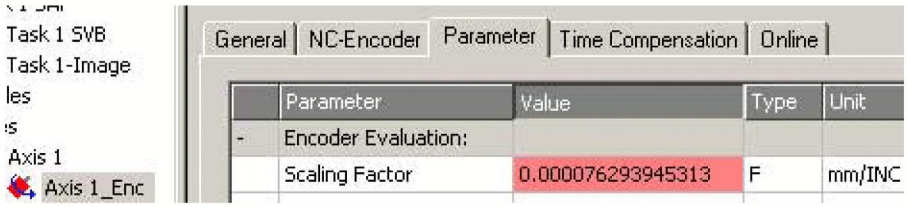
Example:

Mechanical system: 1 revolution corresponds to 10 mm

Position scaling in the product: 1 revolution corresponds to 131072 INC

Calculation: 1 / (131072 INC / 10 mm) = 0.000076293945313 mm/INC

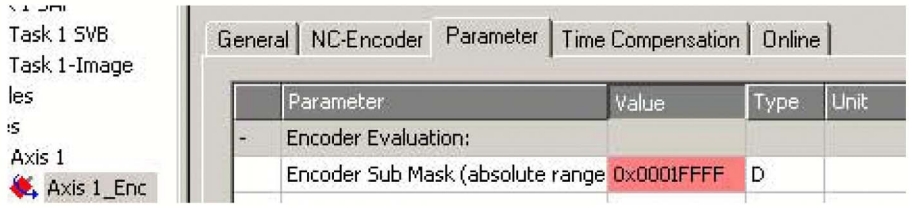
Position scaling in the product is adapted by the list of startup parameters, see chapter List of the Startup Parameters *(see page 23)*.



- Set "Scaling Factor" to 0.000076293945313 (example).

Setting Homing

For the TwinCAT homing method Software Sync, you must adjust the setting "Encoder Sub Mask (absolute range maximum value)".



- Set "Encoder Sub Mask (absolute range maximum value)" to 0x0001FFFF.

Setting the Output Scaling

The output scaling must be set for the operating mode Cyclic Synchronous Velocity.

Formula:

Output scaling = (`ScaleVELdenom` / `ScaleVELnum`) x 0.007153

Example:

Velocity scaling in the product

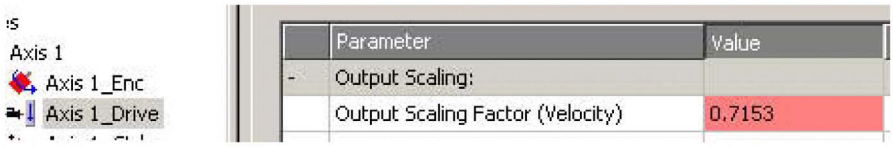
`ScaleVELdenom` = 100

`ScaleVELnum` = 1

Calculation:

(100 / 1) x 0.007153 = 0.7153

NOTE: The velocity scaling in the product must be adapted via additional parameters in the list of the startup parameters, see chapter List of the Startup Parameters *(see page 23)*.



- Set "Output Scaling Factor (Velocity)" to 0.7153 (example).

Setting the Velocity Gain Kv of the Position Controller

The velocity gain kV or the position controller must be adapted for the operating mode Cyclic Synchronous Velocity.

- Set the velocity gain (Kv factor) of the position controller as described in the TwinCAT manual under "TwinCAT Axis Commissioning".

List of the Startup Parameters

Overview

The list of the startup parameters comprises parameters of the product. These parameters are adjusted so that the product can be added to "TwinCAT" as an NC axis.

The following parameters are contained in the list of start-up parameters:

- CompParSyncMot
- MOD_Enable
- LIM_QStopReact
- IOsigRespOfPS
- ScalePOSdenom
- ScalePOSnum
- CTRL1_KFPp
- CTRL2_KFPp
- DCOMopmode
- ECATinpshifttime

The following parameters must be added to the list of startup parameters if you want to use the operating mode Cyclic Synchronous Velocity:

- ScaleVELdenom
- ScaleVELnum
- RAMP_v_max
- CTRL_v_max
- MON_v_zeroclamp

Setting the Compatibility for Synchronous Operating Modes

The parameter for the compatibility setting for the Synchronous operating modes is set to the following value:

Parameter name	Value that is written
CompParSyncMot	1 The value must not be changed.

Setting the Modulo Range

The parameter for the modulo range is set to the following value:

Parameter name	Value that is written
MOD_Enable	0 The value must not be changed.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MOD_Enable CONF → ACG - ATYP	Activation of Modulo **0 / Modulo Off /** OFF: Modulo is off **1 / Modulo On /** On: Modulo is on Setting can only be changed if power stage is disabled. Changed settings become active immediately. Available with firmware version ≥V01.01.	- 0 0 1	UINT16 R/W per. -	CANopen $3006:38_h$ Modbus 1648 Profibus 1648 CIP 106.1.56 ModbusTCP 1648 EtherCAT $3006:38_h$ PROFINET 1648

Setting the Response to "Quick Stop"

The parameter for the response to a "Quick Stop" is set to the following value:

Parameter name	Value that is written
LIM_QStopReact	-1

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_QStopReact CONF → FLt - QStP	Quick Stop option code **-2 / Torque ramp (Fault)**: Use torque ramp and transit to operating state 9 Fault **-1 / Deceleration Ramp (Fault)**: Use deceleration ramp and transit to operating state 9 Fault **6 / Deceleration ramp (Quick Stop)**: Use deceleration ramp and remain in operating state 7 Quick Stop **7 / Torque ramp (Quick Stop)**: Use torque ramp and remain in operating state 7 Quick Stop Type of deceleration for Quick Stop. Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP. If a deceleration ramp is already active, the parameter cannot be written. Changed settings become active immediately.	- -2 6 7	INT16 R/W per. -	CANopen 3006:18$_h$ Modbus 1584 Profibus 1584 CIP 106.1.24 ModbusTCP 1584 EtherCAT 3006:18$_h$ PROFINET 1584

Setting the Response to a Limit Switch Error

The parameter for the response to a limit switch error is set to the following value:

Parameter name	Value that is written
IOsigRespOfPS	1 The value must not be changed.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigRespOfPS	Response to active limit switch during enabling of power stage **0 / Error**: Active limit switch triggers an error. **1 / No Error**: Active limit switch does not trigger an error. Defines the response when the power stage is enabled while a hardware limit switch is active. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	CANopen 3006:6$_h$ Modbus 1548 Profibus 1548 CIP 106.1.6 ModbusTCP 1548 EtherCAT 3006:6$_h$ PROFINET 1548

Setting Position Scaling

The parameter for position scaling is set to the following value:

Parameter name	Value that is written
ScalePOSdenom	131072 The value must not be changed.
ScalePOSnum	1 The value must not be changed.

These values are required for the operating modes Cyclic Synchronous Position, Cyclic Synchronous Velocity and Cyclic Synchronous Torque; they must not be changed.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
ScalePOSdenom	Position scaling: Denominator Refer to numerator (ScalePOSnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_p 1 16384 2147483647	INT32 R/W per. -	CANopen 3006:7$_h$ Modbus 1550 Profibus 1550 CIP 106.1.7 ModbusTCP 1550 EtherCAT 3006:7$_h$ PROFINET 1550
ScalePOSnum	Position scaling: Numerator Specification of the scaling factor: Motor revolutions ---------- User-defined units [usr_p] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	revolution 1 1 2147483647	INT32 R/W per. -	CANopen 3006:8$_h$ Modbus 1552 Profibus 1552 CIP 106.1.8 ModbusTCP 1552 EtherCAT 3006:8$_h$ PROFINET 1552

Setting the Velocity Feed-Forward Control

The parameter for the velocity feed-forward control is set to the following value:

Parameter name	Value that is written
CTRL1_KFPp	1000
CTRL2_KFPp	1000

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_KFPp CONF → drC - FPP I	Velocity feed-forward control In the case of switching between the two control loop parameter sets, the values are changed linearly over the time defined in the parameter CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	CANopen 3012:6$_h$ Modbus 4620 Profibus 4620 CIP 118.1.6 ModbusTCP 4620 EtherCAT 3012:6$_h$ PROFINET 4620

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_KFPp CONF → drC - FPP2	Velocity feed-forward control In the case of switching between the two control loop parameter sets, the values are changed linearly over the time defined in the parameter CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	CANopen 3013:6_h Modbus 4876 Profibus 4876 CIP 119.1.6 ModbusTCP 4876 EtherCAT 3013:6_h PROFINET 4876

Setting the Operating Mode

The parameter for the operating mode is set to the following value:

Parameter name	Value that is written
DCOMopmode	8

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMopmode	Operating mode **-6 / Manual Tuning / Autotuning**: Manual Tuning or Autotuning **-3 / Motion Sequence**: Motion Sequence **-2 / Electronic Gear**: Electronic Gear **-1 / Jog**: Jog **0 / Reserved**: Reserved **1 / Profile Position**: Profile Position **3 / Profile Velocity**: Profile Velocity **4 / Profile Torque**: Profile Torque **6 / Homing**: Homing **7 / Interpolated Position**: Interpolated Position **8 / Cyclic Synchronous Position**: Cyclic Synchronous Position **9 / Cyclic Synchronous Velocity**: Cyclic Synchronous Velocity **10 / Cyclic Synchronous Torque**: Cyclic Synchronous Torque Changed settings become active immediately. * Datatype for CANopen: INT8	- -6 - 10	INT16* R/W - -	CANopen 6060:0_h Modbus 6918 Profibus 6918 CIP 127.1.3 ModbusTCP 6918 EtherCAT 6060:0_h PROFINET 6918

Setting the Input Shift Time

The parameter for the input shift time is set to the following value:

Parameter name	Value that is written
ECATinpshifttime	250000 The value must not be changed.

Adapting the Velocity Scaling for the Operating Mode Cyclic Synchronous Velocity

The parameters for velocity scaling must be set in the product:

Parameter name	Example
ScaleVELdenom	100
ScaleVELnum	1

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
ScaleVELdenom	Velocity scaling: Denominator See numerator (ScaleVELnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_v 1 1 2147483647	INT32 R/W per. -	CANopen $3006:21_h$ Modbus 1602 Profibus 1602 CIP 106.1.33 ModbusTCP 1602 EtherCAT $3006:21_h$ PROFINET 1602
ScaleVELnum	Velocity scaling: Numerator Specification of the scaling factor: Speed of rotation of motor [min-1] ---------- User-defined units [usr_v] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	rpm 1 1 2147483647	INT32 R/W per. -	CANopen $3006:22_h$ Modbus 1604 Profibus 1604 CIP 106.1.34 ModbusTCP 1604 EtherCAT $3006:22_h$ PROFINET 1604

Adapting the Velocity Limitations for the Operating Mode Cyclic Synchronous Velocity

Due to the changed velocity scaling, the following parameters must be adapted:

Formula: (ScaleVELdenom/ScaleVELnum) x value of the parameter

Parameter name	Example(1)
RAMP_v_max	1320000 ((100/1) x 13200)
CTRL_v_max	1320000 ((100/1) x 13200)
MON_v_zeroclamp	1000 ((100/1) x 10)
(1) The sample values relate to the factory settings.	

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_v_max CONF → ACG - nrMP	Maximum velocity of the motion profile for velocity If a greater reference velocity is set in one of these operating modes, it is automatically limited to RAMP_v_max. This way, commissioning at limited velocity is easier to perform. Setting can only be changed if power stage is disabled. Changed settings become active the next time the motor moves.	usr_v 1 13200 2147483647	UINT32 R/W per. -	CANopen $607F:0_h$ Modbus 1554 Profibus 1554 CIP 106.1.9 ModbusTCP 1554 EtherCAT $607F:0_h$ PROFINET 1554

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_v_max CONF → drC- nMA?	Velocity limitation During operation, the velocity limit is one of the following values (whichever is lowest): - CTRL_v_max - M_n_max - Velocity limitation via analog input (module IOM1) - Velocity limitation via digital input Changed settings become active immediately.	usr_v 1 13200 2147483647	UINT32 R/W per. -	CANopen 3011:10$_h$ Modbus 4384 Profibus 4384 CIP 117.1.16 ModbusTCP 4384 EtherCAT 3011:10$_h$ PROFINET 4384
MON_v_zeroclamp CONF → I-O- SCLP	Velocity limit for Zero Clamp A Zero Clamp operation is only possible if the reference velocity is below the Zero Clamp velocity limit. Changed settings become active immediately.	usr_v 0 10 2147483647	UINT32 R/W per. -	CANopen 3006:28$_h$ Modbus 1616 Profibus 1616 CIP 106.1.40 ModbusTCP 1616 EtherCAT 3006:28$_h$ PROFINET 1616

Adapting the Additional Velocity Limitations for the Operating Mode Cyclic Synchronous Velocity

Due to the changed velocity scaling, the following parameters must be verified.

If a parameter is used in the application, it must be adapted.

- Velocities of the operating mode Jog
  - JOGv_slow
  - JOGv_fast
- Velocities of the operating mode Electronic Gear
  - GEARpos_v_max
  - OFSv_target
- Velocities of the operating mode Homing
  - HMv
  - HMv_out
- Automatically switching between control parameter sets
  - CLSET_v_Threshol
- Limitation of the velocity via digital signal input
  - IO_v_limit
- Velocity deviation window
  - MON_v_DiffWin
- Velocity threshold value
  - MON_v_Threshold
- Velocity window
  - MON_v_win
- Velocity for autotuning
  - AT_v_ref
- Relative movement after capture
  - RMAC_Velocity

Setting EtherCAT "Identification"

Overview

The following possibilities are available for an EtherCAT "Identification":

- Selection of a value via a parameter
- Selection of a value via the TwinCAT system manager

In the TwinCAT system manager, the setting Slave-Register (ADO): 12_h is required (also known as Station Alias).

Setting via Parameter

A value for an EtherCAT "Identification" can be set via the parameter `ECAT2ndaddress`.

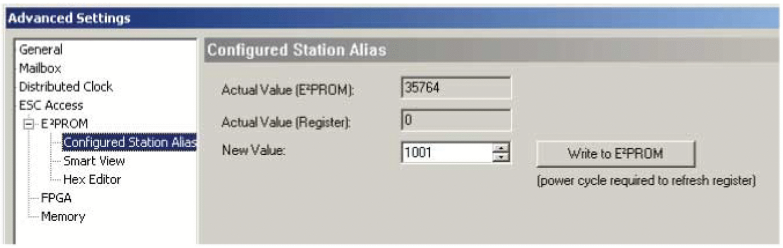
If a value >0 has been set via the parameter `ECAT2ndaddress`, it is no longer possible to assign a value via the TwinCAT system manager.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ECAT2ndaddress` CONF → COM - ECSA	Value for an EtherCAT Identification Value for an EtherCAT "Identification" (also known as "Station Alias"), for example, for the EtherCAT function Hot Connect. Changed settings become active the next time the product is powered on.	- 0 0 65535	UINT16 R/W per. -	CANopen 3045:6_h Modbus 17676 Profibus 17676 CIP 169.1.6 ModbusTCP 17676 EtherCAT 3045:6_h PROFINET 17676

Setting via TwinCAT System Manager

A value for an EtherCAT "Identification" can be set via the TwinCAT system manager.

The value is set by means of the menu item Configured Station Alias.



The value set via the TwinCAT system manager becomes effective when the parameter `ECAT2ndaddress` is set to the value 0 (factory setting).

Chapter 4
Operating States and Operating Modes

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Operating States

What Is in This Section?

This section contains the following topics:

Indication of the Operating State

Status Word

The parameter DCOMstatus provides information on the operating state of the device and the processing status of the operating mode.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_DCOMstatus	DriveCom status word Bit assignments: Bit 0: Operating state Ready To Switch On Bit 1: Operating state Switched On Bit 2: Operating state Operation Enabled Bit 3: Operating state Fault Bit 4: Voltage Enabled Bit 5: Operating state Quick Stop Bit 6: Operating state Switch On Disabled Bit 7: Error of error class 0 Bit 8: HALT request active Bit 9: Remote Bit 10: Target Reached Bit 11: Internal Limit Active Bit 12: Operating mode-specific Bit 13: x_err Bit 14: x_end Bit 15: ref_ok	- - - -	UINT16 R/- - -	CANopen $6041:0_h$ Modbus 6916 Profibus 6916 CIP 127.1.2 ModbusTCP 6916 EtherCAT $6041:0_h$ PROFINET 6916

Bits 0, 1, 2, 3, 5 and 6

Bits 0, 1, 2, 3, 5 and 6 of the DCOMstatus parameter provide information on the operating state.

Operating state	Bit 6 Switch On Disabled	Bit 5 Quick Stop	Bit 3 Fault	Bit 2 Operation Enabled	Bit 1 Switch On	Bit 0 Ready To Switch On
2 Not Ready To Switch On	0	X	0	0	0	0
3 Switch On Disabled	1	X	0	0	0	0
4 Ready To Switch On	0	1	0	0	0	1
5 Switched On	0	1	0	0	1	1
6 Operation Enabled	0	1	0	1	1	1
7 Quick Stop Active	0	0	0	1	1	1
8 Fault Reaction Active	0	X	1	1	1	1
9 Fault	0	X	1	0	0	0

Bit 4

Bit 4=1 indicates whether the DC bus voltage is correct. If the voltage is insufficient, the device does not transition from operating state 3 to operating state 4.

Bit 7

Bit 7 is 1 if parameter _WarnActive contains an error message of error class 0. The movement is not interrupted. The bit remains set to 1 as long as the message is contained in parameter _WarnActive. The bit remains set to 1 for at least 100 ms, even if an error message of error class 0 is active for a shorter time. The bit is immediately reset to 0 in the case of a "Fault Reset".

Bit 8

Bit 8=1 indicates that a "Halt" is active.

Bit 9

If bit 9 is set to 1, the device carries out commands via the fieldbus. If Bit 9 is reset to 0, the device is controlled via a different access channel. In such a case, it is still possible to read or write parameters via the fieldbus.

Bit 10

Bit 10 is used for monitoring the operating mode. Details can be found in the chapters on the individual operating modes.

Bit 11

The meaning of bit 11 can be set via the parameter `DS402intLim`.

Bit 12

Bit 12 is used for monitoring the operating mode. Details can be found in the chapters on the individual operating modes.

Bit 13

Bit 13 is only set to 1 in the case of an error which needs to be corrected prior to further processing. The device responds corresponding to the error class.

Bit 14

Bit 14 changes to "0" if an operating mode is started. When processing is terminated or interrupted, for example by a "Halt", bit 14 toggles back to "1" once the motor has come to a standstill. The signal change of bit 14 to "1" is suppressed if one process is followed immediately by a new process in a different operating mode.

Bit 15

Bit 15 is set to 1 if the motor has a valid zero point, for example as a result of a reference movement. A valid zero point remains valid even if the power stage is disabled.

Changing the Operating State

Control Word

It is possible to switch between operating states via the parameter DCOMcontrol.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMcontrol	DriveCom control word See chapter Operation, Operating States, for bit assignment information. Bit 0: Operating state Switch On Bit 1: Enable Voltage Bit 2: Operating state Quick Stop Bit 3: Enable Operation Bits 4 … 6: Operating mode-specific Bit 7: Fault Reset Bit 8: Halt Bit 9: Operating mode-specific Bits 10 … 15: Reserved (must be 0) Changed settings become active immediately.	- - - -	UINT16 R/W - -	CANopen 6040:0_h Modbus 6914 Profibus 6914 CIP 127.1.1 ModbusTCP 6914 EtherCAT 6040:0_h PROFINET 6914

Bits 0, 1, 2, 3 and 7

Bits 0, 1, 2, 3 and 7 of the parameter DCOMcontrol allow you to switch between the operating states.

Fieldbus command	State transitions	State transition to	Bit 7 Fault Reset	Bit 3 Enable Operation	Bit 2 Quick Stop	Bit 1 Enable Voltage	Bit 0 Switch On
Shutdown	T2, T6, T8	**4** Ready To Switch On	0	X	1	1	0
Switch On	T3	**5** Switched On	0	0	1	1	1
Disable Voltage	T7, T9, T10, T12	**3** Switch On Disabled	0	X	X	0	X
Quick Stop	T7, T10 T11	**3** Switch On Disabled **7** Quick Stop Active	0	X	0	1	X
Disable Operation	T5	**5** Switched On	0	0	1	1	1
Enable Operation	T4, T16	**6** Operation Enabled	0	1	1	1	1
Fault Reset	T15	**3** Switch On Disabled	0->1	X	X	X	X

Bits 4 ... 6

Bits 4 to 6 are used for the operating mode-specific settings. Details can be found in the descriptions of the individual operating modes in this chapter.

Bit 8

Bit 8 is used to trigger a "Halt". Set bit 8 to 1 to stop a movement with "Halt".

Bit 9

Bit 9 is used for the operating mode-specific settings. Details can be found in the descriptions of the individual operating modes in this chapter.

Bits 10 ... 15

Reserved.

Section 4.2
Operating Modes

What Is in This Section?

This section contains the following topics:

Starting and Changing an Operating Mode

The parameter DCOMopmode is used to set the operating mode.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMopmode	Operating mode **-6 / Manual Tuning / Autotuning**: Manual Tuning or Autotuning **-3 / Motion Sequence**: Motion Sequence **-2 / Electronic Gear**: Electronic Gear **-1 / Jog**: Jog **0 / Reserved**: Reserved **1 / Profile Position**: Profile Position **3 / Profile Velocity**: Profile Velocity **4 / Profile Torque**: Profile Torque **6 / Homing**: Homing **7 / Interpolated Position**: Interpolated Position **8 / Cyclic Synchronous Position**: Cyclic Synchronous Position **9 / Cyclic Synchronous Velocity**: Cyclic Synchronous Velocity **10 / Cyclic Synchronous Torque**: Cyclic Synchronous Torque Changed settings become active immediately. * Datatype for CANopen: INT8	- -6 - 10	INT16* R/W - -	CANopen 6060:0$_h$ Modbus 6918 Profibus 6918 CIP 127.1.3 ModbusTCP 6918 EtherCAT 6060:0$_h$ PROFINET 6918

The parameter _DCOMopmode_act can be used to read the operating mode.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_DCOMopmd_act	Active operating mode **-6 / Manual Tuning / Autotuning**: Manual Tuning / Autotuning **-3 / Motion Sequence**: Motion Sequence **-2 / Electronic Gear**: Electronic Gear **-1 / Jog**: Jog **0 / Reserved**: Reserved **1 / Profile Position**: Profile Position **3 / Profile Velocity**: Profile Velocity **4 / Profile Torque**: Profile Torque **6 / Homing**: Homing **7 / Interpolated Position**: Interpolated Position **8 / Cyclic Synchronous Position**: Cyclic Synchronous Position **9 / Cyclic Synchronous Velocity**: Cyclic Synchronous Velocity **10 / Cyclic Synchronous Torque**: Cyclic Synchronous Torque * Datatype for CANopen: INT8	- -6 - 10	INT16* R/- - -	CANopen 6061:0$_h$ Modbus 6920 Profibus 6920 CIP 127.1.4 ModbusTCP 6920 EtherCAT 6061:0$_h$ PROFINET 6920

Operating Mode Cyclic Synchronous Torque

Overview

The drive synchronously follows the torque values transmitted on a cyclic basis. The transmitted values are linearly interpolated (internally).

The motion profile is generated by the master controller, in the case of TwinCAT via the NC axis with the blocks of the TcMc.lib library.

The possible applications for this operating mode are described in the manual of the master controller.

Starting the Operating Mode

The operating mode is set in the parameter `DCOMopmode`.

A transition to the operating state **6** Operation Enabled starts the set operating mode.

The parameter `PTtq_target` provides the target value.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PTtq_target`	Target torque for operating mode Profile Torque 100.0 % correspond to the continuous stall torque _M_M_0. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 0.0 3000.0	INT16 R/W - -	CANopen 6071:0_h Modbus 6944 Profibus 6944 CIP 127.1.16 ModbusTCP 6944 EtherCAT 6071:0_h PROFINET 6944

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	Reserved
Bit 12	0: Target torque ignored 1: Target torque shall be used as input to torque control loop

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

Terminating the Operating Mode

The operating mode is terminated when a different operating mode is selected or when the operating state **6** Operation Enabled is left.

Operating Mode Cyclic Synchronous Velocity

Overview

The drive synchronously follows the velocity values transmitted on a cyclic basis. The transmitted values are linearly interpolated (internally).

The motion profile is generated by the master controller, in the case of TwinCAT via the NC axis with the blocks of the TcMc.lib library.

The possible applications for this operating mode are described in the manual of the master controller.

Starting the Operating Mode

The operating mode is set in the parameter `DCOMopmode`.

A transition to the operating state **6** Operation Enabled starts the set operating mode.

The parameter `PVv_target` provides the target value.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`PVv_target`	Target velocity for operating mode Profile Velocity The target velocity is limited to the setting in CTRL_v_max and RAMP_v_max. Changed settings become active immediately.	usr_v - 0 -	INT32 R/W - -	CANopen 60FF:0_h Modbus 6938 Profibus 6938 CIP 127.1.13 ModbusTCP 6938 EtherCAT 60FF:0_h PROFINET 6938

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	**Meaning**
Bit 10	Reserved
Bit 12	0: Target velocity ignored 1: Target velocity shall be used as input to velocity control loop

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

Terminating the Operating Mode

The operating mode is terminated when a different operating mode is selected or when the operating state **6** Operation Enabled is left.

Operating Mode Cyclic Synchronous Position

Overview

The drive synchronously follows the position values transmitted on a cyclic basis. The transmitted values are linearly interpolated (internally).

The motion profile is generated by the master controller, in the case of TwinCAT via the NC axis with the blocks of the TcMc.lib library.

The possible applications for this operating mode are described in the manual of the master controller.

Starting the Operating Mode

The operating mode is set in the parameter `DCOMopmode`.

A transition to the operating state **6** Operation Enabled starts the set operating mode.

The parameter `PPp_target` provides the target value.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PPp_target`	Target position for operating mode Profile Position Minimum/maximum values depend on: - Scaling factor - Software limit switches (if they are activated) Changed settings become active immediately.	usr_p - - -	INT32 R/W - -	CANopen 607A:0_h Modbus 6940 Profibus 6940 CIP 127.1.14 ModbusTCP 6940 EtherCAT 607A:0_h PROFINET 6940

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	Reserved
Bit 12	0: Target position ignored 1: Target position shall be used as input to position control loop

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

Terminating the Operating Mode

The operating mode is terminated when a different operating mode is selected or when the operating state **6** Operation Enabled is left.

Operating Mode Jog

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The parameter `JOGactivate` starts the movement.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`JOGactivate`	Activation of operating mode Jog Bit 0: Positive direction of movement Bit 1: Negative direction of movement Bit 2: 0=slow 1=fast Changed settings become active immediately.	- 0 0 7	UINT16 R/W - -	CANopen 301B:9_h Modbus 6930 Profibus 6930 CIP 127.1.9 ModbusTCP 6930 EtherCAT 301B:9_h PROFINET 6930

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

The operating mode-specific bits 10 and 12 are reserved in this operating mode.

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 of the parameter `JOGactivate` is 0
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by a detected error

Operating Mode Electronic Gear

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The parameter `GEARreference` starts the movement.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`GEARreference`	Synchronization method for operating mode Electronic Gear **0 / Deactivated**: Deactivated **1 / Position Synchronization Immediate**: Position synchronization without compensation movement **2 / Position Synchronization Compensated**: Position synchronization with compensation movement **3 / Velocity Synchronization**: Velocity synchronization Changed settings become active immediately.	- 0 0 3	UINT16 R/W - -	CANopen 301B:12$_h$ Modbus 6948 Profibus 6948 CIP 127.1.18 ModbusTCP 6948 EtherCAT 301B:12$_h$ PROFINET 6948

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

The operating mode-specific bits 10 and 12 are reserved in this operating mode.

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 of the parameter `GEARreference` is 0
- Stop caused by "Halt" or "Quick Stop"
- Stop caused by a detected error

Operating Mode Profile Torque

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The parameter `PTtq_target` starts the movement if the reference value source (parameter `PTtq_reference`) is set to **Parameter PTtq_target**.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PTtq_target`	Target torque for operating mode Profile Torque 100.0 % correspond to the continuous stall torque _M_M_0. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 0.0 3000.0	INT16 R/W - -	CANopen 6071:0_h Modbus 6944 Profibus 6944 CIP 127.1.16 ModbusTCP 6944 EtherCAT 6071:0_h PROFINET 6944

See the product user guide of the drive if the reference value source is set to **Analog Input** or **PTI Interface**.

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	0: Target torque not reached 1: Target torque reached
Bit 12	Reserved

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 a detected error

Operating Mode Profile Velocity

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The parameter `PVv_target` starts the movement if the reference value source (parameter `PVv_reference`) is set to **Parameter PVv_target**.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PVv_target`	Target velocity for operating mode Profile Velocity The target velocity is limited to the setting in CTRL_v_max and RAMP_v_max. Changed settings become active immediately.	usr_v - 0 -	INT32 R/W - -	CANopen 60FF:0_h Modbus 6938 Profibus 6938 CIP 127.1.13 ModbusTCP 6938 EtherCAT 60FF:0_h PROFINET 6938

See the product user guide of the drive if the reference value source is set to **Analog Input**.

Control Word

The operating mode-specific bits 4, 5, 6 and 9 are reserved in this operating mode and must be set to 0.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	0: Target velocity not reached 1: Target velocity reached
Bit 12	0: Velocity = >0 1: Velocity = 0

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 a detected error

Operating Mode Profile Position

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The movement is started via the control word.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PPp_target`	Target position for operating mode Profile Position Minimum/maximum values depend on: - Scaling factor - Software limit switches (if they are activated) Changed settings become active immediately.	usr_p - - -	INT32 R/W - -	CANopen 607A:0_h Modbus 6940 Profibus 6940 CIP 127.1.14 ModbusTCP 6940 EtherCAT 607A:0_h PROFINET 6940
`PVv_target`	Target velocity for operating mode Profile Velocity The target velocity is limited to the setting in CTRL_v_max and RAMP_v_max. Changed settings become active immediately.	usr_v - 0 -	INT32 R/W - -	CANopen 60FF:0_h Modbus 6938 Profibus 6938 CIP 127.1.13 ModbusTCP 6938 EtherCAT 60FF:0_h PROFINET 6938

Control Word

Bit 9: Change on setpoint	Bit 5: Change setpoint immediately	Bit 4: New setpoint	Meaning
0	0	0->1	Starts a movement to a target position. Target values transmitted during a movement become immediately effective and are executed at the target. The movement is stopped at the target position.
1	0	0->1	Starts a movement to a target position. Target values transmitted during a movement become immediately effective and are executed at the target. The movement is not stopped at the target position.
x	1	0->1	Starts a movement to a target position. Target values transmitted during a movement become immediately effective and are immediately executed.

Parameter value	Meaning
Bit 6: Absolute / relative	0: Absolute movement 1: Relative movement

Target values include target position, target velocity, acceleration and deceleration.

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	0: Target position not reached 1: Target position reached
Bit 12	0: New position possible 1: New target position accepted

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 a detected error

Operating Mode Homing

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The movement is started via the control word.

The parameter `HMmethod` lets you set the method.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`HMmethod`	Homing method 1: LIMN with index pulse 2: LIMP with index pulse 7: REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33: Index pulse neg. direction 34: Index pulse pos. direction 35: Position setting Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in neg. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch Changed settings become active immediately. * Datatype for CANopen: INT8	- 1 18 35	INT16* R/W - -	CANopen 6098:0_h Modbus 6936 Profibus 6936 CIP 127.1.12 ModbusTCP 6936 EtherCAT 6098:0_h PROFINET 6936

Control Word

Parameter `DCOMcontrol`	Meaning
Bit 4	Start Homing
Bits 5, 6 and 9	Reserved (must be set to 0)

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	0: Homing not completed 1: Homing completed
Bit 12	1: Homing successfully completed

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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 a detected error

Operating Mode Motion Sequence

Starting the Operating Mode

The operating mode must be set in the parameter `DCOMopmode`. Writing the parameter value causes the operating mode to start.

The movement is started via the control word.

The parameter `MSM_start_ds` allows you to set the data set to be started.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MSM_start_ds`	Selection of a data set to be started for operating mode Motion Sequence Changed settings become active immediately.	- 0 0 127	UINT16 R/W - -	CANopen 301B:A_h Modbus 6932 Profibus 6932 CIP 127.1.10 ModbusTCP 6932 EtherCAT 301B:A_h PROFINET 6932

Control Word

Parameter `DCOMcontrol`	Meaning
Bit 4	0 -> 1: Start data set
Bit 5	0: Start individual data set 1: Start sequence
Bit 6	1: Use data set from parameter `MSM_start_ds` for starting a sequence
Bit 9	Reserved (must be set to 0)

For the common bits of the Control Word see chapter Changing the Operating State *(see page 35)*.

Status Word

Parameter `DCOMstatus`	Meaning
Bit 10	1: End of a sequence
Bit 12	Reserved

For the common bits of the Status Word see chapter Indication of the Operating State *(see page 33)*.

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
- 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 a detected error

Examples of a Movement via DS402 Objects

Operating Mode Jog

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	-1
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
301B:9$_h$	JOGactivate
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Set the velocity for slow movement (for example, 100 rpm)	3029:4$_h$	JOGv_slow	64$_h$
SDO: Set the velocity for fast movement (for example, 300 rpm)	3029:5$_h$	JOGv_fast	012C$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	FF$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	FF$_h$
RxPDO: Start movement (for example, slow movement in positive direction)	301B:9$_h$	JOGactivate	01$_h$
TxPDO: Get the state via status parameters	6041:0$_h$	_DCOMstatus (Status word)	0237$_h$
RxPDO: Terminate movement	301B:9$_h$	JOGactivate	00$_h$
TxPDO: Get the state via status parameters (wait for end of movement)	6041:0$_h$	_DCOMstatus (Status word)	4237$_h$

Operating Mode Electronic Gear

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	-2
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Set the numerator of the gear ratio (for example 1)	3026:4$_h$	GEARnum	01$_h$
SDO: Set the denominator of the gear ratio (for example 10)	3026:3$_h$	GEARdenom	0A$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	FE$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	FE$_h$
SDO: Start movement	301B:12$_h$	GEARreference	01$_h$
TxPDO: Get the state via status parameters	6041:0$_h$	_DCOMstatus (Status word)	0237$_h$
SDO: Terminate movement	301B:12$_h$	GEARreference	00$_h$

Operating Mode Profile Torque

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	4
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
6071:0$_h$	PTtq_target (Target torque)
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Slope setting of the motion profile for torque (example 10.0 %/s)	3029:4$_h$	RAMP_tq_slope (Torque slope)	64$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	04$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	04$_h$
RxPDO: Start movement by transmitting a target torque (example 1.0 %)	60FF:0$_h$	PTtq_target (Target torque)	0A$_h$
TxPDO: Verify whether target torque has been reached	6041:0$_h$	_DCOMstatus (Status word)	0637$_h$
RxPDO: Terminate movement (with Quick Stop)	6040:0$_h$	DCOMcontrol (Control word)	0B$_h$
RxPDO: Reset Quick Stop	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$

Operating Mode Profile Velocity

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	3
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
60FF:0$_h$	PVv_target (Target velocity)
6083:0$_h$	RAMP_v_acc (Profile acceleration)
6084:0$_h$	RAMP_v_dec (Profile deceleration)
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
RxPDO: Set acceleration (for example, 100 rpm/s)	6083:0$_h$	RAMP_v_acc (Profile acceleration)	64$_h$
RxPDO: Set deceleration (for example, 300 rpm/s)	6084:0$_h$	RAMP_v_dec (Profile deceleration)	012C$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	03$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	03$_h$
RxPDO: Start movement by setting a target velocity (for example, 600 rpm)	60FF:0$_h$	PVv_target (Target velocity)	0258$_h$
TxPDO: Verify whether target velocity has been reached	6041:0$_h$	_DCOMstatus (Status word)	0637$_h$
RxPDO: Terminate movement (with Quick Stop)	6040:0$_h$	DCOMcontrol (Control word)	0B$_h$
RxPDO: Reset Quick Stop	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$

Operating Mode Profile Position

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	1
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
607A:0$_h$	PPp_target (Target position)
6081:0$_h$	PPv_target (Profile velocity)
6083:0$_h$	RAMP_v_acc (Profile acceleration)
6084:0$_h$	RAMP_v_dec (Profile deceleration)
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
RxPDO: Set acceleration (for example, 100 rpm/s)	6083:0$_h$	RAMP_v_acc (Profile acceleration)	64$_h$
RxPDO: Set deceleration (for example, 300 rpm/s)	6084:0$_h$	RAMP_v_dec (Profile deceleration)	012C$_h$
RxPDO: Set target velocity (for example, 60 rpm)	6081:0$_h$	PPv_target (Profile velocity)	3C$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	01$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	01$_h$
RxPDO: Set target position (for example, 10000_usr)	607A:0$_h$	PPp_target (Target position)	2710$_h$
RxPDO: Start relative movement	6040:0$_h$	DCOMcontrol (Control word)	5F$_h$
TxPDO: Verify whether target position has been reached	6041:0$_h$	_DCOMstatus (Status word)	5637$_h$

Meaning	Index	Parameter name (DS402 name)	Value
RxPDO: Reset bit "New setpoint"	$6040:0_h$	`DCOMcontrol` (Control word)	$4F_h$
TxPDO: Verify whether new target position has been accepted	$6041:0_h$	`_DCOMstatus` (Status word)	4637_h

Operating Mode Homing

Adapting the list of the startup parameters

Index	Parameter name (DS402 name)	Value
3006:3D$_h$	CompParSyncMot	0
3006:38$_h$	MOD_Enable	0
3006:18$_h$	LIM_QStopReact	6
3006:6$_h$	IOsigRespOfPS	0
3006:7$_h$	ScalePOSdenom	16384
3006:8$_h$	ScalePOSnum	1
3012:6$_h$	CTRL1_KFPp	1000
3013:6$_h$	CTRL2_KFPp	1000
6060:0$_h$	DCOMopmode (Mode of operation)	6
1C33:3$_h$	ECATinpshifttime	250000

Adapting the mapping for RxPDO

Index	Parameter name (DS402 name)
6040:0$_h$	DCOMcontrol (Control word)
6060:0$_h$	DCOMopmode (Mode of operation)

Adapting the mapping for TxPDO

Index	Parameter name (DS402 name)
6041:0$_h$	_DCOMstatus (Status word)
6060:0$_h$	_DCOMopmd_act (Mode of operation display)

Example

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Set homing method (for example 17)	6098:0$_h$	HMmethod (Homing method)	11$_h$
SDO: Set target velocity for searching the switch (for example, 100 rpm)	6099:1$_h$	HMv (Homing speed during search for switch)	64$_h$
SDO: Target velocity for moving away from switch (for example 6 rpm)	6099:2$_h$	HMv_out (Speed during search for zero)	6$_h$
RxPDO: Enable power stage	6040:0$_h$	DCOMcontrol (Control word)	00$_h$
	6040:0$_h$	DCOMcontrol (Control word)	06$_h$
	6040:0$_h$	DCOMcontrol (Control word)	0F$_h$
TxPDO: Verify whether power stage has been enabled	6041:0$_h$	_DCOMstatus (Status word)	4637$_h$
RxPDO: Set the operating mode	6060:0$_h$	DCOMopmode (Mode of operation)	06$_h$
TxPDO: Verify whether operating mode has been set	6061:0$_h$	_DCOMopmd_act (Mode of operation display)	06$_h$
RxPDO: Start Homing	6040:0$_h$	DCOMcontrol (Control word)	1F$_h$
TxPDO: Verify whether Homing has been successful	6041:0$_h$	_DCOMstatus (Status word)	D637$_h$

Chapter 5
Diagnostics and Troubleshooting

What Is in This Chapter?

This chapter contains the following topics:

Fieldbus Communication Error Diagnostics

Checking Connections

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

If the product cannot be addressed via the fieldbus, first verify the connections.

Verify the following connections:

- System power supply
- Supply connections
- Fieldbus cables and wiring
- Fieldbus connection

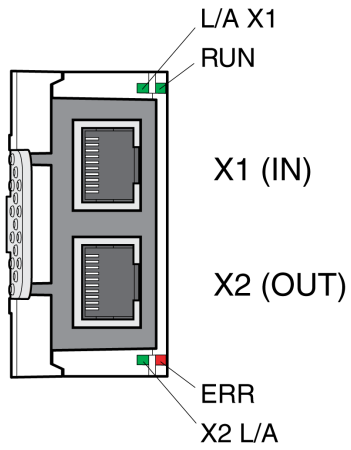
Fieldbus Function Test

If the connections are correct, verify that you can address the product on the fieldbus.

Fieldbus Status LEDs

Overview

The fieldbus status LEDs visualize the status of the fieldbus.



LED **L/A X1** and **X2 L/A**

Status	Meaning
Off	No link
On	Link, no activity
Fast flashing	Link, activity

LED **RUN**

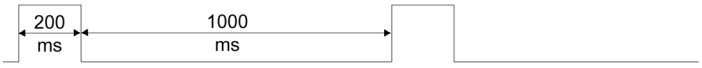
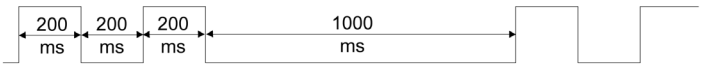
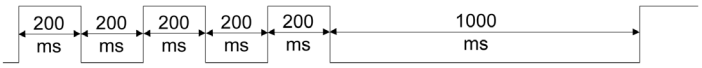
Status	Meaning
Off	EtherCAT state INIT
Flashing	EtherCAT state PRE-OPERATIONAL
Single flash	EtherCAT state SAFE-OPERATIONAL
On	EtherCAT state OPERATIONAL

LED **ERR**

Status	Meaning
Double flash	Watchdog timeout
Single flash	Local error (such as synchronization error)
Flashing	Invalid configuration
Off	No error

Meaning of the Status Signals

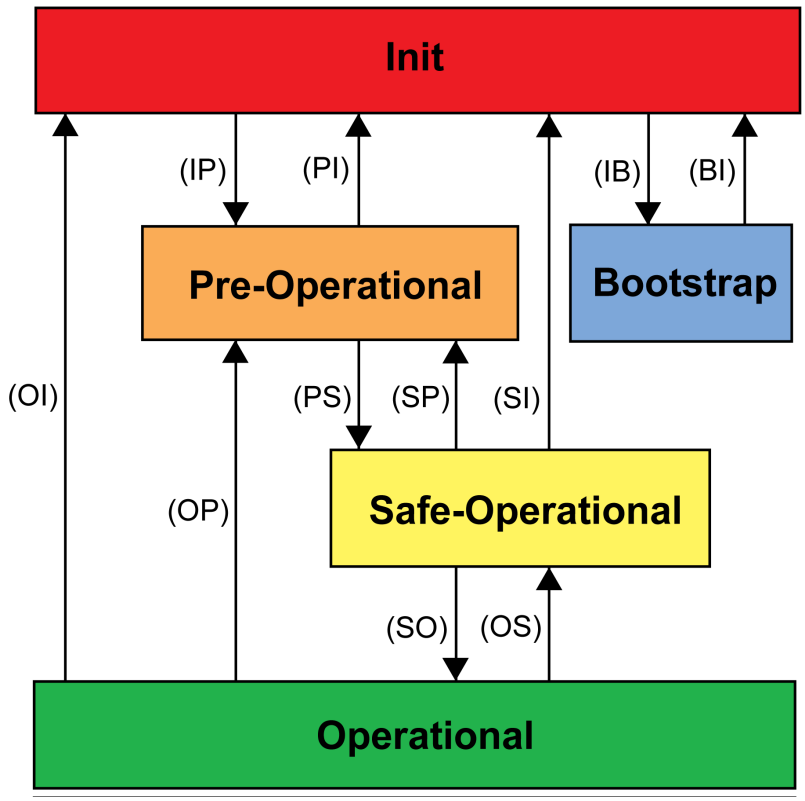
The table below summarizes the meaning of the flashing signals of the EtherCAT LEDs.

Status	Meaning
Fast flashing	
Flashing	
Single flash	
Double flash	
Triple flash	

EtherCAT State Machine

Overview

According to IEC 61800-7-304, the following EtherCAT operating states have been defined for an EtherCAT network:



States

The operating state **Init** defines the foundation of the communication relationship between the master and the slaves at the application layer. Direct communication between the master and the slave is impossible at the application layer. The master uses the Init state to initialize a set of configuration registers of the EtherCAT slave controllers. If the slaves support mailbox services, the Sync Manager is also configured in this state.

In the operating state **Pre-Operational**, the mailbox is active. Both master and slave use the mailbox and the corresponding protocol to interchange application-specific initialization data and parameters. In this operating state, process data communication is not possible.

If the drive does not receive a valid mapping for the process data from the EtherCAT master, it remains in this operating state.

In the operating state **Safe-Operational**, the slave application provides input data such as limit switch data. Output data of the master are ignored in this operating state. This operating state is not a safety-related function.

In the operating state **Operational**, the slave applications deliver input data and the drive processes the output data from the master, such as target positions.

State Transitions

The following state transitions are defined:

State transition	Local management service
IP	Start Mailbox Communication
PI	Stop Mailbox Communication
PS	Start Input Update
SP	Stop Input Update
SO	Start Output Update
OS	Stop Output Update
OP	Stop Output Update and Stop Input Update
SI	Stop Input Update, Stop Mailbox Communication
OI	Stop Input Update, Stop Input Update, Stop Mailbox Communication
IB	Start Bootstrap Mode
BI	Restart Device

Glossary

C

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.

D

DOM

Date **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. For example:

31.12.11 corresponds to December 31, 2011

31.12.2011 corresponds to December 31, 2011

E

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.

F

Factory setting

Settings when the product is shipped.

Fault

Fault is an operating state. If the monitoring functions detect an error, a transition to this operating state is triggered, depending on the error class. A "Fault Reset" or a power cycle are required to exit this operating state. Prior to this, the cause of the detected error must be removed. Further information can be found in the pertinent standards such as IEC 61800-7, ODVA Common Industrial Protocol (CIP).

Fault reset

Function used to exit the operating state Fault. Before the function is used, the cause of the detected error must be removed.

M

Master

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

P

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 power to the drive has been removed.

Q

Quick Stop

The function can be used for fast deceleration of a movement as a response to a detected error or via a command.

U

User-defined unit

Unit whose reference to motor movement can be determined by the user via parameters.

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