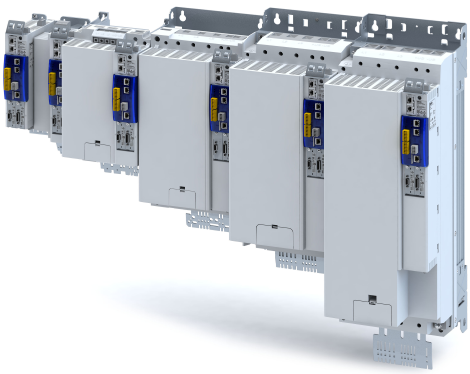
Commissioning EN



Inverters

i950 servo inverters

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1 About this document

⚠WARNING!

Read this documentation carefully before starting any work.

► Please observe the safety instructions!

The information in this document represents the following version:

Product	Hardware data version	Date
i950	V0009	2018-10-04

Firmware version	Software data version	Date
V_1_1_3	V_1_1_3_007	2018-09-24

1.1 Document description

1.1.1 Further documents

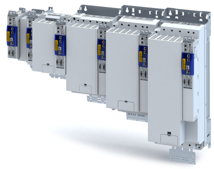
For certain tasks, information is available in further documents.

Document	Contents/topics
Configuration document	Basic information on project planning and ordering the product
Commissioning document	Fundamental information for the installation and commissioning of the product

For certain tasks, information is available in other forms.

Form	Contents/topics
Engineering Tools	For commissioning
AKB articles	Application Knowledge Base with additional technical information for users
CAD data	Exports in different formats
EPLAN macros	Project planning, documentation and management of projects for P8. • Data reference via Lenze or EPLAN data portal

Information and tools with regard to the Lenze products can be found on the Internet:
http://www.lenze.com → Download



1.2 Notations and conventions

This document uses the following conventions to distinguish different types of information:

Numeric notation			
	Decimal separator	Point	The decimal point is always used. Example: 1 234.56
Warning			
	UL warning	UL	Are used in English and French.
	UR warning	UR	
Text			
	Engineering tools	» «	Software Example: »Engineer«, »EASY Starter«
Icons			
	Page reference	🕮	Reference to another page with additional information Example: 🕮 16 = see page 16
	Documentation reference	⊛	Reference to another documentation with additional information Example: ⊛ EDKxxx = see documentation EDKxxx

Layout of the safety instructions

⚠ DANGER!

Indicates an extremely hazardous situation. Failure to comply with this instruction will result in severe irreparable injury and even death.

⚠ WARNING!

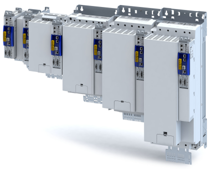
Indicates an extremely hazardous situation. Failure to comply with this instruction may result in severe irreparable injury and even death.

⚠ CAUTION!

Indicates a hazardous situation. Failure to comply with this instruction may result in slight to medium injury.

NOTICE

Indicates a material hazard. Failure to comply with this instruction may result in material damage.



2 Safety instructions

Disregarding the following basic safety measures and safety information may lead to severe personal injury and damage to property!

Observe all specifications of the corresponding documentation supplied. This is the precondition for safe and trouble-free operation and for obtaining the product features specified.

Please observe the specific safety information in the other sections!

2.1 Basic safety instructions

Personnel

The product must only be used by qualified personnel. IEC 60364 or CENELEC HD 384 define the skills of these persons:

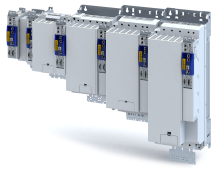
- They are familiar with installing, mounting, commissioning, and operating the product.
- They have the corresponding qualifications for their work.
- They know and can apply all regulations for the prevention of accidents, directives, and laws applicable at the place of use.

Process engineering

The procedural notes and circuit details described are only proposals. It is up to the user to check whether they can be adapted to the particular applications. Lenze does not take any responsibility for the suitability of the procedures and circuit proposals described.

2.2 Application as directed

- The product must only be operated under the operating conditions prescribed in this documentation.
- The product meets the protection requirements of 2014/35/EU: Low-Voltage Directive.
- Commissioning or starting the operation as directed of a machine with the product is not permitted until it has been ensured that the machine meets the regulations of the EC Directive 2006/42/EU: Machinery Directive; observe EN 60204−1.
- Commissioning or starting operation as directed is only permissible if the EMC Directive 2014/30/EU is complied with.
- The harmonised standards EN 61800−5−1 and EN 61800−3 are applied to the inverters.
- The product is not a household appliance, but is only designed as a component for commercial or professional use in terms of EN 61000−3−2.
- Drive systems comply with categories according to EN 61800−3, if the product is used in accordance with the technical data.
- In residential areas, the product may cause EMC interferences. The operator is responsible for taking interference suppression measures.
- The product must only be actuated with motors that are suitable for the operation with inverters.
  - Lenze L-force motors meet the requirements
  - Exception: m240 motors are designed for mains operation only.



2.3 Residual hazards

Product

Observe the warning labels on the product!

Icon	Description
	**Electrostatic sensitive devices:** Before working on the product, the staff must ensure to be free of electrostatic charge!
	**Dangerous electrical voltage** Before working on the product, check if no voltage is applied to the power terminals! After mains disconnection, the power terminals carry the hazardous electrical voltage for the time given next to the symbol!
	**High leakage current:** Carry out fixed installation and PE connection in compliance with EN 61800−5−1 or EN 60204−1!
	**Hot surface:** Use personal protective equipment or wait until the device has cooled down!

Motor protection

With some settings of the inverter, the connected motor can be overheated.

- E. g. by longer operation of self-ventilated motors at low speed.
- E. g. by longer operation of the DC-injection brake.

Protection of the machine/system

Drives can reach dangerous overspeeds.

- E. g. by setting high output frequencies in connection with motors and machines not suitable for this purpose.
- The inverters do not provide protection against such operating conditions. For this purpose, use additional components.

Switch contactors in the motor cable only if the controller is inhibited.

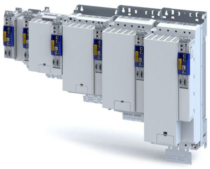
- Switching while the inverter is enabled is only permissible if no monitoring functions are activated.

Motor

If there is a short circuit of two power transistors, a residual movement of up to 180°/number of pole pairs can occur at the motor! (e. g. 4-pole motor: residual movement max. 180°/2 = 90°).

Degree of protection - protection of persons and device protection

- Information applies to the mounted and ready-for-use state.
- Information does not apply to the wire range of the terminals.
  - Terminals that are not assigned only have a low protection against contact.
  - Terminals for large cable cross-sections have lower classes of protection, e. g. from 15 kW IP10 only.



3 Product information

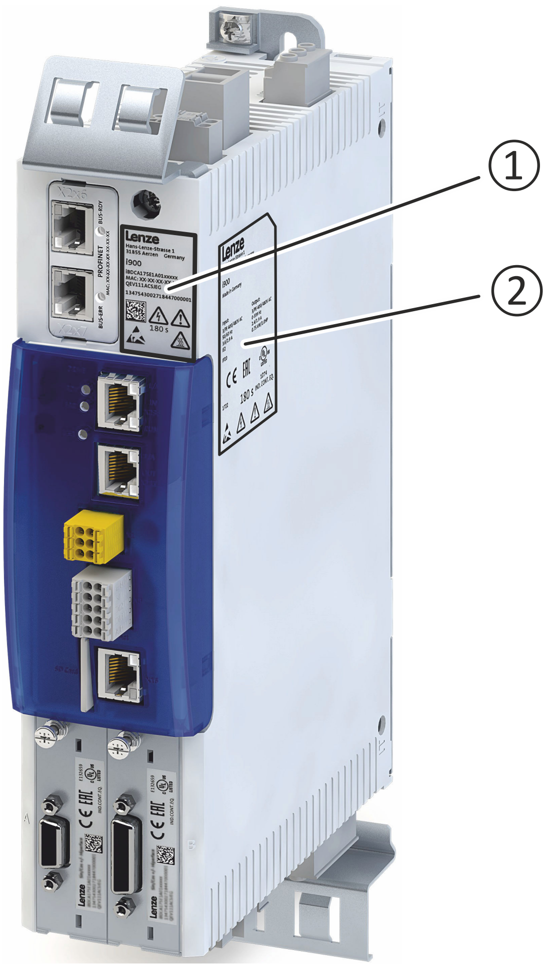
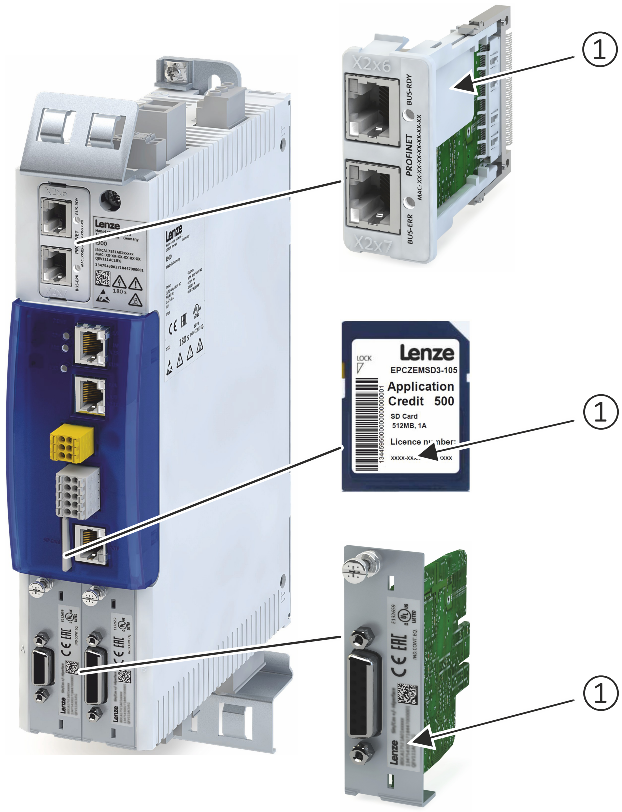
3.1 Identification of the products

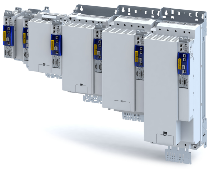
3.1.1 Product codes

		I	9	5	A	E	□□□	F	1	□	□	□	0	□□□□
Product type	Inverter	I												
Product family	i900		9											
Product	i950			5										
Product generation	Generation 1				A									
Mounting type	Control cabinet mounting					E								
Rated power [W]	0.55 kW						155							
	0.75 kW						175							
	2.2 KW						222							
	4.0 kW						240							
	7,5 kW						275							
	11 kW						311							
	15 kW						315							
	22 kW						322							
	30 kW						330							
	45 kW						345							
	55 kW						355							
	75 kW						375							
	90 kW						390							
	110 kW						411							
Mains voltage and connection type	3/PE AC 400 V 3/PE 480 V AC							F						
Motor connections	Single axis								1					
Integrated functional safety	Basic Safety STO									A				
	Extended Safety									C				
Enclosure	IP20										0			
	IP20, coated										V			
Interference suppression	Without											0		
	Integrated RFI filter											1		
Design types	Control code												0	□□□□

3.1.2 Nameplates

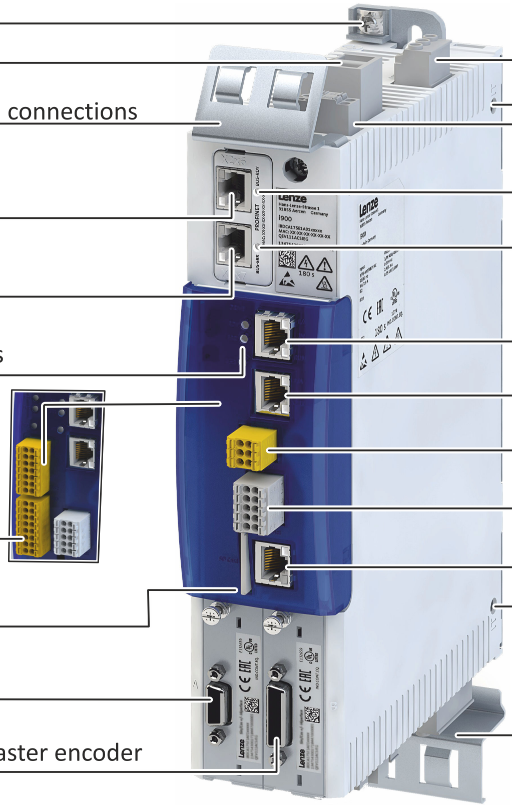
Position and meaning of the nameplates

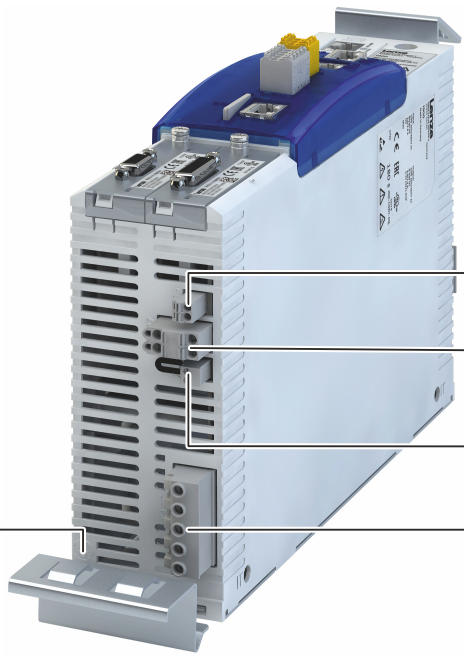
<table>
<tr><th colspan="2">Complete inverter</th><th colspan="2">Component (options)</th></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td>①</td><td>Nameplate at front top: Technical data, type and serial number of the inverter</td><td>①</td><td>Type and serial number of the component</td></tr>
<tr><td>②</td><td>Nameplate at the side: Technical data of the inverter</td><td>-</td><td>-</td></tr>
</table>

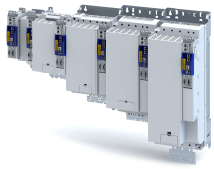


3.2 Features

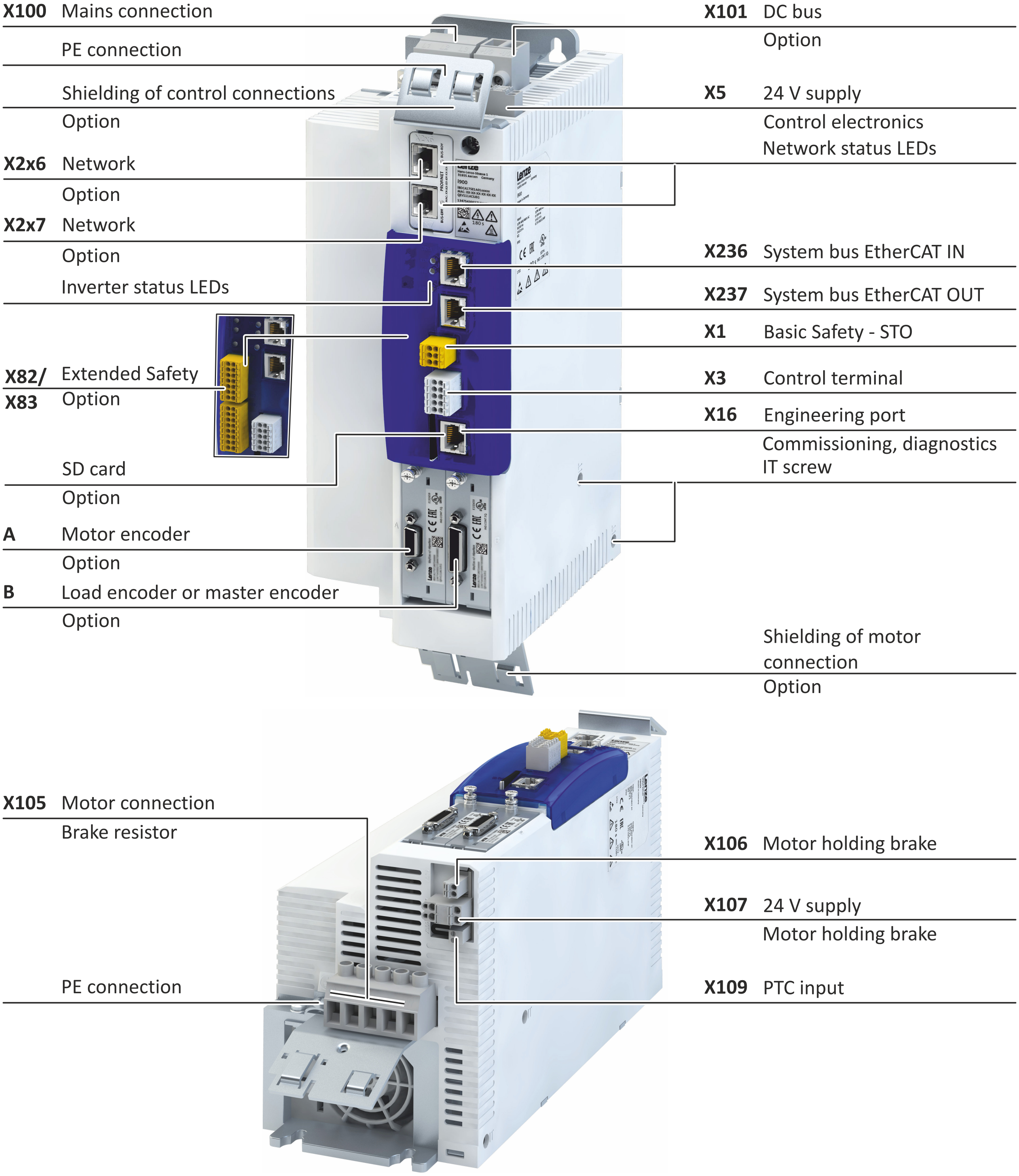
Power range 0.55 kW ... 4 kW

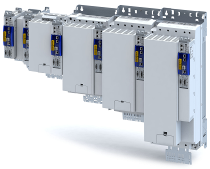




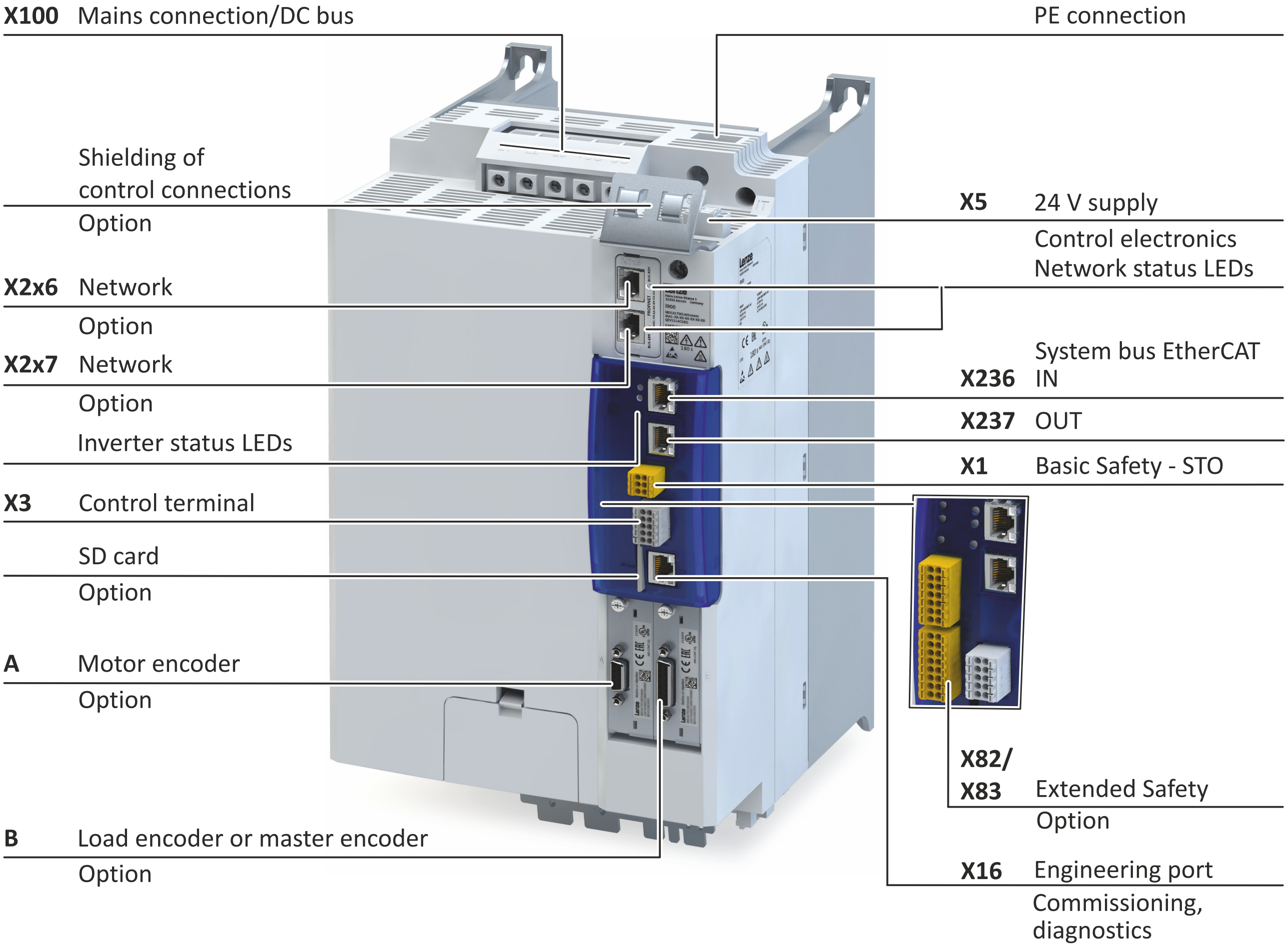


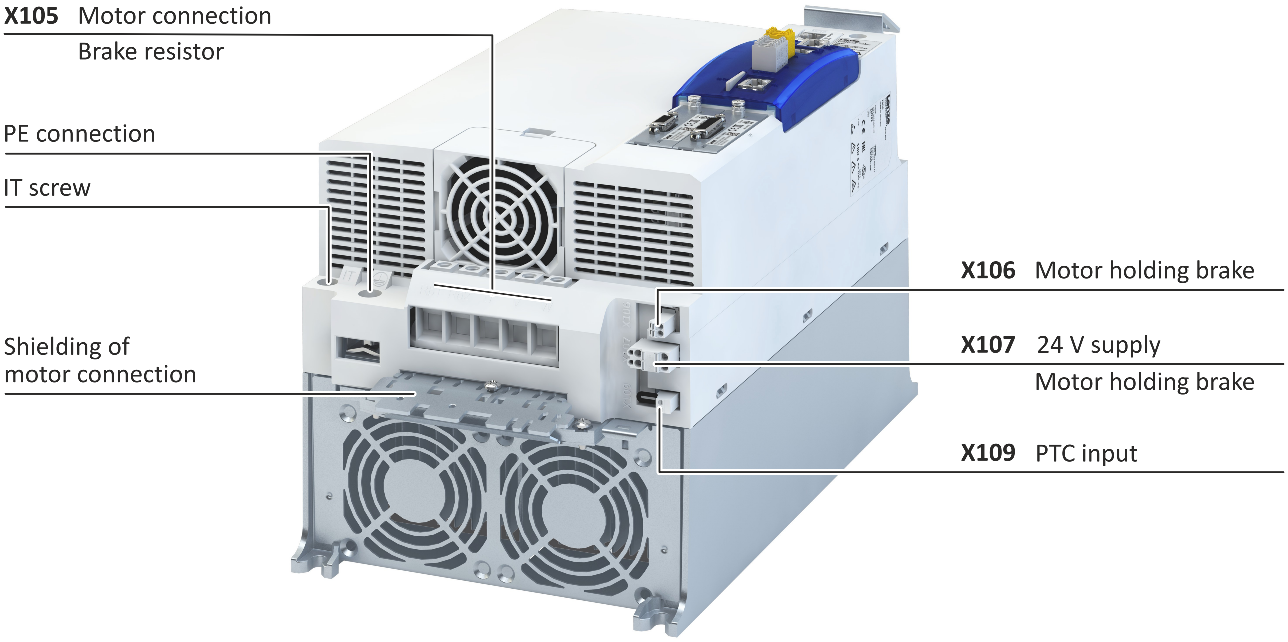
Power range 7.5 kW ... 15 kW

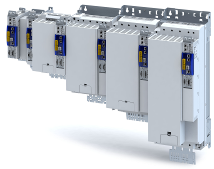




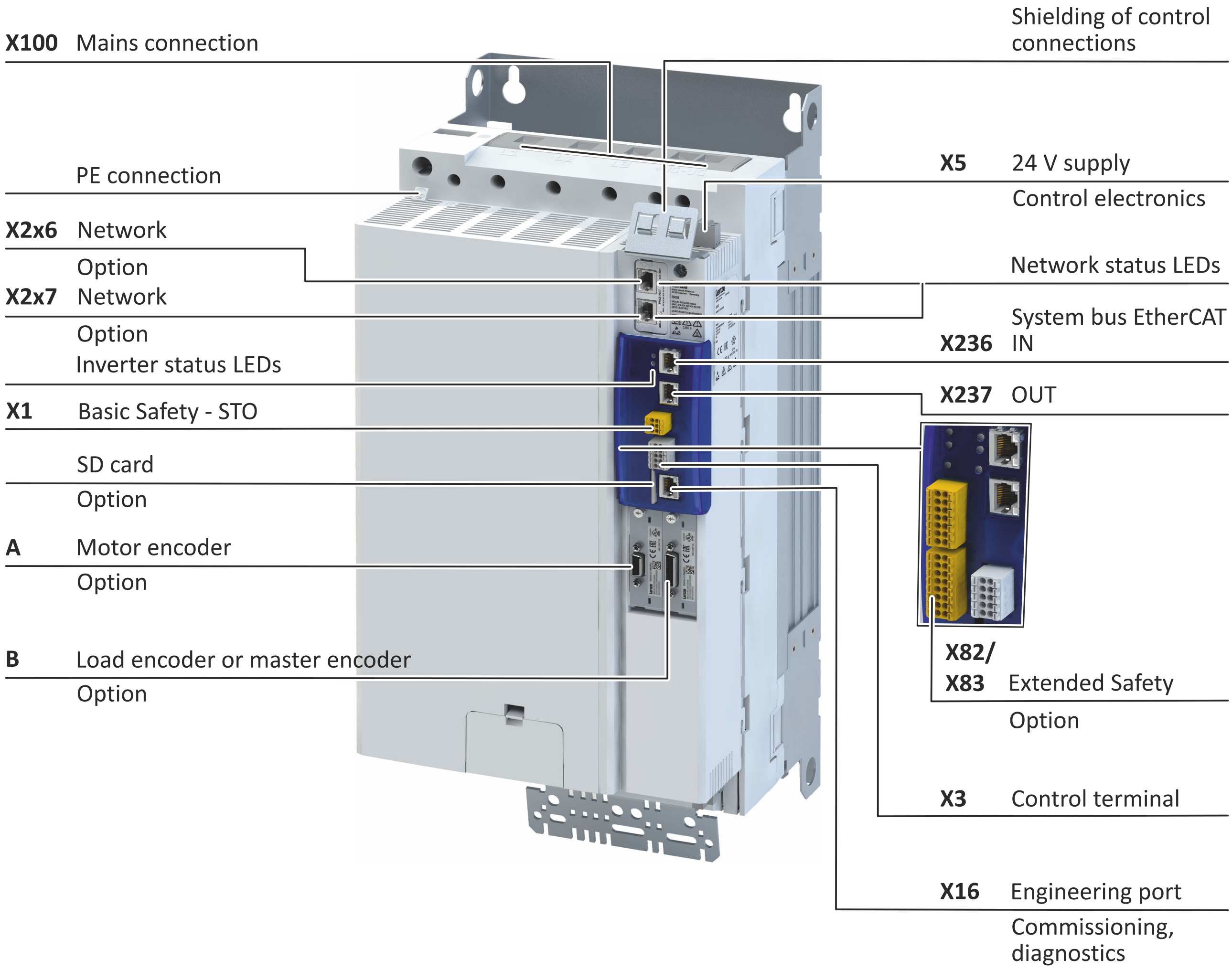
Power range22 kW

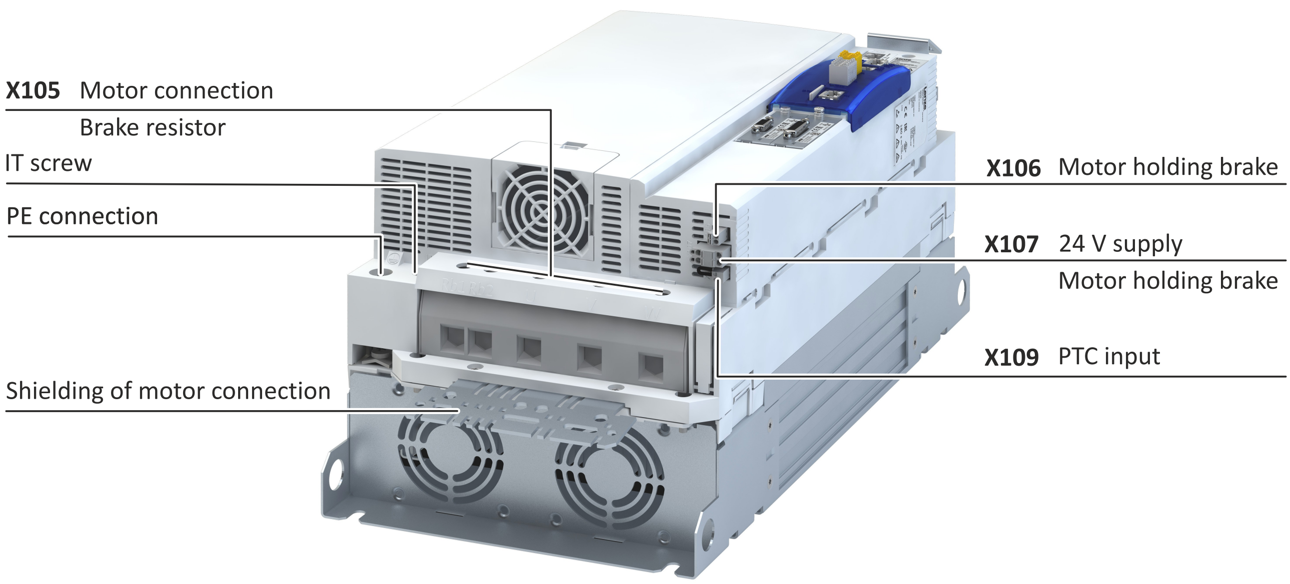




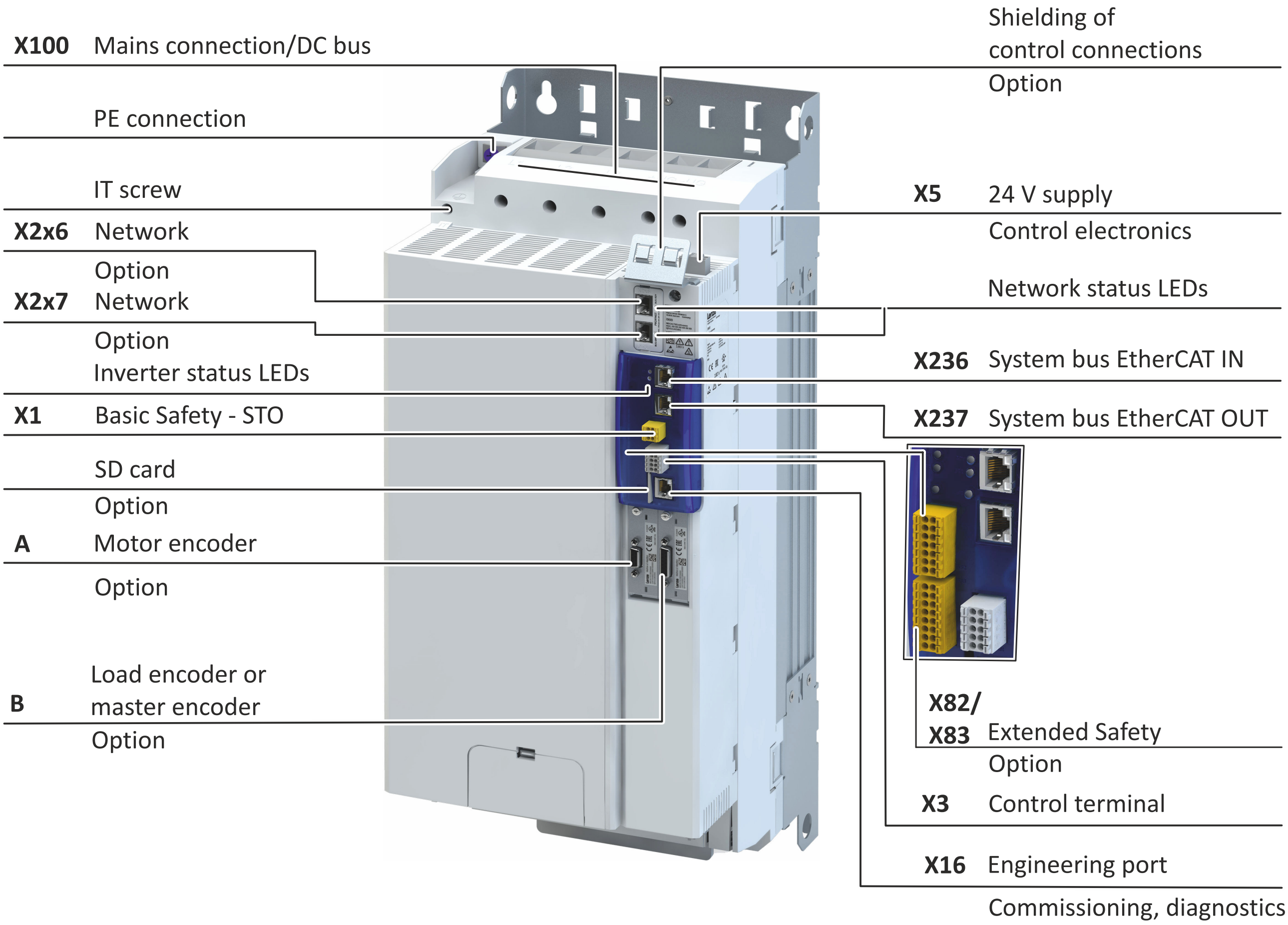


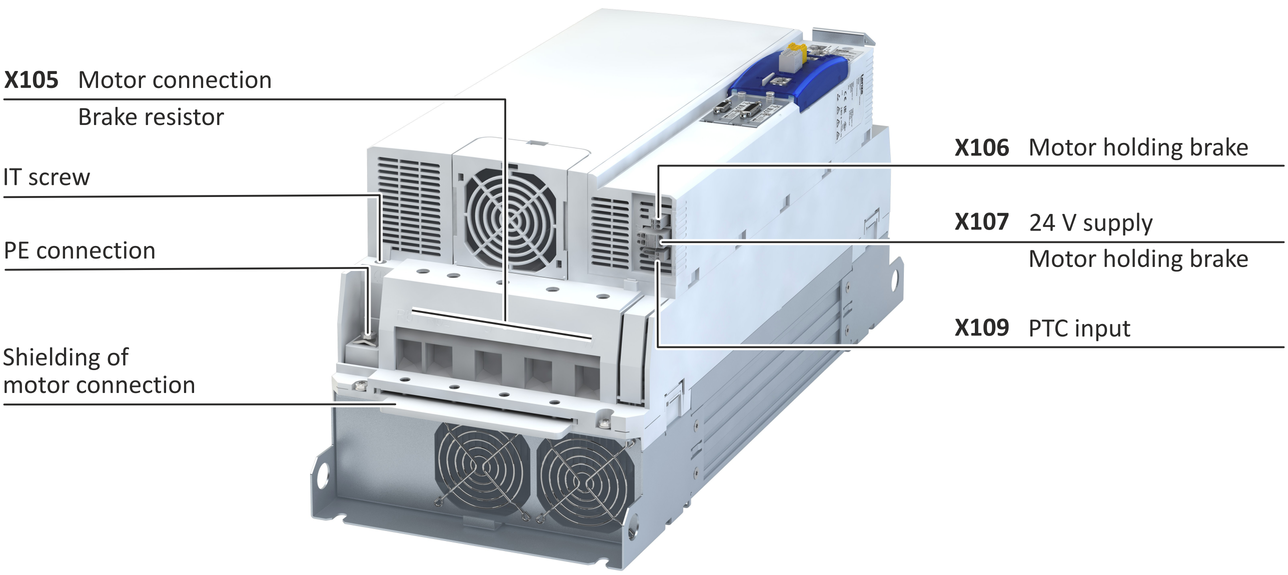
Power range 30 kW ... 45 kW

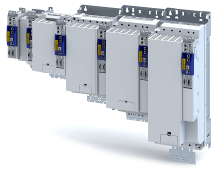




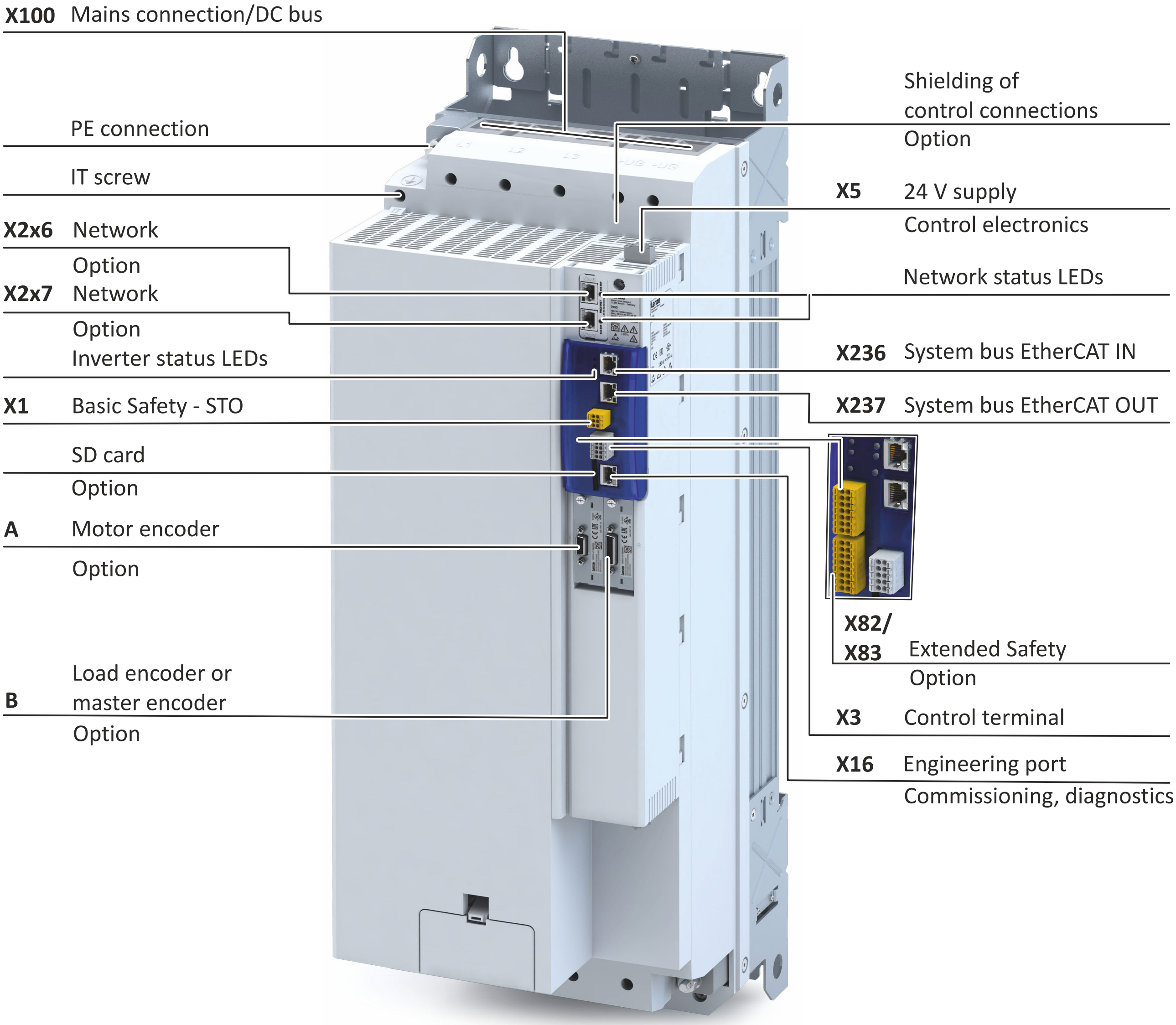
Power range 55 kW ... 75 kW

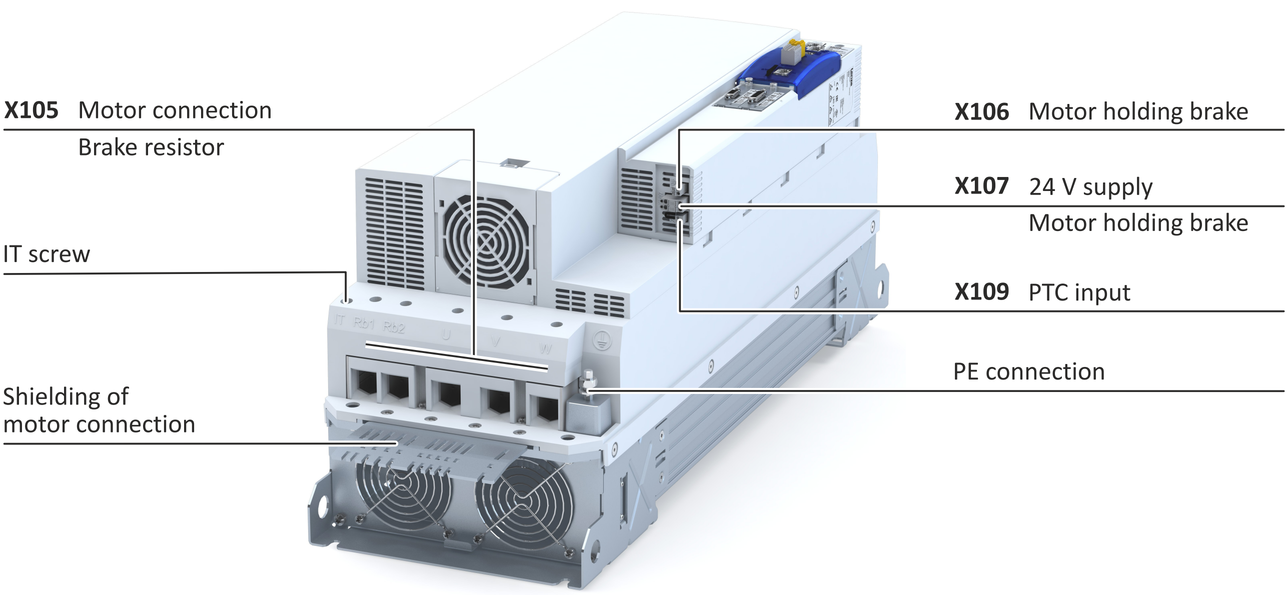


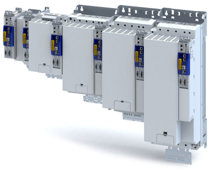




Power range 90 kW ... 110 kW







4 Commissioning

The purpose of commissioning is to adapt the inverter as part of a machine with a variable-speed drive system to its drive task.

4.1 Important notes

⚠ DANGER!

Incorrect wiring can cause unexpected states during the commissioning phase.

Possible consequences: death, severe injuries or damage to property

Ensure the following before switching on the mains voltage:

► Wiring must be complete and correct.

► Wiring must be free of short circuits and earth faults.

► The motor circuit configuration (star/delta) must be adapted to the inverter output voltage.

► The motor must be connected in-phase (direction of rotation).

► The "emergency off" function of the overall system must operate correctly.

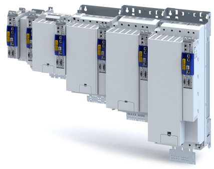
⚠ DANGER!

Incorrect settings during commissioning may cause unexpected and dangerous motor and system movements.

Possible consequences: death, severe injuries or damage to property

► Clear hazardous area.

► Observe safety instructions and safety clearances.



4.2 Operating interfaces

Depending on the inverter, there are one or several options for accessing the device parameters that are available for customising the drive task.

Simple access to the device parameters is provided by the Lenze Engineering Tool »EASY Starter«. Connection **X16** is used as an interface for an engineering PC in this case.

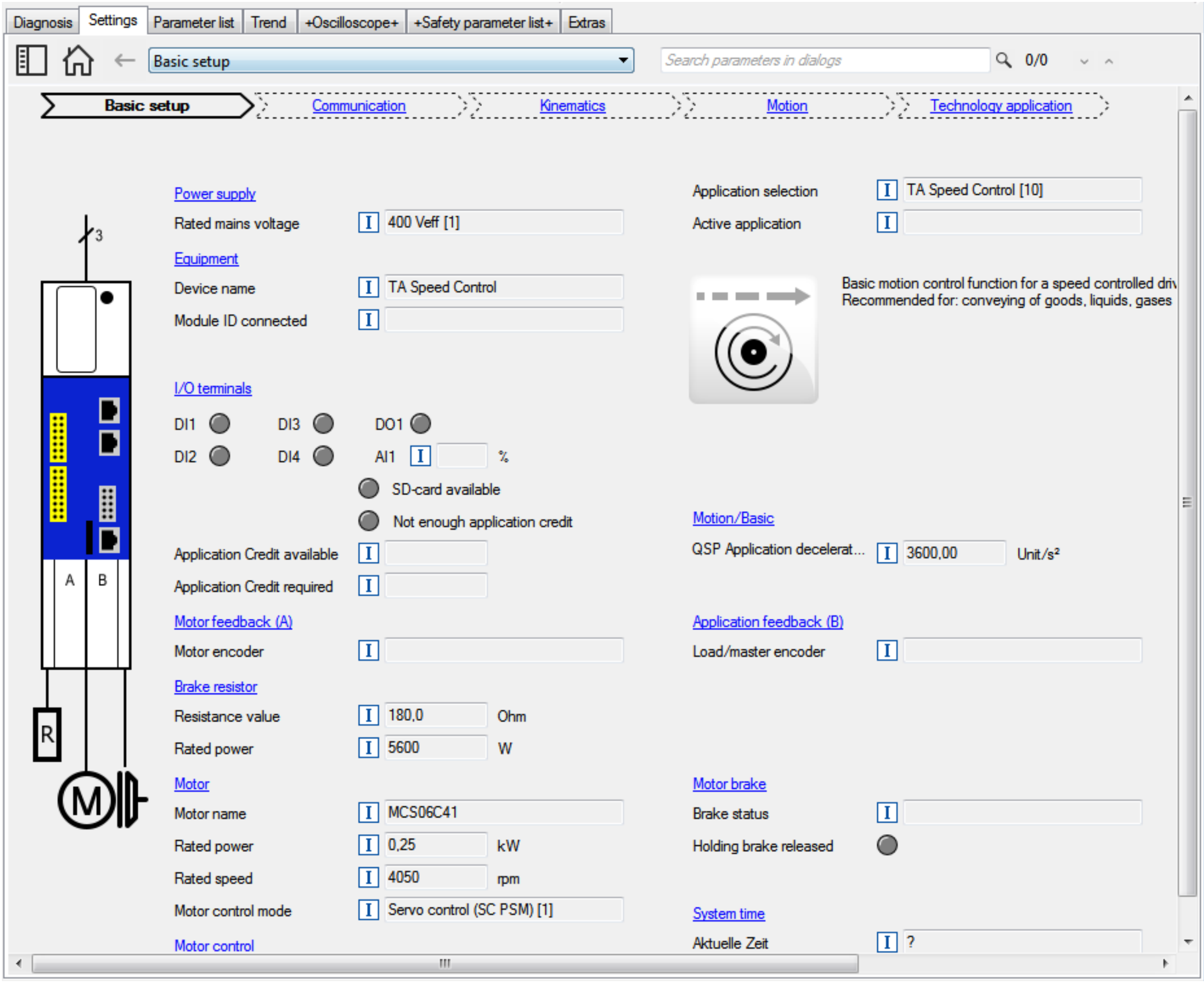
If the inverter is equipped with the "PROFINET" network option, the terminals **X2x6** or **X2x7** can also be used.

4.2.1 Engineering tool »EASY Starter«

The »EASY Starter« is a PC software that is especially designed for the commissioning and diagnostics of the inverter.

- »EASY Starter« Download

Sample screenshot:



The upper part of the **Settings** tab displays the sequence of five essential commissioning steps. By clicking a link, the corresponding interface appears with the most important parameters to be set.

Commissioning step	Description of the settings
Basic setting	Settings to adapt the inverter to a simple application based on the default setting.
Communication	Settings for communication via the system bus (EtherCAT), another fieldbus and the engineering port X16 (PC interface).
Kinematics	Basic settings of the technology application serve to adapt the motor and load side (gearbox ratio, mounting direction, moment of inertia etc.)
Motion	Basic settings of the technology application for adapting the motion control.
Technology application	Settings to adapt the technology application to the application.

Parameter fields

- The parameters are sorted by topic.
- The parameter values currently set are displayed.
- Fields highlighted in yellow indicate the online connection to the device.
- Pressing the key [F1] opens the program help.

4.2.1.1 Generate a connection between inverter and »EASY Starter«

For commissioning the inverter with the »EASY Starter«, a communication link with the inverter is required. This can be established in a wired manner only.

Additional information on network configuration: ▸ Configure engineering port 🕮 278

Further information on how to create a communication link via "PROFINET": ▸ PROFINET 🕮 320

How to establish a communication to the inverter via the engineering port X16:

Preconditions
- The functional test described in the mounting and switch-on instructions has been completed successfully (without any errors or faults).
- The inverter is ready for operation (mains voltage is switched on).

Required accessories
- Engineering PC with installed »EASY Starter«
- Standard network cable

1. Plug the network cable into the engineering port **X16** of the inverter.
2. Use the network cable to connect the inverter to the PC on which the »EASY Starter« is installed.
3. Start the »EASY Starter«.
   The "Add devices" dialog is shown.
4. Select the "Ethernet" connection.
5. Click the **Insert** button.

The »EASY Starter« searched for connected devices via the communication path selected. When the connection has been established successfully, the inverter is displayed in the device list. The inverter parameters can now be accessed via the tabs of the »EASY Starter«.

4.3 General information on parameter setting

Being part of a machine with a variable-speed drive system, the inverter must be adapted to its drive task. The inverter is adapted by changing parameters These parameters can be accessed by the »EASY Starter«.

Certain device commands or settings which might cause a critical state of the drive behaviour can only be carried our when the inverter is inhibited.

4.3.1 Addressing of the parameters

Each parameter features a 16-bit index as address. Under this address, the parameter is stored in the object directory of the inverter.

- Parameters that belong together functionally are combined in a data set. These parameters are additionally provided with an 8-bit subindex.
- The colon is used as a separator between the index and subindex Example: "0x2540:001"
- There are parameters the setting of which can be changed, and (diagnostic) parameters which can only be read.

4.3.2 Structure of the parameter descriptions

- The parameter descriptions in this documentation are structured in table form.
- The representation distinguishes parameters with a setting range, text, selection list, and bit-coded display.
- The default setting of parameters with a write access feature is shown in **bold**.

Example: parameters with a setting range

Address	Name / setting range / [default setting]	Info
Index:Subindex	Parameter designation Minimum value ... [**default setting**] ... maximum value • Optional information with regard to the parameter.	Explanations & notes with regard to the parameter.

Example: parameters with a selection list

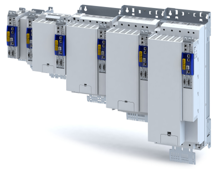
Address	Name / setting range / [default setting]		Info
Index:Subindex	Parameter designation • Optional information with regard to the parameter.		Explanations & notes with regard to the parameter. **Note:** The corresponding selection number (here 0, 1, or 2) must be set. Other values are not permissible.
	0	**Designation of selection 0**	Optionally: Explanations & notes with regard to the corresponding selection. The default selection is shown in **bold**.
	1	Designation of selection 1	
	2	Designation of selection 2	

Example with bit coded display

Address	Name / setting range / [default setting]		Info
Index:Subindex	Parameter designation • Optional information with regard to the parameter.		Explanations & notes with regard to the parameter.
	Bit 0	Designation of bit 0	Optionally: Explanations & notes with regard to the corresponding bit.
	Bit 1	Designation of bit 1	
	Bit 2	Designation of bit 2	
	...	...	
	Bit 15	Designation of bit 15	

4.3.3 Parameter overview lists

Parameter attribute list: contains a list of all inverter parameters. This list in particular includes some information that is relevant for the reading and writing of parameters via the network. 📖 428



4.3.4 Favourites

In order to gain quick access using the »EASY Starter«, frequently used parameters of the inverter can be defined as "Favorites".

- »EASY Starter« provides quick access to the "Favorites" via the *Favorites* tab.

4.3.4.1 Configuring the "Favourites"

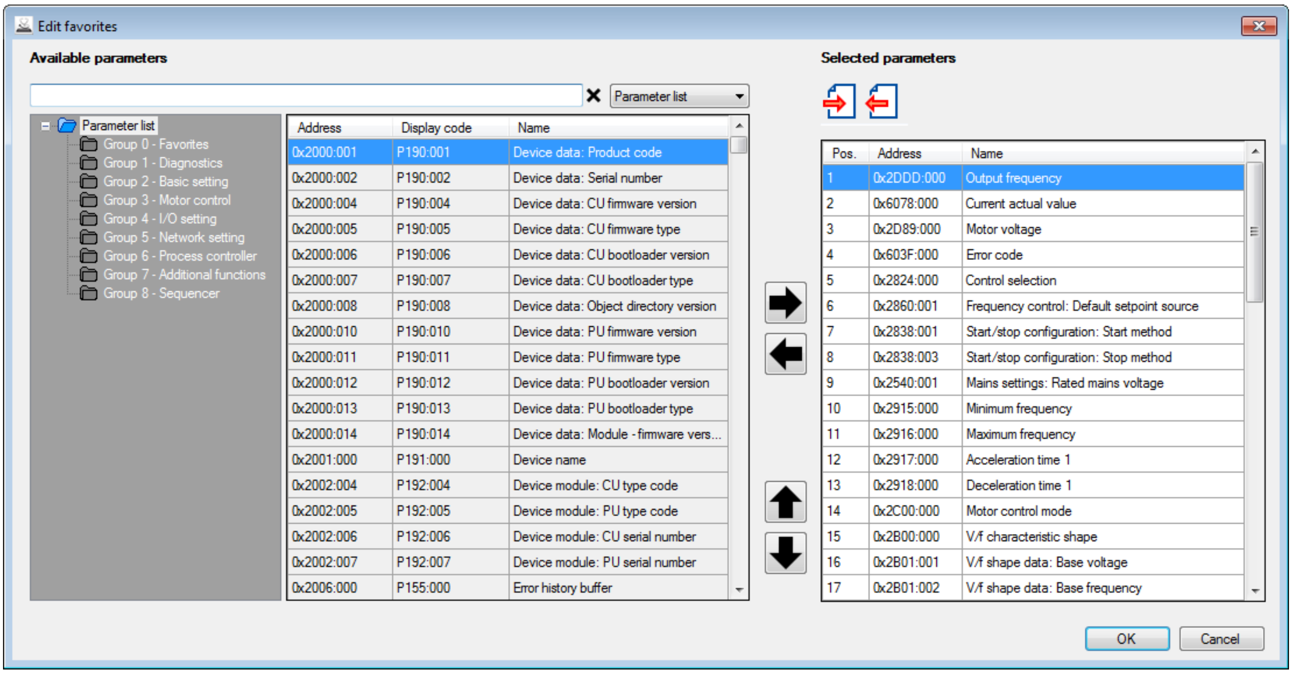
The "Favorites" can be configured by the user.

Details

A maximum number of 50 parameters can be defined as "Favorites".

The easiest way to process the selection of the favorites is via the parameterisation dialog in the »EASY Starter«:

1. Change to the "Parameter list" tab.
2. Select group 0 - Favorites.
3. Click the button.
4. Process favorites:



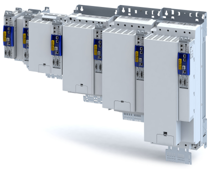
Default favorites can be changed via network using the following parameters:

Parameter

Address	Name / setting range / [default setting]	Info
0x261C:001	Favorites settings: Parameter 1 0 ... [] ... 4294967295	Definition of the "Favorites" parameters. • Format: 0xiiiiss00 (iiii = hexadecimal index, ss = hexadecimal subindex) • The lowest byte is always 0x00. • The keypad can be used to select the desired parameter from a list.
0x261C:002	Favorites settings: Parameter 2 0 ... [] ... 4294967295	
0x261C:003	Favorites settings: Parameter 3 0 ... [] ... 4294967295	
0x261C:004	Favorites settings: Parameter 4 0 ... [] ... 4294967295	
0x261C:005	Favorites settings: Parameter 5 0 ... [] ... 4294967295	
0x261C:006	Favorites settings: Parameter 6 0 ... [] ... 4294967295	
0x261C:007	Favorites settings: Parameter 7 0 ... [] ... 4294967295	
0x261C:008	Favorites settings: Parameter 8 0 ... [] ... 4294967295	
0x261C:009	Favorites settings: Parameter 9 0 ... [] ... 4294967295	

Address	Name / setting range / [default setting]	Info
0x261C:010	Favorites settings: Parameter 10 0 ... [] ... 4294967295	
0x261C:011	Favorites settings: Parameter 11 0 ... [] ... 4294967295	
0x261C:012	Favorites settings: Parameter 12 0 ... [] ... 4294967295	
0x261C:013	Favorites settings: Parameter 13 0 ... [] ... 4294967295	
0x261C:014	Favorites settings: Parameter 14 0 ... [] ... 4294967295	
0x261C:015	Favorites settings: Parameter 15 0 ... [] ... 4294967295	
0x261C:016	Favorites settings: Parameter 16 0 ... [] ... 4294967295	
0x261C:017	Favorites settings: Parameter 17 0 ... [] ... 4294967295	
0x261C:018	Favorites settings: Parameter 18 0 ... [] ... 4294967295	
0x261C:019	Favorites settings: Parameter 19 0 ... [] ... 4294967295	
0x261C:020	Favorites settings: Parameter 20 0 ... [] ... 4294967295	
0x261C:021	Favorites settings: Parameter 21 0 ... [] ... 4294967295	
0x261C:022	Favorites settings: Parameter 22 0 ... [] ... 4294967295	
0x261C:023	Favorites settings: Parameter 23 0 ... [] ... 4294967295	
0x261C:024	Favorites settings: Parameter 24 0 ... [] ... 4294967295	
0x261C:025	Favorites settings: Parameter 25 0 ... [] ... 4294967295	
0x261C:026	Favorites settings: Parameter 26 0 ... [] ... 4294967295	
0x261C:027	Favorites settings: Parameter 27 0 ... [] ... 4294967295	
0x261C:028	Favorites settings: Parameter 28 0 ... [] ... 4294967295	
0x261C:029	Favorites settings: Parameter 29 0 ... [] ... 4294967295	
0x261C:030	Favorites settings: Parameter 30 0 ... [] ... 4294967295	
0x261C:031	Favorites settings: Parameter 31 0 ... [] ... 4294967295	
0x261C:032	Favorites settings: Parameter 32 0 ... [] ... 4294967295	
0x261C:033	Favorites settings: Parameter 33 0 ... [] ... 4294967295	
0x261C:034	Favorites settings: Parameter 34 0 ... [] ... 4294967295	
0x261C:035	Favorites settings: Parameter 35 0 ... [] ... 4294967295	
0x261C:036	Favorites settings: Parameter 36 0 ... [] ... 4294967295	
0x261C:037	Favorites settings: Parameter 37 0 ... [] ... 4294967295	
0x261C:038	Favorites settings: Parameter 38 0 ... [] ... 4294967295	
0x261C:039	Favorites settings: Parameter 39 0 ... [] ... 4294967295	

Address	Name / setting range / [default setting]	Info
0x261C:040	Favorites settings: Parameter 40 0 ... [] ... 4294967295	
0x261C:041	Favorites settings: Parameter 41 0 ... [] ... 4294967295	
0x261C:042	Favorites settings: Parameter 42 0 ... [] ... 4294967295	
0x261C:043	Favorites settings: Parameter 43 0 ... [] ... 4294967295	
0x261C:044	Favorites settings: Parameter 44 0 ... [] ... 4294967295	
0x261C:045	Favorites settings: Parameter 45 0 ... [] ... 4294967295	
0x261C:046	Favorites settings: Parameter 46 0 ... [] ... 4294967295	
0x261C:047	Favorites settings: Parameter 47 0 ... [] ... 4294967295	
0x261C:048	Favorites settings: Parameter 48 0 ... [] ... 4294967295	
0x261C:049	Favorites settings: Parameter 49 0 ... [] ... 4294967295	
0x261C:050	Favorites settings: Parameter 50 0 ... [] ... 4294967295	



4.4 Commissioning

Prerequisites

- The mechanical and electrical installation of the inverter is complete.
- If necessary, the motor is mechanically decoupled from the system.
  - Check whether the system can be mechanically damaged if the non-decoupled drive makes uncontrolled movements.
- The connection between the inverter and the engineering PC with installed »EASY Starter« has been established.
- The »EASY Starter« is open and connected to the inverter.
- The inverter is supplied with voltage.
  - For parameterisation purposes, it makes sense to supply the device with 24 V if the mains voltage and the motor data deviate from the default setting. ▸ Function assignment of the inputs and outputs (default setting) 📖 37
  - If it has been ensured that the mains voltage and motor data settings correspond to the real conditions , the mains voltage can be connected.
- The device list of the »EASY Starter« contains the inverter with the correct device description.
  - Additional information on the device description can be found in the chapter dealing with configuration of the respective fieldbus network. ▸ Configuring the network 📖 281
  - For an explanation of where the device list can be found, please consult the online help of the »EASY Starter«. Press the **F1** key to call up the online help.
- No fault is indicated by the inverter diagnostics.
  - Check the LED status displays.
  - Check the error messages.
  - Check available application credit on the storage medium.

Commissioning

The five main commissioning steps are shown in order towards the top of the **Settings** tab. Clicking on a link displays a corresponding interface containing the most important parameters that need to be set.

▸ General information on parameter setting 📖 31

Commissioning step	Description of the settings
Basic settings	The basic settings are sufficient for drive rotation . • Check every preset parameter value to determine whether it can be retained for the application. • If a value has to be changed, click the cross-reference highlighted in blue to which the parameter is assigned. A new interface opens. Here, the relevant value can now be changed. • Once all parameters have been correctly set in the basic settings, you can allow the drive to rotate .
Communication	These commissioning steps are for adjusting the drive and only have to be adapted where necessary. • Basic settings of the technology application for adjusting the motor end and load side (gearbox ratio, mounting direction, moments of inertia, etc.) • Basic settings of the technology application for adjusting the motion control. • Settings for adjusting the technology application for the application.
Kinematics	
Motion	
Technology application	

After adjusting the parameters: ▸ Saving the parameter settings 📖 36

Setting and transferring safety parameters

Safety-relevant parameters only have to be set for devices that feature integrated safety engineering or safety modules.

Observe the **online help information on the safety parameter list**.

In »EASY Starter« and »PLC Designer«, safety parameters can only be set and transferred using the **safety parameter list**. When a device featuring integrated safety engineering or a safety module is selected in the device list, the **safety parameter list** becomes available in the form of an additional tab.

4.5 Saving the parameter settings

During operation with the CiA 402 device profile, no settings are saved. The settings are transmitted when the master control is started. If applications are used, the SD card with the licence data also serves as storage medium.

The active application is displayed in the parameter. C2013:001

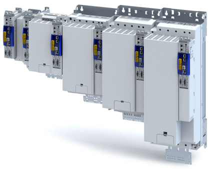
The application can be modified via the parameter. ▶ 0x4000

4.5.1 Save parameter settings with »EASY Starter«

If a parameter setting has been changed with the »EASY Starter« but not yet saved in the memory medium with mains failure protection, the status line of the »EASY Starter« displays the note "The parameter set was changed".

There are 3 options to save the parameter settings in the user memory of the storage medium:

- Click the button in the toolbar of the »EASY Starter« .
- Press the function key **F6**.
- Execute the device command "Save user data": 0x2022:003 = "On / start [1]".



5 Basic setting

This chapter contains the most frequently used functions and settings to adapt the inverter to a simple application based on the default setting.

5.1 Device name

Parameter

Address	Name / setting range / [default setting]	Info
0x2001	Device name ["**Device**"]	Any device name (e.g. "Wheel drive") can be set in this object for the purpose of device identification.

5.2 Mains voltage

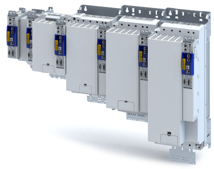
The rated mains voltage set for the inverter has an impact on the operating range of the inverter.

Parameter

Address	Name / setting range / [default setting]		Info
0x2540:001	Mains settings: Rated mains voltage		Selection of the mains voltage for actuating the inverter.
	0	230 Veff	
	1	**400 Veff**	
	2	480 Veff	
	4	60 V (setting-up operation)	
	10	230 Veff/reduced LU level	
	11	400 Veff/reduced LU level	
	12	480 Veff/reduced LU level	
0x2540:002	Mains settings: Undervoltage warning threshold 0 ... [**430**] ... 800 V		Setting of the warning threshold for monitoring DC bus undervoltage. • If the DC bus voltage falls below the threshold set, the inverter outputs a warning. • The warning is reset with a hysteresis of 10 V.
0x2540:003	Mains settings: Undervoltage error threshold • Read only: x V		Display of the fixed error threshold for monitoring DC bus undervoltage. • If the DC-bus voltage falls below the threshold displayed, the "Error" response is triggered.
0x2540:004	Mains settings: Undervoltage reset threshold • Read only: x V		Display of the fixed reset threshold for monitoring DC bus undervoltage.
0x2540:005	Mains settings: Overvoltage warning threshold 0 ... [**795**] ... 800 V		Setting of the warning threshold for monitoring DC bus overvoltage. • If the DC bus voltage exceeds the threshold set, the inverter outputs a warning. • The warning is reset with a hysteresis of 10 V.
0x2540:006	Mains settings: Overvoltage error threshold • Read only: x V		Display of the fixed error threshold for monitoring the DC bus overvoltage. • If the DC-bus voltage exceeds the threshold displayed, the "Fault" response is triggered.
0x2540:007	Mains settings: Overvoltage reset threshold • Read only: x V		Display of the fixed reset threshold for monitoring DC bus overvoltage.
0x2540:008	Mains settings: DC link voltage critical • Read only		Display of value "1": the DC-bus voltage has reached a critical value.

5.3 Function assignment of the inputs and outputs (default setting)

"I/O extensions and control connections" describes the assignment of functions to inputs and outputs. 📖 273



5.4 Motor data

The term "motor data" comprises all parameters only depending on the motor and only characterising the electrical behaviour of the motor. Motor data are independent of the application in which the inverter and the motor are used.

Preconditions

The equivalent circuit data ("Settings" tab, path: "Basic setting\motor", parameterisation dialog "Derived motor properties and equivalent circuit") apply to a motor in star connection. In case of a motor in delta connection, the delta values must be converted into equivalent star values.

Possible settings

If a Lenze motor is connected to the inverter, you can select the motor in the engineering tool from the "motor catalogue".

- For details see chapter "Select motor from motor catalogue". 📖 39

Otherwise the motor data must be set manually (for details see chapter "Manual setting of the motor data“). 📖 41

Parameter

Address	Name / setting range / [default setting]		Info
0x2C08	Method for setting motor parameters		Representation of the method selected for setting the motor parameters. (Is used by the engineering tools.)
	1	**Select from catalogue (Lenze motors)**	
	2	Enter motor nameplate data (other motors)	
	3	Manual input (other motors)	
	4	Identification run (all motors)	

5.4.1 Select motor from motor catalogue

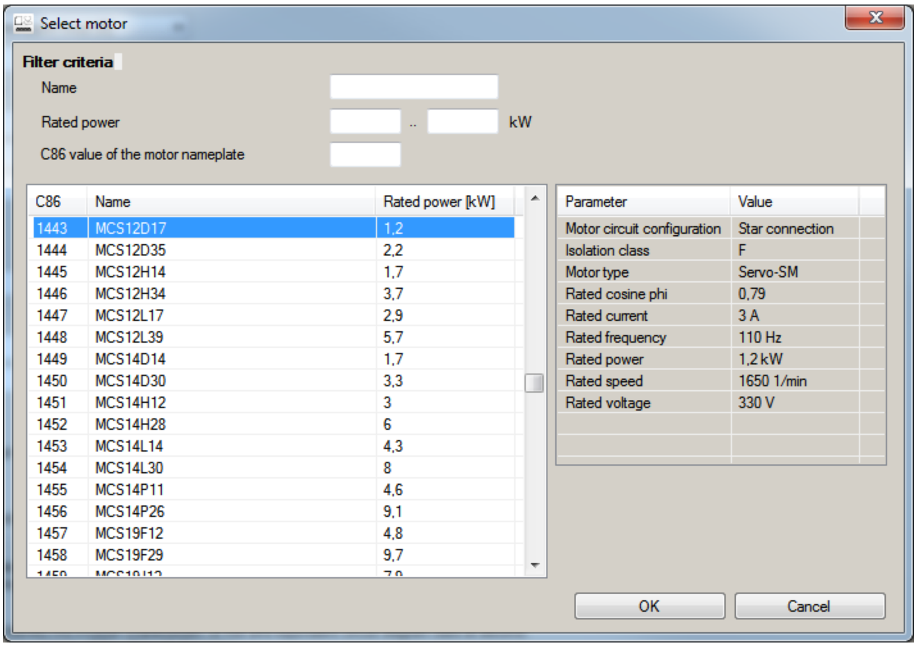
The following describes how to parameterise your drive system by selecting a Lenze motor from the motor catalogue. Several processes are started invisibly in the background to load/ calculate the settings for the relevant parameters.

Preconditions

- Access to a Lenze engineering tool (e. g. »EASY Starter«).
- Parameters can be set online or offline (with or without connected motor).

Required steps

1. Open the Lenze engineering tool that provides for the functionality of a “Motor catalogue".
2. Click the **Select motor...** button. In case of the »EASY Starter«, you find the **Select motor...** button on the "settings". tab.
3. Select the used motor in the "Select motor" dialog:



By entering filter criteria, you can restrict the selection.

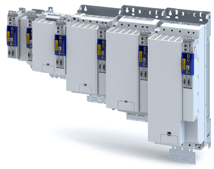
Name (e. g. "MCS..."), rated power and C86 value can be found on the motor nameplate.

4. Press the **Please select** button to select the thermal sensor.

   This is not required for all motors. For older motors, such as MDSKA056-22 (C86=10), a thermal sensor **CANNOT** be selected.

Observe the notes on the **?** button.

5. Click the **OK** button to start the optimisation.



Parameterisation sequence

As soon as the parameterisation has been started, the following steps are initiated by the engineering tool:

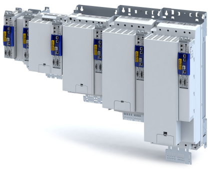
1. The motor rating data and the motor equivalent circuit diagram data are loaded from the motor catalogue.
2. The motor controller settings and the speed controller settings are automatically calculated based on the previously loaded data.

Notes:

- The data involved in this parameterisation are provided be the motor catalogue alone. Further user data is not required.
- The inverter characteristic is not changed by this optimisation.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C01:010	Motor parameters: Motor name ["**MCS06C41**"]	The name (e.g. " 1") can be freely selected by the user. If the motor in the engineering tool has been selected from the "motor catalog", the respective motor name is automatically entered here (example: "MDSKA080-22, 70").



5.4.2 Manual setting of the motor data

There are two options to parameterise a motor.

1. Enter nameplate data

Enter the following motor data:

- 0x2C01:001 Number of pole pairs
- 0x2C01:002 Stator resistance
- 0x2C01:003 Stator leakage inductance
- 0x2C01:004 Rated speed
- 0x2C01:005 Rated frequency
- 0x2C01:006 Rated power
- 0x2C01:007 Rated voltage
- 0x2C01:008 Cosine phi
- 0x2C01:009 Insulation class
- 0x6075 Rated motor current

When you touch the "Estimate" button in the engineering tool, more parameters depending on the motor are shown.

2. Enter data of the motor data sheet

The motor data and the parameters depending on the motor are entered. The parameters mentioned under 1. are the following:

- 0x2D4C:001 Thermal time constant of the winding
- 0x2D4C:002 Thermal time constant - laminated core
- 0x2D4C:003 Influence of winding
- 0x2D4C:004 Starting value
- 0x6067 Rated motor torque

Additionally for ASM:

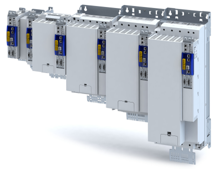
- 0x2C02:001 Rotor resistance
- 0x2C02:002 Mutual inductance
- 0x2C02:003 Magnetising current

Additionally for PSM:

- 0x2C03:001 EMF constant
- 0x2C03:002 Resolver pole position
- 0x2C03:003 Temperature coefficient magnets (kTN)
- 0x2C03:004 Encoder pole position

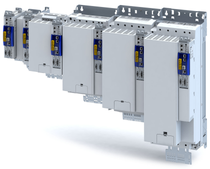
After the motor data has been parameterised via one of the two options, the following monitoring and limit values are initialised with motor-dependent preset values by touching the "Initialise" button:

- 0x2D44:001 Overspeed monitoring threshold
- 0x2D46:001 Overcurrent monitoring threshold
- 0x2D49:003 Motor temperature monitoring warning threshold
- 0x2D49:004 Motor temperature monitoring error threshold
- 0x6073 Maximum current
- 0x6075 Rated motor current

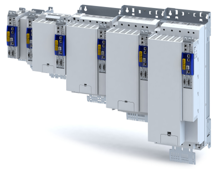


Parameter

Address	Name / setting range / [default setting]	Info
0x2C01:001	Motor parameters: Number of pole pairs • Read only	Display of the number of pole pairs calculated from the rated speed and rated frequency.
0x2C01:002	Motor parameters: Stator resistance 0.0000 ... [**13.5000**] ... 125.0000 Ω	General motor data. Carry out settings as specified by manufacturer data/motor data sheet. Note! When you enter the motor nameplate data, take into account the phase connection implemented for the motor (star or delta connection). Only enter the data applying to the connection type selected.
0x2C01:003	Motor parameters: Stator leakage inductance 0.000 ... [**51.000**] ... 500.000 mH	
0x2C01:004	Motor parameters: Rated speed 0 ... [**4050**] ... 50000 rpm	General motor data. Carry out settings as specified by motor nameplate data. Note! When you enter the motor nameplate data, take into account the phase connection implemented for the motor (star or delta connection). Only enter the data applying to the connection type selected.
0x2C01:005	Motor parameters: Rated frequency 0.0 ... [**270.0**] ... 1000.0 Hz	
0x2C01:006	Motor parameters: Rated power 0.00 ... [**0.25**] ... 655.35 kW	
0x2C01:007	Motor parameters: Rated voltage 0 ... [**225**] ... 65535 V	
0x2C01:008	Motor parameters: Cosine phi 0.00 ... [**0.80**] ... 1.00	
0x2C01:009	Motor parameters: Insulation class	Insulation class of the motor (see motor nameplate).
	0 Y (cut-off temperature = 90 °C)	
	1 A (cut-off temperature = 105 °C)	
	2 E (cut-off temperature = 120 °C)	
	3 B (cut-off temperature = 130 °C)	
	4 F (cut-off temperature = 155 °C)	
	5 H (cut-off temperature = 180 °C)	
	6 G (cut-off temperature > 180 °C)	
0x2C02:001	Motor parameter (ASM): Rotor resistance 0.0000 ... [**0.0000**] ... 214748.3647 Ω	Equivalent circuit data required for the motor model of the asynchronous machine.
0x2C02:002	Motor parameter (ASM): Mutual inductance 0.0 ... [**0.0**] ... 214748364.7 mH	
0x2C02:003	Motor parameter (ASM): Magnetising current 0.00 ... [**0.00**] ... 500.00 A	
0x2C03:001	Motor parameter (PSM): Back EMF constant 0.0 ... [**41.8**] ... 100000.0 V/1000rpm	Voltage induced by the motor (rotor voltage / 1000 rpm). For permanently excited synchronous motors, the e.m.f. constant describes the r.m.s. value of the line-to-line voltage (phase voltage) induced in idle state by the motor (reference: 1000 rpm, 20 °C).
0x2C03:002	Motor parameter (PSM): Resolver pole position -179.9 ... [**-90.0**] ... 179.9 °	Equivalent circuit data required for the motor model of the synchronous machine.
0x2C03:003	Motor parameter (PSM): Magnets temperature coefficient (kTN) -1.000 ... [**-0.110**] ... 0.000 %/°C	
0x2C03:004	Motor parameter (PSM): Encoder pole position -179.9 ... [**0.0**] ... 179.9 °	
0x2D4C:001	Thermisches Modell Motorauslastung (i^2xt): Motor utilisation (i^2xt) 1 ... [**60**] ... 36000 s	Setting of the time constant for the winding.
0x2D4C:002	Thermisches Modell Motorauslastung (i^2xt): Thermal time constant - laminations 1 ... [**852**] ... 36000 s	Setting of the time constant for the laminated core.
0x2D4C:003	Thermisches Modell Motorauslastung (i^2xt): Winding influence 0 ... [**27**] ... 100 %	Part of the thermal motor model: distribution factor of the copper winding influence.



Address	Name / setting range / [default setting]	Info
0x6073	Max current 0.0 ... [**150.0**] ... 3276.7 %	Maximum overload current of the inverter. • 100 % ≡ Motor rated current (0x6075) • If the current consumption of the motor exceeds this current limit, the inverter changes its dynamic behaviour in order to counteract this exceedance. • If the modified dynamic behaviour fails to eliminate the excess current consumption, the inverter outputs an error. When (current actual value in %) exceeds 0x6073 (max. current actual value in %) the message 0x238A is displayed. This status is also displayed in the following network status word bits: • 0x400C:001 bit 14 • 0x400C:002 bit 2
0x6075	Motor rated current 0.001 ... [**1.300**] ... 500.000 A • Setting can only be changed if the inverter is inhibited.	The rated motor current that needs to be set here serves as a reference value for different parameters that involve a setting for/display of a current value in percent. Example: • Motor rated current = 1.7 A • Max current 0x6073 = 200 % Motor rated current = 3.4 A
0x6076	Motor rated torque 0.001 ... [**0.600**] ... 1000.000 Nm • Setting can only be changed if the inverter is inhibited.	The rated motor torque to be set here serves as a reference value for different parameters with a setting/display of a torque value in percent. Example: • Motor rated torque = 1.65 Nm • Max torque 0x6072 = 250 % Motor rated torque = 4.125 Nm
0x6080	Max motor speed 0 ... [**6075**] ... 480000 rpm	Limitation of the maximum motor speed.



5.5 Motor control mode

The inverter supports different modes for closed-loop/open-loop motor control.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C00	Motor control mode • Setting can only be changed if the inverter is inhibited.		Selection of the motor control type.
	1	**Servoregelung (SC-PSM)**	This control mode is used for servo control of a synchronous motor. ▸ Servo control for synchronous motor (SC-PSM) 📖 203 A motor encoder must be connected to the inverter. This motor encoder serves as a feedback system for engine control.
	2	Servo control (SC ASM)	This control mode is used for servo control of an asynchronous motor. ▸ Servo control for asynchronous motor (SC-ASM) 📖 204 A motor encoder must be connected to the inverter. This motor encoder is used as a feedback system for the motor control.
	3	Sensorless control (SL PSM)	This control type is used for the sensorless control of a synchronous motor. • Control mode is possible up to a rated power of 22 kW. ▸ Sensorless control for synchronous motor (SL-PSM) 📖 204
	4	Sensorless vector control (SLVC)	This control type is used for sensorless vector control of an asynchronous motor.
	5	Reserved	
	6	V/f characteristic control (VFC open loop)	This control mode is used for the speed control of an asynchronous motor via a V/f characteristic and is the simplest control mode. ▸ V/f characteristic control for asynchronous motor (VFC open loop) 📖 205

Supplementary chapters:

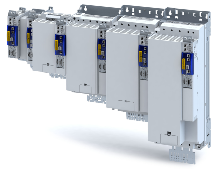
- Chapter "Configure feedback system for motor control" describes how to set resolvers or sine/cosine encoders as motor feedback. 📖 166
- Chapter "Second feedback system for the techology application" describes how a higher-level control loop can be used as an actual value feedback application for higher accuracy. 📖 179

The detailed description of each motor control type can be found in the chapter "Configuring the motor control“. 📖 202

6 Technology application (TA) basic settings

This chapter describes the basic functions of the technology application.

Here you will find information on the following topics:



6.1 Kinematic settings

The kinematic parameters describe, among other things, the motor end with regard to the mechanics used:

- Mass inertia (load/motor) 46
- Torque feedforward control 46
- Motor/encoder mounting direction 46
- Motor/encoder gearbox ratio 47
- Motor/encoder feed constant 49
- Motor/encoder travel ranges and cycle length 50
- Virtual mode 52

Settings in the »EASY Starter«:

- Tab **Settings** - Parameter dialog **Kinematics**

6.1.1 Mass inertia (load/motor)

The resulting moment of inertia consists of the moment of inertia of the motor and the moment of inertia of the load.

Parameter

Address	Name / setting range / [default setting]	Info
0x2910:001	Inertia settings: Motor moment of inertia 0.00 ... [**0.14**] ... 20000000.00 kg cm²	Setting of the moment of inertia of the motor, relating to the motor.
0x500A:037	Load moment of inertia 0.00 ... [**0.00**] ... 21474836.47 kg cm²	Setting of the mass inertia of the load with regard to the gearbox output.

6.1.2 Torque feedforward control

For an optimal motion control, the motion axis has an automatic function for the torque feedforward control.

The torque feedforward control is calculated from the current setpoint acceleration and the resulting moment of inertia.

6.1.3 Motor/encoder mounting direction

Depending on the mounting direction, the direction of motor rotation or the encoder direction of rotation can be inverted.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:035	Motor mounting direction • Setting can only be changed if the inverter is inhibited.		If the parameter is set to CCW, a positive motion of the machine is inverted so that the direction of rotation of the motor becomes negative.
	false	CW	CW : Clockwise rotating motor = positive machine direction
	true	CCW	CCW : Counter-clockwise rotating motor = negative machine direction
0x500B:035	Load encoder mounting direction • Setting can only be changed if the inverter is inhibited.		The mounting direction of the additional load encoder is set in this parameter.
	false	CW	CW : Clockwise rotating motor = positive machine direction
	true	CCW	CCW : Counter-clockwise rotating motor = negative machine direction

6.1.4 Motor/encoder gearbox ratio

The necessary data for configuring the gearbox ratio is listed in the gearbox catalog.

For a precise specification of the gearbox ratio, the specified number of teeth **z1 ... z4** from the gearbox catalog must be used.

The gearbox ratio indicates how many motor axis revolutions equal one revolution of the load axis.

The gearbox ratio is configured using a quotient (numerator/denominator).

The gearbox ratio for the motor is influenced by 4 parameters:

- Gearbox factor numerator ▸ 0x500A:033
- Gearbox factor denominator ▸ 0x500A:034
- Additional gearbox factor numerator ▸ 0x500A:025
- Additional gearbox factor denominator ▸ 0x500A:026

The gearbox ratio for the second encoder is influenced by 2 parameters:

- Gearbox factor numerator ▸ 0x500B:033
- Gearbox factor denominator ▸ 0x500B:034

Example:

After 58,667 rotations (i) of the motor axis, the spindle turns once.

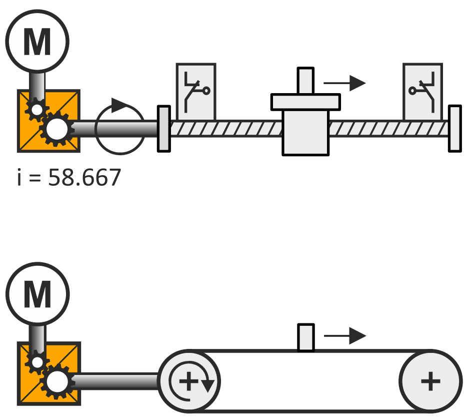
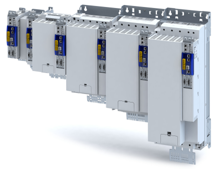


Fig. 1: Schematic diagram of the gearbox ratio



Parameter

Address	Name / setting range / [default setting]	Info
0x500A:025	Additional gearbox factor - numerator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	
0x500A:026	Additional gearbox factor - denominator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	
0x500A:033	Gearbox factor - nominator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	
0x500A:034	Gearbox factor - denominator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	
0x500B:033	Gearbox factor - nominator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	
0x500B:034	Gearbox factor - denominator 1 ... [**1**] ... 4294967295 • Setting can only be changed if the inverter is inhibited.	

Example of how to calculate the ratio

Example calculation	
$i = \frac{0x500A:033}{0x500A:034} = \frac{z2 * z4}{z1 * z3} = \frac{88 * 72}{12 * 9} = \frac{6336}{108} = 58.667$	
Gearbox factor numerator	0x500A:033
Gearbox factor denominator	0x500A:034

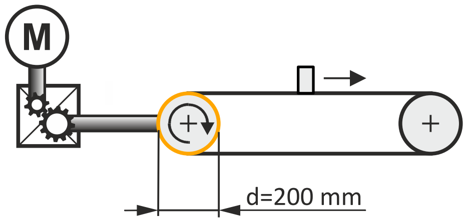
Tab. 1: Example of how to calculate the gearbox ratio

6.1.5 Motor/encoder feed constant

The feed constant corresponds to the machine motion for one revolution of the gearbox output shaft.

When a turntable is used, the feed constant is = 360°/revolution when defined as an angle.

The feed constant of a conveyor drive results from the circumference of the drive roll.



Calculation of the feed constant
$$V_K = \frac{\pi * d}{n}$$

Symbol	Description
F_C	Feed constant
d	Diameter
n	Revolution

Example:

The feed constant of a spindle drive (linear axis) results from the leadscrew pitch. The feed constant indicates the distance travelled by the slide in one revolution (in the following example 5,023 mm).

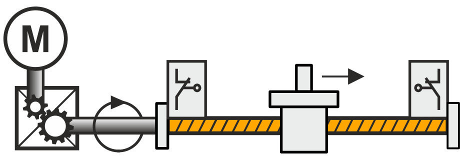


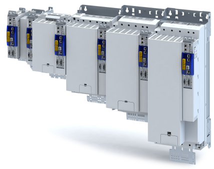
Fig. 2: Feed constant of a spindle drive

h Leadscrew pitch from the technical data of the linear axis

The kinematic parameters for the second encoder can be used to define how an imported encoder position or encoder speed should be converted into machine units.

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:032	Feed constant 0.0001 ... [**360.0000**] ... 214748.3647 • Setting can only be changed if the inverter is inhibited.	
0x500B:032	Feed constant 0.0001 ... [**360.0000**] ... 214748.3647 • Setting can only be changed if the inverter is inhibited.	



6.1.6 Motor/encoder travel ranges and cycle length

Linearly limited travel range

- The travel range in the positive and negative direction is limited mechanically and on the software side by limit switches.
- After travelling a defined distance, the drive returns in the opposite direction.

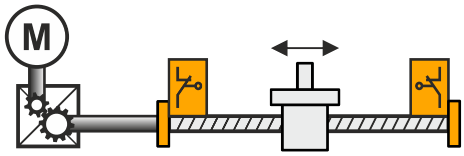


Fig. 3: Spindle drive (linear axis)

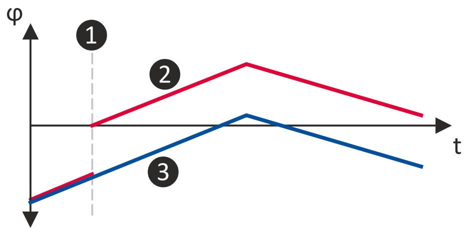


Fig. 4: Position representation

1	Setting of the home position	3	Position in the motor measuring system
2	Position in the machine measuring system		

Unlimited travel range (Modulo)

- The measuring system is repeated.
- When the set cycle length is exceeded, a defined overflow takes place.
- The cycle length corresponds to one revolution or tool distance of a turntable (end position = starting position).
- Software limit switches are not active.
- Absolute targets can be approached by exceeding the measuring system limit.

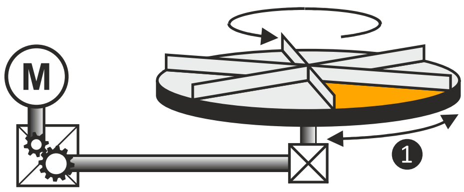


Fig. 5: Turntable

1 Cycle length (illustration = 60°)

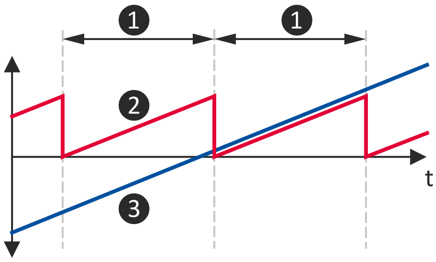


Fig. 6: Position representation

1	Cycle length ▸ 0x500A:031	3	Position in the motor measuring system
2	Position in the machine measuring system		

The kinematic parameters for the second encoder serve to define the conversion of an imported encoder position or encoder speed in machine units.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:030	Travel range • Setting can only be changed if the inverter is inhibited.		Selection of the traversing range for the motor
	0	Modulo	Unlimited traversing range (turntable). The cycle length must also be specified here.
	1	**Limited**	Linearly limited traversing range (spindle drive).
0x500A:031	Cycle length 0.0001 ... [**360.0000**] ... 214748.3647 • Setting can only be changed if the inverter is inhibited.		The cycle length for an unlimited traversing range defines the position where the measuring system is repeated (position return to 0).
0x500B:030	Travel range • Setting can only be changed if the inverter is inhibited.		Selection of the traversing range with regard to the encoder position.
	0	Modulo	Unlimited traversing range (turntable). The cycle length must also be specified here.
	1	**Limited**	Linearly limited traversing range (spindle drive).
0x500B:031	Cycle length 0.0001 ... [**360.0000**] ... 214748.3647 • Setting can only be changed if the inverter is inhibited.		The cycle length for an unlimited traversing range defines the position where the measuring system is repeated (position return to 0).

6.1.7 Virtual mode

The application can be tested without a connected motor. For this purpose, the setpoint selection for the drive can be interrupted.

When the virtual mode is active, the setpoints generated in the application are not transmitted to the drive. The actual values (e. g. position and velocity) are generated from the setpoints.

The kinematic parameters do not have any influence in the virtual mode. Only the parameters **travel range** and **cycle length** are used for the machine measuring system.

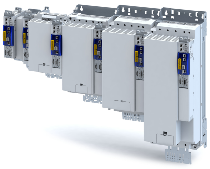
Machine measuring system parameters

- **Travel range** ▶ 0x500A:030
- **Cycle length** ▶ 0x500B:031

For diagnostic purposes, an active virtual mode is displayed in the **Status word** parameter. ▶ 0x500A:005 Bit 0

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:029	Virtual mode • Setting can only be changed if the inverter is inhibited.		
	false	Inactive	
	true	Active	



6.2 Motion settings

Motion settings can be made for the following functions:

- Quick stop 53
- Halt 54
- Following error monitoring 54
- Target position detection 55
- Motor/encoder standstill detection 55
- Conditioning of the encoder signal 55
- Behaviour in the event of inverter disable 56
- Control modes 57
- Manual jog (inching mode) 58
- Homing 59
- Limitations 71

Settings in the »EASY Starter«:

- Tab **Settings** - Parameter dialog **Motion**

6.2.1 Quick stop

The quick stop function is used for stopping the axis and in the event of an error.

The ramp used can be set via the following parameters:

- Quick stop deceleration 0x500A:048
- Quick stop jerk 0x500A:049

If the quick stop function is active, it is displayed in the **Status word** parameter. 0x500A:005 Bit 13.

Special features of quick stop:

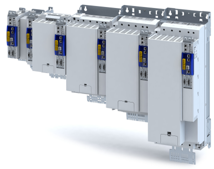
- Setpoint generation for the quick stop function starts at the current actual speed.
- The quick stop function starts with the acceleration 0.

Exception: If the axis is already in the deceleration phase, the start is performed with the active setpoint acceleration to avoid prolonging the existing braking process.

- During the deceleration, a change to speed-controlled operation takes place.
- A transition to position control takes place when a standstill has been reached.
- There is no reduction in torque while the stop is being performed.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:048	Application quick stop - deceleration 0.01 ... [**3600.00**] ... 21474836.47		
0x500A:049	Application quick stop - jerk 0.00 ... [**0.00**] ... 21474836.47		
0x5020:007	Application quick stop source		Selection of the signal source for activating the quick stop.
	0	**FALSE**	
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	



6.2.2 Halt

By triggering this function, the technology application enables the axis to be braked to standstill with the values parameterised for deceleration and jerk based on the current setpoints.

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:186	Deceleration of Halt 0.00 ... [**1800.00**] ... 21474836.47	
0x500A:187	Jerk of Halt 0.00 ... [**0.00**] ... 21474836.47	

6.2.3 Following error monitoring

The difference between the setpoint position and the actual position is the following error. The following error should be "0". If the position control is set optimally, only a minimal following error will occur. The following error is compensated dynamically and does not grow continuously.

However, certain processes impose a certain maximum limit in terms of the difference between the setpoint position and the actual position. If the limit is exceeded, it might be (for example) because of a failure to perform a movement within the machine, meaning that the system component does not reach the defined position at the relevant point in time. In such cases, it is appropriate to trigger an error response. The error response is adjustable.
▶ 0x500A:059

For diagnostic purposes, the current and maximum following error are displayed in the diagnostic parameter. ▶ 0x500A:058

Behaviour when the following error monitoring is active (0x500A:054 = activated)

Two following error limits can be parameterised.

Exceedance of following error limit 1 (0x500A:055):

- A warning is displayed.
- The current movement of the axis is not interrupted.

Exceedance of following error limit 2 (0x500A:056):

- The set error response is executed. 0x500A:059

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:054	Following error monitoring	
	false | Inactive	
	true | Active	
0x500A:055	Following error: Warning threshold 0.0000 ... [**180.0000**] ... 214748.3647	
0x500A:056	Following error: Error threshold 0.0000 ... [**360.0000**] ... 214748.3647	
0x500A:057	Actual following error • Read only	
0x500A:058	Max. following error • Read only	
0x500A:059	Response to following error	
	20 | Fault > Application quick stop > Quick stop	
	21 | Fault> Application quick stop > Inverter disabled	

6.2.4 Target position detection

The target position detection identifies whether the axis is in the symmetrical target position window after the dwell time has elapsed.

The information is provided in the **Status word** parameter of the technology application.

- Status word — Axis: 0x500A:005 Bit 23
- Status word — Virtual master axis:0x500C:005 Bit 23

Under these conditions, the "Axis in target" status (bit 23 = TRUE) is reset to FALSE:

- The actual position has left the target position window.
- A new motion task is started.
- The home position is reset.

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:130	Position window size 0.0000 ... [**0.0000**] ... 214748.3647	
0x500A:131	Position window dwell time 0.000 ... [**0.000**] ... 2147483.647 s	
0x500A:135	Modulo positioning tolerance window 0.0000 ... [**0.0000**] ... 214748.3647	

6.2.5 Motor/encoder standstill detection

The standstill detection identifies whether the axis is at standstill.

The information is provided in the **status word** parameter of the technology application.

- Axis status word: 0x500A:005, bit 22

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:132	Standstill window size (motor encoder) 0.0000 ... [**0.0000**] ... 214748.3647	
0x500B:132	Standstill window size (load encoder) 0.0000 ... [**0.0000**] ... 214748.3647	

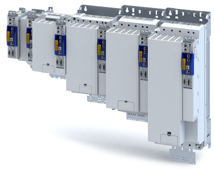
6.2.6 Conditioning of the encoder signal

For further processing of encoder values in the technology application, it might be necessary to condition the value so that interference within the signal does not detrimentally affect the coupling.

The following separately adjustable filters are available for conditioning the actual value:

Parameter

Address	Name / setting range / [default setting]	Info
0x500B:065	Filter cycles of actual velocity 1 ... [**1**] ... 100	
0x500B:066	Filter cycles of actual position 1 ... [**1**] ... 100	



6.2.7 Behaviour in the event of inverter disable

In standard cases, the setpoint position is compared against the actual position when the inverter is disabled. A position window can be used to control the automatic comparison between the setpoint position and actual position in the case of a disabled inverter. In the position window, positive and negative deviations can be set separately. If the distance between the last setpoint position before inverter disable and the current actual position is smaller than the parametrised value, the setpoint position keeps its last value. The setpoint position and the actual position will be compared upon exiting this window.

If the value is set to 0 units, the setpoint position is equated with the actual position in the case of an inverter disable. The limit value set for the upper and lower limits of the window in the parameters must not exceed the drift of the actual position at drive standstill plus an additional safety margin.

If higher values are set, the position controller makes a jerky compensation after the inverter is enabled. This is due to the existing system deviation.

Limit values:

▶ 0x500A:136

▶ 0x500A:137

Behaviour in case of an inverter disable during a movement

If the drive is disabled during a movement, for instance by the control word in the application or via the STO safety function, an error is triggered.

The **Resp. to inverter disable during motion** parameter can be used to set a different response. ▶ 0x500A:107

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:107	Response to inverter disable during operation		
	0	**No response**	
	19	Fault > Application quick stop > Quick stop	
0x500A:136	Tolerance window actual position=set position upper limit 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:137	Tolerance window actual position=set position lower limit 0.0000 ... [**0.0000**] ... 214748.3647		

6.2.8 Control modes

With the default setting, the axis will always be operated with activated speed control unless the function used in the application requires a different control type. ▶ 0x500A:090

The speed control is used when no motor encoder is available.

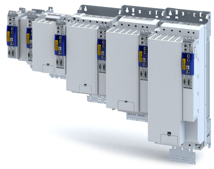
The speed control is used in the first phase of the reference run, during the search for the reference signal.

The speed control is used during deceleration with the quick stop function.

The active control type is shown in the **Active control mode** parameter. ▶ 0x500A:091

Parameter

<table>
<tr><th>Address</th><th colspan="2">Name / setting range / [default setting]</th><th>Info</th></tr>
<tr><td rowspan="4">0x500A:090</td><td colspan="2">Default control mode
• Setting can only be changed if the inverter is inhibited.</td><td rowspan="18"></td></tr>
<tr><td>0</td><td>Position control via motor encoder</td></tr>
<tr><td>1</td><td>Position control via load encoder</td></tr>
<tr><td>10</td><td>Speed control via motor encoder</td></tr>
<tr><td rowspan="5">0x500A:091</td><td colspan="2">Actual control mode
• Read only</td></tr>
<tr><td>0</td><td>Position control via motor encoder</td></tr>
<tr><td>1</td><td>Position control via load encoder</td></tr>
<tr><td>10</td><td>Speed control via motor encoder</td></tr>
<tr><td>20</td><td>Torque control</td></tr>
<tr><td rowspan="3">0x500A:092</td><td colspan="2">Load encoder selection
• Setting can only be changed if the inverter is inhibited.</td></tr>
<tr><td>-</td><td></td></tr>
<tr><td>Encoder_Axis</td><td></td></tr>
<tr><td>0x500A:093</td><td colspan="2">Position controller gain
0.0000 ... [20.0000] ... 214748.3647 1/s</td></tr>
<tr><td>0x500A:094</td><td colspan="2">Load encoder output limit
0.0000 ... [100000.0000] ... 214748.3647</td></tr>
<tr><td>0x500A:095</td><td colspan="2">Position controller output
• Read only</td></tr>
</table>



6.2.9 Manual jog (inching mode)

The "manual jog" function enables manual traversing of the drive ("inching mode").

"Manual jog" can be activated via 2 control signals in the technology application. "Manual jog" is possible in the positive and negative directions.

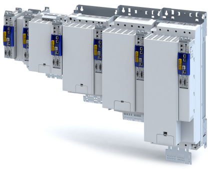
- As long as the control bit is set, the drive moves.
- If both requests are set simultaneously, the drive stops.
- If the reference is known and the software limit switches are activated, positioning to the corresponding software limit switch is carried out.

  Exception: If the manual jog has been stopped manually before this by resetting the control inputs, a positioning to the corresponding software limit switch is aborted.

  The drive brakes with the set deceleration to the position of the corresponding hardware limit switch.
- If the reference is not known or the software limit switches are not activated, the axis only stops at the hardware limit switch.

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:181	Manual jog velocity 0.0000 ... [**360.0000**] ... 214748.3647	
0x500A:182	Manual jog acceleration 0.00 ... [**720.00**] ... 21474836.47	
0x500A:183	Manual jog deceleration 0.00 ... [**1440.00**] ... 21474836.47	
0x500A:184	Manual jog jerk 0.00 ... [**0.00**] ... 21474836.47	



6.2.10 Homing

Homing serves to define the zero point in the traversing range.

The activation takes place by the control word of the technology application.

The information that a home position has been recognised is provided in the **Status word** parameter of the technology application. 0x500A:005, bit 5

Safety function: Safe homing (SHOM) 394

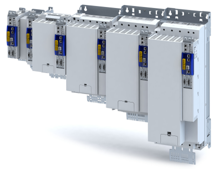
Profile data - Referencing

For the reference search, 2 profile data sets can be parameterised with different speeds and accelerations. The time for referencing is reduced and the accuracy is increased.

- Profile data set 1: Quick approach of the limit switch (depending on the selected mode).
- Profile data set 2: Slow and exact approach of the limit switch and positioning to the target position.
- If speed 2 is set = "0" (initial value), there is no changeover to the profile data set 2. The reference search is carried out with the profile parameters of profile data set 1.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:070	Homing mode		
	-2	CwTorqueLimit	
	-1	CcwTorqueLimit	
	0	**SetPositionDirect**	
	1	CcwLimitSwitchCwTP	
	2	CwLimitSwitchCcwTP	
	3	CwRpCcwRnTP	
	5	CcwRpCwRnTP	
	17	CcwLimitSwitch	
	18	CwLimitSwitch	
	19	CwRpCcwRn	
	21	CcwRpCwRn	
	33	CcwTP	
	34	CwTP	
	99	Reset home position	
0x500A:071	Action after "Home position detected"		
	0	**Stop positioning**	
	1	Relative positioning	
	2	Absolute positioning	
0x500A:078	Homing : Torque limit 0.00 ... [**0.10**] ... 21474836.47 Nm		
0x500A:079	Homing : Blocking time 0.000 ... [**1.000**] ... 2147483.647 s		



Address	Name / setting range / [default setting]		Info
0x500A:080	Homing : Touch probe configuration		
	0	External source	
	1	**TP1 - positive edge**	
	2	TP1 - negative edge	
	3	TP1 - any edge	
	4	TP1 - zero pulse	
	11	TP2 - positive edge	
	12	TP2 - negative edge	
	13	TP2 - any edge	
	14	TP2 - zero pulse	
	21	TP3 - positive edge	
	22	TP3 - negative edge	
	23	TP3 - any edge	
	24	TP3 - zero pulse	
	31	TP4 - positive edge	
	32	TP4 - negative edge	
	33	TP4 - any edge	
	34	TP4 - zero pulse	
0x500A:084	Home position -214748.3648 ... [**0.0000**] ... 214748.3647		

6.2.10.1 Homing modes

Designation	Initial value	Evaluated signals/sensors			
		TP sensor: encoder zero pulse	Travel range limit switch		Reference switch *HomeAbsSwitch*
			negative	positive	
Set position directly	0	Set reference directly			
CcwLimitSwitchCwTP	1	X	X		
CwLimitSwitchCcwTP	2	X		X	
CwRpCcwRnTP	3	X			X
CcwRpCwRnTP	5	X			X
CcwLimitSwitch	17		X		
CwLimitSwitch	18			X	
CwRpCcwRn	19	X			X
CcwRpCwRn	21	X			X
CcwTP	33	X			
CwTP	34	X			
ResetHomeInfo	99	If the reference is known, the status is reset.			
CwTorqueLimit	-2	Positive direction to torque limit			
CcwTorqueLimit	-1	Negative direction to torque limit			

Homing mode 1: CcwLimitSwitchCwTP

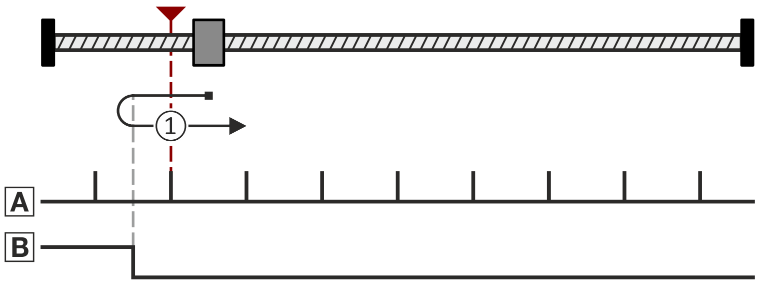


Fig. 7: Negative direction with reversing limit switch to touch probe

A Touch probe/zero pulse B Negative travel range limit switch

Sequence of case ①:

1. The machine part moves in negative direction with profile data set 1.
2. The machine part reverses to the negative travel range limit switch (B) and changes to profile data set 2.
3. The negative edge of the travel range limit switch (B) activates the touch probe detection.
4. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
5. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 2: CwLimitSwitchCcwTP

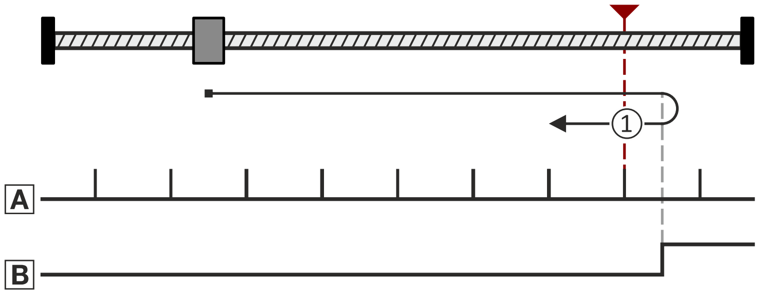


Fig. 8: Positive direction with reversing limit switch to touch probe

A	Touch probe/zero pulse	B	Positive travel range limit switch

Sequence of case ①:

1. The machine part moves in positive direction with profile data set 1.
2. Machine part reverses to positive travel range switch (B) and changes to profile data set 2.
3. The negative edge of the travel range limit switch (B) activates the touch probe detection.
4. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
5. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Reference run 3: CwRpCcwRnTP

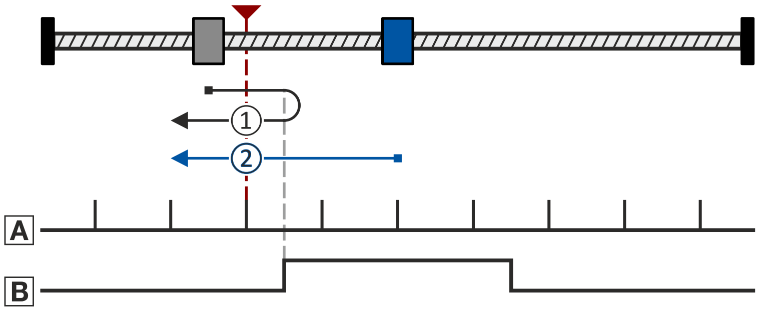


Fig. 9: Positive direction with reversing limit switch and negative edge of the reference switch to touch probe

A Touch probe/zero pulse B Reference switch

Sequence of case ①:

The axis has not yet activated the reference switch:

1. The machine part moves in positive direction with profile data set 1.
2. The machine part reverses with positive edge of the reference switch (B) and changes to profile data set 2.
3. The negative edge of the reference switch (B) activates the touch probe detection.
4. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
5. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning around a set target position.
   - Absolute positioning to a set target position.

Sequence for case ②:

The axis has already activated the reference switch:

1. The machine part moves in negative direction with profile data set 2.
2. The negative edge of the reference switch (B) activates the touch probe detection.
3. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning around a set target position.
   - Absolute positioning to a set target position.

Homing mode 5: CcwRpCwRnTP

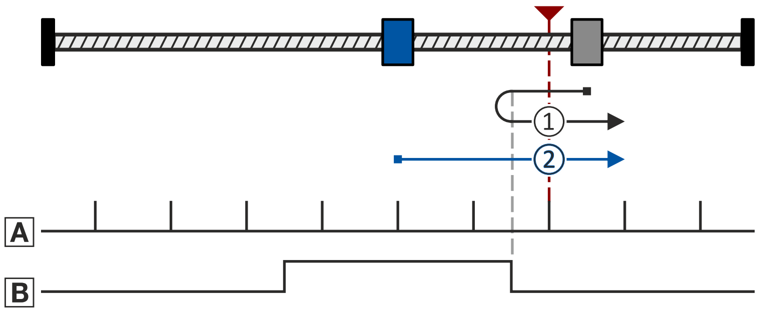


Fig. 10: Negative direction with reversing reference switch and negative edge of the reference switch to touch probe

A	Touch probe/zero pulse	B	Reference switch

Sequence of case ①:

The axis has not yet activated the reference switch:

1. The machine part moves in negative direction with profile data set 1.
2. The machine part reverses with positive edge of the reference switch (B) and changes to profile data set 2.
3. The negative edge of the reference switch (B) activates the touch probe detection.
4. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
5. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Sequence of case ②:

The axis has already activated the reference switch:

1. The machine part moves in positive direction with profile data set 2.
2. The negative edge of the reference switch (B) activates the touch probe detection.
3. The following positive edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 17: CcwLimitSwitch

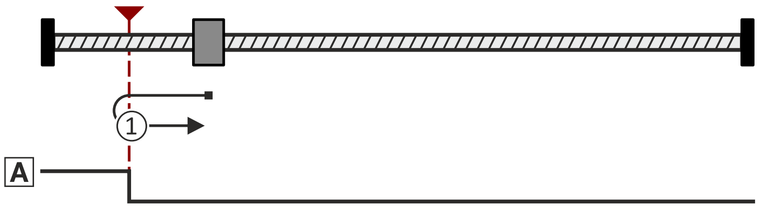


Fig. 11: Negative direction to limit switch

A Negative travel range limit switch

Sequence of case ①:

1. The machine part moves in negative direction with profile data set 1.
2. The machine part reverses to negative travel range limit switch (A) and changes to profile data set 2.
3. The following negative edge of the travel range limit switch (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 18: CwLimitSwitch

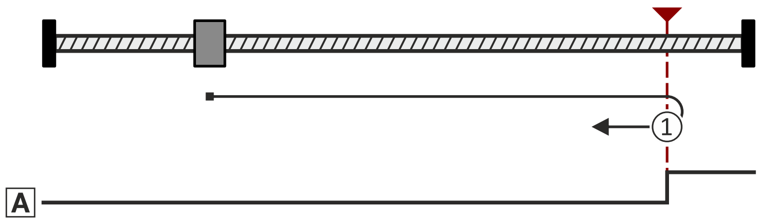


Fig. 12: Positive direction to limit switch

A Positive travel range limit switch

Sequence of case ①:

1. The machine part moves in positive direction with profile data set 1.
2. The machine part reverses to positive travel range limit switch (A) and changes to profile data set 2.
3. The following negative edge of the travel range limit switch (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 19: CwRpCcwRn

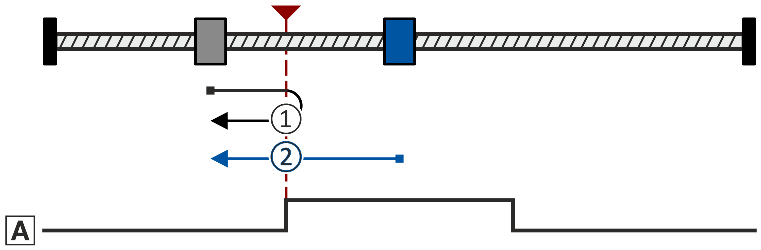


Fig. 13: Sequence representation of case 1 and case 2

A Reference switch

Sequence of case ①:

The axis has not yet activated the reference switch:

1. The machine part moves in positive direction with profile data set 1.
2. Machine part reverses with positive edge of the reference switch (A) and changes to profile data set 2.
3. The negative edge of the reference switch (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Sequence of case ②:

The axis has already activated the reference switch:

1. The machine part moves in negative direction with profile data set 2.
2. The negative edge of the reference switch (A) sets the reference.
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 21: CcwRpCwRn

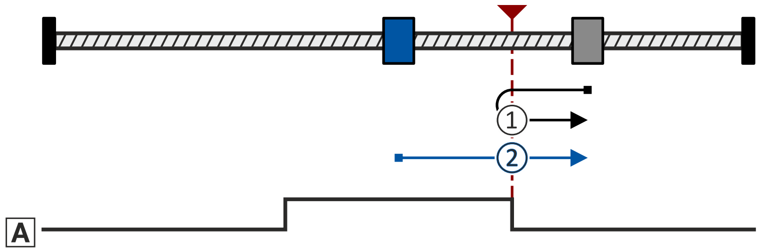


Fig. 14: Sequence representation of case 1 and case 2

A Reference switch

Sequence of case ①:

The axis has not yet activated the reference switch:

1. The machine part moves in negative direction with profile data set 1.
2. The machine part reverses with positive edge of the reference switch (A) and changes to profile data set 2.
3. The negative edge of the reference switch (A) sets the reference.
4. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Sequence of case ②:

The axis has already activated the reference switch:

1. The machine part moves in positive direction with profile data set 2.
2. The negative edge of the reference switch (A) sets the reference.
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 33: CcwTP

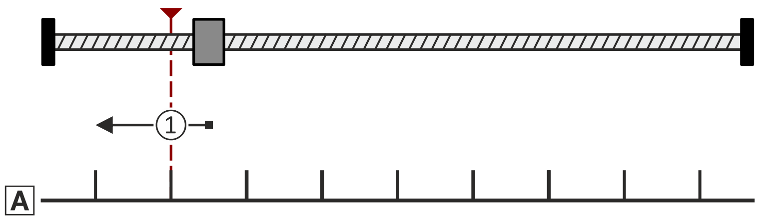


Fig. 15: Negative direction to touch probe

A Touch probe/zero pulse

Sequence of case ①:

1. The machine part moves to negative direction with profile data set 1 and activates the touch probe detection.
2. The following set edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode 34: CwTP

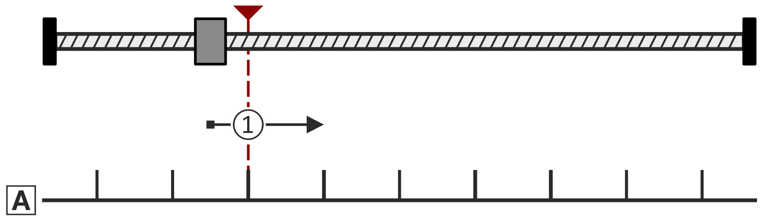


Fig. 16: Positive direction to touch probe

A Touch probe/zero pulse

Sequence of case ①:

1. The machine part moves to positive direction with profile data set 1 and activates the touch probe detection.
2. The following set edge of the encoder zero pulse/touch probe sensor (A) sets the reference.
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode -1: CcwTorqueLimit

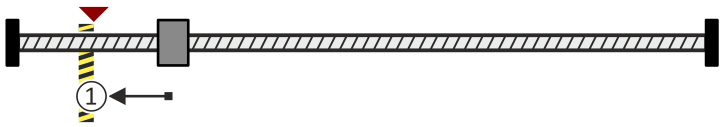


Fig. 17: Negative direction to torque limit

Sequence of case ①:

1. The machine part moves in negative direction with reduced torque and profile data set 1.
2. The reference is set if the following two conditions for the set blocking time are fulfilled at the same time:
   - The current speed is lower than the threshold set for standstill detection.
   - The current torque is higher than the set torque limit (homing to end stop).
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Homing mode -2: CwTorqueLimit

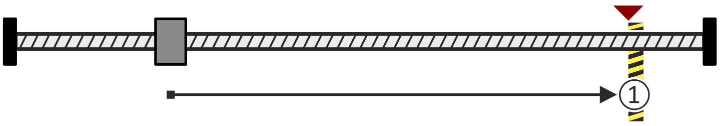


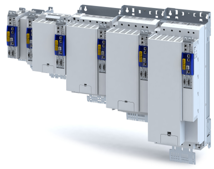
Fig. 18: Positive direction to torque limit

Sequence of case ①:

1. The machine part moves in positive direction with reduced torque and profile data set 1.
2. The reference is set if the following two conditions for the set blocking time are fulfilled at the same time:
   - The current speed is lower than the threshold set for standstill detection.
   - The current torque is higher than the set torque limit (homing to end stop).
3. Further actions can be selected:
   - Drive stops (default setting).
   - Relative positioning by a set target position.
   - Absolute positioning to a set target position.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:070	Homing mode		
	-2	CwTorqueLimit	
	-1	CcwTorqueLimit	
	0	**SetPositionDirect**	
	1	CcwLimitSwitchCwTP	
	2	CwLimitSwitchCcwTP	
	3	CwRpCcwRnTP	
	5	CcwRpCwRnTP	
	17	CcwLimitSwitch	
	18	CwLimitSwitch	
	19	CwRpCcwRn	
	21	CcwRpCwRn	
	33	CcwTP	
	34	CwTP	
	99	Reset home position	
0x500A:072	Homing: Set position -214748.3648 ... [**0.0000**] ... 214748.3647		
0x500A:073	Homing: Set position 0.0000 ... [**360.0000**] ... 214748.3647		
0x500A:074	Homing : Velocity 2 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:075	Homing : Acceleration 1 0.00 ... [**720.00**] ... 21474836.47		
0x500A:076	Homing : Acceleration 2 0.00 ... [**360.00**] ... 21474836.47		
0x500A:077	Homing : Jerk 0.00 ... [**7200.00**] ... 21474836.47		



6.2.10.2 Digital input for reference switch

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:006	Source of homing switch for touch probe		Selection of the signal source for activating the reference switch for touch probe evaluation.
	0	FALSE	
	1	TRUE	
	2	**Digital input 1**	
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	

6.2.10.3 Motor/encoder behaviour after mains switching

With multipole resolvers, a renewed referencing is required.

The home position is deleted when:

- The home position is not within the parameterised angle after switching on.
- The encoder shaft is rotated by ≥ 50% when using resolvers.
- The encoder shaft is rotated by ≥ 50% when using single turn absolute value encoders.

Conditions for obtaining the home position after mains switching:

- Set parameter to 1:Active. ▶ 0x500A:081
- Observe maximum configurable angle of rotation. Parameterise ≤ 50% of maximum presentable range of encoder shaft. ▶ 0x500A:082

No check takes place when:

- The angle is parameterised for 0°.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:081	Keep home position after mains switching		
	false	Inactive	
	true	Active	
0x500A:082	Max. angle of rotation after mains switching -2147483648.0000000000 ... [**0.0000000000**] ... 2147483647.0000000000 °		Setting of the maximum angle of rotation for the motor. • The angle of rotation must be parameterised smaller than half of the maximum display area des Gebers. • If the angle is parameterised to 0°, no check will be performed.
0x500B:081	Keep home position after mains switching		
	false	Inactive	
	true	Active	
0x500B:082	Max. angle of rotation after mains switching -2147483648.0000000000 ... [**0.0000000000**] ... 2147483647.0000000000 °		Setting of the maximum angle of rotation for the encoder. • The angle of rotation must be parameterised smaller than 50% of the maximum display area of the encoder. • If the angle is parameterised to 0°, there will be no check.

6.2.11 Limitations

6.2.11.1 Torque limits

For the axis, static torque limits can be defined which are active in normal operation. They are defined via the parameters:

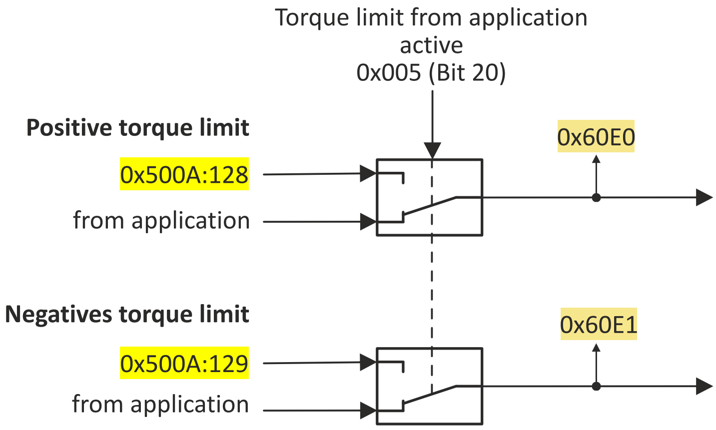
- **Positive torque limit** ▸ 0x500A:128
- **Negative torque limit** ▸ 0x500A:129

The torque limits can be deactivated in the technology application and can be replaced by alternative torque limits.

The alternative torque limits are configured in the technology application via a control word in the inverter and in the controller-based automation via the function block **L_MC1P_SetTorqueLimit**.

If the set torque limits were changed in the technology application, this will be displayed in the **Status word** parameter in bit 20. ▸ 0x500A:005 Bit 20

The torque limits currently effective in the drive are displayed in the parameters **Positive torque limit** and **Negative torque limit**. ▸ 0x60E0 ▸ 0x60E1



Parameter

Address	Name / setting range / [default setting]	Info
0x500A:013	Actual torque • Read only: x.xx Nm	
0x500A:128	Positive torque limit -3276.8 ... [**200.0**] ... 3276.7 %	
0x500A:129	Negative torque limit -3276.8 ... [**200.0**] ... 3276.7 %	Negative torque limit
0x6076	Motor rated torque 0.001 ... [**0.600**] ... 1000.000 Nm • Setting can only be changed if the inverter is inhibited.	The rated motor torque to be set here serves as a reference value for different parameters with a setting/display of a torque value in percent. Example: • Motor rated torque = 1.65 Nm • Max torque 0x6072 = 250 % Motor rated torque = 4.125 Nm
0x6077	Torque actual value • Read only: x.x %	Display of the current torque. • 100 % ≡ Rated Motor Torque. ▸ 0x6076
0x60E0	Positive torque limit 0.0 ... [**100.0**] ... 3276.7 %	Positive torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque. ▸ 0x6076
0x60E1	Negative torque limit 0.0 ... [**100.0**] ... 3276.7 %	Code previously C3687. Negative torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque ▸ 0x6076

6.2.11.2 Maximum values for travel profiles

The following parameters can be used to set maximum values for velocity, acceleration and jerk.

These parameters depend on the mechanics (e.g. the tool used).

The respective limitation is only effective if a non-zero maximum value is set.

If a generated setpoint exceeds the set maximum value (e.g. the maximum velocity), the motion axis triggers a configured error response.

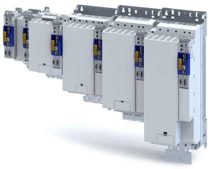
If the axis is not in a synchronised movement, the profile parameters are automatically limited to the set maximum values.

A non-synchronised movement is e.g. a positioning or the manual jog function.

A warning indicates that the profile data have been limited.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:045	Max. velocity 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:046	Max. acceleration 0.00 ... [**0.00**] ... 21474836.47		
0x500A:047	Max. jerk 0.00 ... [**0.00**] ... 21474836.47		
0x500A:106	Response to error "max. values exceeded"		
	0	No response	
	2	**Warning**	
	19	Fault > Application quick stop > Quick stop	
	21	Fault> Application quick stop > Inverter disabled	



6.2.11.3 Hardware limit switches

Connection of the hardware limit switches

The hardware limit switches are assigned to the digital inputs via the **Source for positive hardware limit switch** and **Source for negative hardware limit switch** parameters.

Limit switch source

- **Source for positive hardware limit switch** ▸ 0x5020:004
- **Source for negative hardware limit switch** ▸ 0x5020:005

The limit switch evaluation responds to a positive edge.

> If the limit switch connections for the digital inputs used are to be fail-safe, change the terminal polarity of the corresponding digital inputs.

Triggering of the hardware limit switches

If either of the hardware limit switches is triggered and the signal at the input = TRUE, the parametrised error response is executed. ▸ 0x500A:104

The error message "HWLimitPos" or "HWLimitNeg" is generated, irrespective of whether the axis is currently moving and in which direction the axis is currently moving.

Acknowledge the error in order to move the axis.

Behaviour when retracting the limit switches:

If a limit switch is triggered and the error message is acknowledged, only travel requests in the opposite direction (retracting direction) are possible. Travel requests in the direction of the limit switch are aborted in the event of an error.

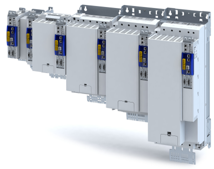
Diagnostics

Status word parameter bit 9 ▸ 0x500A:005 Bit 9

Status word parameter bit 10 ▸ 0x500A:005 Bit 10

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:104	Response to hardware limit switch error		
	19	**Fault > Application quick stop > Quick stop**	
	21	Fault> Application quick stop > Inverter disabled	
0x5020:004	Source of positive hardware limit switch		Selection of the digital inputs for the positive hardware limit switch.
	0	FALSE	Specification of the digital inputs for the positive hardware limit switch.
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	Digital input 3	
	5	**Digital input 4**	
0x5020:005	Source of negative hardware limit switch		Selection of the digital inputs for the negative hardware limit switch.
	0	FALSE	Specification of the digital inputs for the negative hardware limit switch.
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	**Digital input 3**	
	5	Digital input 4	



6.2.11.4 Software limit switches

The parameterisable software end switches limit the traversing range set via the software.

> The software end switches are not active for the "Modulo" traversing range and when a reference run is active.

In the following situations, the software end switches are evaluated, monitored, and shown in the status word when triggered: ▶ 0x500A:005 Bit 6

- The home position is known to the drive. ▶ 0x500A:005 Bit 5
- The software limit switches are effectively switched. ▶ 0x500A:050
- The monitoring was not deactivated from within the application. ▶ 0x500A:005 Bit 24

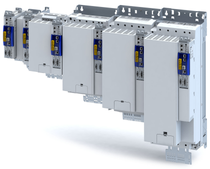
In the device states "Deactivated" or "Error stop", traversing the software limit switch does not result in an error.

If the software limit switches are exceeded, the set error response is triggered. ▶ 0x500A:105

The software limit switches can be retracted in the direction of the permitted traversing range.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:050	Enable software limit switches		
	false	Inactive	
	true	Active	
0x500A:051	Software limit switch positive -214748.3648 ... [**0.0000**] ... 214748.3647		
0x500A:052	Software limit switch negative -214748.3648 ... [**0.0000**] ... 214748.3647		
0x500A:053	Action after "software limit switch reached"		
	0	Stop after software limit switch	
	1	**Stop at software limit switch**	
0x500A:105	Response to software limit switch error		
	19	**Fault > Application quick stop > Quick stop**	
	21	Fault> Application quick stop > Inverter disa-bled	



6.2.11.5 Safety limits

The inverter has functions for supporting the safety technology. Depending on the required safety function, automatic intervention in the setpoint value generation of the axis takes place.

When safety technology is used in coupled axes, it might be required that a requested safety function does not respond within the single axes but that the responses are recognised centrally. This recognition can be realised via a virtual master.

The following safety functions can be limited or deactivated:

- Safe Torque Off (STO) 364
- Safe Stop 1 (SS1) 369
- Safe Stop 2 (SS2) 372
- Safely-Limited Speed (SLS) 1 ... 4 378
- Safe Direction (SDI) positive/negative 386

The requested safety function is displayed in the **Status limiter** parameter. 0x500A:163

The safety function can be deactivated in the **Deactivate safety functions** parameter.
0x500A:162

In the case of deactivated functions, the axis does not influence the setpoint value.

Safe stop (SSE) / Safe stop 2 (SS2)

Limited Stop 1	Limited Stop 2
Status display 0x500A:163 bit 1	Status display 0x500A:163 bit 2
Quick stop application - deceleration 0x500A:048	Quick stop application - deceleration 0x500A:048
Quick stop application - jerk 0x500A:049	Quick stop application - jerk 0x500A:049
After the standstill is reached, the drive is disabled.	The drive is braked to standstill with the parameters **Quick stop application - deceleration** und **Quick stop application - jerk**. After standstill has been reached, the position control of the drive remains active.

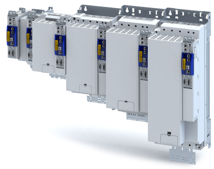
Safely limited speed (SLS) 1 ... 4

The following parameters limit the speeds and set delay times of the axis:

	Speed	Deceleration time
Limited speed 1	0x500A:150	0x500A:151
Limited speed 2	0x500A:152	0x500A:153
Limited speed 3	0x500A:154	0x500A:155
Limited speed 4	0x500A:156	0x500A:157

- If the current setpoint speed exceeds the value set for the requested limited speed, the setpoint speed is reduced to the requested limited speed within the parametrised delay time.
- If several limited speeds are requested at the same time, the lowest speed is reduced with the highest deceleration.

Status display in **Status limiter** parameter bit 4 ... bit 7. 0x500A:163



Master-slave coupling

In the event of an active master/slave coupling (e. g. synchronism or cam profiler application), the speed is not reduced automatically in the default setting. The automatic speed reduction is generally realised via the master axis.

Automatic speed reduction is activated via the **Follower - Response to SLS** parameter.
▶ 0x500A:160

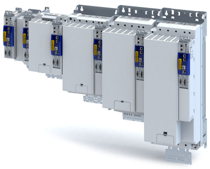
If automatic speed reduction is activated, the cyclically specified setpoint values are reduced to the limited speed. The synchronism of the master axis is no longer guaranteed.

An offset occurring between master and slave is automatically resolved by deactivating the parameter. ▶ 0x500A:159

An excessive rotational speed due to following error compensation is avoided by limiting the setpoint values at the speed regulator input. ▶ 0x500A:161

Parameter

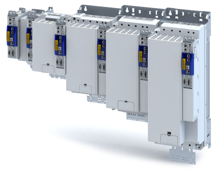
Address	Name / setting range / [default setting]		Info
0x500A:150	SLS1 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:151	SLS1 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:152	SLS2 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:153	SLS2 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:154	SLS3 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:155	SLS3 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:156	SLS4 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:157	SLS4 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:159	Compensation velocity of SLS 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:160	Follower - Response to SLS		
	false	Inactive	
	true	Active	
0x500A:161	Speed controller limitation (SLS)		
	false	Inactive	
	true	Active	
0x500A:162	Deactivate safety functions 0x00000000 ... [**0x00000000**] ... 0xFFFFFFFF		
	Bit 1	Ignore SS1 request	
	Bit 2	Ignore SS2 request	
	Bit 3	Ignore SLS1-4 request	
	Bit 4	Ignore SDI request	
0x500A:163	Limiter status • Read only		
	Bit 0	STO active	
	Bit 1	SS1 active	
	Bit 2	SS2 active	
	Bit 4	SLS1 active	
	Bit 5	SLS2 active	
	Bit 6	SLS3 active	
	Bit 7	SLS4 active	
	Bit 8	SDIpos active	
	Bit 9	SDIneg active	



6.2.12 Status signals

Parameter

Address	Name / setting range / [default setting]	Info
0x500A:004	PLCopen status • Read only	
	1 ErrorStop	
	2 Disabled	
	3 Standstill	
	4 Stopping	
	5 DiscMotion	
	6 SyncMotion	
	7 ContMotion	
	8 Homing	
	10 Service	
0x500A:005	Status word • Read only	
	Bit 0 Virtual mode active	
	Bit 1 Axis ready	
	Bit 2 Axis enabled	
	Bit 3 Warning active	
	Bit 4 Error active	
	Bit 5 Home position detected	
	Bit 6 Software limit switches enabled	
	Bit 7 Software limit switch positive	
	Bit 8 Software limit switch negative	
	Bit 9 Hardware limit switch positive	
	Bit 10 Hardware limit switch negative	
	Bit 11 STO active	
	Bit 12 Brake opened	
	Bit 13 Application quick stop active	
	Bit 14 Limitation active	
	Bit 16 "Following error" warning active	
	Bit 17 "Following error" error active	
	Bit 18 Homing active	
	Bit 19 Homing switch for touch probe active	
	Bit 20 Application torque limits	
	Bit 21 Manual jog active	
	Bit 22 Standstill active	
	Bit 23 Position setpoint reached	
	Bit 24 Switch off software limit switches	
0x500A:010	Actual position • Read only	
0x500A:011	Actual velocity • Read only	
0x500A:012	Actual acceleration • Read only	
0x500A:014	Position setpoint • Read only	
0x500A:015	Velocity setpoint • Read only	
0x500A:016	Acceleration setpoint • Read only	
0x500A:017	Torque setpoint • Read only: x.xx Nm	



Address	Name / setting range / [default setting]		Info
0x500B:005	Status word • Read only		
	Bit 1	Encoder ready	
	Bit 3	Warning active	
	Bit 4	Error active	
	Bit 5	Home position detected	
	Bit 22	Standstill active	
0x500B:010	Actual position • Read only		The current position value is resolved with 4 decimal positions.
0x500B:011	Actual velocity • Read only		The current speed value is resolved with 4 decimal positions.
0x500B:012	Actual acceleration • Read only		

6.3 Defining control sources

This chapter describes the selection of the control source for various control signals.

▸ Source of quick stop 📖 79

▸ Source of error reset 📖 79

▸ Source of digital output 1 📖 80

▸ Source of monitoring signal 📖 80

Settings in the »EASY Starter«:

- Tab **Settings** - Parameter dialog **Technology application**

6.3.1 Source of quick stop

A quick stop can be requested via the control word or via a digital input. Use the **Source for quick stop** parameter to select which input is used. ▸ 0x5020:007

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:007	Application quick stop source		Selection of the signal source for activating the quick stop.
	0	**FALSE**	
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	

6.3.2 Source of error reset

An error can be reset via the fieldbus, the system bus or via a digital input. Use the **Source for error reset** parameter to select which input is used. ▸ 0x5020:008

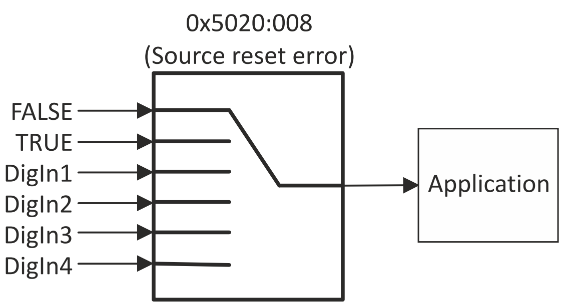


Fig. 19: "Reset error" selection

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:008	Source of fault reset		Selection of digital inputs for resetting errors.
	0	**FALSE**	
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	

6.3.3 Source of digital output 1

The signal for digital output 1 is selected via the **Source for digital output 1** parameter.
▶ 0x5020:030

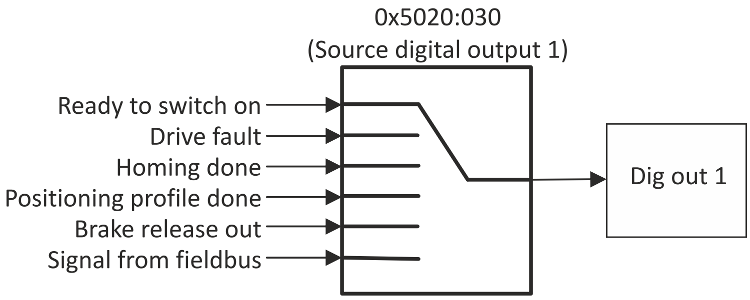


Fig. 20: Selection of "Digital output 1"

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:030	Source of digital output 1		Signal selection for the digital output 1.
	0	**Ready to switch on**	
	1	Fault	
	2	Homing done	
	3	Profile done	
	4	Brake opened	
	5	Network signal	

6.3.4 Source of monitoring signal

The source for the monitoring signal to be output is selected via the **Source for monitoring signal** parameter. The number of decimal positions transferred depends on the value selected.
▶ 0x5030:006

Parameter

Address	Name / setting range / [default setting]		Info
0x5030:006	Display value 1		
	0	**None**	
	1	Actual motor temperature	
	2	Actual motor current	
	3	DC-bus voltage	
	4	Device utilisation	
	5	Motor utilisation	
	6	Analog input 1	
0x5030:116	Display value 1 0 ... [**0**] ... 4294967295		Transmits the monitor signal assigned.

6.4 System bus communication

The system bus serves to transfer cyclic-synchronous master values. For the transfer, 8 input words and 8 output words are available, with a data width of 32 bits each. The assignment of the double words is shown in the figure "Assignment of system bus input/output".

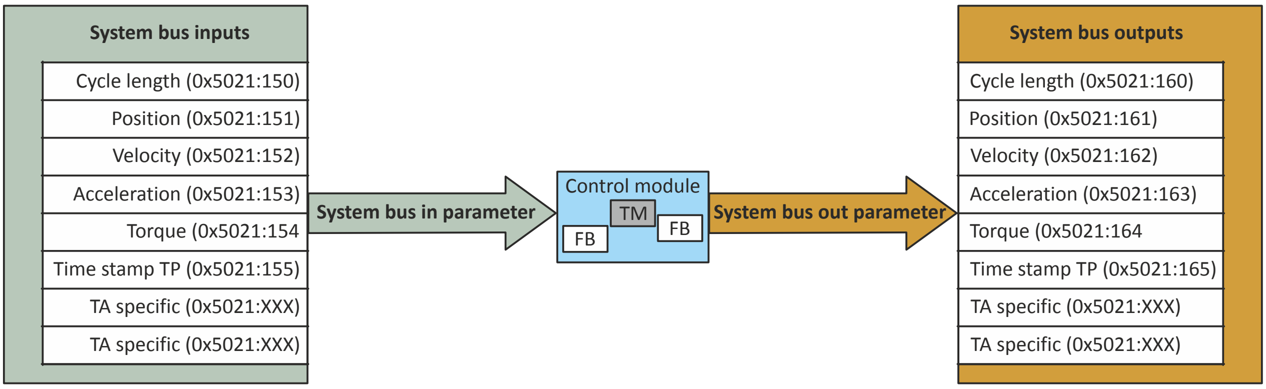


Fig. 21: Assignment of system bus inputs/outputs

Information on network configuration ▶ EtherCAT system bus 332

6.4.1 Inputs

The following parameters are available for the diagnostics of the system bus input values:

Parameter

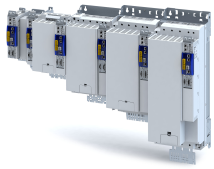
Address	Name / setting range / [default setting]	Info
0x5021:150	System bus diagnostics: Cycle length (input value) • Read only	Cycle length of the master axis
0x5021:151	System bus diagnostics: Position (input value) • Read only	Master position value
0x5021:152	System bus diagnostics: Velocity (input value) • Read only	Speed conductivity
0x5021:153	System bus diagnostics: Acceleration (input value) • Read only	Acceleration conductivity
0x5021:154	System bus diagnostics: Torque (input value) • Read only: x.xx Nm	Torque of the master axis
0x5021:155	System bus diagnostics: Time stamp (input value) • Read only: x ns	Time stamp of the master axis
0x5021:156	System bus diagnostics: Input data word 6 • Read only	This system bus input word is currently not used, but can be connected in the technology application by the user.
0x5021:157	System bus diagnostics: Input data word 7 • Read only	

6.4.2 Outputs

The following parameters are available for the diagnostics of the system bus output values:

Parameter

Address	Name / setting range / [default setting]	Info
0x5021:160	System bus diagnostics: Cycle length (output value) • Read only	Cycle length of the source set via **Master value output of system bus** 0x5020:001.
0x5021:161	System bus diagnostics: Position (output value) • Read only	Master position value of the source set via **Master value output of system bus** 0x5020:001.
0x5021:162	System bus diagnostics: Velocity (output value) • Read only	Master speed value of the source set via **Master value output of system bus** 0x5020:001.
0x5021:163	System bus diagnostics: Acceleration (output value) • Read only	Master acceleration value of the source set via **Master value output of system bus** 0x5020:001.
0x5021:164	System bus diagnostics: Torque (output value) • Read only: x.xx Nm	Torque of the master axis of the source set via **Master value output of system bus** 0x5020:001.
0x5021:165	System bus diagnostics: Time stamp (output value) • Read only: x ns	Time stamp of the touchprobe source in ns selected via **source TP1** 0x5020:011.



Address	Name / setting range / [default setting]	Info
0x5021:166	System bus diagnostics: Output data word 6 • Read only	This system bus input word is currently not used, but can be connected in the technology application by the user.
0x5021:167	System bus diagnostics: Output data word 7 • Read only	

6.4.2.1 Master value output

The system bus is used to distribute process data in a connection.

A technology application can provide its own setpoint values and actual values or the setpoint values and actual values of an optional encoder connected via the slot (B) for other technology applications. The values are transferred independently of the role of the node in the system bus (master or slave). The values are configured via the **Master value output of system bus** parameter. Every bus node sends the values.

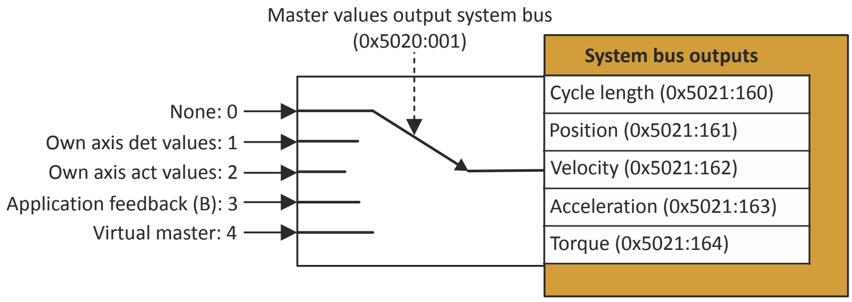


Fig. 22: Selection of the source for the master value output

"Virtual Master: 4" can be selected in the following technology applications:

- **Electronic Gearbox**
- **Sync and correction**
- **Cross cutter**

6.4.2.2 Source of touch probe time stamp

The **Touch probe system bus source** parameter serves to set the source of the touch probe time stamp. ▶ 0x5020:011

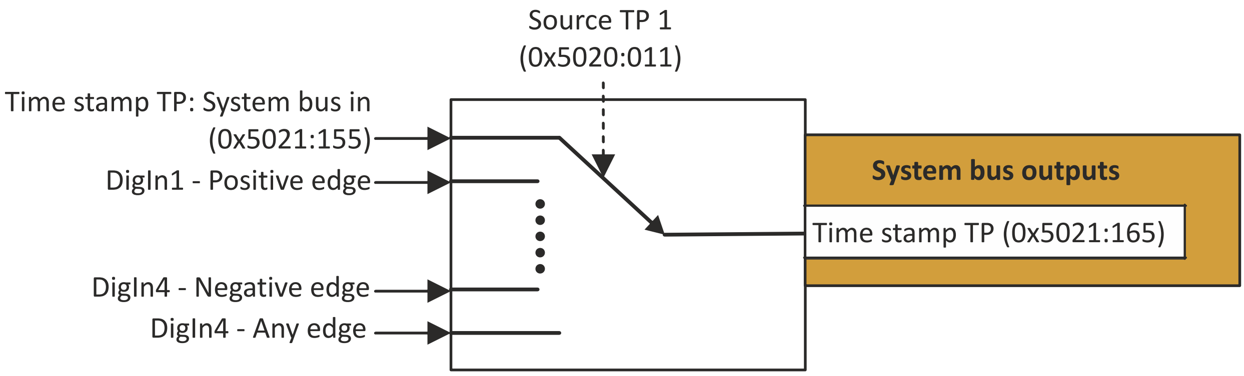
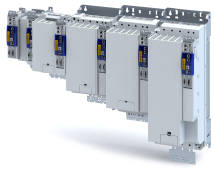


Fig. 23: Selection of the source of the touch probe time stamp

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:011	TP1 source		The sensor source and the edge to be evaluated are selected via the parameter (rising, falling, any)
	0	External source	Source: System bus
	1	Digital input 1, positive edge	
	2	Digital input 1, negative edge	
	3	Digital input 1, any edge	
	11	**Digital input 2, positive edge**	
	12	Digital input 2, negative edge	
	13	Digital input 2, any edge	
	21	Digital input 3, positive edge	
	22	Digital input 3, negative edge	
	23	Digital input 3, any edge	
	31	Digital input 4, positive edge	
	32	Digital input 4, negative edge	
	33	Digital input 4, any edge	
0x5021:155	System bus diagnostics: Time stamp (input value) • Read only: x ns		Time stamp of the master axis
0x5021:165	System bus diagnostics: Time stamp (output value) • Read only: x ns		Time stamp of the touchprobe source in ns selected via **source TP1** 0x5020:011.



6.4.3 Distribution of the master values by the master

The parameter settings for distributing the master values must be configured in the system bus master.

In standard cases, no additional configuration needs to be performed for the slaves.

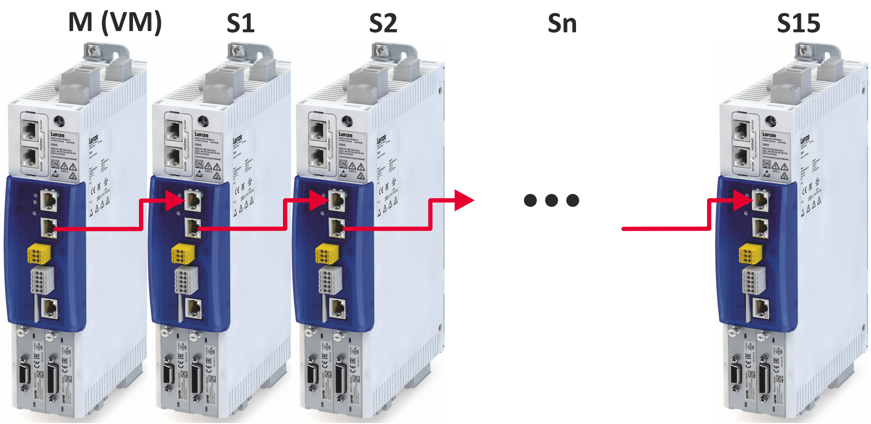


Fig. 24: Distribution of master values via the master

Application examples:

- Example: System bus master is master value master 🕮 85
- Example: System bus slave is master value master 🕮 86
- Example: Using time stamp of another axis 🕮 87

6.4.3.1 Example: System bus master is master value master

Generally, the system bus master is the master value master. All other system bus nodes (slaves) receive an identical master value from the master.

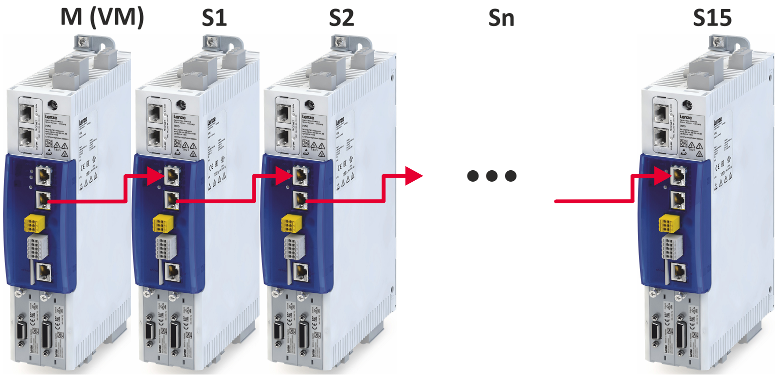


Fig. 25: Example 1 - System bus master is master value master

M	System bus master	S	Slave
VM	Virtual master		

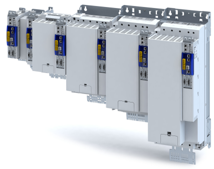
In the system bus master, the existing virtual master is used to generate master values. These generated master values constitute the master values for all system nodes so all parameters of the system bus matrix are set to "Master" (default setting).

<table>
<tr><th colspan="2">System bus
Input words</th><th>Master</th><th>Slave 1</th><th>Slave 2</th><th>...</th><th>Slave 15</th></tr>
<tr><td>00</td><td>Taktlänge der Leitachse
(0x5021:150)</td><td colspan="3" rowspan="4">0x5021:010
01: Master</td><td rowspan="8">...</td><td rowspan="4">0x5021:010
01: Master</td></tr>
<tr><td>01</td><td>Positionsleitwert
(0x5021:151)</td></tr>
<tr><td>02</td><td>Geschwindigkeitsleitwert
(0x5021:152)</td></tr>
<tr><td>03</td><td>Beschleunigungsleitwert
(0x5021:153)</td></tr>
<tr><td>04</td><td>Drehmoment der Leitachse
(0x5021:154)</td><td>0x5021:020
01: Master</td><td>0x5021:021
01: Master</td><td>0x5021:022
01: Master</td><td>0x5021:035
01: Master</td></tr>
<tr><td>05</td><td>Zeitstempel der Leitachse
(0x5021:155)</td><td>0x5021:040
01: Master</td><td>0x5021:041
01: Master</td><td>0x5021:042
01: Master</td><td>0x5021:055
01: Master</td></tr>
<tr><td>06</td><td>Free input word
(0x5021:156)</td><td>0x5021:060
01: Master</td><td>0x5021:061
01: Master</td><td>0x5021:062
01: Master</td><td>0x5021:075
01: Master</td></tr>
<tr><td>07</td><td>Free input word
(0x5021:157)</td><td>0x5021:080
01: Master</td><td>0x5021:081
01: Master</td><td>0x5021:082
01: Master</td><td>0x5021:095
01: Master</td></tr>
</table>

Tab. 2: System bus matrix

Example for interpreting the table

The "Torque of master axis (0x5021:154)" for "Slave 2" is contained in parameter 0x5021:022.



6.4.3.2 Example: System bus slave is master value master

If the system bus master is not simultaneously the master value master, the **Parameter source for words 0 ...3** parameter must be set to the corresponding source. 0x5021:010

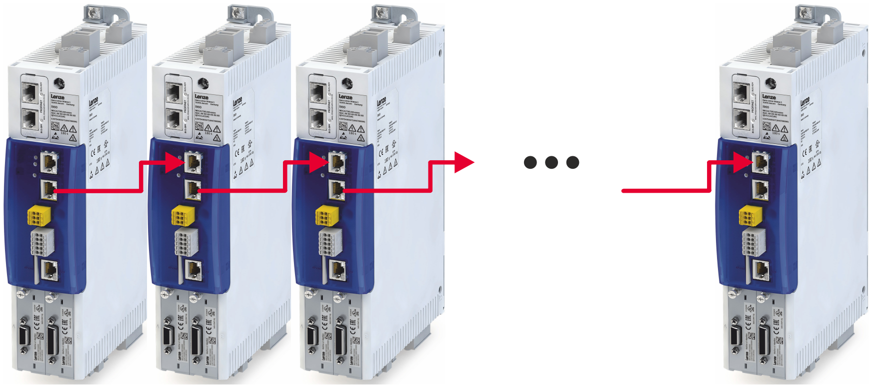


Fig. 26: Example 2 - System bus slave is master value master

M = System bus master

VM = Virtual master

S = Slave

If the virtual master for master value generation is not used in the system bus master (▸ Example: System bus master is master value master), but instead in Slave 2 (S2) the **Parameter source for words 0 ... 3** parameter must be set to **Slave 2 [3]**. 0x5021:010

<table>
<tr><th colspan="2">System bus
Input words</th><th>Master</th><th>Slave 1</th><th>Slave 2</th><th>. . .</th><th>Slave 15</th></tr>
<tr><td>00</td><td>Taktlänge der Leitachse
(0x5021:150)</td><td colspan="3" rowspan="4">0x5021: 010
03: Slave 2</td><td rowspan="8">. . .</td><td rowspan="4">0x5021:010
03: Slave 2</td></tr>
<tr><td>01</td><td>Positionsleitwert
(0x5021:151)</td></tr>
<tr><td>02</td><td>Geschwindigkeitsleitwert
(0x5021:152)</td></tr>
<tr><td>03</td><td>Beschleunigungsleitwert
(0x5021:153)</td></tr>
<tr><td>04</td><td>Drehmoment der Leitachse
(0x5021:154)</td><td>0x5021:020
01: Master</td><td>0x5021:021
01: Master</td><td>0x5021:022
01: Master</td><td>0x5021:035
01: Master</td></tr>
<tr><td>05</td><td>Zeitstempel der Leitachse
(0x5021:155)</td><td>0x5021:040
01: Master</td><td>0x5021:041
01: Master</td><td>0x5021:042
01: Master</td><td>0x5021:055
01: Master</td></tr>
<tr><td>06</td><td>Free input word
(0x5021:156)</td><td>0x5021:060
01: Master</td><td>0x5021:061
01: Master</td><td>0x5021:062
01: Master</td><td>0x5021:075
01: Master</td></tr>
<tr><td>07</td><td>Free input word
(0x5021:157)</td><td>0x5021:080
01: Master</td><td>0x5021:081
01: Master</td><td>0x5021:082
01: Master</td><td>0x5021:095
01: Master</td></tr>
</table>

6.4.3.3 Example: Using time stamp of another axis

The touch probe timestamp of the technology application **Sync and correction** (S1) is to be used by the technology application **Table Positioning** (S2). The master value master is the virtual master in the system bus master.

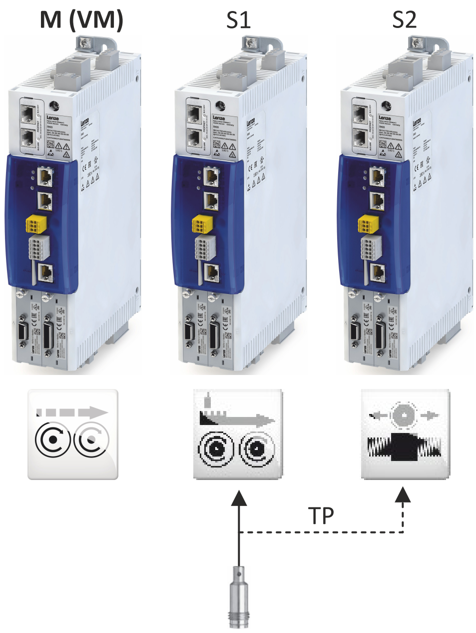


Fig. 27: Example 3 - Using the timestamp of another axis

M = System bus master

VM = Virtual master

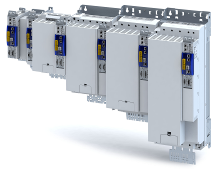
S = Slave

TP = Touch probe

In order to allow the timestamp of Slave 1 to be used by Slave 2 as well, the **Parameter source for word 5 (Slave 2)** parameter must be set to **Slave 1 [2]** (see following table). 0x5021:042

<table>
<tr><th colspan="2">System bus
Input words</th><th>Master</th><th>Slave 1</th><th>Slave 2</th><th>. . .</th><th>Slave 15</th></tr>
<tr><td>00</td><td>Taktlänge der Leitachse
(0x5021:150)</td><td rowspan="4" colspan="3">0x5021: 010
01: Master</td><td rowspan="8">. . .</td><td rowspan="4">0x5021:010
01: Master</td></tr>
<tr><td>01</td><td>Positionsleitwert
(0x5021:151)</td></tr>
<tr><td>02</td><td>Geschwindigkeitsleitwert
(0x5021:152)</td></tr>
<tr><td>03</td><td>Beschleunigungsleitwert
(0x5021:153)</td></tr>
<tr><td>04</td><td>Drehmoment der Leitachse
(0x5021:154)</td><td>0x5021:020
01: Master</td><td>0x5021:021
01: Master</td><td>0x5021:022
01: Master</td><td>0x5021:035
01: Master</td></tr>
<tr><td>05</td><td>Zeitstempel der Leitachse
(0x5021:155)</td><td>0x5021:040
01: Master</td><td>0x5021:041
01: Master</td><td>0x5021:042
02: Slave 1</td><td>0x5021:055
01: Master</td></tr>
<tr><td>06</td><td>Free input word
(0x5021:156)</td><td>0x5021:060
01: Master</td><td>0x5021:061
01: Master</td><td>0x5021:062
01: Master</td><td>0x5021:075
01: Master</td></tr>
<tr><td>07</td><td>Free input word
(0x5021:157)</td><td>0x5021:080
01: Master</td><td>0x5021:081
01: Master</td><td>0x5021:082
01: Master</td><td>0x5021:095
01: Master</td></tr>
</table>

As shown in the table, the parameters 0x5021:020 ... 095 can also be used for the distribution of the torque values and for specific data from the technology application.



7 Configuring the "Table Positioning" TA

In addition to the basic settings for kinematics and the motion functions, the technology application offers the following functions for the set-up or continuous movement of an axis:

- Positioning modes 105
- Source of hardware limit switch 109
- Positioning to torque limit 113
- Touch probe positioning 114
- Source of reference switch (touch probe) 116
- Executing and interrupting positioning 116
- Flying homing 117
- Connecting the speed override 118

The technology application can also be used for the status display, error message, or to reset an error.

Settings in »EASY Starter«:

- **Settings** tab - Parameters dialog **Technology application**
- Application selection: 0x4000

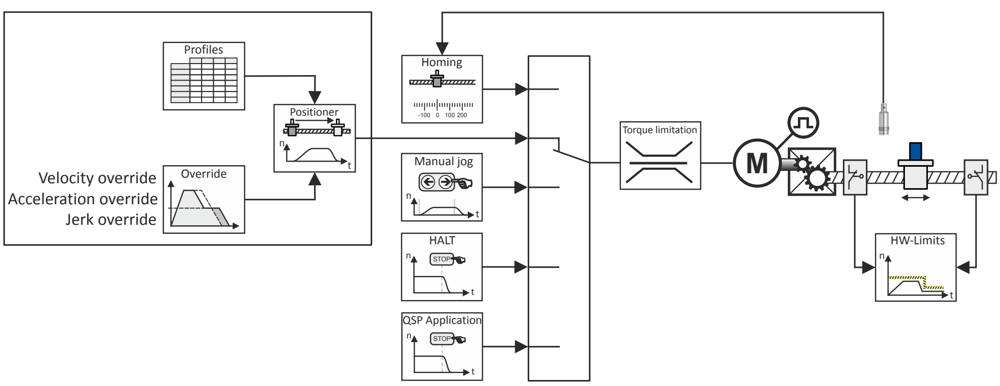
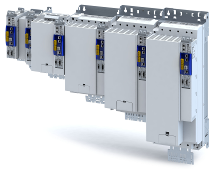


Fig. 28: "Table Positioning" technology application block diagram



Parameter

Address	Name / setting range / [default setting]		Info
0x4000	Application selection • Setting can only be changed if the inverter is inhibited.		
	0	"CiA 402" technology application	
	10	"Speed Control" technology application	
	20	**"Table Positioning" technology application**	
	40	"Electronic Gearbox" technology application	
	41	"Sync and Correction" technology application	
	50	"Winder Dancer" technology application	
	51	"Winder Tension" technology application	
	10000	"User" technology application	

7.1 Control settings

Relevant parameters of other functions

Address	Designation	Default setting	Setting range
0x4001	Interface selection	**Fieldbus network [0]**	Selection list
0x5020:004	Source of positive hardware limit switch	**Digital input 4 [5]**	Selection list
0x5020:005	Source of negative hardware limit switch	**Digital input 3 [4]**	Selection list
0x5020:006	Source of homing switch for touch probe	**Digital input 1 [2]**	Selection list
0x5020:007	Application quick stop source	**FALSE [0]**	Selection list
0x5020:008	Source of fault reset	**FALSE [0]**	Selection list
0x5020:010	Control word	**FALSE [0]**	Selection list
0x5020:011	TP1 source	**Digital input 2, positive edge [11]**	Selection list
0x5020:030	Source of digital output 1	**Ready to switch on [0]**	Selection list
0x5030:003	Effect of external torque limit	**Positive and negative direction [0]**	Selection list
0x5030:006	Display value 1	**None [0]**	Selection list
0x5030:008	Activate flying homing	**FALSE [0]**	Selection list
0x5030:009	Activate "Positive stop positioning"	**FALSE [0]**	Selection list
0x5030:150	Read external profile data in edge-controlled manner	**FALSE [0]**	Selection list

7.2 Interface

The following interfaces are available for controlling a technology application:

- Fieldbus interface [0]
- System bus interface [1]

The selection of the interface is performed in »EASY Starter«:

- Select the **Settings** tab, then the **Technology application** parameter dialog.

When changing the parameter, the inverter must be inhibited.

During a change-over, only the control and status words are switched. Depending on the technology application chosen, the bits of the respective control words and status words are already pre-assigned.

Assignment of control words and status words:

▸ Control signals 📖 92

▸ Status signals 📖 93

The following illustration shows the basic signal flow within the technology application and the change-over mechanism of the **Interface selection** parameter.

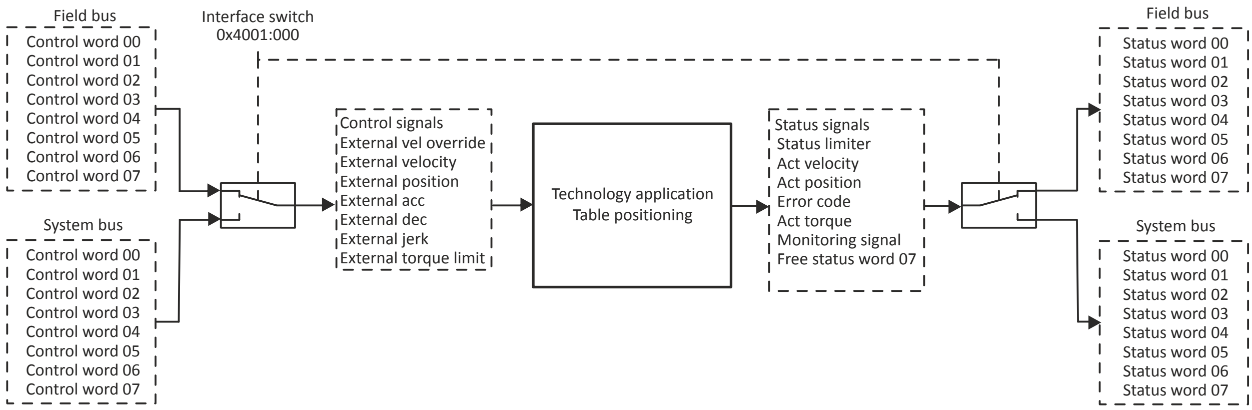


Fig. 29: Signal flow — Technology application

▸ External travel profile parameters 📖 102

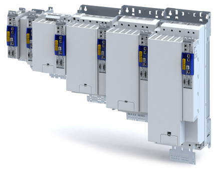
Control and status signals for fieldbus/system bus

The **Interface selection** parameter is used to select whether the technology application interface is to be controlled via the process data objects (control words) of the fieldbus or the system bus. ▸ 0x4001

- In each case, 8 control words and 8 status words are provided, with a data width of 32 bits per word.
- Depending on the setting in the **Interface selection** parameter, the status signals are also written to the fieldbus or the system bus.

Parameter

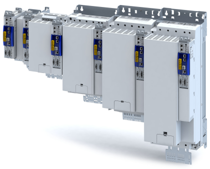
Address	Name / setting range / [default setting]		Info
0x4001	Interface selection		Selecting the interface determines the interface that receives the signals.
	0	**Fieldbus network**	Control of the application via the fieldbus.
	1	Systembus network	Activation of the application via the system bus.



7.2.1 Control signals

Parameter

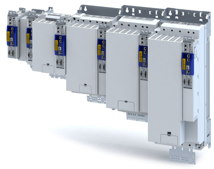
Address	Name / setting range / [default setting]	Info
0x5030:010	Control signals 0x00000000 ... [**0x00000000**] ... 0xFFFFFFFF	
	Bit 0 Control signal bit 0	This bit can be assigned to optional functions.
	Bit 1 Control signal bit 1	
	Bit 2 Activate application quick stop	Rotating drive is stopped via the QSP ramp. The drive control remains active while it is at a standstill.
	Bit 3 Enable operation	Drive is enabled. With a LOW level, a rotating drive is stopped via the quick stop ramp and inhibited at a standstill.
	Bit 4 Control signal bit 4	This bit can be assigned to optional functions.
	Bit 5 Manual jog positive	In manual operation, the drive traverses in positive direction. The positive software limit switch is taken into consideration.
	Bit 6 Manual jog negative	In manual operation, the drive traverses in negative direction. The negative software limit position is taken into consideration.
	Bit 7 Fault reset	Errors are reset when the causes are eliminated.
	Bit 8 Halt	This bit causes a stop in the applications.
	Bit 9 Start homing	Start homing.
	Bit 10 Reset home position	Reset "Home position known" status information.
	Bit 11 Control signal bit 11	This bit can be assigned to optional functions.
	Bit 12 Control signal bit 12	
	Bit 13 Activate velocity overrride	External speed override is activated.
	Bit 14 Open brake manually	Holding brake is released.
	Bit 15 Control signal bit 15	This bit is not used in the TA.
	Bit 16 Profile number bit 0	These bits are used for the bit-coded profile selection. Bit 0 represents the decimal 1. Bit 1 represents the decimal 2. Bit 2 represents the decimal 4. Bit 3 represents the decimal 8.
	Bit 17 Profile number bit 1	
	Bit 18 Profile number bit 2	
	Bit 19 Profile number bit 3	
	Bit 20 Start positioning	Positioning is started.
	Bit 21 Abort positioning	An active positioning process is aborted.
	Bit 22 Resume positioning	An interrupted positioning process is continued.
	Bit 23 Deactivate touch probe	The touch probe functionality is activated.
	Bit 24 Control signal bit 24	This bit can be assigned to optional functions.
	Bit 25 Control signal bit 25	
	Bit 26 Control signal bit 26	
	Bit 27 Control signal bit 27	
	Bit 28 Activate external set position	The external setpoint position is used as the target position.
	Bit 29 Activate external set velocity	The external profile speed is used.
	Bit 30 Activate external acceleration/deceleration/ jerk	External acceleration and decleration values and an external jerk are activated.
	Bit 31 Activate external torque limits	The external torque limits are activated.
0x5030:011	External velocity override 0.00 ... [**0.00**] ... 100.00 %	Change of the profile speed during a positioning process.
0x5030:012	External velocity -214748.3648 ... [**0.0000**] ... 214748.3647	The value of the external speed setpoint is preselected in the unit/s and has 4 decimal position.
0x5030:014	External acceleration 0.00 ... [**0.00**] ... 21474836.47	The value of the external acceleration is specified in the unit [units/s^2]. The value of the external acceleration has 2 decimal positions.
0x5030:015	External deceleration 0.00 ... [**0.00**] ... 21474836.47	The value of the external deceleration is specified in the unit [unit/s^2]. The value of the external deceleration has 2 decimal positions.
0x5030:016	External jerk -21474836.48 ... [**0.00**] ... 21474836.47	The value of the external jerk is specified in the unit [Units/s^3]. The value of the external jerk has 2 decimal positions.
0x5030:017	External torque limit 0.00 ... [**0.00**] ... 21474836.47 %	The value of the external torque limit is specified in [%], relating to the rated motor torque. ▸ 0x6076. The value has 2 decimal positions.
0x5030:023	External position setpoint -214748.3648 ... [**0.0000**] ... 214748.3647	The value of the setpoint position is specified in the unit [units]. The value of the setpoint position has 4 decimal positions.



7.2.2 Status signals

Parameter

Address	Name / setting range / [default setting]		Info
0x5030:110	Status signals 0x00000000 ... [**0x00000000**] ... 0xFFFFFFFF		
	Bit 0	Ready for operation	Axis ready for switch-on.
	Bit 1	Homing active	This status signal bit can be assigned to a function status. This status signal bit can be assigned to a function status.
	Bit 2	Operation enabled	Axis is enabled.
	Bit 3	Fault	Drive error is active.
	Bit 4	Homing done	This status signal bit can be assigned to a function status.
	Bit 5	Application quick stop active	Quick stop has been triggered.
	Bit 6	Manual jog active	Manual operation is active.
	Bit 7	Warning	Errors are reset when the causes are eliminated. A stop has been triggered in the application.
	Bit 8	Halt active	
	Bit 9	Status signal bit 9	This status signal bit can be assigned to a function status.
	Bit 10	Position setpoint reached	Actual speed complies with setpoint speed.
	Bit 11	Status signal bit 11	This status signal bit can be assigned to a function status.
	Bit 12	Standstill	Drives are at a standstill.
	Bit 13	Direction of rotation inverted	Direction of rotation is inverted.
	Bit 14	Brake opened	Holding brake is released.
	Bit 15	STO active	Safe Torque Off is active.
	Bit 16	Active profile bit 0	Profile number 1 selected.
	Bit 17	Active profile bit 1	Profile number 2 selected.
	Bit 18	Active profile bit 2	Profile number 4 selected.
	Bit 19	Active profile bit 3	Profile number 8 selected.
	Bit 20	Positioning profile busy	Positioning is active.
	Bit 21	Positioning profile done	Positioning is completed.
	Bit 22	Negative hardware limit switch active	The negative hardware limit switch has been triggered.
	Bit 23	Positive hardware limit switch active	The positive hardware limit switch has been triggered.
	Bit 24	Touch probe detected	Touch probe has been detected.
	Bit 25	Status signal bit 25	This status signal bit can be assigned to a function status.
	Bit 26	Status signal bit 26	
	Bit 27	Status signal bit 27	
	Bit 28	External position active	External position is activated.
	Bit 29	External velocity active	External speed is activated.
	Bit 30	External acceleration/deceleration/jerk active	External acceleration and deceleration values are activated.
	Bit 31	External torque active	External torque limit is activated.



Address	Name / setting range / [default setting]		Info
0x5030:111	Status signals limiter 0x00000000 ... [**0x00000000**] ... 0xFFFFFFFF		
	Bit 0	STO active	Safe torque off.
	Bit 1	SS1 active	Quick stop with subsequent inverter disable has been requested.
	Bit 2	SS2 active	Quick stop requested.
	Bit 3	SOS active	Safe operational stop (SOS) function is activated. The safe operational stop is monitored. The function is activated after the Safe stop 2 (SS2) has elapsed.
	Bit 4	SLS1 active	Request limited speed 1. The travel profile changes according to the parameters of speed 1 set.
	Bit 5	SLS2 active	Request limited speed 2. The travel profile changes according to the parameters of speed 2 set.
	Bit 6	SLS3 active	Request limited speed 3. The travel profile changes according to the parameters of speed 3 set.
	Bit 7	SLS4 active	Request limited speed 4. The travel profile changes according to the parameters of speed 4 set.
	Bit 8	SDpos active	Allow positive direction of rotation.
	Bit 9	SDneg active	Allow negative direction of rotation.
	Bit 10	SLI active	Safely limited increment (SLI) function is activated. Note: This function is not supported!
	Bit 11	SSE active	Safe stop emergency (SSE) function is activated.
	Bit 12	Button S82 active	Enable switch (ES) function for motion function in special operation is activated. Note: This function is not supported!
	Bit 13	Operation modes selector (OMS) active	Operation mode selector (OMS) function for special operation has been requested. Note: This function is not supported!
0x5030:112	Actual velocity -214748.3648 ... [**0.0000**] ... 214748.3647		Actual velocity is specified in the unit [units/s]. The speed is given with 4 decimal positions.
0x5030:114	Error code -2147483648 ... [**0**] ... 2147483647		Display of the current error number.
0x5030:115	Actual torque -21474836.48 ... [**0.00**] ... 21474836.47 Nm		The drive-end actual torque is specified in the unit [Nm]. The torque is specified with 2 decimal positions.
0x5030:116	Display value 1 0 ... [**0**] ... 4294967295		Transmits the monitor signal assigned.
0x5030:117	Status word 7 0 ... [**0**] ... 4294967295		This word is not used in the application.
0x5030:123	Actual position -214748.3648 ... [**0.0000**] ... 214748.3647		The current actual position is specified in the unit [unit]. The position is given with 4 decimal positions.
0x5030:150	Read external profile data in edge-controlled manner		Acceptance of the profile data preselected externally.
	0	**FALSE**	The external profile data are directly accepted.
	1	TRUE	The external profile data are only accepted with control bit 20 = TRUE.

7.2.3 Simulation of the interface

The technology interface is simulated (manually operated) via the parameters **Manual control (bits 0 ... 7)** and **Simulation of status signals (bit 0)**.

Status bit 0 activates the simulation of the entire technology interface and changes over all control words. Data from the fieldbus/system bus no longer enter the technology application. Via the control bits 1 ... 7, individual control words can once again be connected to the field-bus/system bus.

Change-over parameters

- Status bit 0 ▸ 0x5030:101
- Control bits 1 ... 7 ▸ 0x5030:001

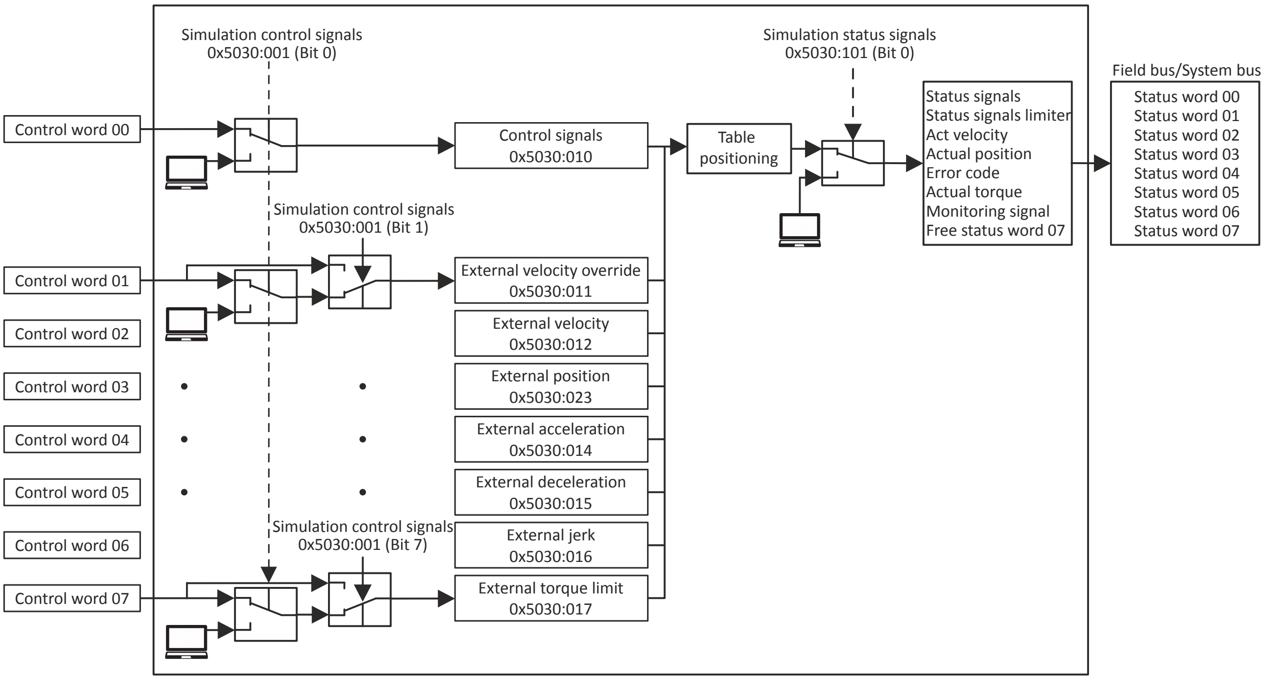
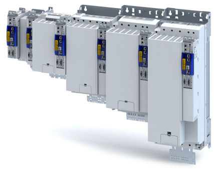
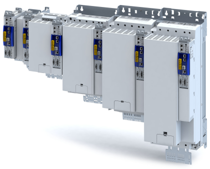


Fig. 30: Signal flow in the simulation of the technology interface



Parameter

Address	Name / setting range / [default setting]		Info
0x5030:001	Simulation of control signals 0x00 ... [**0x00**] ... 0xFF		
	Bit 0	Enable control signal simulation	TRUE: The simulation of the control signals is activated. FALSE: The control signals are transferred via the fieldbus/system bus interface.
	Bit 1	Activate simulation of control word 1	TRUE: The simulation of control word 1 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 2	Activate simulation of control word 2	TRUE: The simulation of control word 2 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 3	Activate simulation of control word 3	TRUE: The simulation of control word 3 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 4	Activate simulation of control word 4	TRUE: The simulation of control word 4 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 5	Activate simulation of control word 5	TRUE: The simulation of control word 5 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 6	Activate simulation of control word 6	TRUE: The simulation of control word 6 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
	Bit 7	Activate simulation of control word 7	TRUE: The simulation of control word 7 is activated. FALSE: The control word is transmitted via the fieldbus/system bus interface.
0x5030:101	Simulation of status signals 0x00 ... [**0x00**] ... 0xFF		Simulation status signals - positioner as follower
	Bit 0		



7.3 Travel profiles

The application enables the use of maximally 15 different travel profiles. A travel profile describes a motion task for the positioning. The motion task is converted into a rotary motion.

Settings in the »EASY Starter«:

- Tab **Settings** - Parameter dialog **Profiles**

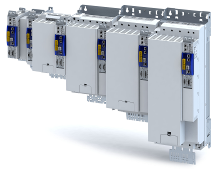
Select profile

A profile is selected bit-coded:

Profile	0x5030:010			
	Bit 19	Bit 18	Bit 17	Bit 16
No profile selected	FALSE	FALSE	FALSE	FALSE
Profile 1	FALSE	FALSE	FALSE	TRUE
Profile 2	FALSE	FALSE	TRUE	FALSE
Profile 3	FALSE	FALSE	TRUE	TRUE
Profile 4	FALSE	TRUE	FALSE	FALSE
Profile 5	FALSE	TRUE	FALSE	TRUE
Profile 6	FALSE	TRUE	TRUE	FALSE
Profile 7	FALSE	TRUE	TRUE	TRUE
Profile 8	TRUE	FALSE	FALSE	FALSE
Profile 9	TRUE	FALSE	FALSE	TRUE
Profile 10	TRUE	FALSE	TRUE	FALSE
Profile 11	TRUE	FALSE	TRUE	TRUE
Profile 12	TRUE	FALSE	FALSE	FALSE
Profile 13	TRUE	TRUE	FALSE	FALSE
Profile 14	TRUE	TRUE	TRUE	FALSE
Profile 15	TRUE	TRUE	TRUE	TRUE

Relevant parameters of other functions

Address	Designation	Default setting	Setting range
0x5031:021, 032, 043, 054, 065, 076, 087, 098, 109, 120, 131, 142, 153, 164, 175	Positioning mode	**absolute [0]**	Selection list



7.3.1 Technology application travel profile parameters

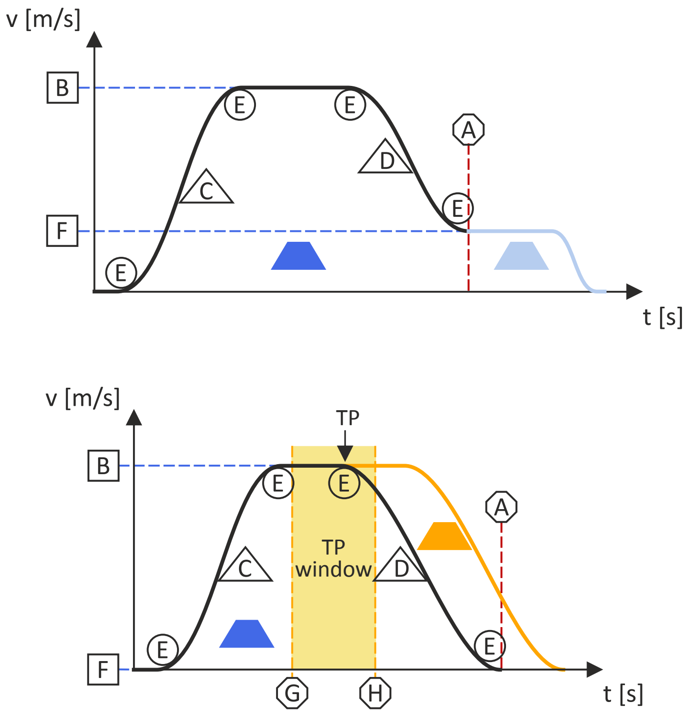
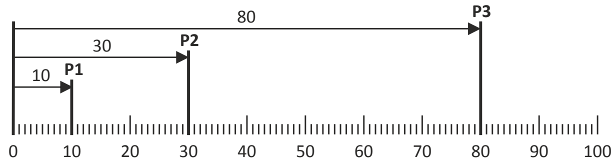
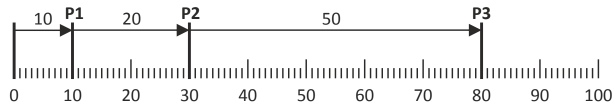
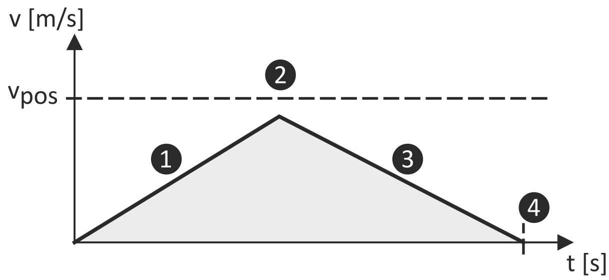


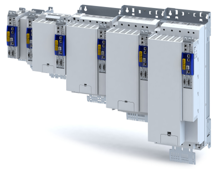
Fig. 31: Profile types

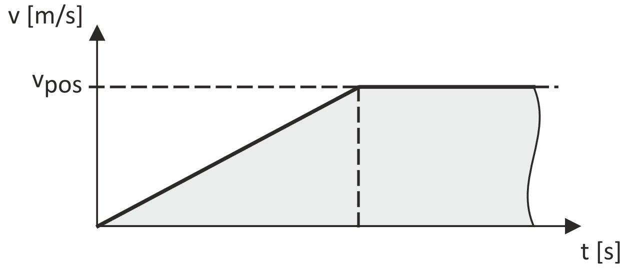
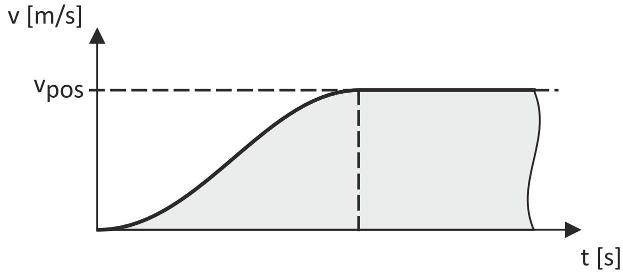
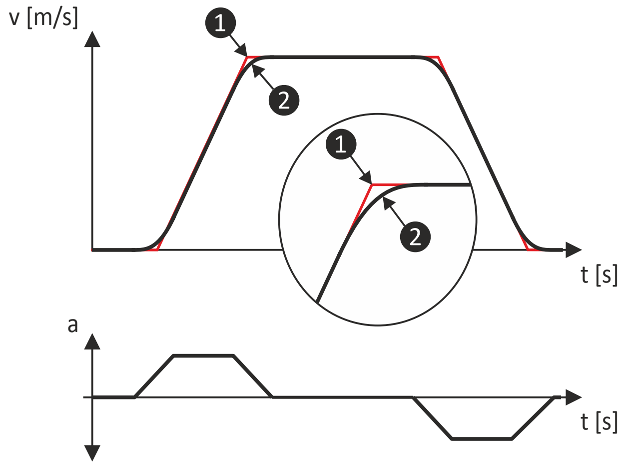
Symbol	Description
	Start profile Number of the travel profile executed first (1 ... 15), which consists of 0x5030:010, bit 16 ... 19.
	Sequence profile 1 ... 15
	Sequence profiles after TP 1 ... 15
A	**Profile position 1 ... 15**
B	**Profile speed 1 ... 15**
C	**Profile acceleration 1 ... 15**
D	**Profile deceleration 1 ... 15**
E	**Profile jerk 1 ... 15**
F	**Final speed 1 ... 15**
G	**Profile touch probe window - lower limit**
H	**Profile touch probe window - upper limit**

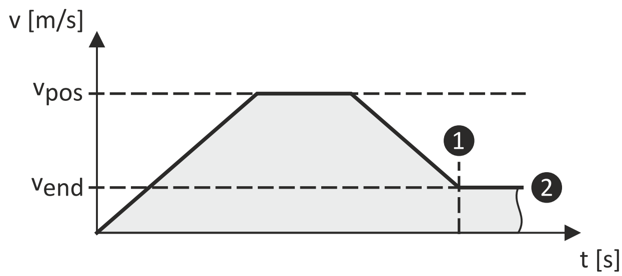
Travel profile selection: Travel profiles 97

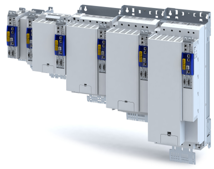
Parameter

Address	Name / setting range / [default setting]	Info
0x5031:022, 033, 044, 055, 066, 077, 088, 099, 110, 121, 132, 143, 154, 165, 176	Profile position -214748.3648 ... [**360.0000**] ... 214748.3647	Target position or distance to be travelled. The target position is given in an absolute or relative manner. • The absolute position is the distance from the zero position to the target position • The home position for the absolute position is the zero position.  • The relative position considers the current position at the starting time of the travel command. • The home position for the starting point of the distance is the target position of the previously executed travel profile. 
0x5031:023, 034, 045, 056, 067, 078, 089, 100, 111, 122, 133, 144, 155, 166, 177	Profile velocity -214748.3648 ... [**360.0000**] ... 214748.3647	Maximum speed at which the target position is approached. The maximum speed depends on the target position, the acceleration and the deceleration. If the graph is a triangle, the drive has not reach the maximum speed.  1 Acceleration 2 Maximum speed 3 Deceleration 4 Target position



Address	Name / setting range / [default setting]	Info
0x5031:024, 035, 046, 057, 068, 079, 090, 101, 112, 123, 134, 145, 156, 167, 178	Profile acceleration -21474836.48 ... [**720.00**] ... 21474836.47	Acceleration to reach the maximum speed. The following acceleration types are distinguished: • Linearly increasing acceleration  • Acceleration increasing in S-shape 
0x5031:025, 036, 047, 058, 069, 080, 091, 102, 113, 124, 135, 146, 157, 168, 179	Profile deceleration -21474836.48 ... [**720.00**] ... 21474836.47	Deceleration to brake from the maximum speed to standstill.
0x5031:026, 037, 048, 059, 070, 081, 092, 103, 114, 125, 136, 147, 158, 169, 180	Profile jerk -21474836.48 ... [**7200.00**] ... 21474836.47	Jerk limitation for the acceleration and deceleration. If a jerk limitation is given for a travel profile, the acceleration and deceleration are executed via S-shaped ramps. • S-shaped ramps protect machine parts from damages. • The S-shaped acceleration and deceleration extend the duration of positioning compared to linear acceleration and deceleration.  ❶ Profile without jerk limitation ❷ Profile with jerk limitation

Address	Name / setting range / [default setting]	Info
0x5031:027, 038, 049, 060, 071, 082, 093, 104, 115, 126, 137, 148, 159, 170, 181	Final velocity -214748.3648 ... [**0.0000**] ... 214748.3647	Final speed the drive uses to execute the next travel profile after reaching the target position. • When the target position has been reached, the next travel profile is executed without braking the drive to a standstill at the target position. • The final speed can be used to execute a velocity changeover.  1 Target position 2 Final speed
0x5031:028, 039, 050, 061, 072, 083, 094, 105, 116, 127, 138, 149, 160, 171, 182	Profile TP window - lower limit -214748.3648 ... [**0.0000**] ... 214748.3647	Lower limit value for the touch probe window. Above this position, touch probe evaluation is active.
0x5031:029, 040, 051, 062, 073, 084, 095, 106, 117, 128, 139, 150, 161, 172, 183	Profile TP window - upper limit -214748.3648 ... [**0.0000**] ... 214748.3647	Upper limit value for the touch probe window. Below this position, touch probe evaluation is active.
0x5031:030, 041, 052, 063, 074, 085, 096, 107, 118, 129, 140, 151, 162, 173, 184	Sequence profile after TP 0 ... [**0**] ... 65535	Number of the profile data set (1 ... 15) that is executed if a touch probe has been detected. With the setting 0, no travel profile is executed after a touch probe has been detected.
0x5031:031, 042, 053, 064, 075, 086, 097, 108, 119, 130, 141, 152, 163, 174, 185	Sequence profile 0 ... [**0**] ... 65535	Number of the profile data set (1 ... 15) that is executed subsequently to the current travel profile. With the setting 0, no further travel profile is executed.
0x5032:012	Active profile: acceleration setpoint • Read only	The acceleration setpoint is specified in the unit [unit/s^2]. The acceleration setpoint is terminated with 2 decimal positions.
0x5032:013	Active profile: deceleration setpoint • Read only	The deceleration setpoint is specified in the unit [unit/s^2]. The deceleration setpoint is terminated with 2 decimal positions.
0x5032:014	Active profile: jerk setpoint • Read only	The jerk setpoint is specified in the unit [unit/s^2]. The jerk setpoint is terminated with 2 decimal positions.
0x5032:015	Active profile: Velocity setpoint • Read only	The profile setpoint speed is given in the unit [unit/s]. The value of the profile setpoint speed is displayed with 4 decimal positions.
0x5032:020	Active profile: position setpoint • Read only	The position setpoint is specified in the unit [unit]. The position setpoint is terminated with 4 decimal positions.
0x5032:025	Selected profile • Read only	



7.3.2 External travel profile parameters

External travel profile parameters can be transferred via the network interface.

The travel profile to be changed can be selected in the **Control signals** parameter.
▸ 0x5030:010, Bit 16 ... Bit 19

> The selected travel profile defines the external travel profile parameters.
>
> Existing data in the selected travel profile are overwritten when the external values are accepted.

In the selected profile data set, the following parameters can be replaced by external profile data:

1. External position: **Activate external setpoint position** ▸ 0x5030:010, bit 28
2. External speed: **Activate external setpoint speed** ▸ 0x5030:010, bit 29
3. External acceleration, deceleration and jerk: **Activate external acceleration/deceleration/jerk** ▸ 0x5030:010, bit 30

The parameters can be combined. This makes it possible to change just the external setpoint position or to accept all external setpoints within the profile.

Alternatively, the acceptance of the profile data can be linked to the level of the **Start positioning** bit. 0x5030:010 Bit 20

This can be activated with the **Read external profile data in edge-controlled manner** selection parameter. ▸ 0x5030:150

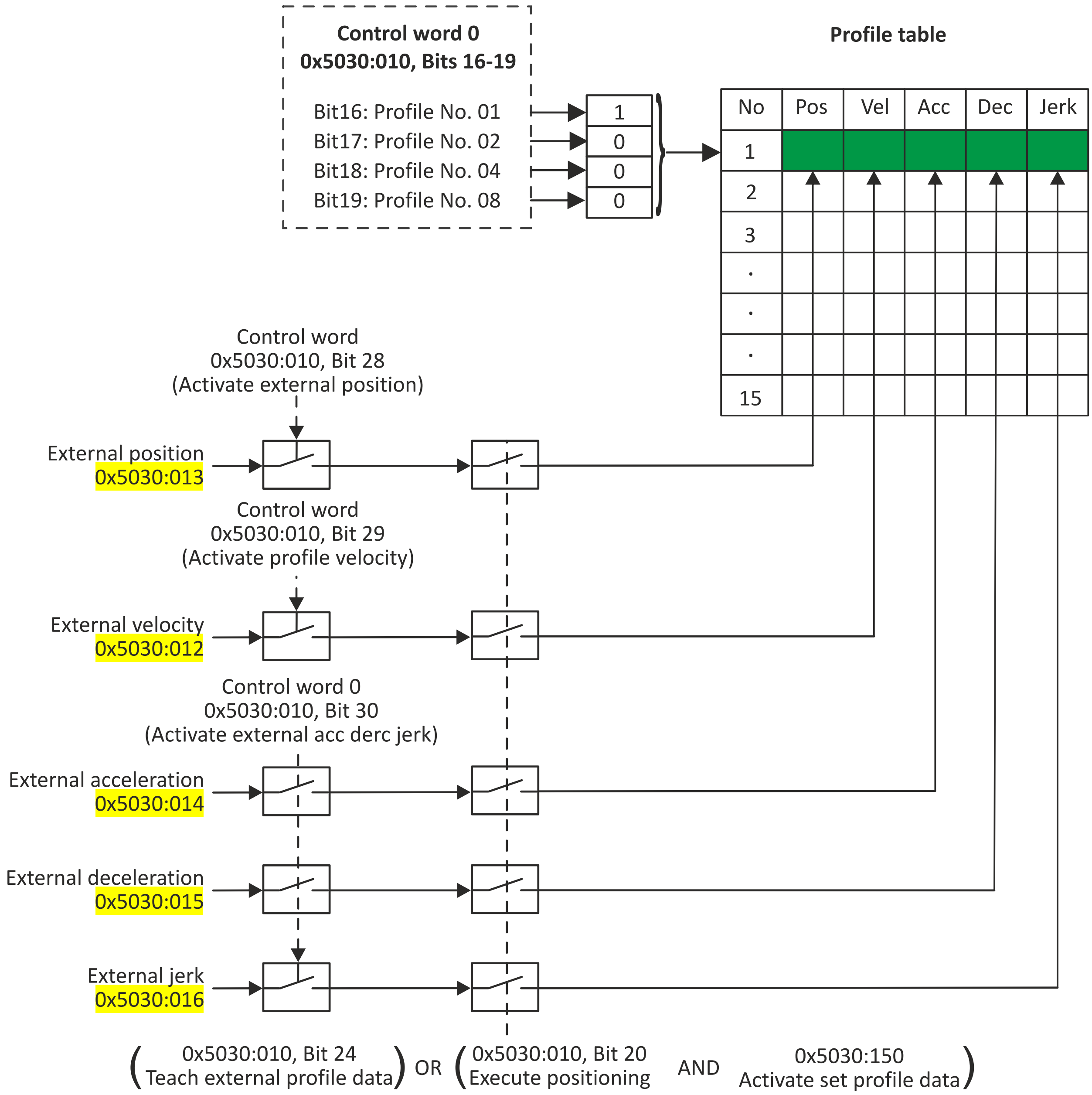
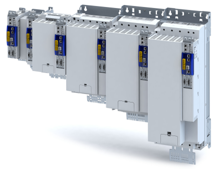


Fig. 32: Accepting external profile data

Parameter

Address	Name / setting range / [default setting]		Info
0x5030:012	External velocity -214748.3648 ... **[0.0000]** ... 214748.3647		The value of the external speed setpoint is preselected in the unit/s and has 4 decimal position.
0x5030:014	External acceleration 0.00 ... **[0.00]** ... 21474836.47		The value of the external acceleration is specified in the unit [units/s^2]. The value of the external acceleration has 2 decimal positions.
0x5030:015	External deceleration 0.00 ... **[0.00]** ... 21474836.47		The value of the external deceleration is specified in the unit [unit/s^2]. The value of the external deceleration has 2 decimal positions.
0x5030:016	External jerk -21474836.48 ... **[0.00]** ... 21474836.47		The value of the external jerk is specified in the unit [Units/s^3]. The value of the external jerk has 2 decimal positions.
0x5030:023	External position setpoint -214748.3648 ... **[0.0000]** ... 214748.3647		The value of the setpoint position is specified in the unit [units]. The value of the setpoint position has 4 decimal positions.
0x5030:150	Read external profile data in edge-controlled manner		Acceptance of the profile data preselected externally.
	0	**FALSE**	The external profile data are directly accepted.
	1	TRUE	The external profile data are only accepted with control bit 20 = TRUE.



7.3.3 Travel profile linkage

In the profile data set (profile no. 1 ... 15), the profile data of the sequence profile are stored and executed after the standard profile has been executed. This is called **profile linkage**.

The sequence profile is also executed in a touch probe positioning if no touch probe has been detected within the touch probe window.

Relevant parameters of other functions

Address	Designation	Default setting	Setting range
0x5030:011	External velocity override	**0.00 %**	0.00 ... 100.00 %
0x5030:012	External velocity	**0.0000**	-214748.3648 ... 214748.3647
0x5030:014	External acceleration	**0.00**	0.00 ... 21474836.47
0x5030:015	External deceleration	**0.00**	0.00 ... 21474836.47
0x5030:016	External jerk	**0.00**	-21474836.48 ... 21474836.47
0x5030:023	External position setpoint	**0.0000**	-214748.3648 ... 214748.3647
0x5030:150	Read external profile data in edge-controlled manner	**FALSE [0]**	Selection list
0x5032:012	Active profile: acceleration setpoint	- (Read only)	
0x5032:013	Active profile: deceleration setpoint	- (Read only)	
0x5032:014	Active profile: jerk setpoint	- (Read only)	
0x5032:015	Active profile: Velocity setpoint	- (Read only)	
0x5032:020	Active profile: position setpoint	- (Read only)	
0x5032:025	Selected profile	- (Read only)	
0x5032:027	Velocity override setpoint	- (Read only)	

7.4 Signal flow

Settings in »EASY Starter«:

- **Settings** tab - Parameters dialog **Signal flow**

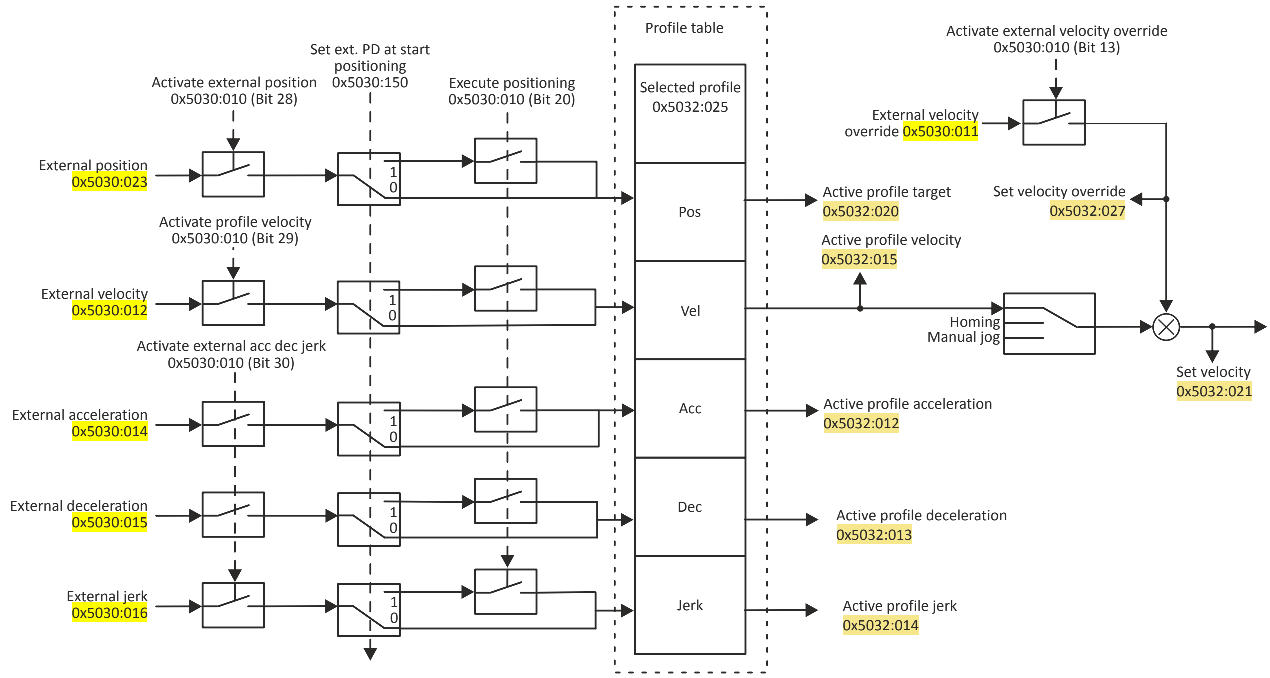


Fig. 33: Signal flow

7.5 Functions

The following sections describe in detail the configuration of the single subfunctions of the technology application.

- Positioning modes 📖 105
- Positioning to torque limit 📖 113
- Touch probe positioning 📖 114
- Executing and interrupting positioning 📖 116
- Flying homing 📖 117
- Connecting the speed override 📖 118

7.5.1 Positioning modes

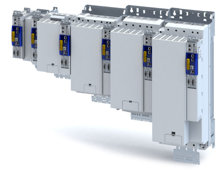
In the following sections, the travel profiles 1 ... 15 and their positioning modes are described.

- Absolute positioning 📖 106
- Absolute positioning in clockwise direction 📖 106
- Absolute positioning in anti-clockwise direction 📖 107
- Relative positioning 📖 107
- Continuous positioning 📖 107
- Positioning with final velocity 📖 108

The positioning modes for the travel profiles are defined via the following parameters.

Parameter

Address	Name / setting range / [default setting]		Info
0x5031:021, 032, 043, 054, 065, 076, 087, 098, 109, 120, 131, 142, 153, 164, 175	Positioning mode		Profile modes of the corresponding profile data set.
	0	**absolute**	Absolute positioning.
	1	relative	Relative positioning.
	2	velocity	Positioning with speed.
	3	absolute_CW_modulo	Clockwise absolute positioning.



Address	Name / setting range / [default setting]		Info
	4	absolute_CCW_modulo	Counter-clockwise absolute positioning.

7.5.1.1 Absolute positioning

The axis travels to an absolute position.

- The absolute position describes the distance between the zero position and the target position.
- The home position for the absolute position is the zero position.

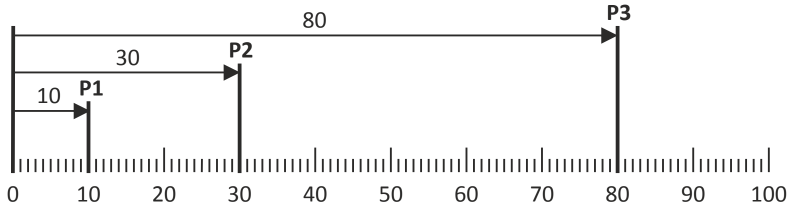


Fig. 34: Absolute positioning in linear measurement system

The rotary table positioning is an absolute positioning with target positions between 0 and 360 angular degrees [°]. In this mode the zero point can be overtravelled if this is the shortest way to the target position.

- The home position must be known.

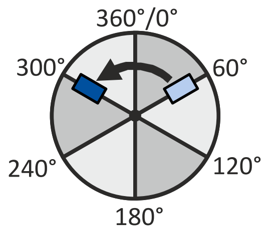


Fig. 35: Absolute positioning in Modulo measurement system

7.5.1.2 Absolute positioning in clockwise direction

The axis travels to an absolute position in a CW direction.

- Only applicable in Modulo measuring system (rotary table application).
- The home position for the absolute position is the zero position.
- The home position must be known.

For an absolute positioning in a CW direction, the zero position of the axis can be overtravelled.

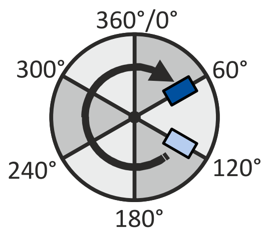


Fig. 36: Example for positioning in a clockwise direction

7.5.1.3 Absolute positioning in anti-clockwise direction

The axis travels to an absolute position in a CCW direction.

- Can only be used for Modulo measuring system (rotary table application).
- The home position for the absolute position is the zero position.
- The home position must be known.

For an absolute positioning in a CCW direction, the zero position of the axis can be overtravelled.

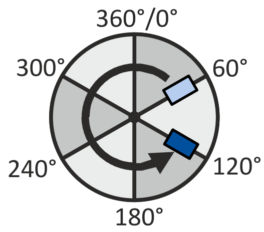


Fig. 37: Example for positioning in a CCW direction

7.5.1.4 Relative positioning

The axis travels a defined distance.

- The relative position is given by the distance between the start position and the target position. This means: Relative position = target position – start position.
- The home position for the starting point of the distance is the target position of the travel profile executed previously.

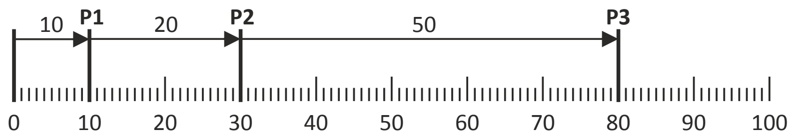


Fig. 38: Relative positioning

7.5.1.5 Continuous positioning

This mode does not require a predefined position, but instead follows the profile parameters.

- The acceleration and the deceleration are based on the profile parameters **real acceleration** and **real deceleration**.
- The travel direction is defined by the sign of the travelling speed. A positive value signifies travel in the clockwise direction.

The travel is stopped by means of a control bit:

- **Abort positioning**, ▸ 0x5030:010, bit 21 = TRUE
- **Stop**, ▸ 0x5030:010, bit 8 = TRUE

▸ Executing and interrupting positioning 116

7.5.1.6 Positioning with final velocity

For almost all positioning modes, a final speed can be parameterised for the travel profile.

This does not apply for the following positioning modes:

- Continuous positioning with constant speed
- Continuous positioning with touch probe

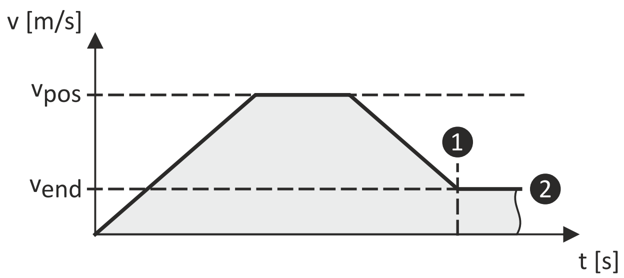


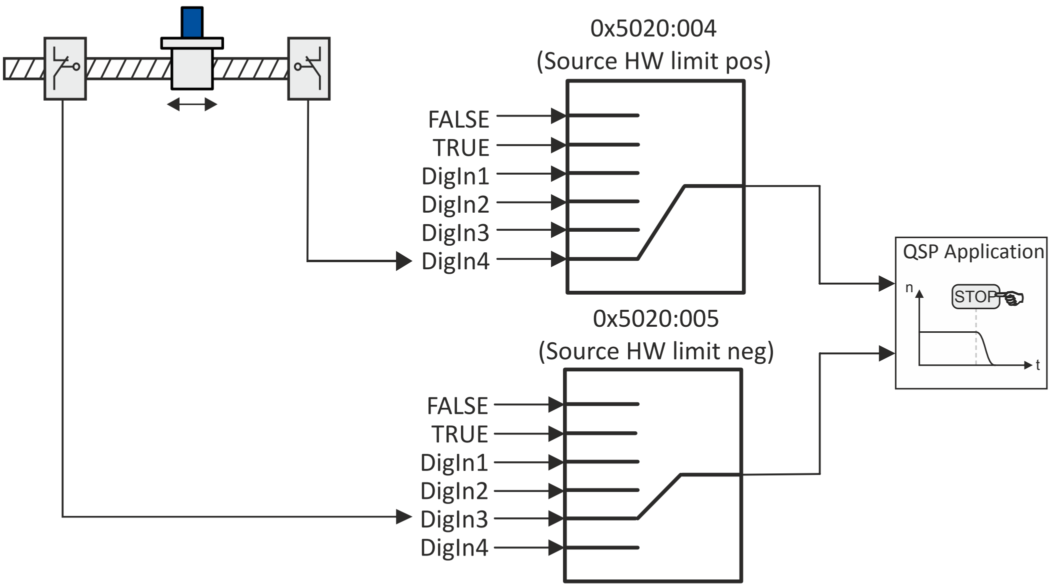
Fig. 39: Velocity changeover or overtaking

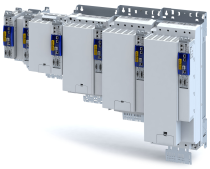
1	Target position	2	Final speed

The selected profile is travelled. The drive has reached the final speed when the target position is reached.

7.5.2 Source of hardware limit switch

The hardware limit switches are defined via the **Source for positive hardware limit switch** and **Source for negative hardware limit switch** parameters. ▸ 0x5020:004 ▸ 0x5020:005


0x5020:004
(Source HW limit pos)
FALSE
TRUE
DigIn1
DigIn2
DigIn3
DigIn4
0x5020:005
(Source HW limit neg)
FALSE
TRUE
DigIn1
DigIn2
DigIn3
DigIn4
QSP Application
n
STOP
t



Parameter

Address	Name / setting range / [default setting]		Info
0x5020:004	Source of positive hardware limit switch		Selection of the digital inputs for the positive hardware limit switch.
	0	FALSE	Specification of the digital inputs for the positive hardware limit switch.
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	Digital input 3	
	5	**Digital input 4**	
0x5020:005	Source of negative hardware limit switch		Selection of the digital inputs for the negative hardware limit switch.
	0	FALSE	Specification of the digital inputs for the negative hardware limit switch.
	1	TRUE	
	2	Digital input 1	
	3	Digital input 2	
	4	**Digital input 3**	
	5	Digital input 4	

7.5.3 External torque limitation

An external torque limit is defined via the **External torque limit** parameter. ▶ 0x5030:017

The external torque limit is activated with bit 31 of the **Control signal** parameter.
▶ 0x5030:010

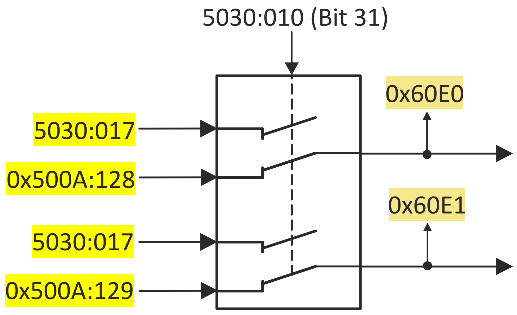
Bit 31 of the **Status signals** parameter indicates whether the external torque limit is active.
▶ 0x5030:110

As long as the external torque limit remains inactive, the two parameters **Positive torque limit** and **Negative torque limit** define what torque limits apply. ▶ 0x500A:128 ▶ 0x500A:129

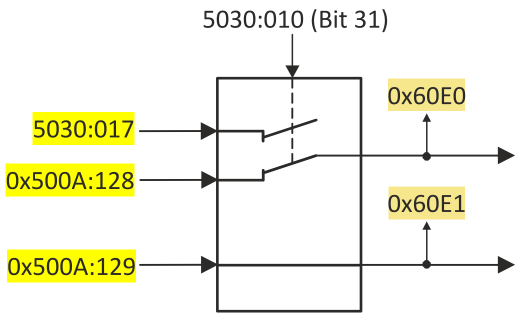
The function mode of the external torque limit is set via the **Impact of external speed limit** parameter. ▶ 0x5030:003

The following settings are possible via this parameter:

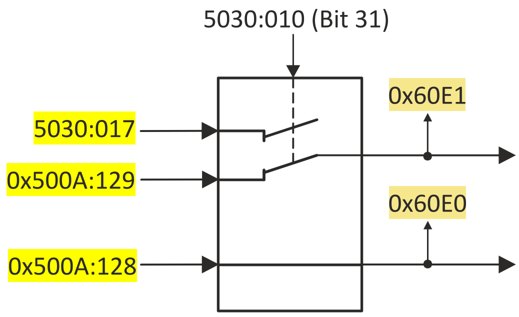
0x5030:003 = 0: Setting affects the positive and negative torque limit



0x5030:003 = 1: Setting affects the positive torque limit

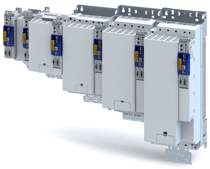


0x5030:003 = 2: Setting affects the negative torque limit



Parameter

Address	Name / setting range / [default setting]	Info
0x500A:128	Positive torque limit -3276.8 ... [**200.0**] ... 3276.7 %	
0x500A:129	Negative torque limit -3276.8 ... [**200.0**] ... 3276.7 %	Negative torque limit



Address	Name / setting range / [default setting]		Info
0x5030:003	Effect of external torque limit		Validity external torque limit
	0	**Positive and negative direction**	
	1	Positive direction	
	2	Negative direction	
0x5030:017	External torque limit 0.00 ... [**0.00**] ... 21474836.47 %		The value of the external torque limit is specified in [%], relating to the rated motor torque. ▸ 0x6076. The value has 2 decimal positions.
0x5030:115	Actual torque -21474836.48 ... [**0.00**] ... 21474836.47 Nm		The drive-end actual torque is specified in the unit [Nm]. The torque is specified with 2 decimal positions.
0x60E0	Positive torque limit 0.0 ... [**100.0**] ... 3276.7 %		Positive torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque. ▸ 0x6076
0x60E1	Negative torque limit 0.0 ... [**100.0**] ... 3276.7 %		Code previously C3687. Negative torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque ▸ 0x6076

7.5.4 Positioning to torque limit

Positioning at the torque limit makes it possible to perform positioning against an obstacle. This is e.g. necessary for pressing materials. When this function is activated, the assigned control bit has the level high, and the following error is constantly ignored during positioning. When the function is deactivated, the following error is deleted. The function is activated via a selectable bit in the control signal.

The following signals are available for activating the function:

Parameter

Address	Name / setting range / [default setting]		Info
0x5030:009	Activate "Positive stop positioning"		Positioning against an obstacle. The following error is permanently ignored during the positioning process.
	0	**FALSE**	Positioning is deactivated.
	1	TRUE	The positioning function is always activated.
	124	Control signal bit 24	The positioning function is activated via the corresponding control bit.
	125	Control signal bit 25	
	126	Control signal bit 26	
	127	Control signal bit 27	

7.5.5 Touch probe positioning

During the touch probe positioning, the travel profile is executed according to the profile data. If a touch probe is detected during positioning, it is automatically changed to the profile that is defined in the **Profile TP window - upper limit** profile parameter.

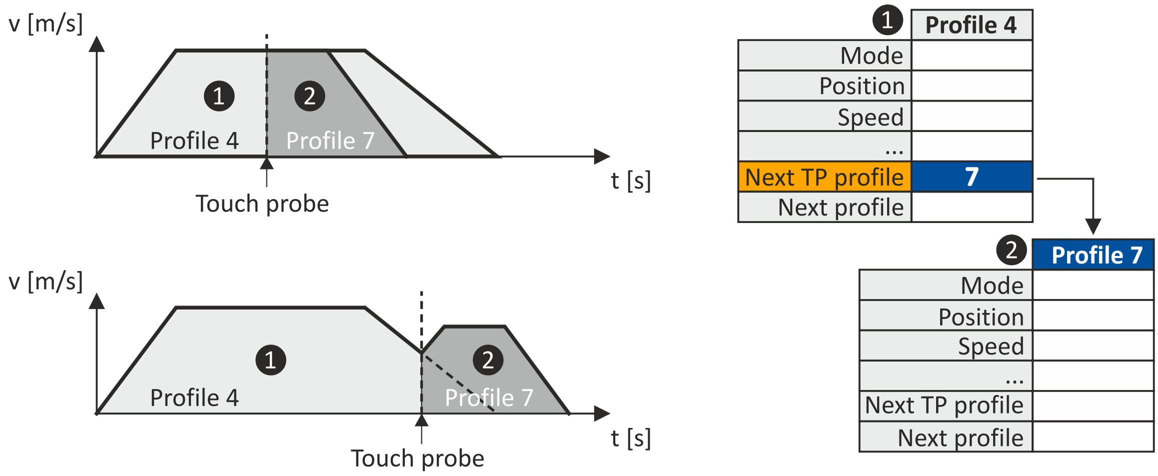


Fig. 41: Touch probe positioning

1	Start travel profile according to the profile data	2	Travel profile from the profile parameter - touch probe profile

The **Profile TP window - lower limit** and **Profile TP window - upper limit** profile parameters limit the area in which a touch probe can be detected. If both parameters have the value 0, the touch probe detection for the whole travel profile or the whole travel range is activated. If no touch probe has been detected and the travel profile has been fully executed, the profile set in the **sequence profile** profile parameter will be executed.

Notes

- If the touch probe positioning starts while a profile is executed with maximum speed and a residual path to be travelled is too short for the set deceleration ramp, the target position will be overtravelled. A reversing motion takes place.
- Constellations with linking of travel profiles are possible that make it impossible to reverse and reach the target position. A reversing motion of the axis can be prevented by the "Safe Direction (SDI)" safety function.

Source for touch probe signal

The following inputs are available for connecting a sensor for **touch probe positioning**:

- Digital inputs of the inverter
- Zero pulse of the position encoder
- EtherCAT system bus

The sensor source and the edge to be evaluated (rising, falling, both) are selected via the **Source TP 1** parameter. 0x5020:011

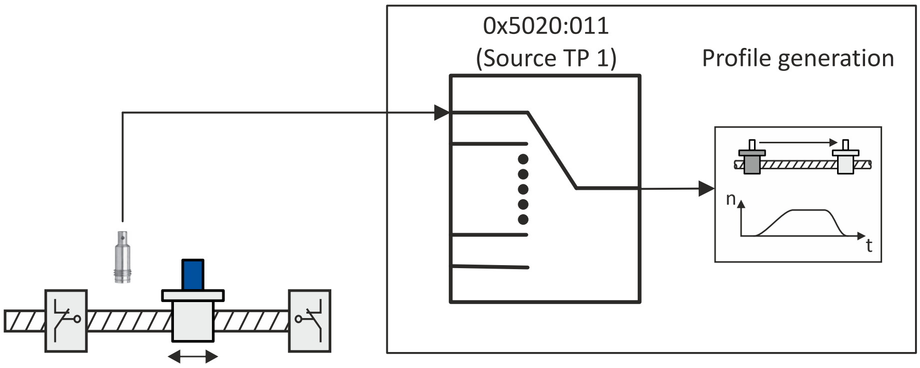
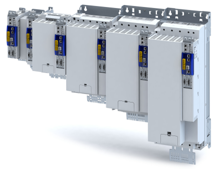


Fig. 42: Selection of "Touch probe sensor"

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:011	TP1 source		The sensor source and the edge to be evaluated are selected via the parameter (rising, falling, any)
	0	External source	Source: System bus
	1	Digital input 1, positive edge	
	2	Digital input 1, negative edge	
	3	Digital input 1, any edge	
	11	**Digital input 2, positive edge**	
	12	Digital input 2, negative edge	
	13	Digital input 2, any edge	
	21	Digital input 3, positive edge	
	22	Digital input 3, negative edge	
	23	Digital input 3, any edge	
	31	Digital input 4, positive edge	
	32	Digital input 4, negative edge	
	33	Digital input 4, any edge	
0x5031:028, 039, 050, 061, 072, 083, 094, 105, 116, 127, 138, 149, 160, 171, 182	Profile TP window - lower limit -214748.3648 ... [**0.0000**] ... 214748.3647		Lower limit value for the touch probe window. Above this position, touch probe evaluation is active.
0x5031:029, 040, 051, 062, 073, 084, 095, 106, 117, 128, 139, 150, 161, 172, 183	Profile TP window - upper limit -214748.3648 ... [**0.0000**] ... 214748.3647		Upper limit value for the touch probe window. Below this position, touch probe evaluation is active.
0x5031:030, 041, 052, 063, 074, 085, 096, 107, 118, 129, 140, 151, 162, 173, 184	Sequence profile after TP 0 ... [**0**] ... 65535		Number of the profile data set (1 ... 15) that is executed if a touch probe has been detected. With the setting 0, no travel profile is executed after a touch probe has been detected.



7.5.6 Source of reference switch (touch probe)

The reference switch which serves to activate the touch probe evaluation is selected via the **Source for reference switch for touch probe** parameter. ▸ 0x5020:006

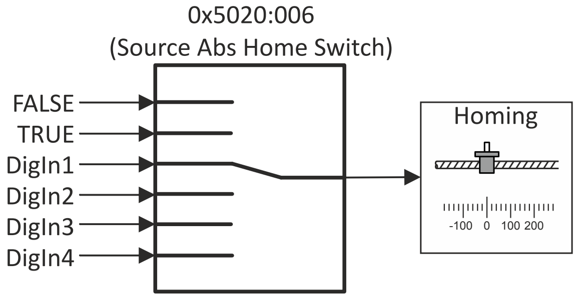


Fig. 43: Selection of "Reference switch"

Parameter

Address	Name / setting range / [default setting]		Info
0x5020:006	Source of homing switch for touch probe		Selection of the signal source for activating the reference switch for touch probe evaluation.
	0	FALSE	
	1	TRUE	
	2	**Digital input 1**	
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	

7.5.7 Executing and interrupting positioning

A travel profile can be executed, interrupted, and resumed via control signals.

Status signals indicate the current status of the positioning.

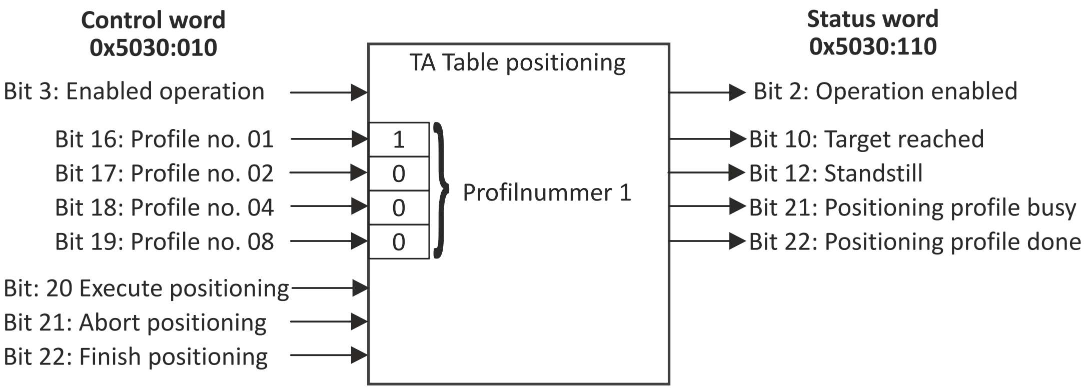


Fig. 44: Execute, cancel, and resume positioning

Procedure

- At least one valid travel profile must be defined. ▸ Travel profiles
- The drive must be ready for operation. ▸ 0x5030:010, bit 3 = TRUE (1)

1. Using the control bits 16 ... 19, select the desired travel profile. ▸ 0x5030:010, Bits 16 ... 19
2. With a rising FALSE-TRUE edge on control bit 20, execute the selected profile. ▸ 0x5030:010, Bit 20
3. With a rising FALSE-TRUE edge on control bit 21, interrupt the profile. ▸ 0x5030:010, Bit 21

   The drive is brought to a standstill with the current profile data.
4. With a rising FALSE-TRUE edge on control bit 22, resume the profile. ▸ 0x5030:010, Bit 22

7.5.8 Flying homing

With referencing "on the fly", the home position of a machine can be set during ongoing movement. Jerking and compensating movements do not occur. A sensor for on-the-fly referencing can be connected via the digital inputs.

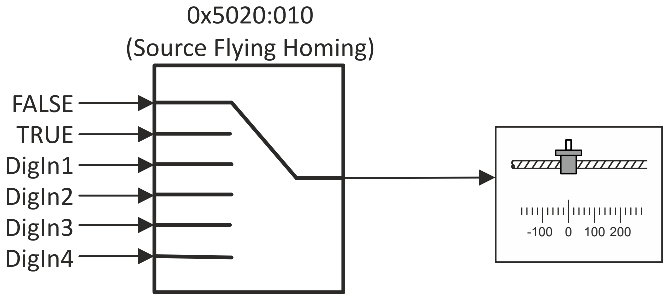
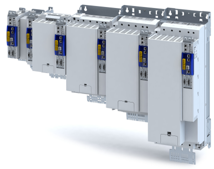


Fig. 45: Selection of "Source for referencing on the fly"

- The source of the home position is selected in the **Source for referencing on the fly** parameter. 0x5020:010
- The **Activate referencing on the fly** parameter is used to activate referencing on the fly. ▸ 0x5030:008
- The home position is set in the **Home position** parameter. ▸ 0x500A:084
- The procedure can be performed at a standstill as well as when the drive is moving.

Parameter

Address	Name / setting range / [default setting]		Info
0x500A:084	Home position -214748.3648 ... [**0.0000**] ... 214748.3647		
0x5020:010	Control word		
	0	**FALSE**	No source selected for homing on the fly.
	1	TRUE	Homing on the fly is active permanently.
	2	Digital input 1	Selection of digital inputs for homing on the fly.
	3	Digital input 2	
	4	Digital input 3	
	5	Digital input 4	
0x5030:008	Activate flying homing		Activation of homing on the fly.
	0	**FALSE**	Homing on the fly is deactivated.
	1	TRUE	Homing on the fly is active permanently.
	124	Control signal bit 24	Homing on the fly is activated via one of the control bits.
	125	Control signal bit 25	
	126	Control signal bit 26	
	127	Control signal bit 27	



7.5.9 Connecting the speed override

"Speed override" describes the change in profile speed during a positioning process. The speed can be adapted for the travel profile. This ensures that the defined target position is reached exactly.

Activation takes place via the **Control signals** parameter. ▶ 0x5030:010, Bit 13

The override value is specified via the **External speed override** parameter. ▶ 0x5030:011

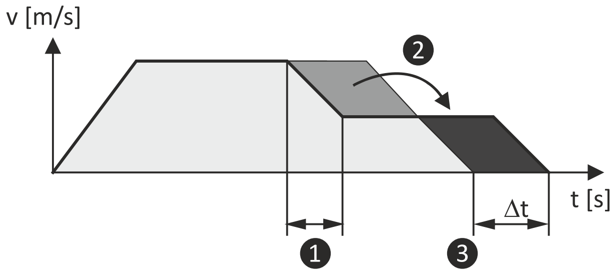


Fig. 46: Schematic diagram for speed override

1	The velocity decreases during the positioning process.
2	In order to reach the missing target position, the missing area has to be added.
3	Hence, more time is required for the positioning.

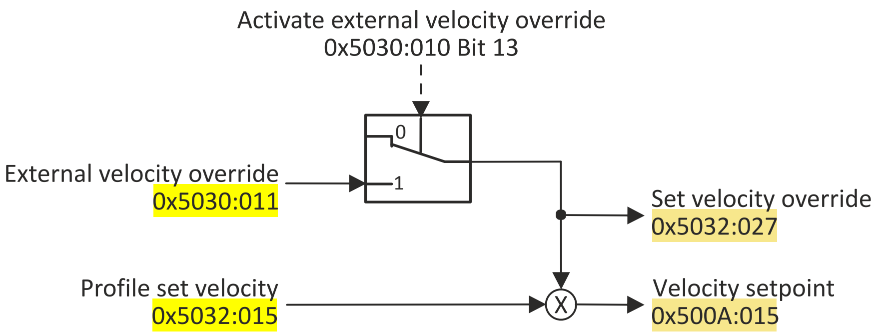


Fig. 47: Signal flow — Speed override

Parameter

Address	Name / setting range / [default setting]	Info
0x5030:011	External velocity override 0.00 ... [**0.00**] ... 100.00 %	Change of the profile speed during a positioning process.
0x5032:015	Active profile: Velocity setpoint • Read only	The profile setpoint speed is given in the unit [unit/s]. The value of the profile setpoint speed is displayed with 4 decimal positions.
0x5032:027	Velocity override setpoint • Read only	

7.6 Diagnostics

The diagnostic dialog of the »EASY Starter«enables you to view the status of the device and the technology application. Errors and warnings and related error numbers can be read out via the dialog.

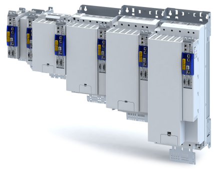
A more detailed diagnostics of the technology application and its individual functions can be executed in the **Signal flow** parameter dialog. ▶ Signal flow 📖 104

8 Start, stop and rotating direction commands

8.1 Control selection

Parameter

Address	Name / setting range / [default setting]		Info
0x2824	Control selection • Setting can only be changed if the inverter is inhibited.		Selection of the type of inverter control.
	0	Flexible I/O configuration	This selection enables a flexible assignment of the start, stop, and rotating direction commands with digital signal sources. • Digital signal sources can be digital inputs, network and keypad. • The I/O configuration is made via the parameters 0x2631:xx (P400.xx).
	1	**Keypad**	This selection enables the motor to be started exclusively via the start key of the keypad. Other signal sources for starting the motor are ignored. I Start motor O Stop motor Note! • The functions "Enable inverter" and "Run" must be set to TRUE to start the motor. • If jog operation is active, the motor cannot be stopped via the O keypad key.



9 Configure position control

This operating mode provides a fast position follower with speed, torque and feed force feed-forward control.

Typical applications for positioning are, for instance, transport facilities, feed drives and dosing systems.

Preconditions

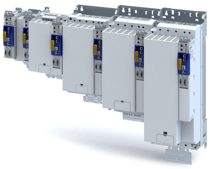
A positioning control is parameterised in the servo control types to be set. ▸ 0x2C00

Configure one of these motor control types:

- 0x2C00 = 1: Servo control for synchronous motor (SC-PSM) 203
- 0x2C00 = 2: Servo control for asynchronous motor (SC-ASM) 204

Further conditions are:

- The correct entry of the ▸ Motor data 38
- The parameter setting of the motor control in chapter Configuring the motor control 202

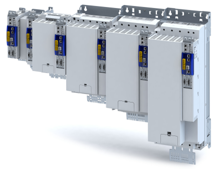


9.1 Basic setting

In the following, the steps required for configuring the position control are described.

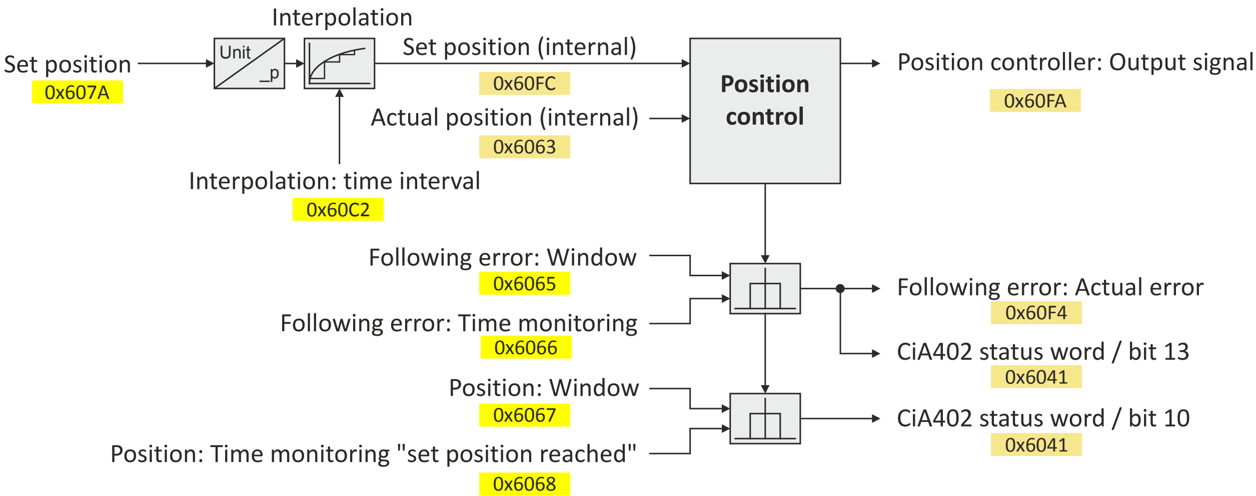
1. Set the manufacturer spanning operating mode according to CiA 402.
    - 0x6060: "Cyclic sync position mode [8]"
    - Detailed description in ▶ Operating mode "CiA 402 Cyclic sync position mode (csp)" 124
2. Set the maximum motor speed: 0x6080
3. Set the rated motor torque: 0x6076
4. Set the positive torque limit: 0x60E0
5. Set the negative torque limit: 0x60E1

The position control is now active and the inverter responds to the defined position setpoint.



9.1.1 Following error detection and in-position detection

The "following error recognition" and "in-position recognition" are functions of the position control. All parameters correspond to the CiA 402 specification.



Input data

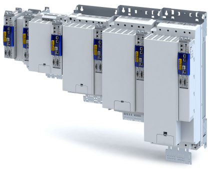
Parameter	Designation	Data type
0x607A	Target position	INTEGER_32
0x60FC	Position demand internal value	INTEGER_32
0x6062	Position demand value	INTEGER_32
0x6065	Following error window	UNSDIGNED_32
0x6066	Following error time out	UNSIGNED_16
0x6067	Position window	UNSIGNED_32
0x6068	Position window time	UNSIGNED_16

Output data

Parameter	Designation	Data type
0x6063	Position actual internal value	INTEGER_32
0x6064	Position actual value	INTEGER_32
0x60F4	Following error actual value	INTEGER_32
0x60FA	Control effort	INTEGER_32
0x6041	CiA: Statusword	UNSIGNED_16

Parameter

Address	Name / setting range / [default setting]	Info
0x6065	Following error window 0 ... **[1000]** ... 4294967295 pos. unit	Setting of the symmetrical tolerance window around the setpoint position for following error detection. • 0 ≡ following error detection deactivated. • > 0 ≡ following error detection activated. • A following error is detected if the actual position is outside this tolerance window. • If the following error is detected longer than the time defined in 0x6066 in [ms], bit 13 ("following error") is set in the CiA402 status word (0x6041). • 0x60F4 displays the current deviation of the actual position from the setpoint position.
0x6066	Following error time out 0 ... [**0**] ... 0 ms	Setting of time monitoring for the following error detection. 0 ≡ the following error is evaluated without a time delay.



Address	Name / setting range / [default setting]	Info
0x6067	Position window 0 ... [**1000**] ... 4294967295 pos. unit	Setting of the symmetrical tolerance window around the target position (0x607A) for the target position detection. If the actual position is within this tolerance window longer than the time defined in 0x6068 in [ms], the target position is deemed to be reached and bit 10 ("target position reached") is set in the CiA402 status word (0x6041).
0x6068	Position window time 0 ... [**0**] ... 0 ms	Setting of time monitoring for the target position detection. 0 ≡ the position in the target window is evaluated without a time delay.

9.1.2 Interpolation

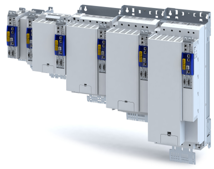
When you select an operating mode with cyclic setpoint selection, all setpoints are first led via interpolators which divides down setpoint step-changes of the bus cycle to the cycle time of the control loops.All interpolators together are parameterised via 0x60C2:001 (Interpolation time period value).

Parameter

Address	Name / setting range / [default setting]	Info
0x60C0	Interpolation sub mode select	Setting of the interpolation algorithm.
	-1 **Quadratic Interpolation**	
	0 Linear Interpolation	
0x60C2:001	Interpolation time period: Interpolation time period value 0 ... [**1**] ... 255	Basic multiplier for the interpolation time interval.
0x60C2:002	Interpolation time period: Interpolation time index -6 ... [**-3**] ... 0	Exponent for the interpolation time interval.

$$t = 0x60C2:001 * 10^{(0x60C2:002)}$$

$$t = 1 * 10^{(-3)} s = 0.001 s = 1 ms$$



9.2 Operating mode "CiA 402 Cyclic sync position mode (csp)"

Subfunctions of the operating mode

- Interpolation between communication cycle and control cycle
- Position control
- Speed control
- Torque control
- Update of the actual values for position, speed and torque

9.2.1 Default mapping

The default mapping for the "cyclic sync position mode" is defined in the following parameters:

Parameter	Designation	Data type
0x1600	RPDO-->axis: cyclic sync position mode (csp)	RECORD
0x1606	RPDO-->axis: torque limit	RECORD
0x1A00	Axis-->TPDO: cyclic sync position mode (csp)	RECORD

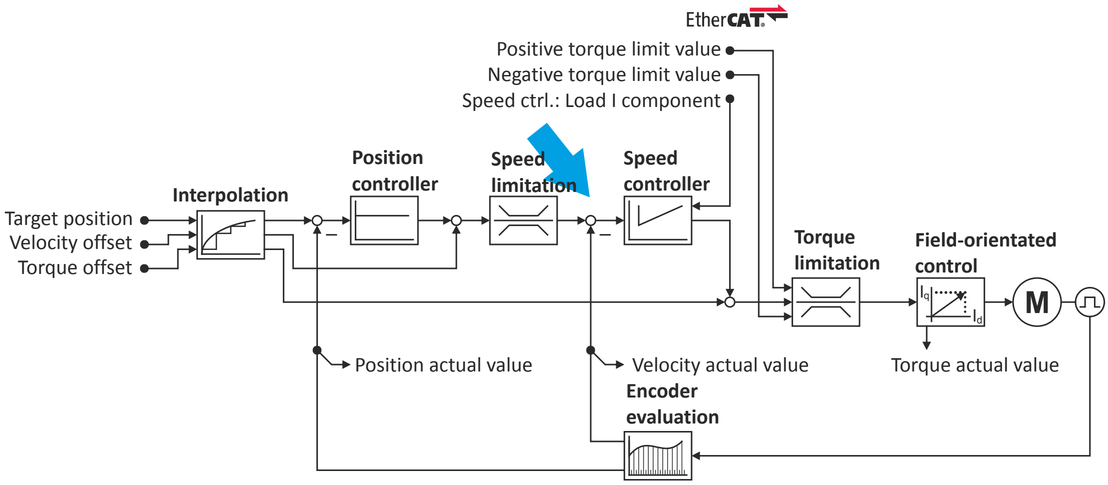
Data received from the Controller (RPDO)

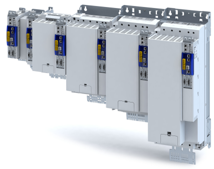
Parameter	Designation	Data type
0x6040	CiA402 control word	UNSIGNED_16
0x2830	Lenze control word	UNSIGNED_16
0x6060	Operating mode: selection	INTEGER_8
0x60B2	Torque: offset	INTEGER_16
0x607A	Position: setpoint position	INTEGER_32
0x60B1	Velocity: offset	INTEGER_32
0x2902	Speed controller: load I component	INTEGER_16
0x60E0	Torque: positive limit value	UNSIGNED_16
0x60E1	Torque: negative limit value	UNSIGNED_16

Data sent to the Controller (TPDO)

Parameter	Designation	Data type
0x6041	CiA402 status word	UNSIGNED_16
0x2831	Lenze status word	UNSIGNED_16
0x6061	Operating mode: display	INTEGER_8
0x603F	Error code	UNSIGNED_16
0x606C	Velocity: actual velocity	UNSIGNED_16
0x6077	Torque: actual torque	INTEGER_16
0x6064	Position: actual position	INTEGER_32
0x60F4	Following error: actual error	INTEGER_32

9.2.2 Signal flow





Overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA: Controlword
	0x2830	Inverter control word
	0x6060	Modes of operation
	0x607A	Target position
	0x60B1	Velocity offset
	0x60B2	Torque offset
	0x60E0	Positive torque limit
	0x60E1	Negative torque limit
	0x2902	I component load value
Output data	0x6041	CiA: Statusword
	0x2831	Inverter-Statuswort
	0x6061	Modes of operation display
	0x6064	Position actual value
	0x606C	Velocity actual value
	0x6077	Torque actual value
Interpolation	0x60C0	Interpolation sub mode select
	0x60C2:001	Interpolation time period
	0x60C2:002	Interpolation time period
Position controller	0x2980	Position controller gain
	0x2981	Position controller gain adaption
	0x2982	Position controller output signal limitation
	0x2983	Actual position start value
	0x2984	Mode for setting the actual position
	0x2986	Resulting gain adaption
Speed limitation	0x6080	Max motor speed
Speed controller	0x2900:001	Gain
	0x2900:002	Reset time
	0x2900:003	Rate time
	0x2901	Speed controller gain adaption
	0x2902	I component load value
Torque limitation	0x60E0	Positive torque limit
	0x60E1	Negative torque limit
	0x6076	Motor rated torque
	0x6072	Max torque
Field-oriented control	0x6073	Device: max. current
	0x6075	Motor: rated current
	0x2941	Current controller: feedforward control
	0x2942:001	Current controller: gain
	0x2942:002	Current controller: reset time
	0x29E2	DC bus: actual voltage - filter time
	0x29E3	Motor: actual voltage - filter time
	0x29E0:001	Field weakening controller: gain
	0x29E0:002	Field weakening controller: reset time
	0x29E1	Limitation of setpoint field
	0x29C0:001	Field controller: gain
	0x29C0:002	Field controller: reset time
	0x2939	Switching frequency

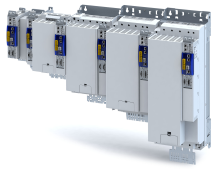
9.2.3 Control commands and status information

The following control commands can be executed via the CiA 402 control word 0x6040:

Control word	State	Function
Bit 4	0	*reserved* (bit must be set to "0".)
Bit 5	0	*reserved* (bit must be set to "0".)
Bit 6	0	*reserved* (bit must be set to "0".)
Bit 8	0↗1	Stop

The following status information is output via the CiA402 status word 0x6041:

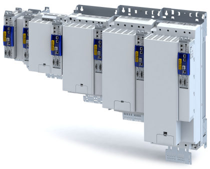
Status word	State	Meaning
Bit 12	0	Operating mode is inactive.
	1	The drive follows the setpoint selection.



9.3 Process input data (CiA 402 objects)

Parameter

Address		Name / setting range / [default setting]	Info
0x2830		Inverter control word 0x0000 ... [**0x0000**] ... 0xFFFF	The control word serves to influence the control functions.
	Bit 0	Flying restart completed	This bit enables the control to report the acceptance of the recorded speed to the "flying restart" function. Thus, the flying restart process is completed.
	Bit 1	Block flying restart	TRUE: the flying restart process is blocked.
	Bit 4	Set load value	TRUE: set load value.
	Bit 5	Select new actual position	TRUE: define new actual position. • Setting/shifting of Position actual value (0x6064) to Actual position start value (0x2983) considering the set resolution (0x608F:001, 0x608F:002). • Mode for setting the actual position: 0x2984)
	Bit 6	Activate DC-injection braking or short-circuit braking	DC-injection braking or short-circuit braking is activated via this bit.
	Bit 10	Reserved	
	Bit 11	Reserved	
0x2902		I component load value -1000.0 ... [**0.0**] ... 1000.0 %	Setting of the load value.
0x6040		CiA: Controlword 0x0000 ... [**0x0000**] ... 0xFFFF	Mappable CiA 402 control word with bit assignment according to device profile CiA 402.
	Bit 0	Switch on	1 = switch-on
	Bit 1	Enable voltage	1 = DC bus: Establish readiness for operation
	Bit 2	Quick stop	0 = activate quick stop
	Bit 3	Enable operation	1 = enable operation
	Bit 4	Operation mode specific	
	Bit 5	Operation mode specific	
	Bit 6	Operation mode specific	
	Bit 7	Fault reset	0-1 edge = reset error
	Bit 8	Halt	1 = stop motor (ramping down to frequency setpoint 0 Hz)
	Bit 9	Operation mode specific	Operating mode dependent
	Bit 14	Release holding brake	1 = releasing holding brake manually ⚠ CAUTION! • The manually triggered "Release holding brake" command has a direct impact on the "Release holding brake [115]" trigger. Thus, the holding brake can be manually released if the power section is switched off. • The responsibility for a manual release of the holding brake has the external trigger source for the "Release holding brake" command. ▶ Holding brake control 219
0x6060		Modes of operation	Selection of the operating mode.
	0	**No mode change/no mode assigned**	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode ▶ Operating mode "CiA 402 Velocity mode (vl)" 138
	8	Cyclic sync position mode	▶ Operating mode "CiA 402 Cyclic sync position mode (csp)" 124
	9	Cyclic sync velocity mode	▶ Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 143
	10	Cyclic sync torque mode	▶ Operating mode "CiA 402 Cyclic sync torque mode (cst)" 157
0x607A		Target position -2147483648 ... [**0**] ... 2147483647 pos. unit	Setting of the position setpoint.
0x60B1		Velocity offset -480000.00 ... [**0.00**] ... 480000.00 rpm	Additive value for setpoint velocity or velocity feedforward control.
0x60B2		Torque offset -3276.8 ... [**0.0**] ... 3276.7 %	Additive value for setpoint torque or torque feedforward control • 100 % ≡ rated motor power (0x6076)
0x60E0		Positive torque limit 0.0 ... [**100.0**] ... 3276.7 %	Positive torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque. ▶ 0x6076
0x60E1		Negative torque limit 0.0 ... [**100.0**] ... 3276.7 %	Code previously C3687. Negative torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque ▶ 0x6076



9.4 Process output data (CiA 402 objects)

Parameter

Address	Name / setting range / [default setting]		Info
0x2831	Inverter-Statuswort • Read only		Bit coded status word of the internal motor control.
	Bit 1	Speed setpoint 1 limited	1 ≡ input of speed controller 1 in limitation.
	Bit 2	Speed controller in limitation	1 ≡ output of speed controller 1 in limitation.
	Bit 3	Torque setpoint limited	1 ≡ setpoint torque in limitation.
	Bit 4	Soll-Q-Strom limitiert	1 ≡ setpoint current in limitation.
	Bit 5	Speed setpoint 2 limited	1 ≡ input of the speed controller 2 in "torque mode" in limitation.
	Bit 6	Obere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to upper speed limit 0x2946:001.
	Bit 7	Untere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to lower speed limit0x2946:002.
	Bit 10	Output frequency limited	1 ≡ setpoint frequency with V/f operation in limitation.
	Bit 11	Magnetisation completed	1 ≡ during V/f operation, the factor 7 rotor time constant has passed (calculated from the time at which the inverter was enabled without restart on the fly and with a total motor current of 20 % rated motor current for the first time). Otherwise 0.
	Bit 12	Motorphasenfehler	1 ≡ motor phase failure detection active.
	Bit 14	Error reset blocking time active	1 ≡ the fault can only be reset when the blocking time has elapsed.
0x603F	Error code • Read only		Error message
	Bit 0		
0x6041	CiA: Statusword • Read only		Mappable CiA 402 status word with bit assignment according to device profile CiA 402.
	Bit 0	Ready to switch on	1 ≡ drive ready to start
	Bit 1	Switched on	1 ≡ drive switched-on
	Bit 2	Operation enabled	1 ≡ operation enabled
	Bit 3	Fault	1 ≡ fault or trouble active
	Bit 4	Voltage enabled	1 ≡ DC bus ready for operation
	Bit 5	Quick stop	0 ≡ quick stop active
	Bit 6	Switch on disabled	1 ≡ operation inhibited
	Bit 7	Warning	1 ≡ warning active
	Bit 8	RPDOs deactivated	1 ≡ cyclic PDOs have been deactivated.
	Bit 9	Remote	1 ≡ inverter can receive commands via network. • Bit is not set in the operating mode 0x6060 = "MS: Velocity mode [-2]".
	Bit 10	Target reached	1 ≡ the actual position is in the window.
	Bit 11	Internal limit active	1 ≡ internal limitation of a setpoint active.
	Bit 12	Operation mode active	1 ≡ operation enabled and no test mode activated. (no internal setpoint generation active.)
	Bit 13	Following error	1 ≡ following error active
	Bit 14	Holding brake released	1 ≡ holding brake released
	Bit 15	Integrated safety not active	0 ≡ the inverter has been disabled by the integrated safety system 1 ≡ the integrated safety system is not active Not available with i410 and i510 (always TRUE).
0x6061	Modes of operation display • Read only		Display of the current operating mode.
	-11	Identification	
	-10	Test mode	
	0	No mode change/no mode assigned	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode
	8	Cyclic sync position mode	
	9	Cyclic sync velocity mode	
	10	Cyclic sync torque mode	
0x6064	Position actual value • Read only: x pos. unit		Display of the current position.

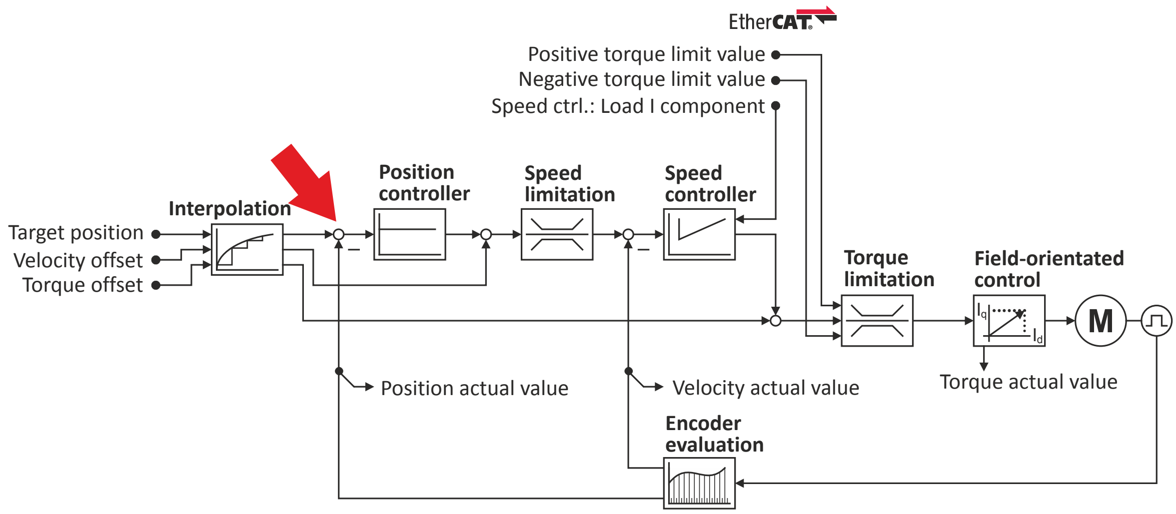
Address	Name / setting range / [default setting]	Info
0x606C	Velocity actual value • Read only: rpm	Display of the actual velocity.
0x6077	Torque actual value • Read only: x.x %	Display of the current torque. • 100 % ≡ Rated Motor Torque. ▸ 0x6076
0x60F4	Following error actual value • Read only: x pos. unit	Display of the current following error.

9.5 Monitoring the position error

Position error monitoring can be used for the following control modes:

- Servo control for synchronous motor (SM), 0x2C00 = [1]
- Servo control for asynchronous motor (ASM), 0x2C00 = [2]

Following error monitoring is effective in an operating mode with position controller. The system deviation (i. e. the following error) is compared to the following error tolerance set at the input of the position controller (see red arrow in the figure below).

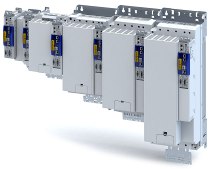


The error response set in 0x2D51:006 is executed if ...

1. the following error tolerance set in 0x2D51:004 is exceeded and ...
2. the exceedance lasts at least as long as set in 0x2D51:005.

Parameter

Address	Name / setting range / [default setting]		Info
0x2D51:004	Position error/speed error - monitoring: Position error - error threshold 1 ... [**360**] ... 2147483647 °		Setting of the error threshold for position error monitoring.
0x2D51:005	Position error/speed error - monitoring: Position error - min. time for error 0 ... [**0**] ... 50 ms		Setting of the minimum time a position error must be pending until an error/warning message is triggered.
0x2D51:006	Position error/speed error - monitoring: Position error - error response		Setting of the error response of position error monitoring.
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	



9.6 Position detection with touch probe (TP)

A "touch probe" (short: "TP") is an event that can be triggered, for instance via a digital input in an edge-controlled manner to detect and further process an actual value (which is changing fast) at the triggering time.

- Typical applications for touch probes:
  - Homing
  - Mark synchronisation
  - Length measurements
- Up to 2 touch probe channels can be used in parallel.
- Possible touch probe sources:
  - TP1 : Zero pulse position encoder or digital input DI1
  - TP2 : Zero pulse position encoder or digital input DI2

The digital inputs DI1 and DI2 can be additionally evaluated any time as "normal" digital inputs via .

9.6.1 Default mapping

The default mapping for a touch probe detection is defined in the following parameters:

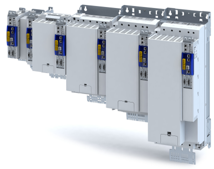
Parameter	Designation	Data type
0x1604	RPDO-->axis: touch probe (TP)	RECORD
0x1A04	Axis-->TPDO: touch probe (TP)	RECORD

Data received from the Controller (RPDO)

Parameter	Designation	Data type
0x60B8	Touch probe control word	UNSIGNED_16

Data sent to the Controller (TPDO)

Parameter	Designation	Data type
0x60B9	Touch probe status word	UNSIGNED_16
0x60BA	TP1: actual position - rising edge	INTEGER_32
0x60BB	TP1: actual position - falling edge	INTEGER_32
0x60BC	TP2: actual position - rising edge	INTEGER_32
0x60BD	TP2: actual position - falling edge	INTEGER_32

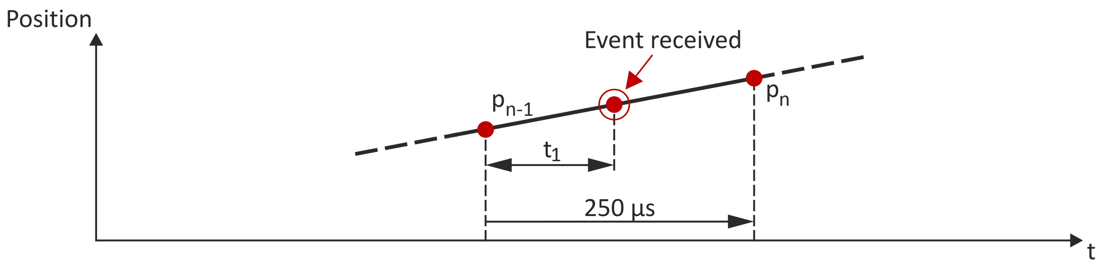


9.6.2 General mode of operation

If an event occurs at the configured touch probe source, a time stamp is detected in the servo inverter.

The detected time stamp is related to the system time and can thus be divided into two parts: One part is the control cycle in which the of the event. The other part is the time difference starting from the detected control cycle to the real detection of the event

Thanks to a history buffer, the servo inverter knows the last n position values. Thus, the actual position is known at the start and at the end of the control cycle in which the event has occurred. A linear interpolation takes place between these two position grid points. The result is the exact position at the motor shaft at the time the event is triggered, see the schematic diagram:



t_1: Time difference starting from the detected control cycle to the real detection of the event

P_{n-1}: Actual position grid point 1

P_n: Actual position grid point 2

The position grid points are detected in the servo inverter in a grid of 250 µs. After a touch probe has been triggered, the input is deactivated for up to 250 µs to avoid bouncing. Thus, the maximum frequency for touch probe triggering is 4 kHz.

If in contrast to the uniform movement given in the figure, an accelerated movement is taken as a basis, the 250 µs grid also allows for a very good linear position reconstruction because the speed change at the motor shaft only has a marginal impact in 250 µs.

9.6.3 Filtering of the touch probe signal

For the touch probe inputs, a common filter time (debounce time) can be parameterised to debounce the TP signals so that there is no response to external interfering signals.

- The signal status of the debouncing filter is detected at the TP input and a new value is added to the filter.
- A separate setting for a touch probe is not possible. Thus, the filter time is set for all touch probe inputs.

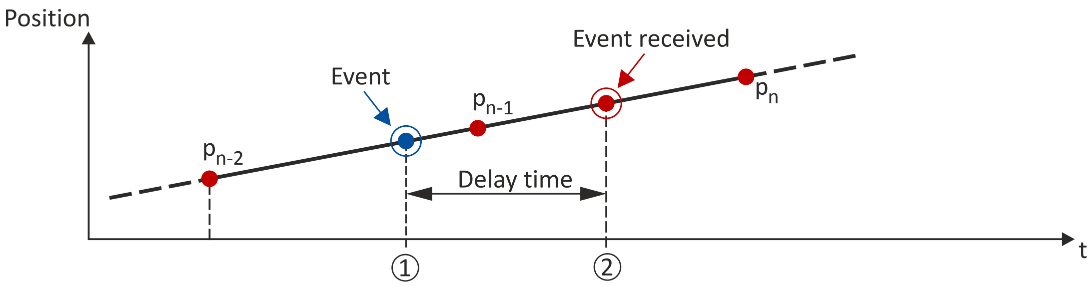
Parameter

Address	Name / setting range / [default setting]	Info
0x2500	Touch probe filter time 0 ... [**0**] ... 1984 us	The set filter time is automatically taken into account in the touch probe calculation. The setting "0" deactivates the filter. Note! Values can be set directly. When entering a filter time between 0 ... 1984 µs, the value is automatically rounded down internally to the next value that can be set and is shown in the case of read requests.

9.6.4 Compensation of runtime delays

In reality, both the input circuit in the servo inverter and the touch probe sensor have runtime delays (latencies) themselves. These can be taken into account in the calculation of the real trigger time and thus the real position at the trigger time.

In the following figure, the event is detected in the servo inverter at the time ②. Due to the input circuit and the sensor used, the signal runtime, however, has been delayed. The real physical event has already occurred at time ①. For compensating this runtime delay, you can set a corresponding delay time for each touch probe channel that is included in the determination of the control cycle and interpolation of the position, see figure in chapter "General mode of operation". 📖 132



"Delay time": Delay time between the real physical event and the electrical detection.
① Real physical event
② Electrical detection of the event in the servo inverter

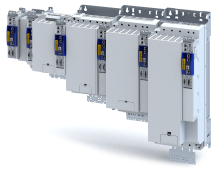
Delay times of the digital input and the required minimum signal duration

The following table lists the typical delay times and the required minimum signal durations for the digital inputs of the servo inverter:

Digital signal	Typical delay time	Minimum signal duration
Rising edge (HIGH pulse)	4 µs	4 µs
Falling edge (LOW pulse)	4 µs	4 µs

Parameter

Address	Name / setting range / [default setting]	Info
0x2D00:001	Touch probe (TP) delay time: Touch probe 1 delay time 0.000 ... [**0.000**] ... 7.000 ms	Setting of the delay time for touch probe 1.
0x2D00:002	Touch probe (TP) delay time: Touch probe 2 delay time 0.000 ... [**0.000**] ... 7.000 ms	Setting of the delay time for touch probe 2.
0x2D00:003	Touch probe (TP) delay time: Touch probe 3 delay time 0.000 ... [**0.000**] ... 7.000 ms	Setting of the delay time for touch probe 3.
0x2D00:004	Touch probe (TP) delay time: Touch probe 4 delay time 0.000 ... [**0.000**] ... 7.000 ms	Setting of the delay time for touch probe 4.



9.6.5 Touch probe control word

Control word for configuring the touch probe functionality.

Parameter

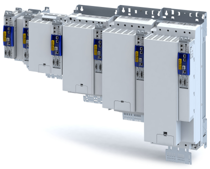
Address	Name / setting range / [default setting]		Info
0x60B8	Touch probe function 0x0000 ... [**0x0000**] ... 0xFFFF		Control word for configuring the touch probe functionality.
	Bit 0	Enable touch probe 1	0: deactivate touch probe channel 1. 1: activate touch probe channel 1.
	Bit 1	TP1: 1. or continous	Event for touch probe channel 1 0: only detect the first event. 1: detect all events.
	Bit 2	TP1: DIx or zero pulse	Source for touch probe channel 1 0: digital input 1 1: zero pulse position encoder
	Bit 4	TP1: Activate pos. edge	0: deactivate scanning. 1: activate scanning.
	Bit 5	TP1: Activate neg. edge	
	Bit 8	Enable touch probe 2	0: deactivate touch probe channel 2. 1: activate touch probe channel 2.
	Bit 9	TP2: 1. or continous	Event for touch probe channel 2 0: only detect the first event. 1: detect all events.
	Bit 10	TP2: DIx or zero pulse	Source for touch probe channel 2 0: digital input 2 1: zero pulse position encoder
	Bit 12	TP2: Activate pos. edge	0: deactivate scanning. 1: activate scanning.
	Bit 13	TP2: Activate neg. edge	

9.6.6 Touch probe status word

Status word of the touch probe functionality.

Parameter

Address	Name / setting range / [default setting]		Info
0x60B9	Touch probe status • Read only		Status of the touch probe functionality.
	Bit 0	Touch-Probe 1 enabled	0: touch probe channel 1 deactivated. 1: touch probe channel 1 activated.
	Bit 1	TP1: Pos. edge detected	0: position not detected. 1: position detected.
	Bit 2	TP1: Neg. edge detected	
	Bit 6	TP1: Detected level	Level for detection via touch probe channel 1 0: LOW level 1: HIGH level
	Bit 8	Touch-Probe 2 enabled	0: touch probe channel 2 deactivated. 1: touch probe channel 2 activated.
	Bit 9	TP2: Pos. edge detected	0: position not detected. 1: position detected.
	Bit 10	TP2: Neg. edge detected	
	Bit 14	TP2: Detected level	Level for detection via touch probe channel 2 0: LOW level 1: HIGH level



9.6.7 Extension for the digital inputs DI3 and DI4

The content of this section is currently being processed.

Parameter

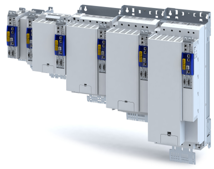
Address	Name / setting range / [default setting]		Info
0x2D02:001	Touch probe diagnostics: Touch probe 3/4 function 0x0000 ... **[0x0000]** ... 0xFFFF		
	Bit 0	Activate touch probe 3	
	Bit 1	Touch probe 3 trigger = 1st event/continous	
	Bit 2	Touch probe 3 source = TP input/zero pulse	
	Bit 4	Touch probe 3 sampling = rising edge	
	Bit 5	Touch probe 3 sampling = falling edge	
	Bit 6	Position feedback source	
	Bit 8	Activate touch probe 4	
	Bit 9	Touch probe 4 trigger = 1st event/continous	
	Bit 10	Touch probe 4 source = TP input/zero pulse	
	Bit 12	Erfassung Touch-Probe 4 = steigende Flanke	
	Bit 13	Erfassung Touch-Probe 4 = fallende Flanke	
	Bit 14	Position feedback source	
0x2D02:002	Touch probe diagnostics: Touch-Probe 3/4 status • Read only		
	Bit 0	Touch-Probe 3 ist aktiviert	
	Bit 1	Touch-Probe 3 - Position erfasst fallende Flanke	
	Bit 2	Touch-Probe 3 - Position erfasst steigende Flanke	
	Bit 6	Touch-Probe 3 - Pegel bei Zeitstempel	
	Bit 8	Touch-Probe 4 ist aktiviert	
	Bit 9	Touch-Probe 4 - Position erfasst fallende Flanke	
	Bit 10	Touch-Probe 4 - Position erfasst steigende Flanke	
	Bit 14	Touch-Probe 4 - Pegel bei Zeitstempel	
0x2D03:001	Touch probe position: Touch probe 3 position rising edge • Read only: x pos. unit		
0x2D03:002	Touch probe position: Touch probe 3 position falling edge • Read only: x pos. unit		
0x2D03:003	Touch probe position: Touch probe 4 position rising edge • Read only: x pos. unit		
0x2D03:004	Touch probe position: Touch probe 4 position falling edge • Read only: x pos. unit		

9.6.8 Detected time stamp and positions

In case of the "continuous touch probe configuration", a newly detected value overwrites the previously detected value.

Parameter

Address	Name / setting range / [default setting]	Info
0x2D01:001	Touch probe (TP) time stamp: Touch probe 1-rising edge time stamp • Read only: x ns	Display of the time stamp of the rising edge for touch probe 1.
0x2D01:002	Touch probe (TP) time stamp: Touch probe 1-falling edge time stamp • Read only: x ns	Display of the time stamp of the falling edge for touch probe 1.



Address	Name / setting range / [default setting]	Info
0x2D01:003	Touch probe (TP) time stamp: Touch probe 2-rising edge time stamp • Read only: x ns	Display of the time stamp of the rising edge for touch probe 2.
0x2D01:004	Touch probe (TP) time stamp: Touch probe 2-falling edge time stamp • Read only: x ns	Display of the time stamp of the falling edge for touch probe 2.
0x2D01:005	Touch probe (TP) time stamp: Touch probe 3-rising edge time stamp • Read only: x ns	Display of the time stamp of the rising edge for touch probe 3.
0x2D01:006	Touch probe (TP) time stamp: Touch probe 3-falling edge time stamp • Read only: x ns	Display of the time stamp of the falling edge for touch probe 3.
0x2D01:007	Touch probe (TP) time stamp: Touch probe 4-rising edge time stamp • Read only: x ns	Display of the time stamp of the rising edge for touch probe 4.
0x2D01:008	Touch probe (TP) time stamp: Touch probe 4-falling edge time stamp • Read only: x ns	Display of the time stamp of the falling edge for touch probe 4.
0x60BA	Touch probe pos1 pos value • Read only: x pos. unit	Touch probe position 1 detected with rising edge.
0x60BB	Touch probe pos1 neg value • Read only: x pos. unit	Touch probe position 1 detected with falling edge.
0x60BC	Touch probe pos2 pos value • Read only: x pos. unit	Touch probe position 2 detected with rising edge.
0x60BD	Touch probe pos2 neg value • Read only: x pos. unit	Touch probe position 2 detected with falling edge.

9.7 Setpoint diagnostics

The following parameters provide information on the setpoints set for position control.

Parameter

Address	Name / setting range / [default setting]	Info
0x6062	Position demand value • Read only: x pos. unit	Display of the interpolated setpoint position for the position control.
0x6063	Position actual internal value • Read only: x incr.	Display of the current position in the internal unit.
0x60FC	Position demand internal value • Read only: x incr.	Display of the interpolated setpoint position for the position control in the internal unit.
0x60FA	Control effort • Read only: rpm	Display of the actuating signal (setpoint speed) of the position controller.

10 Configure speed control

Two operating modes are available for configuring the speed control:

- Operating mode "CiA 402 Velocity mode (vl)" 138

  Here, a speed-controlled movement of the drive is realised by defining a speed setpoint.
- Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 143

  This operating mode provides a fast speed follower with torque/feed force feedforward control.

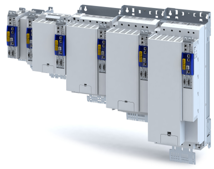
The conditions are a correct entry of the motor data (Motor data) and the parameter setting of the motor control (Configuring the motor control).

10.1 Basic setting

The following describes the steps required for configuring the speed control.

1. 0x6060Set the manufacturer spanning operating mode "CiA: Velocity mode [2]" or "Cyclic sync velocity mode [9]".
   - A detailed description of the "CiA: Velocity mode" operating mode can be found in the section Operating mode "CiA 402 Velocity mode (vl)" . 138
   - A detailed description of the "Cyclic sync velocity mode" operating mode can be found in the section Operating mode "CiA 402 Cyclic sync velocity mode (csv)" . 143
2. Set the maximum motor speed in Max motor speed. ▶ 0x6080
3. Set the rated motor torque in Motor rated torque. ▶ 0x6076
4. Set the positive torque limit. ▶ 0x60E0
5. Set the negative torque limit. ▶ 0x60E1

The speed control is now active and the inverter responds to the speed setpoint.



10.2 Operating mode "CiA 402 Velocity mode (vl)"

Selection of the operating mode

The "speed" operating mode is selected with the setting "2" in 0x6060.

10.2.1 Default mapping

The default mapping for the "Speed" operating mode is defined in the following parameters.

Parameter	Designation	Data type
0x1603	RPDO-->axis: Velocity mode (vl)	RECORD
0x1A03	Axis-->TPDO: Velocity mode (vl)	RECORD

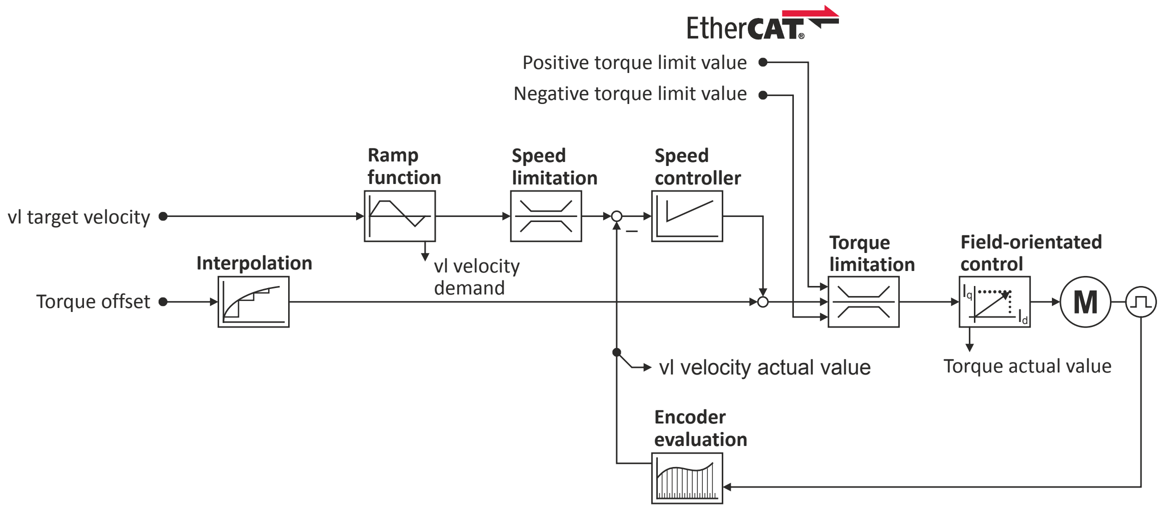
Data received from the Controller (RPDO)

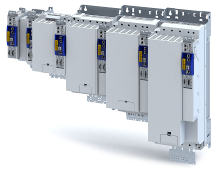
Parameter	Designation	Data type
0x6040	CiA402 control word	UNSIGNED_16
0x2830	Lenze control word	UNSIGNED_16
0x6060	Operating mode: selection	INTEGER_8
0x6042	Velocity: setpoint velocity vl	INTEGER_8

Data sent to the Controller (TPDO)

Parameter	Designation	Data type
0x6041	CiA402 control word	UNSIGNED_16
0x2831	Lenze control word	UNSIGNED_16
0x6061	Operating mode: display	INTEGER_8
0x603F	Error code	UNSIGNED_16
0x6044	Velocity: actual velocity vl	INTEGER_8

10.2.2 Signal flow (servo control)

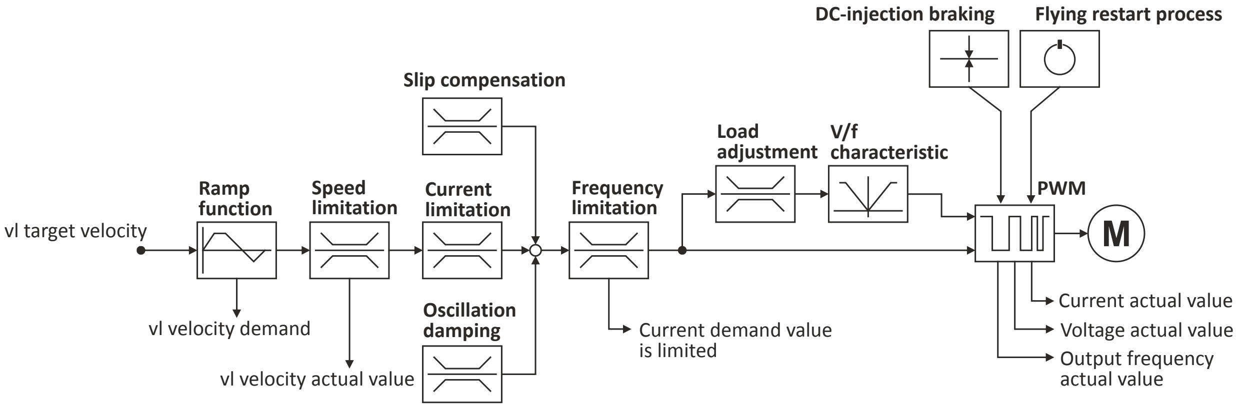


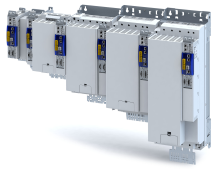


Short overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA402 control word
	0x2830	Lenze control word
	0x6060	Operating mode: selection
	0x6042	Velocity: setpoint velocity vl
	0x60B2	Torque: offset
	0x60E0	Torque: positive limit value
	0x60E1	Torque: negative limit value
Output data	0x6041	CiA402 control word
	0x2831	Lenze status word
	0x6061	Operating mode: display
	0x6043	Velocity: interpolated setpoint velocity vl
	0x606C	Velocity: actual velocity
	0x6077	Torque: actual torque
Interpolation	0x60C2	Interpolation: time interval
Ramp function	0x6048:001	Ramp: speed interval (for acceleration)
	0x6048:002	Ramp: time interval (for acceleration)
	0x6049:001	Ramp: speed interval (for deceleration)
	0x6049:002	Ramp: time interval (for deceleration)
Speed limitation	0x6080	Motor: max. speed
Speed controller	0x2900:001	Speed controller: gain
	0x2900:002	Speed controller: reset time
	0x2900:003	Speed controller: rate time
	0x2901	Speed controller: gain - adjustment
	0x2902	Speed controller: load I component
Torque limiter	0x60E0	Torque: positive limit value
	0x60E1	Torque: negative limit value
	0x6076	Motor: rated torque
	0x6072	Torque: max. torque
Field-oriented control	0x6073	Device: max. current
	0x6075	Motor: rated current
	0x2941	Current controller: feedforward control
	0x2942:001	Current controller: gain
	0x2942:002	Current controller: reset time
	0x29E2	DC bus: actual voltage - filter time
	0x29E3	Motor: actual voltage - filter time (only if 0x2C00 = 2: Servo control for asynchronous motor (SC-ASM))
	0x29E0:001	Field weakening controller: gain
	0x29E0:002	Field weakening controller: reset time
	0x29E1	Limitation of setpoint field (only if 0x2C00 = 2: Servo control for asynchronous motor (SC-ASM))
	0x29C0:001	Field controller: gain
	0x29C0:002	Field controller: reset time
	0x2939	Switching frequency

10.2.3 Signal flow (V/f characteristic control)

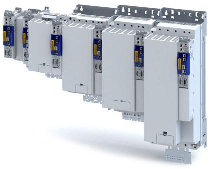




Short overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA402 control word
	0x2830	Lenze control word
	0x6060	Operating mode: selection
	0x6042	Velocity: setpoint velocity vl
Output data	0x6041	CiA402 control word
	0x2831	Lenze status word
	0x6061	Operating mode: display
	0x6043	Velocity: interpolated setpoint velocity vl
	0x606C	Velocity: actual velocity
		Motor: actual current
		Motor: actual voltage - Vrms, phase-phase
		Device: actual output frequency
Ramp function	0x6048:001	Ramp: speed interval (for acceleration)
	0x6048:002	Ramp: time interval (for acceleration)
	0x6049:001	Ramp: speed interval (for deceleration)
	0x6049:002	Ramp: time interval (for deceleration)
Speed limitation	0x6080	Motor: max. speed
Slip compensation	0x2B09:001	VFC: slip compensation - influence
	0x2B09:002	VFC: slip compensation - filter time
Current limitation	0x2B08:001	Gain
	0x2B08:002	Reset time
	0x6073	Max current
Oscillation damping	0x2B0A:001	VFC: oscillation damping - gain
	0x2B0A:002	VFC: oscillation damping - filter time
	0x2B0A:003	VFC: oscillation damping - limitation
	0x2B0A:004	VFC: oscillation damping - ramp end frequency
Load adjustment	0x2B07:001	VFC: load adjustment - direction of rotation
	0x2B07:002	VFC: load adjustment - value
V/f characteristic	0x2B01:001	VFC: V/f characteristic - voltage in the reference point
	0x2B01:002	VFC: V/f characteristic - frequency in the reference point
	0x2B06	VFC: voltage boost
	0x2B04	VFC: voltage vector control - setpoint current
	0x2B00	VFC: V/f characteristic - form
	0x2B02:001 ... 0x2B02:011	VFC: user-definable V/f characteristic • Frequency grid points (x1 ... x11)
	0x2B03:001 ... 0x2B03:011	VFC: user-definable V/f characteristic • Voltage grid points (y1 ... y11)
DC-injection braking	0x2B80	DC-injection braking: current

A more detailed representation of the signal flow with all relevant parameters can be found in the »PLC Designer« on the signal flow tab for the servo inverter.



10.3 Operating mode "CiA 402 Cyclic sync velocity mode (csv)"

This operating mode provides a fast velocity follower with torque/feed force feedforward control.

Subfunctions of the operating mode

- Interpolation between communication cycle and control cycle
- Speed control
- Limitation of the motor speed
- Update of the actual values for position, velocity and torque

10.3.1 Default mapping

The default mapping for the cyclic sync velocity mode (csv)" is defined in the following parameters.

Parameter	Designation	Data type
0x1602	RPDO-->axis: cyclic sync velocity mode (csv)	RECORD
0x1606	RPDO-->axis: torque limit	RECORD
0x1A02	Axis-->TPDO: cyclic sync velocity mode (csv)	RECORD

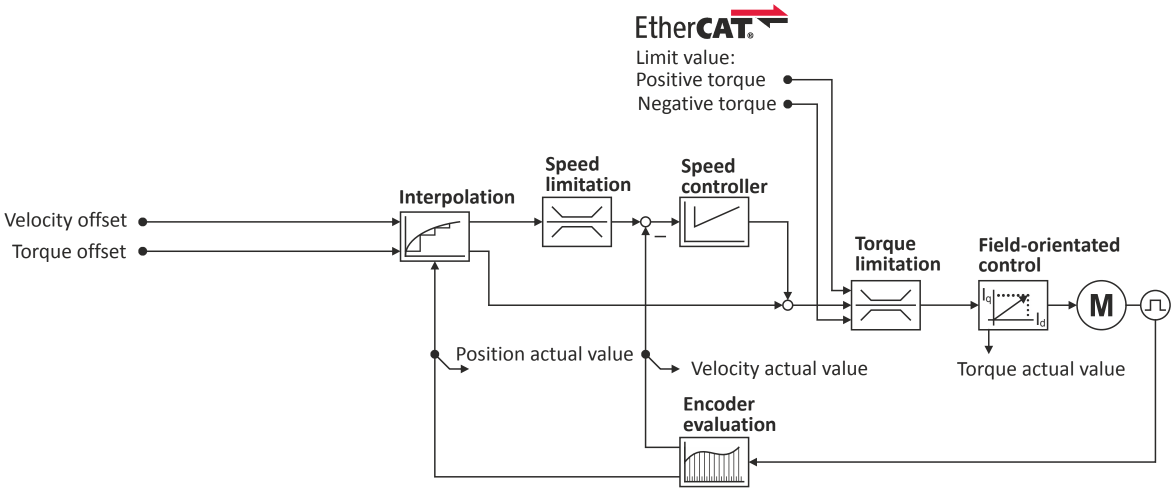
Data received from the Controller (RPDO)

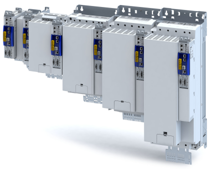
Parameter	Designation	Data type
0x6040	CiA402 control word	UNSIGNED_16
0x2830	Lenze control word	UNSIGNED_16
0x6060	Operating mode: selection	INTEGER_8
0x60B2	Torque: offset	INTEGER_16
0x60FF	Velocity: setpoint velocity	INTEGER_32
0x60E0	Torque: positive limit value	UNSIGNED_16
0x60E1	Torque: negative limit value	UNSIGNED_16

Data sent to the Controller (TPDO)

Parameter	Designation	Data type
0x6041	CiA402 status word	UNSIGNED_16
0x2831	Lenze status word	UNSIGNED_16
0x6061	Operating mode: display	INTEGER_8
0x603F	Error code	UNSIGNED_16
0x606C	Velocity: actual velocity	UNSIGNED_16
0x6077	Torque: actual torque	INTEGER_16
0x6064	Position: actual position	INTEGER_32

10.3.2 Signal flow (servo control)

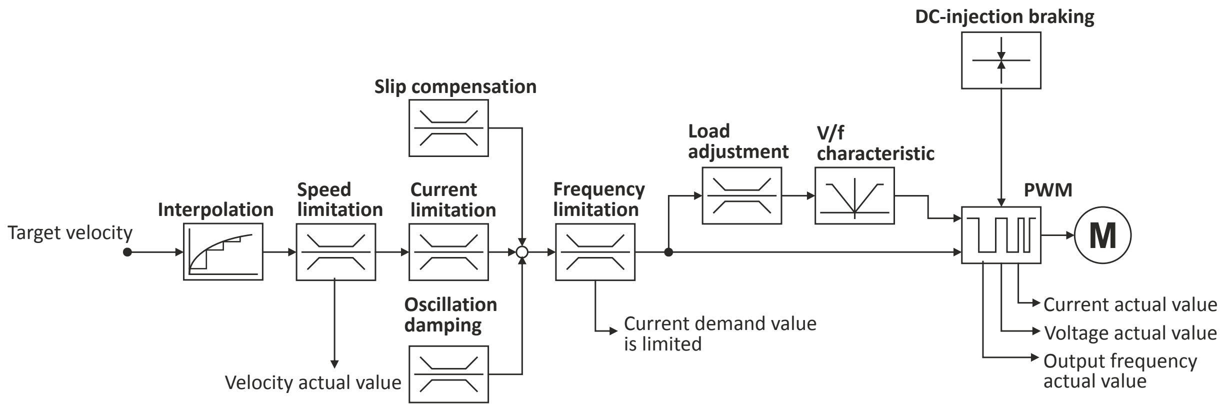




Short overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA402 control word
	0x2830	Lenze control word
	0x6060	Operating mode: selection
	0x60B1	Velocity: offset
	0x60B2	Torque: offset
	0x60E0	Torque: positive limit value
	0x60E1	Torque: negative limit value
Output data	0x6041	CiA402 status word
	0x2831	Lenze status word
	0x6061	Operating mode: display
	0x6064	Position: actual position
	0x606C	Velocity: actual velocity
	0x6077	Torque: actual torque
Interpolation	0x60C2:001	Interpolation: time interval
Speed limitation	0x6080	Motor: max. speed
Speed controller	0x2900:001	Speed controller: gain
	0x2900:002	Speed controller: reset time
	0x2900:003	Speed controller: rate time
	0x2901	Speed controller: gain - adjustment
	0x2902	Speed controller: load I component
Torque limitation	0x60E0	Positive limit value
	0x60E1	Negative limit value
	0x6076	Motor: rated torque
	0x6072	Torque: max. torque
Field-oriented control	0x6073	Device: max. current
	0x6075	Motor: rated current
	0x2941	Current controller: feedforward control
	0x2942:001	Current controller: gain
	0x2942:002	Current controller: reset time
	0x29E2	DC bus: actual voltage - filter time
	0x29E3	Motor: actual voltage - filter time
	0x29E0:001	Field weakening controller: gain
	0x29E0:002	Field weakening controller: reset time
	0x29E1	Limitation of setpoint field
	0x29C0:001	Field controller: gain
	0x29C0:002	Field controller: reset time
	0x2939	Switching frequency

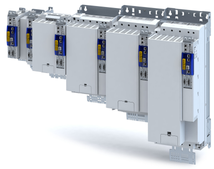
10.3.3 Signal flow (V/f characteristic control)



Short overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA402 control word
	0x2830	Lenze control word
	0x6060	Operating mode: selection
	0x60FF	Velocity: Setpoint velocity
Output data	0x6041	CiA402 status word
	0x2831	Lenze status word
	0x6061	Operating mode: display
	0x606C	Velocity: actual velocity
		Motor: actual current
		Motor: actual voltage - Vrms, phase-phase
		Device: actual output frequency
Interpolation	0x60C2:001 0x60C2:002	Interpolation: Time interval and interpolation time: exponent
Speed limitation	0x6080	Motor: max. speed
Slip compensation	0x2B09:001	VFC: Slip compensation - influence
	0x2B09:002	VFC: Slip compensation - filter time
Current limitation	0x2B08:001	Gain
	0x2B08:002	Reset time
Oscillation damping	0x2B0A:001	VFC: Oscillation damping - gain
	0x2B0A:002	VFC: Oscillation damping - filter time
	0x2B0A:003	VFC: Oscillation damping - limitation
	0x2B0A:004	VFC: Oscillation damping - ramp end frequency
Load adjustment	0x2B07:001	VFC: Load adjustment - direction of rotation
	0x2B07:002	VFC: Load adjustment - value
V/f characteristic	0x2B01:001	VFC: V/f characteristic - voltage in the reference point
	0x2B01:002	VFC: V/f characteristic - frequency in the reference point
	0x2B06	VFC: voltage boost
	0x2B04	VFC: voltage vector control - setpoint current
	0x2B00	VFC: V/f characteristic form
	0x2B02:001 ... 0x2B02:011	VFC: user-definable V/f characteristic • Voltage grid points (x1 ... x11)
	0x2B03:001 ... 0x2B03:011	VFC: user-definable V/f characteristic • Tension grid points (y1 ... y11) Field weakening controller: reset time
DC-injection braking	0x2B80	DC-injection braking: current

A more detailed representation of the signal flow with all relevant parameters can be found in the »PLC Designer« on the signal flow tab for the servo inverter.



10.3.4 Control commands and status information

The following control commands can be executed in the "cyclic sync velocity mode" via the CiA402 control word (0x6040):

Control word	State	Function
Bit 4	0	reserved (bit must be set to "0")
Bit 5	0	reserved (bit must be set to "0")
Bit 6	0	reserved (bit must be set to "0")
Bit 8	0 ↗ 1	Stop

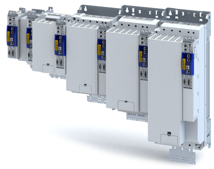
The following status information are output via the CiA402 status word (0x6041) in the "cyclic sync velocity mode":

Status word	State	Meaning
Bit 12	0	"Cyclic sync velocity mode" is inactive
	1	"Cyclic sync velocity mode" is active

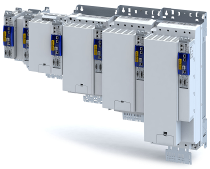
10.4 Process input data (CiA 402 objects)

Parameter

Address	Name / setting range / [default setting]	Info
0x2830	Inverter control word 0x0000 ... [**0x0000**] ... 0xFFFF	The control word serves to influence the control functions.
	Bit 0 Flying restart completed	This bit enables the control to report the acceptance of the recorded speed to the "flying restart" function. Thus, the flying restart process is completed.
	Bit 1 Block flying restart	TRUE: the flying restart process is blocked.
	Bit 4 Set load value	TRUE: set load value.
	Bit 5 Select new actual position	TRUE: define new actual position. • Setting/shifting of Position actual value (0x6064) to Actual position start value (0x2983) considering the set resolution (0x608F:001, 0x608F:002). • Mode for setting the actual position: 0x2984)
	Bit 6 Activate DC-injection braking or short-circuit braking	DC-injection braking or short-circuit braking is activated via this bit.
	Bit 10 Reserved	
	Bit 11 Reserved	
0x6040	CiA: Controlword 0x0000 ... [**0x0000**] ... 0xFFFF	Mappable CiA 402 control word with bit assignment according to device profile CiA 402.
	Bit 0 Switch on	1 = switch-on
	Bit 1 Enable voltage	1 = DC bus: Establish readiness for operation
	Bit 2 Quick stop	0 = activate quick stop
	Bit 3 Enable operation	1 = enable operation
	Bit 4 Operation mode specific	
	Bit 5 Operation mode specific	
	Bit 6 Operation mode specific	
	Bit 7 Fault reset	0-1 edge = reset error
	Bit 8 Halt	1 = stop motor (ramping down to frequency setpoint 0 Hz)
	Bit 9 Operation mode specific	Operating mode dependent
	Bit 14 Release holding brake	1 = releasing holding brake manually ⚠ CAUTION! • The manually triggered "Release holding brake" command has a direct impact on the "Release holding brake [115]" trigger. Thus, the holding brake can be manually released if the power section is switched off. • The responsibility for a manual release of the holding brake has the external trigger source for the "Release holding brake" command. ▶ Holding brake control 🕮 219
0x6042	Target velocity -32768 ... [**0**] ... 32767 rpm	Setpoint speed (velocity mode).
0x6046:001	Velocity min max amount: Velocity min amount 0 ... [**0**] ... 0 rpm	Minimum speed (velocity mode).
0x6046:002	Velocity min max amount: Velocity max amount 2147483647 ... [**2147483647**] ... 2147483647 rpm	Maximum speed (velocity mode).
0x6048:001	Velocity acceleration: Delta speed 0 ... [**0**] ... 2147483647 rpm	Acceleration: speed interval
0x6048:002	Velocity acceleration: Delta time 0 ... [**10**] ... 65535 s	Acceleration: time interval
0x6049:001	Velocity deceleration: Delta speed 0 ... [**0**] ... 2147483647 rpm	Deceleration: speed interval
0x6049:002	Velocity deceleration: Delta time 0 ... [**10**] ... 65535 s	Deceleration: time interval



Address	Name / setting range / [default setting]		Info
0x6060	Modes of operation		Selection of the operating mode.
	0	**No mode change/no mode assigned**	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode ▶ Operating mode "CiA 402 Velocity mode (vl)" 📖 138
	8	Cyclic sync position mode	▶ Operating mode "CiA 402 Cyclic sync position mode (csp)" 📖 124
	9	Cyclic sync velocity mode	▶ Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 📖 143
	10	Cyclic sync torque mode	▶ Operating mode "CiA 402 Cyclic sync torque mode (cst)" 📖 157
0x60B1	Velocity offset -480000.00 ... [**0.00**] ... 480000.00 rpm		Additive value for setpoint velocity or velocity feedforward control.
0x60FF	Target velocity -480000.00 ... [**0.00**] ... 480000.00 rpm		Setting of the setpoint velocity.



10.5 Process output data (CiA 402 objects)

Parameter

Address		Name / setting range / [default setting]	Info
0x2831		Inverter-Statuswort • Read only	Bit coded status word of the internal motor control.
	Bit 1	Speed setpoint 1 limited	1 ≡ input of speed controller 1 in limitation.
	Bit 2	Speed controller in limitation	1 ≡ output of speed controller 1 in limitation.
	Bit 3	Torque setpoint limited	1 ≡ setpoint torque in limitation.
	Bit 4	Soll-Q-Strom limitiert	1 ≡ setpoint current in limitation.
	Bit 5	Speed setpoint 2 limited	1 ≡ input of the speed controller 2 in "torque mode" in limitation.
	Bit 6	Obere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to upper speed limit 0x2946:001.
	Bit 7	Untere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to lower speed limit0x2946:002.
	Bit 10	Output frequency limited	1 ≡ setpoint frequency with V/f operation in limitation.
	Bit 11	Magnetisation completed	1 ≡ during V/f operation, the factor 7 rotor time constant has passed (calculated from the time at which the inverter was enabled without restart on the fly and with a total motor current of 20 % rated motor current for the first time). Otherwise 0.
	Bit 12	Motorphasenfehler	1 ≡ motor phase failure detection active.
	Bit 14	Error reset blocking time active	1 ≡ the fault can only be reset when the blocking time has elapsed.
0x603F		Error code • Read only	Error message
	Bit 0		
0x6041		CiA: Statusword • Read only	Mappable CiA 402 status word with bit assignment according to device profile CiA 402.
	Bit 0	Ready to switch on	1 ≡ drive ready to start
	Bit 1	Switched on	1 ≡ drive switched-on
	Bit 2	Operation enabled	1 ≡ operation enabled
	Bit 3	Fault	1 ≡ fault or trouble active
	Bit 4	Voltage enabled	1 ≡ DC bus ready for operation
	Bit 5	Quick stop	0 ≡ quick stop active
	Bit 6	Switch on disabled	1 ≡ operation inhibited
	Bit 7	Warning	1 ≡ warning active
	Bit 8	RPDOs deactivated	1 ≡ cyclic PDOs have been deactivated.
	Bit 9	Remote	1 ≡ inverter can receive commands via network. • Bit is not set in the operating mode 0x6060 = "MS: Velocity mode [-2]".
	Bit 10	Target reached	1 ≡ the actual position is in the window.
	Bit 11	Internal limit active	1 ≡ internal limitation of a setpoint active.
	Bit 12	Operation mode active	1 ≡ operation enabled and no test mode activated. (no internal setpoint generation active.)
	Bit 13	Following error	1 ≡ following error active
	Bit 14	Holding brake released	1 ≡ holding brake released
	Bit 15	Integrated safety not active	0 ≡ the inverter has been disabled by the integrated safety system 1 ≡ the integrated safety system is not active Not available with i410 and i510 (always TRUE).
0x6061		Modes of operation display • Read only	Display of the current operating mode.
	-11	Identification	
	-10	Test mode	
	0	No mode change/no mode assigned	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode
	8	Cyclic sync position mode	
	9	Cyclic sync velocity mode	
	10	Cyclic sync torque mode	
0x6043		Velocity demand • Read only: x rpm	Display of the setpoint velocity (velocity mode).

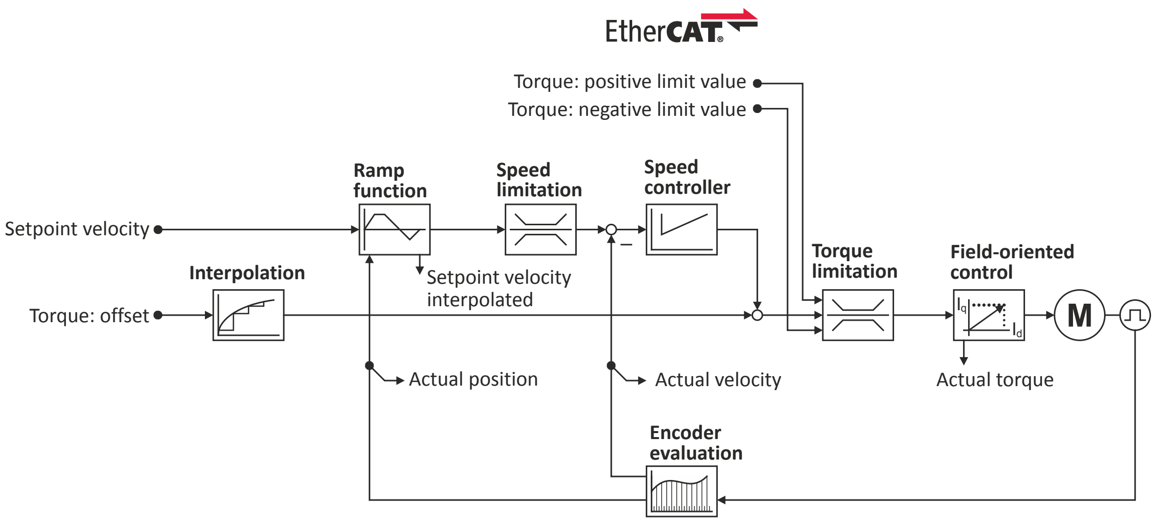
Address	Name / setting range / [default setting]	Info
0x6044	Velocity actual value • Read only: x rpm	Display of the actual speed (velocity mode).
0x606C	Velocity actual value • Read only: rpm	Display of the actual velocity.

10.6 Monitoring the speed deviation

Monitoring of the speed deviation shall only be used in the following control modes:

- Servo control for synchronous motor (SM)
- Servo control for asynchronous motor (ASM)

Monitoring of the speed deviation is effective in the operating modes with speed controller. It monitors the system deviation at the input of the speed controller (see blue arrow):



The error response set in 0x2D51:003 is executed if

1. the set tolerance of the speed deviation is 0x2D51:001 exceeded and
2. the exceedance lasts at least as long as set in 0x2D51:002.

Parameter

Address	Name / setting range / [default setting]		Info
0x2D51:001	Position error/speed error - monitoring: Speed error - error threshold 1 ... **[50]** ... 2147483647 rpm		Setting of the error threshold for speed error monitoring.
0x2D51:002	Position error/speed error - monitoring: Speed error - min. time for error 0 ... **[0]** ... 50 ms		Setting of the minimum time a speed error must be pending until an error/warning message is triggered.
0x2D51:003	Position error/speed error - monitoring: Speed error - error response		Setting of the error response of speed error monitoring.
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	

11 Configuring the torque control

This operating mode provides a fast torque follower with speed limitation.

Typical applications are, for instance, winders or packaging machines.

Preconditions

The conditions are a correct entry of the motor data (Motor data) and the parameter setting of the motor control (Configuring the motor control).

A torque control can only be implemented in the motor control types to be set with 0x2C00:

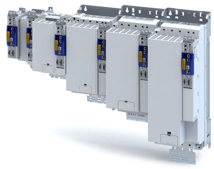
- Servoregelung (SC-PSM) [1]
- Servo control (SC ASM) [2]

Thus, first one of these motor control types must be configured.

For details see the following chapter:

▸ Servo control for synchronous motor (SC-PSM) 📖 203

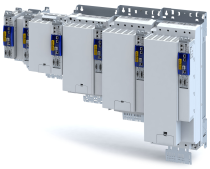
▸ Servo control for asynchronous motor (SC-ASM) 📖 204



11.1 Basic setting

1. Set the manufacturer spanning operating mode "Cyclic sync torque mode [10]" according to CiA402.
   - A detailed description of this operating mode can be found in the "Operating mode "CiA 402 Cyclic sync torque mode (cst)"" section. 157
2. Set the rated motor torque. ▸ 0x6076
3. Set the permissible maximum torque. ▸ 0x6072
   - The maximum torque is preset in 0x6072.
   - The change of the positive and negative limit of the maximum torque is described in the "Torque limits" section. 155
4. Parameterise speed limit. 0x2946
   - The maximum speed is preset. ▸ 0x6080
   - The change of the upper and lower speed limit is described in the "Speed limitation" section. 156
5. Define a torque setpoint for the torque control instead of a speed setpoint. The value is given in percent and based on the rated motor torque set in 0x6076.

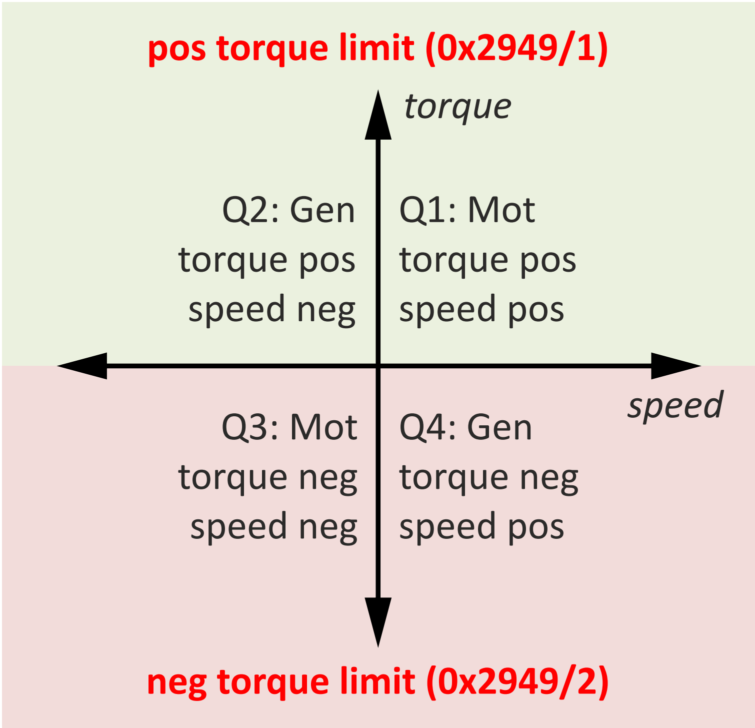
The torque control with speed limitation is now active and the inverter responds to the defined torque setpoint.



11.1.1 Torque limits

Details

The positive and negative torque limit can be set independently of each other. The torque limit is to be configured to the maximum torque. ▶ 0x6072



- Display of the current positive torque limit in 0x2949:004.
- Display of the current negative torque limit in 0x2949:003.

The torque limits are also active in the "Velocity Mode" for the SC-ASM control mode.

Regardless of the setting in 0x2949:004 and 0x2949:004, the maximum torque does not exceed the value configured in ▶ 0x6072.

The setting is made in percent with reference to the rated motor torque set in 0x6076.

Parameter

Address	Name / setting range / [default setting]	Info
0x294A:001	Torque limits offset: Torque offset -3276.7 ... [**0.0**] ... 3276.7 %	
0x294A:002	Torque limits offset: Resulting positive torque limit • Read only: x.x %	
0x294A:003	Torque limits offset: Resulting negative torque limit • Read only: x.x %	
0x60E0	Positive torque limit 0.0 ... [**100.0**] ... 3276.7 %	Positive torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque. ▶ 0x6076
0x60E1	Negative torque limit 0.0 ... [**100.0**] ... 3276.7 %	Code previously C3687. Negative torque limit source for speed control with torque limitation. • 100 % ≡ Rated Motor Torque ▶ 0x6076

11.1.2 Speed limitation

The torque control controls the assigned torque setpoint within the set speed limits. The actual speed results from the load conditions of the application. For example, high speeds may occur in a torque control if no counter torque is available (load-free machine).

When the actual speed reaches the set speed limits, it is kept on the respective limit value. This function is also called "speed limitation".

Details

The lower and upper speed limit for speed limitation can be set independently of each other.

Parameter

Address	Name / setting range / [default setting]	Info
0x2946:001	Speed limitation: Upper speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm	Upper limit for the speed limitation. • Setting is only effective with the selection "Upper speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]
0x2946:002	Speed limitation: Lower speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm	Lower limit for speed limitation. • Setting is only effective with the selection "Lower speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]

11.2 Operating mode "CiA 402 Cyclic sync torque mode (cst)"

During the quick stop, the current limit 0x6073 and the torque limit 0x6072 are active. The lower of the two limits determines the motor output torque. The torque limits from 0x60E0 and 0x60E1 are not effective during quick stop.

Subfunctions of the operating mode

- Torque control with speed limitation
- Limitation of the motor speed
- Update of the actual values for position, velocity and torque

11.2.1 Default mapping

The default mapping for the "Cyclic sync torque mode" is defined in the following parameters:

Parameter	Designation	Data type
0x1601	RPDO-->axis: cyclic sync torque mode (cst)	RECORD
0x1A01	Axis-->TPDO: cyclic sync torque mode (cst)	RECORD

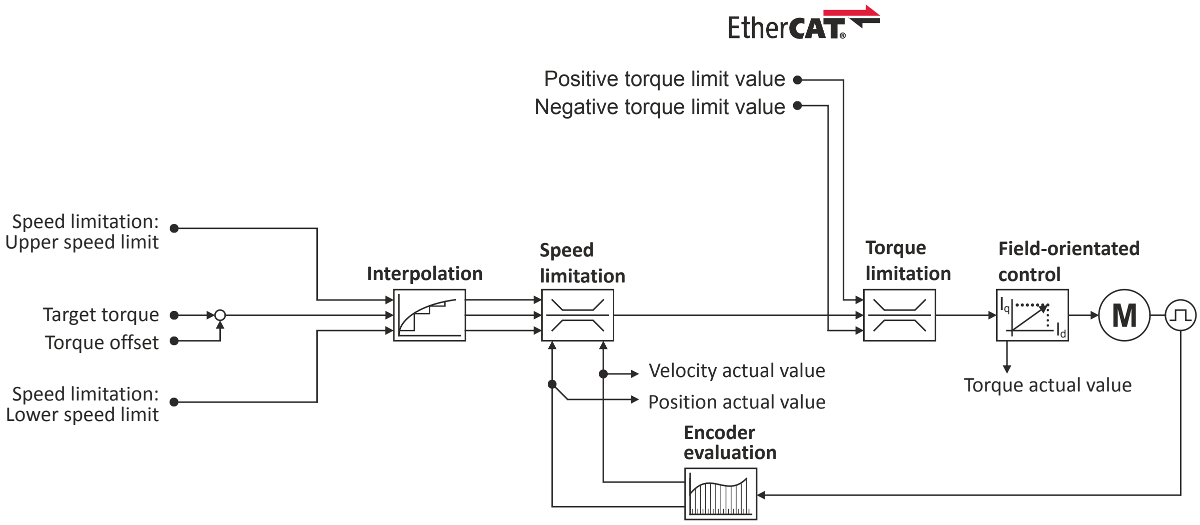
Data received from the Controller (RPDO)

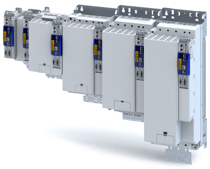
Parameter	Designation	Data type
0x6040	CiA402 control word	UNSIGNED_16
0x2830	Lenze control word	UNSIGNED_16
0x6060	Operating mode: selection	INTEGER_8
0x60B2	Torque: offset	INTEGER_16
0x6071	Torque: setpoint torque	INTEGER_16
0x2946:1	Speed limitation: upper speed limit	INTEGER_32
0x2946:2	Speed limitation: lower speed limit	INTEGER_32

Data sent to the Controller (TPDO)

Parameter	Designation	Data type
0x6041	CiA402 status word	UNSIGNED_16
0x2831	Lenze status word	UNSIGNED_16
0x6061	Operating mode: display	INTEGER_8
0x603F	Error code	UNSIGNED_16
0x606C	Velocity: actual velocity	UNSIGNED_16
0x6077	Torque: actual torque	INTEGER_16

11.2.2 Signal flow

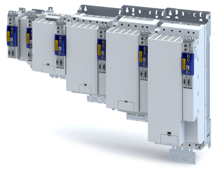




Short overview of the most important parameters

Function	Parameter	Designation
Input data	0x6040	CiA402 control word
	0x2830	Lenze control word
	0x6060	Operating mode: selection
	0x2946:001	Speed limitation: upper speed limit
	0x60B2	Torque: offset
	0x6071	Torque: setpoint torque
	0x2946:002	Speed limitation: lower speed limit
	0x60E0	Torque: positive limit value
	0x60E1	Torque: negative limit value
Output data	0x6041	CiA402 status word
	0x2831	Lenze status word
	0x6061	Operating mode: display
	0x606C	Velocity: actual velocity
	0x6077	Torque: actual torque
Interpolation	0x60C0	Interpolation algorithm
	0x60C2:001 0x60C2:002	Interpolation: time interval and interpolation time: Exponent
Speed limitation	0x6080	Motor: max. speed
	0x2946:001	Speed limitation: upper speed limit
	0x2946:002	Speed limitation: lower speed limit
Torque limitation	0x60E0	Torque: positive limit value
	0x60E1	Torque: negative limit value
	0x6076	Motor: rated torque
	0x6072	Torque: max. torque
Field-oriented control	0x6073	Device: max. current
	0x6075	Motor: rated current
	0x2941	Current controller: feedforward control
	0x2942:001	Current controller: gain
	0x2942:002	Current controller: reset time
	0x29E2	DC bus: actual voltage - filter time
	0x29E3	Motor: actual voltage - filter time
	0x29E0:001	Field weakening controller: gain
	0x29E0:002	Field weakening controller: reset time
	0x29E1	Field: limitation of setpoint field
	0x29C0:001	Field controller: gain
	0x29C0:002	Field controller: reset time
	0x2939	Switching frequency

A more detailed representation of the signal flow with all relevant parameters can be found in the »PLC Designer« on the signal flow tab for the inverter.



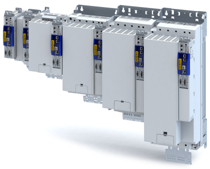
11.2.3 Control commands and status information

The following control commands can be executed in the "cyclically synchronous torque" operating mode via the CiA402 control word 0x6040:

Control word	State	Function
Bit 4	0	*reserved* (bit must be set to "0")
Bit 5	0	*reserved* (bit must be set to "0")
Bit 6	0	*reserved* (bit must be set to "0")
Bit 8	0↗1	Stop

The following status information are output via the CiA402 status word 0x6041 in the "cyclic sync torque mode":

Status word	State	Meaning
Bit 12	0	"Cyclic sync torque mode" is inactive
	1	"Cyclic sync torque mode" is active



11.3 Process input data (CiA 402 objects)

Parameter

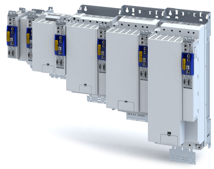
Address	Name / setting range / [default setting]		Info
0x2830	Inverter control word 0x0000 ... [**0x0000**] ... 0xFFFF		The control word serves to influence the control functions.
	Bit 0	Flying restart completed	This bit enables the control to report the acceptance of the recorded speed to the "flying restart" function. Thus, the flying restart process is completed.
	Bit 1	Block flying restart	TRUE: the flying restart process is blocked.
	Bit 4	Set load value	TRUE: set load value.
	Bit 5	Select new actual position	TRUE: define new actual position. • Setting/shifting of Position actual value (0x6064) to Actual position start value (0x2983) considering the set resolution (0x608F:001, 0x608F:002). • Mode for setting the actual position: 0x2984)
	Bit 6	Activate DC-injection braking or short-circuit braking	DC-injection braking or short-circuit braking is activated via this bit.
	Bit 10	Reserved	
	Bit 11	Reserved	
0x2946:001	Speed limitation: Upper speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm		Upper limit for the speed limitation. • Setting is only effective with the selection "Upper speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]
0x2946:002	Speed limitation: Lower speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm		Lower limit for speed limitation. • Setting is only effective with the selection "Lower speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]
0x6040	CiA: Controlword 0x0000 ... [**0x0000**] ... 0xFFFF		Mappable CiA 402 control word with bit assignment according to device profile CiA 402.
	Bit 0	Switch on	1 = switch-on
	Bit 1	Enable voltage	1 = DC bus: Establish readiness for operation
	Bit 2	Quick stop	0 = activate quick stop
	Bit 3	Enable operation	1 = enable operation
	Bit 4	Operation mode specific	
	Bit 5	Operation mode specific	
	Bit 6	Operation mode specific	
	Bit 7	Fault reset	0-1 edge = reset error
	Bit 8	Halt	1 = stop motor (ramping down to frequency setpoint 0 Hz)
	Bit 9	Operation mode specific	Operating mode dependent
	Bit 14	Release holding brake	1 = releasing holding brake manually ⚠ CAUTION! • The manually triggered "Release holding brake" command has a direct impact on the "Release holding brake [115]" trigger. Thus, the holding brake can be manually released if the power section is switched off. • The responsibility for a manual release of the holding brake has the external trigger source for the "Release holding brake" command. ▶ Holding brake control 📖 219
0x6060	Modes of operation		Selection of the operating mode.
	0	**No mode change/no mode assigned**	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode ▶ Operating mode "CiA 402 Velocity mode (vl)" 📖 138
	8	Cyclic sync position mode	▶ Operating mode "CiA 402 Cyclic sync position mode (csp)" 📖 124
	9	Cyclic sync velocity mode	▶ Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 📖 143
	10	Cyclic sync torque mode	▶ Operating mode "CiA 402 Cyclic sync torque mode (cst)" 📖 157

Address	Name / setting range / [default setting]	Info
0x6071	Target torque -3276.8 ... [**0.0**] ... 3276.7 %	Setting of the setpoint torque for the torque operating modes. • 100 % ≡ Motor rated torque 0x6076 • The inverter does not support the operating mode "CiA 402 torque mode".
0x6072	Max torque 0.0 ... [**250.0**] ... 3276.7 %	• 100 % ≡ Motor rated torque 0x6076 • The torque limitation is both effective in the static and dynamic operating points. It is used, for instance, as overload protection of the mechanical transmission path/elements, starting from the motor shaft. • If a value is entered here that is higher than in 0x60E0 (Positive torque limit) and 0x60E1 (Negative torque limit), the torque is limited to the lowest value.
0x60B2	Torque offset -3276.8 ... [**0.0**] ... 3276.7 %	Additive value for setpoint torque or torque feedforward control • 100 % ≡ rated motor power (0x6076)

11.4 Process output data (CiA 402 objects)

Parameter

Address	Name / setting range / [default setting]	Info
0x2831	Inverter-Statuswort • Read only	Bit coded status word of the internal motor control.
	Bit 1 Speed setpoint 1 limited	1 ≡ input of speed controller 1 in limitation.
	Bit 2 Speed controller in limitation	1 ≡ output of speed controller 1 in limitation.
	Bit 3 Torque setpoint limited	1 ≡ setpoint torque in limitation.
	Bit 4 Soll-Q-Strom limitiert	1 ≡ setpoint current in limitation.
	Bit 5 Speed setpoint 2 limited	1 ≡ input of the speed controller 2 in "torque mode" in limitation.
	Bit 6 Obere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to upper speed limit 0x2946:001.
	Bit 7 Untere Drehzahlgrenze aktiv	1 ≡ in "torque mode", the speed is limited to lower speed limit0x2946:002.
	Bit 10 Output frequency limited	1 ≡ setpoint frequency with V/f operation in limitation.
	Bit 11 Magnetisation completed	1 ≡ during V/f operation, the factor 7 rotor time constant has passed (calculated from the time at which the inverter was enabled without restart on the fly and with a total motor current of 20 % rated motor current for the first time). Otherwise 0.
	Bit 12 Motorphasenfehler	1 ≡ motor phase failure detection active.
	Bit 14 Error reset blocking time active	1 ≡ the fault can only be reset when the blocking time has elapsed.
0x603F	Error code • Read only	Error message
	Bit 0	
0x6041	CiA: Statusword • Read only	Mappable CiA 402 status word with bit assignment according to device profile CiA 402.
	Bit 0 Ready to switch on	1 ≡ drive ready to start
	Bit 1 Switched on	1 ≡ drive switched-on
	Bit 2 Operation enabled	1 ≡ operation enabled
	Bit 3 Fault	1 ≡ fault or trouble active
	Bit 4 Voltage enabled	1 ≡ DC bus ready for operation
	Bit 5 Quick stop	0 ≡ quick stop active
	Bit 6 Switch on disabled	1 ≡ operation inhibited
	Bit 7 Warning	1 ≡ warning active
	Bit 8 RPDOs deactivated	1 ≡ cyclic PDOs have been deactivated.
	Bit 9 Remote	1 ≡ inverter can receive commands via network. • Bit is not set in the operating mode 0x6060 = "MS: Velocity mode [-2]".
	Bit 10 Target reached	1 ≡ the actual position is in the window.
	Bit 11 Internal limit active	1 ≡ internal limitation of a setpoint active.
	Bit 12 Operation mode active	1 ≡ operation enabled and no test mode activated. (no internal setpoint generation active.)
	Bit 13 Following error	1 ≡ following error active
	Bit 14 Holding brake released	1 ≡ holding brake released
	Bit 15 Integrated safety not active	0 ≡ the inverter has been disabled by the integrated safety system 1 ≡ the integrated safety system is not active Not available with i410 and i510 (always TRUE).
0x6061	Modes of operation display • Read only	Display of the current operating mode.
	-11 Identification	
	-10 Test mode	
	0 No mode change/no mode assigned	No operating mode (standstill)
	2 CiA: Velocity mode	CiA 402 velocity mode
	8 Cyclic sync position mode	
	9 Cyclic sync velocity mode	
	10 Cyclic sync torque mode	
0x606C	Velocity actual value • Read only: rpm	Display of the actual velocity.



Address	Name / setting range / [default setting]	Info
0x6074	Torque demand value • Read only: x.x %	Display of the setpoint torque. • 100 % ≡ Motor rated torque 0x6076
0x6077	Torque actual value • Read only: x.x %	Display of the current torque. • 100 % ≡ Rated Motor Torque. ▸ 0x6076

11.5 Setpoint diagnostics

The following parameters provide information on the setpoints set for torque control.

Parameter

Address	Name / setting range / [default setting]	Info
0x2DD5	Torque setpoint • Read only: x.xx Nm	Display of the current torque setpoint.

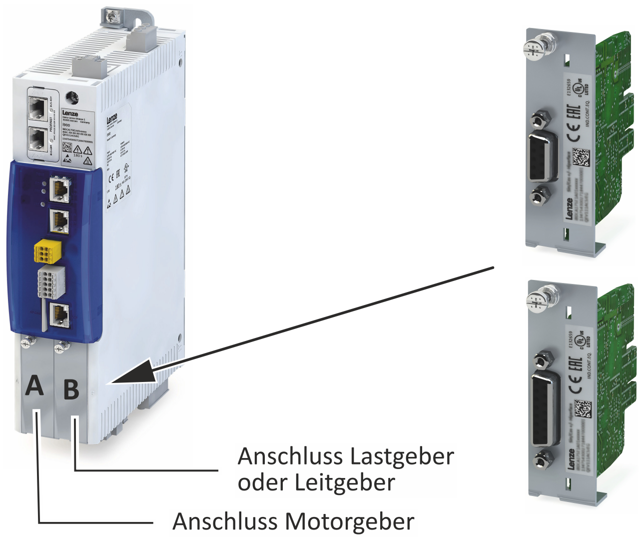
12 Configuring the feedback system

This chapter provides information on how to use feedback systems.

The inverter can be equipped to allow the connection of up to two independent feedback systems.

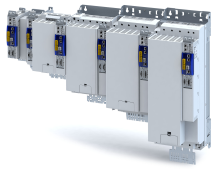
Each of the two feedback systems

- Is placed in a designated slot in the lower part of the inverter
- Has an encoder connection on its front side
- Is an optional equipment feature of the inverter



At the time of commissioning, the feedback system is already specified by the hardware of the respective device version.

Please note that one of two sets of parameters will be effective depending on which feedback system option has been selected: either the parameters for resolver evaluation or the parameters for encoder evaluation.



12.1 Configure feedback system for motor control

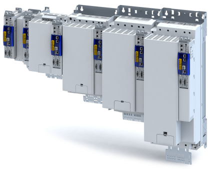
The parameter settings for the motor feedback system are accessed in »EASY Starter« via the following path:

- **Settings** tab
    - Basic setting \ Motor feedback (A)

Here, you have the choice of using the following feedback systems:

- Resolver
- Encoder

You can select the feedback system that you wish to use by pressing the correspondingly named button.



12.1.1 General settings

This chapter provides information on general settings of feedback systems for the motor control.

Pressing the **Select resolver** or **Select encoder** button displays a list of resolvers or encoders.

If the displayed list contains the feedback system used, the data is applied automatically.

Otherwise, you must enter the data of the feedback system manually.

Monitoring of the encoder cable for wire breakage

The resolver or encoder cable can be monitored for wire breakage in the default settings of parameter 0x2C45.

⚠ DANGER!

When the encoder / resolver is used as a motor encoder, safe motor operation is not possible in the event of an error.

Destruction of system parts

► **Fault** should always be used as a response for resolver/encoder wire breakage monitoring.

► To prevent interference injections when using an encoder, only use shielded motor and encoder cables.

Wire breakage monitoring trips in the following cases:

- Resolver
  - Wire breakage in the encoder cable
  - When the resolver impedance is too great
  - In the event of interference injections (EMC interference)
- Encoder
  - Wire breakage in the encoder cable

Sensitivity of wire breakage monitoring

The sensitivity of wire breakage monitoring can be set as a percentage using the 0x2C47 parameter.

Reducing the monitoring sensitivity is advantageous in environments that are severely affected by EMC problems.

If the sensitivity is not reduced (100 %), the software response time of monitoring in case of an encoder is approx. 3.5 ms and in case of a resolver 0.3 ms.

Halving the sensitivity means doubling the response time.

NOTICE

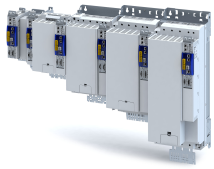
A reduced sensitivity delays the response in case of wire breakage!

Destruction of system parts by reduced sensitivity of the open-circuit monitoring.

► Increase the sensitivity to reduce the monitoring response time.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C45	Encoder-error response		Selection of the response to the triggering of the encoder signal loss monitoring. Only active when used as: • Feedback system for motor control, when set Associated error code: • 29443 | 0x7303 - RANLI_CIMES_1000_20870
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	



Address	Name / setting range / [default setting]	Info
0x2C46	Number of the absolute ascertainable revolutions of motor encoder • Read only	Is set by the firmware according to the available version: • 0: no absolute value encoder (sin/cos encoder) or resolver with number of pole pairs > 1 • 1: Single-turn absolute value encoder or resolver with number of pole pairs = 1 • >1: Multi-turn absolute value encoder
0x2C47	Open circuit detection sensitivity of motor encoder 1 ... [**100**] ... 100 %	The sensitivity can be reduced by percentage, e. g. in case of EMC interferences.
0x608F:001	Position encoder resolution: Encoder increments • Setting can only be changed if the inverter is inhibited.	Setting the number of bits to be used for resolving a mechanical motor revolution. Resolving the position detection by the motor encoder.
	65536 | **16 bit**	
	262144 | 18 bit	
	1048576 | 20 bit	
	4194304 | 22 bit	
	16777216 | 24 bit	
	67108864 | 26 bit	
	268435456 | 28 bit	
	1073741824 | 30 bit	
0x608F:002	Position encoder resolution: Motor revolutions 1 ... [**1**] ... 1 • Setting can only be changed if the inverter is inhibited.	Setting of the number of motor revolutions. Only setting "1" is accepted.
0x6090:001	Velocity encoder resolution: Encoder increments per second 0 ... [**33554432**] ... 2147483647 • Setting can only be changed if the inverter is inhibited.	Setting of the encoder increments per second.
0x6090:002	Velocity encoder resolution: Motor revolutions per second 0 ... [**125**] ... 2147483647 • Setting can only be changed if the inverter is inhibited.	Setting of the motor revolutions per second.

12.1.2 Resolver settings

Resolvers with a number of pole pairs > 1 are not absolute value encoders.

Bit 4 in (Lenze status word 2) therefore remains set to "0".

The "distinguishable revolutions" specification in 0x2C46 is also set to "0".

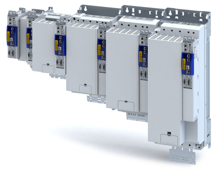
The following applies to synchronous motors:

- When the number of motor pole pairs to the number of resolver pole pairs is an integer ratio (0x2C01:001), the pole position only has to be identified once.
- When the number of motor pole pairs to the number of resolver pole pairs is a non-integer ratio (0x2C01:001), the pole position must be identified every time the inverter is connected to 24 V. ▶ Synchronous motor: Pole position identification (PPI) 🕮 191

Parameter

Address	Name / setting range / [default setting]	Info
0x2822:025	Axis commands: Get motor encoder characteristic (resolver)	Values determined in order to compensate for resolver faults.
	0 | **Off/Ready**	Obtain Hiperface information from the encoder for application feedback.
	1 | On/Start	
	2 | In process	
	3 | Action cancelled	
	4 | No access	
	5 | No access (controller inhibit)	

Address	Name / setting range / [default setting]	Info
0x2C43	Motor encoder resolver number of pole pairs 1 ... [**1**] ... 10 • Setting can only be changed if the inverter is inhibited.	Setting of the number of pole pairs.



12.1.2.1 Resolver error compensation

The actual position detected by the resolver is not exactly the same as the real physical position. There are always deviations to a lesser or greater extent.

An identification run of the resolver automatically generates the adjustment values required for compensation of the resolver error.

The values calculated have a counteractive corrective effect on the underlying cause in the following parameters:

Cause	Remedy
Sine and cosine track do not magnetise orthogonally to each other.	0x2C44:001 Correction of the angle by means of which the two resolver tracks are supplied in a manner relative to one another.
The inductances of the sine and cosine track of the resolver have slightly different values.	0x2C44:002 and 0x2C44:003 Adjusting the gains of the digital-analog converters which feed the resolver tracks.

Conditions for executing the identification run

1. Mechanical motor / inverter connection
   - If possible, execute the identification run before the motor is installed in the machine. Bigger load changes at the motor may have a negative impact on the identification result.
   - Motor and resolver must be properly connected to the inverter.
   - The motor must rotate freely.
2. Voltage supply of the inverter
   - The inverter must be supplied with mains voltage. Check: 0x6041, bit 4 = TRUE.
   - The control electronics must be supplied with voltage. For this purpose, some designs require an external voltage source.
3. Correct setting of the following data in the »EASY Starter« engineering tool:
   - Number of resolver pole pairs (0x2C43)
   - Speed-controlled or position-controlled motor in servo control
4. The inverter must be connected "online" to the engineering tool.

Possible responses during the execution

- The identification method can cause an uneven motor running during the identification.
- The direction of rotation can change.

  This does not have a negative impact on the quality of the identification. In this case, the inverter automatically interrupts the identification run and automatically continues it if a constant speed is reached again.
- If the motor already installed in the machine does not have sufficient range in one direction for executing the identification run, you can also reverse the driving direction while the identification is active. In this case, the identification automatically switches to the "Identification temporarily interrupted ". The status is deactivated as soon as a constant speed has been reached again.

> In the event of an interruption, the identification run is stopped. An error message is displayed.
>
> If 0 % is set, the gain of the respective resolver track is only 95 % of the Lenze setting.
>
> The detected gain can assume values in the range of 0 ... 100 %.
>
> In case of a successful resolver error compensation, only one of the two gains is adjusted. The other value remains at 100 %.

How to run an identification

> If possible, execute the identification run before the motor is installed in the machine. If relatively big load changes occur in the kinematics to be moved, this may have a negative impact on the result of the identification run.

1. Initiate an identification run with parameter 0x2822:025.
2. Enable inverter.
   The identification run is in standby mode.
3. Approach a constant speed between n = 500 rpm and n = 3000 rpm.
   The identification run is started automatically after the drive has reached a constant speed and maintains it over the time defined in .

   This speed is saved for the identification run. In order that the identification run can be continued again, e.g. after an interruption, the drive must be operated again with this speed.

   End of the identification run

   After the resolver error identification has been executed successfully, the parameters 0x2C44:001 ... 0x2C44:003 are written automatically. The resolver now works with these settings.

   Short-time interruption of the identification run

   A short-time interruption, e.g. by removing the controller enable, does not stop the measurement. It is continued after the controller is enabled anew. For the duration of the interruption, the following status message is displayed: "Identification interrupted temporarily")

   Abort of the identification run

   The measurement is aborted if the controller inhibit persists or after the time-out time has elapsed. A time-out error is output for the identification run (see error messages in the logbook).
4. If the measurement was successful, the motor can be stopped
5. At the end of the procedure, save the changed parameters 0x2C44:001 ... 0x2C44:003 in the inverter.

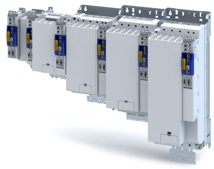
»EASY Starter« can be used to save the inverter parameter settings, see ▶ Saving the parameter settings. 📖 36

Deactivating the resolver error compensation

For deactivating the resolver error compensation, the respective parameters must be reset again to the Lenze setting.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C44:001	Motor encoder identification (Resolver): Angle -100 ... [**0**] ... 100	Setting of the angle to the resolver error compensation.
0x2C44:002	Motor encoder identification (Resolver): Cosine track gain 0 ... [**100**] ... 100 %	Setting of the gain of the cosine track to the resolver error compensation.
0x2C44:003	Motor encoder identification (Resolver): Sine track gain 0 ... [**100**] ... 100 %	Setting of the gain of the sine track to the resolver error compensation.



Address	Name / setting range / [default setting]		Info
0x2C44:006	Motor encoder identification (Resolver): Identification status • Read only		Display of the resolver identification status.
	Bit 0	Identification activated	TRUE if: • Identification has been started. • Controller enable is active. FALSE if: • Identification has been aborted or completed successfully. • A timeout error is active. • The 24V supply has been switched on and default settings are loaded.
	Bit 1	Constant speed detected	TRUE if: • A constant motor speed has been detected. FALSE if: • Identification has been aborted or completed successfully. • A timeout error is active. • The 24V supply has been switched on and default settings are loaded.
	Bit 2	Identification is running	TRUE if: • Identification is running. FALSE if: • The motor speed has fallen below the minimum speed of 500 rpm. • The identification process has been aborted temporarily and is on standby.
	Bit 3	Identification successful	TRUE if: • Identification has been completed successfully. FALSE if: • The identification is not completed yet after default settings were loaded.
	Bit 4	Identification failed	TRUE if: • A timeout error has occurred. FALSE if: • Identification has been completed successfully.

12.1.3 Encoder settings

In general, an encoder is a measuring system which serves to detect the velocity/speed and the position of a kinematics or motor.

Details

If a resolver variant is to be plugged into the respective slot of the inverter as a feedback system, the parameters in this section have no function.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C40	Motor encoder type • Setting can only be changed if the inverter is inhibited.		Selection of the encoder type.
	1	**SinCos encoder**	
	2	Hiperface absolute value encoder	
	5	SSI encoder	
0x2C42:001	Encoder settings: Increments/revolution 1 ... [**1024**] ... 131072 • Setting can only be changed if the inverter is inhibited.		Setting of the encoder number of increments per revolution (according to manufacturer data/encoder data sheet).

Address	Name / setting range / [default setting]	Info
0x2C42:002	Encoder settings: Supply voltage 5.0 ... [**5.0**] ... 12.0 V • Setting can only be changed if the inverter is inhibited.	Setting of the supply voltage.

12.1.3.1 SinCos encoder

The following SinCos encoder types without HIPERFACE® protocol are supported by the inverter:

Type	Increments/revolution	Absolute revolutions
IG1024-5V-V3 (RVS58S)	1024	0
IG2048-5V-S (ITD22)	2048	0
IG2048-5V-S	2048	0

12.1.3.2 SinCos absolute value encoder with HIPERFACE® protocol

The following SinCos encoder types with HIPERFACE® protocol are supported by the inverter:

Type	Increments/revolution	Absolute revolutions	Type code 0x2C41:001
AM1024-8V-H (SRM50)	1024	4096 (Multiturn)	39
AM1024-8V-H (SFM60)	1024		39
AM1024-8V-K2 (SRM50S)	1024		39
AM128-8V-H (SKM36)	128		55
AM16-8V-H (SEL37)	16		71
AM16-8V-H (SEL52)	16		71
AM512-8V-H (SCM70)	512		7
AS1024-8V-H (SRS50)	1024	4096 (Single-turn)	34
AS1024-8V-K2 (SRS50S)	1024		34
AS16-8V-H (SEK37)	16		66
AS16-8V-H (SEK52)	16		66
AS512-8V-H (SCS70)	512		2

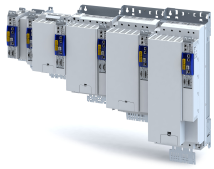
Use of non-supported encoder types

If the type code of the encoder used is not listed in the table of supported encoder types, this encoder can be introduced to the inverter via the 0x2C41:002 and 0x2C41:003 parameters.

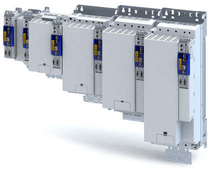
In this context, please also observe the information provided in the parameter description 0x2C41:008.

Parameter

Address	Name / setting range / [default setting]	Info
0x2822:026	Axis commands: Get motor encoder information (Hiperface)	Command for reading out data from the connected motor encoder.
	0 **Off/Ready**	Obtain Hiperface information from the encoder for application feedback.
	1 On/Start	
	2 In process	
	3 Action cancelled	
	4 No access	
	5 No access (controller inhibit)	
0x2C41:001	Motor encoder settings (Hiperface): Type code detected • Read only	Type code read out of the encoder. This value is "0" if ... • a sin/cos encoder is set (0x2C40 = 2); • a communication error has occurred.
0x2C41:002	Motor encoder settings (Hiperface): Type code manual input 0 ... [**0**] ... 255 • Setting can only be changed if the inverter is inhibited.	Manual setting of the encoder type code (display in 0x2C41:001).



Address	Name / setting range / [default setting]	Info
0x2C41:003	Motor encoder settings (Hiperface): No. of periods manual input 1 ... [**1**] ... 65535 • Setting can only be changed if the inverter is inhibited.	Manual setting of the number of distinguishable revolutions.
0x2C41:004	Motor encoder settings (Hiperface): Error response	Selection of the response for communication errors or in the event of an unknown encoder. Associated error codes: • 29568 | 0x7380 - RANLI_CIMES_1000_20894 • 29569 | 0x7381 - RANLI_CIMES_1000_20900 • 65302 | 0xFF16 - RANLI_CIMES_1000_20897
	0 No response	
	1 Fault > CiA402	
	2 Warning	
0x2C41:005	Motor encoder settings (Hiperface): Serial number • Read only	The displayed serial number can be used for identifying an encoder change.
0x2C41:006	Motor encoder settings (Hiperface): Actual position (raw data) • Read only	The encoder-internal position value is output without being converted.
0x2C41:007	Motor encoder settings (Hiperface): No. of periods detected • Read only	Display of the encoder increment according to encoder nameplate or type code.
0x2C41:008	Motor encoder settings (Hiperface): Type code verification • Read only	If an encoder is connected that is not supported by the firmware, it will be displayed here. In this case, the same response takes place as in case of a communication error. The error can be removed by manually setting the type code in 0x2C41:002. This serves to signalise to the firmware that the number of distinguishable revolutions is as well set correctly in 0x2C41:003 by the user.
	0 Unknown - manual data input	If an encoder is connected that is not supported by the firmware, it will be displayed here.
	1 Known - parameterisation ok	
0x2C41:009	Motor encoder settings (Hiperface): Encoder type • Read only	Display of the detected encoder type (rotary/linear).
	0 Rotative encoder	
	1 Linear encoder	
0x2C41:010	Motor encoder settings (Hiperface): No. of periods linear encoder • Read only: x nm	Display of the period length of the linear encoder.



12.1.3.3 SSI encoder

SSI absolute value encoders (**S**ynchronous **S**erial **I**nterface) generate the angle information via optical scanning of a code disc (e.g. Gray code). Every (absolute) angle position of the encoder corresponds to a uniquely identifiable code pattern.

All encoders that use the Stegemann SSI protocol are supported:

- Supported bit rates for SSI communication: 150 ... 1000 kbits
- Supported data word widths: 1 ... 31 bits (effective)
- Supported output code of the SSI encoder: Gray or binary
- Cycle time: 62.5 µs, 125 µs and 250 µs .
- Encoder supply: U < 12 V, I ≤ 0.25 A

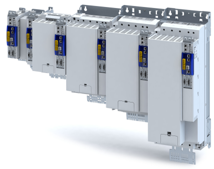
How to parameterise the SSI encoder:

1. Set the supply voltage of the SSI encoder used in 0x2C42:002.
2. Set selection "5: SSI encoder" as the encoder type in 0x2C40.
3. Set the transmission rate for SSI communication in 0x2C4A:001.
   With the SSI protocol, the permissible transmission rate decreases as the cable lengths increase. A safe transmission rate must be set according to the length of the encoder cable used and the electromagnetic interference level.
4. Set the telegram length in 0x2C4A:002.

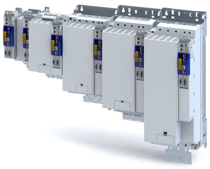
   The telegram length reflects the number of data bits used for transmission of a complete SSI data packet.
5. Break the received SSI data word down into partwords and, if necessary, activate data conversion of Gray into binary code.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C4A:001	Protokoll-Parameter Motorgeber (SSI): Übertragungsrate 150 ... [**300**] ... 1000 kbps • Setting can only be changed if the inverter is inhibited.	To enable a stable transmission rate, the length of the encoder cable used and any electromagnetic interference levels must be taken into account when setting the value.
0x2C4A:002	Protokoll-Parameter Motorgeber (SSI): Telegrammlänge 1 ... [**25**] ... 31 • Setting can only be changed if the inverter is inhibited.	The set value specifies the number of data bits which are transmitted as a complete SSI data packet.
0x2C4A:003	Protokoll-Parameter Motorgeber (SSI): Bits/Umdrehung 1 ... [**13**] ... 31 • Setting can only be changed if the inverter is inhibited.	Resolution of the encoder. For example, the resolution for the preset value is "13": 2^{13} = 8196 (bits/revolution).
0x2C4A:004	Protokoll-Parameter Motorgeber (SSI): Startbit Positionsdaten 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where the position data word begins.
0x2C4A:005	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 1 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 1 begins.
0x2C4A:006	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 2 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 2 begins.



Address	Name / setting range / [default setting]	Info
0x2C4A:007	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 3 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 3 begins.
0x2C4A:008	Protokoll-Parameter Motorgeber (SSI): Länge Positionsdaten 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	SSI position data length
0x2C4A:009	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 1 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 1.
0x2C4A:010	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 2 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 2.
0x2C4A:011	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 3 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 3.
0x2C4A:012	Protokoll-Parameter Motorgeber (SSI): Codierung Positionsdaten • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of position data word (read only). If a value of "0" is set for the position data length in 0x2C4A:008, then the value displayed for this parameter is also "0".
0x2C4A:013	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 1 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 1
0x2C4A:014	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 2 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 2
0x2C4A:015	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 3 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 3
0x2C4A:016	Protokoll-Parameter Motorgeber (SSI): Rohdaten Position • Read only	Raw value of position data word (read only). If a value of "0" is set for the position data length in 0x2C4A:008 , then the value displayed for this parameter is also "0".
0x2C4A:017	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 1 • Read only	Raw value of data packet 1 (read only). If a value of "0" is set for the data packet length 1 in 0x2C4A:013 , then the value displayed for this parameter is also "0".
0x2C4A:018	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 2 • Read only	Raw value of data packet 2 (read only). If a value of "0" is set for the data packet length 2 in 0x2C4A:014 , then the value displayed for this parameter is also "0".
0x2C4A:019	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 3 • Read only	Raw value of data packet 3 (read only). If a value of "0" is set for the data packet length 3 in 0x2C4A:015 , then the value displayed for this parameter is also "0".



12.1.3.4 Evaluation of the signal quality

Signal quality

The signal quality is evaluated by the 0x2C42:004 parameter, which is used to monitor the initial read-out and setting of the position.

If a transmission error should occur:

- The current angular drift is marked as invalid in parameter , bit 7
- The inverter maintains its operating status

Angular drift

Communication with the encoder is no longer monitored during angular drift determination.

The value displayed in 0x2C42:003 is determined in different ways depending on the type of encoder:

- **Determination of the current angular drift for the SinCos encoder**

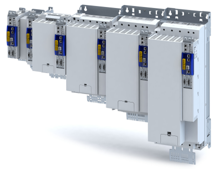
  In the case of an incremental SinCos encoder, the pulses between two zero pulse events of the Z-track are counted. Assuming that there are no faults, this value corresponds to the set number of increments. The accuracy of this process corresponds to ± 1 increment graduation of the encoder, with the difference between the set number of increments and the counted pulses being converted to an angle with an accuracy of ±0.1°. The disadvantage is that an updated angular drift value only become available at the end of a complete encoder revolution. In turn, this means that the update rate depends on the speed.

- **Determination of the current angular drift for the SinCos Hiperface® absolute value encoder**

  In the case of a SinCos absolute value encoder with HIPERFACE® protocol, no Z-track is available; instead, the position is regularly read out of the encoder. When the first encoder read-out operation is performed (after power-up or elimination of wire breakage), the encoder position is used to initialise the internal device counter unit and to set an internal device position. All other read-out processes from the encoder are used to generate a difference between the internal device position and the encoder position. Assuming that there are no faults, the difference is zero. However, the dead time of the communication with the encoder means that the accuracy of the process is dependent on the speed and therefore restricted compared to the zero pulse process. However, the advantage is that the update rate does not depend on the speed, but is instead only determined by the communication rate. The update rate is encoder-specific and is generally in the range between 30 ... 50 ms.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C42:003	Encoder settings: Angle drift • Read only: x.x °	Display of the angular drift of the current angle error. This indicates whether too many or two few pulses have been detected by the internal device counter unit for EMC-related reasons.
0x2C42:004	Encoder settings: Actual amplitude signal quality • Read only: x %	The signal quality indicates the actual amplitude of the SinCos analog signals with regard to 1 Vss = 100 %. • The signal quality should be between 95 ... 105 %. • There is no need for optimisation if the signal quality is within the tolerance zone for the analog encoder signals given in the data sheet of the encoder manufacturer.



12.1.4 Detection of changed settings of the feedback system

Bit 0 of status word 2 indicates whether the settings of the feedback system have been changed since leaving the **Not ready to start** state. If a change has been made, bit 0 is set to value "1".

During the transition to the **Operation enabled** state, bit 0 is reset to value "0".

In all device states, changes to the following parameters continue to be monitored.

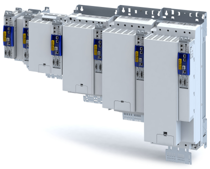
Relevant parameters of other functions

Address	Designation	Default setting	Setting range
0x2C40	Motor encoder type	**SinCos encoder [1]**	Selection list
0x2C41:002	Motor encoder settings (Hiperface): Type code manual input	**0**	0 ... 255
0x2C41:003	Motor encoder settings (Hiperface): No. of periods manual input	**1**	1 ... 65535
0x2C41:005	Motor encoder settings (Hiperface): Serial number	- (Read only)	
0x2C42:001	Encoder settings: Increments/revolution	**1024**	1 ... 131072
0x608F:001	Position encoder resolution: Encoder increments	**16 bit [65536]**	Selection list
0x608F:002	Position encoder resolution: Motor revolutions	**1**	1 ... 1

12.1.5 Diagnostics

Parameter

Address	Name / setting range / [default setting]		Info
0x2C4F	Parameter CRC of motor encoder • Read only		Display of the cyclic redundancy check (CRC) of selected encoder parameters to detect changes in the feedback settings.
0x2DDF:005	Axis information: Motor encoder • Read only		Display of supported feedback system for the motor.
	0	Produktdefiniert	
	1	Kein Geber	
	2	Resolver	
	3	SinCos-Geber oder Hiperface-Absolutwertgeber	



12.2 Second feedback system for the techology application

The parameter settings for the feedback system of the application are accessed in »EASY starter« via the following path:

- **Settings** tab
  - Basic setting \ Feedback application (B)

Here, you have the choice of using the following feedback systems:

- Resolver
- Encoder

You can select the feedback system that you wish to use by pressing the correspondingly named button.

12.2.1 General settings

This chapter provides information on general feedback system settings for the application.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C55	Load encoder/master encoder error response		Via this parameter, the error response to an encoder error of application feedback B (slot B) is set. Selection of the response to the triggering of the encoder signal loss monitoring. Only active when used as: • Feedback system for motor control if set, • Signal source for the "position counter" function. Associated error code: • 29444 | 0x7304 - RANLI_CIMES_1000_20910
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	
0x2C56	Number of the absolute ascertainable revolutions of load encoder/master encoder • Read only		Is set by the firmware according to the available version: • 0: no absolute value encoder (sin/cos encoder) or resolver with number of pole pairs > 1 • 1: Hiperface encoder SingleTurn or resolver with number of pole pairs = 1 • > 1: Hiperface encoder Multi Turn
0x2C57	Open circuit detection sensitivity of load encoder/ master encoder 1 ... [**100**] ... 100 %		The sensitivity can be reduced by percentage, e. g. in case of EMC interferences.
0x2E00:041	Set position for load encoder		
	0	**Off**	
	1	On	
0x60E6:001	Additional position encoder resolution - encoder increments: Load encoder/master encoder - number of increments • Setting can only be changed if the inverter is inhibited.		Setting the number of bits to be used for resolving a mechanical revolution of the secondary feedback system.
	65536	**16 Bit**	
	262144	18 Bit	
	1048576	20 Bit	
	4194304	22 Bit	
	16777216	24 Bit	
	67108864	26 Bit	
	268435456	28 Bit	
	1073741824	30 Bit	
0x60EB:001	Additional position encoder resolution - motor revolutions: Load encoder/master encoder - resolution of motor revolutions 1 ... [**1**] ... 1 • Setting can only be changed if the inverter is inhibited.		Setting of the number of revolutions of the secondary feedback system. Only setting "1" is accepted.

12.2.2 Resolver settings

Resolvers with a number of pole pairs > 1 are not absolute value encoders.

Bit 10 in (Lenze status word 2) therefore remains set to "0".

The "distinguishable revolutions" specification in 0x2C56 is also set to "0".

Parameter

Address	Name / setting range / [default setting]		Info
0x2822:029	Axis commands: Get load encoder/master encoder characteristic (resolver)		Definition of the resolver characteristic for application feedback.
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
0x2C53	Load encoder/master encoder resolver number of pole pairs 1 ... [**1**] ... 1 • Setting can only be changed if the inverter is inhibited.		Setting of the number of pole pairs.

12.2.2.1 Resolver error compensation

The actual position detected by the resolver is not exactly the same as the real physical position. There are always deviations to a lesser or greater extent.

An identification run of the resolver automatically generates the adjustment values required for compensation of the resolver error.

The values calculated have a counteractive corrective effect on the underlying cause in the following parameters:

Cause	Remedy
Sine and cosine track do not magnetise orthogonally to each other.	0x2C44:001 Correction of the angle by means of which the two resolver tracks are supplied in a manner relative to one another.
The inductances of the sine and cosine track of the resolver have slightly different values.	0x2C44:002 and 0x2C44:003 Adjusting the gains of the digital-analog converters which feed the resolver tracks.

Conditions for executing the identification run

1. Mechanical motor / inverter connection
   - If possible, execute the identification run before the motor is installed in the machine. Bigger load changes at the motor may have a negative impact on the identification result.
   - Motor and resolver must be properly connected to the inverter.
   - The motor must rotate freely.
2. Voltage supply of the inverter
   - The inverter must be supplied with mains voltage. Check: 0x6041, bit 4 = TRUE.
   - The control electronics must be supplied with voltage. For this purpose, some designs require an external voltage source.
3. Correct setting of the following data in the »EASY Starter« engineering tool:
   - Number of resolver pole pairs (0x2C43)
   - Speed-controlled or position-controlled motor in servo control
4. The inverter must be connected "online" to the engineering tool.

Possible responses during the execution

- The identification method can cause an uneven motor running during the identification.
- The direction of rotation can change.

  This does not have a negative impact on the quality of the identification. In this case, the inverter automatically interrupts the identification run and automatically continues it if a constant speed is reached again.
- If the motor already installed in the machine does not have sufficient range in one direction for executing the identification run, you can also reverse the driving direction while the identification is active. In this case, the identification automatically switches to the "Identification temporarily interrupted ". The status is deactivated as soon as a constant speed has been reached again.

In the event of an interruption, the identification run is stopped. An error message is displayed.

If 0 % is set, the gain of the respective resolver track is only 95 % of the Lenze setting.

The detected gain can assume values in the range of 0 ... 100 %.

In case of a successful resolver error compensation, only one of the two gains is adjusted. The other value remains at 100 %.

How to run an identification

If possible, execute the identification run before the motor is installed in the machine. If relatively big load changes occur in the kinematics to be moved, this may have a negative impact on the result of the identification run.

1. Initiate an identification run with parameter 0x2822:025.
2. Enable inverter.
   The identification run is in standby mode.
3. Enter a constant speed between n = 500 rpm and n = 3000 rpm.
   The identification run is started automatically after the drive has reached a constant speed and maintains it over the time defined in .

   This speed is saved for the identification run. In order that the identification run can be continued again, e.g. after an interruption, the drive must be operated again with this speed.

   End of the identification run

   After the resolver error identification has been executed successfully, the parameters 0x2C44:001 ... 0x2C44:003 are written automatically. The resolver now works with these settings.

   Short-time interruption of the identification run

   A short-time interruption, e.g. by removing the controller enable, does not stop the measurement. It is continued after the controller is enabled anew. For the duration of the interruption, the following status message is displayed: "Identification interrupted temporarily")

   Abort of the identification run

   The measurement is aborted if the controller inhibit persists or after the time-out time has elapsed. A time-out error is output for the identification run (see error messages in the logbook).
4. If the measurement was successful, the motor can be stopped
5. At the end of the procedure, save the changed parameters 0x2C44:001 ... 0x2C44:003 in the inverter.

»EASY Starter« can be used to save the inverter parameter settings, see ▸ Saving the parameter settings. 📖 36

Deactivating the resolver error compensation

For deactivating the resolver error compensation, the respective parameters must be reset again to the Lenze setting.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C54:001	Load encoder/master encoder identification (Resolver): Angle -100 ... [**0**] ... 100	Setting of the angle to the resolver error compensation.
0x2C54:002	Load encoder/master encoder identification (Resolver): Cosine track gain 0 ... [**100**] ... 100 %	Setting of the gain of the cosine track to the resolver error compensation.
0x2C54:003	Load encoder/master encoder identification (Resolver): Sine track gain 0 ... [**100**] ... 100 %	Setting of the gain of the sine track to the resolver error compensation.

Address	Name / setting range / [default setting]		Info
0x2C54:006	Load encoder/master encoder identification (Resolver): Identification status • Read only		Display of the resolver identification status.
	Bit 0	Identification activated	TRUE if: • Identification has been started. • Controller enable is active. FALSE if: • Identification has been aborted or completed successfully. • A timeout error is active. • The 24V supply has been switched on and default settings are loaded.
	Bit 1	Constant speed detected	TRUE if: • A constant motor speed has been detected. FALSE if: • Identification has been aborted or completed successfully. • A timeout error is active. • The 24V supply has been switched on and default settings are loaded.
	Bit 2	Identification is running	TRUE if: • Identification is running. FALSE if: • The motor speed has fallen below the minimum speed of 500 rpm. • The identification process has been aborted temporarily and is on standby.
	Bit 3	Identification successful	TRUE if: • Identification has been completed successfully. FALSE if: • The identification is not completed yet after default settings were loaded.
	Bit 4	Identification failed	TRUE if: • A timeout error has occurred. FALSE if: • Identification has been completed successfully.

12.2.3 Encoder settings

In general, an encoder is a measuring system which serves to detect the velocity/speed and possibly the position of a kinematics or motor.

Details

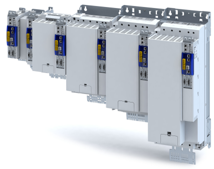
If a resolver variant is to be plugged into the respective slot of the inverter as a feedback system, the parameters in this section have no function.

Generally, an encoder can be used for a variety of tasks:

- As setpoint encoder for defining a speed / frequency setpoint.
- As setpoint encoder for defining a position setpoint.
- As setpoint encoder for defining a setpoint for the process controller.
- As actual value encoder for feeding back the variable for the process controller.
- As kinematics encoder (feedback system).

Parameter

Address	Name / setting range / [default setting]		Info
0x2C50	Load encoder/master encoder type • Setting can only be changed if the inverter is inhibited.		Selection of the encoder type.
	1	**SinCos encoder**	
	2	Hiperface absolute value encoder	
	5	SSI encoder	
0x2C52:001	Load encoder/master encoder settings (encoder): Increments/revolution 1 ... [**1024**] ... 131072 • Setting can only be changed if the inverter is inhibited.		Setting of the encoder number of increments (according to manufacturer data/encoder data sheet).



Address	Name / setting range / [default setting]	Info
0x2C52:002	Load encoder/master encoder settings (encoder): Supply voltage 5.0 ... [**5.0**] ... 12.0 V • Setting can only be changed if the inverter is inhibited.	Setting of the supply voltage.

12.2.3.1 SinCos encoder

The following SinCos encoder types without HIPERFACE® protocol are supported by the inverter:

Type	Increments/revolution	Absolute revolutions
IG1024-5V-V3 (RVS58S)	1024	0
IG2048-5V-S (ITD22)	2048	0
IG2048-5V-S	2048	0

12.2.3.2 SinCos absolute value encoder with HIPERFACE® protocol

The following SinCos encoder types with HIPERFACE® protocol are supported by the inverter:

Type	Increments/revolution	Absolute revolutions	Type code 0x2C41:001
AM1024-8V-H (SRM50)	1024	4096 (Multiturn)	39
AM1024-8V-H (SFM60)	1024		39
AM1024-8V-K2 (SRM50S)	1024		39
AM128-8V-H (SKM36)	128		55
AM16-8V-H (SEL37)	16		71
AM16-8V-H (SEL52)	16		71
AM512-8V-H (SCM70)	512		7
AS1024-8V-H (SRS50)	1024	4096 (Single-turn)	34
AS1024-8V-K2 (SRS50S)	1024		34
AS16-8V-H (SEK37)	16		66
AS16-8V-H (SEK52)	16		66
AS512-8V-H (SCS70)	512		2

Use of non-supported encoder types

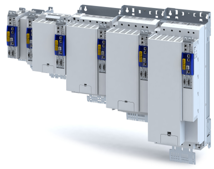
If the type code of the encoder used is not listed in the table of supported encoder types, this encoder can be introduced to the inverter via two parameters. ▶ 0x2C51:002 ▶ 0x2C51:003

In this context, please also observe the information provided in the parameter description 0x2C41:008.

Parameter

Address	Name / setting range / [default setting]	Info
0x2822:030	Axis commands: Get load encoder/master encoder information (Hiperface) **0 Off/Ready** 1 On/Start 2 In process 3 Action cancelled 4 No access 5 No access (controller inhibit)	Obtain Hiperface information from the encoder for application feedback.
0x2C51:001	Hiperface load encoder/master encoder settings: Type code detected • Read only	Type code read out of the encoder. This value is "0" if ... • a sin/cos encoder is set (0x2C50 = 2); • a communication error has occurred.
0x2C51:002	Hiperface load encoder/master encoder settings: Type code manual input 0 ... [**0**] ... 255 • Setting can only be changed if the inverter is inhibited.	Manual setting of the encoder type code (display in 0x2C51:001).

Address	Name / setting range / [default setting]	Info
0x2C51:003	Hiperface load encoder/master encoder settings: No. of periods manual input 1 ... [**1**] ... 65535 • Setting can only be changed if the inverter is inhibited.	Manual setting of the number of distinguishable revolutions.
0x2C51:004	Hiperface load encoder/master encoder settings: Error response	Selection of the response for communication errors or in the event of an unknown encoder. Associated error codes: • 29570 | 0x7382 - RANLI_CIMES_1000_20911 • 29571 | 0x7383 - RANLI_CIMES_1000_20912 • 65306 | 0xFF1A - RANLI_CIMES_1000_20913
	0 No response	
	1 Fault > CiA402	
	2 Warning	
0x2C51:005	Hiperface load encoder/master encoder settings: Serial number • Read only	The displayed serial number can be used for identifying an encoder change.
0x2C51:006	Hiperface load encoder/master encoder settings: Actual position (raw data) • Read only	The encoder-internal position value is output without being converted.
0x2C51:007	Hiperface load encoder/master encoder settings: No. of periods detected • Read only	Display of the encoder increment according to encoder nameplate or type code.
0x2C51:008	Hiperface load encoder/master encoder settings: Type code verification • Read only	If an encoder is connected that is not supported by the firmware, it will be displayed here. In this case, the same response takes place as in case of a communication error. The error can be removed by manually setting the type code in 0x2C51:002. This serves to signalise to the firmware that the number of distinguishable revolutions is as well set correctly in 0x2C51:003 by the user.
	0 Unknown - manual data input	In this case, the same response takes place as in case of a communication error. The error can be removed by manually setting the type code in 0x2C51:002. This serves to signalise to the firmware that the number of distinguishable revolutions is as well set correctly in 0x2C51:003 by the user.
	1 Known - parameterisation ok	
0x2C51:009	Hiperface load encoder/master encoder settings: Encoder type • Read only	Display of the detected encoder type (rotary/linear).
	0 Rotative encoder	
	1 Linear encoder	
0x2C51:010	Hiperface load encoder/master encoder settings: No. of periods linear encoder • Read only: x nm	Display of the period length of the linear encoder.



12.2.3.3 SSI encoder

SSI absolute value encoders (**S**ynchronous **S**erial **I**nterface) generate the angle information via optical scanning of a code disc (e.g. Gray code). Every (absolute) angle position of the encoder corresponds to a uniquely identifiable code pattern.

All encoders that use the Stegemann SSI protocol are supported:

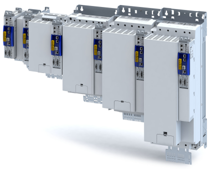
- Supported bit rates for SSI communication: 150 ... 1000 kbits
- Supported data word widths: 1 ... 31 bits (effective)
- Supported output code of the SSI encoder: Gray or binary
- Cycle time: 62.5 µs, 125 µs and 250 µs .
- Encoder supply: U < 12 V, I ≤ 0.25 A

How to parameterise the SSI encoder:

1. Set the supply voltage of the SSI encoder used in 0x2C52:002.
2. Set selection "5: SSI encoder" as the encoder type in 0x2C50.
3. Set the transmission rate for SSI communication in 0x2C5A:001.
   With the SSI protocol, the permissible transmission rate decreases as the cable lengths increase. A safe transmission rate must be set according to the length of the encoder cable used and the electromagnetic interference level.
4. Set the telegram length in 0x2C5A:002.
   The telegram length reflects the number of data bits used for transmission of a complete SSI data packet.
5. Break the received SSI data word down into partwords and, if necessary, activate data conversion of Gray into binary code.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C5A:001	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Übertragungsrate 150 ... [**300**] ... 1000 kbps • Setting can only be changed if the inverter is inhibited.	To enable a stable transmission rate, the length of the encoder cable used and any electromagnetic interference levels must be taken into account when setting the value.
0x2C5A:002	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Telegrammlänge 1 ... [**25**] ... 31 • Setting can only be changed if the inverter is inhibited.	The set value specifies the number of data bits which are transmitted as a complete SSI data packet.
0x2C5A:003	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Bits/Umdrehung 1 ... [**13**] ... 31 • Setting can only be changed if the inverter is inhibited.	Resolution of the encoder. For example, the resolution for the preset value is "13": 2^{13} = 8196 (bits/revolution).
0x2C5A:004	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Positionsdaten 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where the position data word begins.
0x2C5A:005	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 1 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 1 begins.
0x2C5A:006	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 2 0 ... [**0**] ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 2 begins.



Address	Name / setting range / [default setting]	Info
0x2C5A:007	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 3 0 ... **[0]** ... 30 • Setting can only be changed if the inverter is inhibited.	Indicates the position in the telegram where data packet 3 begins.
0x2C5A:008	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Positionsdaten 0 ... **[25]** ... 30 • Setting can only be changed if the inverter is inhibited.	SSI position data length
0x2C5A:009	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 1 0 ... **[0]** ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 1.
0x2C5A:010	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 2 0 ... **[0]** ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 2.
0x2C5A:011	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 3 0 ... **[0]** ... 30 • Setting can only be changed if the inverter is inhibited.	Length of data packet 3.
0x2C5A:012	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Positionsdaten • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of position data word (read only). If a value of "0" is set for the position data length in 0x2C4A:008, then the value displayed for this parameter is also "0".
0x2C5A:013	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 1 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 1
0x2C5A:014	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 2 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 2
0x2C5A:015	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 3 • Setting can only be changed if the inverter is inhibited. **0** **Binär** 1 Gray	Coding of data packet 3
0x2C5A:016	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Position • Read only	Raw value of position data word (read only). If a value of "0" is set for the position data length in 0x2C4A:008 , then the value displayed for this parameter is also "0".
0x2C5A:017	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 1 • Read only	Raw value of data packet 1 (read only). If a value of "0" is set for the data packet length 1 in 0x2C4A:013 , then the value displayed for this parameter is also "0".
0x2C5A:018	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 2 • Read only	Raw value of data packet 2 (read only). If a value of "0" is set for the data packet length 2 in 0x2C4A:014 , then the value displayed for this parameter is also "0".
0x2C5A:019	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 3 • Read only	Raw value of data packet 3 (read only). If a value of "0" is set for the data packet length 3 in 0x2C4A:015 , then the value displayed for this parameter is also "0".

12.2.3.4 Evaluation of the signal quality

Signal quality

The signal quality is evaluated by the parameter 0x2C52:004, which serves to monitor the initial reading and setting of the position.

If a transmission error occurs

- the current angular drift is marked as invalid in the parameter , bit 9.
- the inverter keeps its operating status.

Angular drift

Communication with the encoder is no longer monitored during the angular drift determination.

The value displayed in 0x2C52:003 is determined in different ways depending on the encoder type:

- **Determination of the current angular drift for the sin/cos encoder**

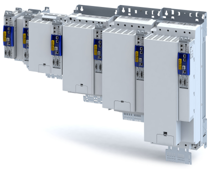
  In the case of an incremental SinCos encoder, the pulses between two zero pulse events of the Z-track are counted. Assuming that there are no faults, this value corresponds to the set number of increments. The accuracy of this process corresponds to ± 1 increment graduation of the encoder, with the difference between the set number of increments and the counted pulses being converted to an angle with an accuracy of ±0.1°. The disadvantage is that an updated angular drift value only becomes available at the end of a complete encoder revolution. In turn, this means that the update rate depends on the speed.

- **Determination of the current angular drift for the SinCos-Hiperface® absolute value encoder**

  In the case of a SinCos absolute value encoder with HIPERFACE® protocol, no Z-track is available; instead, the position is regularly read out of the encoder. When the first encoder read-out operation is performed (after power-up or elimination of wire breakage), the encoder position is used to initialise the internal device counter unit and to set an internal device position. All other read-out processes from the encoder are used to generate a difference between the internal device position and the encoder position. Assuming that there are no faults, the difference is zero. However, the dead time of the communication with the encoder means that the accuracy of the process is dependent on the speed and therefore restricted compared to the zero pulse process. However, the advantage is that the update rate does not depend on the speed, but is instead only determined by the communication rate. The update rate is encoder-specific and is generally in the range between 30 ... 50 ms.

Parameter

Address	Name / setting range / [default setting]	Info
0x2C52:003	Load encoder/master encoder settings (encoder): Angle drift • Read only: x.x °	Display of the angular drift of the current angle error.
0x2C52:004	Load encoder/master encoder settings (encoder): Actual amplitude signal quality • Read only: x %	The signal quality indicates the actual amplitude of the SinCos analog signals with regard to 1 Vss = 100 %. • The signal quality should be between 95 ... 105 %. • There is no need for optimisation if the signal quality is within the tolerance zone for the analog encoder signals given in the data sheet of the encoder manufacturer.



12.2.4 Detection of changed settings of the feedback system

Bit 0 of status word 2 indicates whether the settings of the feedback system have been changed since leaving the **Not ready to start** state. If a change has been made, bit 0 is set to value "1".

During the transition to the **Operation enabled** state, bit 0 is reset to value "0".

In all device states, changes to the following parameters continue to be monitored.

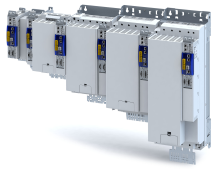
Relevant parameters of other functions

Address	Designation	Default setting	Setting range
0x2C50	Load encoder/master encoder type	**SinCos encoder [1]**	Selection list
0x2C51:002	Hiperface load encoder/master encoder settings: Type code manual input	**0**	0 ... 255
0x2C51:003	Hiperface load encoder/master encoder settings: No. of periods manual input	**1**	1 ... 65535
0x2C51:005	Hiperface load encoder/master encoder settings: Serial number	- (Read only)	
0x2C52:001	Load encoder/master encoder settings (encoder): Increments/revolution	**1024**	1 ... 131072
0x608F:001	Position encoder resolution: Encoder increments	**16 bit [65536]**	Selection list
0x608F:002	Position encoder resolution: Motor revolutions	**1**	1 ... 1

12.2.5 Diagnostics

Parameter

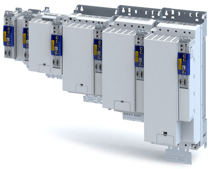
Address	Name / setting range / [default setting]	Info
0x2C56	Number of the absolute ascertainable revolutions of load encoder/master encoder • Read only	Is set by the firmware according to the available version: • 0: no absolute value encoder (sin/cos encoder) or resolver with number of pole pairs > 1 • 1: Hiperface encoder SingleTurn or resolver with number of pole pairs = 1 • > 1: Hiperface encoder Multi Turn
0x2C5F	Parameter CRC of load encoder/master encoder • Read only	Display of the cyclic redundancy check (CRC) of selected encoder parameters to detect changes in the feedback settings.
0x2DDF:006	Axis information: Load encoder/master encoder • Read only 0 Produktdefiniert 1 Kein Geber 2 Resolver 3 SinCos-Geber oder Hiperface-Absolutwertgeber	Display of the supported feedback system for the application. Cannot be used as motor feedback.
0x60E4:001	Additional position actual value: Load encoder/master encoder - actual position • Read only: x pos. unit	Display of the actual position of the secondary feedback system.
0x60E5:001	Additional velocity actual value: Load encoder/master encoder - actual speed • Read only: rpm	Display of the actual velocity of the secondary feedback system.



12.3 Encoder: Evaluation of safely speed and position

Parameter

Address	Name / setting range / [default setting]	Info
0x2878:001	Motor encoder: Motor encoder system • Read only	
	0 No motor encoder	
	1 SinCos encoder	
	2 Resolver	
0x2878:002	Motor encoder: SinCos encoder increments • Read only	
0x2878:003	Motor encoder: Number of resolver pole pairs • Read only	
0x2879:001	Mechanical data: Motor mounting direction • Read only	
	0 Clockwise rotating motor	
	1 Counter-clockwise rotating motor	
0x287A:001	Load encoder: Load encoder system • Read only	
	0 No load encoder	
	1 Analog encoder	
	2 Digital encoder	
0x287A:003	Load encoder: Load encoder gearbox factor numerator • Read only	
0x287A:004	Load encoder: Load encoder gearbox factor denominator • Read only	
0x287A:005	Load encoder: Load encoder mounting direction • Read only	
	0 Same as motor encoder	
	1 Inverse to motor encoder	
0x287A:006	Load encoder: Load encoder position -2147483648 ... [**0**] ... 2147483647	
0x287A:007	Load encoder: Status of load encoder position	
	0 Invalid	
	1 Valid	
0x287B:001	Velocity monitoring: Tolerance window (n=0) • Read only: x rpm	
0x287B:002	Velocity monitoring: Velocity comparison tolerance • Read only: x rpm	
0x287B:003	Velocity monitoring: Actual velocity n_safe • Read only: x rpm	
0x287B:004	Velocity monitoring: Internal actual velocity nSD • Read only: x rpm	
0x287B:005	Velocity monitoring: Internal actual velocity nBD • Read only: x rpm	
0x287B:006	Velocity monitoring: Actual velocity difference nSD-nBD • Read only: x rpm	
0x287C:001	Position monitoring: Position comparison tolerance • Read only	
0x287C:002	Position monitoring: Actual Position p_safe • Read only	
0x287C:003	Position monitoring: Internal actual position pSD • Read only	
0x287C:004	Position monitoring: Internal actual position pBD • Read only	
0x287C:005	Position monitoring: Current pos. difference pSD-pBD • Read only	



12.4 Synchronous motor: Pole position identification (PPI)

For controlling a permanent-magnet synchronous motor, the pole position - the angle between the motor phase U and the field axis of the rotor - must be known.

- For Lenze motors with absolute value encoder or resolver, the pole position has already been set correctly.
- When incremental encoders are used (TTL or sin/cos encoders without absolute position information), a pole position identification (PPI) is always required. This also applies to Lenze motors.

NOTICE

The pole position identification (PPI) must only be executed

► for servo control with a synchronous motor of an original equipment manufacturer.
► for servo control with a synchronous motor and incremental encoders (TTL or sin/cos encoder).
► after changes to the motor feedback system, e.g. feedback replacement.

The parameter settings for pole position identification are accessed in »EASY Starter« via the following path:

- **Settings** tab
  - Basic setting \ Motor feedback (A)

Three different identification methods are offered here:

- 360° electrical
- With min. movement
- Without movement

The criteria for selecting the most suitable identification method are presented below.

Selection criteria for using the suitable pole position identification

For identifying the pole position for the currently activated feedback, the following functions are available which all provide almost the same result. Due to e.g. friction, bearing forces and a trapezoidal field pattern, the results may differ from each other.

▸ Pole position identification (PPI) 360° 🕮 193

- The motor must not be braked, blocked or mechanically driven during the pole position identification! This function must not be used for hanging loads!
- Especially in case of idling drives or drives with a low load (inertia / friction), this function delivers the most accurate results.

▸ Pole position identification (PPI) with minimum movement 🕮 197

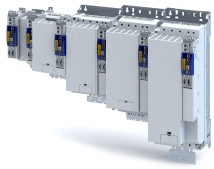
- The motor must not be braked, blocked or driven during the pole position identification! Thus, this function must not be used for hanging loads!
- Regarding the accuracy, this function is in the middle range. A percentage increase of the current amplitude can enhance the accuracy of the results if required.

▸ Pole position identification (PPI) without movement 🕮 200

- In case of stalled motors (e.g. with hanging loads), only this function shall be used!
- This function was developed for a wide range of motor characteristics. In case of some motor types, however, the identified pole position angle may differ considerably from the real pole position angle, so that a considerable loss in torque and greater motor losses may occur. Thus, especially when using third-party motors, we recommend the execution of a reference identification with an idling motor ▸ Pole position identification (PPI) 360° . 🕮 193

  If the identified values of both processes differ from each other by more than 20°, please contact Lenze.

Detailed information on the respective function can be found in the following subchapters.



12.4.1 Monitoring the pole position identification

If an error occurs during the pole position identification or if the pulse inhibit gets active (e.g. due to a short-time undervoltage), the process is stopped with disabling the inverter without the settings being changed.

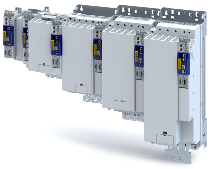
If the motor was braked or blocked during the process, this will be detected at the end of the measurement and no change will be made (exception: "pole position identification PLI (without movement)").

The error response can be parameterised:

If an error occurs during the pole position identification,
- the procedure is stopped without the settings being changed.
- the response set in 0x2C60 is effected.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C60	PPI monitoring: Reaction		Selection of the response triggered by the occurrence of an error during the pole position identification (PLI). Associated error codes: • 65284 | 0xFF04 - RANLI_CIMES_1000_20880 • 65299 | 0xFF13 - RANLI_CIMES_1000_15967
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	



12.4.2 Pole position identification (PPI) 360°

DANGER!

Mechanical damage of the motor caused by hanging loads!

The motor may be permanently damaged.

► The motor must not be braked or blocked during the pole position identification. Thus, this function must not be used for hanging loads!

NOTICE

Thermal overload of the motor!

The motor may be permanently damaged.

► Before executing the pole position identification, check that the following monitoring systems are parameterised correctly.

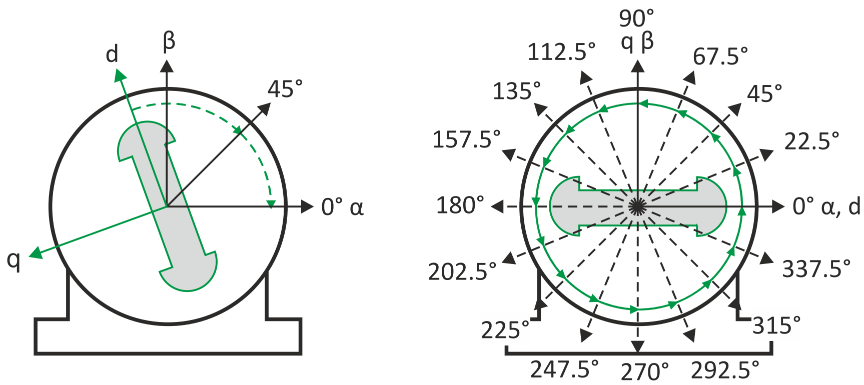
► Motor overload monitoring (i^2*t)

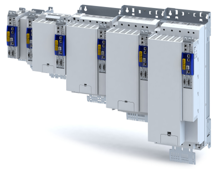
► Overcurrent monitoring

NOTICE

► Please observe the following: Synchronous motor: Pole position identification (PPI)

Functional description





If the servo control is set for synchronous motor and no error is pending, the current is first raised in a ramp-shaped manner to 141 % of the rated motor current after the inverter is enabled.

Left image

First, the rotor is moved from any position of rest to the 0° angle.

- For this purpose, the amplitude of the d current vector is created in the stator coordinate system at a starting angle of 45° and then turned to 0°.
- A sufficiently high amplitude of the d current vector and its rotary motion result in a magnetic force that moves the rotor to the angle 0°.

Right image

Afterwards, the d current vector is turned further in 15 steps by 22.5° each starting at the angle 0°.

- Due to the magnetic forces, the rotor adjusts to the respective angle.
- After 16 steps, the rotor has moved by absolute electrical 360°.

Result

For determining the pole position, a mean value is calculated from all 16 messages. The rotor displacement angle can be recorded via the 0x2DDE parameter (actual motor rotor angle position). The detected pole position is stored in the inverter parameters , 0x2C03:0020x2C03:004. The detected pole position must then be saved.

Abort of the pole position identification

The pole position identification is aborted if the deviations between the rotary motion of the current vector and the rotor exceed the fault tolerance set in 0x2C41:004 (check if parameter is available).

Preconditions for the performance

- The motor must not be braked or blocked during the pole position identification.
- The servo inverter is error-free and in Switched on device state.

Response of the motor during performance

The rotor aligns during the pole position identification. The motor shaft moves by max. one electrical revolution which causes a corresponding movement of the connected mechanics!

How to execute the pole position identification PLI (360°):

1. If the servo inverter is enabled, disable it.Enable operation
2. Set the object 0x2825 to "5" to change to the "pole position identification PLI (360°)" operating mode.
3. Before the PLI can be started, the works mentioned below must be completed.
4. Enable the servo inverter to start the pole position identification (360°). Note: Inhibiting the controller serves to abort the started procedure any time if required without changing the settings.

After the pole position identification has been completed successfully...

...the controller is inhibited automatically and the pole position determined for the activated feedback system is set in the 0x2C03:002 object.

- Save the changed settings.

  The »EASY Starter« serves to save the parameter settings of the servo inverter as parameter file (*.gdc). Saving the parameter settings
- The inverter disable set automatically by the procedure can be deactivated again via the CiA402 control word 0x6040. Enable operation

Adapt pole position identification PLI (360°)

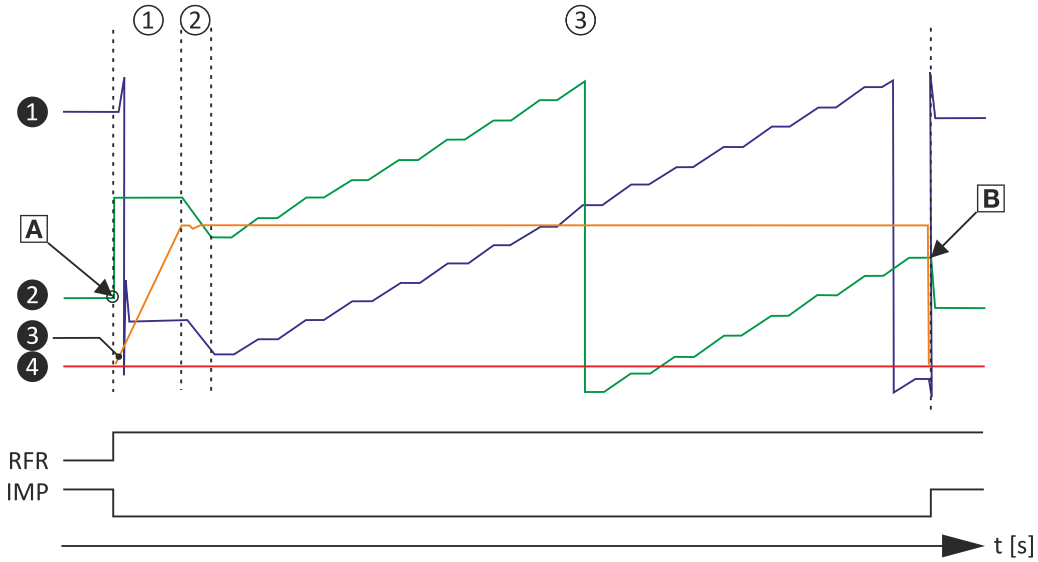


Fig. 48: Chronological sequence of the pole position identification

In case of drives with a high static friction, mass inertia or alternating load, an optimisation may be necessary:

- The amplitude of the current vector must be set so high that the motor with a high mass inertia can be accelerated.
- The cyclic continued rotation of the current vector by 22.5° has to cause an equivalent angular rotation of the motor shaft (rotor). A step function has to be achieved. Here, actual positions with very low overshoots are visible.

NOTICE

Thermal overload of the motor!

The motor may be permanently damaged.

► If no temperature monitoring is available in the motor, and/or the I²xt motor monitoring and the maximum current monitoring are not parameterised correctly, the motor can be permanently damaged if the current amplitude is set too high!

► Motor overload monitoring (i²*t)

► Overcurrent monitoring

Overview of more objects available for

- Identification
- Triggering
- Diagnostics

Tip!

An oscilloscope serves to execute the optimisation

Parameter	Subindex	Value/unit	INFO
0x2825	0	CiA402 mode active [0]	Operating modes [5] for PLI 360°
0x2824	0	Activate [1]	
0x6040	0	0x0000	Simulation of the CiA state machine
0x2823	0	100	Progress bar
0x2C61:001	1	100 %	PLI(360°) current amplitude
0x2C61:002	2	40 s	PLI(360°) ramp time
0x2C61:003	3	Field: clockwise [0]	PLI(360°) direction of rotation
0x2C61:004	4	20°	PLI(360°) fault tolerance
0x2C61:005	5	4.81 A	Display
0x2C03:002	2	-90.0°	Detected pole position values
0x2C03:004	4	0.0°	
0x2DDE	0	1850	current rotor angle
	2	0.03 A	Phase U current
	3	0.04 A	Phase V current
	4	-0.01 A	Phase W current
	3	0.00 A	Setpoint D current
	1	0.01 A	Current D current
0x6073	0	150.0 %	Max current
0x6075	0	3.400 A	Motor rated current, reference for 0x2C61:1
0x2D46:001	1	16.5 A	Overcurrent monitoring: threshold
	1	5.00 A	User info regarding rated current
	2	10.00 A	User info regarding maximum current

Parameter

Address	Name / setting range / [default setting]	Info
0x2C61:001	Pole position identification (360°) settings: Current amplitude 1 ... [**100**] ... 1000 % • Setting can only be changed if the inverter is inhibited.	Percentage adaptation of the current amplitude. • For large machines and high mass inertia values or for linear direct drives, the current amplitude usually must be increased. • Default setting 100 % ≡ 141 % of Motor rated current (0x6075) Note! If the current amplitude is set to > 100 %, the device utilisation (Ixt) monitoring and/or one of the motor monitoring functions may respond and cause the abort of the pole position identification.
0x2C61:002	Pole position identification (360°) settings: Ramp time 1 ... [**40**] ... 600 s • Setting can only be changed if the inverter is inhibited.	Percentage adaptation of the ramp time. • For large machines and high mass inertia values, the ramp time must be increased. • For small machines, however, the pole position identification can be accelerated by reducing the ramp time.
0x2C61:003	Pole position identification (360°) settings: Direction of rotation • Setting can only be changed if the inverter is inhibited. **0** **CW** 1 Drehfeldrichtung	Selection of travel direction. In some situations, it may be helpful to reverse the travel direction for the pole position identification (e. g. for linear motor at the end stop).
0x2C61:004	Pole position identification (360°) settings: Error tolerance 15 ... [**20**] ... 50 °	Setting of the fault tolerance for the plausibility check. • If the rotor position detected via the encoder system is not within the tolerance zone around the position that is output in a controlled manner, the pole position identification is aborted and the parameterised error response is tripped.
0x2C61:005	Pole position identification (360°) settings: Absolute current amplitude • Read only: x.xx A	Display of the absolute current amplitude.

12.4.3 Pole position identification (PPI) with minimum movement

DANGER!

Mechanical damage of the motor caused by hanging loads!

The motor may be permanently damaged.

► The motor must not be braked or blocked during the pole position identification. Thus, this function must not be used for hanging loads!

NOTICE

Thermal overload of the motor!

The motor may be permanently damaged.

► Before executing the pole position identification, check that the following monitoring systems are parameterised correctly in order to prevent a permanent damage of the motor in the event of an error:

► Motor overload monitoring (i^2*t) 254

► Overcurrent monitoring

Functional description

If servo control for synchronous motor is set and if no error is pending, the current position is memorised after controller enable, and the current is increased along a ramp for 10 s to 35 % of the rated motor current. This will cause the rotor to align, which, however, is compensated by a position control. If the rotor makes an electrical movement of more than 20°, an error message is output, and the value measured is discarded. This might occur in the case of motors with considerable detent torques.

If the current has reached its final value, a plausibility check is executed after a short interval: in order to detect a non-permissible blocking of the motor, a positive and a negative test angle (± 20°) relative to the current position are defined after the identification. The motor must align itself to these two test angles within a tolerance of 25 %.

Conditions for the execution

- The motor must not be braked or blocked during the pole position identification.
- The servo inverter is error-free and in Switched on device state.

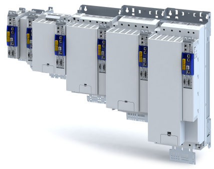
Response of the motor during performance

The motion of the motor will maximally correspond to the set "Max. permissible motion" (Lenze setting: 20°). If a greater motion is detected via the encoder system, the pole position identification is cancelled and the parameterised error response (Lenze setting: Fault) is triggered.

How to execute the pole position identification PLI (min. movement):

1. If the servo inverter is enabled, disable it.Enable operation
2. Set the object 0x2825 to "6" to change to the "pole position identification PLI (min. movement)" operating mode.
3. Enable the servo inverter to start the process.

   Note: Inhibiting the controller serves to abort the started procedure any time if required without changing the settings.



After the pole position identification has been completed successfully...

...the controller is inhibited automatically and the pole position determined for the activated feedback system is set in the 0x2C03:002 object.

- Save the changed settings.

  The »EASY Starter« serves to save the parameter settings of the servo inverter as parameter file (*.gdc). This file can then be imported in the »PLC Designer«. Saving the parameter settings
- The inverter disable set automatically by the procedure can be deactivated again via the CiA402 control word 0x6040. Enable operation

Adapt pole position identification PLI (min. movement)

The process of pole position identification described above can be adapted to the respective machine and the existing moments of inertia by using the parameters described in the following.

NOTICE

Thermal overload of the motor!

The motor may be permanently damaged.

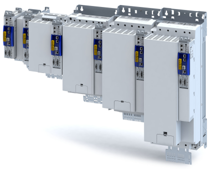
► If no temperature monitoring is available in the motor, and/or the I²xt motor monitoring and the maximum current monitoring are not parameterised correctly, the motor can be permanently damaged if the current amplitude is set too high!

► Motor overload monitoring (i²*t)

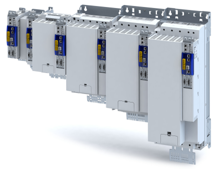
► Overcurrent monitoring

Parameter

Address	Name / setting range / [default setting]	Info
0x2C62:001	Pole position identification (min. movement) settings: Current amplitude 1 ... [**25**] ... 1000 % • Setting can only be changed if the inverter is inhibited.	Percentage adaptation of the current amplitude. • For large machines, high mass inertia values or for linear direct drives, the current amplitude usually must be increased. • Default setting 25 % ≡ 35 % of Motor rated current (0x6075) Note! If the current amplitude is set to > 100 %, the device utilisation (Ixt) monitoring and/or one of the motor monitoring functions may respond and cause the abort of the pole position identification.
0x2C62:002	Pole position identification (min. movement) settings: Ramp time 1 ... [**10**] ... 600 s • Setting can only be changed if the inverter is inhibited.	Percentage adaptation of the rate of current rise.
0x2C62:003	Pole position identification (min. movement) settings: Gain 0 ... [**0**] ... 1000 %	Adaptation of the proportional PI controller gain. With the Lenze setting "0 %",the PI controller works as an I controller.
0x2C62:004	Pole position identification (min. movement) settings: Reset time 0.1 ... [**62.5**] ... 6000.0 ms	Adaptation of the reset time of the PI controller. • In order to be able to compensate a positional variation faster, first the reset time should be reduced. If this does not result in the desired behaviour, the proportional gain can be increased. • Ensure that the position control does not get unstable. We therefore recommend you to use an I controller.
0x2C62:005	Pole position identification (min. movement) settings: Max. move permitted 1 ... [**20**] ... 90 °	Adaptation of the permitted movement. • The pole position identification comprises a monitoring function for the follow-up control. If a movement greater than the permissible movement set is detected by the encoder system, the pole position identification is aborted and the error response parameterised is tripped: • In order to detect a non-permissible blocking of the machine, a positive and negative test angle relative to the current position are defined after the identification. The machine must align itself to these two test angles within a tolerance of 25 %. The size of the test angle corresponds to the max. move permitted set here.



Address	Name / setting range / [default setting]	Info
0x2C62:006	Pole position identification (min. movement) settings: Absolute current amplitude • Read only: x.xx A	Display of the absolute current amplitude.



12.4.4 Pole position identification (PPI) without movement

The PLI function can also be used if no motor revolution is possible (holding brake active).

NOTICE

With an incorrect parameter setting and dimensioning of the inverter, the maximum permissible motor current may be exceeded during the pole position identification.

Possible consequence: irreversible damage of the motor.

► Set the motor data correctly. ▸ Motor data 📖 38

► Only use an inverter that is performance-matched to the motor.

⚠ DANGER!

Uncontrolled acceleration of the motor!

Undefined state of the feedback system, caused by wire breakage!

► Each pole position identification causes an update of the pole position set in the device! Therefore, ensure that the response to open circuit in the feedback system is set to Lenze setting "1: Fault" in 0x2C45! Otherwise, the status of the feedback system in case of open circuit is undefined and the pole position can assume any value. There is a danger that the machine accelerates in an uncontrolled way after pole position identification!

NOTICE

Device state "switched-on"/"operation"

► The process of the pole position identification only lasts some milliseconds. During the pole position identification, the device status does not change. Only after the pole position identification, the Operation enabled device status changes to the Operation enabled device status.

► If pole position identification is started via parameter 0x2825, the inverter is automatically disabled at the end of the pole position identification process.

Preconditions

- The wiring of the three motor phases and the motor encoder must be carried out according to the specifications from the mounting instructions.
- The inverter is ready for operation (no fault active).
- For pole position identification (PPI) without movement, the motor must be at standstill.

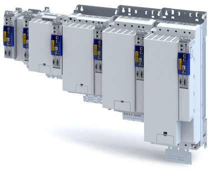
NOTICE

► During the pole position identification, the error 0xFF13 ("identification cancelled") may occur. This may be an indication that the motor features are not suitable for this PLI process.

Functional description

After inverter enable, a defined pulse pattern is output that provides currents up to approx. maximum motor current. The respective currents are measured. Based on these currents, the field distribution can be detected so that the pole position can be calculated. Then, the inverter is automatically disabled.

The pole position identification PLI (without movement) does not need any parameterisation.



Preconditions for the performance

- The wiring of the three motor phases and the feedback must be carried out in accordance with the specifications from the hardware manual.
- The motor may be stalled.
- The servo inverter is error-free and in Switched on device state.
- Please observe the notes in the Synchronous motor: Pole position identification (PPI)section.

Response of the motor during performance

The current test pulses cause audible engine noises that may be increased by the machine mechanics depending on the mechanical coupling!

How to execute the pole position identification PLI (without movement):

1. If the servo inverter is enabled, disable it.Enable operation
2. Set the object 0x2825 to "7" to change to the "pole position identification PLI (without movement)" operating mode.
3. Enable the servo inverter to start the process.

   Note: Inhibiting the controller serves to abort the started procedure any time if required without changing the settings.

After the pole position identification has been completed successfully...

...the controller is inhibited automatically and the pole position determined for the activated feedback system is set in the 0x2C03:002 object.

- For permanent storage, the changed settings from the servo inverter must be uploaded in the Controller.

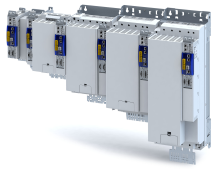
  The »EASY Starter« serves to save the parameter settings of the servo inverter as parameter file (*.gdc). Saving the parameter settings
- The inverter disable set automatically by the procedure can be deactivated again via the CiA402 control word 0x6040. Enable operation

Optional settings (starting performance)

Optionally, a pole position identification without motion can be activated after switching on the servo inverter.

Parameter

Address	Name / setting range / [default setting]		Info
0x2C63:001	PPI without movement: Execution • Setting can only be changed if the inverter is inhibited.		Starting performance (with or without pole position identification before the start).
	0	**Deactivated**	No pole position is identified.
	1	Only after 1st enable/encoder error	After the first controller enable and after each encoder wire breakage, a PLI without movement takes place. ⚠ CAUTION! After an encoder wire breakage, the drive may accelerate in an uncontrolled manner subsequent to the pole position identification. • Cause: In case of a wire breakage, the feedback system state is undefined and the pole position assumes any value. • Remedy: Set the error response "Warning" (0x2C450x2C45 = 2) for an encoder wire breakage in order that the pole position will be identified after a wire breakage.
	2	After each enable	After every inverter release, the pole position is identified without any movement.



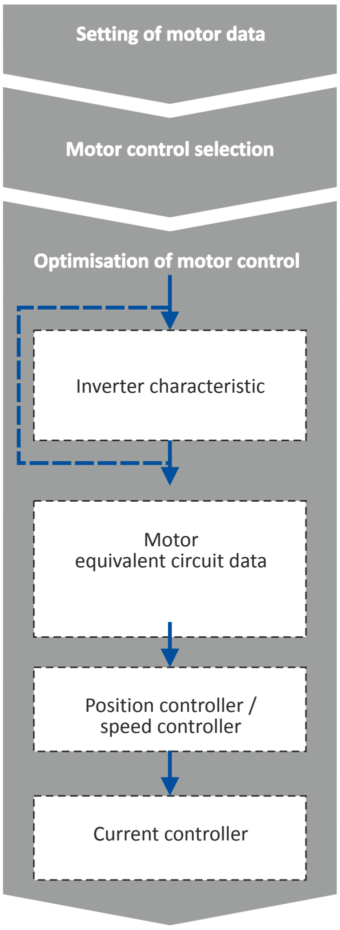
13 Configuring the motor control

This chapter contains all functions and settings relevant for the motor control.

Basic procedure of commissioning the motor control

In the first step, the rated data of the motor must be set. The other steps depend on the respective application case.

There are several options for setting the motor data and optimising the control loops. Basically, you can select between a manual and an automatic process. Whether a setting can be applied or not depends on the motor (Lenze motor yes/no) and the application. If possible, use the possible setting listed first in the following diagram since this one leads to the most accurate results.



Possible settings:
a) Using data from motor catalogue
b) Entering data manually (e.g. from the nameplate)

Options:
Servo control (SC-PSM) [1], Servo control(SC-ASM) [2],
V/f-control (open loop) [6]

Parameterisable functions:
Current control, speed control, position control ,V/f voltage boost, skip frequencies, optimisation of the stalling behaviour,

Possible settings:
a) Identifying data automatically (by inverter)
b) Loading preset inverter characteristics

Possible settings:
a) Identifying data automatically (by inverter)
b) Using data from the motor catalogue
c) Entering data manually

Possible settings:
- Entering data manually

Possible settings:
- Entering data manually

13.1 Servo control for synchronous motor (SC-PSM)

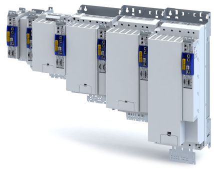
The motor control is based on a feedback, field-oriented and cascaded controller structure and enables a dynamic and stable operation in all four quadrants.

Preconditions

- The servo control (SC-PSM) is only suitable for synchronous motors.
- The servo control (SC-PSM) requires a feedback of the position.

13.1.1 Required commissioning steps

1. Check wiring by means of manual test modes: Testing the motor control 267
2. Activate motor control type: 0x2C00 = "Servoregelung (SC-PSM) [1]".
3. Set motor data: Motor data 38
4. Set motor monitoring:
   - Motor temperature monitoring 262
5. Configuring the feedback system 165
6. Only required for motors of other manufacturers:
   - Set and optimise current controller: Current controller 233
   - Correction of the stator leakage inductance (Lss)... 241
   - Synchronous motor: Pole position identification (PPI) 191
7. Only required for an automatic calculation of the speed controller parameters:
   - Define total moment of inertia: Tuning of the motor and the speed controller 224
8. Set speed controller: Speed controller 230.
9. Set position controller: Position controller 239
10. Optional: Synchronous motor (SM): Compensate temperature and current influences 246
11. Optional: Jerk limitation 250
12. Optional: Notch filter (band-stop filter) 251
13. Optional: Short-circuit braking 218



13.2 Servo control for asynchronous motor (SC-ASM)

The motor control is based on a feedback, field-oriented and cascaded controller structure and enables a dynamic and stable operation in all four quadrants.

Preconditions

- The servo control (SC ASM) is only suitable for asynchronous motors.
- The servo control (SC ASM) requires a feedback of the position.

13.2.1 Required commissioning steps

1. Check wiring by means of manual test modes: Testing the motor control 🕮 267
2. Activate motor control type: 0x2C00 = "Servo control (SC ASM) [2]".
3. Set motor data: Motor data 🕮 38
4. Configuring the feedback system 🕮 165
5. Only required for motors of other manufacturers:
   - Set and optimise current controller: Current controller 🕮 233
   - Correction of the stator leakage inductance (Lss)... 🕮 241
6. Only required for an automatic calculation of the speed controller parameters:
   - Define total moment of inertia: Tuning of the motor and the speed controller 🕮 224
7. Set speed controller: Speed controller 🕮 230.
8. Set position controller: Position controller 🕮 239
9. Only required for motors of other manufacturers:
   - Set field controller: ASM field controller 🕮 235
   - Set field weakening controller: ASM field weakening controller 🕮 236
10. Optional: Correction of the stator leakage inductance (Lss)... 🕮 241
11. Optional: Asynchronous motor (ASM): Identify Lh saturation characteristic 🕮 247
12. Optional: Estimate optimum magnetising current 🕮 249
13. Optional: Jerk limitation 🕮 250
14. Optional: Notch filter (band-stop filter) 🕮 251
15. Optional: DC braking 🕮 217

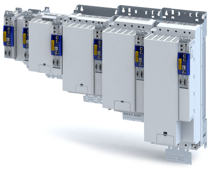
13.3 Sensorless control for synchronous motor (SL-PSM)

13.3.1 Required commissioning steps

1. Optional: Activate flying restart circuit:
   - From firmware version 4 onwards, a flying restart circuit for the synchronous motor up to speeds lower than half the rated speed is supported.
   - If the flying restart circuit shall be used, set the start method "Flying restart circuit [2]" in . More settings are not required for the flying restart circuit at sensorless control of a synchronous motor.
2. Optional for a speed control with torque limitation in operating mode 0x6060 = "MS: Velocity mode [-2]":
   - Select the source in for the positive torque limit source and set it accordingly.

> The torque limitation (parameter 0x2949:001/002) can only be used for open-loop controlled operation of the SL-PSM, not for closed-loop controlled operation.

   - Select the source in for the negative torque limit source and set it accordingly.



13.4 V/f characteristic control for asynchronous motor (VFC open loop)

The V/f characteristic control is a motor control for conventional frequency inverter applications. It is based on a simple and robust control mode for the operation of asynchronous motors with a linear or square-law load torque characteristic (e.g. fan). Because of the minimal parameterisation effort, such applications can be commissioned easily and quickly.

Preconditions

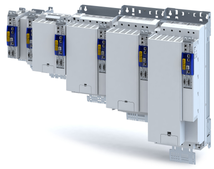
- The V/f characteristic control is only suitable for asynchronous motors.
- If you want to actuate a drive with a square-law V/f characteristic: Please always check whether the corresponding drive is suitable for operation with a square-law V/f characteristic!
- Set the motor data according to the information on the nameplate of the motor. ▶ Motor data 🕮 38

13.4.1 Required commissioning steps

1. Check wiring by means of manual test modes. ▶ Testing the motor control 🕮 267
2. Activate motor control type: 0x2C00 = "V/f characteristic control (VFC open loop) [6]".
3. Set limiting factors for the V/f characteristic:
    1. 0x2540:001, Rated mains voltage
    2. 0x2B01:001, Base voltage
    3. 0x2B01:002, Base frequency
4. Set and optimise current controller ▶ Current controller. 🕮 233

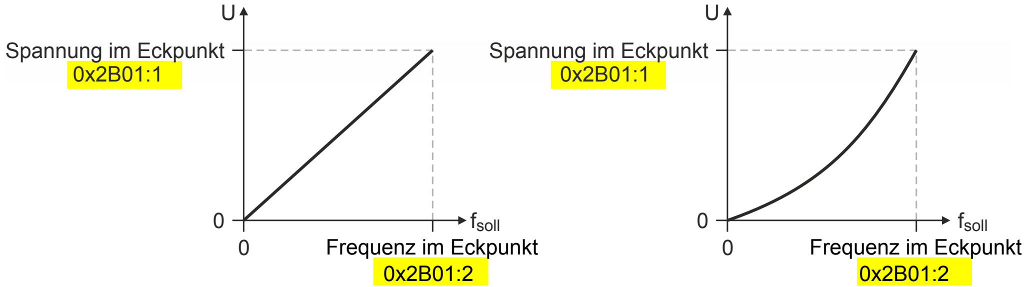
    Setting and optimising the current controller is only required if at least one of the following functions is active:

    - Voltage vector control ▶ Activate voltage vector control (Imin controller) 🕮 209
    - DC braking ▶ DC braking 🕮 217
    - Flying restart function ▶ Flying restart circuit 🕮 215
5. Select a characteristic shape suitable for the application ▶ Define V/f characteristic shape. 🕮 207
6. Set voltage boost 🕮 211
7. Activate voltage vector control (Imin controller) 🕮 209
8. Imax controller 🕮 238
9. Optional ▶ Set load adjustment 🕮 212
10. Optional ▶ Flying restart circuit 🕮 215
11. Optional ▶ Set slip compensation 🕮 212
12. Optional ▶ Set oscillation damping 🕮 213



13.4.2 Basic setting

The base voltage and the base frequency define the ratio of the two variables and thus the gradient of the V/f characteristic.



Parameter

Address	Name / setting range / [default setting]	Info
0x2B01:001	V/f shape data: Base voltage 0 ... [**225**] ... 5000 V	Base voltage and base frequency define the V/f ratio and thus the gradient of the V/f characteristic. • The V/f base voltage is usually set to the rated motor voltage. 0x2C01:007 • The V/f base frequency is usually set to the rated motor frequency. 0x2C01:005
0x2B01:002	V/f shape data: Base frequency 0 ... [**270**] ... 5000 Hz	

13.4.3 Define V/f characteristic shape

For adaptation purposes to different load profiles, you can select the shape of the characteristic:

Parameter

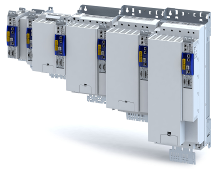
Address	Name / setting range / [default setting]		Info
0x2B00	V/f characteristic shape • Setting can only be changed if the inverter is inhibited.		Selection of the V/f characteristic shape for the adaptation to different load profiles.
	0	**Linear**	Linear characteristic for drives with constant load torque over the speed. ▶ Linear V/f characteristic 📖 207
	1	Quadratic	Square-law characteristic for drives with a square-law load torque over the speed. • Square-law V/f characteristics are preferably used for centrifugal pumps and fan drives. • Please always check whether the corresponding drive is suitable for operation with a square-law V/f characteristic! • If your pump drive or fan drive is not suitable for operation with a square-law V/f characteristic, use the linear V/f characteristic instead. ▶ Square-law V/f characteristic 📖 207
	2	Multipoint	User-definable characteristic for being adapted to special load profiles.
	3	Eco	Linear characteristic with energy optimisation in the partial load operational range.

13.4.3.1 Linear V/f characteristic

The linear V/f characteristic leads to a constant torque.

13.4.3.2 Square-law V/f characteristic

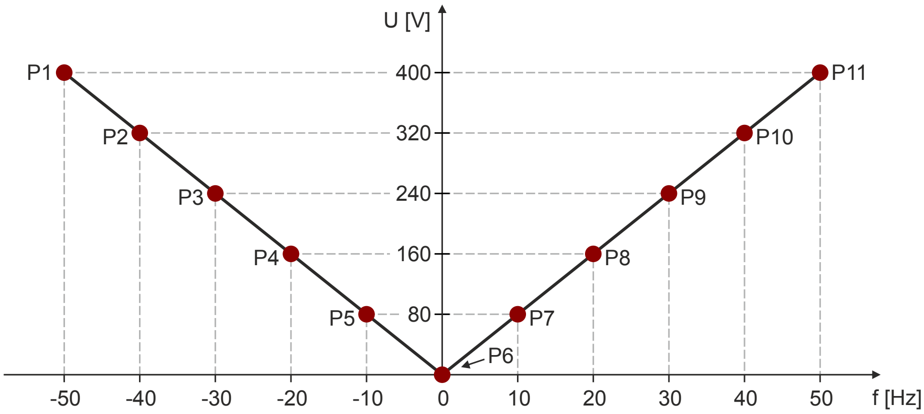
The square-law V/f characteristic is typically used in heating, ventilation and climate applications to control the speed of fans and pumps.



13.4.3.3 User-definable V/f characteristic

The "user-definable V/f characteristic" is provided for the individual adjustment of the motor magnetisation to the actual application if linear and square-law characteristics are not suitable.

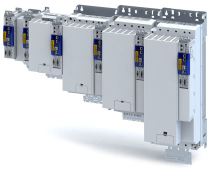
- The characteristic is defined by means of 11 parameterisable grid points (voltage/ frequency values).
- In the Lenze setting the 11 grid points represent a linear characteristic:



	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
V	400 V	320 V	240 V	160 V	80 V	0 V	80 V	160 V	240 V	320 V	400 V
f	-50 Hz	-40 Hz	-30 Hz	-20 Hz	-10 Hz	0 Hz	10 Hz	20 Hz	30 Hz	40 Hz	50 Hz

Parameter

Address	Name / setting range / [default setting]	Info
0x2B02:001	Frequency grid points (x) user V/f characteristic: x1 = f01 -5000 ... [**-50**] ... 5000 Hz	Freely parameterisable V/f characteristic (values for X axis).
0x2B02:002	Frequency grid points (x) user V/f characteristic: x2 = f02 -5000 ... [**-40**] ... 5000 Hz	
0x2B02:003	Frequency grid points (x) user V/f characteristic: x3 = f03 -5000 ... [**-30**] ... 5000 Hz	
0x2B02:004	Frequency grid points (x) user V/f characteristic: x4 = f04 -5000 ... [**-20**] ... 5000 Hz	
0x2B02:005	Frequency grid points (x) user V/f characteristic: x5 = f05 -5000 ... [**-10**] ... 5000 Hz	
0x2B02:006	Frequency grid points (x) user V/f characteristic: x6 = f06 -5000 ... [**0**] ... 5000 Hz	
0x2B02:007	Frequency grid points (x) user V/f characteristic: x7 = f07 -5000 ... [**10**] ... 5000 Hz	
0x2B02:008	Frequency grid points (x) user V/f characteristic: x8 = f08 -5000 ... [**20**] ... 5000 Hz	
0x2B02:009	Frequency grid points (x) user V/f characteristic: x9 = f09 -5000 ... [**30**] ... 5000 Hz	
0x2B02:010	Frequency grid points (x) user V/f characteristic: x10 = f10 -5000 ... [**40**] ... 5000 Hz	
0x2B02:011	Frequency grid points (x) user V/f characteristic: x11 = f11 -5000 ... [**50**] ... 5000 Hz	



Address	Name / setting range / [default setting]	Info
0x2B03:001	Voltage grid points (y) user V/f characteristic: y1 = U01 (x = f01) 0.00 ... [**400.00**] ... 1000.00 V	Freely parameterisable V/f characteristic (values for Y axis).
0x2B03:002	Voltage grid points (y) user V/f characteristic: y2 = U02 (x = f02) 0.00 ... [**320.00**] ... 1000.00 V	
0x2B03:003	Voltage grid points (y) user V/f characteristic: y3 = U03 (x = f03) 0.00 ... [**240.00**] ... 1000.00 V	
0x2B03:004	Voltage grid points (y) user V/f characteristic: y4 = U04 (x = f04) 0.00 ... [**160.00**] ... 1000.00 V	
0x2B03:005	Voltage grid points (y) user V/f characteristic: y5 = U05 (x = f05) 0.00 ... [**80.00**] ... 1000.00 V	
0x2B03:006	Voltage grid points (y) user V/f characteristic: y6 = U06 (x = f06) 0.00 ... [**0.00**] ... 1000.00 V	
0x2B03:007	Voltage grid points (y) user V/f characteristic: y7 = U07 (x = f07) 0.00 ... [**80.00**] ... 1000.00 V	
0x2B03:008	Voltage grid points (y) user V/f characteristic: y8 = U08 (x = f08) 0.00 ... [**160.00**] ... 1000.00 V	
0x2B03:009	Voltage grid points (y) user V/f characteristic: y9 = U09 (x = f09) 0.00 ... [**240.00**] ... 1000.00 V	
0x2B03:010	Voltage grid points (y) user V/f characteristic: y10 = U10 (x = f10) 0.00 ... [**320.00**] ... 1000.00 V	
0x2B03:011	Voltage grid points (y) user V/f characteristic: y11 = U11 (x = f11) 0.00 ... [**400.00**] ... 1000.00 V	

13.4.4 Activate voltage vector control (Imin controller)

The voltage vector control is used if a comparatively high starting torque must be provided. This function ensures that the required motor current is maintained in the lower speed range.

NOTICE

The boost function described here adds to the ▶ Set voltage boost function. 📖 211

Only set one of the two "boost" functions.

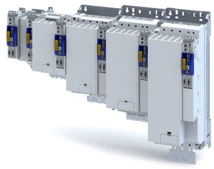
► Recommendation: torque increase in the lower speed range

► Take into consideration that the increased current at low speeds also entails higher heat losses of the motor.

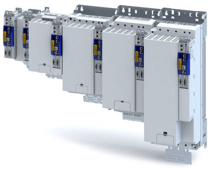
- The voltage vector control is activated by defining a current setpoint.
- For the automatic calculation of the control parameters, the "Calculate Imin controller" function is provided via parameter .

Parameter

Address	Name / setting range / [default setting]	Info
0x2B04	V/f boost controller - current setpoint 0.00 ... [**0.00**] ... 500.00 A	Setting of the current setpoint for the voltage vector control. • The setting "0.00 A" deactivates the voltage vector control. • When defining the current setpoint, we recommend you to provide a reserve of 20 % in order to largely exclude a "stalling" of the motor caused by unexpected additional loads. • Example of starting torque = rated motor torque: set the current setpoint to approx. 120 % of the load current.



Address	Name / setting range / [default setting]	Info
0x2B05:001	V/f boost controller settings: Gain 0.00 ... [**148.21**] ... 750.00 V/A	Setting of the gain for the voltage vector control.
0x2B05:002	V/f boost controller settings: Reset time 0.01 ... [**3.77**] ... 2000.00 ms	Setting of the reset time for the voltage vector control.



13.4.5 Set voltage boost

As an alternative for the "Activate voltage vector control (Imin controller)" function, a constant, load independent voltage boost can be specified for low speeds (below the V/f rated frequency) or for a motor standstill in order to optimise the starting performance.

⚠WARNING!

Insufficient cooling of the motor due to longer operation at standstill.

If the motor is operated at standstill for a longer time - especially in case of smaller motors - the motor can be destroyed by overtemperature!

- ▶ Connect the PTC thermistor (single sensor according to DIN 44081 or triple sensor according to DIN 44082) or thermal contact (normally-closed contact) ▸ Motor temperature monitoring. 📖 262
- ▶ Parameterise and activate the ▸ Motor overload monitoring (i²*t). 📖 254

NOTICE

The voltage boost is added to the function ▸ Activate voltage vector control (Imin controller). 📖 209

Only set one of the two "boost" functions.

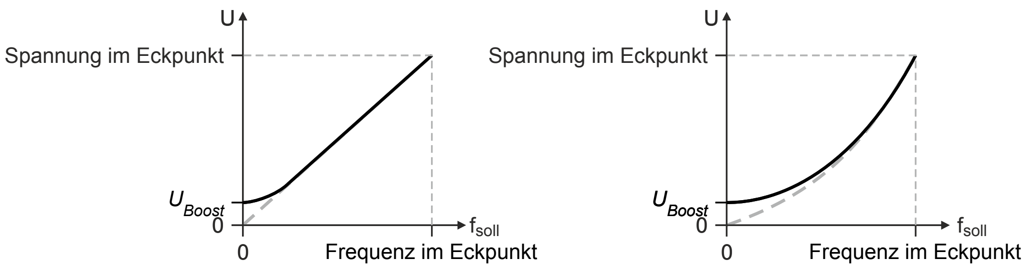
Recommendation: voltage vector control

For magnetising the motor, consider a sufficient time from the controller enable to the start of the speed ramp function generator. The bigger the motor the longer the time required for magnetisation. A motor with a power of 90 kW requires up to 2 seconds.

Depending on the required starting torque, the voltage boost must be set so that the required motor current will be available after controller enable.

- The voltage boost can be calculated by multiplying the stator resistance by the rated magnetising current:

$$\text{Anlaufstrom} \sim U_{\text{Boost}} = R_s \times I_{mN}$$

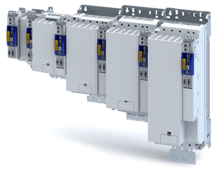


- Optionally, the voltage boost can be determined empirically by increasing the setting until the rated magnetising current flows.
- The voltage boost is added geometrically to the voltage of the characteristic:

$$U = \sqrt{U^2_{\text{Kennlinie}} + U^2_{\text{Boost}}}$$

Parameter

Address	Name / setting range / [default setting]	Info
0x2B06	Voltage boost 0.0 ... [**0.0**] ... 100.0 V	Setting of the voltage boost for the voltage vector control.



13.4.6 Set load adjustment

⚠CAUTION!

If the load adjustment is too high, the motor current may increase in idle state and the motor may overheat!

Parameter

Address	Name / setting range / [default setting]		Info
0x2B07:001	Load adaption: Direction of rotation • Setting can only be changed if the inverter is inhibited.		Selection for adapting the characteristic as a function of the load in case of CW and CCW rotation.
	0	**Passive load**	
	1	Active load CCW	
	2	Active load CW	
0x2B07:002	Load adaption: Load adaption value 0.00 ... [**20.00**] ... 200.00 %		Setting of the load adaptation in [%] proportionally to the rated motor torque to obtain an appropriately "rigid" drive behaviour even after start-up. • For starting torque = rated motor torque, a load adaptation of 50 % is suitable for most applications.

13.4.7 Set slip compensation

The speed of an asynchronous motor depends on the load. This load-dependent speed drop is called “slip”. The slip compensation serves to counteract the load-dependent speed loss.

Observe correct parameterisation of the rated motor frequency 0x2C01:005 and the rated motor speed 0x2C01:004. Both parameters serve to calculate the rated motor slip.

Parameter

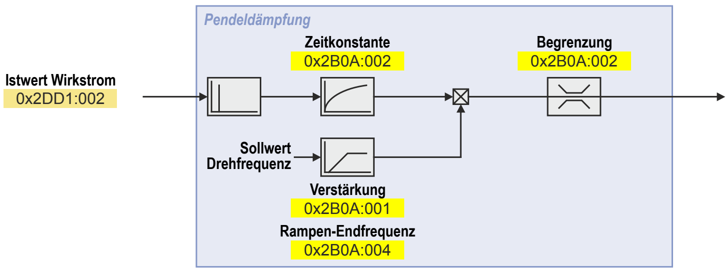
Address	Name / setting range / [default setting]	Info
0x2B09:001	Slip compensation: Gain -200.00 ... [**0.00**] ... 200.00 %	Adjustment in percent of the slip calculated. • For instance required for deviations of the real motor data from the nameplate data. • A setting of 100 % corresponds to the rated slip of the machine in the nominal operating point.
0x2B09:002	Slip compensation: Filter time 1 ... [**2000**] ... 6000 ms	Filter time for the slip compensation.

13.4.8 Set oscillation damping

The oscillation damping serves to reduce the oscillations during no-load operation which are caused by energy oscillating between the mechanical system (mass inertia) and the electrical system (DC bus). Furthermore, the oscillation damping can also be used to compensate for resonances.

> Damping is possible only for constant oscillations at a steady-state operating point.
>
> Oscillations occurring sporadically cannot be damped.
>
> Oscillation damping is not suitable for oscillations occurring during dynamic processes (e.g. accelerations or load changes). Oscillation damping is only active if the setpoint speed is greater than 10 rpm and the DC-bus voltage exceeds a value of 100 V.

The determination of the oscillation is based on the active current. In order to obtain the alternating component of the active current, this current is differentiated. This signal is then passed through a PT1 filter.



Identification of the oscillation

Before the oscillation damping can be parameterised, the oscillation must be identified. One option is to look at the motor current when the oscillation damping is switched off (gain = 0 %). The oscilloscope function of the »PLC Designer« enables to record the following currents:

- Q current
- Total current

A passive load and continuous operation with constant speed (steady-state operation) result in a constant current. If the drive oscillates, the motor current oscillates as well. This makes it possible to detect the frequency and amplitude of the oscillation by means of the AC component in the motor current. Hereinafter this AC component will be referred to as "current oscillation".

Parameter setting

The gain of the oscillation damping is to be set according to the following equation:

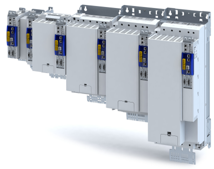
$$\text{Verstärkung der Schwingungsdämpfung} = \frac{\text{Stromamplitude}}{\sqrt{2} \cdot \text{Gerätemaximalstrom}} \cdot 100\%$$

The time constant must be set so that the oscillation can be dampened, but that higher-frequency components are filtered from the signal. The time constant is determined from the reciprocal value of the double current oscillation frequency:

$$\text{Zeitkonstante} = \frac{1}{2 \cdot \text{Schwingfrequenz}}$$

The calculated oscillation frequency can be limited before being added to the rotating field frequency. The maximum frequency can be derived from the amplitude of the current oscillation, the rated motor current and the slip frequency of the connected motor:

$$\text{max. Frequenz} = \frac{2 \cdot \text{Amplitude der Stromschwingung}}{\text{Motor} - \text{Bemessungsstrom}} \cdot \text{Nennschlupffrequenz}$$



Parameter

Address	Name / setting range / [default setting]	Info
0x2B0A:001	Oscillation damping: Gain -100 ... [**20**] ... 100 %	Gain of the oscillation signal. • With the setting 0, oscillation damping is deactivated.
0x2B0A:002	Oscillation damping: Filter time 1 ... [**5**] ... 600 ms	Time constant of the PT1 filter.
0x2B0A:003	Oscillation damping: Limitation 0.1 ... [**0.2**] ... 20.0 Hz	Limitation of the calculated oscillation frequency.
0x2B0A:004	Oscillation damping: Final ramp frequency 0 ... [**0**] ... 100 %	Ramp end frequency from which the gain factor is expected to have reached its rated value. • By setting a ramp end frequency, a possible negative impact of the oscillation damping on the concentricity factor in the lower speed range can be reduced. • The ramp end frequency refers to the rated motor frequency in percentage terms.

13.4.9 Optimising the stalling behaviour

The stalling protection function or the maximum permissible motor current in the field weakening range can be adapted.

- If the motor stalls in the field weakening range, the override point can be shifted by reducing the set value so that the motor stalling can be prevented.
- If the motor does not provide enough torque in the field weakening range, the set value must be increased.

Parameter

Address	Name / setting range / [default setting]	Info
0x2B0C	Override field weakening -500.0 ... [**0.0**] ... 500.0 Hz	Offset of the override point for field weakening.

13.4.10 Flying restart circuit

The "flying restart" function serves as a protective function against high compensation currents. High compensation currents can occur in the V/f characteristic control if the drive is not at standstill at the time the inverter is enabled. The "flying restart" function detects the motor speed by means of a test current and uses this information to define the frequency setpoint.

⚠CAUTION!

If the "flying restart" function is deactivated and the inverter is not enabled at standstill, the output voltage and the output frequency do not match the current motor speed.

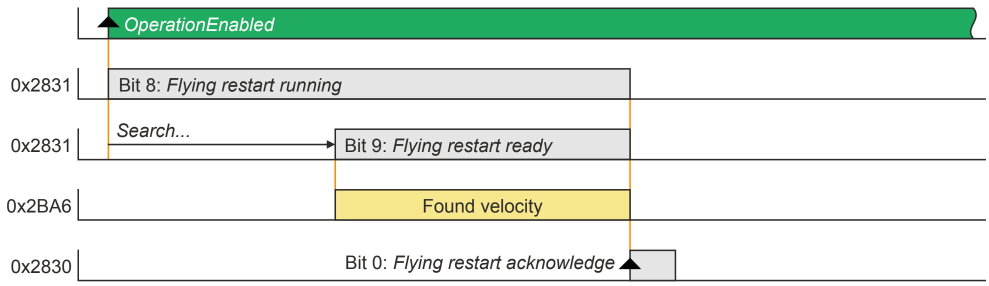
High compensation currents may flow! First the drive is braked towards 0 Hz to be then accelerated again!

► Ensure that the drive is at standstill before the inverter is enabled.

Flying restart process

If this function is active, the flying restart process starts after the inverter is enabled.

1. The inverter reports the started flying restart process to the Controller via bit 8 in the Lenze status word0x2831.
2. If a speed is found, it is reported to the Controller via bit 9 in the Lenze status word.
3. The Controller reports to the inverter via bit 0 in the Lenze control word 0x2830 that the detected speed has been accepted. As long as this is not the case, no further flying restart process is possible.

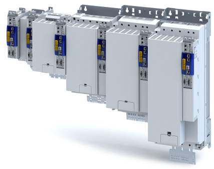


Parameter setting

The flying restart algorithm needs a motor voltage as exact as possible. Thus, a previous detection of the inverter error characteristic is absolutely necessary. Compensate inverter influence to output voltage In addition to the exact motor voltage, a detailed knowledge of the stator resistance is required. If the flying restart process does not work as desired, slightly adapt the setting of the stator resistance in the 0x2C01:002 object. Bit 1 in the Lenze control word 0x2830 serves to block a flying restart process.

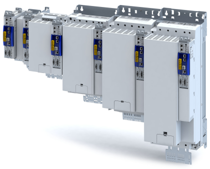
The flying restart process involves a control loop, the controller parameter 0x2BA3 of which must be adapted to the motor. The automatic calculation is made with the parameter ▸ 0x2822:022.

The actual flying restart process can be adjusted via the following parameters:



Parameter

Address	Name / setting range / [default setting]	Info
0x2BA0	Activate flying restart	Activation of the additional "flying restart" function. If the "flying restart" function is activated ("1: on") and the inverter disable is deactivated, a flying restart process is automatically started for determining the current motor speed if the following conditions are met: • The V/f characteristic control is set as motor control. • The CiA402 mode is selected as drive mode. • The "flying restart" function is not blocked via bit 2 in the Inverter control word (0x2830). • No DC-injection braking is active. • No motor phase failure has been identified.
	0 **Off**	
	1 On	
0x2BA1	Flying restart circuit 0 ... [**15**] ... 100 %	
0x2BA2	Start frequency -600.0 ... [**20.0**] ... 600.0 Hz	Start frequency of flying restart algorithm • If it is foreseeable at which frequency the motor can be restarted on the fly, set the frequency here.
0x2BA3	Integration time 1 ... [**600**] ... 60000 ms	Integration time of the angle controller • The default setting is adapted for medium-power machines. • A guide value for the integration time can be calculated as a function of the motor power with the following equation: Ti = 1.1 μ/W * Rated power (0x2C01:006) + 9.4 ms • For accelerating the search process, this guide value can be reduced. • If the flying restart frequency oscillates too much, increase the integration time again. • A longer integration time extends the time for a flying restart of the drive.
0x2BA4	Minimum deviation 0.00 ... [**5.00**] ... 90.00 °	Setting of the minimum permissible deviation.
0x2BA5	Delay time 0 ... [**0**] ... 10000 ms	In order to prevent the start of a flying restart process if the controller inhibit time is too short, a minimum active time for the inverter disable can be set here in order that a flying restart process will be started. As a pulse inhibit > 500 ms causes a controller inhibit, this also applies to pulse inhibit.
0x2BA6:001	Result: Determined speed [rpm] • Read only: x rpm	Display of the determined speed in [rpm].
0x2BA6:002	Result: Determined speed [n unit] • Read only: rpm	Display of the determined speed in [n unit].



13.5 Parameterisable motor functions

13.5.1 DC braking

The control modes for asynchronous motors provide the opportunity to use the "DC-braking" function (DC-injection braking) for braking. In this case, the motor control injects a DC current the amplitude of which is adjustable.

Preconditions

Using the "DC braking" function, the motor control injects a DC current, the amplitude of which is adjustable in the 0x2B80 parameter. To this end, it is necessary that the current control is adapted to the corresponding motor. For setting and optimising the current controller, see Current controller. 233

Details

The function can be used as follows:

1. "DC braking" can be parameterised via bit 6 in the Lenze control word 0x2830.

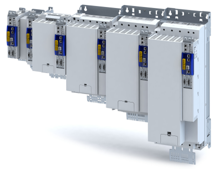
   In this case, the motor system itself can be used as an energy converter.

   This option is useful if
   - the system is not provided with a brake resistor required for absorbing the braking energy. This method requires that a sufficient braking torque can be achieved with "DC braking".
   - the power of the brake chopper to be transformed is limited and thus must be exclusively used for the main drives of the DC network. The quality of the deceleration ramp via "DC braking" is sufficient for auxiliary drives and unburdens the brake chopper.
   - a fan drive is to be braked in the V/f characteristic operation.
2. "DC braking" can be parameterised as a response to minor faults.

   An example of a minor fault is the error of an encoder of an asynchronous machine. Due to the error, the quick stop function cannot be executed anymore. An alternative is provided by the guided shutdown with a minor deceleration via the "DC braking" function.

Parameter

Address	Name / setting range / [default setting]	Info
0x2B80	Current for DC-injection braking 0.00 ... [**0.00**] ... 500.00 A	Braking current for DC-injection braking



13.5.2 Short-circuit braking

The control modes for synchronous motors provide the opportunity to use "short-circuit braking" for braking.

The effect of short-circuit braking on the deceleration behaviour depends on the motor properties, the effective cable length, the load inertia and the initial speed value (starting point). Primarily, short-circuit braking serves to transform a part of the kinetic energy into heat energy which unburdens external brake assemblies and limit position dampers.

NOTICE

In some constellations it is not possible to decelerate the motor speed of a synchronous motor to zero by means of "short-circuit braking"!

Compared to the "quick stop" function, the braking effect is considerably lower.

► Prevention: tbd

Preconditions

If short-circuit braking shall be used as the only deceleration means, it is recommended that the feasibility is previously verified by means of tests. For this purpose, short-circuit braking can be triggered in the application via bit 6 in the Lenze control word 0x2830. The oscilloscope function of the engineering tool (e.g. »EASY Starter«) serves to record the following important parameters:

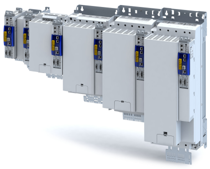
- Actual velocity 0x606C
- Phase current U, V, W ...

Details

The short-circuit current adjusts itself freely in accordance with the motor voltage (kE * speed) and the internal resistance of the system. Thus, it is absolutely necessary that the ampacity of the servo inverter is based on the maximum expected short-circuit current. Guide value: I_{max_device} (3 s) ≥ 1.5 * Imax_motor (according to data sheet / catalog) In case the assignment differs, a rating based on the currently possible parameters (max. speed, max. motor current, field weakening, etc.) is required!

The function can be used as follows:

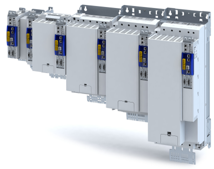
1. "Short-circuit braking" can be parameterised via bit 6 in the Lenze control word 0x2830 if
   - the braking energy cannot be converted into heat in a brake resistor.
   - e.g. an error has been detected in the encoder system which does not permit a braking via quick stop.
2. "Short-circuit braking" can be parameterised as a response to minor faults.
   - Due to an encoder error, for instance, a quick stop might not be possible anymore.



13.5.3 Holding brake control

This device function is used for low-wear control of the motor holding brake connected to the inverter with a supply voltage of 24 V.

The motor holding brake is connected to X106. It is supplied with 24 V via X107.



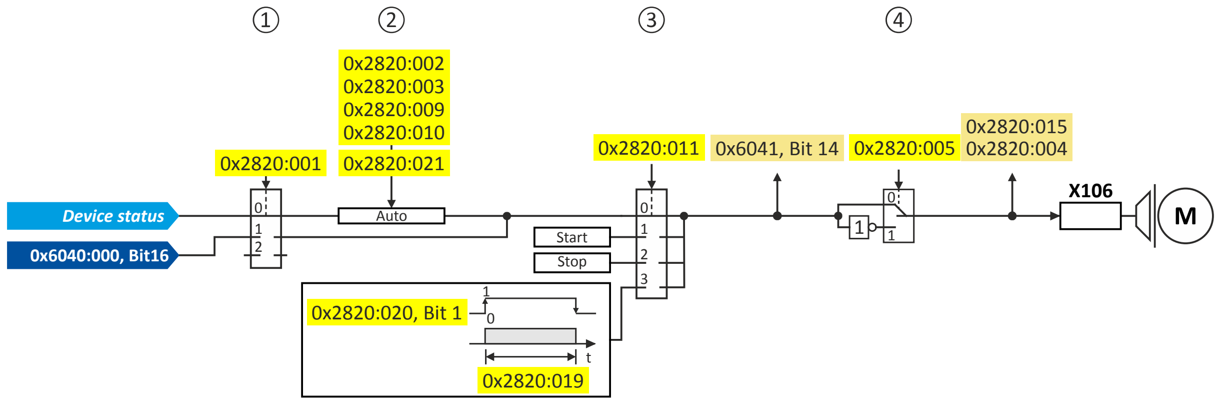
13.5.3.1 Basic setting

The following parameters must be set for the activation and basic setting of the holding brake control.

Details

The following settings are possible:

- Brake mode ①
- For the automatic operation: ②
  - Brake release time and brake application time
  - Torque feedforward control
- Test Brake control ③
- Brake polarity ④



Diagnostic parameters:

- Display status of the automatic brake identification: 0x2820:004
- Display signal of the brake logic before the inversion: 0x6041
- Display status of the holding brake: 0x2820:015

Brake mode

Possible settings: 0x2820:001

- Manual control via the control word. Das control word depends on the technology application :
  - Technology application CiA 402: 0x6040 Bit 14
  - Speed Control technology application: 0x5030:010 Bit 14
  - 0: Close holding brake
  - 1: Release holding brake
- Control via device state machine (automatic operation):
  - The holding brake is controlled as a function of the device state.
  - A torque feedforward control is possible.

> The torque is precontrolled for one second. During this time, the actual torque must have reached 90 % of the setpoint torque, otherwise an error is triggered.

  - Response times of the holding brake during release and application can be compensated for.

> In the event of an error or when STO ("SafeTorqueOff") is activated, the brake is applied immediately without considering the set brake application time. The inverter immediately changes to the switch-on disabled state.

- No brake connected (off):
  - holding brake control, automatic brake identification and brake monitoring are deactivated.

Brake polarity

The control logic of the holding brake can be inverted.

Parameter

Address	Name / setting range / [default setting]	Info
0x2820:001	Holding brake control: Brake mode	Selecting how the "Release holding brake" command is to be triggered.
	0 Automatically (via device state)	Automatic operation: depending on the device state, the "Release holding brake" command is given automatically if the controller is to be enabled.
	1 Manually	Depending on the TA, the "Release holding brake" command can also be initiated by the following external triggers: TA Cia: 0x6040 bit 14 TA Speed Control: bit 10
	2 Off	The holding brake is deactivated.
0x2820:002	Holding brake control: Brake closing time 0 ... [**100**] ... 10000 ms	Application time (engagement time) of the holding brake. • Only effective in automatic operation.
0x2820:003	Holding brake control: Brake opening time 0 ... [**100**] ... 10000 ms	Release time (disengagement time) of the holding brake. • Only effective in automatic operation.
0x2820:004	Holding brake control: Brake detection • Read only	When 0x2825 = 4 (Manual control mode) and the device state changes from "switched-on" to "operation enabled", it is detected automatically whether a holding brake is connected. The brake identification is repeated after every controller enable.
	0 Detection not started	
	1 Detection running	
	2 No brake detected	
	3 Brake detected	
0x2820:005	Holding brake control: Brake polarity	The control logic of the holding brake can be inverted.
	0 Normal	
	1 Inverted	
0x2820:006	Holding brake control: Brake error response	Selection of the response for holding brake monitoring. In the triggered state, the holding brake is monitored cyclically for the presence of brake current. After the brake is connected, the establishment of the brake current is subject to a time delay in accordance with the inductance. Consequently, there is a slight delay in detecting wire breakage, a terminal short-circuit or a missing brake supply. The response set here occurs when monitoring is triggered. **Note:** The brake is not monitored unless it is triggered.
	0 No fault	
	1 Fault	
	2 Warning	
0x2820:015	Holding brake control: Brake status • Read only	Display of the holding brake status. • The status is also displayed via bit 14 in the CiA: Statusword 0x6041.
	0 Active	Holding brake is applied.
	1 Brake released	Holding brake is released.
0x2820:019	Holding brake control: Brake opening time test signal 0 ... [**500**] ... 10000 ms	Setting of the brake opening time when the test signal is transmitted (Brake control word bit 0 = 1).
0x2820:022	Holding brake control: Versorgungsspannung Haltebremse	
	75 Absenkung auf 75%	
	100 Keine Absenkung	

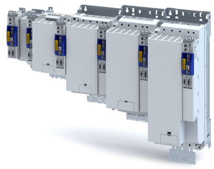
Further setting options:

- Manual brake control 222

13.5.3.2 Brake holding load

Parameter

Address	Name / setting range / [default setting]	Info
0x2820:013	Holding brake control: Holding load ramptime 0 ... [**0**] ... 1000 ms	By setting a ramp time, a vibration stimulation can be reduced that might be caused by the brake holding load .



13.5.3.3 Torque feedforward control

Parameter

Address	Name / setting range / [default setting]		Info
0x2820:009	Holding brake control: Starting torque source		Setting of the source for the holding brake starting torque.
	0	Last torque saved	The stopping value saved automatically during the last closing operation is used as starting torque.
	1	**Torque in 0x2820:010**	The parameterised starting torque is used (0x2820:010).
0x2820:010	Holding brake control: Starting torque -3276.8 ... [**0.0**] ... 3276.7 %		Setting of the feedforward control value for the automatic operation (0x2820:009 = 1).
0x2820:021	Holding brake control: Detected actual torque • Read only: x.x %		Display of the torque actual value that is used for the feedforward control. 0x2820:009 = 0

13.5.3.4 Manual brake control

The holding brake can be released and applied manually independently of the operating mode and operating status of the inverter. This function can be used, for instance, to move the axis manually in the event of an error.

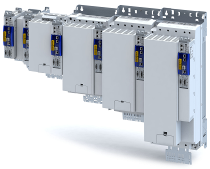
Details

The following settings are possible:

- Open the holding brake:
  - The holding brake remains open until it closed again manually.
- Close the holding brake.
- Release the holding brake for a fixed time by a start signal and then apply it automatically:
  - Time for "Brake released": 0x2820:019
  - Start signal: 0x2820:020, bit 0 = 1
  - After the time has elapsed → bit 0 = 0

Parameter

Address	Name / setting range / [default setting]		Info
0x2820:011	Holding brake control: Override of the brake control		Mode for override or forced opening/closing of the holding brake irrespective of the operating mode. In the event of an error and activated function for forced opening, the brake is not applied.
	0	**No override active**	Mode for override or forced opening/closing of the holding brake irrespective of the operating mode.
	1	Open brake	• In the event of an error and activated function for forced opening, the brake is not applied.
	2	Close brake	
	3	Test pulse	
0x2820:020	Holding brake control: Brake control word 0x00 ... [**0x00**] ... 0xFF		Control word for the holding brake.
	Bit 0	Transmit test signal	



13.6 Options for optimising the control loops

The option to be selected depends on the respective application. Depending on the selected option, different procedures become active and thus different parameter groups are influenced:

- Rated motor data
- Inverter characteristic
- Motor equivalent circuit diagram data
- Motor controller settings
- Speed controller settings
- Position controller settings

13.6.1 Automatic motor identification (energized)

Parameter

Address	Name / setting range / [default setting]		Info
0x2832	Motor identification status • Read only		Display of the status for the automatic identification of the motor parameters. Parameters for interaction with engineering tools.
	Bit 0	Identification enabled	Parameters for interaction with engineering tools.
	Bit 1	Identification active	
	Bit 2	Identification completed	
	Bit 3	Identification failed	

13.6.2 Tuning of the motor and the speed controller

The following describes in general how to optimise the speed controller. This may be required if some parameters have on the load side of the drive system have changed or have not been set yet, such as:

- Motor moment of inertia
- Load moment of inertia
- Type of coupling between motor moment of inertia and load moment of inertia

Preconditions

All rated motor data is known and set in the inverter, either by selecting the motor from the motor catalogue or manually.

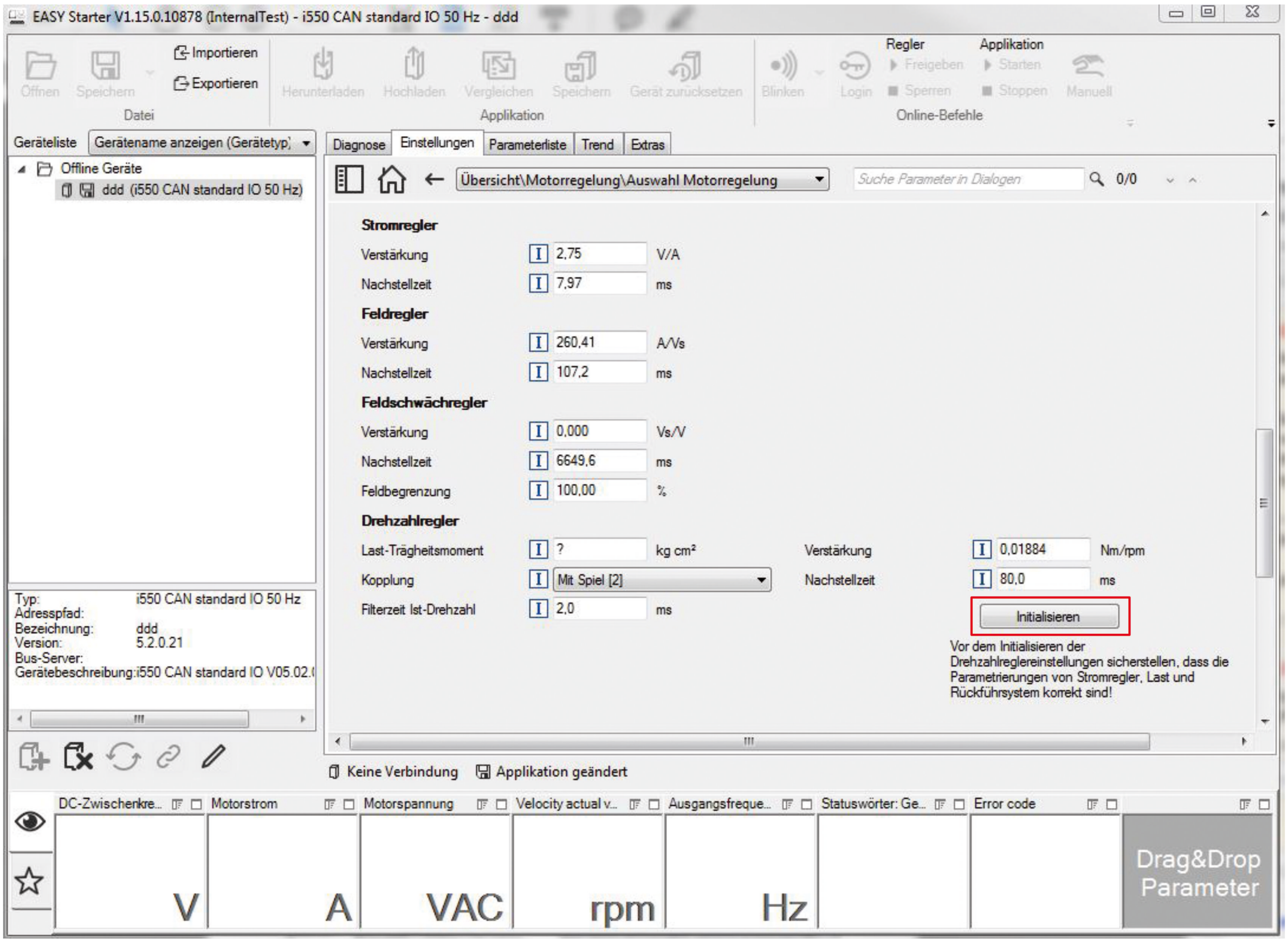
▸ Select motor from motor catalogue 🕮 39
▸ Manual setting of the motor data 🕮 41

Required steps

Adapt the following parameters to your drive system using the engineering tool. Since this only changes load-dependent data, the other parameter groups do not need to be calculated again.

In the engineering tool, the speed control settings can be confirmed via the **Initialise** button.

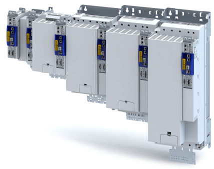
> This function is not available via the keypad.



Parameter

Address	Name / setting range / [default setting]	Info
0x2910:001	Inertia settings: Motor moment of inertia 0.00 ... [**0.14**] ... 20000000.00 kg cm²	Setting of the moment of inertia of the motor, relating to the motor.
0x2910:002	Inertia settings: Load moment of inertia 0.00 ... [**0.00**] ... 20000000.00 kg cm²	Setting of the moment of inertia of the load. • Always adjust the setting to the current load, otherwise the optimisation process for the speed controller cannot be executed successfully.
0x2910:003	Inertia settings: Coupling	Selection of the type of coupling between the moment of inertia of the motor and that of the load.
	0 **Stiff**	
0x2910:004	Inertia settings: Mechanical natural frequency 0.0 ... [**0.0**] ... 250.0 Hz	Setting of the mechanical natural frequency.
0x2910:005	Inertia settings: Load moment of inertia (elastic coupled) 0.00 ... [**0.00**] ... 20000000.00 kg cm²	Setting of the load moment of inertia with elastic coupling (0x2910:003 = 1).

For further details on the speed controller, see chapter "Speed controller". 230



13.6.3 Inverter characteristic

The settings made can be seen if required, but should not be changed. A wrong setting may influence the control negatively!

13.6.3.1 Compensating for inverter influence

Conditions for the execution

- The motor may be stalled.
- The i950 servo inverter is error-free and switched on.

Response of the motor during performance

If the motor is not braked, the motor will move slightly

Disabling the inverter serves to abort the started procedure any time if required. Already determined characteristic values are rejected in this case.

How to detect the inverter characteristic:

1. Disable the servo inverter.
2. Change to the "inverter characteristic: identification" operating mode. ▶ 0x2825 = 8
3. Enable the servo inverter.

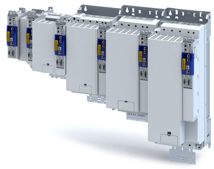
The procedure starts.

After the successful completion, the inverter is automatically disabled and the points of the detected inverter characteristic are set in parameter 0x2947t.

1. Save the changed settings.
2. The inverter characteristic must only be detected again if the servo inverter, the motor or the motor cable have been replaced.
3. The inverter disable set by the procedure can be deactivated via the control word. ▶ 0x6040 = 7

Parameter

Address	Name / setting range / [default setting]	Info
0x2947:001	Inverter characteristic: Value y1 0.00 ... [**0.00**] ... 20.00 V	The inverter characteristic (consisting of 17 values) is calculated and set in the course of the automatic inverter characteristic identification. Note! Changing these values is not recommended by the manufacturer.
0x2947:002	Inverter characteristic: Value y2 0.00 ... [**0.00**] ... 20.00 V	
0x2947:003	Inverter characteristic: Value y3 0.00 ... [**0.00**] ... 20.00 V	
0x2947:004	Inverter characteristic: Value y4 0.00 ... [**0.00**] ... 20.00 V	
0x2947:005	Inverter characteristic: Value y5 0.00 ... [**0.00**] ... 20.00 V	
0x2947:006	Inverter characteristic: Value y6 0.00 ... [**0.00**] ... 20.00 V	
0x2947:007	Inverter characteristic: Value y7 0.00 ... [**0.00**] ... 20.00 V	
0x2947:008	Inverter characteristic: Value y8 0.00 ... [**0.00**] ... 20.00 V	
0x2947:009	Inverter characteristic: Value y9 0.00 ... [**0.00**] ... 20.00 V	
0x2947:010	Inverter characteristic: Value y10 0.00 ... [**0.00**] ... 20.00 V	
0x2947:011	Inverter characteristic: Value y11 0.00 ... [**0.00**] ... 20.00 V	
0x2947:012	Inverter characteristic: Value y12 0.00 ... [**0.00**] ... 20.00 V	
0x2947:013	Inverter characteristic: Value y13 0.00 ... [**0.00**] ... 20.00 V	
0x2947:014	Inverter characteristic: Value y14 0.00 ... [**0.00**] ... 20.00 V	
0x2947:015	Inverter characteristic: Value y15 0.00 ... [**0.00**] ... 20.00 V	



Address	Name / setting range / [default setting]	Info
0x2947:016	Inverter characteristic: Value y16 0.00 ... [**0.00**] ... 20.00 V	
0x2947:017	Inverter characteristic: Value y17 0.00 ... [**0.00**] ... 20.00 V	

In the event of an error

If an error occurs during the procedure or the pulse inhibit gets active (e.g. due to short-time undervoltage), the procedure is terminated with inverter disable without the settings being changed.

13.6.3.2 Extended settings for identification

For determining the characteristic, the current controller is automatically parameterised at the start of the identification process. In case of motors with a very low stator leakage inductance (< 1 mH), the automatic parameterisation can fail and the actual identification process is aborted with an error message such as "short circuit".

- For this case, it is possible to set the current controller manually via the 0x2942 parameter.
- The 0x2DE0:001 parameter serves to select whether the current controller should be calculated automatically or the values in 0x2942 are effective.

Parameter

Address	Name / setting range / [default setting]	Info
0x2DE0:001	Current controller identification settings **0 Automatisch** 1 Manuell (0x2942)	Whether the current controller shall be adapted automatically for the identification or set manually, is selected via: • 0x2942:001 (Gain) • 0x2942:002 (Reset time)
0x2DE0:003	Resolver - position detection dynamics 20 ... [**100**] ... 100 %	Setting of the dynamics for the resolver evaluation. • 100% ≡ max. dynamics • <100% ≡ reduced dynamics
0x2DE0:004	Resolver - 8 kHz safety signal **0 Automatisch durch Gerätetyp** 1 Ein 2 Aus	Usually ,the Der 8-kHz carrier frequency is only activated for the safety version. This parameter can also be used to switch it on and off.
0x2DE0:007	Use measured voltage 0 Aus **1 Ein**	Activation of voltage measurement. Only for devices for which voltage measurement is possible.

13.6.3.3 Load standard inverter characteristic

If none or only one faulty inverter characteristic could be determined, a device-typical standard inverter characteristic can be loaded.

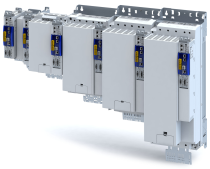
How to load the standard inverter characteristic:

1. **Axis commands: load standard-Lh saturation characteristic** 0x2822:022 = start 1.
2. After completing the procedure, save the inverter characteristic set in in the inverter.

   The »EASY Starter« serves to save the parameter setting of the inverter as parameter file (*.gdc). ▸ Saving the parameter settings

Parameter

Address	Name / setting range / [default setting]	Info
0x2822:022	Axis commands: Load default inverter characteristic **0 Off/Ready** 1 On/Start 2 In process 3 Action cancelled 4 No access 5 No access (controller inhibit)	Parameters for interaction with engineering tools. Obtain Hiperface information from the encoder for application feedback.



13.6.4 Motor equivalent circuit diagram data

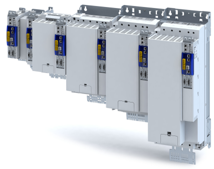
The motor equivalent circuit diagram data is automatically set when the motor is selected from the motor catalogue:

▶ Select motor from motor catalogue 🕮 39

If you use a motor of a different manufacturer, you must adapt the data, e. g. from the motor data sheet according to the sizes and units mentioned if required.

Parameter

Address	Name / setting range / [default setting]		Info
0x2822:024	Axis commands: Estimate motor parameter based on rated data		Parameters for interaction with engineering tools.
	0	**Off/Ready**	Obtain Hiperface information from the encoder for application feedback.
	1	On/Start	
	2	In process	
	3	Action cancelled	
	4	No access	
	5	No access (controller inhibit)	
0x2832	Motor identification status • Read only		Display of the status for the automatic identification of the motor parameters. Parameters for interaction with engineering tools.
	Bit 0	Identification enabled	Parameters for interaction with engineering tools.
	Bit 1	Identification active	
	Bit 2	Identification completed	
	Bit 3	Identification failed	
0x2C01:002	Motor parameters: Stator resistance 0.0000 ... [**13.5000**] ... 125.0000 Ω		General motor data. Carry out settings as specified by manufacturer data/motor data sheet. Note! When you enter the motor nameplate data, take into account the phase connection implemented for the motor (star or delta connection). Only enter the data applying to the connection type selected.
0x2C01:003	Motor parameters: Stator leakage inductance 0.000 ... [**51.000**] ... 500.000 mH		
0x2C01:009	Motor parameters: Insulation class		Insulation class of the motor (see motor nameplate).
	0	Y (cut-off temperature = 90 °C)	
	1	A (cut-off temperature = 105 °C)	
	2	E (cut-off temperature = 120 °C)	
	3	B (cut-off temperature = 130 °C)	
	4	**F (cut-off temperature = 155 °C)**	
	5	H (cut-off temperature = 180 °C)	
	6	G (cut-off temperature > 180 °C)	
0x2C02:001	Motor parameter (ASM): Rotor resistance 0.0000 ... [**0.0000**] ... 214748.3647 Ω		Equivalent circuit data required for the motor model of the asynchronous machine.
0x2C02:002	Motor parameter (ASM): Mutual inductance 0.0 ... [**0.0**] ... 214748364.7 mH		
0x2C02:003	Motor parameter (ASM): Magnetising current 0.00 ... [**0.00**] ... 500.00 A		
0x2C03:001	Motor parameter (PSM): Back EMF constant 0.0 ... [**41.8**] ... 100000.0 V/1000rpm		Voltage induced by the motor (rotor voltage / 1000 rpm). For permanently excited synchronous motors, the e.m.f. constant describes the r.m.s. value of the line-to-line voltage (phase voltage) induced in idle state by the motor (reference: 1000 rpm, 20 °C).
0x2C03:002	Motor parameter (PSM): Resolver pole position -179.9 ... [**-90.0**] ... 179.9 °		Equivalent circuit data required for the motor model of the synchronous machine.
0x2C03:003	Motor parameter (PSM): Magnets temperature coefficient (kTN) -1.000 ... [**-0.110**] ... 0.000 %/°C		
0x2C03:004	Motor parameter (PSM): Encoder pole position -179.9 ... [**0.0**] ... 179.9 °		



13.6.5 Motor control settings

13.6.5.1 Speed controller

The speed controller is automatically set when the motor has been selected from the motor catalogue:

▸ Select motor from motor catalogue 📖 39

The automatically calculated settings for the speed controller enable an optimal control behaviour for typical load requirements.

Manual post-optimisation of the speed controller

1. Setting of the gain

   Set the proportional gain V_p in parameter 0x2900:001.

   a) Specify speed setpoint.
   b) Increase parameter until the drive gets unstable (observe engine noise). ▸ 0x2900:001
   c) Reduce parameter until the drive runs stable again. ▸ 0x2900:001
   d) Reduce the parameter to approx. half the value. ▸ 0x2900:001

2. Setting of the reset time

   Set the reset time T_n in parameter 0x2900:002.

   a) Reduce parameter until the drive gets unstable (observe engine noise). ▸ 0x2900:002
   b) Increase parameter until the drive runs stable again. ▸ 0x2900:002
   c) Increase parameter to approx. double the value. ▸ 0x2900:002

3. Setting of the rate time

   Set the rate time T_d in parameter 0x2900:003.

   a) Increase parameter during operation until an optimal control mode is achieved. ▸ 0x2900:003

Automatically calculated settings for the speed controller

We recommend a manual post-optimisation for the optimal operation.

The function for automatically calculating the gain and reset time is executed via the parameter 0x2822:014.

The following equations apply to a "rigid" system.

- For elastic systems and systems with batches, the determined gain must be reduced.
- The moment of inertia required for the calculation is the sum of the moment of inertia of the motor and the load mass inertias transformed to the motor side.

Equation for calculating the gain

$$V_p = \frac{J}{a \cdot \left(T_{Filter} + T_{Stromregler}\right)} \cdot \frac{2\pi}{60}$$

Equation for calculating the reset time

$$T_n = a^2 \cdot \left(T_{Filter} + T_{Stromregler}\right)$$

Parameter	Symbol	Description	Dimension unit
0x2900:001	V_p	Speed controller gain	Nm / rpm
-	J	Moment of inertia = J_{motor} + sum (J_{load})	kgm^2
-	a	Measure for the phase reserve (recommendation: a = 4≡ 60° phase reserve)	
0x2904	T_{Filter}	Filter time constant - actual speed value	s
-	$T_{current\ controller}$	Equivalent time constant of the current control loop = 0.0005 s	s
0x2900:002	T_n	Reset time - speed controller	s

Special case of the linear motor

In this case, a re-calculation from a linear system to a rotary system must be made. Therefore, via the feedback system a degree of freedom results for the determination of the number of pole pairs. For a rotary system, the number of pole pairs specifies the ratio of electrical and mechanical revolution, the number of encoder increments being defined via one mechanical revolution. In the case of a linear system, the user is free to decide for which length he or she wants to specify the number of encoder increments. Usually, the number of increments is given for a pole distance or for the total length of the linear scale. If the number of increments = "number of increments for one pole distance" is selected, a motor with the number of pole pairs zp = 1 is created. The effective moment of inertia for a linear motor can be calculated according to the following equations. With this J value, the equations shown above can be used to calculate the speed controller gain and reset time.

Equation for calculating the effective moment of inertia

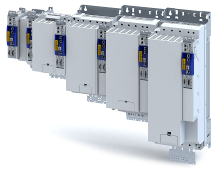
$$J = m \cdot \left(\frac{zp \cdot 2 \cdot \tau_{Polpaar}}{2\pi}\right)^2$$

$$zp = \mathrm{Ganzzahl} \cdot \frac{s}{2 \cdot \tau_{Polpaar}}$$

Parameter	Symbol	Description	Dimension unit
-	s	Length on which the specification for the number of encoder increments is based (e.g. per pole distance or total length).	m
-	$2\ \tau_{Pole\ pair}$	Pole distance of the permanent magnets, pole pair width	m
-	J	Moment of inertia = J_{Forcer} + J_{Slide} + J_{Load}	kgm^2
-	m	Moving mass = m_{Forcer} + m_{Slide} + m_{Load}	kg

Parameter

Address	Name / setting range / [default setting]	Info
0x2900:001	Speed controller settings: Gain 0.00000 ... [**0.00033**] ... 20000.00000 Nm/rpm	Gain factor Vp of the speed controller.
0x2900:002	Speed controller settings: Reset time 1.0 ... [**17.6**] ... 6000.0 ms	Reset time Ti of the speed controller.
0x2900:003	Speed controller settings: Rate time 0.00 ... [**0.00**] ... 3.00 ms	Setting of the rate time for the speed controller.
0x2901	Speed controller gain adaption 0.00 ... [**100.00**] ... 200.00 %	Mappable parameter for adaptive adjustment of the speed controller gain.



Address	Name / setting range / [default setting]	Info
0x2902	I component load value -1000.0 ... [**0.0**] ... 1000.0 %	Setting of the load value.
0x2903	Speed setpoint filter time 0.0 ... [**0.0**] ... 50.0 ms	Time constant for the speed setpoint filter.
0x2904	Actual speed filter time 0.0 ... [**0.3**] ... 50.0 ms	Time constant for the actual speed value filter.

13.6.5.2 Current controller

The current controller consists of a direct-axis current controller and a cross current controller which are both parameterised identically. The direct-axis current controller controls the field-producing current (D current). The cross current controller controls the torque-producing current (Q current).

For a servo control, the current controller should always be optimised if a motor of another manufacturer with unknown motor data is used! For a V/f characteristic control, the current controller only has to be optimised if voltage vector control Activate voltage vector control (Imin controller) is used, or if DC-injection braking or the flying restart process is activated.

Automatically calculated settings for the current controller

If one of the values calculated exceeds the upper object limit, the value is limited to the limit value.

There is a coupling between the two control loops (direct-axis current controller, cross current controller) which makes every actuation of a controller occur as fault in the control loop of the other controller. This coupling can be compensated by activating the current controller feedforward control via object 0x2941.

For the automatic calculation of the two controller parameters (gain and reset time), the "Calc. current contr. param." function is provided via object 0x2822:013. The calculating function is based on the stator resistance 0x2C01:002 and the stator leakage inductance 0x2C01:003. Thus, these motor parameters must be parameterised before, e. g. by entering the data sheet values manually. Subsequently, the calculated controller parameters can be optimised by means of an experimental adjustment. The procedure is described in the following section Manual "current pulse" test mode . 📖 271

Equation for calculating the gain of the synchronous motor

$$V_p = \frac{L_{ss}}{T_{Totzeit}}$$

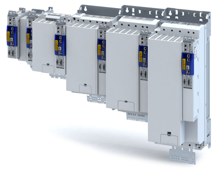
Equation for calculating the reset time of the synchronous motor

$$T_n = \frac{L_{ss}}{R_s}$$

Parameter	Symbol	Description	Dimension unit
0x2942:001	V_p	Current controller gain	V/A
0x2C01:003	L_{ss}	Stator leakage inductance	H
-	$T_{Dead\ time}$	Equivalent time constant for the analog detection and scanning = 0.00009375 s (93.75 µs)	s
0x2942:002	T_n	Current controller reset time	s
0x2C01:002	R_s	Stator resistance (value at 20° C)	Ω

Equation for calculating the gain of the asynchronous motor

$$V_p = \frac{\sigma \cdot L_s}{T_{Totzeit}} \approx \frac{2 \cdot L_{ss}}{T_{Totzeit}}$$



Equation for calculating the reset time of the asynchronous motor

$$\tau_n = \frac{\sigma \cdot L_s}{R_s} \approx \frac{2 \cdot L_{ss}}{R_s}$$

Parameter	Symbol	Description	Dimension unit
0x2942:001	V_p	Current controller gain	V/A
-	σ	Leakage	
-	L_s	Motor stator inductance	H
0x2C01:003	L_{ss}	Motor stator leakage inductance	H
-	$T_{\text{Dead time}}$	Equivalent time constant for the analog detection and scanning = 0.00034 s	s
0x2942:002	T_n	Current controller reset time	s
0x2C01:002	R_s	Motor stator resistance (value at 20° C)	Ω

Parameter

Address	Name / setting range / [default setting]	Info
0x2941	Current controller feedforward control **0 Disable** 1 Enable	Activate/deactivate feedforward control. Since the actuation of the current controller is known, they can be pre-controlled to increase the actuations of the current controller. Note! For a feedforward control, the Motor equivalent circuit diagram data must be known. If only estimated values are available, we recommend you not to activate the feedforward control.
0x2942:001	Current controller parameters: Gain 0.00 ... [**148.21**] ... 750.00 V/A	Gain factor Vp of the current controller.
0x2942:002	Current controller parameters: Reset time 0.01 ... [**3.77**] ... 2000.00 ms	Reset time Ti of the current controller.
0x2943	Current setpoint filter time 0.00 ... [**0.00**] ... 10.00 ms	Setting of the setpoint current filter time.

13.6.5.3 ASM field controller

For motors with great rotor time constants or small rotor resistances, very high gain factors are calculated. Since the setting range of the field controller is limited to the double rated magnetising current, the field control loop in the case of these motors tends to a two-point response when the values calculated are entered.

The automatic calculation is made via the parameter 0x2822:016 = 1.

Starting from a calculated gain factor of approx. 1000 A/Vs, do not set the full value anymore.

Example

Calculated value: 10000 A/Vs

Setting: 3000 A/Vs

Calculation of the gain

$$V_p \approx \frac{1}{4 \cdot R_r \cdot T_{Stromregler}}$$

Calculation of the reset time

$$T_n = T_r = \frac{L_r}{R_r}$$

Parameter	Symbol	Description	Dimension unit
0x29C0:001	V_p	Field controller gain	A/Vs
0x29C0:002	T_n	Field controller reset time	s
0x2C02:002	L_h	Mutual motor inductance (ASM)	H
0x2C02:001	R_r	Motor rotor resistance (ASM)	Ω
-	$T_{current\ controller}$	Equivalent time constant of the current control loop = 0.0005 s	
-	T_r	Motor rotor time constant	
-	K_{Path}	Gain of the control path	
-	L_r	Motor rotor resistance (ASM)	H

Parameter

Address	Name / setting range / [default setting]	Info
0x29C0:001	Field controller settings: Gain 0.00 ... [**165.84**] ... 50000.00 A/Vs	Gain factor Vp of the field controller.
0x29C0:002	Field controller settings: Reset time 1.0 ... [**15.1**] ... 6000.0 ms	Reset time Tn of the field controller.

13.6.5.4 ASM field weakening controller

Since the controlled system gain changes with the speed, the field weakening controller is corrected via the speed.

The automatic calculation is made via the parameter 0x2822:017 = 1.

Calculation of the gain

$$V_p = 0, \qquad V_{Strecke\_Fs} = p \cdot n_{eck} \cdot \frac{2\pi}{60}$$

Calculation of the reset time

$$T_n = 4 \cdot \frac{V_{Strecke\_Fs}}{60} \cdot \left(T_{EF} + T_{Filter}\right), \qquad T_{EF} = T_r = \frac{L_r}{R_r} \approx \frac{L_h + L_{ss}}{R_r}$$

Parameter	Symbol	Description	Dimension unit
0x29E0:001	V_p	Gain of the field weakening controller	Vs / A
-	V_{Path_Fs}	Gain of the control path	
-	P	Number of pole pairs	rpm
-	$n_{transition}$	Speed at which the field weakening is approximately initiated.	
0x29E0:002	T_n	Reset time of the field weakening controller	s
-	T_{EF}	Filter time constant of the field control loop	
0x29E3	T_{Filter}	Filter time constant for the required voltage	s
-	T_r	Motor rotor time constant	
-	L_r	Motor rotor resistance (ASM)	
0x2C02:002	L_h	Mutual motor inductance (ASM)	H
0x2C01:003	L_{ss}	Motor stator leakage inductance (ASM) or motor leakage inductance (SM)	H
0x2C02:001	R_r	Motor rotor resistance	Ω

Parameter

Address	Name / setting range / [default setting]	Info
0x29E0:001	Field weakening controller settings: Gain (ASM) 0.000 ... [**0.000**] ... 2147483.647 Vs/V	Gain factor Vp of the field weakening controller.
0x29E0:002	Field weakening controller settings: Reset time (ASM) 1.0 ... [**2000.0**] ... 240000.0 ms	Reset time Tn of the field weakening controller.
0x29E1	Field weakening controller Field limitation 5.00 ... [**100.00**] ... 100.00 %	Field limitation of the field weakening controller.

13.6.5.5 ASM field weakening controller (extended)

For a quick commissioning, the calculations and settings are made automatically during the optimisation.

Parameter

Address	Name / setting range / [default setting]	Info
0x29E2	DC-bus filter time 1.0 ... [**25.0**] ... 1000.0 ms	Filter time for the current DC-bus voltage used for field weakening.
0x29E3	Motor voltage filter time 1.0 ... [**25.0**] ... 1000.0 ms	Filter time for the current motor voltage used for field weakening.
0x29E4	Voltage reserve range 1 ... [**5**] ... 20 %	Voltage reserve at the transition point to the field weakening, with reference to the current value of the DC-bus voltage. Only relevant for: • Servoregelung (SC-PSM) (0x2C00 = 1) • Servo control (SC ASM) (0x2C00 = 2)

13.6.5.6 PSM field weakening controller

The inverter control enables a synchronous motor to be operated outside the voltage range. If a motor is selected in the »EASY Starter«, the control is parameterised automatically.

Improve the transition from the base speed range to field weakening by activating the **current controller: feedforward control** parameter. ▶ 0x2941

- The current controller precontrol is defined via the following parameters:
  - Motor parameter: stator resistance ▶ 0x2C01:002
  - Motor parameter: stator leakage inductance ▶ 0x2C01:003
  - Motor parameter (PSM): back EMF constant ▶ 0x2C03:001
- If you want to operate a third-party motor in the field weakening range, you have to determine the parameters previously mentioned

Operation of synchronous motors outside the voltage range:

If pulse inhibit is set in the inverter, e.g. in case of an inverter disable or an error, the DC bus is loaded in accordance with the current speed (see equation).

• At high speed and outside the voltage range, the terminal voltage can be higher than the mains voltage!

• In order to prevent the DC bus from being loaded impermissibly high, connect a brake chopper to the DC bus!

The terminal voltage corresponds to the following equation

$$U_K = n * \frac{U_N}{n_M}$$

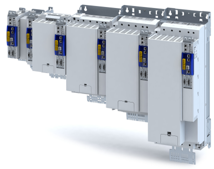
V_K	Terminal voltage
n	Speed
V_{rated}	Rated mains voltage
n_m	Rated motor voltage

- Mains settings: rated mains voltage ▶ 0x2540:001
- Motor parameter: rated speed ▶ 0x2C01:004

Delaying the buildup of field weakening

With the default setting (5 %), field weakening is initiated, thus ensuring that a punctual buildup of the field weakening current shortly before the voltage threshold is reached.

In the case of synchronous motors, setting the **Voltage reserve range** parameter may bring about a delayed start of field weakening for synchronous machines, e.g in order to slightly reduce the thermal load of the motor. ▶ 0x29E4



13.6.5.7 Imax controller

Defining the behaviour at the current limit (Imax controller)

The maximum output current or the current limit is defined by the 0x6073 "max. current" parameter. In case of the V/f characteristic control, an Imax controller is implemented for complying with this limit. If the motor current exceeds the set maximum current, the Imax controller is activated.

- The Imax controller changes the rotating field frequency so that the motor current does not exceed the current limit. In motor mode, the frequency is reduced and in generator mode it is increased.
- The gain and reset time of the Imax controller can be parameterised.

Optimising the Imax controller

The automatic calculation serves to determine starting parameters of the Imax controller which are sufficient for many applications. Thus, an optimisation is not required for most of the applications.

The automatic calculation is made via the parameter 0x2822:019 = 1.

The parameters of the Imax controller must be adapted if

- a power control is implemented with great moments of inertia.

  Recommendation:

  Step 1: increase reset time in ▶ 0x2B08:002

  Step 2: reduce gain in ▶ 0x2B08:001
- vibrations occur with V/f characteristic control during the operation of the Imax controller.

  Recommendation:

  Step 1: increase reset time in ▶ 0x2B08:002

  Step 2: reduce gain in ▶ 0x2B08:001
- overcurrent errors occur due to load impulses or too high acceleration/deceleration ramps.

  Recommendation:

  Step 1: reduce reset time in ▶ 0x2B08:001

  Step 2: increase gain in ▶ 0x2B08:002

Parameter

Address	Name / setting range / [default setting]	Info
0x2B08:001	V/f Imax controller: Gain 0.000 ... [**0.001**] ... 1000.000 Hz/A	Gain factor Vp of the Imax controller.
0x2B08:002	V/f Imax controller: Reset time 1.0 ... [**100.0**] ... 2000.0 ms	Reset time Ti of the Imax controller.

13.6.5.8 Flying restart controller

Parameter

Address	Name / setting range / [default setting]	Info
0x2BA1	Flying restart circuit 0 ... [**15**] ... 100 %	

13.6.5.9 Position controller

Equation for calculating the gain

The automatic calculation is made via the parameter 0x2822:015 = 1.

$$V_p = \frac{1}{32 \cdot T_{Summe}}, \qquad T_{Summe} = T_{Filter} + T_{Stromregler}$$

Parameter	Symbol	Description	Dimension unit
0x2980	V_p	Position controller gain	Hz
0x2985:001 ... 0x2985:011	$V_p(n)$	Speed-dependent V_p adaptation	
0x2904	T_{Filter}	Filter time constant - actual speed value	s
-	$T_{current\ controller}$	Equivalent time constant of the current control loop = 0.0005 s (500 µs)	s

Instability of the position control loop due to too high dynamic performance of the speed controller

The following countermeasure must be taken if the following error cannot be reduced to acceptable values while setting the position controller:

1. Reduce speed controller by the factor 2 and slowly increase the position controller until it gets slightly unstable again.
2. Reduce the position controller slightly and increase the speed controller until the position control loop gets slightly unstable again.
3. Repeat these steps until the following error is reduced to acceptable values.

Parameter

Address	Name / setting range / [default setting]		Info
0x2980	Position controller gain 0.00 ... [**28.40**] ... 1000.00 Hz		Setting of the position controller gain.
0x2981	Position controller gain adaption 0.00 ... [**100.00**] ... 200.00 %		Setting of the percentage adaptation for the position controller gain.
0x2982	Position controller output signal limitation 0.00 ... [**480000.00**] ... 480000.00 rpm		Setting of the output signal limitation.
0x2983	Actual position start value -2147483647 ... [**0**] ... 2147483647 pos. unit		Specifying a new actual position.
0x2984	Mode for setting the actual position		Selection of the mode for setting or shifting the actual position.
	0	**Absolute**	Actual position = Actual position start value (0x2983)
	1	Relative	Actual position = actual position + Actual position start value (0x2983)
0x2986	Resulting gain adaption • Read only: x.xx %		Display of the resulting gain after being adapted.

13.7 Fine adjustment of the motor model

The further commissioning steps are only required for servo controls if more stringent requirements with regard to the torque linearity have to be met. During the commissioning process of Lenze motors, typical values for the relevant parameters are provided. For motors of other manufacturers, these values are to be requested from the motor manufacturer, or they have to be estimated.

13.7.1 Correction of the stator leakage inductance (Lss)...

...and the current controller parameters by means of the saturation characteristic

For the most part, the electrical characteristics of the motor are the relevant factors for an optimal current controller setting (Vp, Ti), especially the stator resistance and the stator leakage inductance (Lss). However, modern motors have their stator leakage inductance changed along with the current level so that it is impossible to have an optimal current controller setting for all working points at all times.

For applications with operating phases that involve very different current and torque requirements and, at the same time, high requirements on dynamic drive behaviour, the i700 servo inverter provides the possibility of the correction of the stator leakage inductance and the current controller settings by means of the adjustable saturation characteristic.

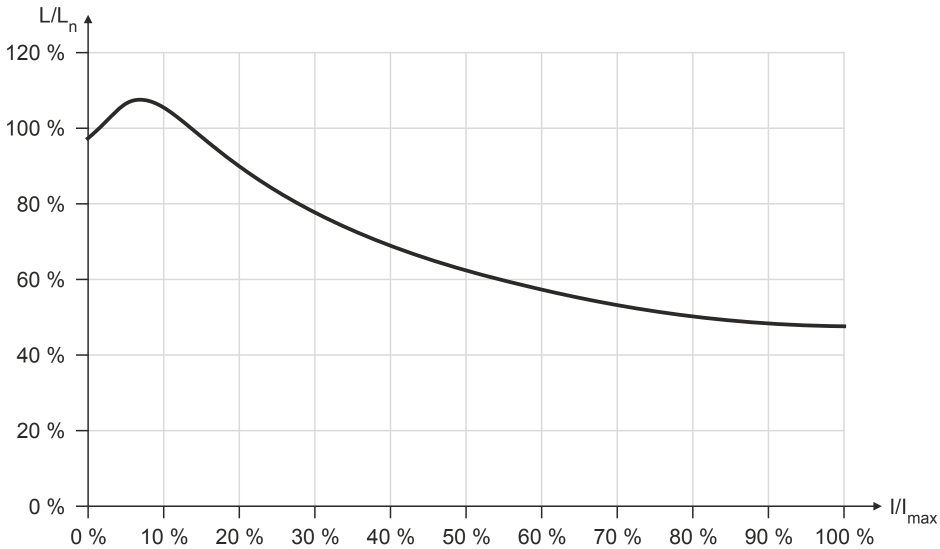
The saturation characteristic is a typical characteristic of motors of one type/size. It does not depend on the maximum process current of the motor in the prevailing application. Thus the defined values should be based on the key data of the motors. These are rated motor current, peak motor current for a limited time and the ultimate motor current.

NOTICE

Impact of the saturation characteristic on the current controller feedforward control

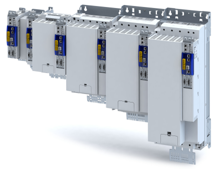
► The saturation characteristic is not only used to correct the current controller, but it also influences the current controller feedforward control (can be activated via parameter 0x2941).

The following picture shows a typical saturation characteristic of an MCS motor:



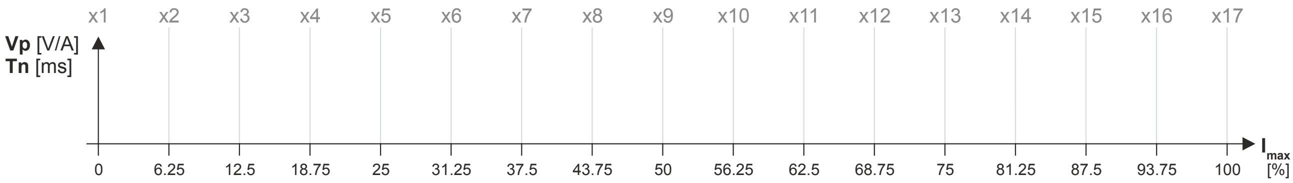
The saturation characteristic represents the change in inductance (L/Ln) as a function of the motor current (I/Imax). The variables of both axes which were scaled to a reference value are represented as percentages.

- When a Lenze motor is selected, the saturation characteristic is already filled with values typical of the series.



Distribution of the grid points

- The saturation characteristic is represented by 17 grid points.
- The 17 grid points are spaced on the X axis at equal intervals (equidistantly) in a range of 0 ... 100 %. The 100% value of the X axis refers to the current value (max. motor current in the process) set in parameter 0x2C05.
- The y values for the grid points can be accessed via the subindices of parameter .



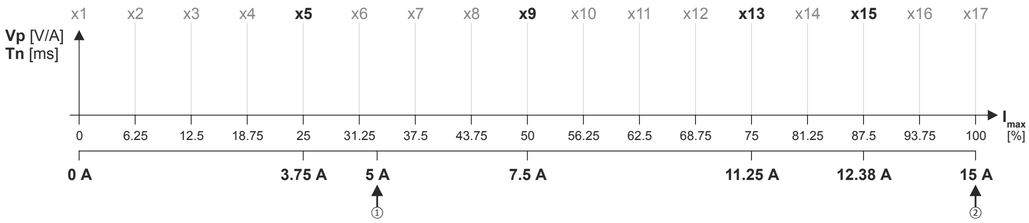
- The 100 % value of a grid point refers to
  - the set motor stator leakage inductance 0x2C01:003 and
  - the set current controller gain V_p 0x2942:001.
- Preferably select a display area of the grid points which includes at least the ultimate motor current. The current controller step response is then recorded actively only until the grid point with peak motor current. In order to prevent the motor winding from being overloaded, use the manual test mode "current pulse" for recording: ▶ Manual "current pulse" test mode. 📖 271
- The grid points with current setpoints above the peak motor current are determined through interpolation.
- When the saturation characteristics for motor types are determined, it makes sense in some cases to select a scaled representation of the grid point distribution. This requires to know the highest value of the quotient from "ultimate motor current / rated motor current" of the motor series.

Example of determining the saturation characteristic
Given values:

- Rated motor current: 5 A
- Maximum motor current: 20 A
- Maximum process current: 15 A

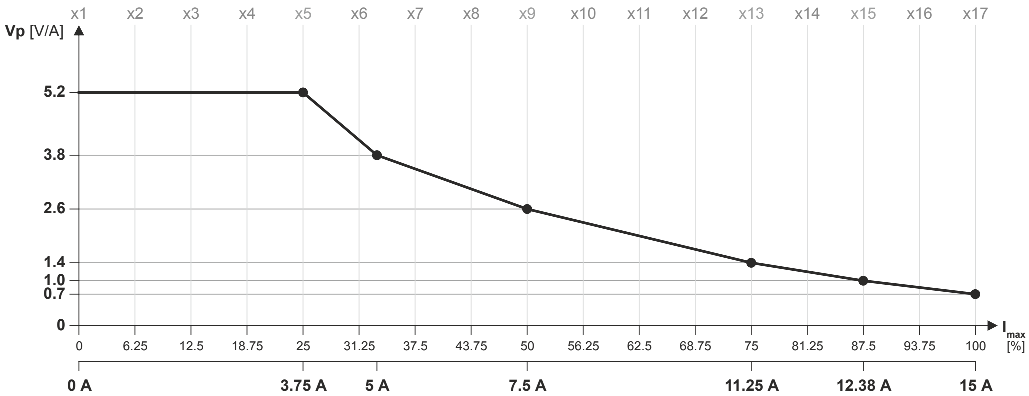
Proceeding

1. Deactivate correction: Set all subindices (0x2C04:001 ... 0x2C04:017) to 100 %.
2. Use 0x2C05 to set the maximum current up to which the motor is to be operated in the process (in this example "15 A").
3. Adjust the current controller with different current setpoints by means of the manual test mode Manual "current pulse" test mode and take down the corresponding settings for Vp and Tn.
    - The procedure is described in section Manual "current pulse" test mode.
    - The current setpoints to be set for the corresponding adjustment in object 0x2835:001 result from the scaling of the maximum process current to the X axis of the saturation characteristic.
    - The grid points which are required to define the saturation characteristic with a sufficient quality varies from motor to motor and thus has to be determined individually.
    - For this example, currents that are part of the grid points 5, 9, 13, and 15 have been selected, and a measurement at rated motor current was carried out additionally:

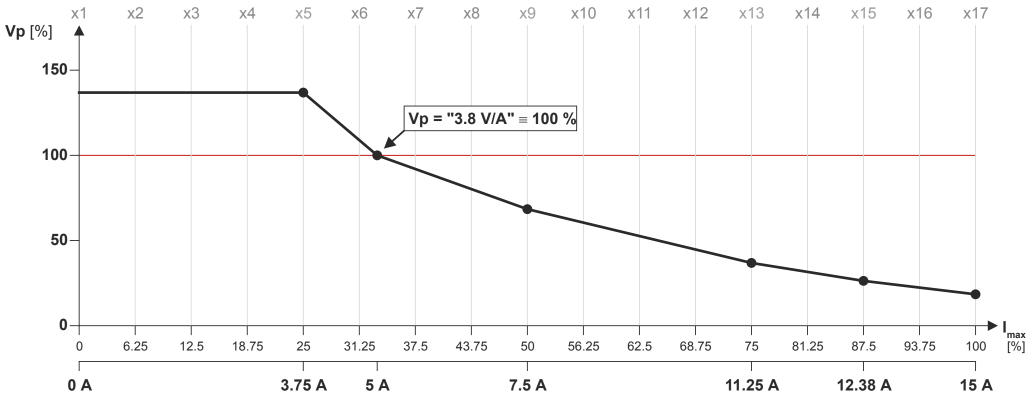


See table "Specifications for adjustment / measured values" after this listing

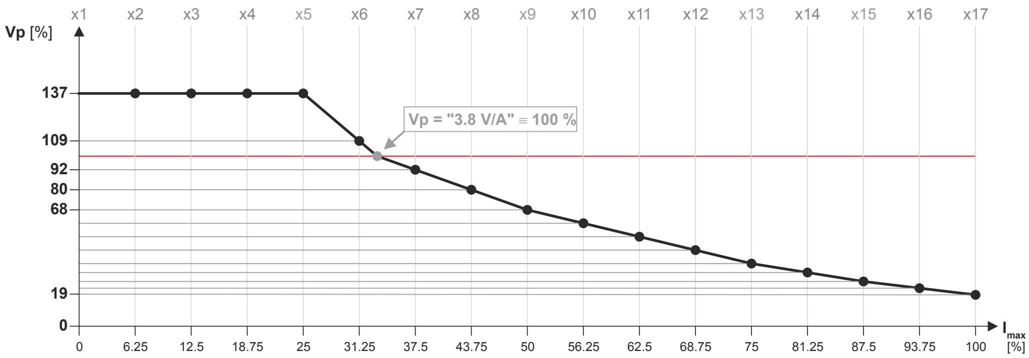
4. Create a characteristic based on the detected values for Vp (but do not enter any values in yet).
    - Determine the values of the grid points that have not been adjusted by interpolation between two values.
    - **Note:** This example assumes that the inductance does not change considerably below 3.75 A. For this reason, the same Vp value that resulted from the measurement with a motor current of 3.75 A was used for all grid points below 3.75 A.



5. Set gain Vp and reset time Tn to the values that were determined during the adjustment with the rated motor current (in this example "5 A"):
    - 0x2942:001 is set to "3.8 V/A".
    - 0x2942:002 is set to "5 ms".
6. Scale Vp values on the Y axis of the characteristic to the Vp setting "3.8 V/A":



7. Enter the percentage Vp values of the grid points into the subindices (0x2C04:001 ... 0x2C04:017):



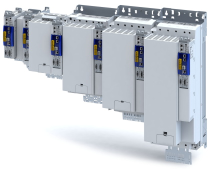
See table "Setting of grid point 1 ... 17 in [%]" after this listing

8. Enter the maximum process current ("15 A") in 0x6073 as the maximum current.
   - The settings made should now cause the same basic current characteristic irrespective of the current level.
   - Now that the current controller gain is actively corrected, the step responses may slightly differ from the previous measurements. In this case, the current controller parameters must be post-optimised for the last time.
9. For permanent storage: save the characteristic determined.

   The »EASY Starter« serves to save the parameter settings of the inverter as parameter file (*.gdc). Saving the parameter settings

Specifications for adjustment			**Measured values**	
Grid point	**Scaling**	**Current setpoint**	**Vp [V/A]**	**Tn [ms]**
5	0.25 * 15 A =	3.75 A	5.2	6.5
9	0.5 * 15 A =	7.5 A	2.6	4
13	0.75 * 15 A =	11.25 A	1.4	2.5
15	0.875 * 15 A =	12.38 A	1.0	2
17	1.0 * 15 A =	15 A	0.7	1.7
Rated motor current=		5 A	3.8	5

Setting of grid point 1 ... 17 in [%]																
y1	**y2**	**y3**	**y4**	**y5**	**y6**	**y7**	**y8**	**y9**	**y10**	**y11**	**y12**	**y13**	**y14**	**y15y**	**y16**	**y17**
137	137	137	137	137	109	92	80	68	61	53	45	37	32	26	22	19



Parameter

Address	Name / setting range / [default setting]	Info
0x2C04:001	Inductance grid points (y) Lss saturation characteristic: y1 = L01 (x = 0.00 %) 0 ... [**165**] ... 400 %	Saturation characteristic of the leakage inductance. The linear distribution via the current results from the maximum motor current (0x2C05).
0x2C04:002	Inductance grid points (y) Lss saturation characteristic: y2 = L02 (x = 6.25 %) 0 ... [**200**] ... 400 %	
0x2C04:003	Inductance grid points (y) Lss saturation characteristic: y3 = L03 (x = 12.50 %) 0 ... [**146**] ... 400 %	
0x2C04:004	Inductance grid points (y) Lss saturation characteristic: y4 = L04 (x = 18.75 %) 0 ... [**117**] ... 400 %	
0x2C04:005	Inductance grid points (y) Lss saturation characteristic: y5 = L05 (x = 25.00 %) 0 ... [**97**] ... 400 %	
0x2C04:006	Inductance grid points (y) Lss saturation characteristic: y6 = L06 (x = 31.25 %) 0 ... [**82**] ... 400 %	
0x2C04:007	Inductance grid points (y) Lss saturation characteristic: y7 = L07 (x = 37.50 %) 0 ... [**71**] ... 400 %	
0x2C04:008	Inductance grid points (y) Lss saturation characteristic: y8 = L08 (x = 42.75 %) 0 ... [**62**] ... 400 %	
0x2C04:009	Inductance grid points (y) Lss saturation characteristic: y9 = L09 (x = 50.00 %) 0 ... [**55**] ... 400 %	
0x2C04:010	Inductance grid points (y) Lss saturation characteristic: y10 = L10 (x = 56.25 %) 0 ... [**50**] ... 400 %	
0x2C04:011	Inductance grid points (y) Lss saturation characteristic: y11 = L11 (x = 62.50 %) 0 ... [**46**] ... 400 %	
0x2C04:012	Inductance grid points (y) Lss saturation characteristic: y12 = L12 (x = 68.75 %) 0 ... [**43**] ... 400 %	
0x2C04:013	Inductance grid points (y) Lss saturation characteristic: y13 = L13 (x = 75.00 %) 0 ... [**42**] ... 400 %	
0x2C04:014	Inductance grid points (y) Lss saturation characteristic: y14 = L14 (x = 81.25 %) 0 ... [**41**] ... 400 %	
0x2C04:015	Inductance grid points (y) Lss saturation characteristic: y15 = L15 (x = 87.50 %) 0 ... [**41**] ... 400 %	
0x2C04:016	Inductance grid points (y) Lss saturation characteristic: y16 = L16 (x = 93.25 %) 0 ... [**41**] ... 400 %	
0x2C04:017	Inductance grid points (y) Lss saturation characteristic: y17 = L17 (x = 100.00 %) 0 ... [**41**] ... 400 %	
0x2C04:018	Inductance grid points (y) Lss saturation characteristic: Activation Lss saturation characteristic	Switch on/off the correction by means of saturation characteristic.
	0 Adjustment off	
	1 Adjustment on	
0x2C05	Reference for current grid points (x) Lss saturation characteristic 0.0 ... [**5.4**] ... 500.0 A	Setting of the maximum motor current. Serves as reference value for the scaled current data of the X axis of the saturation characteristic.

13.7.2 Synchronous motor (SM): Compensate temperature and current influences

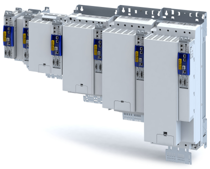
The properties of the permanent magnets of permanently excited synchronous motors depend on the temperature and the amperage. The relationship between motor current and resulting torque changes correspondingly.

The influences of the temperature and the amperage on the magnetisation can be taken into account by the motor control and hence be compensated for.

- To compensate for the temperature dependence of the magnets, the temperature coefficient (kT) of the permanent magnet must be entered in object 0x2C03:003 (linear characteristic).
- To compensate for the current dependence of the magnets, multiple grid points of a characteristic must be entered in the following object (non-linear characteristic):

Parameter

Address	Name / setting range / [default setting]	Info
0x2C06:001	Grid points for magnet characteristic (current): x1 = i01/iN 0 ... [**0**] ... 1000 %	Characteristic for the dependency of the magnetic flux on the active motor current.
0x2C06:002	Grid points for magnet characteristic (current): y1 = kT01/kTN 0 ... [**100**] ... 1000 %	
0x2C06:003	Grid points for magnet characteristic (current): x2 = i02/iN 0 ... [**100**] ... 1000 %	
0x2C06:004	Grid points for magnet characteristic (current): y2 = kT02/kTN 0 ... [**100**] ... 1000 %	
0x2C06:005	Grid points for magnet characteristic (current): x3 = i03/iN 0 ... [**200**] ... 1000 %	
0x2C06:006	Grid points for magnet characteristic (current): y3 = kT03/kTN 0 ... [**100**] ... 1000 %	
0x2C06:007	Grid points for magnet characteristic (current): x4 = i04/iN 0 ... [**415**] ... 1000 %	
0x2C06:008	Grid points for magnet characteristic (current): y4 = kT04/kTN 0 ... [**72**] ... 1000 %	



13.7.3 Asynchronous motor (ASM): Identify Lh saturation characteristic

In case of an asynchronous motor, the relationship between current and torque is basically determined by the saturation behaviour of the mutual inductance. If the achieved torque accuracy, especially in the field weakening range should not be sufficient, the accuracy can be increased by the individual identification of the saturation characteristic. This behaviour can be measured by the servo inverter.

Conditions for the execution

- Before this commissioning function is executed, the inverter characteristic and the motor parameters must be identified ▶ Motor equivalent circuit diagram data. 📖 229
- The motor may be stalled.
- The inverter is error-free and in "Switched on" device state.

Response of the motor during "standstill" performance

How to identify the L_h saturation characteristic:

The identification of the L_h saturation characteristic can take up to 11 minutes.

1. If the servo inverter enabled, disable it .
2. Select the drive mode [10] in parameter 0x2825: Lh saturation characteristic identification
3. Enable the inverter to start the process.
   - Check the progress in 0x2823:002.
   - Disabling the inverter serves to abort the started procedure any time if required. Already determined characteristic values are rejected in this case.

After successful completion...

...the inverter will be disabled automatically and the points of the determined L_h saturation characteristic are set in the parameters 0x2C07:001 ... 0x2C07:017.

- Save the changed settings.

  The »EASY Starter« serves to save the parameter settings of the servo inverter as parameter file (*.gdc). ▶ Saving the parameter settings 📖 36
- The inverter disable set automatically by the procedure can be deactivated again via the CiA402 control word 0x6040 (setting = 7, 15).

In the event of an error

If an error occurs during the procedure or the pulse inhibit gets active (e.g. due to short-time undervoltage), the procedure is terminated with inverter disable without the settings being changed.

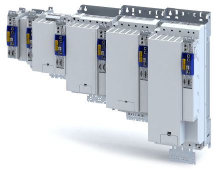
Load standard L_h saturation characteristic

If an incorrect L_h saturation characteristic has been determined or none at all, it is possible to load a standard L_h characteristic.

How to load the standard L_h saturation characteristic:

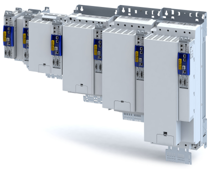
1. The start is made via the parameter 0x2822:021 = 1.
2. For permanent storage: after the process has been completed, save the L_h saturation characteristic set in .

   The »EASY Starter« serves to save the parameter settings of the inverter as parameter file (*.gdc). Saving the parameter settings



Parameter

Address	Name / setting range / [default setting]		Info
0x2822:021	Axis commands: Load default Lh saturation characteristic		Parameters for interaction with engineering tools.
	0	**Off/Ready**	Obtain Hiperface information from the encoder for application feedback.
	1	On/Start	
	2	In process	
	3	Action cancelled	
	4	No access	
	5	No access (controller inhibit)	
0x2C07:001	Inductance grid points (y) Lh saturation characteristic: y1 = L01 (x = 0.00 %) 0 ... [**118**] ... 400 %		Saturation characteristic of the mutual inductance of an asynchronous machine as a function of the magnetising current.
0x2C07:002	Inductance grid points (y) Lh saturation characteristic: y2 = L02 (x = 6.25 %) 0 ... [**118**] ... 400 %		
0x2C07:003	Inductance grid points (y) Lh saturation characteristic: y3 = L03 (x = 12.50 %) 0 ... [**118**] ... 400 %		
0x2C07:004	Inductance grid points (y) Lh saturation characteristic: y4 = L04 (x = 18.75 %) 0 ... [**117**] ... 400 %		
0x2C07:005	Inductance grid points (y) Lh saturation characteristic: y5 = L05 (x = 25.00 %) 0 ... [**116**] ... 400 %		
0x2C07:006	Inductance grid points (y) Lh saturation characteristic: y6 = L06 (x = 31.25 %) 0 ... [**114**] ... 400 %		
0x2C07:007	Inductance grid points (y) Lh saturation characteristic: y7 = L07 (x = 37.50 %) 0 ... [**111**] ... 400 %		
0x2C07:008	Inductance grid points (y) Lh saturation characteristic: y8 = L08 (x = 43.75 %) 0 ... [**107**] ... 400 %		
0x2C07:009	Inductance grid points (y) Lh saturation characteristic: y9 = L09 (x = 50.00 %) 0 ... [**100**] ... 400 %		
0x2C07:010	Inductance grid points (y) Lh saturation characteristic: y10 = L10 (x = 56.25 %) 0 ... [**93**] ... 400 %		
0x2C07:011	Inductance grid points (y) Lh saturation characteristic: y11 = L11 (x = 62.50 %) 0 ... [**86**] ... 400 %		
0x2C07:012	Inductance grid points (y) Lh saturation characteristic: y12 = L12 (x = 68.75 %) 0 ... [**78**] ... 400 %		
0x2C07:013	Inductance grid points (y) Lh saturation characteristic: y13 = L13 (x = 75.00 %) 0 ... [**71**] ... 400 %		
0x2C07:014	Inductance grid points (y) Lh saturation characteristic: y14 = L14 (x = 81.25 %) 0 ... [**64**] ... 400 %		
0x2C07:015	Inductance grid points (y) Lh saturation characteristic: y15 = L15 (x = 87.50 %) 0 ... [**57**] ... 400 %		
0x2C07:016	Inductance grid points (y) Lh saturation characteristic: y16 = L16 (x = 93.75 %) 0 ... [**50**] ... 400 %		
0x2C07:017	Inductance grid points (y) Lh saturation characteristic: y17 = L17 (x = 100.00 %) 0 ... [**42**] ... 400 %		



13.7.4 Estimate optimum magnetising current

In case of the given L_h saturation behaviour, there is (usually) a magnetising current where the torque efficiency is highest. This magnetising current can be determined by the servo inverter.

- Executing this function also compresses or extends the L_h saturation characteristic (interpolation points 0x2C07:001 ... 0x2C07:001).
- After the function has been executed, the determined magnetising current is entered in 0x2C02:003.

Preconditions for the performance

- Before this commissioning function is executed, the motor parameters and the L_h saturation characteristic must be identified ▸ Motor equivalent circuit diagram data. 🕮 229
- The motor must be stalled.

Response of the motor during "standstill" performance

How to estimate the optimal magnetising current:

1. Start **Axis commands: estimate optimum magnetising current** parameter with = 1.
   ▸ 0x2822:023
2. After the process has been completed, save the changed inverter parameters:
   - L_h saturation characteristic (0x2C07:001 ... 0x2C07:017)
   - Magnetising current0x2C02:003

   The »EASY Starter« serves to save the parameter settings of the inverter as parameter file (*.gdc). ▸ Saving the parameter settings

Parameter

Address	Name / setting range / [default setting]		Info
0x2822:023	Axis commands: Estimate optimum magnetizing current		Parameters for interaction with engineering tools.
	0	**Off/Ready**	Obtain Hiperface information from the encoder for application feedback.
	1	On/Start	
	2	In process	
	3	Action cancelled	
	4	No access	
	5	No access (controller inhibit)	

13.8 Parameterise filter elements in the setpoint path

13.8.1 Jerk limitation

Via the max. acceleration change that can be set in parameter 0x2945 C00274, the change of the setpoint torque can be limited for jerk limitation. Hence, sudden torque step changes can be avoided. The entire speed characteristic is smoothed.

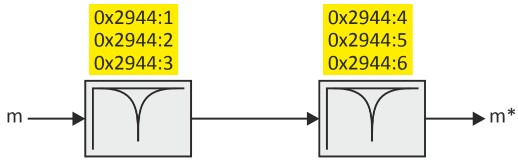
Parameter

Address	Name / setting range / [default setting]	Info
0x2945	Torque setpoint jerk limitation 0.1 ... [**400.0**] ... 400.0 %	Setting of the maximum acceleration change.

13.8.2 Notch filter (band-stop filter)

Due to the high dynamic performance or limit frequency of the closed current control loop, mechanical natural frequencies can be activated which may lead to an unstable speed control loop in the case of resonance.

To mask out or at least damp these resonant frequencies, two notch filters are integrated in the speed control loop of the inverter. In the Lenze setting, these filters are switched off:



Use of the notch filters depending on the resonant frequency

⚠WARNING!

Improperly set notch filters have a negative impact on the response and disturbance behaviour of the speed control: increased overshoot of the motor speed in case of response behaviour and / or higher speed deviations (extreme case: complete instability of the drive)

In the case of impairment,

- ▶ the drive that is still running must either be coasted down by activating the inverter disable or immediately be brought to a standstill via a brake.
- ▶ the speed controller must be optimised again afterwards.
- ▶ the test procedure must be repeated.

Output frequency	Use of notch filters
0...1/2 $f_{limit\_speed\_controller}$	No
1/2 $f_{limit\_speed\_controller...f\_limit\_speed-Controller}$	yes, with restriction
<$f_{limit\_speed\_controller}$	yes, without restriction

- The notch filters are suitable for use with resonant frequencies equal to or higher than the limit frequency of the speed controller:
  - Resonant frequencies ≥ $f_{limit\_speed\_controller}$ = 70 Hz ... 110 Hz
- For resonant frequencies lower than the limit frequency of the speed controller, the use of suitable speed profiles with an S-shaped ramp is recommended.

Setting the notch filters

Since the exact frequency response of the speed control path in most cases is not known beforehand, an experimental procedure for setting the notch filters is described in the following.

How to set the notch filters:

1. Set and optimise current controller, see section Current controller . 📖 233
2. Adapt the speed controller reset time to the filter time constant of the actual speed filter time and the equivalent time constant of the current control loop:
   - The following applies: 0x2900:002 = 16 * (0x2904 + 500 µs)

   Note: The setting of the reset time includes the equivalent time constant of the current control loop. The 500 µs indicated are typical in a power range of up to 50 kW. Above this value, greater time constants may occur.
3. Slowly increase the proportional gain of the speed controller in 0x2900:001 until the speed control loop starts to be unstable (acoustic determination, measurement of the motor current or recording of the speed output signal).
4. Measure the oscillation frequency using an oscilloscope:
   - Assessing the motor current via .
   - Assessing the motor speed via 0x6044.
5. Set the oscillation frequency determined as filter frequency in 0x2944:001.
6. Set the filter width to 40 % of the filter frequency in 0x2944:002.
7. Se the filter depth to 40 dB in 0x2944:003.
   - If "0 dB" is set (default setting), the filter is not effective.
8. Further increase the proportional gain of the speed controller in 0x2900:001 until the speed control loop starts to be unstable again.
   - If the oscillation frequency has changed now, readjust the filter frequency by trimming. The use of a second filter is ineffective here.
   - If the oscillation frequency remains the same, readjust the filter depth and/or the filter width by trimming (the first reduces the amplitude, the second lets the phase rotate faster).
   - Repeat step 8 until the desired behaviour or the limit of a sensible speed controller gain has been reached.
9. Check the drive behaviour in case of quick stop (QSP)
   - Accelerate drive
   - Then, brake with quick stop (QSP) and check whether a reduced drive dynamics can be detected.
   - If so, reduce the influence of the filters until the reachable dynamics corresponds to the requirements.

NOTICE

► Readjust the speed controller after setting the notch filters (see section "Speed controller"). 📖 230

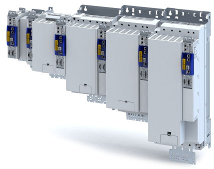
► Save the changed settings.

► The »EASY Starter« serves to save the parameter settings of the servo inverter as parameter file (*.gdc), see section Saving the parameter settings . 📖 36

Parameter

Address	Name / setting range / [default setting]	Info
0x2944:001	Torque setpoint notch filter: Frequency notch filter 1 1.0 ... [**200.0**] ... 1000.0 Hz	Setting of the frequency for notch filter 1.
0x2944:002	Torque setpoint notch filter: Bandwidth notch filter 1 0.0 ... [**20.0**] ... 500.0 Hz	Setting of the bandwidth for notch filter 1.
0x2944:003	Torque setpoint notch filter: Damping notch filter 1 0 ... [**0**] ... 100 dB	Setting of the damping for notch filter 1.
0x2944:004	Torque setpoint notch filter: Frequency notch filter 2 1.0 ... [**400.0**] ... 1000.0 Hz	Setting of the frequency for notch filter 2.

Address	Name / setting range / [default setting]	Info
0x2944:005	Torque setpoint notch filter: Bandwidth notch filter 2 0.0 ... [**40.0**] ... 500.0 Hz	Setting of the bandwidth for notch filter 2.
0x2944:006	Torque setpoint notch filter: Damping notch filter 2 0 ... [**0**] ... 100 dB	Setting of the damping for notch filter 2.



13.9 Motor protection

Many monitoring functions integrated in the inverter can detect errors and thus protect the device or motor from being destroyed or overloaded.

13.9.1 Motor overload monitoring (i^2*t)

This function monitors the thermal utilisation of the motor, taking the motor currents recorded and a mathematical model as a basis.

DANGER!

Fire hazard by overheating of the motor.

Possible consequences: Death or severe injuries

- ▶ Since the motor utilisation calculated in the thermal model gets lost after mains switching, the following operating states cannot be determined correctly: 1.) Restarting (after mains switching) of a motor that is already very hot and 2.) Change of the cooling conditions (e.g. cooling air flow interrupted or too warm).
- ▶ To achieve full motor protection, an additional temperature monitoring function with a separate evaluation must be installed.
- ▶ When actuating motors that are equipped with PTC thermistors or thermal contacts, always activate the PTC input.

Motor overload monitoring is important for motors without thermal sensor.

Details

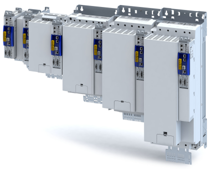
During the calculation of the parameters 0x2D4D:001 ...0x2D4D:008, the speed dependence of the permissible motor load and thus of the permissible current (difference between the standstill current and rated current is taken into consideration.

In case of permanent overload and excess of the warning threshold set in parameter 0x2D4E, a warning is output in order that the higher-level Controller is still able to respond and reduce the motor load or interrupt the operation.

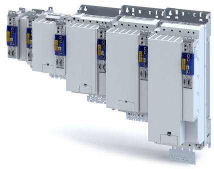
The calculated thermal motor utilisation is displayed in parameter .

Parameter

Address	Name / setting range / [default setting]	Info
0x2D4F	Motor utilisation (i^2*t) • Read only: x %	Display of the current thermal motor utilisation.
0x2D4E	Motor utilisation (i^2xt) - warning threshold 0 ... [**100**] ... 250 %	Setting of the warning threshold for motor overload monitoring.
0x2D50:001	Motor utilisation (i^2xt) - monitoring: Error response	For displaying the motor utilisation error response (I^2xt). Associated error code: • 9041 | 0x2351 - RANLI_CIMES_1000_20892
	0 Keine Reaktion	
	1 Fehler > CiA402	



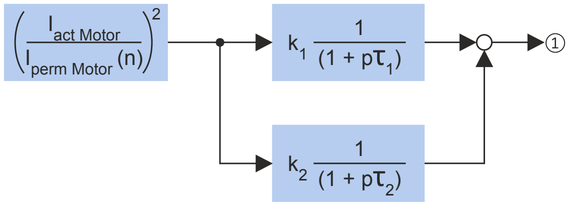
Address	Name / setting range / [default setting]	Info
0x2D50:002	Motor utilisation (i^2xt) - monitoring: Error threshold 0 ... [**105**] ... 250 %	Setting of the error threshold for motor overload monitoring.



13.9.1.1 Parameters for the thermal model

The introduction of a two-component model with two time constants (one for the winding and the other for the housing/laminated core) serves to display the thermal behaviour of the motors up to 500% of the rated current.

Structure of the monitoring



① Thermal utilisation of the motor in [%]

Parameter	Symbol	Description	Dimension unit
-	$I_{actMotor}$	Actual motor current	A
-	$I_{permMotor}$	Permissible motor current (speed-dependent)	A
0x2D4C:001	τ_1	Therm. time constant of winding	s
0x2D4C:002	τ_2	Therm. time constant of laminated core	s
0x2D4C:003	k_1	Percentage of the winding in the final temperature	%
-	k_2	Percentage of the laminated core in the final temperature: k2 = 100 % - k1	%

Calculation with only one time constant

If k1 = "0 %" is set, the part of the winding is not taken into consideration and the thermal model is only calculated using the time constant set for the housing/laminated core. This setting is e.g. required if only the time constant of the laminated core (T2) is known.

Parameter setting of the time constant and the influence of the winding on motors of other manufacturers

When the influence of the winding is activated, the i^2 xt monitoring becomes more sensible as if only the influence of the laminated core would be used for monitoring purposes.

The necessity to activate the influence of the winding rises with the increasing utilisation of the motor overload capacity. It also rises with applications where the motor is at standstill for longer periods or cyclically and a load ≥ permanent standstill current is applied.

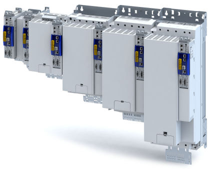
For determining the values for the thermal time constant, try to get the data from the motor manufacturer. If this is not possible, you can use the data of a comparable Lenze motor.

Conditions for comparability are similar values in case of the following motor features:

- Square dimensions of the motor (active part)
- Length of the active part (if available)
- Permanent standstill current Io [A_RMS]
- Peak current/overload capacity [A_RMS]
- Copper resistance of the winding at 20 °C [Rphase]

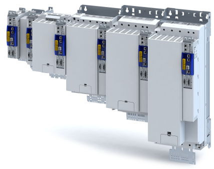
Example:

Motor features	Data of the third-party motor	Description
Square dimension	95 mm	MCS09xxx = 89 mm
Standstill current	2.2 A	MCS09F38 = 3.0 A
Peak current	7.3 A	MCS09F38 = 15 A
Phase resistance	5.1 Ohms	MCS09F38 = 5.2 Ohms



Parameter

Address	Name / setting range / [default setting]	Info
0x2D4C:001	Thermisches Modell Motorauslastung (i^2xt): Motor utilisation (i^2xt) 1 ... [**60**] ... 36000 s	Setting of the time constant for the winding.
0x2D4C:002	Thermisches Modell Motorauslastung (i^2xt): Thermal time constant - laminations 1 ... [**852**] ... 36000 s	Setting of the time constant for the laminated core.
0x2D4C:003	Thermisches Modell Motorauslastung (i^2xt): Winding influence 0 ... [**27**] ... 100 %	Part of the thermal motor model: distribution factor of the copper winding influence.
0x2D4C:004	Thermisches Modell Motorauslastung (i^2xt): Starting value 0 ... [**0**] ... 250 %	Value for initialising the filters for the thermal motor overload monitoring (setting in % of the permissible full load).



13.9.1.2 Speed-dependent evaluation of the motor current

⚠ **WARNING!**

Fire hazard by overheating of the self-ventilated standard motor

Possible consequence: destruction of system parts

► Protect self-ventilated standard motors especially at low speeds by sufficient cooling or from impermissibly high motor currents. Carry out a speed-dependent evaluation of the permissible motor current.

⚠ **WARNING!**

Fire hazard by overheating of PM synchronous motors

Possible consequence: destruction of system parts

► Please check for every individual case which r.m.s. value can be used to permanently operate the motor at standstill. In case of some motors, a derating I1/In < 100 % is required when n1/nn = 0 %. This serves to prevent an overload of individual motor phases as their power loss doubles with continuous DC current load. (It is called DC current load as the field frequency amounts to 0 Hz at standstill.)

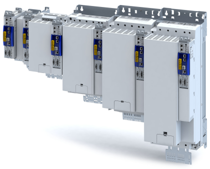
ℹ When you select a Lenze motor from the catalogue and transfer its parameters into the i700 servo inverter a typical characteristic is automatically set for the selected motor. A deviating parameterisation is only required if the motor is operated in ambient conditions which demand a general derating. Example: use in site altitudes > 1000 m. In case of motors of other manufacturers, the operating points have to be parameterised based on the data sheet information.

By selecting a characteristic, the permissible motor current is evaluated depending on speed for calculating the thermal motor utilisation. For this purpose, up to four operating points on the S1 characteristic of a motor can be used.

- The S1 characteristic can be found in the technical data sheet/catalogue of the respective motor.
- The representation in the objects /characteristic is carried out as relative values with reference to rated values.

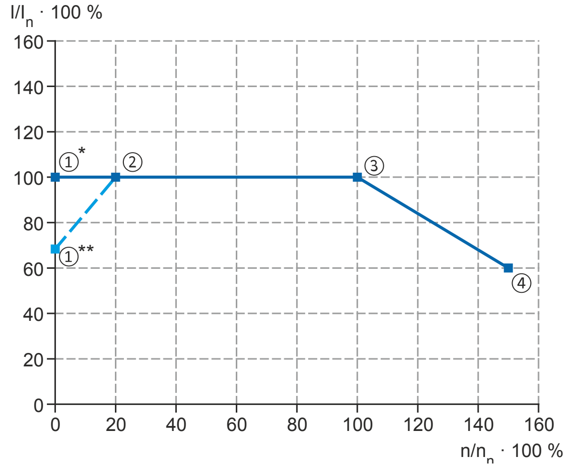
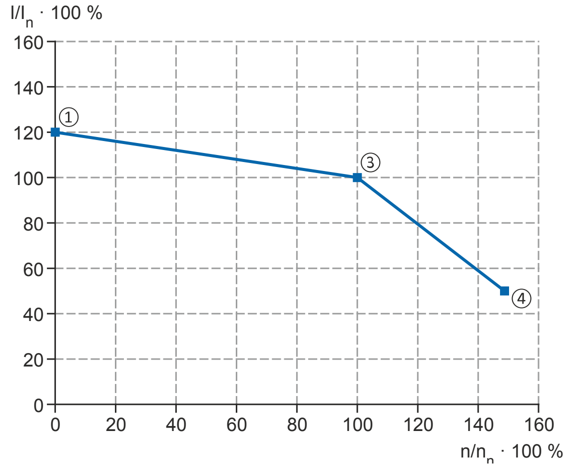
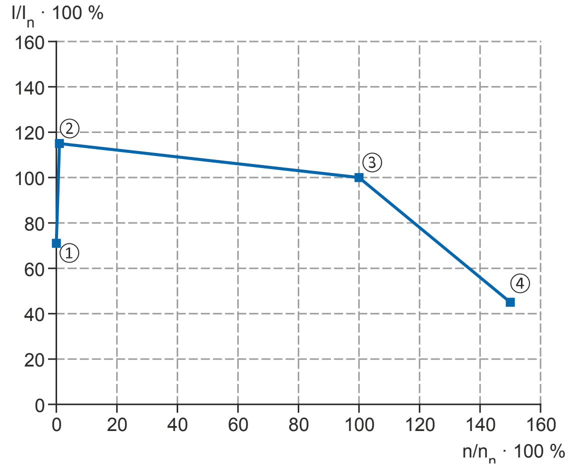
The speed-dependent evaluation of the permissible motor current can actually be switched off by parameterising all 8 characteristic points to "100 %".

Operating points		
①	Standstill n01-I01	For motors, this operating point is often described with the no-Io values.
②	Reference point n02-I02	If the value falls below the speed n02, a derating in the current is required because: • the motor cooling of self-ventilated motors deteriorates considerably. • a DC current load causes an increased power loss in a winding. • For motors, this operating point is also described with the no-Io values.
③	Rated point (n03=nN)-(I03=IN)	Rated values of the motor are the reference for all operating points of the i^2xt monitoring.
④	Field weakening n04-I04	This operating point should be parameterised irrespective of the use in the current application.

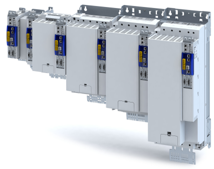


Example of how to enter the characteristic for standard and servo motors

The required data of the operating points result from the S1 characteristic of the prevailing motor:

Examples of S1 characteristics	
Standard motor	
	*forced ventilated standard motor **self-ventilated standard motor
Servo motor	Servo motor with derating at standstill
	

Parameter	Characteristic points		Info
0x2D4D:001	①	n_1/n_n * 100 %	Speed = "0" (standstill)
0x2D4D:002		I_1/I_n * 100 %	Permissible motor current at standstill
0x2D4D:003	②	n_2/n_n * 100 %	Speed from which the current must be reduced for self-ventilated motors. • Below this speed the cooling air flow of the integral fan is not sufficient anymore.
0x2D4D:004		I_2/I_n * 100 %	Permissible motor current at speed n_2 (torque reduction)
0x2D4D:005	③	n_3/n_n * 100 %	Rated speed
0x2D4D:006		I_3/I_n * 100 %	Permissible motor current at rated speed
0x2D4D:007	④	n_4/n_n * 100 %	Speed above the rated speed (in the field weakening range for asynchronous motors)
0x2D4D:008		I_4/I_n * 100 %	Permissible motor current at speed n_4 (field weakening)



Parameter

Address	Name / setting range / [default setting]	Info
0x2D4D:001	Motor utilisation (i^2xt) - specific characteristic: x1 = n01/nN (n01 ~ 0) 0 ... [**0**] ... 600 %	User-definable characteristic for speed-dependent evaluation of the motor current.
0x2D4D:002	Motor utilisation (i^2xt) - specific characteristic: y1 = i01/iN (x1) 0 ... [**100**] ... 600 %	
0x2D4D:003	Motor utilisation (i^2xt) - specific characteristic: x2 = n02/nN (n02 = limit reduced cooling) 0 ... [**0**] ... 600 %	
0x2D4D:004	Motor utilisation (i^2xt) - specific characteristic: y2 = i02/iN (x2) 0 ... [**100**] ... 600 %	
0x2D4D:005	Motor utilisation (i^2xt) - specific characteristic: x3 = n03/nN (n03 = rated speed) 0 ... [**100**] ... 600 %	
0x2D4D:006	Motor utilisation (i^2xt) - specific characteristic: y3 = i03/iN (x3) 0 ... [**100**] ... 600 %	
0x2D4D:007	Motor utilisation (i^2xt) - specific characteristic: x4 = n04/nN (n04 = limit field weakening) 0 ... [**100**] ... 600 %	
0x2D4D:008	Motor utilisation (i^2xt) - specific characteristic: y4 = i04/iN (x4) 0 ... [**100**] ... 600 %	

13.9.1.3 UL 508-compliant motor overload monitoring

If the operation of the motor requires the compliance with the UL Standard 508, and the UL 508-compliant motor overload monitoring is realised by the mathematical model of the I^2xt monitoring, the following conditions must be observed.

UL 508 condition 3:

After mains switching and a motor load > 100 %, the I^2xt warning must be output faster than in the same overload case before mains switching.

- A motor load > 100 % exists if the r.m.s. value of the total motor current displayed in parameter 0x2DD1:005 is higher than the rated motor current 0x6075.

This condition can be fulfilled by setting the following parameters:

- Motor utilisation (I^2xt): starting value ▶ 0x2D4C:004

UL 508 condition 2:

In case of a motor load of 110 %, the I^2xt warning at a motor rotating field frequency of 10 Hz must be output faster than at a motor rotating field frequency of 20 Hz.

- The current motor rotating field frequency is displayed in parameter 0x2DDD.
- A motor load of 110 % exists if the r.m.s. value of the total motor current displayed in parameter 0x2DD1:005 corresponds to 110 % of the rated motor current 0x6075.

This condition can be fulfilled by setting the following parameters:

- I^2xt: x1 = n01/nN (n01 ~ 0) ▶ 0x2D4D:001
- I^2xt: y1 = i01/iN (x = n01 ~ 0) ▶ 0x2D4D:002
- I^2xt: x2 = n02/nN (n02 = reduced cooling limit) ▶ 0x2D4D:003
- I^2xt: y2 = i02/iN (x = n02 = reduced cooling limit ▶ 0x2D4D:004

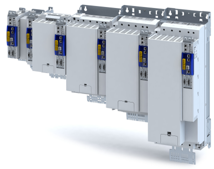
UL 508 condition 1:

In case of a motor load of 600 %, the I^2xt warning must be output within 20 seconds.

- A motor load of 600 % exists if the r.m.s. value of the total motor current displayed in parameter 0x2DD1:005 corresponds to 600% of the rated motor current 0x6075.

This condition can be fulfilled by setting the following parameters:

- Motor utilisation (I^2xt): thermal time constant - laminated core ▶ 0x2D4C:002
- Motor utilisation (I^2xt): influence winding ▶ 0x2D4C:003
- Motor utilisation (I^2xt): motor overload warning threshold ▶ 0x2D4E
- Motor utilisation (I^2xt): response ▶ 0x2D50:001
- Motor utilisation (I^2xt): error threshold ▶ 0x2D50:002



13.9.2 Motor temperature monitoring

In order to record and monitor the motor temperature, a PTC thermistor (single sensor according to DIN 44081 or triple sensor according to DIN 44082) or thermal contact (normally-closed contact) can be connected to the terminals T1 and T2. This measure helps to prevent the motor from being destroyed by overheating.

Preconditions

- The inverter can only evaluate one PTC thermistor! Do not connect several PTC thermistors in series or parallel.
- If several motors are actuated on one inverter, thermal contacts (NC contacts) connected in series are to be used.
- To achieve full motor protection, an additional temperature monitoring function with a separate evaluation must be installed.
- By default, a wire jumper is installed between terminals X109/T1 and X109/T2, which must be removed when the PTC thermistor or thermal contact is connected.

Details

If 1.6 kΩ < R < 4 kΩ at terminals X109/T1 and X109/T2, the monitoring function will be activated; see functional test below.

- If the monitoring function is activated, the response set in 0x2D49:002 will be effected.
- The setting 0x2D49:002 = 0 deactivates the monitoring function.

If a suitable motor temperature sensor is connected to the terminals X109/T1 and X109/T2 and the response in 0x2D49:002 is set to "Fault [3]", the response of the motor overload monitoring may be set other than "Fault [3]" in .
▶ Motor overload monitoring (i²*t) 254

Functional test

Connect a fixed resistor to the PTC input:

- R > 4 kΩ : the monitoring function must be activated.
- R < 1 kΩ : the monitoring function must not be activated.

Parameter

Address	Name / setting range / [default setting]		Info
0x2D48:002	PTC temperature sensor monitoring: Error response		Setting of a response for PTC temperature monitoring. Associated error code: • 17281 | 0x4381 - RANLI_CIMES_1000_21212
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	
0x2D49:001	Motor temperature monitoring: Temperature sensor type		Selection of the motor temperature sensor used.
	0	KTY83-110	
	1	KTY83-110 + 2 x PTC 150 °C in series	
	2	KTY84-130	
	3	Specific characteristic	
	4		
	5	**PT1000**	Selection of the motor temperature sensor used.
	6	PT1000 + 2 x PTC 150 °C in series	
0x2D49:002	Motor temperature monitoring: Response		Selection of the response to the triggering of the motor temperature monitoring. Associated error codes: • 17168 | 0x4310 - Motor temperature error • 17280 | 0x4380 - RANLI_CIMES_1000_02502 • 17282 | 0x4382 - RANLI_CIMES_1000_21218 • 17283 | 0x4383 - RANLI_CIMES_1000_21219
	0	No response	
	1	**Fault > CiA402**	

Address	Name / setting range / [default setting]		Info
0x2D49:003	Motor temperature monitoring: Warning threshold -3276.8 ... [**145.0**] ... 3276.7 °C		Setting of the warning threshold for motor temperature monitoring. The warning threshold is reset with a hysteresis of 5 °C.
0x2D49:004	Motor temperature monitoring: Error threshold -3276.8 ... [**155.0**] ... 3276.7 °C		Setting of the error threshold for motor temperature monitoring The warning threshold is reset with a hysteresis of 5 °C.
0x2D49:005	Motor temperature monitoring: Actual motor temperature • Read only: x.x °C		Display of the current motor temperature.
0x2D49:006	Motor temperature monitoring: Spec. characteristic temperature grid point 1 0.0 ... [**25.0**] ... 255.0 °C		Parameter for the specific thermal sensor characteristic (0x2D49:001 = 3).
0x2D49:007	Motor temperature monitoring: Spec. characteristic temperature grid point 2 0.0 ... [**150.0**] ... 255.0 °C		
0x2D49:008	Motor temperature monitoring: Spec. characteristic resistance grid point 1 0 ... [**1000**] ... 30000 Ω		
0x2D49:009	Motor temperature monitoring: Spec. characteristic resistance grid point 2 0 ... [**2225**] ... 30000 Ω		
0x2D49:010	Motor temperature monitoring: Temperature sensor feedback type		Selection of the temperature sensor feedback type.
	0	**KTY83-110**	Selection of the motor temperature sensor used.
	3	Specific characteristic	
0x2D49:011	Motor temperature monitoring: Motor temperature (Motor encoder) • Read only: x.x °C		Display of the current motor temperature measured by motor feedback.
0x2D49:012	Motor temperature monitoring: Motor temperature (load encoder) • Read only: x.x °C		Display of the current motor temperature measured by load feedback.

13.9.2.1 Individual characteristic for motor temperature sensor

The setting of a characteristic for the motor temperature sensor is not suitable as an adequate replacement of a tripping unit for the thermal protection of rotating electrical machines (EN 60947- 8:2013)!

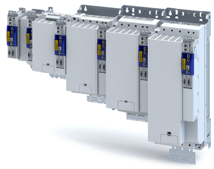
If required, you can define and activate a special characteristic for the motor temperature sensor.

- The special characteristic is activated via the setting 0x2D49:001 = 3
- The special characteristic is defined based on two parameterisable grid points. The two grid points define a line that is extrapolated to the left and to the right.

This default setting can be changed by the following parameters:

- Thermal sensor characteristic: Grid point 1 - temperature ▸ 0x2D49:006
- Thermal sensor characteristic: Grid point 1 - resistance ▸ 0x2D49:008
- Thermal sensor characteristic: Grid point 2 - temperature ▸ 0x2D49:007
- Thermal sensor characteristic: Grid point 2 - resistance ▸ 0x2D49:009

Selecting a motor from the motor catalogue overwrites the parameters of the special characteristic!



13.9.3 Overcurrent monitoring

This function monitors the instantaneous value of the motor current and serves as motor protection.

⚠WARNING!

With an incorrect parameterisation, the maximum permissible motor current may be exceeded in the process.

Possible consequences: irreversible damage of the motor.

Avoid motor damages by using the overcurrent monitoring function as follows:

- ► The setting of the threshold for the overcurrent monitoring in 0x2D46:001 must be adapted to the connected motor.
- ► Set the maximum output current of the inverter in 0x6073 much lower than the threshold for overcurrent monitoring.

Conditions for using this function

This function is suitable for a synchronous motor.

Parameter

Address	Name / setting range / [default setting]		Info
0x2D46:001	Overcurrent monitoring: Threshold 0.0 ... [**5.4**] ... 3000.0 A		• If the active motor current exceeds the set threshold, the response set in 0x2D46:002 is effected for the purpose of motor protection. • The parameter can also be set and overwritten by selecting a motor from the "motor catalog" of the engineering tool.
0x2D46:002	Overcurrent monitoring: Response		Selection of the response to the triggering of motor current monitoring. Associated error code: • 9092 | 0x2384 - RANLI_CIMES_0500_03891
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	

13.9.4 Motor phase failure detection

The motor phase failure detection function can be activated for both synchronous and asynchronous motors.

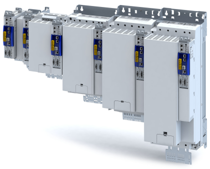
In the Lenze setting, monitoring is not activated!

Preconditions

Motor phase failure detection during operation is suitable for applications which are operated with a constant load and speed. In other cases, transient processes or unfavourable operating points can cause erroneous triggering to occur.

Parameter

Address	Name / setting range / [default setting]		Info
0x2D45:001	Motor phase failure detection: Response - Motor phase 1		Selection of the response following the detection of a motor phase failure during operation. Associated error codes: • 65289 | 0xFF09 - Motor phase missing • 65290 | 0xFF0A - Motor phase failure phase U • 65291 | 0xFF0B - Motor phase failure phase V • 65292 | 0xFF0C - RANLI_CIMES_1000_20883
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	



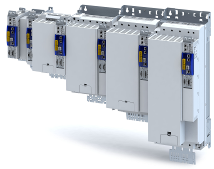
Address	Name / setting range / [default setting]	Info
0x2D45:002	Motor phase failure detection: Current threshold 1.0 ... [**5.0**] ... 10.0 %	• 100 % ≡ Maximum current • Background: in order to be able to reliably detect the failure of a motor phase, first a certain must flow for the current sensor system. The detection function is therefore only activated if the motor current has exceeded the current threshold set here. • Display of the present motor current: .
0x2D45:003	Motor phase failure detection: Voltage threshold 0.0 ... [**10.0**] ... 100.0 V	Voltage threshold for motor phase monitoring for the VFC control mode (0x2C00 = 6). • The monitoring function is triggered if the motor voltage exceeds the threshold value and the motor current falls below the device-dependent current threshold for longer than 20 ms.
0x2D45:004	Motor phase failure detection: Response - Motor phase 2	Selection of the response following the detection of a motor phase failure directly after controller enable. Associated error codes: • 65289 | 0xFF09 - Motor phase missing • 65290 | 0xFF0A - Motor phase failure phase U • 65291 | 0xFF0B - Motor phase failure phase V • 65292 | 0xFF0C - RANLI_CIMES_1000_20883
	0 **No response**	
	1 Fault > CiA402	
	2 Warning	

13.9.5 Motor speed monitoring

This function monitors the motor speed during operation.

Parameter

Address	Name / setting range / [default setting]	Info
0x2D44:001	Overspeed monitoring: Threshold 50 ... [**8000**] ... 50000 rpm	• If the current motor speed reaches the threshold set, the response selected in 0x2D44:002 is effected. • The parameter can also be set and overwritten by selecting a motor from the "motor catalog" of the engineering tool.
0x2D44:002	Overspeed monitoring: Response	Selection of the response to the triggering of motor speed monitoring. Associated error code: • 65286 | 0xFF06 - Motor overspeed
	0 No response	
	1 **Fault > CiA402**	
	2 Warning	



13.10 Frequency and speed limitations

By limiting the maximum output frequency to ± 599 Hz, the devices are not subject to the export restrictions of the "EC-Dual-Use Regulation" (EC 428/2009). This applies to devices supplied from the middle of the year 2015. For certain applications, the supply of devices with the current maximum output frequency of ± 1999 Hz. If required, get in touch with your Lenze contact person.

Output frequency

The output frequency of the i700 servo inverter is limited to a maximum value, the amount of which corresponds to the lower of the two following values:

$$f_{lim} = \frac{f_{chop}}{8} \quad \text{oder} \quad f_{lim} = f_{max\_Geräte}$$

$_{lim}f$	Maximum output frequency
f_{chop}	Switching frequency 0x2939
f_{max_device}	Maximum device output frequency 0x2835:001, depending on the device type ± 599 Hz or ± 1999 Hz

Due to the restrictions by the "dual use regulation" (EC 428/2009), values higher than + 599 Hz to + 1000 Hz or - 599 Hz to - 1000 Hz do not increase the output frequency. Please observe the deadband occurring in this case.

Speed setpoint

If servo control is used, the speed setpoint is limited depending on the number of motor pole pairs:

$$n_{lim} = \frac{f_{lim}}{zp}$$

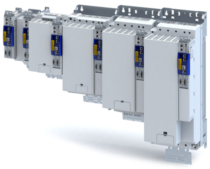
n_{lim}	Speed limit value
f_{lim}	Maximum output frequency0x2939
zp	Number of motor pole pairs

- If the speed setpoint is limited, bit 1 ("Speed: Setpoint 1 limited") or bit 5 ("Speed: Setpoint 2 limited") is set in the Lenze status word 0x2831.
- The behaviour corresponds to the behaviour which is shown when the set maximum speed 0x6080 is reached.
- The sequence is: limit the speed to 0x6080 first, then limit it to the speed limit value n_{lim}.

Frequency setpoint

If V/f characteristic control is used, the frequency setpoint is limited in addition to the speed setpoint.

- If the frequency setpoint is limited, bit 10 ("Output frequency limited") is set in the Lenze status word 0x2831.



13.11 Testing the motor control

Parameter

Address	Name / setting range / [default setting]		Info
0x2825	Drive mode selection • Setting can only be changed if the inverter is inhibited.		Internal service parameter
	0	**CiA402 operating modes**	
	1	Manual "voltage/frequency" test mode	
	2	Manual "current/frequency" test mode	
	3	Manual "current pulse" test mode	
	4	Manual control mode	
	5	Pole position identification (360°)	
	6	Pole position identification (min. movement)	
	7	Pole position identification (without movement)	
	8	Inverter characteristic identification	
	9	Motor parameters identification	
	10	Lh saturation characteristic identification	
	11	PRBS excitation - mechanical plant	
	12	PRBS excitation - current control loop	
	13	PRBS excitation - speed control loop	
	14	PRBS excitation - position control loop	

13.11.1 General settings for test modes

Wiring check by means of manual test modes

Before starting the parameter setting of the inverter, check the motor wiring (motor connection / feedback connection) for errors and function and correct them if required:

1. Provided that the motor is connected in correct phase relation and the rotating field frequency is positive, the motor shaft rotates clockwise.
2. An existing speed feedback in the rotor position () generates a numerical value with positive counting direction. If required, take corrective measures: see the table at the end of the list.
3. After the controller inhibit (0x6040) has been activated, the following manual test modes are available via the parameter 0x2825:

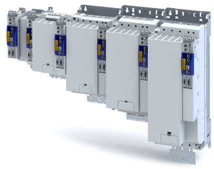
- Manual "tension/frequency" test mode
- Manual "current/frequency" test mode

The parameters for the test modes can be adapted via the parameter . Please observe the notes in the description of the respective test mode.

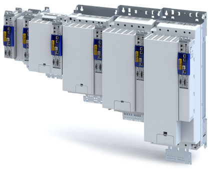
Rotating field frequency	Display	Measure
CW	0...2047	None
	2047...0	Correct motor connection / feedback connection
CCW	2047...0	None
	0...2047	Correct motor connection / feedback connection

Parameter

Address	Name / setting range / [default setting]	Info
0x2835:001	Manual test mode: Current setpoint 0 ... [**0**] ... 1000 %	Setting of the r.m.s. value of a phase current for the test mode. • 100 %: Motor rated current (0x6075)
0x2835:002	Manual test mode: Frequency -1000.0 ... [**0.0**] ... 1000.0 Hz	Setting of the frequency for the test mode.



Address	Name / setting range / [default setting]	Info
0x2835:003	Manual test mode: Starting angle -1000.0 ... [**0.0**] ... 1000.0 °	Setting of the starting angle for the test mode. Note! After the inverter has been enabled, the synchronous motor makes a jerky compensating movement if its pole position does not correspond to the starting angle.
0x2E00:042	Voltage offset compensation	
	0 Off	
	1 **On**	



13.11.2 Manual "tension/frequency" test mode

Functional description

In case of devices that correspond to the "dual use regulation" (EC 428/2009), values higher than + 599 Hz up to lower than - 599 Hz do not increase the output frequency. Please observe the deadband occurring in this case.

Further information can be found in the section "Frequency and speed limitations". 266

After the controller is enabled in this test mode, a rotary field voltage is output at the motor terminals with the set output frequency f_{out}.

- If the selected frequency is positive, the motor should rotate clockwise when looking at the A side of the motor. If this is not the case, the motor phases are connected incorrectly.
- The output voltage level is determined by the following equation

Equation for calculating the output voltage			
$$U_{out} = f_{out} \cdot \frac{U_{rated}}{f_{rated}}$$			
Parameter	Symbol	Description	Dimension unit
	V_{out}	Current output voltage	V
0x2835:002	f_{out}	Output frequency for test mode Please observe the notes in the section "Frequency and speed limitations". 266	Hz
0x2B01:001	V_{rated}	Base voltage	V
0x2B01:002	f_{rated}	Base frequency	Hz

The manual "voltage / frequency" test mode also serves to check the wiring of the feedback system.

- If the feedback system of a synchronous motor is set correctly, an actual speed should be displayed that can be calculated with the following equation (if the feedback system of an asynchronous motor is set correctly, the actual speed is a bit lower due to the slip):

Equation for calculating the actual speed			
$$n_{act} = \frac{f_{out}}{zp_{motor}} \cdot 60$$			
Parameter	Symbol	Description	Dimension unit
0x606C	n_{act}	Velocity actual value	rpm
0x2835:002	f_{out}	Output frequency for test mode	Hz
0x2C01:001	zp_{Motor}	Number of motor pole pairs	

Conditions for the execution

- The motor must rotate freely.
- The servo inverter is error-free and in the "switched-on" device state.

Response of the motor during performance

The motor moves as a function of the set output frequency.

How to activate the manual "voltage/frequency" test mode:

1. Disable the inverter ▶ Enable operation. 286
2. Change to the "voltage/frequency" test mode. ▶ 0x2825 = 1
3. Enable the inverter to start the test mode.
4. To stop the test mode again:
   - Disable inverter.
   - Change back to the "CiA402 operating mode". ▶ 0x2825 = 0

13.11.3 Manual "current/frequency" test mode

Preconditions for the performance

- The motor must rotate freely.
- The inverter is error-free and in "Switched on" device state.

Functional description

In this test mode, three phase currents are injected into the connected motor after the inverter is enabled.

- Adaptation of the phase currents:

Parameter	Info	Data type
0x2835:001	R.m.s. value of a phase current • Selected in [%] based on the rated motor current.	INTEGER_16
0x2835:002	Frequency	INTEGER_16
0x2835:003	Starting angle	INTEGER_16

- Reading out the present phase currents:

Parameter	Info	Data type
	Motor current phase U	INTEGER_32
	Motor current phase V	INTEGER_32
	Motor current phase W	INTEGER_32

Advantages compared to the manual "voltage/frequency" test mode

- The current cannot be set freely but is adjusted to a defined value.
- If a synchronous motor is connected, it is possible to predict the torque.

Response of the motor during performance

- The motor moves as a function of the set output frequency.

After the inverter has been enabled, the synchronous motor makes a jerky compensating movement if its pole position does not correspond to the starting angle.

How to activate the manual "current/frequency" test mode:

1. Disable inverter ▶ Enable operation. 286
2. Change to the "current/frequency" test mode. ▶ 0x2825 =2
3. Enable the inverter to start the test mode.
4. To stop the test mode again:
    - Disable inverter.
    - Change back to the CiA402 operating mode. ▶ 0x2825 = 0

13.11.4 Manual "current pulse" test mode

The stator resistance and the stator inductance of the inverter must be adapted to the electrical characteristics of the motor. For an experimental adjustment, the manual "Current pulse" test mode can be used.

This test mode is provided for adjusting the current controller in the "Servo control for synchronous motor/asynchronous motor" operating mode and is not suitable for adjusting the Imax controller in the "V/f characteristic control (VFC)" operating mode!

In the manual "Current pulse" test mode, setpoint step-changes are applied to the current controller input subsequent to controller enable. The step responses must then either be recorded using an oscilloscope and a clamp-on ammeter, or using the oscilloscope function of the inverter. It is the objective to optimise the two "Gain" and "Reset time" current controller parameters by evaluating the step responses so that a speedy current characteristic is achieved, which, if possible, is free of harmonics.

In the case of motors with single pole windings, satisfactory results are possibly only achieved with a current-dependent correction of the current controller parameters. For this purpose, a characteristic is stored in the inverter, which describes the current dependance of the stator leakage inductance and which tracks the current controller gain.

After the inverter has been enabled, the synchronous motor makes a jerky compensating movement if its pole position does not correspond to the starting angle.

The motor phase U is energized with a DC current the level of which is determined via the following equation.

$$I_{phase\_U} = \sqrt{2} * \mathrm{I_{test}}[\%] * \frac{I_{rated}}{100\%}$$

In motor phases V and W, half of this DC current flows (negative; from the motor).

$$I_{phase\_V,\_W} = -0.5 * \sqrt{2} * I_{test}[\%] * \frac{I_{rated}}{100\%}$$

The following parameters are relevant to the calculation:

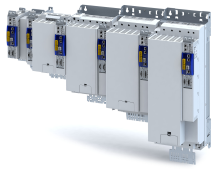
- Manual test mode: setpoint current ▶ 0x2835:001
- Motor rated current ▶ 0x6075
- Read only: current phase U 0x2D83:002
- Read only: current phase V 0x2D83:003
- Read only: current phase W 0x2D83:004

Conditions for the execution

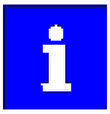
- The motor must be parameterised completely.
- The motor utilisation (I^2xt) monitoring must be parameterised and switched to active.
  ▶ Motor overload monitoring (i²*t) 254
- The motor must rotate freely.
- The inverter is error-free and switched on.
- The rotor of synchronous motors must be in the pole centre during the test. For some synchronous motors, it might be required to align and lock the rotor in the pole centre.
  - Using the manual test mode "current/frequency" is useful for a one-time alignment of the rotor with the following settings:

    R.m.s. value = 70 ... 100 %; frequency = 0 Hz; starting angle = 0°

    ▶ Manual "current/frequency" test mode 270
  - Fixation by means of the holding brake or the use of external fixation aids



Responses of the motor during performance

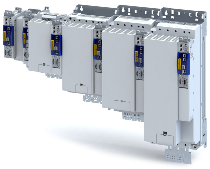


Remove the mechanical fixation after the current controller has been adjusted!

The motor usually aligns itself only once with the first controller enable.

How to adjust the current controller by means of the manual test mode "current pulse":

- Disable inverter.
- Calculate start parameters for the inverter based on the parameterised motor data.
  - The automatic calculation is made via the parameter 0x2822:013.
  - You can determine the start parameter manually.
- Change to the "current pulse" test mode. ▶ 0x2825 = 3
- Set the setpoint current for the manual test mode. ▶ 0x2835:001
- Enable the inverter for a short while to start the test mode.
- Measure the step response of the motor current in the motor phase U by means of an oscilloscope and a clamp-on ammeter.
- Evaluate the step response.
- Adjust the gain and the reset time of the inverter.
- Repeat steps 1 ... 6 until the optimum step response of the motor current has been reached.
- Exit the test mode:
  - Disable the inverter.
  - Change to the CiA402 mode. ▶ 0x2825 = 0
- For permanent saving: save changed current controller parameters.



14 I/O extensions and control connections

14.1 Configure digital inputs

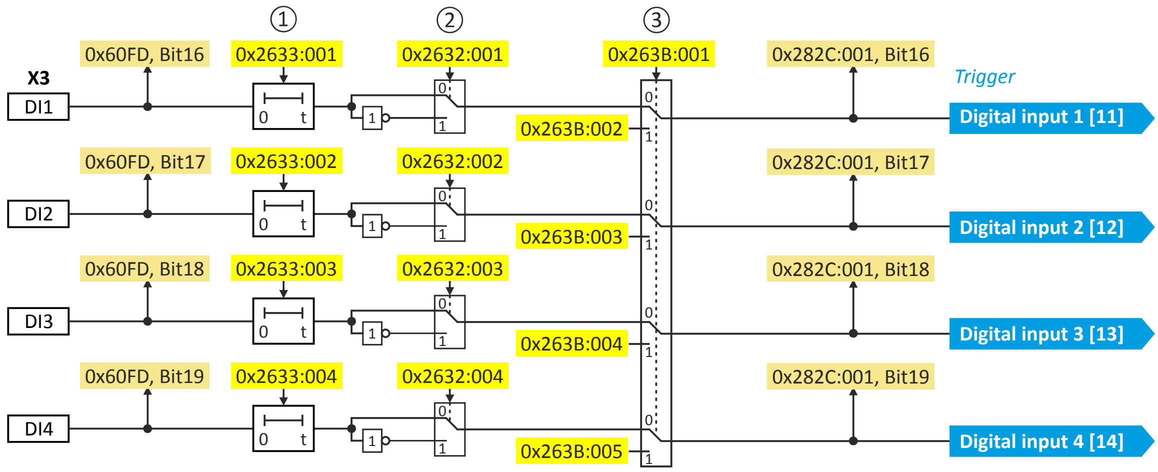
Settings for digital input 1 ... 4.

Details

The digital inputs are used for control tasks. For this purpose, the digital inputs are available as selectable triggers for functions.

The following settings are possible for the digital inputs:

- Debounce time ①
- Inversion ②
- Manual I/O control ③



Diagnostic parameters:

- Display of the logic state of the digital inputs:

Debounce time

For minimising interference pulses, a debounce time of 1 ms is set for all digital inputs.
Via »EASY Starter« (or network), the debounce time for can be increased individually for each digital input to maximally 50 ms.

Inversion

Each digital input can be configured in such a way that the status pending at the terminal is internally inverted logically. This way, a closed contact, for instance, serves to deactivate an assigned function instead of activating it. Thus, the control of the inverter can be flexibly adapted to the requirements of the actual application.

Manual I/O control

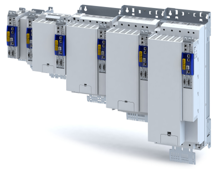
Each digital input can be overridden manually. After the function is activated, the actual values are "frozen". Afterwards, each digital input can be overwritten manually.

Setting:

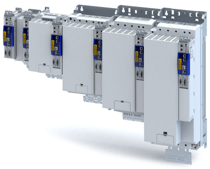
- Activation for all digital inputs: 0x263B:001
- Entering the individual manual values: 0x263B:002 ... 0x263B:005

Parameter

Address	Name / setting range / [default setting]		Info
0x2632:001	Inversion of digital inputs: Digital input 1		Inversion of digital input 1
	0	**Not inverted**	
	1	Inverted	
0x2632:002	Inversion of digital inputs: Digital input 2		Inversion of digital input 2
	0	**Not inverted**	
	1	Inverted	



Address	Name / setting range / [default setting]		Info
0x2632:003	Inversion of digital inputs: Digital input 3		Inversion of digital input 3
	0	**Not inverted**	
	1	Inverted	
0x2632:004	Inversion of digital inputs: Digital input 4		Inversion of digital input 4
	0	**Not inverted**	
	1	Inverted	
0x2633:001	Digital input debounce time: Digital input 1 0 ... [**0**] ... 50 ms		Debounce time of digital input 1
0x2633:002	Digital input debounce time: Digital input 2 0 ... [**0**] ... 50 ms		Debounce time of digital input 2
0x2633:003	Digital input debounce time: Digital input 3 0 ... [**0**] ... 50 ms		Debounce time of digital input 3
0x2633:004	Digital input debounce time: Digital input 4 0 ... [**0**] ... 50 ms		Debounce time of digital input 4
0x263B:001	Digital inputs internal control: Activation		
	0	**Aus**	
	1	Ein	
0x263B:002	Digital inputs internal control: DI1 internal control		
	0	**Aus**	
	1	Ein	
0x263B:003	Digital inputs internal control: DI2 internal control		
	0	**Aus**	
	1	Ein	
0x263B:004	Digital inputs internal control: DI3 internal control		
	0	**Aus**	
	1	Ein	
0x263B:005	Digital inputs internal control: DI4 internal control		
	0	**Aus**	
	1	Ein	



14.2 Configure analog inputs

14.2.1 Analog input 1

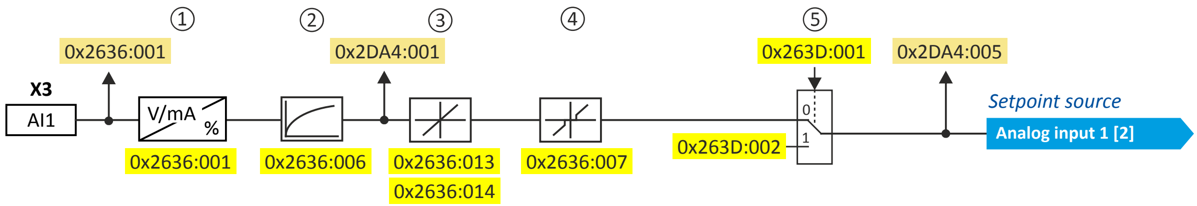
Settings for analog input 1.

Details

The analog input 1 can be used as setpoint source.

The following settings are possible for the analog input:

- Definition of the input range ①
- Filter time for low-pass filters ②
- Definition of the setting range (min/max range)③
- Dead band for eliminating the smallest signal levels ④
- Manual I/O control ⑤



Diagnostic parameters:

- Display of the input signal status:
  - 24-V supply status
  - Calibration status
  - Input current status
  - Input voltage status
- Display of filtered input signal in %:
- Display of setpoint in %: 0x2DA4:005

Definition of the input range

The analog input can be configured as voltage or current input. Internally, the signal is always converted to a value in percent.

Definition of the setting range

The setting range results from the set min and max value for the respective mode.

Manual I/O control

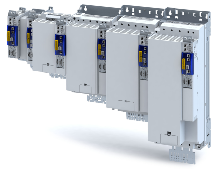
The analog input can be overridden manually. After the function is activated, the actual values are "frozen". Afterwards, each analog input can be overwritten manually.

Setting:

- Activation: 0x263D:001
- Entering the manual value: 0x263D:002

Parameter

Address	Name / setting range / [default setting]		Info
0x2636:001	Analog input 1: Input range		Definition of the input range.
	0	**0 ... 10 VDC**	
	3	-10 ... +10 VDC	
	4	4 ... 20 mA	
	5	0 ... 20 mA	
0x2636:006	Analog input 1: Filter time 0 ... [**10**] ... 10000 ms		PT1 time constant for low-pass filter. • By the use of a low-pass filter, the impacts of noise to an analog signal can be minimised. • For an optimum filter effect, first the noise frequency has to be determined. The time constant then has to be set so that it equals the reciprocal value of the double frequency.



Address	Name / setting range / [default setting]		Info
0x2636:007	Analog input 1: Dead band 0.0 ... [**0.0**] ... 100.0 %		Optional setting of a dead band that is placed symmetrically around the frequency zero point. • If the analog input value is within the dead band, the output value for the motor control is set to "0". • 100 % ≡ maximum value of analog input (, ,) • Example: Dead band 10% of 50Hz: -10V … 10V dead band -5Hz … 5 Hz, 0 … 10V dead band 0Hz … 5 Hz
0x2636:010	Analog input 1: Error response		Error response for analog input 1. Associated error code: • 28801 | 0x7081 - Analog input 1 fault
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	
0x2636:013	Analog input 1: Minimum value for scaling -200.0 ... [**0.0**] ... 200.0 %		Minimum value in percent for scaling the value at the analog input (Value in percent ()).
0x2636:014	Analog input 1: Maximum value for scaling -200.0 ... [**100.0**] ... 200.0 %		Maximum value in percent for scaling the value at the analog input (Value in percent ()).
0x2DA4:005	Diagnostics of analog input 1: Scaled percent value • Read only: x.xx %		Current value of the analog input is resolved with 2 decimal places. Display of the actual value at the analog input, scaled with the following parameters: • **Minimum value for scaling**. ▶ 0x2636:013 • **Maximum value for scaling**. ▶ 0x2636:014
0x263D:001	Analog inputs internal control: Activation		
	0	**Aus**	
	1	Ein	
0x263D:002	Analog inputs internal control: AI1 internal control -200.00 ... [**100.00**] ... 200.00 %		

14.3 Configure digital outputs

14.3.1 Digital output 1

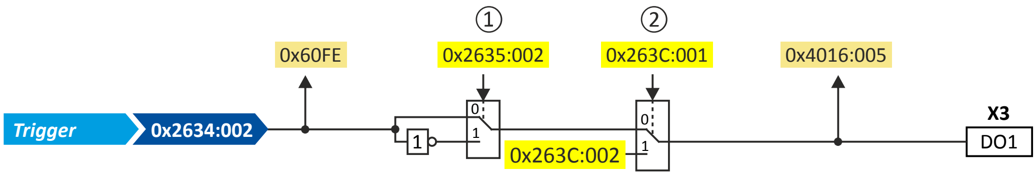
Settings for digital output 1.

Details

The digital output 1 is controlled with the trigger selected in .

The following settings are possible for the digital output:

- Inversion ①
- Manual I/O control ②



Diagnostic parameters:

- Display of the logic state of the trigger signal:
- Display of the logic state of the digital output: 0x4016:005

Inversion

The trigger signal of the digital output can be internally inverted logically.

Manual I/O control

The digital output can be overridden manually. After the function is activated, the actual values are "frozen". Afterwards, each digital output can be overwritten manually.

Setting:

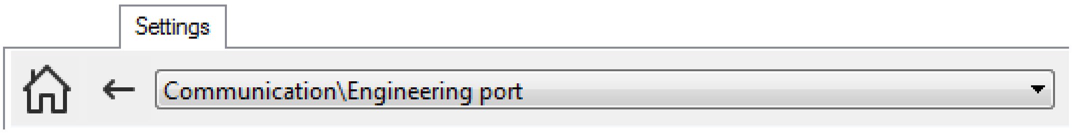
- Activation: 0x263C:001
- Entering the manual value: 0x263C:002

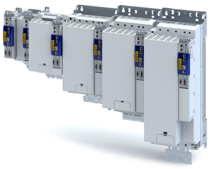
Parameter

Address	Name / setting range / [default setting]		Info
0x2635:002	Inversion of digital outputs: Digital output 1		Inversion of digital output 1
	0	**Not inverted**	
	1	Inverted	
0x4016:005	Digital output 1: Terminal state • Read only		Display of the logic state of output terminal X3/DO1.
	0	FALSE	
	1	TRUE	
0x263C:001	Digital outputs internal control: Activation		
	0	**Aus**	
	1	Ein	
0x263C:002	Digital outputs internal control: DO1 internal control		
	0	**Aus**	
	1	Ein	

15 Configure engineering port

The given path leads you to the engineering port.





15.1 Basic setting

Preconditions

- The wired communication with the inverter has been established.
  - If this condition is not met, read more detailed notes in section "Generate a connection between inverter and »EASY Starter«". 📖 30
- The PC with the installed »EASY Starter« is started.

Automatic configuration

By default, the engineering port of the inverter receives its IP address automatically from a DHCP server. By pressing the "DHCP" button, the 0x2451:004 parameter is active ("enabled").

Now, the IP configuration is completed. The inverter can be accessed via the Ethernet connection.

Manual configuration

Make sure to press the "Restart with current values" button every time you change the values.

The engineering port must be configured when a static address is to be assigned.

For this purpose, the "DHCP" button must bet set to the "Disabled" state.

The following parameters can be entered in the »EASY Starter«:

- IP address
- Network mask
- Gateway address

Using a configuration file

A file named "ip.txt" can be used to reset the IP address. This file must be stored on the SD card in the root directory.

The network settings are evaluated and accepted when the inverter is started. The file is then renamed as "ip_old.txt".

The structure of the text file can look as follows:

- *192.168.101.221*
- *255.255.255.0*
- *192.168.101.1*

If the static IP address is to be reset to DHCP, only the content of the ip.txt file must be set to "DHCP". This serves to use DCHP for a dynamic address allocation at next boot.

Parameter

Address	Name / setting range / [default setting]		Info
0x2450	Engineering port control		Activation of the engineering port settings (Ethernet).
	0	**No action/No error**	
	1	Restart with current values	
	10	Busy	
	11	Cancelled	
	12	Faulted	
0x2451:001	Engineering port settings: IP address 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the IP address. The default setting 276605120 corresponds to the IP address 192.168.124.16. • 276605120 = 0x107CA8C0 → 0xC0.0xA8.0x7C.0x10 = 192.168.124.16
0x2451:002	Engineering port settings: Subnet 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the subnet mask. The default setting 16777215 corresponds to the subnet mask 255.255.255.0. • 16777215 = 0xFFFFFF → 0xFF.0xFF.0xFF.0x00 = 255.255.255.0

Address	Name / setting range / [default setting]		Info
0x2451:003	Engineering port settings: Gateway 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the gateway address. Example: The setting 276344004 corresponds to the gateway address 196.172.120.16. • 276344004 = 0x1078ACC4 → 0xC4.0xAC.0x78.0x10 = 196.172.120.16
0x2451:004	Engineering port settings: DHCP		Use (enable) of the Dynamic Host Configuration Protocol (DHCP).
	0	Disabled	
	1	**Enabled**	
0x245B:001	System time: Time base		
	0	**NTP**	
	1	EtherCAT distributed clock	
	2	Manual input	
0x245B:002	System time: Current time 0 ... [] ... 18446744073709551615 ns		

15.2 NTP server addresses

Parameter

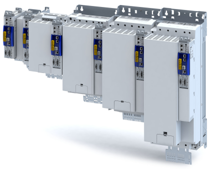
Address	Name / setting range / [default setting]		Info
0x245A:001	NTP server addresses: Activate NTP server addresses		
	0	**No action/no error**	
	1	Restart with current values	
	10	In progress	
	11	Action cancelled	
	12	Fault	
0x245A:002	NTP server addresses: NTP server address 1 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		
0x245A:003	NTP server addresses: NTP server address 2 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		
0x245A:004	NTP server addresses: NTP server address 3 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		
0x245A:005	NTP server addresses: NTP server address 4 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		

15.3 Diagnostics

The network settings can be diagnosed as follows:

Parameter

Address	Name / setting range / [default setting]	Info
0x2452:001	Active engineering port settings: IP address • Read only	Display of the active IP address.
0x2452:002	Active engineering port settings: Subnet • Read only	Display of the active subnet mask.
0x2452:003	Active engineering port settings: Gateway • Read only	Display of the active gateway address.
0x2452:005	Active engineering port settings: MAC address • Read only	Display of the MAC-ID.

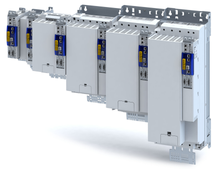


16 Configuring the network

The inverter supports the Device profile CiA 402. 282

The following network options are available for the inverter:

- PROFINET 320
- EtherCAT system bus (on board) 332



16.1 Device profile CiA 402

The CiA® 402 device profile defines the functional behaviour of stepping motors, servo drives, and frequency inverters. In order to be able to describe the different drive types, various operating modes and device parameters are specified in the device profile. Each operating mode provides objects (e.g. for the setpoint speed, acceleration and deceleration) to generate the desired drive behaviour.

- CiA® is a registered community trademark of the CAN in Automation e. V user organisation.
- More information can be found in the CiA 402 specification(CANopen device profile for drives and Motion Control) of the CAN in Automation (CiA) user organisation: http://www.can-cia.org

16.1.1 Supported operating modes

The inverter supports the following CiA 402 operating modes:

CiA 402 operating modes	Can be used with	
	Servo control	V/f characteristic control
Operating mode "CiA 402 Cyclic sync position mode (csp)" 124	●	-
Operating mode "CiA 402 Velocity mode (vl)" 138	●	●
Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 143	●	●
Operating mode "CiA 402 Cyclic sync torque mode (cst)" 157	●	-

A CiA 402 operating mode can be activated via 0x6060.

Parameter

Address	Name / setting range / [default setting]		Info
0x6060	Modes of operation		Selection of the operating mode.
	0	**No mode change/no mode assigned**	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode ▸ Operating mode "CiA 402 Velocity mode (vl)" 138
	8	Cyclic sync position mode	▸ Operating mode "CiA 402 Cyclic sync position mode (csp)" 124
	9	Cyclic sync velocity mode	▸ Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 143
	10	Cyclic sync torque mode	▸ Operating mode "CiA 402 Cyclic sync torque mode (cst)" 157
0x6061	Modes of operation display • Read only		Display of the current operating mode.
	-11	Identification	
	-10	Test mode	
	0	No mode change/no mode assigned	No operating mode (standstill)
	2	CiA: Velocity mode	CiA 402 velocity mode
	8	Cyclic sync position mode	
	9	Cyclic sync velocity mode	
	10	Cyclic sync torque mode	
0x6502	Supported drive modes • Read only		Bit coded display of the operating modes supported.
	Bit 1	CiA: Velocity mode	1 ≡ CiA 402 velocity mode is supported.
	Bit 7	Cyclic sync position mode	1 ≡ Cyclic sync position mode is supported.
	Bit 8	Cyclic sync velocity mode	1 ≡ Cyclic sync velocity mode is supported.
	Bit 9	Cyclic sync torque mode	1 ≡ Cyclic sync torque mode is supported.

16.1.2 Basic setting

Set the following parameters.

Parameter

Address	Name / setting range / [default setting]		Info
0x605A	Quick stop option code		Device status after exiting the quick stop ramp. • Setting is only effective in the operating mode 0x6060 = "CiA: Velocity mode [2]".
	2	**Quick stop ramp > switch-on inhibited**	Automatic change to the "Switch-on inhibited" device state. • The "Quick stop active [54]" status is reset to FALSE after ramp-down to standstill.
	6	Quick stop ramp > quick stop active	The inverter remains in the "Quick stop active" device state. • The "Quick stop active [54]" status remains TRUE until the "Quick stop" function is activated.
0x605B	Shutdown option code		Defines the transition from the status "Operation enabled" to "Ready to start".
	0	**Disable drive function**	0: Immediate inverter disable (standard setting)
	1	Slow down on quick stop ramp and disable drive fun	1: "Quick stop" with subsequent inverter disable.
0x605E	Fault reaction option code		Selection of the response to faults.
	-2	**DC braking**	If possible, the motor is braked to standstill with the "quick stop" function. If this is not possible (e. g. in case of an encoder error), reverse current braking or short-circuit braking are used for the braking process.
	0	Coasting	The motor becomes torqueless (coasts down to standstill).
	2	Quick stop	The motor is brought to a standstill with the "quick stop" function. • In the operating mode 0x6060 = "MS: Velocity mode [-2]", the deceleration time set in is effective. • In the operating mode 0x6060 = "CiA: Velocity mode [2]", the speed change set in 0x6085 is effective.
0x607E	Polarity 0 ... [**0**] ... 0 • Setting can only be changed if the inverter is inhibited.		Setting of the polarity of the position setpoint. 0 ≡ the position setpoint is interpreted as entered in 0x607A (Target position).
0x6085	Quick stop deceleration 0 ... [**2147483647**] ... 2147483647		Change in velocity used for deceleration to a standstill if quick stop is activated. • Setting is only effective in the operating mode 0x6060 = "CiA: Velocity mode [2]". • In operating mode 0x6060 = "MS: Velocity mode [-2]", the deceleration time set in is effective.

16.1.3 Process input data

Information on the CiA 402 process input data can be found in the following sections:

- Configure position control ▶ Process input data (CiA 402 objects) 📖 128
- Configure speed control ▶ Process input data (CiA 402 objects) 📖 149
- Configure torque control ▶ Process input data (CiA 402 objects) 📖 161

16.1.4 Process output data

Information on the CiA 402 process output data can be found in the following sections:

- Configure position control ▶ Process output data (CiA 402 objects) 📖 129
- Configure speed control ▶ Process output data (CiA 402 objects) 📖 151
- Configure torque control ▶ Process output data (CiA 402 objects) 📖 163

16.1.5 Commands for device state control

0x6040 (CiA: Controlword) can be used to trigger commands to put the inverter into a certain device state.

Command	Bit pattern in the CiA 402 control word (0x6040)							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Reset fault	Dependent on the operating mode			Operation enable	Activating quick stop	Establish readiness for opera-tion	Switch-on
	0	X	X	X	X	1	1	0
Switch on 285	0	X	X	X	0	1	1	1
Enable operation 286	0	X	X	X	1	1	1	1
Activate quick stop 287	0	X	X	X	X	0	1	X
	0	X	X	X	0	1	1	1
Pulse inhibit 288	0	X	X	X	X	X	0	X
Reset fault 289	0↗1	X	X	X	X	X	X	X
X = state is not relevant								

More Lenze-specific control bits (bit 8 ... 15)

Command	Bit pattern in the CiA 402 control word (0x6040)							
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
	Reserved	Release brake	Reserved	Dependent on the operating mode				Stop motor
Apply brake	X	0	X	X	X	X	X	X
Release brake	X	1	X	X	X	X	X	X
Stop motor	X	X	X	X	X	X	X	1
X = state is not relevant								

Detailed information on the various commands can be found in the following sections.

Parameter

Address	Name / setting range / [default setting]		Info
0x6040	CiA: Controlword 0x0000 ... [**0x0000**] ... 0xFFFF		Mappable CiA 402 control word with bit assignment according to device profile CiA 402.
	Bit 0	Switch on	1 = switch-on
	Bit 1	Enable voltage	1 = DC bus: Establish readiness for operation
	Bit 2	Quick stop	0 = activate quick stop
	Bit 3	Enable operation	1 = enable operation
	Bit 4	Operation mode specific	
	Bit 5	Operation mode specific	
	Bit 6	Operation mode specific	
	Bit 7	Fault reset	0-1 edge = reset error
	Bit 8	Halt	1 = stop motor (ramping down to frequency setpoint 0 Hz)
	Bit 9	Operation mode specific	Operating mode dependent
	Bit 14	Release holding brake	1 = releasing holding brake manually CAUTION! • The manually triggered "Release holding brake" command has a direct impact on the "Release holding brake [115]" trigger. Thus, the holding brake can be manually released if the power section is switched off. • The responsibility for a manual release of the holding brake has the external trigger source for the "Release holding brake" command. ▸ Holding brake control 219

Example

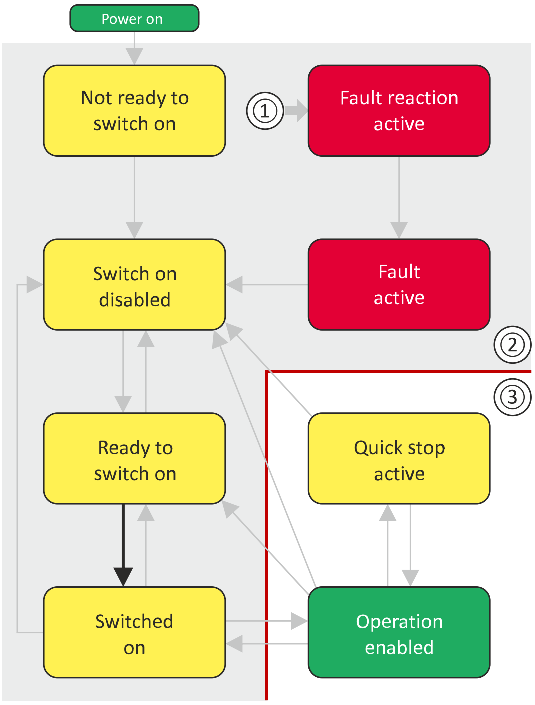
A PLC program of a PLCopen control can, for instance, trigger several commands for state changes in a row by the level change at the *bRegulatorOn* input of the "MC_Power" block.

In the mentioned example, these device commands are "" and "Switch on" in this order.

16.1.5.1 Switch on

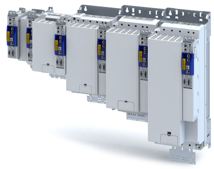
This command serves to deactivate the switch on inhibit which is active after switch on or after the reset (acknowledgement) of an error.

A changeover to the "Switched on" device status takes place.



A From all states
B Power section inhibited (pulse inhibit)
C Power section enabled

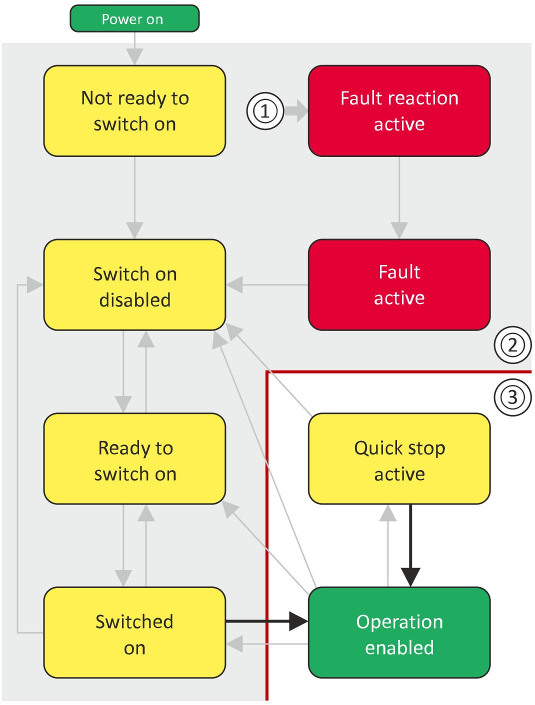
Bit pattern in the CiA 402 control word (0x6040)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Reset fault**	**Operating mode-dependent**			**Operation enabled**	**Activating quick stop**	**Establish readiness for operation**	**Switch-on**
X	0	X	X	X	0	1	1	1
X = state is not relevant								



16.1.5.2 Enable operation

This command enables the operation and stop an active quick stop again.

- A changeover to the "Operation enabled" device status takes place.
- The output stages of the inverter become active.



A From all states
B Power section inhibited (pulse inhibit)
C Power section enabled

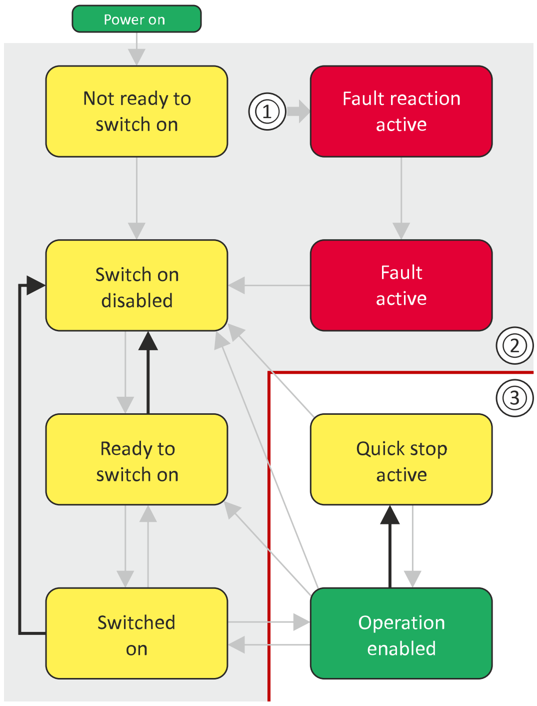
Bit pattern in the CiA 402 control word (0x6040)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Reset fault**	**Operating mode dependent**			**Operation enabled**	**Activating quick stop**	**Establish readiness for operation**	**Switch-on**
X	0	X	X	X	1	1	1	1
X = state is not relevant								

16.1.5.3 Activate quick stop

This command activates quick stop when the operation is enabled.

- The drive is brought to a standstill irrespective of the setpoint specified with the deceleration (0x6085) set for quick stop.
- A changeover to the "Quick stop active" device status takes place.
- Then, status change to the "Switch-on inhibited“ status in accordance with the default value parameter 0x605A "Quick stop option code".

If the operation is not enabled (device state "Ready to switch on" or "Switched on"), this command changes the state to "".



A From all states
B Power section inhibited (pulse inhibit)
C Power section enabled

Bit pattern in the CiA 402 control word (0x6040)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Reset fault**	**Operating mode dependent**			**Operation enabled**	**Activating quick stop**	**Establish readiness for operation**	**Switch-on**
X	0	X	X	X	X	1	1	X
X = state is not relevant								

- During quick stop, the inverter executes the setpoint generation and no longer follows the setpoint defined by the network master.
- If several inverters execute a chained synchronous motion, the quick stop function has to be coordinated by the network master by means of a quick stop profile (master function). In this case, quick stop cannot be activated via the control bit 2.
- During the quick stop, the current limit (0x6073) and the torque limit (0x6072) are active. The lower of the two limits determines the motor output torque. The torque limits from 0x60E0 and 0x60E1 are not effective during the quick stop.

16.1.5.4 Pulse inhibit

This command disables the output stages of the inverter.

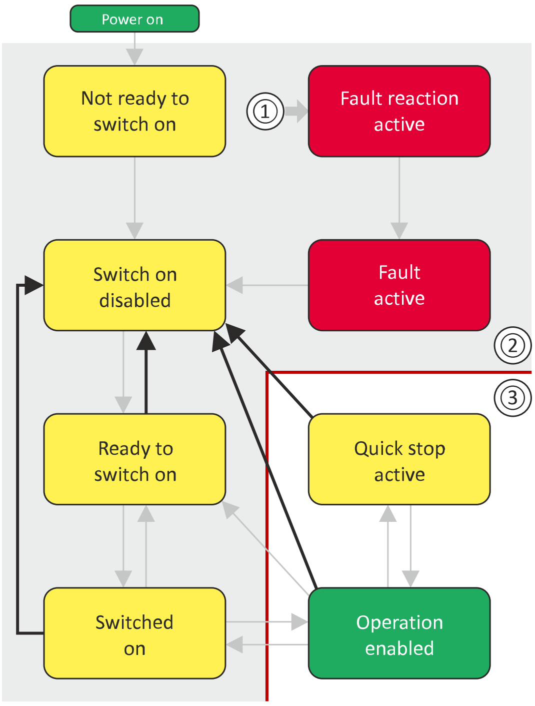
- The pulse inhibit is activated (pulses of the inverter are inhibited) if not already active.
- The motor becomes torqueless.
- A changeover to the "Switch-on inhibited" device state takes place.

⚠ DANGER!

Uncontrolled movement

If the motor becomes torqueless, a load that is connected to motors without a holding brake may cause uncontrolled movements!

► Without a load, the motor will coast.



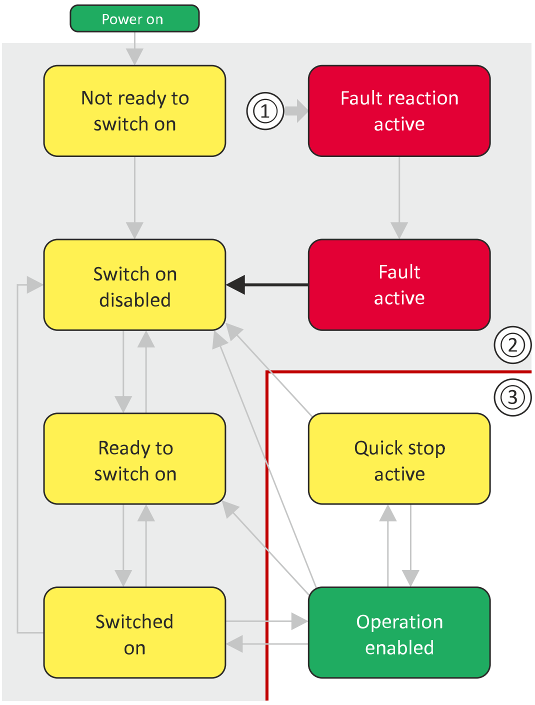
A From all states
B Power section inhibited (pulse inhibit)
C Power section enabled

Bit pattern in the CiA 402 control word (0x6040)								
Bit 15 ... 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved (specific)	Reset fault	Operating mode dependent			Operation enabled	Activating quick stop	Establish readiness for operation	Switch-on
X	0	X	X	X	X	X	0	X
X = state is not relevant								

16.1.5.5 Reset fault

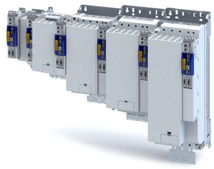
This command resets a pending fault if the cause of the fault has been eliminated.

- The pulse inhibit remains active (pulses of the inverter are inhibited).
- A changeover to the "Switch-on inhibited" device status takes place (switch-on inhibit remains active).



A From all states
B Power section inhibited (pulse inhibit)
C Power section enabled

Bit pattern in the CiA 402 control word (0x6040)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Reset fault**	**Operating mode dependent**			**Operation enabled**	**Activating quick stop**	**Establish readiness for operation**	**Switch-on**
X	0↗1	X	X	X	X	X	X	X
X = state is not relevant								



16.1.6 Device states

0x6041 (CiA: Statusword) displays the current device status of the inverter.

Device status	Bit pattern in the CiA 402 status word (0x6041)							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Warning is active	Operation inhibited	Quick stop active	DC bus ready for operation	Fault active	Operation enabled	Switched on	Ready to switch on
Not ready to switch on 🕮 292	X	1	X	X	0	0	0	0
Switch-on inhibited 🕮 293	X	1	X	X	0	0	0	0
Ready to switch on 🕮 294	X	1	1	X	0	0	0	1
Switched on 🕮 295	X	1	1	X	0	0	1	1
Operation enabled 🕮 296	X	0	0	X	0	1	1	1
Quick stop active 🕮 297	X	0	1	X	0	1	1	1
Fault reaction active 🕮 298	X	0	X	X	1	1	1	1
Trouble 🕮 299	X	1	X	X	1	0	0	0
X = state is not relevant								

Status bit 7: "Warning active"

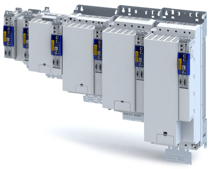
Status bit 7 indicates a warning.

- A warning does **not** cause a state change.
- Warnings do not need to be reset.

More Lenze-specific status bits (bit 8 ... 15)

Device status	Bit pattern in the CiA 402 status word (0x6041)							
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
	Not active	Brake released	Following error is active	Drive follows setpoint selection	Internal limitation is active	Target position reached	Control word processed successfully	RPDOs deactivated
Brake applied	X	0	X	X	X	X	X	X
Brake released	X	1	X	X	X	X	X	X
Active	0	X	X	X	X	X	X	X
not active	1	X	X	X	X	X	X	X
X = state is not relevant								

Detailed information on the various device states can be found in the following sections.



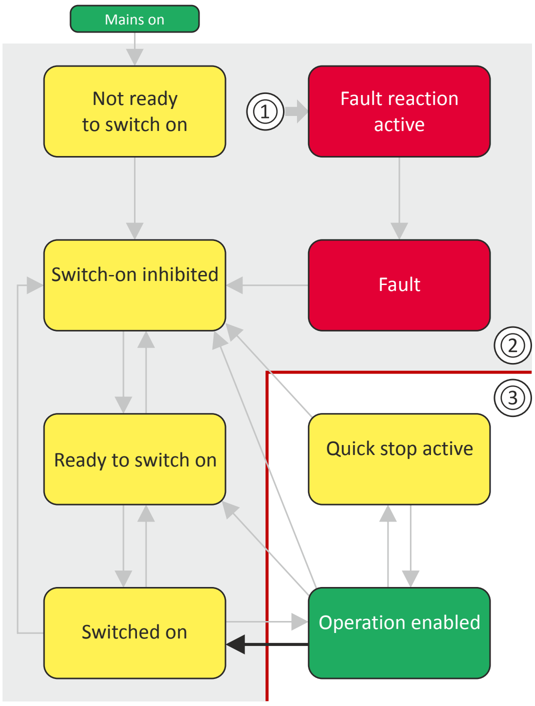
Parameter

Address	Name / setting range / [default setting]		Info
0x6041	CiA: Statusword • Read only		Mappable CiA 402 status word with bit assignment according to device profile CiA 402.
	Bit 0	Ready to switch on	1 ≡ drive ready to start
	Bit 1	Switched on	1 ≡ drive switched-on
	Bit 2	Operation enabled	1 ≡ operation enabled
	Bit 3	Fault	1 ≡ fault or trouble active
	Bit 4	Voltage enabled	1 ≡ DC bus ready for operation
	Bit 5	Quick stop	0 ≡ quick stop active
	Bit 6	Switch on disabled	1 ≡ operation inhibited
	Bit 7	Warning	1 ≡ warning active
	Bit 8	RPDOs deactivated	1 ≡ cyclic PDOs have been deactivated.
	Bit 9	Remote	1 ≡ inverter can receive commands via network. • Bit is not set in the operating mode 0x6060 = "MS: Velocity mode [-2]".
	Bit 10	Target reached	1 ≡ the actual position is in the window.
	Bit 11	Internal limit active	1 ≡ internal limitation of a setpoint active.
	Bit 12	Operation mode active	1 ≡ operation enabled and no test mode activated. (no internal setpoint generation active.)
	Bit 13	Following error	1 ≡ following error active
	Bit 14	Holding brake released	1 ≡ holding brake released
	Bit 15	Integrated safety not active	0 ≡ the inverter has been disabled by the integrated safety system 1 ≡ the integrated safety system is not active Not available with i410 and i510 (always TRUE).

16.1.6.1 Not ready to switch on

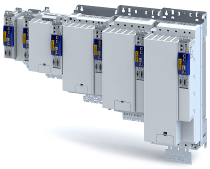
This is the device state of the inverter directly after switching on the supply voltage.

- In this device status, the device is initialised.
- Communication is not possible yet.
- The inverter cannot be parameterised yet and no device commands can be carried out yet.
- The motor brake, if available, is closed.
- Operation is inhibited.



1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	0	X	X	0	0	0	0
X = state is not relevant								

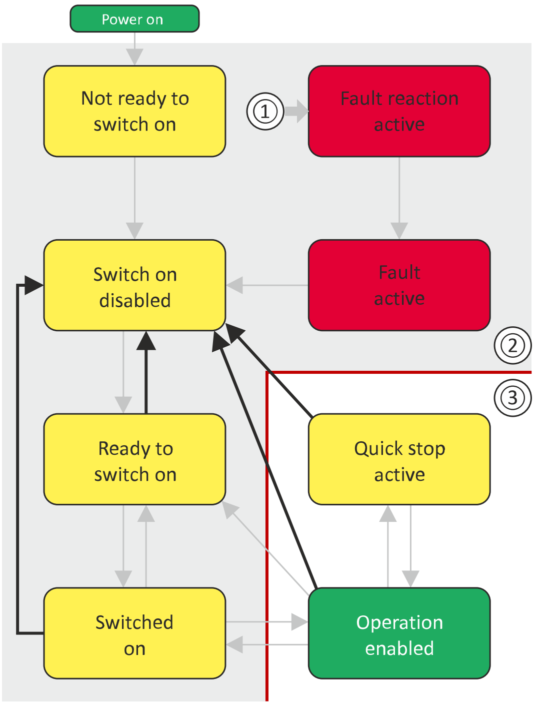


16.1.6.2 Switch-on inhibited

This is the device state of the inverter after the device has been initialised successfully.

A change to this state also takes place when the EtherCAT bus is in "Operational" state or the PDO communication via 0x2824 (Control selection) is deactivated.

- Process data monitoring is active.
- Communication is possible.
- The DC-bus voltage can be present.
- The inverter can be parameterised.
- If the internal holding brake control (0x2820:001) is active in the inverter, the motor brake is closed.
- Operation is inhibited.



1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

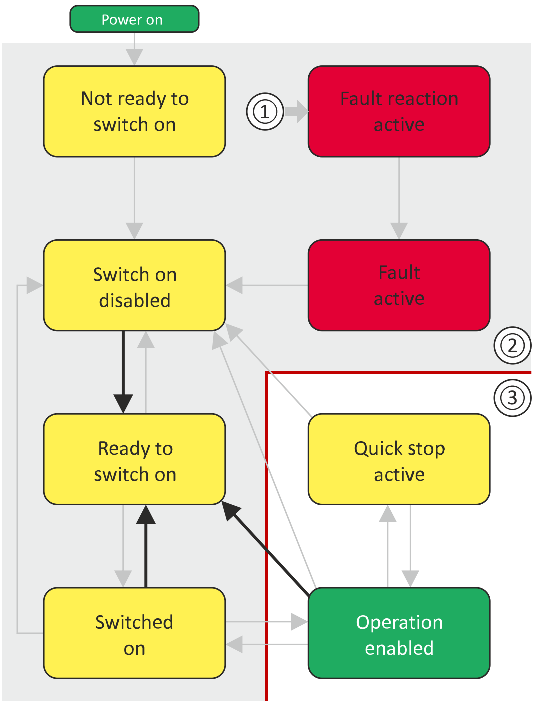
Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	1	X	X	0	0	0	0
X = state is not relevant								

16.1.6.3 Ready to switch on

This is the device state of the inverter after the device has been initialised successfully and after the command has been triggered.

A change to this device state also takes place if the "" command was triggered in the states "Switched on" or ".

- Process data monitoring is active.
- Communication is possible.
- The DC-bus voltage is available.
- The inverter can be parameterised.
- If the internal holding brake control (0x2820:001) is active in the inverter, the motor brake is closed.
- Operation is inhibited.



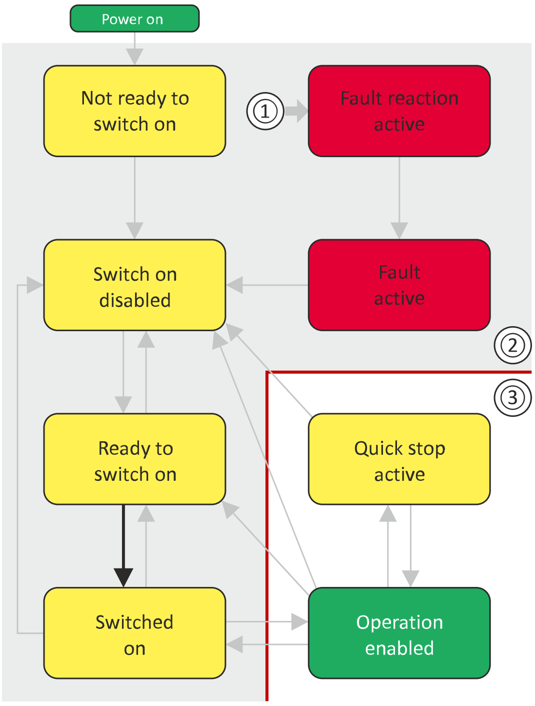
1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved (specific)	Warning active	Operation inhibited	Quick stop active	DC bus ready for operation	Fault active	Operation enabled	Switched on	Ready to switch on
X	X	0	1	X	0	0	0	1
X = state is not relevant								

16.1.6.4 Switched on

This is the device state of the inverter after the "Switch on" command has been triggered in the "Ready to switch on" device state.

- Process data monitoring is active.
- Communication is possible.
- The DC-bus voltage is available.
- The inverter can be parameterised.
- If the internal holding brake control (0x2820:001) is active in the inverter, the motor brake is closed.
- Operation is inhibited.



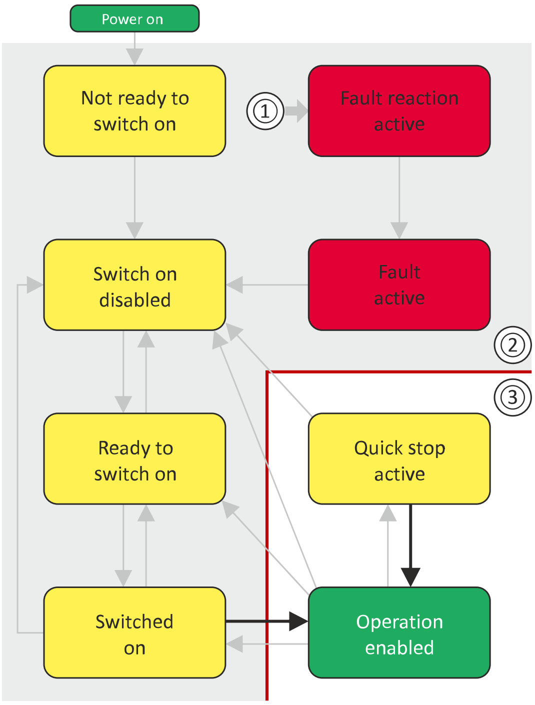
1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	1	1	X	0	0	1	1
X = state is not relevant								

16.1.6.5 Operation enabled

This device state represents normal operation. Operation in the selected operating mode is enabled and no errors have occurred.

- Only the parameters of the inverter can be changed that do not require an inverter disable.
- A motor brake, if any, is open if the automatic operation of the holding brake control is activated (0x2820:001 = 0).
- The drive control is active.



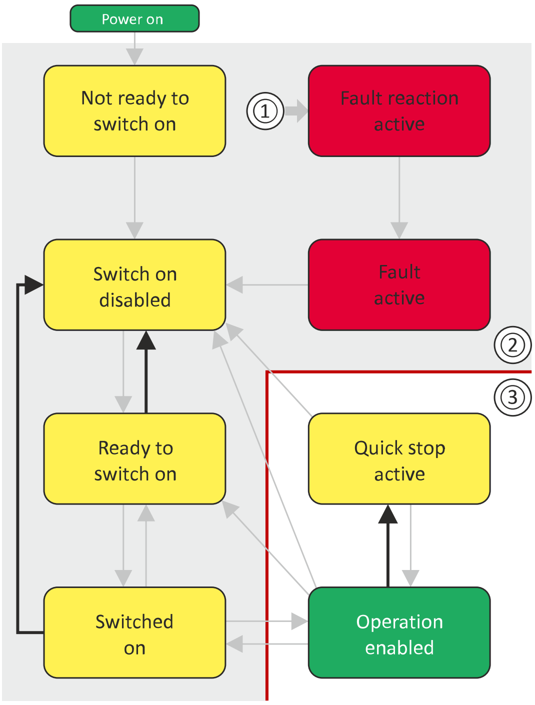
1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	0	1	X	0	1	1	1
X = state is not relevant								

16.1.6.6 Quick stop active

This device state is active if quick stop is executed or active.

- Only the parameters of the inverter can be changed that do not require an inverter disable.
- If the internal holding brake control (0x2820:001) is active in the inverter, the motor brake is closed.
- The drive control is active.



1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	0	0	X	0	1	1	1
X = state is not relevant								

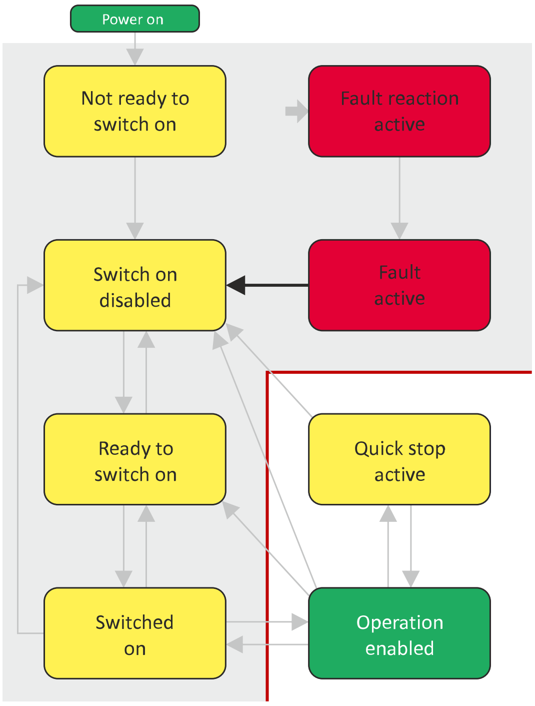
The "Enable operation" command stops an active quick stop.

16.1.6.7 Fault reaction active

This device state becomes active if a minor fault occurs. This means that the inverter is still able to drive the motor in a controlled way.

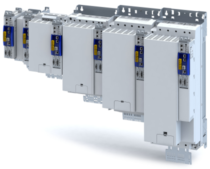
- The inverter is brought to a standstill irrespective of the setpoint specified with the deceleration (0x6085) set for quick stop.

  If the inverter is at standstill, a change to the "Trouble" device state take place automatically.
- Only the parameters of the inverter can be changed that do not require an inverter disable.
- If the internal holding brake control (0x2820:001) is active in the inverter, the motor brake is closed.
- The drive control is active.



1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

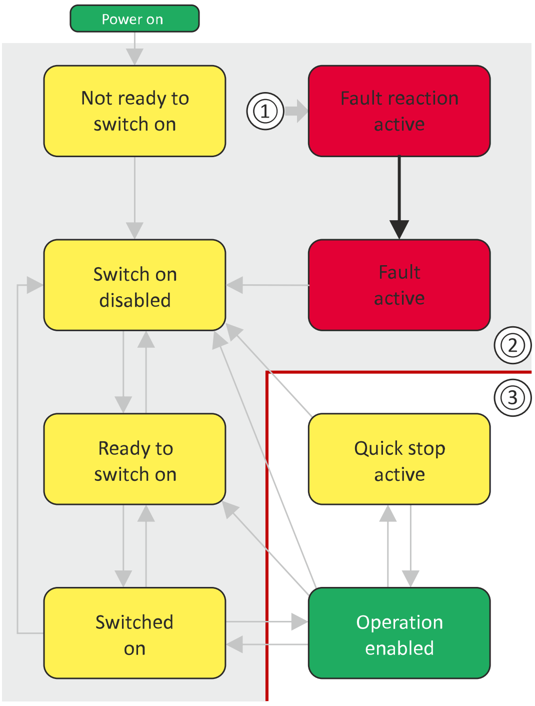
Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	0	X	X	1	1	1	1
X = state is not relevant								



16.1.6.8 Trouble

This device state becomes active if a serious system fault occurs. This means that the inverter is no longer able to drive the motor in a controlled way. The inverter is switched off immediately.

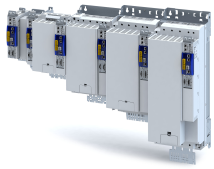
- The pulse inhibit is active (pulses of the inverter are inhibited).
- The motor is torqueless.
- The motor brake, if available, is closed.
- Operation is inhibited.
- The inverter can be parameterised.



1 From all states
2 Power section inhibited (pulse inhibit)
3 Power section enabled

Bit pattern in the CiA 402 status word (0x6041)								
Bit 15 ... 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved (specific)	**Warning active**	**Operation inhibited**	**Quick stop active**	**DC bus ready for operation**	**Fault active**	**Operation enabled**	**Switched on**	**Ready to switch on**
X	X	0	X	X	1	0	0	0
X = state is not relevant								

This device state can only be left with the "Reset fault" command if the cause of the fault has been removed.



16.2 EtherCAT

EtherCAT® (Ethernet for Controller and Automation Technology)is an Ethernet-based fieldbus system which fulfils the application profile for industrial realtime systems.

- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- Detailed information on EtherCAT can be found on the web page of EtherCAT Technology Group (ETG): http://www.ethercat.org
- Information about the dimensioning of an EtherCAT network can be found in the configuration document for the inverter.

Preconditions

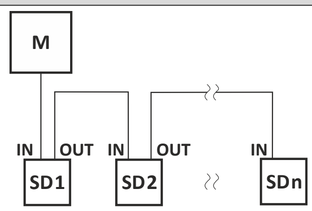
- The inverter is equipped with the EtherCAT option.
- For commissioning, the »PLC Designer« and current device description files for EtherCAT are available:
  - Download »PLC Designer«
  - Download XML/ESI files for Lenze devices

Preconditions

The inverter is equipped with the "EtherCAT" network option.

Typical topology

Line



M	Master
SD	Slave Device

16.2.1 Commissioning

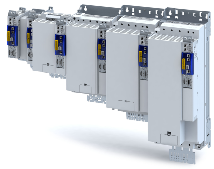
During commissioning, the EtherCAT master operates as gateway to access from the Engineering PC to the slaves.

In the following, the required steps are described to control the device as EtherCAT slave.

Preconditions

- The inverter is networked as EtherCAT slave to an EtherCAT master and, if necessary, further EtherCAT devices.

  See "Typical topologies" under: ▶ EtherCAT 📖 300
- The entire wiring has already been checked for completeness, short circuit and earth fault.
- All EtherCAT devices are supplied with voltage and are switched on.
- An Engineering PC with installed »PLC Designer« is connected to the master.
  - Download »PLC Designer«
- A »PLC Designer« project with current device description files for EtherCAT is available.
  - Download XML/ESI files for Lenze devices
  - The files are installed via the device repository of the »PLC Designer« (menu command "Tools → Device repository").



Commissioning steps

How to configure the network:

> In the default setting, the digital input DI1 is assigned the "Run" function. If the network control is activated, this function serves as "start enable" for start commands via network. Hence, the digital input DI1 must be set to the HIGH level in order that the motor can be started via the network.

1. **Configure gateway function of the master**
   1. Start »PLC Designer«.
   2. Open or recreate a »PLC Designer« project.
   3. Open the "Communication settings" tab of the master.
   4. Click "Add gateway".

      Do the following in the appearing dialog window:

      a) Enter the IP address of the master.

      b) Confirm the entry with "OK".
   5. Click "Search network".
   6. Select the corresponding master for the previously entered IP address.
   7. Click "Set active path".
   8. Log into the master using the "Online → Log in" menu command or with <Alt>+<F8>.

      Now you can access the slaves from the Engineering PC via the EtherCAT master as gateway.
2. **Carry out network scan.**
   1. Execute the "Start Search" command in the context menu of the master.

      The appearing dialog box lists all available EtherCAT devices according to the physical order in the network.
   2. Click "Copy all devices into the project".

      The physical network structure is reproduced in the »PLC Designer« project.

> A proper operation requires that the network topology generated in the project corresponds to the physical order of the EtherCAT nodes in the network. Otherwise, an error message displays which slave (product code) is to be expected at which position.

3. **Integrate L_MC1P_BasicActuatingSpeed functional module**
   1. Open the PLC program code (PLC_PRG).
   2. Open the **Input Help** in the lower input area by right clicking via the context menu.
   3. Open the category ***Function blocks***.
   4. Select the element

      L_MC1_P → L_MC1_P_MotionControlBasic → 1_POUs → PLCopenAdditional and then the function block ***L_MC1P_BasicActuatingSpeed***. Click OK.
   5. Enter a variable name in the "Declare variables" dialog box.
   6. Close the dialogue box by clicking on the ***OK*** button.

      The ***L_MC1P_BasicActuatingSpeed*** function block together with its data structure is now integrated in the PLC program code.
   7. Open the ***L_MC1P_BasicActuatingSpeed*** function block and set the reference to the axis data structure (Axis:=i550_Motion_Axis).

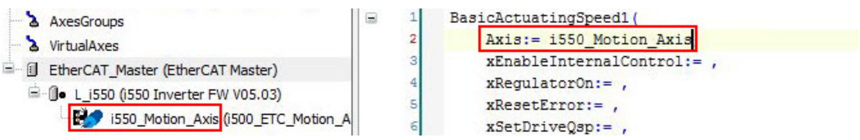


Fig. 49: Assign axis

   8. Open the Application context menu in the device tree for ***Application***, select the command ***Add object → Visualisation ...*** and insert the visualization of the function block.
   9. Insert a frame into the visualization using the ***Frame tool*** (Basic tab).

10. To the frame visualisation, add the function block ***L_MC1P_BasicActuatingSpeed*** and close the dialogue box by clicking the ***OK*** button.
11. Under ***Properties***, select the reference of the function block with which the visualisation should be linked.

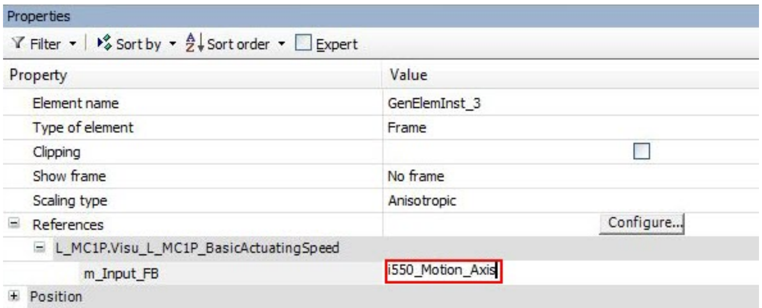


Fig. 50: Select reference

4. **Adapt EtherCAT device to the application**
   1. Select the axis movement of the i550.

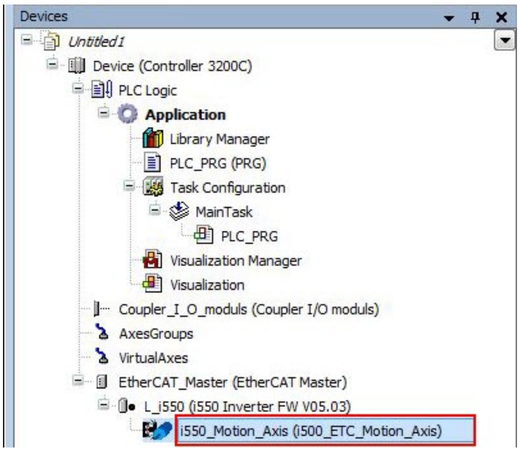
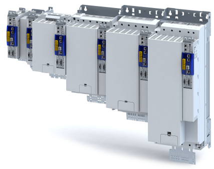


Fig. 51: Select i550

   2. In case of "Switch on axis", select ***Simple [0]*** for the use of the axis L_MC1P_BasicActuatingSpeed.
   3. The following parameters need to be configured:
      Modes of operation 0x6060 = "CiA: Velocity mode [2]"
      Function list: Start = "Constant TRUE [1]"
5. **Adjust the parameter values of the inverter**
   1. Adapt parameter values under the "Settings" and "Parameter list" tabs.
   2. Set the PDO-Mapping under the “Process data” tab.
   3. Assign variable names under the "EtherCAT I/O image" by double-clicking the variable fields.
6. **Load the network configuration into the master**
   1. Log off: Menu command "Online → Log off" or <Ctrl>+<F8>.
   2. Compiling: Menu command "Build → Build" or <F11>.
   3. Log in: Menu command "Online → Log in" or <Alt>+<F8>.
      The configuration, the parameter settings and the PLC program are loaded into the master. Afterwards, all EtherCAT slaves are initialised.

> **i** These steps must be carried out after each change within the »PLC Designer« project. An already available configuration and an available PLC program in the master will then be overwritten.



Parameter

Address	Name / setting range / [default setting]		Info
0x5850:001	Kommandos für Systembus EtherCAT-Master: Kommunikation neu starten		
	0	**No action/no error**	
	1	Neustart	
	10	Busy	
	11	Cancelled	
	12	Faulted	

16.2.2 Basic setting and options

The content of this section is currently being processed.

16.2.2.1 Synchronisation with "distributed clocks" (DC)

The content of this section is currently being processed.

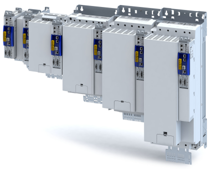
Parameter

Address	Name / setting range / [default setting]		Info
0x10F8	Actual time stamp • Read only: x ns		The time information currently used by the inverter (the device time, so to speak).
0x2580:001	Distributed Clocks: Real time status • Read only		Since its switch-on, the inverter has not yet received any real time information from outside. The inverter still works with a time based on the time of the last switch-off or the time stamp of the firmware.
	0	Not adjusted	Since its switch-on, the inverter has not yet received any real time information from outside.
	1	Adjusted once	
	2	Adjusted cyclically	
0x2580:002	Distributed Clocks: First setting time • Read only: x ns		Display of the time when the inverter has received a real time information from outside for the for first time after its switch-on. In the "No real time information received yet", the value "0" is displayed.
0x2580:003	Distributed Clocks: Newest setting time • Read only: x ns		Display of the time when the inverter has most recently received a real time information from outside.
0x2580:004	Distributed Clocks: Current time • Read only: x ns		Display of the time information currently used by the inverter (device time).

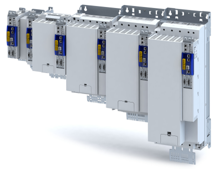
16.2.2.2 Parameterising additional functions

Parameter

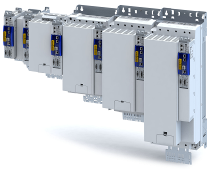
Address	Name / setting range / [default setting]	Info
0x2946:001	Speed limitation: Upper speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm	Upper limit for the speed limitation. • Setting is only effective with the selection "Upper speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]
0x2946:002	Speed limitation: Lower speed limit -479999.999776482 ... [**0**] ... 479999.999776482 rpm	Lower limit for speed limitation. • Setting is only effective with the selection "Lower speed limit [5]" in . • Entry via keypad and Lenze Tools is in rpm! • Via RPDO, the unit is vel. unit. and the scaling must be taken into account. • ± 480000 rpm = ±2 ^ 31 [n-unit]
0x2DD5	Torque setpoint • Read only: x.xx Nm	Display of the current torque setpoint.



Address	Name / setting range / [default setting]	Info
0x6040	CiA: Controlword 0x0000 ... [**0x0000**] ... 0xFFFF	Mappable CiA 402 control word with bit assignment according to device profile CiA 402.
	Bit 0 Switch on	1 = switch-on
	Bit 1 Enable voltage	1 = DC bus: Establish readiness for operation
	Bit 2 Quick stop	0 = activate quick stop
	Bit 3 Enable operation	1 = enable operation
	Bit 4 Operation mode specific	
	Bit 5 Operation mode specific	
	Bit 6 Operation mode specific	
	Bit 7 Fault reset	0-1 edge = reset error
	Bit 8 Halt	1 = stop motor (ramping down to frequency setpoint 0 Hz)
	Bit 9 Operation mode specific	Operating mode dependent
	Bit 14 Release holding brake	1 = releasing holding brake manually ⚠ CAUTION! • The manually triggered "Release holding brake" command has a direct impact on the "Release holding brake [115]" trigger. Thus, the holding brake can be manually released if the power section is switched off. • The responsibility for a manual release of the holding brake has the external trigger source for the "Release holding brake" command. ▸ Holding brake control 📖 219
0x6041	CiA: Statusword • Read only	Mappable CiA 402 status word with bit assignment according to device profile CiA 402.
	Bit 0 Ready to switch on	1 ≡ drive ready to start
	Bit 1 Switched on	1 ≡ drive switched-on
	Bit 2 Operation enabled	1 ≡ operation enabled
	Bit 3 Fault	1 ≡ fault or trouble active
	Bit 4 Voltage enabled	1 ≡ DC bus ready for operation
	Bit 5 Quick stop	0 ≡ quick stop active
	Bit 6 Switch on disabled	1 ≡ operation inhibited
	Bit 7 Warning	1 ≡ warning active
	Bit 8 RPDOs deactivated	1 ≡ cyclic PDOs have been deactivated.
	Bit 9 Remote	1 ≡ inverter can receive commands via network. • Bit is not set in the operating mode 0x6060 = "MS: Velocity mode [-2]".
	Bit 10 Target reached	1 ≡ the actual position is in the window.
	Bit 11 Internal limit active	1 ≡ internal limitation of a setpoint active.
	Bit 12 Operation mode active	1 ≡ operation enabled and no test mode activated. (no internal setpoint generation active.)
	Bit 13 Following error	1 ≡ following error active
	Bit 14 Holding brake released	1 ≡ holding brake released
	Bit 15 Integrated safety not active	0 ≡ the inverter has been disabled by the integrated safety system 1 ≡ the integrated safety system is not active Not available with i410 and i510 (always TRUE).
0x6042	Target velocity -32768 ... [**0**] ... 32767 rpm	Setpoint speed (velocity mode).
0x6043	Velocity demand • Read only: x rpm	Display of the setpoint velocity (velocity mode).
0x6044	Velocity actual value • Read only: x rpm	Display of the actual speed (velocity mode).
0x6046:001	Velocity min max amount: Velocity min amount 0 ... [**0**] ... 0 rpm	Minimum speed (velocity mode).
0x6046:002	Velocity min max amount: Velocity max amount 2147483647 ... [**2147483647**] ... 2147483647 rpm	Maximum speed (velocity mode).
0x6048:001	Velocity acceleration: Delta speed 0 ... [**0**] ... 2147483647 rpm	Acceleration: speed interval
0x6048:002	Velocity acceleration: Delta time 0 ... [**10**] ... 65535 s	Acceleration: time interval



Address	Name / setting range / [default setting]	Info
0x6049:001	Velocity deceleration: Delta speed 0 ... [**0**] ... 2147483647 rpm	Deceleration: speed interval
0x6049:002	Velocity deceleration: Delta time 0 ... [**10**] ... 65535 s	Deceleration: time interval
0x605A	Quick stop option code	Device status after exiting the quick stop ramp. • Setting is only effective in the operating mode 0x6060 = "CiA: Velocity mode [2]".
	2 **Quick stop ramp > switch-on inhibited**	Automatic change to the "Switch-on inhibited" device state. • The "Quick stop active [54]" status is reset to FALSE after ramp-down to standstill.
	6 Quick stop ramp > quick stop active	The inverter remains in the "Quick stop active" device state. • The "Quick stop active [54]" status remains TRUE until the "Quick stop" function is activated.
0x605E	Fault reaction option code	Selection of the response to faults.
	-2 **DC braking**	If possible, the motor is braked to standstill with the "quick stop" function. If this is not possible (e. g. in case of an encoder error), reverse current braking or short-circuit braking are used for the braking process.
	0 Coasting	The motor becomes torqueless (coasts down to standstill).
	2 Quick stop	The motor is brought to a standstill with the "quick stop" function. • In the operating mode 0x6060 = "MS: Velocity mode [-2]", the deceleration time set in is effective. • In the operating mode 0x6060 = "CiA: Velocity mode [2]", the speed change set in 0x6085 is effective.
0x6060	Modes of operation	Selection of the operating mode.
	0 **No mode change/no mode assigned**	No operating mode (standstill)
	2 CiA: Velocity mode	CiA 402 velocity mode ▶ Operating mode "CiA 402 Velocity mode (vl)" 📖 138
	8 Cyclic sync position mode	▶ Operating mode "CiA 402 Cyclic sync position mode (csp)" 📖 124
	9 Cyclic sync velocity mode	▶ Operating mode "CiA 402 Cyclic sync velocity mode (csv)" 📖 143
	10 Cyclic sync torque mode	▶ Operating mode "CiA 402 Cyclic sync torque mode (cst)" 📖 157
0x6061	Modes of operation display • Read only	Display of the current operating mode.
	-11 Identification	
	-10 Test mode	
	0 No mode change/no mode assigned	No operating mode (standstill)
	2 CiA: Velocity mode	CiA 402 velocity mode
	8 Cyclic sync position mode	
	9 Cyclic sync velocity mode	
	10 Cyclic sync torque mode	
0x6071	Target torque -3276.8 ... [**0.0**] ... 3276.7 %	Setting of the setpoint torque for the torque operating modes. • 100 % ≡ Motor rated torque 0x6076 • The inverter does not support the operating mode "CiA 402 torque mode".
0x6074	Torque demand value • Read only: x.x %	Display of the setpoint torque. • 100 % ≡ Motor rated torque 0x6076
0x6079	DC link circuit voltage • Read only: x.xxx V	Display of the current DC-bus voltage.
0x6085	Quick stop deceleration 0 ... [**2147483647**] ... 2147483647	Change in velocity used for deceleration to a standstill if quick stop is activated. • Setting is only effective in the operating mode 0x6060 = "CiA: Velocity mode [2]". • In operating mode 0x6060 = "MS: Velocity mode [-2]", the deceleration time set in is effective.
0x6502	Supported drive modes • Read only	Bit coded display of the operating modes supported.
	Bit 1 CiA: Velocity mode	1 ≡ CiA 402 velocity mode is supported.
	Bit 7 Cyclic sync position mode	1 ≡ Cyclic sync position mode is supported.
	Bit 8 Cyclic sync velocity mode	1 ≡ Cyclic sync velocity mode is supported.
	Bit 9 Cyclic sync torque mode	1 ≡ Cyclic sync torque mode is supported.



16.2.3 Process data transfer

- Process data is cyclically transferred between the EtherCAT master and the slaves (permanent exchange of current input and output data).
- The transfer of process data is time-critical.
- The process data serve to control the EtherCAT slaves.
- The process data can be directly accessed by the master. The data in the PLC, for instance, are directly stored in the I/O area.
- The contents of the process data are defined via I/O Data mapping (definition of the EtherCAT objects that are to be transmitted cyclically).
- Process data is not saved in the device.
- Process data is, e. g. setpoints, actual values, control and status words.

The content of this section is currently being processed.

Configuration

- The available objects can be mapped in the CiA 402 operating mode "CiA: Velocity mode" (0x6060 = 2) and as dynamic (free) configuration. The contents can be selected from all mappable objects.
  - Standard mapping objects for the CiA 402 operating mode "CiA: Velocity mode": ▸ Standard mapping 📖 307
  - Mapping objects for a dynamic (free) assignment: ▸ Dynamic (free) configuration 📖 307
- Mapping is executed in the master configuration and automatically transferred to the slave.
- The data format is 0xAAAABBCC (AAAA = index, BB = subindex, CC = length).

16.2.3.1 Standard mapping

The content of this section is currently being processed.

Standard mapping of the RPDOs in the CiA 402 operating mode "CiA: Velocity mode"

Master → slave	
RPDO mapping entry 1 (CiA: Velocity mode)	CiA: Controlword (0x6040)
RPDO mapping entry 2 (CiA: Velocity mode)	CiA 402 parameter "Target velocity" (0x6042)
RPDO mapping Entry 1 (freely configurable)	Not assigned.

Standard mapping of the TPDOs in the CiA 402 operating mode "CiA: Velocity mode"

Slave → master	
TPDO mapping entry 1 (CiA: Velocity mode)	CiA: Statusword (0x6041)
TPDO mapping entry 2 (CiA: Velocity mode)	CiA 402 parameter "Velocity actual value" (0x6044)
TPDO mapping entry 3 (CiA: Velocity mode)	Error code (0x603F)
TPDO mapping entry 1 (freely configurable)	Digital inputs

16.2.3.2 Dynamic (free) configuration

The content of this section is currently being processed.

The freely configurable mapping objects contain an 8 bit dummy entry (0x00050008). This ensures that each object is transferred cyclically with 16 bits.

16.2.3.3 Further communication objects

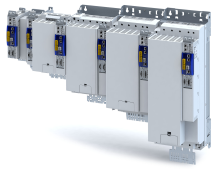
The content of this section is currently being processed.

The parameters for the implemented EtherCAT objects are described below.

16.2.3.4 Expert settings

The content of this section is currently being processed.

- The sync managers are configured for the cyclic data transfer and the mailbox communication (display in ...).
- For the communication, the I/O data mapping must be configured via ... (for RPDOs) and ... (for TPDOs).
- The basic settings for the sync managers are made via ... and ... .



16.2.4 Parameter data transfer

- For configuring and diagnosing the EtherCAT devices, the parameters are accessed by means of acyclic communication.
- Parameter data is transferred as SDOs (Service Data Objects).
- The SDO services enable the writing and reading access to parameters, EtherCAT objects and CiA 402 objects.
  - Process input data (CiA 402 objects) 149
  - Process output data (CiA 402 objects) 151
- The transfer of parameter data is usually not time-critical.
- Parameter data is, for instance, operating parameters, motor data and diagnostic information.

The content of this section is currently being processed.

SDO return values

If an SDO request is evaluated negatively, a corresponding error code is output:

Index	Description
0x00000000	No fault.
0x05030000	The state of the toggle bit has not changed.
0x05040000	SDO protocol time-out.
0x05040001	Invalid or unknown specification symbol for the client/server command.
0x05040005	The space in the main memory is not sufficient.
0x06010000	Unsupported access to an object.
0x06010001	Read access to a write-only object.
0x06010002	Write access to a read-only object.
0x06020000	An object is not available in the object directory.
0x06040041	An object cannot be mapped into the PDO.
0x06040042	The number and/or length of the mapped objects would exceed the PDO length.
0x06040043	General parameter incompatibility.
0x06040047	General internal incompatibility in the device.
0x06060000	The access has failed due to errors in the hardware.
0x06070010	The data type or the parameter length do not match.
0x06070012	Wrong data type: The parameter length is too big.
0x06070013	Wrong data type: The parameter length is too small.
0x06090011	A subindex is not available.
0x06090030	The value range for parameters is too big (only in case of write access).
0x06090031	The parameter value is too high.
0x06090032	The parameter value is too low.
0x06090036	The maximum value is smaller than the minimum value.
0x08000000	General fault.
0x08000020	Data cannot be transferred to the application or saved in the application.
0x08000021	Due to local control, the data cannot be transferred to the application or saved in the application.
0x08000022	Due to the current device state, the data cannot be transferred to the application or saved in the application.
0x08000023	The dynamic object directory generation has failed or no object directory is available.

16.2.5 Monitoring

The content of this section is currently being processed.

The parameters for setting network monitoring functions are described below.

Parameter

Address	Name / setting range / [default setting]	Info
0x10F1:001	Error settings: Local error reaction 2 **Device specific state**	An error response takes place exclusively via the inverter.
0x10F1:002	Error settings: Sync error counter limit 0 ... [**20**] ... 32	Setting for PDO frame failure detection. When the internal telegram failure error counter reaches the value set here, the inverter changes to the "Safe-Operational" state and causes an error (CiA402 error code 0x8700).

Address	Name / setting range / [default setting]	Info
0x10F3:001	History buffer: Max. number of messages • Read only	Maximum number of messages that can be stored in the history buffer (from subindex 6).
0x10F3:002	History buffer: Latest message • Read only	Subindex of the latest message.
0x10F3:003	History buffer: Latest acknowledged message 0 ... [**0**] ... 255	Subindex of the latest message acknowledged by the EtherCAT master.
0x10F3:004	History buffer: New active message • Read only	TRUE if messages are available that have not been acknowledged yet by the EtherCAT master.
0x10F3:005	History buffer: Control bits 0 ... [**0**] ... 65535	Settings for sending and saving of the messages.

16.2.6 Diagnostics

The content of this section is currently being processed.

16.2.6.1 LED status display

The content of this section is currently being processed.

LED status display

Notes on the EtherCAT connection status and the data transfer can be obtained via the LED displays "RUN" and "L/A" at the RJ45 sockets.

16.2.6.2 Information on the network

The content of this section is currently being processed.

The following parameters show information on the network.

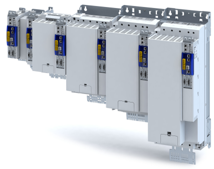
Parameter

Address	Name / setting range / [default setting]	Info
0x2020:001	EoE information: Virtual MAC address • Read only	Display of the virtual MAC address.
0x2020:002	EoE information: IP adress • Read only	Display of the IP address.
0x2020:003	EoE information: Subnet mask • Read only	Display of the subnet mask.
0x2020:004	EoE information: Standard gateway • Read only	Display of the standard gateway.
0x2020:005	EoE information: DNS server • Read only	Display of the DNS server.
0x2020:006	EoE information: DNS name • Read only	Display of the DNS name.
0x2020:007	EoE information: Received packages 0 ... [] ... 4294967295	Display of the packages received during the EoE transmission.
0x2020:008	EoE information: Transmitted packages 0 ... [] ... 4294967295	Display of the packages sent during the EoE transmission.

16.2.6.3 EtherCAT master diagnostics

Parameter

Address	Name / setting range / [default setting]		Info
0x5851:001	EtherCAT master diagnosis: EtherCAT master state • Read only		Display of the EtherCAT master state.
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	



Address	Name / setting range / [default setting]	Info
0x5851:002	EtherCAT master diagnosis: EtherCAT master state summary • Read only	Display of the EtherCAT master state overview.
	Bit 0 Master OK	
	Bit 4 Init	
	Bit 5 Pre-Operational	
	Bit 6 Safe-Operational	
	Bit 7 Operational	
	Bit 8 Slaves in requested state	
	Bit 9 Master in requested state	
	Bit 10 Bus scan match	
	Bit 12 DC enabled	
	Bit 13 DC in sync	
	Bit 14 DC busy	
	Bit 16 Link up	
0x5851:003	EtherCAT master diagnosis: EtherCAT error • Read only	Display whether an EtherCAT network error has occurred.
0x5851:004	EtherCAT master diagnosis: Bus scan match • Read only	Display whether a "Bus Scan Match" exists.
0x5851:005	EtherCAT master diagnosis: Configured cycle time • Read only: x us	Display of the configured cycle time.
0x5851:006	EtherCAT master diagnosis: Connected slaves • Read only	Display of the number of slaves available in the network.
0x5851:007	EtherCAT master diagnosis: Configured slaves • Read only	Display of the number of configured slaves.
0x5860:001	EtherCAT slaves station addresses: Station address slave 1 • Read only	Display of the slave station address.

Address	Name / setting range / [default setting]	Info
0x5860:002	EtherCAT slaves station addresses: Station address slave 2 • Read only	
0x5860:003	EtherCAT slaves station addresses: Station address slave 3 • Read only	
0x5860:004	EtherCAT slaves station addresses: Station address slave 4 • Read only	
0x5860:005	EtherCAT slaves station addresses: Station address slave 5 • Read only	
0x5860:006	EtherCAT slaves station addresses: Station address slave 6 • Read only	
0x5860:007	EtherCAT slaves station addresses: Station address slave 7 • Read only	
0x5860:008	EtherCAT slaves station addresses: Station address slave 8 • Read only	
0x5860:009	EtherCAT slaves station addresses: Station address slave 9 • Read only	
0x5860:010	EtherCAT slaves station addresses: Station address slave 10 • Read only	
0x5860:011	EtherCAT slaves station addresses: Station address slave 11 • Read only	
0x5860:012	EtherCAT slaves station addresses: Station address slave 12 • Read only	
0x5860:013	EtherCAT slaves station addresses: Station address slave 13 • Read only	
0x5860:014	EtherCAT slaves station addresses: Station address slave 14 • Read only	
0x5860:015	EtherCAT slaves station addresses: Station address slave 15 • Read only	
0x5860:016	EtherCAT slaves station addresses: Station address slave 16 • Read only	
0x5861:001	EtherCAT slaves device names: Device name slave 1 • Read only	Display of the slave device name.

Address	Name / setting range / [default setting]	Info
0x5861:002	EtherCAT slaves device names: Device name slave 2 • Read only	
0x5861:003	EtherCAT slaves device names: Device name slave 3 • Read only	
0x5861:004	EtherCAT slaves device names: Device name slave 4 • Read only	
0x5861:005	EtherCAT slaves device names: Device name slave 5 • Read only	
0x5861:006	EtherCAT slaves device names: Device name slave 6 • Read only	
0x5861:007	EtherCAT slaves device names: Device name slave 7 • Read only	
0x5861:008	EtherCAT slaves device names: Device name slave 8 • Read only	
0x5861:009	EtherCAT slaves device names: Device name slave 9 • Read only	
0x5861:010	EtherCAT slaves device names: Device name slave 10 • Read only	
0x5861:011	EtherCAT slaves device names: Device name slave 11 • Read only	
0x5861:012	EtherCAT slaves device names: Device name slave 12 • Read only	
0x5861:013	EtherCAT slaves device names: Device name slave 13 • Read only	
0x5861:014	EtherCAT slaves device names: Device name slave 14 • Read only	
0x5861:015	EtherCAT slaves device names: Device name slave 15 • Read only	
0x5861:016	EtherCAT slaves device names: Device name slave 16 • Read only	
0x5862:001	EtherCAT slaves device types: Device type slave 1 • Read only	Display of the slave type designation.
0x5862:002	EtherCAT slaves device types: Device type slave 2 • Read only	
0x5862:003	EtherCAT slaves device types: Device type slave 3 • Read only	
0x5862:004	EtherCAT slaves device types: Device type slave 4 • Read only	
0x5862:005	EtherCAT slaves device types: Device type slave 5 • Read only	
0x5862:006	EtherCAT slaves device types: Device type slave 6 • Read only	
0x5862:007	EtherCAT slaves device types: Device type slave 7 • Read only	
0x5862:008	EtherCAT slaves device types: Device type slave 8 • Read only	
0x5862:009	EtherCAT slaves device types: Device type slave 9 • Read only	
0x5862:010	EtherCAT slaves device types: Device type slave 10 • Read only	
0x5862:011	EtherCAT slaves device types: Device type slave 11 • Read only	
0x5862:012	EtherCAT slaves device types: Device type slave 12 • Read only	
0x5862:013	EtherCAT slaves device types: Device type slave 13 • Read only	
0x5862:014	EtherCAT slaves device types: Device type slave 14 • Read only	
0x5862:015	EtherCAT slaves device types: Device type slave 15 • Read only	

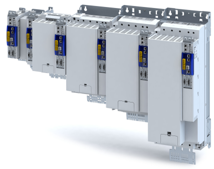
Address	Name / setting range / [default setting]		Info
0x5862:016	EtherCAT slaves device types: Device type slave 16 • Read only		
0x5863:001	Mandatory EtherCAT slaves: Slave 1 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:002	Mandatory EtherCAT slaves: Slave 2 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:003	Mandatory EtherCAT slaves: Slave 3 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:004	Mandatory EtherCAT slaves: Slave 4 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:005	Mandatory EtherCAT slaves: Slave 5 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:006	Mandatory EtherCAT slaves: Slave 6 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:007	Mandatory EtherCAT slaves: Slave 7 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:008	Mandatory EtherCAT slaves: Slave 8 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:009	Mandatory EtherCAT slaves: Slave 9 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:010	Mandatory EtherCAT slaves: Slave 10 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:011	Mandatory EtherCAT slaves: Slave 11 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:012	Mandatory EtherCAT slaves: Slave 12 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:013	Mandatory EtherCAT slaves: Slave 13 is mandatory • Read only		
	0	FALSE	
	1	TRUE	

Address	Name / setting range / [default setting]		Info
0x5863:014	Mandatory EtherCAT slaves: Slave 14 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:015	Mandatory EtherCAT slaves: Slave 15 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:016	Mandatory EtherCAT slaves: Slave 16 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5864:001	EtherCAT slaves initialisation status: Initalisation status slave 1 • Read only		Display of the initialisation state of the EtherCAT slave.
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:002	EtherCAT slaves initialisation status: Initalisation status slave 2 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:003	EtherCAT slaves initialisation status: Initalisation status slave 3 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:004	EtherCAT slaves initialisation status: Initalisation status slave 4 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:005	EtherCAT slaves initialisation status: Initalisation status slave 5 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	

Address	Name / setting range / [default setting]		Info
0x5864:006	EtherCAT slaves initialisation status: Initalisation status slave 6 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:007	EtherCAT slaves initialisation status: Initalisation status slave 7 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:008	EtherCAT slaves initialisation status: Initalisation status slave 8 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:009	EtherCAT slaves initialisation status: Initalisation status slave 9 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:010	EtherCAT slaves initialisation status: Initalisation status slave 10 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:011	EtherCAT slaves initialisation status: Initalisation status slave 11 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:012	EtherCAT slaves initialisation status: Initalisation status slave 12 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	

Address	Name / setting range / [default setting]		Info
0x5864:013	EtherCAT slaves initialisation status: Initalisation status slave 13 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:014	EtherCAT slaves initialisation status: Initalisation status slave 14 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:015	EtherCAT slaves initialisation status: Initalisation status slave 15 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5864:016	EtherCAT slaves initialisation status: Initalisation status slave 16 • Read only		
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5865:001	EtherCAT slaves device status: Device status slave 1 • Read only		Display of the device status of the EtherCAT slave.
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:002	EtherCAT slaves device status: Device status slave 2 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	

Address	Name / setting range / [default setting]		Info
0x5865:003	EtherCAT slaves device status: Device status slave 3 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:004	EtherCAT slaves device status: Device status slave 4 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:005	EtherCAT slaves device status: Device status slave 5 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:006	EtherCAT slaves device status: Device status slave 6 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x5865:007	EtherCAT slaves device status: Device status slave 7 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:008	EtherCAT slaves device status: Device status slave 8 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	



Address	Name / setting range / [default setting]		Info
0x5865:009	EtherCAT slaves device status: Device status slave 9 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:010	EtherCAT slaves device status: Device status slave 10 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:011	EtherCAT slaves device status: Device status slave 11 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x5865:012	EtherCAT slaves device status: Device status slave 12 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x5865:013	EtherCAT slaves device status: Device status slave 13 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:014	EtherCAT slaves device status: Device status slave 14 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	

Address	Name / setting range / [default setting]		Info
0x5865:015	EtherCAT slaves device status: Device status slave 15 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	
0x5865:016	EtherCAT slaves device status: Device status slave 16 • Read only		
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	

16.2.6.4 Error history buffer

Parameter

Address	Name / setting range / [default setting]	Info
0x1001	EtherCAT error register • Read only	

16.2.6.5 Device identification

The content of this section is currently being processed.

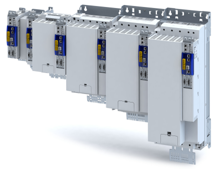
The EtherCAT product code in 0x1018:002 consists of device-specific data and the currently activated technology application (0x4000). The last three positions in the product code refer to the activated technology application.

For device identification in the network, the inverter provides the EtherCAT objects listed in the following.

The objects can only be accessed via the EtherCAT network.

Parameter

Address	Name / setting range / [default setting]	Info
0x1000	Device type • Read only	CANopen device profile according CANopen specification CiA 301/ CiA 402.
0x1008	Manufacturer device name • Read only	Display of the manufacturer device name.
0x1009	Manufacturer hardware version • Read only	Display of the manufacturer hardware version.
0x100A	Manufacturer software version • Read only	Display of the manufacturer software version.
0x1018:001	Identity object: Vendor ID • Read only	Display of the manufacturer's identification number.
0x1018:002	Identity object: Product ID • Read only	Display of the product code of the inverter.
	419446784	
	419479552	
	419479572	
0x1018:003	Identity object: Revision number • Read only	Display of the main and subversion of the firmware.
0x1018:004	Identity object: Serial number • Read only	Display of the serial number of the inverter.



16.3 PROFINET

PROFINET® (Process Field Network) is a real-time capable fieldbus system based on Ethernet.

- PROFINET® is a registered trademark and patented technology licensed by the PROFIBUS & PROFINET International (PI) user organisation.
- Detailed information on PROFINET can be found on the web page of the user organisation: http://www.profibus.com
- PROFINET transmits parameter data, configuration data, diagnostic data, alarm messages, and process data between the IO-Devices and the IO-Controller (PLC).
- The data is transmitted as a function of its time-critical behaviour via corresponding communication channels.
- The inverter is implemented as IO-Device into a PROFINET-RT network.
- The PROFINET connections are carried out as standard RJ45 sockets.
- Further information about the dimensioning of a PROFINET network can be found in the configuration document for the inverter.

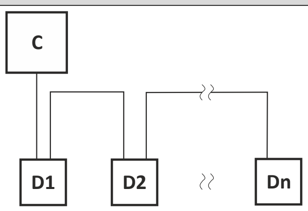
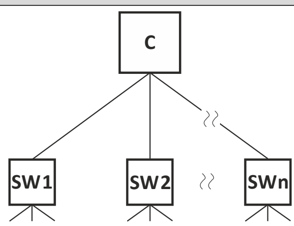
Preconditions

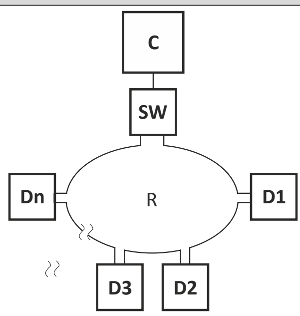
- The inverter is equipped with the "PROFINET" network option.
- The inverter has not been parametrised as a CiA 402 motion drive. Technology application selected with parameter 0x4000.

PROFINET connection

- The PROFINET connection is established via the RJ45 sockets **X2x6** and **X2x7**.
- For establishing the connection to the network, a common standard Ethernet cable from CAT 5/5e is suitable.

Typical topologies

Line	Tree
	

Ring


C	IO controller	SW	Switch SCALANCE (MRP capable)
D	IO device	R	Redundant domain

16.3.1 Commissioning

In the following chapters, the steps required for controlling the inverter with a IO-Controller via PROFINET are described.

Preconditions

- As an IO-Device, the inverter is connected to an IO-Controller and further PROFINET nodes if required.

  See "Typical topologies" under: ▸ PROFINET 320
- The entire wiring has been checked for completeness, short circuit and earth fault.
- All PROFINET devices are supplied with voltage and are switched on.
- The functional test described in the mounting and switch-on instructions has been completed successfully (without any errors or faults).
- The inverter is commissioned with the »EASY Starter«.
  - Download »EASY Starter«
- The IO-Controller is commissioned with a different engineering tool, e. g. Siemens »TIA Portal«.

  For this purpose, install the required GSDML device description file in the engineering tool for the IO-Controller for configuring the inverter.

  We always recommend the use of the current device description.
  - Download of GSDML files
  - Please observe the necessary system requirements and the notes regarding the inverter.

  ▸ Device description file 323

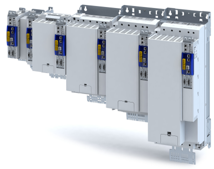
16.3.1.1 Settings in the »EASY Starter«

1. Set the IP address and the station name ("PROFINET device name").

   See: ▸ Station name and IP configuration 324
2. Save the parameters in the inverter with mains failure protection. ▸ 0x2022:003

   See: ▸ Saving the parameter settings 36
3. Restart the PROFINET communication. ▸ 0x2380

   See: ▸ Restarting or stopping the communication 322



16.3.1.2 Restarting or stopping the communication

A restart of communication is required after changes of the interface configuration (e. g. station address and IP configuration) in order that the changed settings become effective without switching the mains.

▶ Station name and IP configuration 📖 324

For restarting the communication, there are two options:
- 0x2380 = 1 (restart with current values).
- 0x2380 must be set = 2 (restart with the values saved last).

The following option can be used to stop communication:
- 0x2380 must be set = 5 (stop network communication).

Parameter

Address	Name / setting range / [default setting]		Info
0x2380	PROFINET communication		Restart / stop communication • When the device command has been executed successfully, the value 0 is shown.
	0	**No action/no error**	Only status feedback
	1	Restart with current values	Restart communication with the current values.
	2	Restart with default values	Restart communication with the values of the PROFINET parameters that have been saved last (0x2381:001 ... 0x2381:009).
	5	Stop network communication	Stop communication
	10	In process	Only status feedback
	11	Action cancelled	
	12	Fault	

16.3.1.3 Settings in the Siemens »TIA Portal«

> **i** Here, commissioning with the Siemens »TIA Portal« is described. Please note that in the standard setting of the Siemens »TIA Portal« changes of network parameters carried out by a Lenze engineering tool (e. g. »EASY Starter«) may be overwritten.

1. Go to the device configuration and open the "net view" to drag the inverter from the catalog to the net view of the PROFINET.
2. Assign the inverter to the associated IO-Controller.
3. Mark the inverter and change to the "device view".
4. Set the IP address and the station name ("PROFINET device name") in "Properties".

   See: ▶ Station name and IP configuration

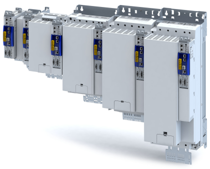
> **i** In order that the inverter can be identified via Ethernet when the IO controller is switched off, the station name and the IP configuration must be saved in the inverter with mains failure protection via the separate entry with the »EASY Starter«. 0x2022:003
>
> See: ▶ Saving the parameter settings 📖 36

5. Below the device name and the name of the device description file, the device view shows the pre-assignment of output and input process data words.

   In slot 1, pre-assigned process data words can be changed.

   When using PROFIsafe, you can add safety process data in slot 2.

   ▶ PROFIsafe 📖 331
6. Save the project in the engineering tool.
7. Load the configuration into the IO-Controller.
8. Set the IO-Controller to "RUN".



16.3.1.4 Device description file

The device description file must be installed in the engineering tool for configuring the network (e. g. Siemens »TIA Portal«).

- Download of GSDML files

The name of the device description file is as follows:

"GSDML-V<x>.<zz>-Lenze-I<NNN>PN<Version>-<yyyy><mm><dd>.xml".

Wildcard	Info
x	Major version of the used GSDML scheme
zz	One-digit or two-digit minor version of the used GSDML scheme
NNN	Specifying the inverter name, e. g. i<550>, i<950>, ...
Version	First software version that can be used with this GSDML.
yyyy	Year of publication
mm	Month of publication
dd	Day of publication

Define the user data length

The configuration of 1 ... 16 process data double words (4 ... 64 bytes) and 8 safety data words is supported.

Examples of selecting the device description file:

- "IEC 8 DWords I/O": 8 process data double words only in slot 1 of the PROFINET telegram)
- "Safety module 4 DWords": 4 safety double words (only in slot 2 of the PROFINET telegram when the extended safety engineering is used simultaneously)

16.3.1.5 Establishing a connection to the »EASY Starter« via PROFINET

To establish a communication link to the inverter via PROFINET ports X2x6/X2x7, proceed as follows:

Requirements:

- The network interface of the engineering PC provided for the connection is parameterised for the PROFINET IP subnetwork.
- A valid IP configuration is set in the inverter. ▶ Station name and IP configuration 📖 324

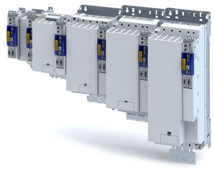
Tools required:

- Engineering PC with installed »EASY Starter«.
- Standard Ethernet cable from CAT 5/5e

1. Plug the network cable into one of the two PROFINET ports **X2x6 / X2x7** of the inverter.
2. Use the network cable to connect the inverter to the PC on which »EASY Starter« is installed.
3. Start the »EASY Starter«.

   The "Add devices" dialog is shown.
4. Select the "PROFINET " connection.
5. Enter the PROFINET IP address of the inverter.
6. Press the **Insert** button.

Once a connection has been successfully established, the inverter is displayed in the device list. The tabs in »EASY Starter« then provide access to the inverter parameters.



16.3.2 Basic setting and options

16.3.2.1 Station name and IP configuration

The station name and the IP configuration can be assigned via the IO-Controller. These settings enable the IO-Controller to identify the inverter in the network and manage the data exchange.

The station name and the IP configuration can also be assigned via the »EASY Starter«:

- The station name of the inverter must be entered with permissible characters according to the PROFINET specification. ▶ 0x2381:004
- Display of the currently used station name: ▶ 0x2382:004
- The IP configuration comprises the assignments of:
  - IP address 0x2381:001
  - Subnet mask 0x2381:002
  - Gateway address 0x2381:003
- Display of the currently used IP configuration: ▶ 0x2382:001 ... 0x2382:003

Save the station name and the IP configuration in the inverter with mains failure protection in order that the inverter can be identified via Ethernet if the IO Controller is switched off. 0x2022:003

See: ▶ Saving the parameter settings 📖 36

An invalid station name or the assignment of invalid combinations of IP address, subnet mask and gateway address may prevent a connection to PROFINET.

In case of impermissible settings, the red LED "BUS ERR" is blinking and the error message "PROFINET: stack initialisation error [0x8192]" is displayed.

▶ LED status display 📖 329

Parameter

Address	Name / setting range / [default setting]	Info
0x2381:001	PROFINET settings: IP address 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set IP address • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:002	PROFINET settings: Subnet 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set subnet mask • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:003	PROFINET settings: Gateway 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set gateway address • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1). • The gateway address is valid if the network address of the IP address is identical to the gateway address. In this case, no gateway functionality is used. • DHCP is not supported.
0x2381:004	PROFINET settings: Station name	Set station name • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:005	PROFINET settings: I&M1 System designation	Input/output of the I&M1 system designation • The default setting is an empty string.
0x2381:006	PROFINET settings: I&M1 Installation site	Input/output of the I&M1 location identification code • The default setting is an empty string.
0x2381:007	PROFINET settings: I&M2 Installation date	Input/output of the I&M2 date of installation • The default setting is an empty string.
0x2381:008	PROFINET settings: I&M3 additional information	Input/output of the I&M3 additional information • The default setting is an empty string.
0x2381:009	PROFINET settings: I&M4 signature code ["**000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000**"]	Input/output of the I&M4 signature • The default setting is an empty string.

16.3.2.2 Suppress diagnostic messages to the IO controller

0x285A:001 serves to set which error response in the inverter suppresses the alarm message to the IO-Controller.

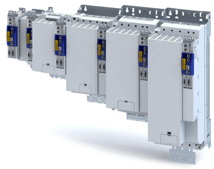
Parameter

Address	Name / setting range / [default setting]		Info
0x285A:001	Diagnostic settings: Alarm supression 0x0000 ... [**0x0000**] ... 0xFFFF		Bit coded selection of error responses in the inverter which suppress the alarm message to the IO Controller. • Bit x = 1 ≡ suppress alarm message. • In the default setting "0", an alarm message is displayed for all error responses.
	Bit 0	Information	
	Bit 1	Warning	
	Bit 2	-	
	Bit 3	Trouble	
	Bit 4	-	
	Bit 5	-	
	Bit 6	-	
	Bit 7	Fault	
	Bit 8	Fault > CiA402	

16.3.3 Process data transfer

The process data is used to control the inverter.

- The process data is transmitted cyclically between the IO-Controller and the IO-Devices participating in PROFINET.
- The process data can be directly accessed by the IO controller. The data in the PLC, for instance, are directly stored in the I/O area.
- The process data length is 1 ... 16 double words (4 ... 64 bytes) for each direction.
- The process data are transmitted 1 : 1 according to its sequence.



16.3.4 Parameter data transfer

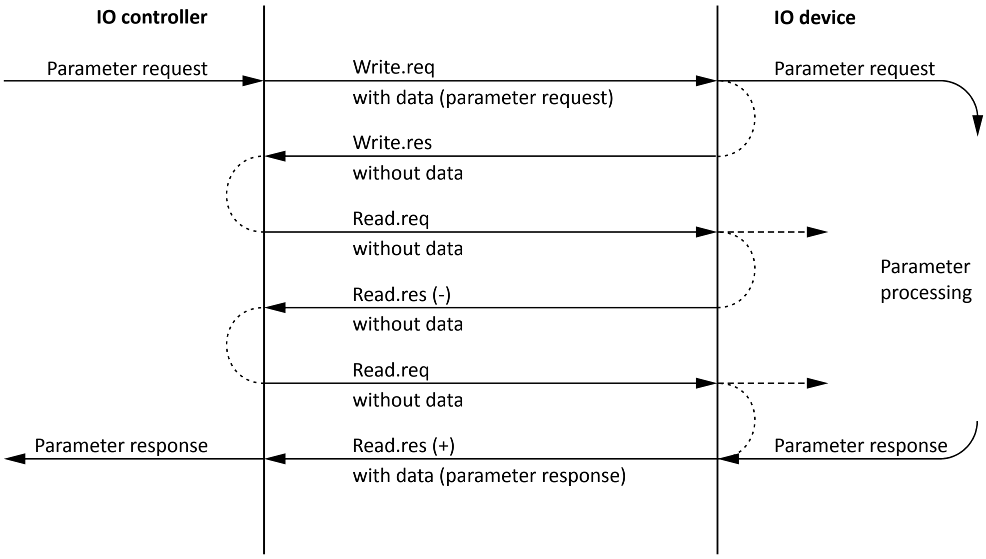
Data communication with PROFINET is characterised by the simultaneous operation of cyclic and acyclic services in the network. As an optional extension, the parameter data transfer belongs to the acyclic services, which provides access to all device parameters.

Details

- The access to the device data depends on the PROFIdrive profile.
- Only one parameter request is processed at a time (no pipelining).
- No spontaneous messages are transferred.
- There are only acyclic parameter requests.

Basically, a IO-Controller can always be used to request parameters from IO-Device if the IO-Device is in the DATA_EXCHANGE state.

Transmission directions for acyclic data transfer



1. A "Write.req" is used to transmit the data set (DB47) as parameter request to the IO-Device.
2. "Write.res" is used to confirm the input of the message for IO-Controller.
3. With Read.req, the IO-Controller requests the response of the IO-Device
4. The IO-Device responds with a "Read.res (-)" if processing has not been completed yet.
5. After parameter processing, the parameter request is completed by transmitting the parameter response to the IO-Controller by "Read.res (+)".

Frame structure

Destr	ScrAddr	VLAN	Type 0x0800	RPC	NDR	Read/Write Block	Data	FCS
6 bytes	6 bytes	4 bytes	4 bytes	80 bytes	64 bytes	64 bytes	0 .... 240 bytes	4 bytes

In the "Read / Write Block field", the initiator specifies the access to the "DB47" data set. The data that is written on this index or read by it, contain a header and the parameter request or the parameter response. The read data or the data to be written are contained in the "Data" field.

Assignment of the user data depending on the data type

Depending on the data type used, the user data is assigned as follows:

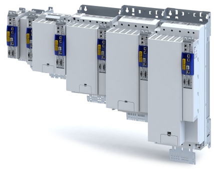
Data type	Length	User data assignment				
		Byte 1	Byte 2	Byte 3	Byte 4	Byte ...
String	x bytes	*Data* (x bytes)				
U8	1 byte	*Data*	0x00			
U16	2 bytes	HIGH byte	LOW byte			
		Data	*Data*			
U32	4 bytes	HIGH word		LOW word		
		HIGH byte	LOW byte	HIGH byte	LOW byte	
		Data	*Data*	*Data*	*Data*	

16.3.5 Monitoring

The parameters for setting network monitoring functions are described below.

Parameter

Address	Name / setting range / [default setting]		Info
0x2859:001	PROFINET monitoring: Watchdog elapsed		Selection of the response to a permanent interruption of the communication to the IO controller. Corresponding error code: 33168 | 0x8190 "PROFINET: Watchdog time-out" Associated error code: • 33168 | 0x8190 - RANLI_CIMES_1000_20915
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	
0x2859:002	PROFINET monitoring: Data exchange exited		Selection of the response to exiting the "Data Exchange" state. Corresponding error code: 33171 | 0x8191 "PROFINET: Exit Data Exchange" Associated error code: • 33169 | 0x8191 - RANLI_CIMES_1000_21217
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	
0x2859:003	PROFINET monitoring: Invalid configuration		Selection of the response triggered by the reception of invalid configuration data. Corresponding error code: 33414 | 0x8286 "PROFINET: Configuration error" Associated error code: • 33415 | 0x8287 - RANLI_CIMES_1000_20916
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	
0x2859:004	PROFINET monitoring: Initialisation error		Selection of the response triggered by the occurrence of an error during the initialisation of the network component. Corresponding error code: 33170 | 0x8192 "PROFINET: Initialisation error" Associated error code: • 33170 | 0x8192 - RANLI_CIMES_1000_20917
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	



Address	Name / setting range / [default setting]	Info
0x2859:005	PROFINET monitoring: Invalid process data	Selection of the response triggered by the reception of invalid process data. Process data marked as invalid (IOPS is "BAD") are received by the IO Controller. Typically in case of • a PLC in STOP state, • alarms, • acyclic demand data. Corresponding error code: 33171 | 0x8193 "PROFINET: Invalid cyclic process data" Associated error code: • 33171 | 0x8193 - RANLI_CIMES_1000_20918
	0 No response	
	1 Fault > CiA402	
	2 Warning	

16.3.6 Diagnostics

16.3.6.1 LED status display

Notes on the connection status to the IO-Controller can be obtained via the LEDs "BUS RDY" and "BUS ERR" of the PROFINET option (on the front of the inverter).

In addition, the LEDs "Link" and "Activity" at the RJ45 sockets indicate the connection status to the network.

LED "BUS RDY" (green)

Blinking pattern	State	Meaning
Off	Not connected	No connection to the IO-Controller
Blinking	Connected	IO-Controller in STOP
On	Data exchange	IO-Controller in RUN (DATA_EXCHANGE)

LED "BUS ERR" (red)

Blinking pattern	State	Meaning
Off	No fault	No fault
flickers	IO-Device identifies (localises)	The PROFINET function "node flashing test" is triggered by IO-Controller. The flickering LED serves to identify (locate) an accessible IO-Device.
Blinking	Impermissible settings	Impermissible settings: Stack, station name or IP parameters are invalid.
On (red)	Fault	Communication error (e. g. Ethernet cable removed)

LED "Link" (green)

Blinking pattern	Status/meaning
off	No connection to the network.
on	A physical connection to the network is available.

LED "Activity" (yellow)

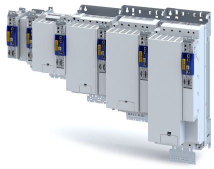
Blinking pattern	Status/meaning
off	No data transfer.
on or flickers	Data is exchanged via the network.

16.3.6.2 Information on the network

The following parameters show information on the network.

Parameter

Address	Name / setting range / [default setting]	Info
0x2382:001	Active PROFINET settings: IP address • Read only	Display of the active IP address.
0x2382:002	Active PROFINET settings: Subnet • Read only	Display of the active subnet mask.
0x2382:003	Active PROFINET settings: Gateway • Read only	Display of the gateway address.
0x2382:004	Active PROFINET settings: Station name • Read only	Display of the active station name.
0x2382:005	Active PROFINET settings: MAC Address • Read only	Display of the active MAC address.



Address	Name / setting range / [default setting]		Info
0x2388	PROFINET status • Read only		Bit coded display of the current Bus status.
	Bit 0	Initialized	The network component is initialised.
	Bit 1	Online	The network component has established a cyclic I/O communication relationship to a communication partner.
	Bit 2	Connected	After initialisation, the network component waits for a communication partner and the system power-up.
	Bit 3	IP address error	The IP address is invalid. Valid IP addresses are defined according to RFC 3330.
	Bit 4	Hardware fault	
	Bit 6	Watchdog elapsed	PROFINET communication is continuously interrupted in the "Data_Exchange" state, e.g. by cable break or failure of the IO Controller. • PROFINET communication changes to the "No_Data_Exchange" state. When the watchdog monitoring time specified by the IO Controller has elapsed, the response set in 0x2859:001 is triggered in the inverter.
	Bit 7	Protocol error	
	Bit 8	PROFINET stack ok	
	Bit 9	PROFINET stack not configured	
	Bit 10	Ethernet controller fault	
	Bit 11	UDP stack fault	
0x2389:001	PROFINET error: Error 1 • Read only		The parameter currently contains the error detected on the network. • The error values may occur in combination with the error values from parameter 0x2389:002.
	0	No error	
	1	Reserved	
	2	Unit ID unknown	
	3	Max. units exceeded	
	4	Invalid size	
	5	Unit type unknown	
	6	Runtime plug error	
	7	Invalid argument	
	8	Service pending	
	9	Stack not ready	
	10	Command unknown	
	11	Invalid address descriptor	
0x2389:002	PROFINET error: Error 2 • Read only		The parameter currently contains the error detected on the network. • The error values may occur in combination with the error values from parameter 0x2389:001.
	Bit 7	IP address error	The IP address is invalid. Valid IP addresses are defined according to RFC 3330.
	Bit 8	Station name problem	The station name must be assigned according to the PROFINET specification.
	Bit 9	DataExch left	PROFINET communication is continuously interrupted in the "Data_Exchange" state, e. g. by cable break. • PROFINET communication changes to the "No_Data_Exchange" state. • When the watchdog monitoring time specified by the IO Controller has elapsed, the response set in is triggered in the inverter.
	Bit 10	Stack boot error	
	Bit 11	Stack online error	
	Bit 12	Stack state error	
	Bit 13	Stack revision error	
	Bit 14	Initialization problem	The stack cannot be initiated with the user specifications. A reason might be, e. g., a station name that does not correspond to the PROFINET specification.
	Bit 15	Stack init error	

16.3.7 PROFIsafe

PROFIsafe via PROFINET enables the transfer of safe information via the PROFIsafe protocol according to the specification "PROFIsafe - Profile for Safety Technology", version 2.0.

- The PROFIsafe data is transmitted in the second slot of a PROFINET telegram.
- In the PROFIsafe data, one bit each is used to control a certain safety function.
- The structure of the PROFIsafe data is described in the PROFIsafe profile.
- The length of the PROFIsafe data (also "PROFIsafe message") is fixed at 16 bytes.
- The inverter forwards the PROFIsafe messages to the safety module (Extended Safety) for a safe evaluation.

16.3.8 PROFIenergy

The device profile PROFIenergy enables an energy management for systems. With the support of the "PROFIenergy Class 3", the energy saving function of the inverter can be triggered and certain energy consumption values can be measured via standardised commands.

Parameter

Address	Name / setting range / [default setting]		Info
0x2590:003	Energy saving: State of actual energy saving mode • Read only		
	Bit 0	StateOperate	
	Bit 4	StatePause	
	Bit 6	StateOperate	

16.3.8.1 Supported commands

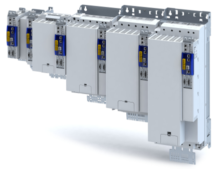
The following PROFIenergy commands are supported:

Command	Description
Start_PauseStart_Pause	Starts the energy saving function.
End_Pause	Stops the energy saving function.
Query_Mode	Requests the list of all supported energy modes.
Get_Mode	Requests the data of an energy mode.
PEM_Status	Requests the current status.
PEM_Status_with_CTTO	Requests the current status of dynamic values.
PE_Identify	Requests basic information on the modes.
Query_Version	Requests the versioning of the query.
Get_Measurement_List	Requests the list of the supported measured values.
Get_Measurement_List_with_object_number	Requests the list of supported measured values indicating the corre-sponding parameters.
Get_Measurement_Values	Requests the values of the measured values.
Get_Measurement_Values_with_object_number	Requests the values of the measured values indicating the correspond-ing parameters.
PE_Mode_ID	Manufacturer-specific energy saving mode The energy saving mode is only active if the power section is inhibited. (0x2590:003 = 1)

16.3.8.2 Supported measured values

The standardised measured values are supported:

ID	Measured value	Description
34	Active power in W	Active power
205	Active energy sum in kWh	Corresponds to the current value from parameter 0x2DA3:002. The value can be reset by writing.



16.4 EtherCAT system bus

The system bus enables the use of several inverters of the i900 series in a network.

The system bus of the inverter uses the EtherCAT® protocol.

- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- Detailed information on EtherCAT can be found on the web page of EtherCAT Technology Group (ETG): http://www.ethercat.org
- Information about the dimensioning of an EtherCAT network can be found in the configuration document for the inverter.

Preconditions

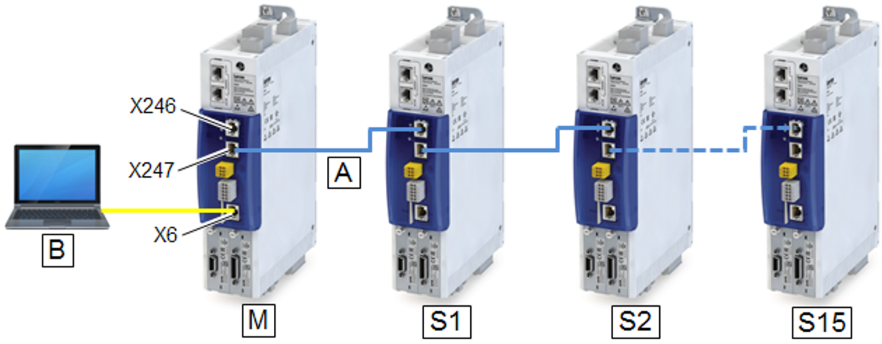
- Only inverters of the i900 series are connected to the system bus.
- A maximum of 16 nodes including the master can be connected via the system bus.
- No further accessories are connected to the system bus.
- The inverters are not parameterised as CiA 402 motion drives. Selection of a technology application: ▸ 0x4000
- The »EASY Starter« does **not** allow a configuration of the system bus cross communication.

The technology application set in the inverter is not identified.

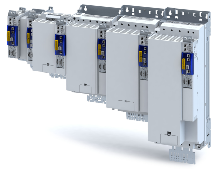
Details

- The inverter can act as a system bus master or system bus slave.
- The system bus is prepared, i. e. a configuration is not required.
- The master assigns an identical master value to all system bus nodes (slaves).
- The »EASY Starter« is sufficient ...
  - to parameterise the devices in the network;
  - to configure the process data individually.
  - Download »EASY Starter«
- If further EtherCAT-compliant devices are to be used in addition to the inverters, the bus configuration must be adapted to the »PLC Designer«.
  - Download »PLC Designer«
  - Download XML/ESI files for Lenze devices
- Detailed information regarding the adaptation of the EtherCAT configuration with the »PLC Designer« can be found here:
  - Online help »EASY Starter«/»PLC Designer«, topic "Controller-based Automation EtherCAT"
  - Communication manual "Controller-based Automation EtherCAT" (PDF)

System bus topology



X246	System bus interface EtherCAT IN
x247	System bus interface EtherCAT OUT
X6	Ethernet NRT interface
A	EtherCAT system bus
B	Engineering PC
M	System bus master
S1 ... 15	System bus slaves 1 ... 15



16.4.1 Commissioning

Commissioning can be subdivided as follows:

- Initial commissioning in which at least the system bus master must be determined.
- System bus change, in which slave devices are added or removed subsequently.

Preconditions

- The inverter is linked in the system bus network (max. 16 devices) as EtherCAT master or EtherCAT slave.

  See "system bus topology" under: EtherCAT system bus 332
- The entire wiring has been checked for completeness, short circuit and earth fault.
- All system bus nodes are supplied with voltage and are switched on.
- An Engineering PC with installed »EASY Starter« is connected to the master.
  - Download »EASY Starter«

Parameterisation required

Set and activate master functionality at the 1st inverter in the system bus network:

1. Setting: 0x2371:009 = 1
2. Save parameter settings.

   Saving the parameter settings 36
3. Restart inverter.

   Device command: 0x2022:035 = 1

The master function of the 1st inverter is now activated.

The cyclic master value and the individual process data are set via the technology application (0x4000) of the system bus master.

> The 0x2371:009 parameter does not need to be set for the slave devices. The slave functionality is already preset with the value "0".

Select and configure technology applications:

1. Select a technology application (unequal to "CiA 402").

   Selection with: 0x4000
2. Optionally set the "IO configuration" with: 0x4001
3. Save parameter settings.

   Saving the parameter settings 36

The technology applications of the inverter are now set.

> The technology application in the system bus master provides the master value. The slave devices are FAST slaves (process slaves) as well and follow the master value of the process master.

Start system bus:

1. Restart system bus master (1st inverter).

   Device command: 0x2022:035 = 1

All devices currently found at the system are assigned and addressed to the corresponding devices in the device tree of the system bus master according to their physical order at the bus. See "Addressing of the system bus nodes under: Basic setting and options 335

The number of devices at the system bus may be lower than the number of devices in the device tree of the system bus master.

All devices at the system bus are set to the "Operational" bus state when they have been identified as system bus nodes.

16.4.2 Basic setting and options

Addressing the system bus nodes

The first device in the system bus network is always active as EtherCAT master. In addition, this device is also an internal EtherCAT slave, which e. g. provides a DC master (Distributed Clocks).

The slave devices at the system bus are addressed via their active EtherCAT station address.

This address is assigned by the master while the system bus is initialised:

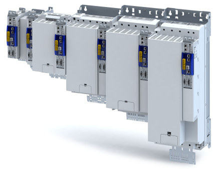
- The internal slave in the master device has the address "1001".
- The first slave in the network has the address "1002".
- The second slave in the network has the address "1003" etc.

Master/slave functionality

The 0x2371:009 parameter is used to set the functionality of the system bus interface of the inverter (EtherCAT master/slave).

Parameter

Address	Name / setting range / [default setting]		Info
0x2371:009	EtherCAT on board: Interface mode • Setting can only be changed if the inverter is inhibited.		Selection of the master/slave functionality for the EtherCAT interface. For activating this setting, save the parameter set and restart the device.
	0	**Slave**	Activation of the slave functionality.
	1	Master	Activation of the master functionality.



16.4.3 Process data transfer

In the system bus network ...

- the setpoint process data (master to slave) are set via the system bus master inside the technology application;
- the actual process data (slave to master) is set via the slave device.

Data mapping

All inverter i950 slave devices have a fixed generic data mapping. This data mapping enables the use of the slave devices with an i950 inverter as system bus master and with other Ether-CAT-based master control systems (PLC).

- The process data is set to 8 double words (32 bytes) for each direction.
- Output data direction: From Master to Slave.
  - Output data: 0xA200:001 ... 0xA200:008
- Input data direction: From Slave to Master.
  - Input data: 0xA680:001 ... 0xA680:008
- This fixed data mapping is automatically activated as master for an i950 inverter.
- The process data is transmitted cyclically in a 1 ms cycle between the master and the slaves.
- The process data transfer is synchronised by the "Distributed Clocks" EtherCAT mechanism.
  - A i950 master device provides the DC master via the internal slave.
  - The data in the slaves is accepted synchronously with the PLC program in the master.
  - All slaves are synchronised with a reference clock, the so-called "DC master".

Parameter

Address	Name / setting range / [default setting]	Info
0xA200:001	Systembus output data: Systembus data output 1 • Read only	Generic system bus output data from the PLC to the inverter.
0xA200:002	Systembus output data: Systembus data output 2 • Read only	
0xA200:003	Systembus output data: Systembus data output 3 • Read only	
0xA200:004	Systembus output data: Systembus data output 4 • Read only	
0xA200:005	Systembus output data: Systembus data output 5 • Read only	
0xA200:006	Systembus output data: Systembus data output 6 • Read only	
0xA200:007	Systembus output data: Systembus data output 7 • Read only	
0xA200:008	Systembus output data: Systembus data output 8 • Read only	
0xA680:001	Systembus input data: Systembus data input 1 0 ... **[0]** ... 4294967295	Generic system bus input data from the inverter to the PLC.
0xA680:002	Systembus input data: Systembus data input 2 0 ... **[0]** ... 4294967295	
0xA680:003	Systembus input data: Systembus data input 3 0 ... **[0]** ... 4294967295	
0xA680:004	Systembus input data: Systembus data input 4 0 ... **[0]** ... 4294967295	
0xA680:005	Systembus input data: Systembus data input 5 0 ... **[0]** ... 4294967295	
0xA680:006	Systembus input data: Systembus data input 6 0 ... **[0]** ... 4294967295	
0xA680:007	Systembus input data: Systembus data input 7 0 ... **[0]** ... 4294967295	
0xA680:008	Systembus input data: Systembus data input 8 0 ... **[0]** ... 4294967295	

16.4.3.1 Standard mapping

16.4.3.2 Process output data

Parameter

Address	Name / setting range / [default setting]	Info
0xA200:001	Systembus output data: Systembus data output 1 • Read only	Generic system bus output data from the PLC to the inverter.
0xA200:002	Systembus output data: Systembus data output 2 • Read only	
0xA200:003	Systembus output data: Systembus data output 3 • Read only	
0xA200:004	Systembus output data: Systembus data output 4 • Read only	
0xA200:005	Systembus output data: Systembus data output 5 • Read only	
0xA200:006	Systembus output data: Systembus data output 6 • Read only	
0xA200:007	Systembus output data: Systembus data output 7 • Read only	
0xA200:008	Systembus output data: Systembus data output 8 • Read only	
0xA200:009	Systembus output data: Systembus data output 9 • Read only	
0xA200:010	Systembus output data: Systembus data output 10 • Read only	
0xA200:011	Systembus output data: Systembus data output 11 • Read only	
0xA200:012	Systembus output data: Systembus data output 12 • Read only	
0xA200:013	Systembus output data: Systembus data output 13 • Read only	
0xA200:014	Systembus output data: Systembus data output 14 • Read only	
0xA200:015	Systembus output data: Systembus data output 15 • Read only	
0xA200:016	Systembus output data: Systembus data output 16 • Read only	

16.4.3.3 Process input data

Parameter

Address	Name / setting range / [default setting]	Info
0xA680:001	Systembus input data: Systembus data input 1 0 ... [**0**] ... 4294967295	Generic system bus input data from the inverter to the PLC.
0xA680:002	Systembus input data: Systembus data input 2 0 ... [**0**] ... 4294967295	
0xA680:003	Systembus input data: Systembus data input 3 0 ... [**0**] ... 4294967295	
0xA680:004	Systembus input data: Systembus data input 4 0 ... [**0**] ... 4294967295	
0xA680:005	Systembus input data: Systembus data input 5 0 ... [**0**] ... 4294967295	
0xA680:006	Systembus input data: Systembus data input 6 0 ... [**0**] ... 4294967295	
0xA680:007	Systembus input data: Systembus data input 7 0 ... [**0**] ... 4294967295	
0xA680:008	Systembus input data: Systembus data input 8 0 ... [**0**] ... 4294967295	

Address	Name / setting range / [default setting]	Info
0xA680:009	Systembus input data: Systembus data input 9 0 ... **[0]** ... 4294967295	
0xA680:010	Systembus input data: Systembus data input 10 0 ... **[0]** ... 4294967295	
0xA680:011	Systembus input data: Systembus data input 11 0 ... **[0]** ... 4294967295	
0xA680:012	Systembus input data: Systembus data input 12 0 ... **[0]** ... 4294967295	
0xA680:013	Systembus input data: Systembus data input 13 0 ... **[0]** ... 4294967295	
0xA680:014	Systembus input data: Systembus data input 14 0 ... **[0]** ... 4294967295	
0xA680:015	Systembus input data: Systembus data input 15 0 ... **[0]** ... 4294967295	
0xA680:016	Systembus input data: Systembus data input 16 0 ... **[0]** ... 4294967295	

16.4.4 Monitoring

Monitoring of the master/slave functionality

The following scenarios are monitored:

- The inverter at position 1 is not configured as system bus master.
- Several inverters have been configured as system bus master.

Depending on the assignment of the system bus interfaces X246 (EtherCAT IN) and X247 (EtherCAT OUT) and the set interface role in 0x2371:009 (master/slave), a warning is output:

Network cable plugged in X246/X247	0x2371:009 = 0 (Slave)	0x2371:009 = 1 (Master)
Only X246 (EtherCAT IN) is assigned.	OK	Warning
Only X247 (EtherCAT OUT) is assigned.	Warning	OK
X246 (EtherCAT IN) and X247 (EtherCAT OUT) are assigned.	OK	Warning

The parameters for setting network monitoring functions are described below.

Parameter

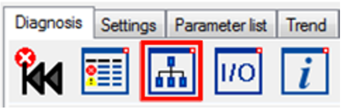
Address	Name / setting range / [default setting]		Info
0x285B:001	EtherCAT system bus monitoring: Watchdog abgelaufen		
	0	No response	
	1	**Fault > CiA402**	
	2	Warning	
0x285B:002	EtherCAT system bus monitoring: EtherCAT role check		
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	

16.4.5 Diagnostics

For diagnostic purposes, the system bus interfaces X246 and X247 provide LED status displays and diagnostic parameters for the EtherCAT system bus.

The diagnostic parameters are divided according to the interface role (master or slave) set in 0x2371:009.

In the »EASY Starter«, the diagnostic parameters can be accessed in the "Diagnostics" tab via the "Network diagnostics" button:



LED status display

Notes on the EtherCAT connection status and the data transfer can be obtained via the LED displays "RUN" and "L/A" at the RJ45 sockets.

16.4.5.1 LED status displays

LED status display

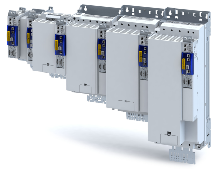
Notes on the EtherCAT connection status and the data transfer can be obtained via the LED displays "RUN" and "L/A" at the RJ45 sockets.

16.4.5.2 Information on the network

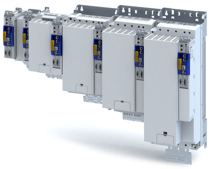
The following parameters show information on the network.

Parameter

Address	Name / setting range / [default setting]		Info
0x2378	Network status • Read only		Display of the active network status.
	1	Initialisation	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x2379	Network error • Read only		Display of the active network error.
0x5851:001	EtherCAT master diagnosis: EtherCAT master state • Read only		Display of the EtherCAT master state.
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x5851:002	EtherCAT master diagnosis: EtherCAT master state summary • Read only		Display of the EtherCAT master state overview.
	Bit 0	Master OK	
	Bit 4	Init	
	Bit 5	Pre-Operational	
	Bit 6	Safe-Operational	
	Bit 7	Operational	
	Bit 8	Slaves in requested state	
	Bit 9	Master in requested state	
	Bit 10	Bus scan match	
	Bit 12	DC enabled	
	Bit 13	DC in sync	
	Bit 14	DC busy	
	Bit 16	Link up	



Address	Name / setting range / [default setting]	Info
0x5851:003	EtherCAT master diagnosis: EtherCAT error • Read only	Display whether an EtherCAT network error has occurred.
0x5851:004	EtherCAT master diagnosis: Bus scan match • Read only	Display whether a "Bus Scan Match" exists.
0x5851:005	EtherCAT master diagnosis: Configured cycle time • Read only: x us	Display of the configured cycle time.
0x5851:006	EtherCAT master diagnosis: Connected slaves • Read only	Display of the number of slaves available in the network.
0x5851:007	EtherCAT master diagnosis: Configured slaves • Read only	Display of the number of configured slaves.
0x5860:001	EtherCAT slaves station addresses: Station address slave 1 • Read only	Display of the slave station address.
0x5861:001	EtherCAT slaves device names: Device name slave 1 • Read only	Display of the slave device name.
0x5862:001	EtherCAT slaves device types: Device type slave 1 • Read only	Display of the slave type designation.
0x5863:001	Mandatory EtherCAT slaves: Slave 1 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:002	Mandatory EtherCAT slaves: Slave 2 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:003	Mandatory EtherCAT slaves: Slave 3 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:004	Mandatory EtherCAT slaves: Slave 4 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:005	Mandatory EtherCAT slaves: Slave 5 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:006	Mandatory EtherCAT slaves: Slave 6 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:007	Mandatory EtherCAT slaves: Slave 7 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:008	Mandatory EtherCAT slaves: Slave 8 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:009	Mandatory EtherCAT slaves: Slave 9 is mandatory • Read only 0 FALSE 1 TRUE	
0x5863:010	Mandatory EtherCAT slaves: Slave 10 is mandatory • Read only 0 FALSE 1 TRUE	



Address	Name / setting range / [default setting]		Info
0x5863:011	Mandatory EtherCAT slaves: Slave 11 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:012	Mandatory EtherCAT slaves: Slave 12 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:013	Mandatory EtherCAT slaves: Slave 13 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:014	Mandatory EtherCAT slaves: Slave 14 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5863:015	Mandatory EtherCAT slaves: Slave 15 is mandatory • Read only		
	0	FALSE	
	1	TRUE	
0x5864:001	EtherCAT slaves initialisation status: Initalisation status slave 1 • Read only		Display of the initialisation state of the EtherCAT slave.
	0	No Error	
	1	No access	
	2	Vendor ID check failed	
	3	Product code check failed	
	4	Revision check failed	
0x5865:001	EtherCAT slaves device status: Device status slave 1 • Read only		Display of the device status of the EtherCAT slave.
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
	65519	Not Present	

16.4.5.3 Device identification

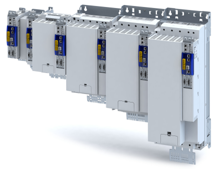
For device identification in the system bus network, the inverter provides the standard EtherCAT parameters 0x1018:001 ... 0x1018:004.

The EtherCAT product code in 0x1018:002 consists of device-specific data and the currently activated technology application (0x4000). The last three positions in the product code refer to the activated technology application.

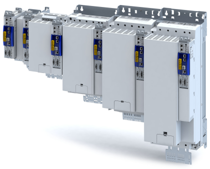
The 0x2372:009 parameter indicates the functionality of the system bus interface of the inverter (EtherCAT master/slave).

Parameter

Address	Name / setting range / [default setting]		Info
0x1018:001	Identity object: Vendor ID • Read only		Display of the manufacturer's identification number.
0x1018:002	Identity object: Product ID • Read only		Display of the product code of the inverter.
	419446784		
	419479552		
	419479572		



Address	Name / setting range / [default setting]	Info
0x1018:003	Identity object: Revision number • Read only	Display of the main and subversion of the firmware.
0x1018:004	Identity object: Serial number • Read only	Display of the serial number of the inverter.
0x2372:009	Systembus EtherCAT-Informationen: Active interface mode • Read only	Display of the active EtherCAT master/slave functionality for the system bus interface.
	0 Slave	Slave functionality is active.
	1 Master	Master functionality is active.



17 Device functions

17.1 Optical device identification

For applications including several interconnected inverters it may be difficult to locate a device that has been connected online. The "Optical device identification" function serves to locate the inverter by means of blinking LEDs.

Details

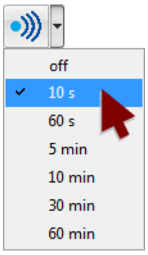
In order to start the visual tracking,

- click the button in the toolbar of the »EASY Starter« or
- set 0x2021:001 = "Start [1]".

After the start, both LEDs "RDY" and "ERR" on the front of the inverter synchronously blink very fast.

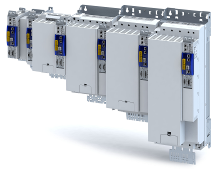
"RDY" LED (blue)	"ERR" LED (red)	Status/meaning
Both LEDs are blinking in a very rapidly synchronous mode		"Visual tracking" function is active.

The blinking duration can be set in 0x2021:002 or selected in the »EASY Starter« in the drop-down list field:



Parameter

Address	Name / setting range / [default setting]		Info
0x2021:001	Optical tracking: Start detection		1 = start optical device identification. • After the start, the two LEDs "RDY" and "ERR" on the front of the inverter are blinking with a blinking frequency of 20 Hz for the blinking duration set in 0x2021:002. The setting is then automatically reset to "0" again. • If the function is reactivated within the blinking time set, the time is extended correspondingly. • A manual reset to "0" makes it possible to stop the function prematurely.
	0	**Stop**	
	1	Start	
0x2021:002	Optical tracking: Blinking duration 0 ... [**5**] ... 6000 s		Setting of the blinking duration for the visual tracking.



17.2 Reset parameters to default

Parameter

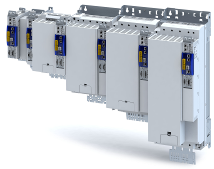
Address	Name / setting range / [default setting]		Info
0x2022:001	Device commands: Load default settings		1 ≡ reset all parameters in the RAM memory of the inverter to the default setting that is stored in the inverter firmware. • All parameter changes made by the user are lost during this process! • It may take some seconds to execute the task. When the task has been executed successfully, the value 0 is shown. • Loading parameters has a direct effect on the cyclic communication: The data exchange for control is interrupted and a communication error is generated.
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
0x2022:039	Device commands: Load TA default settings		
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	

17.3 Saving/loading the parameter settings

If parameter settings of the inverter are changed, these changes at first are only made in the RAM memory of the inverter. In order to save the parameter settings with mains failure protection, the inverter is provided with the corresponding device command in the parameter. 0x2022:003

Parameter

Address	Name / setting range / [default setting]		Info
0x2022:003	Device commands: Save user data		1 = save current parameter settings in the user memory of the memory module with mains failure protection. • It may take some seconds to execute the task. When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage during the saving process and do not unplug the memory module from the inverter! • When the inverter is switched on, all parameters are automatically loaded from the user memory of the memory module to the RAM memory of the inverter.
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
	101	No SD card connected	
	102	SD card is write protected	
	103	SD card is full	
0x2022:040	Device commands: Parameter-Backup • Setting can only be changed if the inverter is inhibited.		
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	No SD card connected	
	102	SD card is write protected	
	103	SD card is full	
0x2022:043	Device commands: Restore • Setting can only be changed if the inverter is inhibited.		
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	No SD card connected	



17.4 Enabling the device

Parameter

Address	Name / setting range / [default setting]	Info
0x2822:001	Axis commands: Enable inverter	Parameters for interaction with engineering tools.
	0 Inverter inhibited	
	1 Inverter enabled	

17.5 Restart device

If the inverter communicates with the master as network node via EtherCAT: executing the device command may cause an interruption of the EtherCAT communication with the master and a standstill of the drive.

Parameter

Address	Name / setting range / [default setting]	Info
0x2022:035	Device commands: Restart Device	Restart of the device.
	0 Off / ready	Only status feedback
	1 On / start	Execute device command
	2 In progress	Only status feedback
	3 Action cancelled	
	4 No access	
	5 No access (Inverter disabled)	

17.6 Restarting Extended Safety

Parameter

Address	Name / setting range / [default setting]	Info
0x2022:041	Device commands: Restart extended safety	
	0 Off / ready	Only status feedback
	1 On / start	Execute device command
	2 In progress	Only status feedback
	3 Action cancelled	
	4 No access	
	5 No access (Inverter disabled)	

17.7 Export logbook

The export of the complete logbook can be started with the 0x2022:036 parameter.

Parameter

Address	Name / setting range / [default setting]	Info
0x2022:036	Device commands: Export Logbook	Exports the logbook for the upload into the engineering tools.
	0 Off / ready	Only status feedback
	1 On / start	Execute device command
	2 In progress	Only status feedback
	3 Action cancelled	
	4 No access	
	5 No access (Inverter disabled)	

17.8 Delete logbook files

The logbook files can be deleted with the parameter.

Parameter

Address	Name / setting range / [default setting]		Info
0x2022:037	Device commands: Delete Logfiles		Deletion of log files on the device that were exported in an earlier step via 0x2022:036 (Export Logbook).
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	

17.9 Activate loaded application

The loaded application can be activated with the 0x2022:038 parameter.

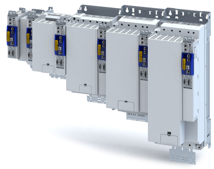
Parameter

Address	Name / setting range / [default setting]		Info
0x2022:038	Device commands: Activate loaded application		Start of the application that is provided/downloaded by the »Application Loader«.
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	

17.10 Uploading the application

Parameter

Address	Name / setting range / [default setting]		Info
0x2022:042	Device commands: Upload application		
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Inverter disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	No SD card connected	



17.11 Inverter control word

Parameter

Address	Name / setting range / [default setting]		Info
0x2830	Inverter control word 0x0000 ... [**0x0000**] ... 0xFFFF		The control word serves to influence the control functions.
	Bit 0	Flying restart completed	This bit enables the control to report the acceptance of the recorded speed to the "flying restart" function. Thus, the flying restart process is completed.
	Bit 1	Block flying restart	TRUE: the flying restart process is blocked.
	Bit 4	Set load value	TRUE: set load value.
	Bit 5	Select new actual position	TRUE: define new actual position. • Setting/shifting of Position actual value (0x6064) to Actual position start value (0x2983) considering the set resolution (0x608F:001, 0x608F:002). • Mode for setting the actual position: 0x2984)
	Bit 6	Activate DC-injection braking or short-circuit braking	DC-injection braking or short-circuit braking is activated via this bit.
	Bit 10	Reserved	
	Bit 11	Reserved	

17.12 Access protection

17.12.1 Brand protection

Parameter

Address	Name / setting range / [default setting]	Info
0x2100:001	Brand protection: PIN set -1 ... [**0**] ... 9999999	• 0: no brand protection. • 1 ... 9999999: possible pins. • -1: brand protection is active.
0x2100:002	Brand protection: PIN input -2 ... [**0**] ... 9999999	• 0: not checked. • 1 ... 9999999: possible pins. • -1: check was successful. • -2: check was not successful.
0x2100:003	Brand protection: Encryption 0 ... [**0**] ... 9	Encryption for brand protection.

17.13 Switching frequency changeover

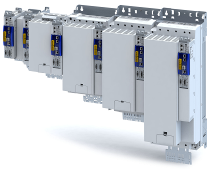
The output voltage of the inverter is a DC voltage with sine-coded pulse width modulation (PWM). This corresponds by approximation to a AC voltage with variable frequency. The frequency of the PWM pulses is adjustable and is called "switching frequency".

Details

The switching frequency has an impact on the smooth running performance and the noise generation in the motor connected as well as on the power loss in the inverter. The lower the switching frequency, the better the concentricity factor, the smaller the power loss and the higher the noise generation.

Parameter

Address	Name / setting range / [default setting]		Info
0x2939	Switching frequency		Selection of the inverter switching frequency. Abbreviations used: • "Variable": adaptation of the switching frequency as a function of the current. The carrier frequency is reduced dependent on the heatsink temperature and the ixt-load. • "Fix.": the carrier frequency is fixed, no frequency reduction. • "Drive-optimised": reduces the capacitive currents from the motor to the earth. • "Min. Pv": increases the capacitive currents from the motor to the earth.
	1	**4 kHz variable / drive-optimised**	
	2	8 kHz variable / drive-optimised	
	3	16 kHz variable / drive-optimised	
	5	2 kHz fixed / drive-optimised	
	6	4 kHz fixed / drive-optimised	
	7	8 kHz fixed / drive-optimised	
	8	16 kHz fixed / drive-optimised	



17.14 Device overload monitoring (i*t)

The inverter calculates the i*t utilisation in order to protect itself against thermal overload. In simple terms: a higher current or an overcurrent that continues for a longer time causes a higher i*t utilisation.

⚠ DANGER!

Uncontrolled motor movements by pulse inhibit.

When the device overload monitoring function is activated, pulse inhibit is set and the motor becomes torqueless. A load that is connected to motors without a holding brake may therefore cause uncontrolled movements! Without a load, the motor will coast.

► Only operate the inverter under permissible load conditions.

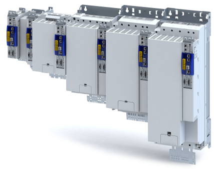
Details

The device overload monitoring function primarily offers protection to the power section. Indirectly, also other components such as filter chokes, circuit-board conductors, and terminals are protected against overheating. Short-time overload currents followed by recovery periods (times of smaller current utilisation) are permissible. The monitoring function during operation checks whether these conditions are met, taking into consideration that higher switching frequencies and lower stator frequencies as well as higher DC currents cause a greater device utilisation.

- If the total utilisation exceeds the total warning threshold set in 0x2D40:008 (default setting: 95 %), the inverter outputs a warning.
- If the device utilisation exceeds the permanent error threshold 100 %, the inverter is disabled immediately and generates an error message.
- The device overload can be obtained from the configuration document.

Parameter

Address	Name / setting range / [default setting]	Info
0x2D40:001	Device utilisation ixt: Power unit actual utilisation • Read only: x %	Display of the power module utilisation.
0x2D40:002	Device utilisation ixt: Power unit warning threshold 0 ... **[95]** ... 101 %	If the device utilisation exceeds the threshold set, the inverter outputs a warning.
0x2D40:003	Device utilisation ixt: Power unit error threshold • Read only: x %	If the power module utilisation exceeds the displayed threshold, the inverter outputs a warning.
0x2D40:004	Device utilisation ixt: Device actual utilisation • Read only: x %	Display of the current device utilisation.
0x2D40:005	Device utilisation ixt: Device warning threshold 0 ... **[95]** ... 101 %	
0x2D40:006	Device utilisation ixt: Device error threshold • Read only: x %	If the device utilisation exceeds the displayed threshold, the device outputs an error.
0x2D40:007	Device utilisation ixt: Actual total utilisation • Read only: x %	Display of the current total device utilisation.
0x2D40:008	Device utilisation ixt: Total utilisation warning threshold 0 ... **[95]** ... 101 %	If the total utilisation exceeds the set threshold, the device outputs a warning.
0x2D40:009	Device utilisation ixt: Total utilisation error threshold • Read only: x %	If the total utilisation exceeds the displayed threshold, the device outputs an error.



17.15 Heatsink temperature monitoring

In order to avoid an impermissible heating of the servo inverter, the temperature of the heatsink is detected and monitored.

The temperature of the heatsink is measured in the temperature range of 0 ... 80 °C with a tolerance of -2 ... +4 °C. Beyond this temperature range, the measuring accuracy decreases faster.

Parameter

Address	Name / setting range / [default setting]	Info
0x2D84:001, 004, 006	Heatsink temperature: Heatsink temperature • Read only: x.x °C	Display of the current heatsink temperature.
0x2D84:002	Heatsink temperature: Warning threshold 50.0 ... [**90.0**] ... 100.0 °C	Warning threshold for temperature monitoring. • If the heatsink temperature exceeds the threshold set here, the inverter outputs a warning. • The warning is reset with a hysteresis of approx. 5 °C. • If the heatsink temperature increases further and exceeds the non-adjustable error threshold (100 °C), the inverter changes to the "Fault" device status. The inverter is disabled and thus any further operation is stopped.

17.16 Update device firmware

17.16.1 Manual firmware download with »EASY Starter (firmware loader)«

17.16.1.1 Download via Ethernet connection

Parameter

Address	Name / setting range / [default setting]		Info
0x243C:001	Device: Ethernet commands: Device: Start firmware update • Setting can only be changed if the inverter is inhibited.		
	0	**Off/Ready**	
	1	On/Start	
	4	Action cancelled	
	20	20%	
	40	40%	
	60	60%	
	80	80%	

18 Additional functions

18.1 Brake energy management

When braking electrical motors, the kinetic energy of the drive train is fed back regeneratively to the DC bus. This energy causes a DC-bus voltage boost. If the energy fed back is too high, the inverter reports an error.

Several different strategies can serve to avoid DC-bus overvoltage:
- Stopping the deceleration ramp function generator when the active voltage threshold for the brake operation is exceeded
- Use of the "Inverter motor brake" function
- Combination of the above named options

Details

The voltage threshold for braking operation results on the basis of the rated mains voltage set:

Rated mains voltage	Voltage thresholds for braking operation	
	Braking operation on	Braking operation off
230 V	DC 390 V	DC 380 V
400 V	DC 725 V	DC 710 V
480 V	DC 780 V	DC 765 V

Parameter

Address	Name / setting range / [default setting]	Info
0x2541:003	Brake energy management: Reduced threshold 0 ... [**0**] ... 100 V	The voltage threshold for the braking operation is reduced by the voltage value set here.

18.1.1 Use of a brake resistor

For braking operation, optionally the brake chopper integrated in the inverter (brake transistor) can be used.

NOTICE

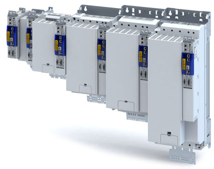
Incorrect dimensioning of the brake resistor may result in the destruction of the integrated brake chopper (brake transistor).

► Only connect a brake resistor complying in terms of performance to terminals R_{B1} and R_{B2} of the inverter.

► Avoiding thermal overload of the brake resistor.

Parameter

Address	Name / setting range / [default setting]	Info
0x2550:001	Brake resistor: Minimum resistance • Read only: x.x Ω	Display of the minimum brake resistance value that can be used.
0x2550:002	Brake resistor: Resistance value 0.0 ... [**180.0**] ... 500.0 Ω	Resistance value of the brake resistor connected. • The value to be entered can be obtained from the brake resistor nameplate.
0x2550:003	Brake resistor: Rated power 0 ... [**5600**] ... 800000 W	Rated power of the brake resistor connected. • The value to be entered can be obtained from the brake resistor nameplate.
0x2550:004	Brake resistor: Maximum thermal load 0 ... [**485**] ... 1000000 kWs	Thermal capacity of the brake resistor connected. • The value to be entered can be obtained from the brake resistor nameplate.
0x2550:006	Brake resistor: Reference resistance **0** **Minimum resistance** 1 Resistance value	Selection of the reference value for the brake resistor.
0x2550:007	Brake resistor: Thermal load • Read only: x.x %	Display of the utilisation of the brake resistor connected.

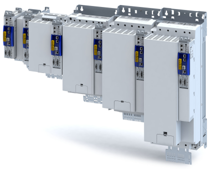


Address	Name / setting range / [default setting]	Info
0x2550:008	Brake resistor: Warning threshold 50.0 ... [**90.0**] ... 150.0 %	Warning threshold for brake resistor monitoring. • If the utilisation shown in reaches the threshold set, the response selected in 0x2550:010 is effected. • The warning is reset with a hysteresis of 20 %.
0x2550:010	Brake resistor: Response to warning	Selection of the response that is executed when the warning threshold for brake resistor monitoring is reached.
	0 No response	
	1 Fault > CiA402	
	2 Warning	
0x2550:011	Brake resistor: Response to error	Selection of the response to be executed when the error threshold for brake resistor monitoring is reached. Associated error code: • 65282 | 0xFF02 - Brake resistor: overload fault
	0 No response	
	1 Fault > CiA402	
	2 Warning	

18.2 Manual jog parameters

Parameter

Address	Name / setting range / [default setting]	Info
0x2836:001	Manual control mode: Current setpoint 0 ... [**30**] ... 200 %	Setting of the current setpoint value for manual control. • 100 % ≡ Rated current ()
0x2836:002	Manual control mode: Frequency -1000.0 ... [**0.0**] ... 1000.0 Hz	Setting of the frequency for manual control.
0x2836:003	Manual control mode: Ramp time (current) 0 ... [**0**] ... 1000 ms	Setting of the period of time during which the current setpoint value is achieved from zero onwards.
0x2836:004	Manual control mode: Ramp time (frequency) 0 ... [**500**] ... 10000 ms	Setting of the period of time during which the frequency is achieved from zero onwards. The frequency ramp only starts up when the current ramp has reached the value configured in 0x2836:001 (Current setpoint).
0x2836:005	Manual control mode: Time monitoring (frequency) 0 ... [**2500**] ... 100000 ms	Setting of the time period for time monitoring. • The manual control features a time monitoring function which is coupled to a write access to 0x2836:002 (Frequency). • If no write access to 0x2836:002 takes place within the time period set here, the frequency is moved to zero via the parameterised ramp. When the 0 Hz have been reached, the inverter changes to the error status and is inhibited. After acknowledging the error, the CiA402 state machine must be switched from "Switch-on inhibited" back to the "Operation enabled" state before proceeding with manual control.
0x2836:006	Manual control mode: Current controller gain 0.00 ... [**20.00**] ... 750.00 V/A	Setting of the current controller gain.
0x2836:007	Manual control mode: Current controller reset time 0.01 ... [**20.00**] ... 2000.00 ms	Setting of the current controller reset time.



18.3 Mains failure control

Parameter

Address	Name / setting range / [default setting]		Info
0x2D66:001	Mains failure control: Enable function		1 = enable mains failure control.
	0	**Disabled**	
	2	Enabled	
0x2D66:002	Mains failure control: DC-bus activation level 60 ... [**75**] ... 90 %		Threshold below which the mains failure control is activated if it is enabled (0x2D66:001 = 1). • 100 % ≡ nominal DC-bus voltage Recommended setting: • In general: 5 ... 10 % above the error threshold for undervoltage (display in 0x2540:003). • 230-V devices: 72 % • 400/480-V devices: 82 %
0x2D66:011	Mains failure control: Filter time 0.00 ... [**0.00**] ... 60.00 s		
0x2D66:012	Mains failure control: Ramp max. torque 0.0 ... [**30.0**] ... 3276.7 %		
0x2D66:013	Mains failure control: Ramp time 0.10 ... [**1.00**] ... 5.00 s		
0x2D66:014	Mains failure control: Actual DC-bus voltage • Read only: x.xxx V		

18.4 Oscilloscope function

The oscilloscope function is operated via the separate "Oscilloscope" tab of the »EASY Starter« engineering tool. Here, you can find the user interface with all the relevant dialogs and setting options.

Preconditions

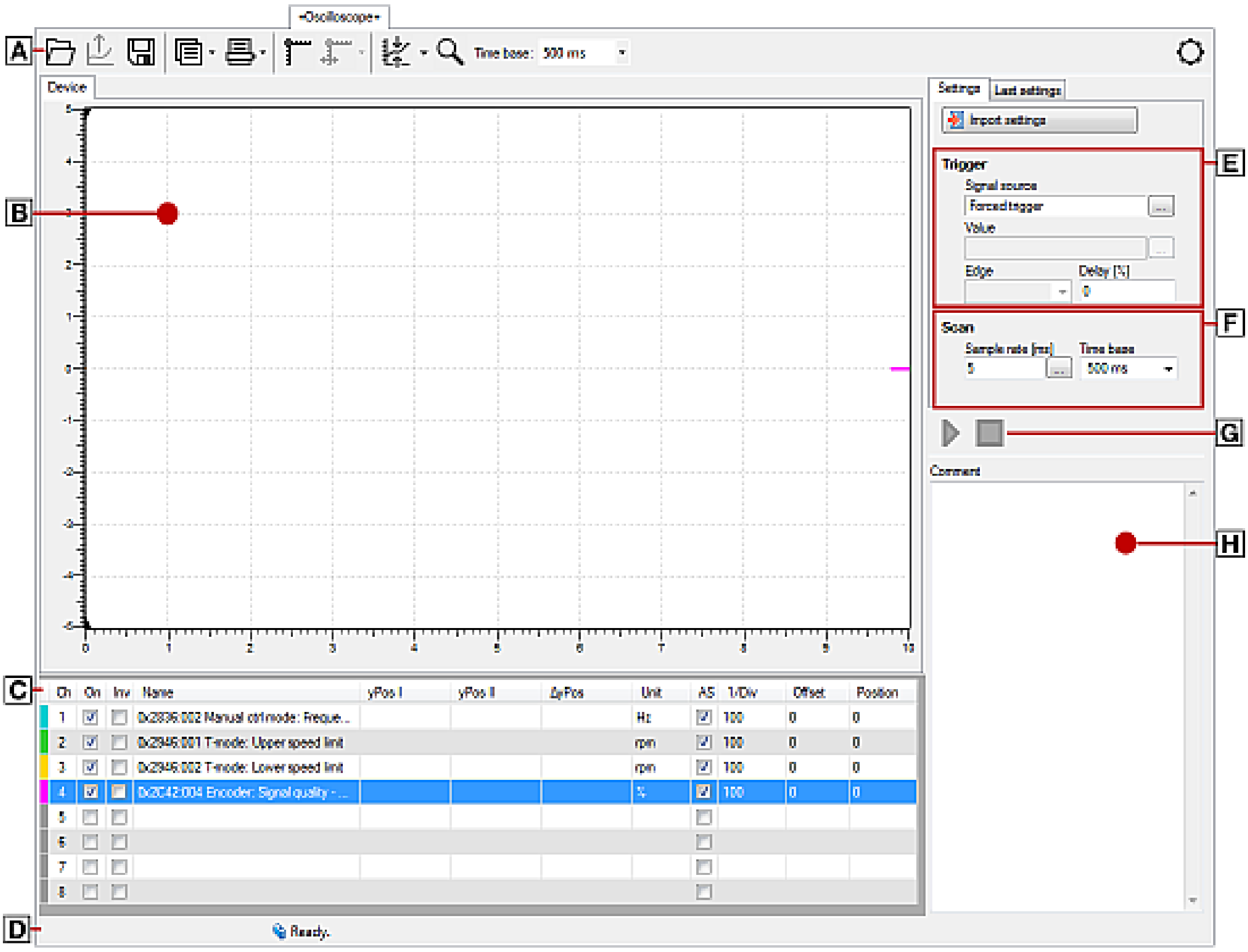
- Configuring the oscilloscope and starting the recording is only possible when an online connection to the inverter has been established.
- The oscilloscope function enable recording of those parameters of the inverter that are marked with the "OSC" attribute. Only these parameters can be transferred into the selection list of the oscilloscope.

User interface

In the Lenze engineering tool used, set the trigger condition and the sample rate via the oscilloscope user interface when an online connection to the inverter has been established and select the parameters to be recorded.

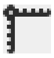
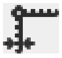
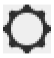
The configuration is transferred into the inverter and checked each time it changes. Should the check identify invalid settings, the oscilloscope triggers an error message.

After the measurement is completed and when an online connection has been established, the measured data in the inverter is transmitted to the engineering tool and represented graphically on the oscilloscope user interface.



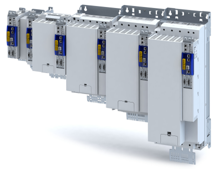
A	Oscilloscope-toolbar	E	Set trigger conditions
B	Oscillogram field	F	Set sample rate and time base
C	**Channel** list field	G	Start / stop of recording
D	Status line	H	Comment input field and error message

Toolbar

Icon	Function
	Load oscillogram / configuration from file
	Load recorded oscillogram from the device
	Save oscillogram in file
	Copy oscillogram to the clipboard
	Print oscillogram
	Display cursor
	Centre cursor
	Scale curve automatically
	Activate zoom function
"Time base:"	Display of the set time base
	Tool settings (right-hand side of the toolbar)

Technical data

Number of channels	1 ... 8
Data memory depth	Maximally 2048 measured values for each channel
Data width of a channel	Maximally 64 bits, according to the data type of the parameter to be recorded
Sample rate	62.5 µs or a multiple thereof
Minimum recording time	128 ms (62.5 µs * 2048 measured values)
Maximum time base	20.47 s
Maximum recording time	20.47 s
Trigger level	According to the value range of the parameter to be triggered
Trigger selection	
Trigger delay	-100 % ... +400 %
Trigger source	Channel 1 ... 8



Selecting parameters to be recorded

The oscilloscope supports up to eight channels, thus maximally eight parameters can be recorded in an oscillogram. The **Channels** list field serves to configure the parameters to be recorded as signal sources:

Column	Name	Meaning
1	-	Curve colour for the representation in the oscillogram
2	Ch	Channel number
3	On	on / off
4	Inv	Inversion on / off
5	Name	Selection of the parameter to be recorded
6	yPos I	Value at cursor I in vertical direction
7	yPos II	Value at cursor II in vertical direction
8	| ΔyPos |	Difference between the two values of yPos I and yPos II (displayed as amount)
9	Unit	Scaling
10	AS	Activation / deactivation of the autoscaling function
11	1 / Div	
12	Offset	The offset value is subtracted from the recorded raw value before the scaling is executed. This serves to, e. g., make very small value fluctuations visible within one consistently very high recording value (e. g. harmonics with a low amplitude).
13	Position	Regarding the vertical curve scale -5 ... 5, the position value determines the vertical position of the zero point of the Y axis of a curve.

How to select a parameter for recording:

1. Double-click the "Name" column in the **Channel** list field to open the "Selection of signal sources" dialog box.
2. Select the parameters to be recorded in the dialog box.
3. Press the "Ok" button. This closes the dialog box and the selection is accepted.
4. Repeat the steps 1 ... 3 to select up to seven further parameters to be recorded.

The selected parameters are recorded when the oscilloscope is started.

How to change a parameter for recording:

1. Double-click the parameter to be changed in the **Channels** list field in the "Name" column.
2. Make a new selection in the "Selection of signal sources" dialog box.
3. Press the "Ok" button. This closes the dialog box and the selection is accepted.

The changed parameters are recorded when the oscilloscope is started.

How to cancel a selection again:

1. Right-click the parameter to be removed in the **Channels** list field in the "Name" column to open the context menu.
2. Select the "Remove parameter" command in the context menu.

The selected and changed parameter will not be recorded anymore when the oscilloscope is started.

Defining the recording time / sample rate

How to define the duration and sample rate for recording:

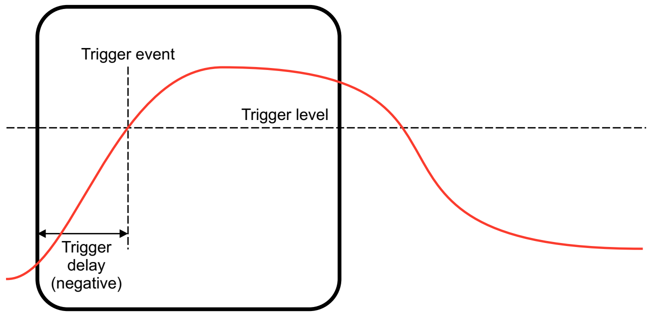
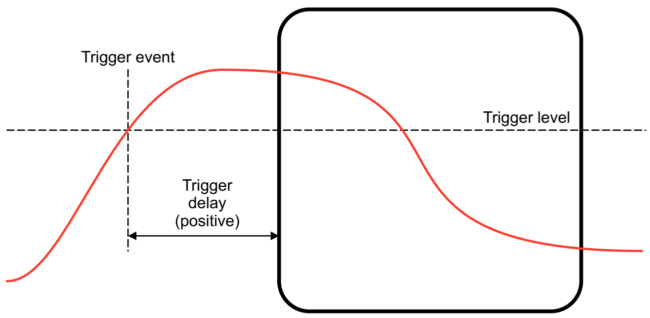
1. Select the desired time base in the time base list field.
   a) The current setting of the time base multiplied by 10 results in the recording time.
   b) As the size of the measured data memory in the inverter is limited, a compromise is usually made between sample rate and recording time.
2. Either enter the desired sample rate in [ms] in the sample rate input field or open the "Sample rate selection" dialog by clicking the "Sample rate" button and select a sample rate < 1 ms.
   a) The sample rate in the inverter is automatically corrected to integer multiples of 62.5 µs.

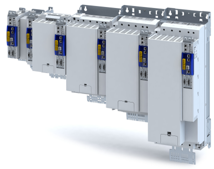
Thus, the duration and sample rate are defined for recording and are considered when the oscilloscope is started.

Defining the trigger condition

Based on the trigger condition, define the starting time of recording in the inverter. The oscilloscope offers various trigger conditions which serve to control the recording of the measured values.

The trigger threshold can be changed in the "Value" input field on the "Settings" tab if the channel is selected in "Signal source" that contains the corresponding parameter.

Setting	Function
Signal source	Selection of the trigger source:
Channel	Triggering takes place on a channel configured in the "vertical channel settings" list field.
immediate trigger	No trigger condition, recording takes place immediately after the start.
Value	Value, from which onwards triggering is caused.
Deceleration	Time delay of recording with regard to the trigger event.
Pre-trigger	When entering a negative delay time, you can detect signals that occur before the trigger event.  The trigger time is marked with a dashed line in the oscillogram. If it is triggered on the occurrence of an event, values caused by the event can be detected in this way.
Post-trigger	When entering a positive delay time, you can detect signals that occur a certain time after the trigger event. 
Edge	Two trigger types are available:
increasing	First, the value must fall below the defined trigger value and then exceed it in order that triggering is activated.
decreasing	First, the value must exceed the defined trigger value and then fall below it in order that triggering is activated.



Starting recording

Press the button ▶, "Start recording"

In order to obtain a sample rate as high as possible when the parameter values are recorded, the data is first saved in the measured data memory of the inverter and then transmitted to the Engineering PC as oscillogram. The current recording status is displayed in the status bar.

Adjusting the representation

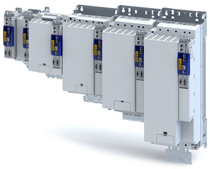
As soon as the diagram does not show the complete measurement anymore, a scrollbar appears below the time axis. You can use the scrollbar to move the visible section horizontally. The time-axis inscription and the position indicator are automatically corrected during scrolling.

After recording and subsequent transmission of the online oscillogram to the Engineering PC, it is visualised in the oscilloscope. If required, you can now adjust the representation using the zoom function or the automatic scaling function.

Change time base subsequently

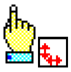
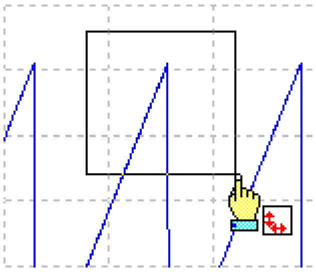
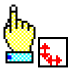
A measurement already carried out can be extended or compressed by changing the time base.

For this purpose, change the setting of the time base via the toolbar (on top).



Zoom function

The zoom function will be activated by selecting the in the toolbar. When the function is activated, the button is highlighted.

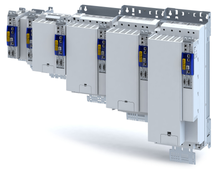
Zoom function	Proceeding
Zoom selection	 Hold down the left mouse button and draw the section to be zoomed:  • The selection is shown with a frame. • When the left mouse button is released, the selection is zoomed in the oscillogram.
Horizontal stretching	On the horizontal scale:  Hold down the left mouse button and move the mouse pointer to the left to stretch the shown selection from the right edge.  Hold down the right mouse button and move the mouse pointer to the right to stretch the shown selection from the left edge. Moving the mouse pointer in opposite direction continuously reduces the stretching.
Vertical stretching	On the vertical scale:  Hold down the left mouse button and move the mouse pointer to the bottom to stretch the shown selection from the top.  Hold down the right mouse button and move the mouse pointer to the top to stretch the shown selection from the bottom. Moving the mouse pointer in opposite direction continuously reduces the stretching.
Return to original representation	 Click the right mouse button in the diagram to return step by step to the original representation.

Automatic scaling function

Use the automatic scaling function to automatically scale and reposition the representation of selectable signal characteristics in the oscillograph and reset the offset to "0".

How to execute automatic scaling

1. Select the channels and parameters for automatic scaling in the **Channels** dialog box.
2. Click the corresponding symbol in the oscilloscope toolbar to activate the automatic scaling function.



The cursor function

In addition to the zoom and scaling function, there is the cursor function which is called by double-clicking the **Channels** list field.

The double-click opens a list of all signal sources with the following options:

- Display of individual measured values of a selectable channel
- Addition, subtraction or multiplication of any two measured values
- Square-law mean value of any two measured values

How to use the cursor function:

1. Go to the oscilloscope toolbar and click the "Cursor" button to activate the cursor function.
   a) Two movable vertical measuring lines are displayed in the oscillogram.
2. Select the channel for which individual measuring lines are to be displayed from the **Channels** list field.
3. Hold down the left mouse button and drag the red vertical measuring line to the desired position.
   a) The active measuring line is represented by a continuous line, the inactive measuring line is represented by a dotted line.
   b) If you position the mouse pointer over the inactive measuring line, the measuring line automatically becomes active.
   c) The columns **yPos I** and **yPos II** in the **Channels** list field display the values measured at the measuring lines. The column **ΔyPos** or **QWM** displays the cursor differential value or square-law mean value of all values between both cursors.
   d) The sum value to be displayed can be defined in the "tool settings" dialog. This dialog can be set via the "Tool settings" dialog on the right in the toolbar.
   e) Comparing peak values: Several values displayed in the oscillogram can be compared to each other using a horizontal measuring line. The measuring line is automatically created based on the current cursor point and thus cannot be shifted.

Managing oscillograms

If several data records are loaded in the oscilloscope at the same time, the measured data to be displayed is selected via the respective tab above the displayed oscillogram. There are three types of oscillograms:

- **Device oscillogram**

  The device oscillogram is the only oscillogram to establish a connection to the target system in order to carry out an oscilloscope measurement. It is always displayed as the first "Device on the left" tab.
- **Offline oscillogram**

  The offline oscillogram is an oscillogram already saved in the Engineering PC.
  - The configuration of the offline oscillogram can be reused for future recordings.
  - The offline oscillogram is displayed as a tab with the file name that was allocated for this oscillogram while being saved.
- **Merge oscillogram**

  The merge oscillogram ("Merge" tab) is automatically available if two or more oscillograms are loaded in the oscilloscope at the same time.
  - In the merge oscillogram, several characteristics from the currently loaded oscillograms can be overlaid, e. g. to compare signal characteristics from different recordings.

Commenting oscillograms

You can add a comment on the selected oscillogram into the comment input field.

- When you execute the "Save oscillogram" command, the comment is saved together with the oscillogram in the file.
- When you select an oscillogram with a comment to be loaded in the "Load oscillogram" dialog box, this comment is displayed in the dialog box.

Saving oscillogram in file

The reuse of a saved configuration is only reasonable for inverters of the same type (e. g. i950 inverters), as otherwise due to a scaling of the oscilloscope channels that is not adapted, incorrect values are displayed!

After selecting the parameters to be recorded from the selection list of the signal sources and making any further necessary settings, you can save this configuration and the recording if already carried out on the Engineering PC for a later reuse.

How to save the oscillogram:

1. Click the symbol in the toolbar. the "Save oscillogram" dialog box is displayed.
2. Define a name in the Name input field of the oscillogram to be saved.
3. Click the "Export to file" button.
4. Specify the folder and file name for the oscillogram be stored in the Save as dialog box.
5. Click the Save button. The dialog box is closed.

The current oscillogram is saved.

Loading oscillogram / configuration from file

The reuse of a saved configuration is only reasonable for inverters of the same type (e.g. i950 inverters), as otherwise due to a scaling of the oscilloscope channels that is not adapted, incorrect values are displayed!

Data sets/configurations which have already been saved can be reloaded into the oscilloscope any time, e.g. for the overlay function.

How to load an oscillogram or a configuration:

1. Click the symbol in the oscilloscope toolbar. The "Load oscillogram" dialog box is displayed.
2. Press the Search... button.
3. Select the file to be imported within the desktop environment from the Open dialog box.
4. If the oscillogram is to be used as configuration, select the As configuration... option.
5. Click the Open button. The dialog box is closed.

The selected oscillogram or configuration is imported.

Closing the oscillogram

You can close an open OFFLINE oscillogram again any time.

- After an oscillogram is closed, it is no longer available in the oscillogram list field. The oscilloscope changes automatically to the display of the ONLINE oscillogram.
- If the closed oscillogram was included in the MERGE oscillogram, its channels will be removed from the MERGE oscillogram.
- Go to the oscilloscope toolbar and click the symbol to close the currently displayed OFFLINE oscillogram.

Overlay function

The overlay function serves to overlay several characteristics from the currently loaded data sets, e.g. to compare signal characteristics from different recordings.

- If two or more oscillograms are loaded in the oscilloscope, e.g. the ONLINE oscillogram and an oscillogram that was previously loaded into a file, a "MERGE" oscillogram will be automatically available in the "Oscillogram" list field.
- If the merge oscillogram is selected, the desired characteristics to be overlaid or compared can be selected from the loaded oscillograms in the Vertical channel settings group field.
- If an ONLINE oscillogram is used in the MERGE oscillogram, an update is carried out in the MERGE oscillogram in the case of a renewed recording.
- Removing variables from an OFFLINE or ONLINE oscillogram causes the characteristics in the MERGE oscillogram to be deleted.

Copying an oscillogram to the clipboard

For documentation purposes, it is possible to copy the measured data of an oscillogram as a table or, alternatively, the oscilloscope user interface as a picture, to the clipboard for use in other programs.

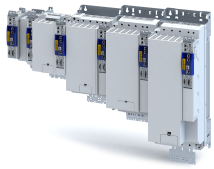
How to copy the oscillogram to the clipboard:

1. Click the symbol in the oscilloscope toolbar. The "Copy oscillogram" dialog box is displayed.
2. Select the desired option:
   a) Curve points: the measured data is copied to the clipboard as a table.
   b) Screenshot: the oscilloscope user interface is copied to the clipboard as a picture.
3. Press the OK button. The dialog box is closed and the selected option is copied to the clipboard.

19 Safety functions

Supported safety functions for "Basic Safety-STO"

▸ Safe Torque Off (STO) 📖 364



19.1 Safe Torque Off (STO)

The motor cannot generate torque and movements of the drive.

⚠ DANGER!

Automatic restart if the request of the safety function is deactivated.

Possible consequences: Death or severe injuries

► You must provide external measures according to EN ISO 13849−1 which ensure that the drive only restarts after a confirmation.

⚠ DANGER!

The power supply is not safely disconnected.

Death or serious injury due to electrical voltage.

► Turn off the power supply.

Preconditions

Motion caused by external forces must be prevented by additional measures such as mechanical braking.

The restart must be set. See chapter .

Details

Safe disconnection of the drive

1. A safety sensor requests the safety function.
2. The pulse width modulation is safely switched off by the safety unit.

The inverter switches to the STO active device status (0x6041, Bit15 = 0).

The power drivers do not generate a rotating field anymore.

The motor is safely switched to torqueless operation (STO).

The functional principle depicted applies to Basic Safety (STO) and Extended Safety. The terminals shown apply to Basic Safety.

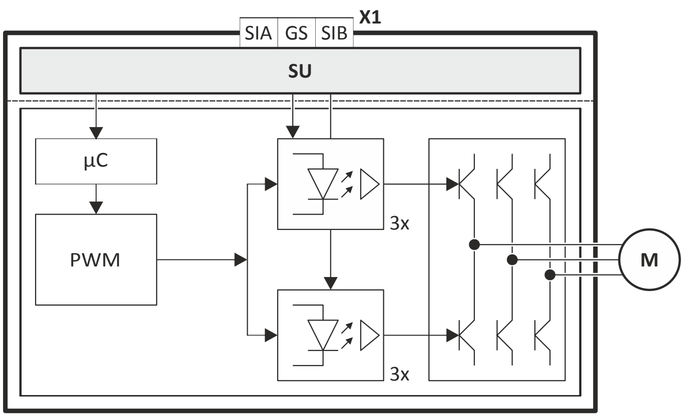


Fig. 52: Functional principle of safety technology for Extended Safety and Basic Safety (STO)

X1	Control terminals of the safety unit	µC	Microcontroller
SU	Basic Safety (STO) or Extended Safety	PWM	Pulse width modulation
		M	Motor

Functional description

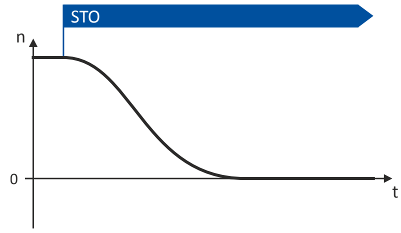


Fig. 53: Safety function STO

> Functional sequence and error response have no adjustable parameters.

Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

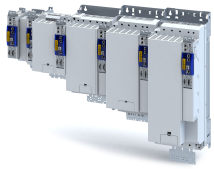
A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfa-ces". 407

In response to the error stop request.

In response to the emergency stop request.

Parameter

Address	Name / setting range / [default setting]		Info
0x2890	STO: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x2891	STO: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x2892:001	STO: STO: Restart • Read only		
	0	Acknowledged Restart	
	1	Automatic Restart	
0x2893	STO active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	



19.2 Safe Emergency Stop (SSE)

The SSE safety function has the highest priority. The SSE safety function is primarily triggered from all states, operating modes or safety functions. Depending on the parameter setting in 0x28A3:0010x28A3:001, the emergency stop function activates one of the functions:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1)

NOTICE

Emergency stop buttons must not be overruled by a special operation.

Otherwise the functional safety of the system cannot be guaranteed anymore.

▶ Please observe the notes in the section

.

▶ Please observe the notes regarding the special operation (OMS) in the section
Operation mode selector (OMS). 400

Preconditions

The emergency stop buttons are connected to the emergency stop function.

Details

The function is activated by the following:

- a data telegram with a corresponding content is sent to the inverter via the safety bus.
- "OFF state" at a safe input which has been assigned to the function by parameterisation.

Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 407

Parameter

Address	Name / setting range / [default setting]		Info
0x28A1	SSE: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28A2	SSE: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28A3:001	SSE: SSE: Emergency Stop function • Read only		
	0	STO	
	1	SS1	
0x28A4	SSE active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.3 Ramp monitoring

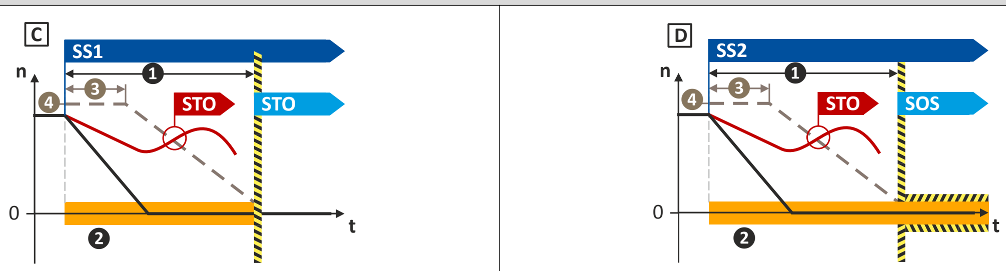
In addition, the deceleration ramp can be parameterised and monitored for the stop functions SS1 and SS2. If the parameterised ramp is not exceeded, it is then switched to the parameterised stop function STO or SOS.

Functional description

Monitoring the deceleration process guarantees a higher safety level.

- The application leads the drive to a standstill.
- If the ramp monitoring is active, the starting value of the ramp and the smoothing time must be defined as percentage value.

If the speed exceeds the deceleration ramp parameterised within the stopping time or before the tolerance window (n = 0) is reached, an error message is triggered and an error stop is initiated.

Safe ramp monitoring for SS1-r and SS2-r

1. 0x2894:001 ▸ 0x2894:001 SS1, SS2: Stopping time
2. 0x287B:001 ▸ 0x287B:001 Tolerance window (n=0)
3. 0x2894:003 ▸ 0x2894:003 SS1, SS2: Ramp smoothing time
4. 0x2894:005 ▸ 0x2894:005 SS1, SS2: start offset ramp

Condition

- Safe speed evaluation via the parameterised encoder system.
- Ramp monitoring is activated. ▸ 0x2894:005

The parameterised monitoring ramp considers the parameters of the deceleration ramp in the application.

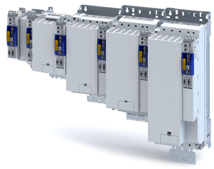
0...30 % of the actual speed are added to the actual speed as start offset. The sum is used as constant starting value.

Alternative: An absolute value can be parameterised as start offset. The value is set in the following parameter. 0x2894:006 ▸ 0x2894:006.

The following parameter defines whether the relative or absolute offset value is used. 0x2894:004 ▸ 0x2894:004

The Lenze setting of the start offset considers the tolerance window (n=0) as offset. 0x2894:005 ▸ 0x2894:005

The monitoring ramp starts after an internal deceleration time has elapsed. The internal deceleration time depends on "SS1, SS2: smoothing time" and "SS1, SS2: stopping time".



Activation

- If the stop functions SS1/SS2 are requested, a monitoring ramp is calculated and placed over the current speed characteristic.

Normal behaviour

While the stopping time elapses or before the tolerance window (n = 0) is reached, the parameterised speed ramp is not exceeded. When the stopping time has elapsed or the parameterised speed ramp has been exceeded, the parameterised stop function STO or SOS is activated.

Error behaviour

An error message and an error stop are triggered if:

- the current speed exceeds the stopping time of the speed ramp parameterised.
- the current speed exceeds the parameterised speed ramp before the tolerance window is reached.

The power supply for generationg the rotating field is safely interrupted ▶ Safe Torque Off (STO). The motor cannot generate torques and movements of the drive.

19.4 Safe Stop 1 (SS1)

The safety function monitors the parameterised stopping time of the drive (n = 0).

The drive switches to torqueless operation via the parameterised mode in the function SS1 (0x2897:0010x2897:001).

Preconditions
The drive is brought to standstill via the application.

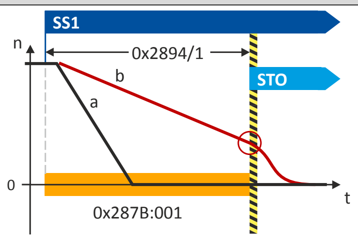
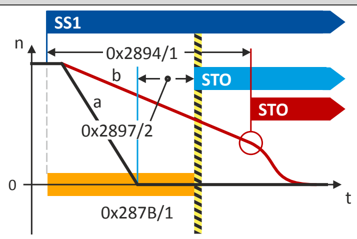
Movements caused by external forces require additional measures. When the stopping time is defined, the application time of the brake must be taken into consideration.

The restart is possible after the stopping time has completely elapsed. An exception from this is the special operation.

Functional description

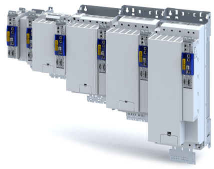
n = 0 means that the motor speed is lower than the motor speed parameterised in the tolerance window. 0x287B:0010x287B:001, tolerance window (n=0).

The deceleration ramp can be parameterised and monitored for the stop function SS1.

<table>
<tr><th>SS1-t
0x2897:001 = 0 (STO after stopping time)</th><th>SS1-t
0x2897:001 = 1 (STO at n = 0)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>The SS1 safety function switches the inverter to STO if the stopping time set in 0x2894:001 0x2894:001 (stopping time for SS1 and SS2) has elapsed. The switching operation is triggered irrespective of whether the motor is at standstill or not!</td><td>This parameter setting brings the motor to a standstill.
The deceleration n = 0 selection is parameterised in the following parameter: 0x2897:002</td></tr>
<tr><td>Curve (a): the motor comes to a standstill within the parameterised stopping time.</td><td>Curve (a): deceleration parameterised in 0x2897:0020x2897:002, deceleration STO after n=0 starts if the speed is lower than the tolerance window of the motor speed parameterised in 0x287B:0010x287B:001, tolerance window (n=0).
After the stopping time parameterised in 0x2894:0010x2894:001, stopping time for SS1 and SS2 has elapsed, the inverter switches to STO.</td></tr>
<tr><td>Curve (b): When the motor switches to STO, it is not yet at standstill. Switching off with STO lets the motor coast to a stop.</td><td>Curve (b): If the deceleration ramp is set too long, it is switched to STO after the stopping time has elapsed. In this case shown, the motor coasts to a stop.</td></tr>
</table>

Notes on how to set the stopping time
When setting the stopping time 0x2894:0010x2894:001,stopping time for SS1 and SS2, observe the following dependency:

1. If an encoder is available, a speed is calculated from the encoder data.
   - In 0x2897:0010x2897:001, selection "1": STO at n = 0, a waiting time 0x2897:0020x2897:002, deceleration STO after n=0 can be set which defines when the STO status is activated. This deceleration defines the time between the standstill of the motor and the activation of STO.
2. If no encoder is available, the function evaluates the speed status n = 0 from the inverter.
   - In this case, the stopping time 0x2894:0010x2894:001, stopping time for SS1 and SS2 0.5 s monitored by the safety system must be parameterised higher than the stopping time parameterised in the inverter.



Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 📖 407

In response to the error stop request.

In response to the emergency stop request.

Behaviour of the function under normal circumstances

When the stopping time (0x2894:0010x2894:001) has elapsed or the value falls below the tolerance window (0x287B:0010x287B:001), a standard stop is activated.

The power supply for generating the rotating field is safely interrupted (STO). The motor cannot generate torques and movements of the drive.

Behaviour of the function in the event of an error

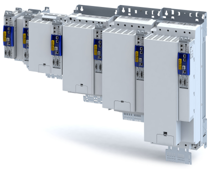
An error message and an error stop are triggered if:

- standstill is not reached after the stopping time (0x2894:001) has elapsed.
- the activated ramp monitoring exceeds the parameterised deceleration ramp.

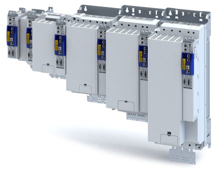
The power supply for generationg the rotating field is safely interrupted (STO). The motor cannot generate torques and movements of the drive.

Parameter

Address	Name / setting range / [default setting]		Info
0x2878:004	Motor encoder: Encoder monitoring response time • Read only: ms		
	12	12 ms	
	50	50 ms	
	100	100 ms	
0x287B:001	Velocity monitoring: Tolerance window (n=0) • Read only: x rpm		
0x2894:001	SS1, SS2: SS1, SS2: Stopping time • Read only: x ms		
0x2894:002	SS1, SS2: SS1, SS2: Ramp Monitoring • Read only		
	0	No Ramp monitoring	
	1	Ramp monitoring active	
0x2894:003	SS1, SS2: SS1, SS2: Ramp smoothing time • Read only: x %		
0x2894:004	SS1, SS2: SS1, SS2: Ramp Offset Mode • Read only		
	0	Relative	
	1	Absolute	
0x2894:005	SS1, SS2: SS1, SS2: Ramp Start Offset relative • Read only: x %		
0x2894:006	SS1, SS2: SS1, SS2: Ramp Start Offset absolute • Read only: x rpm		
0x2894:007	SS1, SS2: SS1, SS2: Actual ramp speed • Read only: x rpm		
0x2894:008	SS1, SS2: SS1, SS2: Minimal speed differerence • Read only: x rpm		
0x2895	SS1: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	



Address	Name / setting range / [default setting]		Info
0x2896	SS1: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x2897:001	SS1: SS1: Mode • Read only		
	0	STO after stop time	
	1	STO at n=0	
0x2897:002	SS1: SS1: Deceleration STO after n=0 • Read only: x ms		
0x2898	SS1 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	



19.5 Safe Stop 2 (SS2)

The safety function monitors whether the drive has reached the set tolerance window (n = 0) within the parameterised stopping time.

After the stopping time has elapsed or the value has fallen below the tolerance window, the monitoring function switches to safe operational stop (SOS) or activates the safety function (STO).

In the safe operational stop, the drive is not switched to torque-free operation. All control functions remain active for maintaining the reached position.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

Preconditions

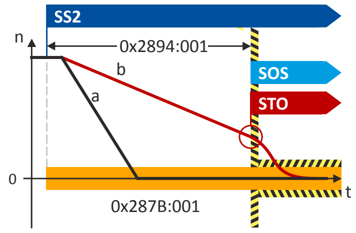
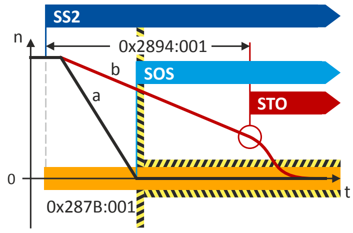
The drive is brought to standstill via the application.

Movements caused by external forces require additional measures. When the stopping time is defined, the application time of the brake must be taken into consideration.

The restart is possible after the stopping time has completely elapsed. An exception from this is the special operation.

Functional description

The deceleration ramp can be parameterised and monitored for the stop function SS2.

<table>
<tr><th>SS2-t
0x289B:001 = 0 (SOS after stopping time)</th><th>SS2-t
0x289B:001 = 1 (SOS at n = 0)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>The safe operational stop Safe Operating Stop (SOS) is activated if the stopping time parameterised in 0x2894:0010x2894:001 (stopping time for SS1 and SS2) has elapsed and the motor speed is lower than the value parameterised in 0x287B:0010x287B:001, tolerance window (n=0).</td><td>Curve (a): for details see Safe Operating Stop (SOS). 🕮 375.</td></tr>
<tr><td>Curve (a): for details see Safe Operating Stop (SOS).🕮 375.</td><td>Curve (b): STO is also activated if, after the stopping time 0x2894:0010x2894:001, stopping time for SS1 and SS2 has elapsed, the speed is not lower than the value parameterised in 0x287B:0010x287B:001, tolerance window (n=0).</td></tr>
<tr><td>Curve (b): STO is also activated if, after the stopping time 0x2894:0010x2894:001, stopping time for SS1 and SS2 has elapsed, the speed is not lower than the value parameterised in 0x287B:0010x287B:001, tolerance window (n=0).</td><td></td></tr>
</table>

Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 🕮 407

In response to the error stop request.

Behaviour of the function under normal circumstances

When the stopping time (0x2894:001C2894/1)) has elapsed or the value has fallen below the tolerance window (0x287B:001C287B/1), the safety function 375 is activated.

Behaviour of the function in the event of an error

An error message and an error stop are triggered if:

- standstill is not reached after the stopping time (0x2894:001) has elapsed.
- the activated ramp monitoring exceeds the parameterised deceleration ramp.

The power supply for generationg the rotating field is safely interrupted (STO). The motor cannot generate torques and movements of the drive.

Parameter

Address	Name / setting range / [default setting]		Info
0x2878:004	Motor encoder: Encoder monitoring response time • Read only: ms		
	12	12 ms	
	50	50 ms	
	100	100 ms	
0x287B:001	Velocity monitoring: Tolerance window (n=0) • Read only: x rpm		
0x2894:001	SS1, SS2: SS1, SS2: Stopping time • Read only: x ms		
0x2894:002	SS1, SS2: SS1, SS2: Ramp Monitoring • Read only		
	0	No Ramp monitoring	
	1	Ramp monitoring active	
0x2894:003	SS1, SS2: SS1, SS2: Ramp smoothing time • Read only: x %		
0x2894:004	SS1, SS2: SS1, SS2: Ramp Offset Mode • Read only		
	0	Relative	
	1	Absolute	
0x2894:005	SS1, SS2: SS1, SS2: Ramp Start Offset relative • Read only: x %		
0x2894:006	SS1, SS2: SS1, SS2: Ramp Start Offset absolute • Read only: x rpm		
0x2894:007	SS1, SS2: SS1, SS2: Actual ramp speed • Read only: x rpm		
0x2894:008	SS1, SS2: SS1, SS2: Minimal speed differerence • Read only: x rpm		
0x2899	SS2: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x289A	SS2: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x289B:001	SS2: SS2: Mode • Read only		
	0	SOS after stop time	
	1	SOS at n=0	
0x289C	SS2 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.6 Safe Operating Stop (SOS)

In the safe operational stop, the drive is not switched to torque-free operation. All control functions are maintained. The reached position remains active.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

Preconditions

The drive is brought to standstill via the application.

Functional description

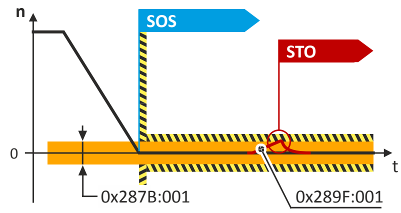


Fig. 54: SOS function

SOS is activated if the motor speed is lower than the tolerance window parameterised in 0x287B:0010x287B:001, tolerance window (n=0),.

In the SOS state, relative position changes are added and saved in 0x289F:0030x289F:003. The value in 0x289F:0030x289F:003 is continuously compared to the permissible value in 0x289F:0010x289F:001.

If one of the two states occurs during a safe operational stop (SOS):

- Position is outside the tolerance window safely monitored in 0x289F:0010x289F:001

an error message is generated and STO is activated:

When the SOS state is left, the maximum relative positioning is displayed in 0x289F:0030x289F:003.

The 0x289F:0020x289F:002 parameter defines the restart behaviour after SOS has been deactivated.

If the SOS state is requested again, the sum of the last position changes in 0x289F:0030x289F:003 is reset to zero.

Example:

The "SS2 active" state is interrupted by an STO request. If the STO request is reset, the transition to the SOS state will follow. The position deviation is reset to p = 0.

Activation of the function

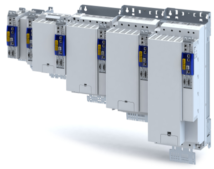
The following options are available to activate the function:

- The Safe Stop 2 (SS2) function📖 372
- The safety bus, see section "Safety bus".
- A safe input, see section "Safe inputs"

Behaviour of the function in the event of an error

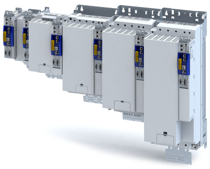
In the final state "Safe operational stop (SOS)", an error message is triggered if:

- the speed exits the tolerance window set 0x287B:001 (n=0).
- the position exits the tolerance window set 0x289F:001 (p=0).



Parameter

Address	Name / setting range / [default setting]		Info
0x2875:019	S bus control bits: SOS • Read only		
0x289D	SOS: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28A0	SOS monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x289E	SOS: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x289F:001	SOS: SOS: Tolerance window (Delta p=0) • Read only		
0x289F:002	SOS: SOS: Restart • Read only		
	0	Acknowledged Restart	
	1	Automatic Restart	
0x289F:003	SOS: SOS: Maximal Change of Position • Read only		



19.7 Safe Maximum Speed (SMS)

The safety function monitors the compliance with the safe maximum motor speed set.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

Functional description

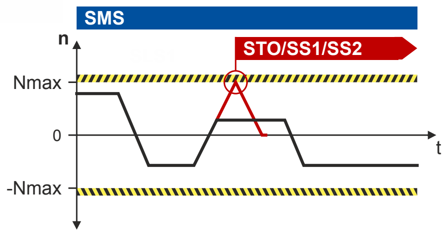


Fig. 55: SMS function

Activation of the function

The function can only be activated via parameterisation.

The function is activated by a value > 0 in 0x28B0:0010x28B0:001.

Behaviour of the function in the event of an error

An error message is triggered if:

- The speed exceeds the maximum speed Nmax set in 0x28B0:0010x28B0:001.

One of the error stops parameterised in 0x28B0:002(0x28B0:002) is initiated:

- Safe Torque Off (STO)🕮 364
- Safe Stop 1 (SS1)🕮 369
- Safe Stop 2 (SS2)🕮 372

Parameter

Address	Name / setting range / [default setting]		Info
0x28B0:001	SMS: SMS: Maximum Speed Nmax • Read only: x rpm		
0x28B0:002	SMS: SMS: Reaction (n>Nmax) • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28B1	SMS monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.8 Safely-Limited Speed (SLS)

The safety function monitors the speed Nlim parameterised, if the following states have occurred:

- the speed parameterised is not reached.
- the braking time set has elapsed.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

Preconditions

The drive must be braked by the application.

If the SLS function is combined with the Safe Direction (SDI) function, the values for the delay times (0x28C4:0010x28C4:001 ... 0x28C4:0040x28C4:004) must be coordinated. The Nlim braking time (0x28C3:0010x28C3:001 ... 0x28C3:0040x28C3:004) starts at the same time as the SDI delay time. See ▶ Safe Direction (SDI) function. 📖 386

Functional description

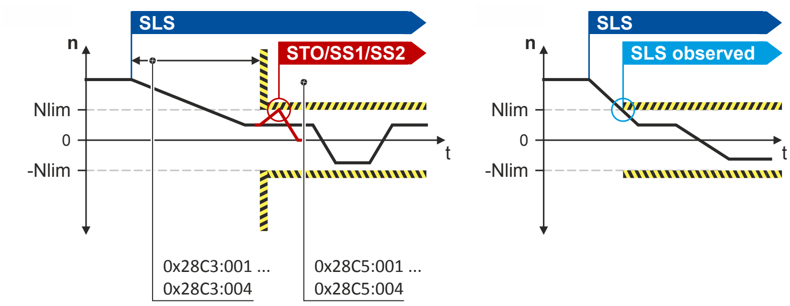


Fig. 56: SLS function

If operation within the limit values is performed, the "SLS1...4 monitored" ("SLS observed") status is set in 0x2870:002, bits 0 ... 3 = 1.

The status can

- be assigned to the safe output as safe speed monitor.
- be reported via the safety bus.

The permissible direction of movement is set via 0x28C4:0010x28C4:001 ... 0x28C4:0040x28C4:004.

Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 📖 407

Behaviour of the function in the event of an error

If the speed is exceeded in the monitored state, an error message is triggered. For the SLS safety function, the following error responses can be parameterised as safe stop:

▶ Safe Torque Off (STO)📖 364

▶ Safe Stop 1 (SS1)📖 369

▶ Safe Stop 2 (SS2)📖 372

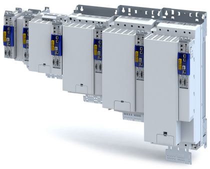
Parameter

Address	Name / setting range / [default setting]		Info
0x2870:002	SafetyInterface: SafetyInterface State • Read only		
	Bit 0	SLS1 monitored	
	Bit 1	SLS2 monitored	
	Bit 2	SLS3 monitored	
	Bit 3	SLS4 monitored	
	Bit 4	SMS monitored	
	Bit 5	SSM within limits	
	Bit 6	SDI positive monitored	
	Bit 7	SDI negative monitored	
	Bit 8	SLP1 monitored	
	Bit 9	SLP2 monitored	
	Bit 10	SLP3 monitored	
	Bit 11	SLP4 monitored	
	Bit 12	SCA1 within limits	
	Bit 13	SCA2 within limits	
	Bit 14	SCA3 within limits	
	Bit 15	SCA4 within limits	
	Bit 16	PDSS positive monitored	
	Bit 17	PDSS negative monitored	
	Bit 18	SOS monitored	
	Bit 19	SBC active	
	Bit 20	SHOM active	
	Bit 21	SHOM available	
	Bit 22	Sichere velocity OK	
	Bit 23	Speed = 0	
	Bit 24	Positive travel direction	
	Bit 25	Slip > 25 %	
	Bit 26	Slip > 50 %	
	Bit 27	Slip > 75%	
	Bit 31	Fault active	
0x28C0:001	SLS: Source SD-In: SLS1: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28C0:002	SLS: Source SD-In: SLS2: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28C0:003	SLS: Source SD-In: SLS3: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	

Address	Name / setting range / [default setting]		Info
0x28C0:004	SLS: Source SD-In: SLS4: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28C1:001	SLS: Source S-Bus: SLS1: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28C1:002	SLS: Source S-Bus: SLS2: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28C1:003	SLS: Source S-Bus: SLS3: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28C1:004	SLS: Source S-Bus: SLS4: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28C2:001	SLS: Limited Speed Nlim: SLS1: Limited Speed Nlim1 • Read only: x rpm		
0x28C2:002	SLS: Limited Speed Nlim: SLS2: Limited Speed Nlim2 • Read only: x rpm		
0x28C2:003	SLS: Limited Speed Nlim: SLS3: Limited Speed Nlim3 • Read only: x rpm		
0x28C2:004	SLS: Limited Speed Nlim: SLS4: Limited Speed Nlim4 • Read only: x rpm		
0x28C3:001	SLS: Braking time Nlim: SLS1: Braking time Nlim1 • Read only: x ms		
0x28C3:002	SLS: Braking time Nlim: SLS2: Braking time Nlim2 • Read only: x ms		
0x28C3:003	SLS: Braking time Nlim: SLS3: Braking time Nlim3 • Read only: x ms		
0x28C3:004	SLS: Braking time Nlim: SLS4: Braking time Nlim4 • Read only: x ms		
0x28C4:001	SLS: Permitted direction: SLS1: Permitted direction • Read only		
	0	Both directions enabled	
	1	Positive direction enabled	
	2	Negative direction enabled	
0x28C4:002	SLS: Permitted direction: SLS2: Permitted direction • Read only		
	0	Both directions enabled	
	1	Positive direction enabled	
	2	Negative direction enabled	
0x28C4:003	SLS: Permitted direction: SLS3: Permitted direction • Read only		
	0	Both directions enabled	
	1	Positive direction enabled	
	2	Negative direction enabled	

Address	Name / setting range / [default setting]		Info
0x28C4:004	SLS: Permitted direction: SLS4: Permitted direction • Read only		
	0	Both directions enabled	
	1	Positive direction enabled	
	2	Negative direction enabled	
0x28C5:001	SLS: Reaction (n>Nlim): SLS1: Reaction (n>Nlim1) • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28C5:002	SLS: Reaction (n>Nlim): SLS2: Reaction (n>Nlim2) • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28C5:003	SLS: Reaction (n>Nlim): SLS3: Reaction (n>Nlim3) • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28C5:004	SLS: Reaction (n>Nlim): SLS4: Reaction (n>Nlim4) • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28C6:001	SLS active: Output: SLS1 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C6:002	SLS active: Output: SLS2 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C6:003	SLS active: Output: SLS3 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C6:004	SLS active: Output: SLS4 active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C7:001	SLS Monitored: Output: SLS1 Monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C7:002	SLS Monitored: Output: SLS2 Monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

Address	Name / setting range / [default setting]		Info
0x28C7:003	SLS Monitored: Output: SLS3 Monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28C7:004	SLS Monitored: Output: SLS4 Monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x2907:001	Additional speed limitation 0 ... [**0**] ... 480000 rpm		
0x500A:150	SLS1 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:151	SLS1 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:152	SLS2 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:153	SLS2 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:154	SLS3 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:155	SLS3 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:156	SLS4 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:157	SLS4 - deceleration time 0.000 ... [**0.000**] ... 2147483.647 s		
0x500A:159	Compensation velocity of SLS 0.0000 ... [**0.0000**] ... 214748.3647		
0x500A:160	Follower - Response to SLS		
	false	Inactive	
	true	Active	
0x500A:161	Speed controller limitation (SLS)		
	false	Inactive	
	true	Active	
0x500A:162	Deactivate safety functions 0x00000000 ... [**0x00000000**] ... 0xFFFFFFFF		
	Bit 1	Ignore SS1 request	
	Bit 2	Ignore SS2 request	
	Bit 3	Ignore SLS1-4 request	
	Bit 4	Ignore SDI request	
0x500A:163	Limiter status • Read only		
	Bit 0	STO active	
	Bit 1	SS1 active	
	Bit 2	SS2 active	
	Bit 4	SLS1 active	
	Bit 5	SLS2 active	
	Bit 6	SLS3 active	
	Bit 7	SLS4 active	
	Bit 8	SDIpos active	
	Bit 9	SDIneg active	



19.9 Safe Speed Monitor (SSM)

The function monitors the limited speed set.

The function is activated if:

- the monitoring limits are parameterised, or
- the values are non-zero.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

NOTICE

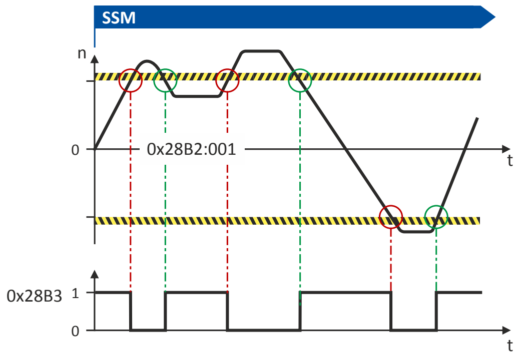
The SSM function does not feature any hysteresis.

Oscillating response of the safe output during operation in the proximity of the speed limit parameterised.

Oscillating response of the safe output when slowly passing the speed limit parameterised.

► Avoid continuous operation at the speed limit parameterised.

Functional description



During operation within the limit values, the SSM status is set on the safety bus within the limits 0x2870:0020x2870:002.

The SSM status is assigned to the safe output as safe speed monitor (amount) 0x28B2:0010x28B2:001.

If the amount of the safe speed adopts the value "0", the SSM function is deactivated.

The status bit in 0x28B30x28B3 influences the control of available outputs.

Parameter

Address	Name / setting range / [default setting]		Info
0x28B2:001	SSM parameters: SSM: Monitored speed • Read only: x rpm		
0x28B3	SSM within limits • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.10 Safely Limited Increment (SLI)

With this function, a maximum permissible position change [incr] can be set.

Within the position window, the increments parameterised can be traversed in positive and negative directions. There is no time limit for executing this function. If the increment limits parameterised are exceeded, an error stop is initiated.

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

► Apply a safety-rated encoder system to use this function.

Functional description

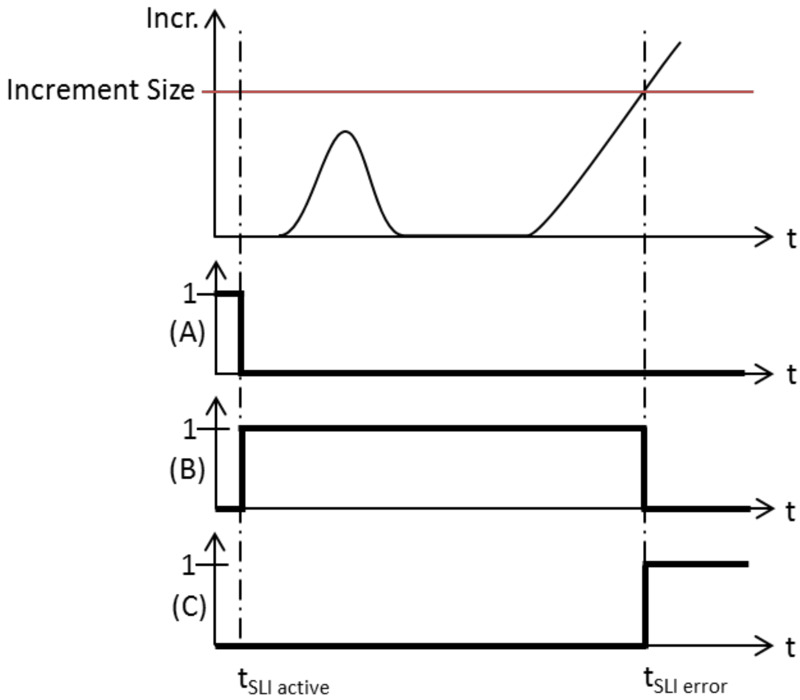


Fig. 57: SLI function

A	Triggering of the function	C	Error status
B	Monitoring active		

If the drive exceeds the increment parameterised in 0x28CA:001 (normal operation) or 0x28CA:003 (special operation), the stop function set in 0x28CA:002 is excecuted.

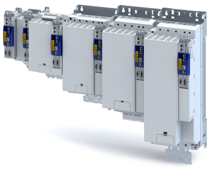
Activation of the function

ℹ The function cannot be activated if the drive is in Safe Operating Stop (SOS).

The function can be activated during operation.

The function is activated

- via the safety bus. For this purpose, a data telegram is sent to the inverter, see safety bus.
- as a function of the operating mode changeover (OMS) by activation of the special operation, Operation mode selector (OMS). 📖 400
- by the OFF state on a safe input. For the OFF state, a function is parameterised. See safe inputs.



Behaviour of the function in the event of an error

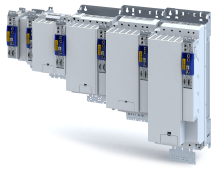
If the maximum permissible position change is exceeded, an error stop is initiated. The following functions can be set as safe stop:

- Safe Torque Off (STO) 364
- Safe Stop 1 (SS1) 369
- Safe Stop 2 (SS2) 372

When exceeding the position change in the OMS mode, the error stop set there is used. See chapter " Operation mode selector (OMS)". 400

Parameter

Address	Name / setting range / [default setting]	Info
0x28C8	SLI: Source SD-In • Read only 0 Deactivated 1 SD-In1 2 SD-In2 3 SD-In3 4 SD-In4	
0x28C9	SLI: Source S-Bus • Read only 0 Deactivated 1 Activated	
0x28CA:001	SLI: SLI: Increment size normal operation • Read only	
0x28CA:002	SLI: SLI: Error reaction normal operation • Read only 0 STO 1 SS1 2 SS2	
0x28CA:003	SLI: SLI: Increment size exceptional operation • Read only	
0x28CA:004	SLI: SLI: Maximum change of Position • Read only	
0x28CB	SLI active: Output • Read only 0 Deactivated 1 SD-Out1 positive logic 2 SD-Out1 negative logic	



19.11 Safe Direction (SDI)

The function monitors the direction of rotation of the motor. A parameterisable tolerance threshold ensures that the drive does not change the permissible direction of rotation. Within the limits parameterised, the drive can rotate in the impermissible direction of rotation.

NOTICE

The delay in 0x28BA:0020x28BA:002 is parameterised with a value > 0.

Machine parts and parts of the facility can be destroyed if this setting is not taken into consideration for the calculation of the safety distance.

▶ Only utilise this function if the safety distance has been calculated previously, taking the delay set into consideration.

▶ If necessary, the "SDIpos observed" or "SDIneg observed" feedback must be evaluated (via the safety bus or via a safe output).

⚠WARNING!

A safety-rated encoder system must be used.

Without an encoder, this safety function cannot be used.

▶ Apply a safety-rated encoder system to use this function.

Conditions

- The risk analysis must ensure that the delay does not pose any hazard.
- The application leads the drive to the permissible direction of rotation.

Functional description

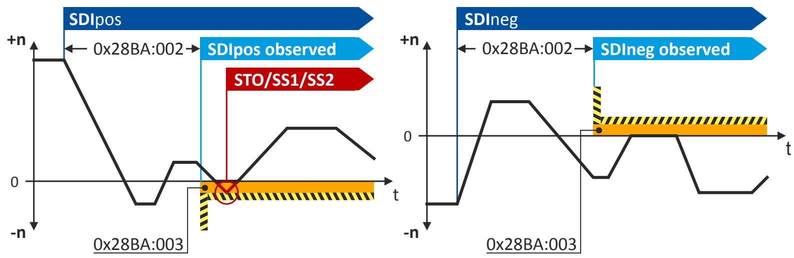


Fig. 58: SDI configuration modes

For operation within the limit values, the SDIpos observed (0x28BB:0010x28BB:001) or SDIneg observed (0x28BB:0020x28BB:002) status is set.

The status can

- be assigned to the safe output (0x28BB:0010x28BB:001 or 0x28BB:0020x28BB:002) or
- can be reported via the safety bus (0x28B9:0010x28B9:001 or 0x28BB:0020x28B9:002).

Via a safe input, if the corresponding parameter is assigned to the safe input.

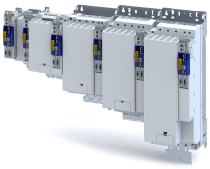
Activation of the function

A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 📖 407

For normal operation, the safe direction can be set via a safe parameter.

The safe direction can be combined with the Safely-Limited Speed (SLS) function. 📖 378

If the tolerance threshold for the SDIpos or SDIneg direction set (0x28BA:0020x28BA:003) is exceeded after the delay time has elapsed (0x28BA:0030x28BA:002), an error message is triggered and the stop function set in 0x28BA:0040x28BA:S004 is activated.



Parameter

Address	Name / setting range / [default setting]	Info
0x28B8:001	SDI: Source SD-In: SDIpos: Source SD-In • Read only	
	0 Deactivated	
	1 SD-In1	
	2 SD-In2	
	3 SD-In3	
	4 SD-In4	
0x28B8:002	SDI: Source SD-In: SDIneg: Source SD-In • Read only	
	0 Deactivated	
	1 SD-In1	
	2 SD-In2	
	3 SD-In3	
	4 SD-In4	
0x28B9:001	SDI: Source S-Bus: SDIpos: Source S-Bus • Read only	
	0 Deactivated	
	1 Activated	
0x28B9:002	SDI: Source S-Bus: SDIneg: Source S-Bus • Read only	
	0 Deactivated	
	1 Activated	
0x28BA:001	SDI: SDI: Monitoring normal operation • Read only	
	0 Both directions enabled	
	1 Positive direction enabled	
	2 Negative direction enabled	
0x28BA:002	SDI: SDI: Delay time • Read only: x ms	
0x28BA:003	SDI: SDI: Tolerance threshold • Read only	
0x28BA:004	SDI: SDI: Error reaction • Read only	
	0 STO	
	1 SS1	
	2 SS2	
0x28BA:005	SDI: SDI: Maximal change of Position • Read only	
0x28BB:001	SDI monitored: Output: SDIpos monitored: Output • Read only	
	0 Deactivated	
	1 SD-Out1 positive logic	
	2 SD-Out1 negative logic	
0x28BB:002	SDI monitored: Output: SDIneg monitored: Output • Read only	
	0 Deactivated	
	1 SD-Out1 positive logic	
	2 SD-Out1 negative logic	

19.12 Safely-Limited Position (SLP)

The function monitors the lower and upper position limit.

Preconditions

The following function must be executed:

- Set upper position value.
- Set lower position value.
- Safe homing (SHOM)

Functional description

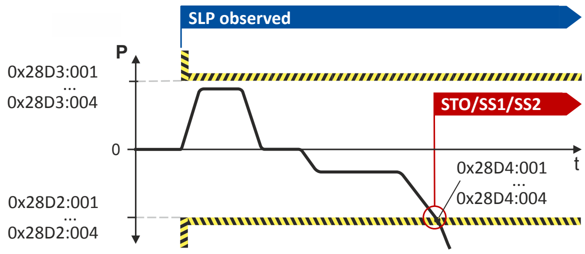


Fig. 59: SLP function

For operation within the upper limit value, the SLPpos observed status is used. 0x28D3:000
For operation within the lower limit value, the SLPneg observed status is used. 0x28D2:000

The upper and lower position limits parameterised are monitored at the time of the request, see SLPx observed status bit.

The status can

- be assigned to the safe output (0x28BB:0010x28BB:001 or 0x28BB:0020x28BB:002).
- be reported via the safety bus (0x28B9:0010x28B9:001 or 0x28BB:0020x28B9:002).

This function can be executed during normal operation and special operation. See Operation mode selector (OMS) . 400

Up to four absolute position setpoint pairs can be parameterised and monitored at the same time.

In connection with this function, please also observe the information with regard to safe homing in chapter Safe homing (SHOM).

Via a safe input, if the corresponding parameter is assigned to the safe input.

Activation of the function

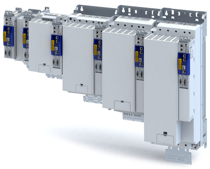
A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfaces". 407

Behaviour of the function in the event of an error

If the Plim position limit is exceeded during the monitoring process,

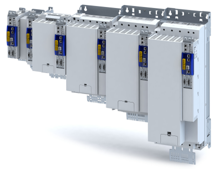
- an error message is triggered.
- a stop function for the parameters set
  - 0x28D2:0010x28D2:001 ... 0x28D2:0040x28D2:004 the lower absolute position limit set
  - 0x28D3:0010x28D3:001 ... 0x28D3:0040x28D3:004 the upper absolute position limit set

  is triggered.

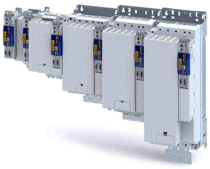


Parameter

Address	Name / setting range / [default setting]		Info
0x28D0:001	SLP: Source SD-In: SLP1: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28D0:002	SLP: Source SD-In: SLP2: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28D0:003	SLP: Source SD-In: SLP3: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28D0:004	SLP: Source SD-In: SLP4: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28D1:001	SLP: Source S-Bus: SLP1: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28D1:002	SLP: Source S-Bus: SLP2: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28D1:003	SLP: Source S-Bus: SLP3: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28D1:004	SLP: Source S-Bus: SLP4: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x28D2:001	SLP: Lower Postion limit: SLP1: Lower Postion limit • Read only		
0x28D2:002	SLP: Lower Postion limit: SLP2: Lower Postion limit • Read only		
0x28D2:003	SLP: Lower Postion limit: SLP3: Lower Postion limit • Read only		
0x28D2:004	SLP: Lower Postion limit: SLP4: Lower Postion limit • Read only		
0x28D3:001	SLP: Upper Postion limit: SLP1: Upper Postion limit • Read only		
0x28D3:002	SLP: Upper Postion limit: SLP2: Upper Postion limit • Read only		



Address	Name / setting range / [default setting]		Info
0x28D3:003	SLP: Upper Postion limit: SLP3: Upper Postion limit • Read only		
0x28D3:004	SLP: Upper Postion limit: SLP4: Upper Postion limit • Read only		
0x28D4:001	SLP: Error reaction: SLP1: Error reaction • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28D4:002	SLP: Error reaction: SLP2: Error reaction • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28D4:003	SLP: Error reaction: SLP3: Error reaction • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28D4:004	SLP: Error reaction: SLP4: Error reaction • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28D5:001	SLP monitored: Output: SLP1 monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28D5:002	SLP monitored: Output: SLP2 monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28D5:003	SLP monitored: Output: SLP3 monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x28D5:004	SLP monitored: Output: SLP4 monitored: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	



19.13 Position-dependent Safe Speed (PDSS)

The function

- monitors the speed of a drive as a function of of the absolute position along a motion range.
- allows for the utilisation of a physically limited motion range without the use of mechanical buffers and limit switches.
- can be parameterised as permanently active.

NOTICE

If the slip compensation is used, the diagnostic marks must be overtravelled cyclically.

Machine parts and parts of the facility may be destroyed if the slip compensation described is not taken into consideration for the respective application.

► Check the slip compensation for the respective application.

► Ensure a diagnostic interval test by a higher-level control component.

Functional description

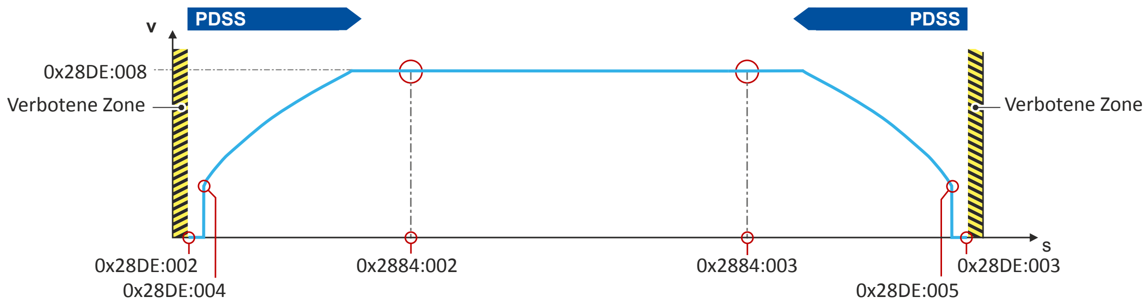
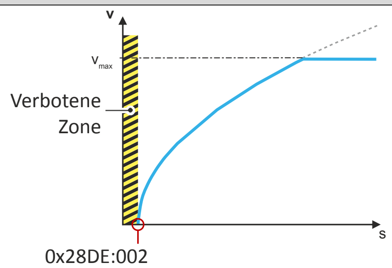
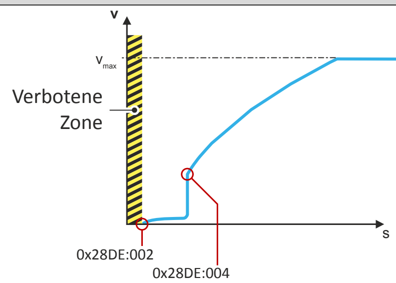


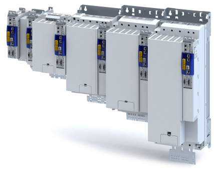
Fig. 60: PDSS function, representation of the key parameters

For this function, please also observe the description relating to the slip compensation in section .

Safe creeping speed (SCS)	
	
It depends on the application whether the drive approaches the position limit (0x28DE:0020x28DE:002) with the limited speed v_{max} (0x28DE:0080x28DE:008). The limited speed is predefined by the monitoring function.	By parameterising a safe creeping speed (SCS), the prohibited zone can nearly be approached. The distance to the position limit (0x28DE:0020x28DE:002) and the tolerance parameterised must be selected extensively enough to rule out a collision. The speed changeover depending on the direction of rotation makes it possible for the drive to move away from the prohibited zone at maximum speed.

In connection with this function, please also observe the information with regard to safe homing. See chapter Safe homing (SHOM). 394

Via a safe input, if the corresponding parameter is assigned to the safe input.



Activation of the function

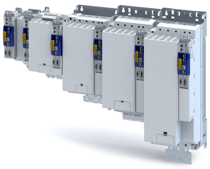
A data telegram is sent to the inverter via the safety bus. See chapter "Safe network interfa-ces". 📖 407

Error behaviour

If the envelope curve is exceeded or when the absolute position limits are exited, an error message is triggered and an error stop with the function set in the 0x28DE:011 0x28DE:011 parameter is initiated.

Parameter

Address	Name / setting range / [default setting]		Info
0x28DC	PDSS: Source SD-In • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
0x28DD	PDSS: Source S bus • Read only		
	0	Deactivated	
	1	Activated	
0x28DE:001	PDSS parameters: PDSS: Permanent activation • Read only		
	0	On demand	
	1	Activated	
0x28DE:002	PDSS parameters: PDSS: Lower position limit • Read only		
0x28DE:003	PDSS parameters: PDSS: Upper position limit • Read only		
0x28DE:004	PDSS parameters: PDSS: Lower SCS limit • Read only		
0x28DE:005	PDSS parameters: PDSS: Upper SCS limit • Read only		
0x28DE:006	PDSS parameters: PDSS: SCS from lower limit • Read only: x rpm		
0x28DE:007	PDSS parameters: PDSS: SCS from upper limit • Read only: x rpm		
0x28DE:008	PDSS parameters: PDSS: Max. speed • Read only: x rpm		
0x28DE:009	PDSS parameters: PDSS: Max. delay - lower limit • Read only		
0x28DE:010	PDSS parameters: PDSS: Max. delay - upper limit • Read only		
0x28DE:011	PDSS parameters: PDSS: Error response • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28DE:012	PDSS parameters: PDSS: Currently monitored speed • Read only: x rpm		
0x28DE:013	PDSS parameters: PDSS: Min difference monitored speed • Read only: x rpm		
0x28DF	PDSS: PDSSpos monitored output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	



Address	Name / setting range / [default setting]		Info
0x28E0	PDSS: PDSSneg monitored output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.14 Mini-homing

The process of mini-homing serves to verify plausibility of the absolute position values of the safety function. Mini-homing is carried out with the safely limited speed (SLS) function and is monitored by the safety function.

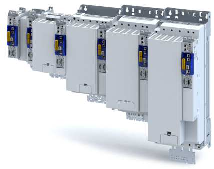
Prerequisites

- The safely limited speed Nlim must have been parameterised. 0x28C2:001
- The distance of the mini reference run must ≥ the 4-fold value of the parameter to be configured. 0x287C:001

Completion of the mini-homing process

After the mini-homing, the status bit is set. 0x2882:006

After returning from the above-mentioned states, with a parameterised safe home position, the path of motion control can generally adopt the motion in the direction of the home position.



19.15 Safe homing (SHOM)

This function supplements the position evaluation of the encoder systems used. See .

⚠WARNING!

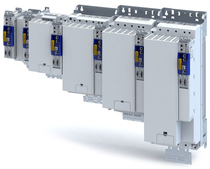
In the switched-off state, the motor position must not be changed by external forces.

A change in the motor position causes injuries and may even result in death.

► Ensure that the motor position does not change.

Preconditions

In applications with only one position switch, this switch must be connected in parallel to the inputs X82/IRS and X82/IRL.



Functional description

The start of the homing process does not cause the drive to execute a homing process. The initialisation and motion control are both executed autonomously by the drive.

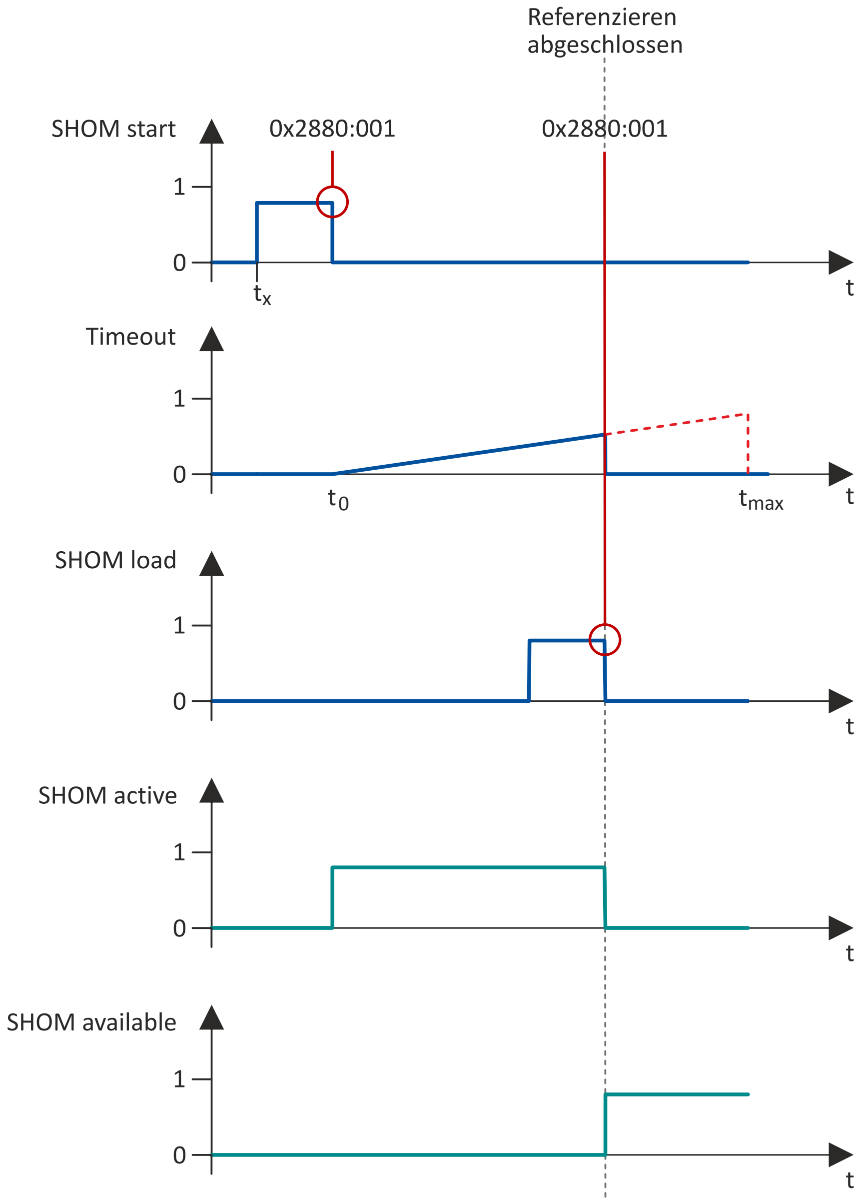


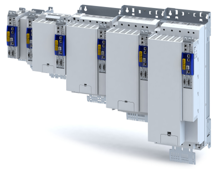
Fig. 61: Timing of the SHOM function

The homing process is for example started via the IRS signal (source can be set in 0x2880:001).

The safely limited speed (SLS) is always activated. ▸ Safely-Limited Speed (SLS) 📖 378.

Within a time period defined in 0x2882:002 (timeout), the 0x2881:001 reference signal is expected via the input X82/IRL (SHOM-Load). The reference signal defines the safe reference point 0x2882:001 (home position) in the absolute area.

When the reference point has been defined, homing is completed. A changeover to normal operation will follow.



The home position parameterised is the absolute reference point for these safety functions:

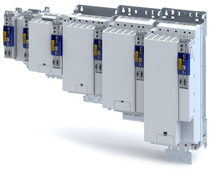
- Safely-Limited Position (SLP) 388
- Position-dependent Safe Speed (PDSS) 391
- Safe Cam (SCA) 398

The following states are shown:

- The "SHOM active" state is reset (display in 0x2882:006).
- The "SHOM available" state is set (display in 0x2882:006)

Parameter

Address	Name / setting range / [default setting]		Info
0x2110:014	SHOM: Delete home position		
	0	**Off / ready**	Only status feedback
	1	On / start	Execute device command
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
0x2880:001	SHOM_Start settings: SHOM_Start: Source • Read only		
	0	Deactivated	
	13	S bus	
	14	IRS	
0x2880:002	SHOM_Start settings: SHOM_Start: Edge trigger IRS • Read only		
	0	Rising edge	
	1	Falling edge	
0x2881:001	SHOM_Load settings: SHOM_Load: Source • Read only		
	13	S bus	
	15	IRL	
0x2881:002	SHOM_Load settings: SHOM_Load: Edge trigger IRL • Read only		
	0	Rising edge	
	1	Falling edge	
0x2882:001	Safe homing (SHOM): SHOM: Home position • Read only		
0x2882:002	Safe homing (SHOM): SHOM: Timeout • Read only: x ms		
0x2882:003	Safe homing (SHOM): SHOM: SLS homing • Read only		
	3	SLS1	
	4	SLS2	
	5	SLS3	
	6	SLS4	
0x2882:007	Safe homing (SHOM): SHOM: Saved position • Read only		
0x2883	SHOM: Diagnostic positions source • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
	14	IRS	
	15	IRL	



Address	Name / setting range / [default setting]		Info
0x2884:001	SHOM diagnostic positions: SHOM: Detection diag position • Read only		
	0	LOW level	
	1	HIGH level	
0x2884:002	SHOM diagnostic positions: SHOM: Lower diagnostic position • Read only		
0x2884:003	SHOM diagnostic positions: SHOM: Upper diagnostic position • Read only		
0x2884:004	SHOM diagnostic positions: SHOM: Tolerance diag positions • Read only		
0x2884:005	SHOM diagnostic positions: SHOM: Error response diag positions • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x2884:006	SHOM diagnostic positions: SHOM: Current difference diagnostic position • Read only		
0x2885:001	SHOM: Slip compensation: SHOM: Maximally compensated slip • Read only		
0x2885:002	SHOM: Slip compensation: SHOM: Slip compensation end area • Read only		
	0	Deactivated	
	1	Activated	
0x2886	SHOM: SHOM active output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x2887	SHOM: SHOM available output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.16 Safe Cam (SCA)

The function monitors the lower and upper position limit.

Preconditions

The following function must be executed:

- Set upper position value.
- Set lower position value.
- Safe homing (SHOM)

Functional description

In connection with this function, please also observe the information with regard to safe homing in chapter Safe homing (SHOM). 394

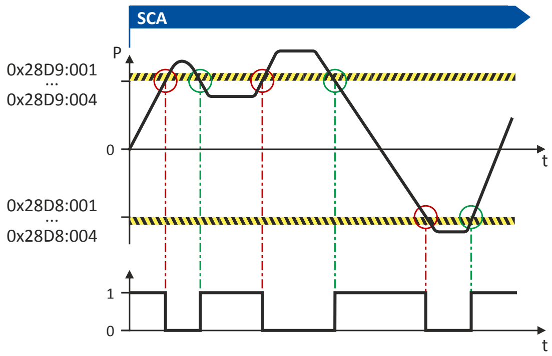


Fig. 62: SCA function

When this function is executed, the current absolute position is compared to the position limits parameterised.

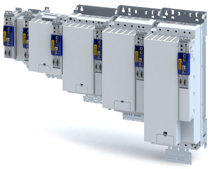
- Upper position limit parameterised (0x28D9:0010x28D9:001 ... 0x28D9:0040x28D9:004)
- Lower position limit parameterised (0x28D8:0010x28D8:001 ... 0x28D8:0040x28D8:004)

The status of the position comparison is specified in a binary fashion in 0x2870:0020x2870:002, bit12 ... bit15.

The status is transmitted to the safety and standard application.

Activation of the function

The function is activated by entry of a parameter value (≠ 0) for the upper and lower position limit.



Parameter

<table>
<tr><th>Address</th><th colspan="2">Name / setting range / [default setting]</th><th>Info</th></tr>
<tr><td>0x28D8:001</td><td colspan="2">SCA: Lower Postion limit: SCA1: Lower Postion limit
• Read only</td><td rowspan="20"></td></tr>
<tr><td>0x28D8:002</td><td colspan="2">SCA: Lower Postion limit: SCA2: Lower Postion limit
• Read only</td></tr>
<tr><td>0x28D8:003</td><td colspan="2">SCA: Lower Postion limit: SCA3: Lower Postion limit
• Read only</td></tr>
<tr><td>0x28D8:004</td><td colspan="2">SCA: Lower Postion limit: SCA4: Lower Postion limit
• Read only</td></tr>
<tr><td>0x28D9:001</td><td colspan="2">SCA: Upper Postion limit: SCA1: Upper Postion limit
• Read only</td></tr>
<tr><td>0x28D9:002</td><td colspan="2">SCA: Upper Postion limit: SCA2: Upper Postion limit
• Read only</td></tr>
<tr><td>0x28D9:003</td><td colspan="2">SCA: Upper Postion limit: SCA3: Upper Postion limit
• Read only</td></tr>
<tr><td>0x28D9:004</td><td colspan="2">SCA: Upper Postion limit: SCA4: Upper Postion limit
• Read only</td></tr>
<tr><td rowspan="4">0x28DA:001</td><td colspan="2">SCA inbetween limits: Output: SCA1 inbetween limits: Output
• Read only</td></tr>
<tr><td>0</td><td>Deactivated</td></tr>
<tr><td>1</td><td>SD-Out1 positive logic</td></tr>
<tr><td>2</td><td>SD-Out1 negative logic</td></tr>
<tr><td rowspan="4">0x28DA:002</td><td colspan="2">SCA inbetween limits: Output: SCA2 inbetween limits: Output
• Read only</td></tr>
<tr><td>0</td><td>Deactivated</td></tr>
<tr><td>1</td><td>SD-Out1 positive logic</td></tr>
<tr><td>2</td><td>SD-Out1 negative logic</td></tr>
<tr><td rowspan="4">0x28DA:003</td><td colspan="2">SCA inbetween limits: Output: SCA3 inbetween limits: Output
• Read only</td></tr>
<tr><td>0</td><td>Deactivated</td></tr>
<tr><td>1</td><td>SD-Out1 positive logic</td></tr>
<tr><td>2</td><td>SD-Out1 negative logic</td></tr>
<tr><td rowspan="4">0x28DA:004</td><td colspan="2">SCA inbetween limits: Output: SCA4 inbetween limits: Output
• Read only</td><td></td></tr>
<tr><td>0</td><td>Deactivated</td><td></td></tr>
<tr><td>1</td><td>SD-Out1 positive logic</td><td></td></tr>
<tr><td>2</td><td>SD-Out1 negative logic</td><td></td></tr>
</table>

19.17 Operation mode selector (OMS)

This function serves to switch between normal operation and special operation of the drive.

If the OMS safety function is requested via a HIGH signal, the safety function is switched off in the case of an open circuit. In this case, there exists no safety function in the case of an open circuit.

⚠ DANGER!

When returning to normal operation, automatic restart is not permissible.

Severe injuries and death.

► Parameterise manual restart.

⚠ WARNING!

Operating mode changeover (OMS) is activated via the safety bus.

If safe communication fails, the OMS function is deactivated.

► Configure at least one stop function (STO, SS1 or SS2).

⚠ WARNING!

The operation mode selector (OMS) is activated via a safe input.

Incalculable response.

Unintentional restart.

► Adapt the polarity of the activation signal to the application.

Preconditions

Functional description

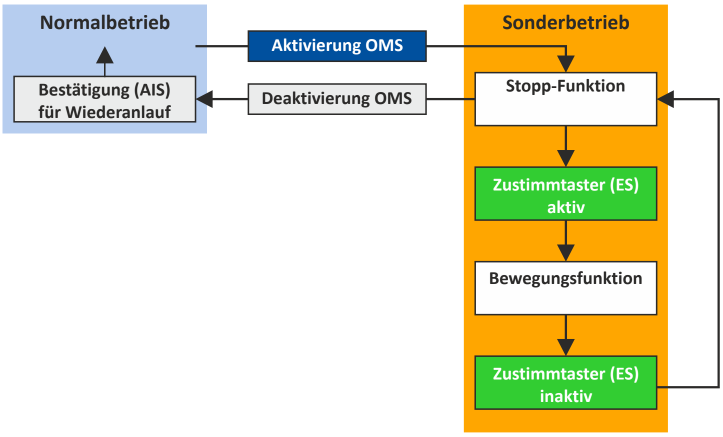


Fig. 63: OMS function

Special operation (OMS) provides for overwriting a normal stop STO, SS1 and SS2 by activating the enable switch (ES), see Enable Switch (ES) function. 📖 403

A detected error in special operation activates the stop function that is correspondingly parameterised there (Safe Torque Off (STO), Safe Stop 1 (SS1) or Safe Stop 2 (SS2)). The stop function can be parameterised in special operation as stop function.

If a request for special operation is pending ("OMS activation"), the stop function that is parameterised for special operation in 0x28A9:0010x28A9:001 (Safe Torque Off (STO), Safe Stop 1 (SS1) or Safe Stop 2 (SS2)) is started.

Via Safely Limited Increment (SLI), the motion function (SLS or retracting) parameterised for special operation in 0x28A9:002 0x28A9:002 can be executed.

Furthermore, 0x28CA:0030x28CA:003 can be used to switch on the monitoring function (Safely Limited Increment (SLI)) for the motion function parameterised.

The setting "0" deactivates the SLI monitoring function.

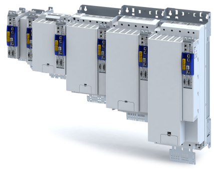
Activation of special operation

By means of the "Operation mode selector" function, special operation is activated by an "ON state" on a safe input. The function Enable Switch (ES) must have been assigned to the corresponding input by parameterisation.

Only if no safe input is utilised, the function can be activated via the safety bus. Via the safety bus, a data telegram with a corresponding content is sent to the inverter, see safety bus .

Deactivation of special operation

- A changeover from special operation to normal operation can only be effected when the drive is at a standstill, see Safe Torque Off (STO), Safe Stop 1 (SS1) or Safe Stop 2 (SS2) .
- In the case of a restart, the restart (AIS) must be acknowledged via the terminals or safety bus.
- An automatic restart is not permissible.
  - If "Automatic restart" is parameterised, this has to be prevented by special measures, e.g. programming in the master control.



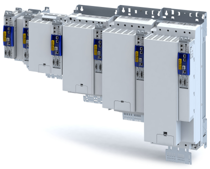
Behaviour of the function in the event of an error

- The monitoring functions Safe Maximum Speed (SMS) and Safely-Limited Speed (SLS) can be activated in both operating modes (normal operation / special operation). In the event of an error, the stop function paramterised (STO, SS1 or SS2) is triggered.
- With an activated monitoring function Safely Limited Increment (SLI), exceeding the position window triggers the stop function parameterised for special operation.

The "Emergency stop" function can be triggered in normal operation and in special operation and has the highest priority.

Parameter

Address	Name / setting range / [default setting]		Info
0x2875:012	S bus control bits: OMS • Read only		
0x28A8	OMS: Source • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
	13	S-Bus	
0x28A9:001	OMS: OMS: Stop function • Read only		
	0	STO	
	1	SS1	
	2	SS2	
0x28A9:002	OMS: OMS: Movement function • Read only		
	3	SLS1	
	4	SLS2	
	5	SLS3	
	6	SLS4	
	11	Free mode	
0x28A9:003	OMS: OMS: Function at Low Level • Read only		
	0	Normal operation	
	1	Special operation	
0x28AA	OMS active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	



19.18 Enable Switch (ES)

This function makes it possible to override the normal stop functions

- Safe Torque Off (STO),
- Safe Stop 1 (SS1) and
- Safe Stop 2 (SS2)

in special operation.

Preconditions

A safe input or the safety bus can be used for connecting an enable switch. If the safe input is used, the **ES** bit of the safety bus must be deactivated. If no safe input is parameterised, the safety bus can be used for activation.

- Activate special operation Operation mode selector (OMS).
- Activate special operation Repair mode select (RMS).

The plausibility check rejects ambiguous settings until they are parameterised correctly.

Functional description

The enable switch activates the motion function parameterised during special operation (OMS) and the repair mode (RMS). The drive can be traversed.

The stop times assigned to the stop functions are directly deactivated or stopped.

Activation of the function

The function is activated by the ON state of a safe input.

The function must have been assigned to the corresponding input by parameterisation.

If no safe input is utilised, the function can be activated via the safety bus. Via the safety bus, a data telegram with a corresponding content is sent to the inverter, seesafety bus.

Parameter

Address	Name / setting range / [default setting]		Info
0x2875:010	S bus control bits: ES • Read only		
0x28AE	ES: Source • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
	13	S-Bus	
0x28AF	ES active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	

19.19 Repair mode select (RMS)

This function moves the drive from a situation that is blocking it ("Deadlock").

In the safety concept, this state is taken into consideration as a special case for actuating an axis connected. The encoders connected are not evaluated in a safety-oriented fashion.

⚠ DANGER!

In the RMS operating mode unexpected movements with an unexpected speed may occur.

In the RMS operating mode, the permissible motion limits of the axis may be violated.

- ► The use of the RMS function is exclusively permissible to release an axis from a "deadlock". If possible, the OMS function should be used!
- ► In the RMS operating mode, exclusively the enable switch is effective. Ensure, if necessary by additional safety measures, that no persons can be endangered.

In the repair mode, the safety functions are solely restricted to the parameterisable STO and SS1 stop functions (without ramp monitoring) and the effectiveness of the enable switch.

⚠ DANGER!

With this function, all monitoring functions are deactivated.

The state of the facility is not monitored.

- ► Only use this function for a vertical axis with a brake on the load side.

Functional description

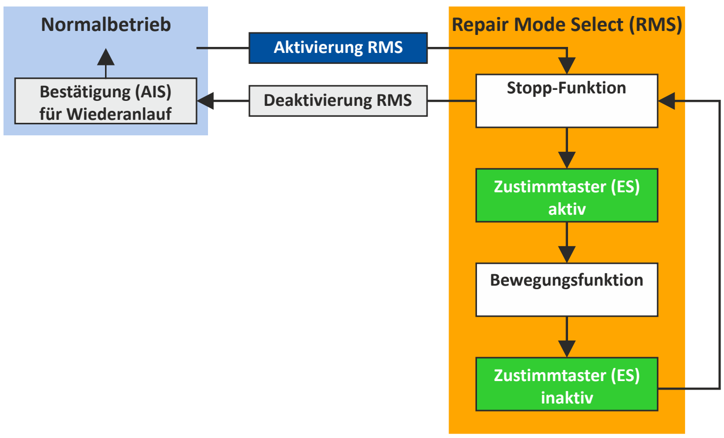


Fig. 64: RMS function

In the repair mode, speed functions and absolute position functions are deactivated. The SHOM status is reset. ▸ Safe homing (SHOM) 📖 394

Request of the repair mode

The repair mode is requested by the "ON state" on a safe input. The function must have been assigned to the corresponding input by parameterisation.

Only if no safe input is utilised, the function can be activated via the safety bus. Via the safety bus, a data telegram with a corresponding content is sent to the inverter, see safety bus .

Behaviour of the function in the event of an error

If the position values of the motor encoder and the load encoder do not comply after the repair mode has been exited, the following error states are displayed if absolute position monitoring is active:

- Exit position window
- Slip error
- Deactivation of Safe homing (SHOM). 📖 394

Parameter

Address	Name / setting range / [default setting]		Info
0x2875:020	S bus control bits: RMS • Read only		
0x28AB	RMS: Source • Read only		
	0	Deactivated	
	1	SD-In1	
	2	SD-In2	
	3	SD-In3	
	4	SD-In4	
	13	S-Bus	
0x28AD	RMS active: Output • Read only		
	0	Deactivated	
	1	SD-Out1 positive logic	
	2	SD-Out1 negative logic	
0x2882:004	Safe homing (SHOM): SHOM: Restart condition • Read only		
	0	Homing required	
	1	load saved reference	
0x2882:005	Safe homing (SHOM): SHOM: Tolerance - starting position • Read only		
0x2882:006	Safe homing (SHOM): SHOM status • Read only		
	0	No reference	
	1	SHOM active	
	2	SHOM available	
	3	small referenz active	
0x28AC:001	RMS: RMS: Stop function • Read only		
	0	STO	
	1	SS1	

19.20 Cascading (CAS)

This function allows for the synchronised shutdown of an entire drive network.

Preconditions

- As source for the cascading request, the SD-In4 input must be parameterised.
  0x21240x2124, 4: SD-In4
- As an active input for the "Emergency stop" function and the input delay, a value ≤ 10 ms must be parameterised for SD-In4. Safe inputs
- As executing stop function, the "Safe torque off (STO)" function must be parameterised.
  Safe Emergency Stop (SSE) 0x28A3:001 366
- As restart behaviour of the drive after executing Safe Torque Off (STO), "Acknowledged restart" must be parameterised. 0x2892:0010x2892:001
- The control of the SD-Out1 output via a parameterised safety bus must be inhibited. Safety bus

The plausibility check rejects other settings until the plausibility check is parameterised correctly.

- If the cascading safety function is used in connection with special operation, "SS2" must be parameterised as stop function in the operation mode selector (OMS).

The STO stop function will trigger the "Cascading" function. Activation by means of the enable switch (ES) is not possible.

Description of the principle

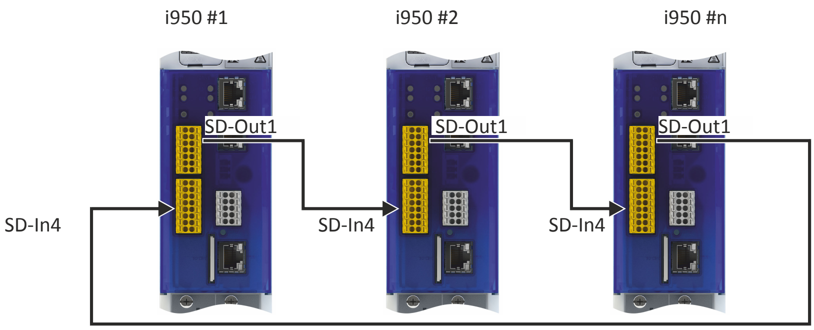


Fig. 65: CAS function

With 0x2125:0010x2125:001, the time period is shown, which elapses from switching the SD-Out1 output to the OFF state to recording the OFF state at the SD-In4 input.

- If, after a stop, the time period "0 ms" is shown, another safety function has triggered the stop via the cascade.
- The time period is shown until the next system acknowledgement takes place.

Activation of the function

The function is activated by parameterisation of the SD-In4 input as source for a cascading request (0x21240x2124, 4: SD-In4).

Parameter

Address	Name / setting range / [default setting]		Info
0x2124	CAS: Quelle SD-In • Read only		
	0	Deactivated	
	4	SD-In4	
0x2125:001	CAS: Cascading: CAS: Stop delay • Read only: x ms		

19.21 Safe network interfaces

Parameter

Address	Name / setting range / [default setting]		Info
0x2128	S-bus: Configuration • Read only		
	0	No safety bus	
	4	PROFIsafe/PROFINET 8 words	

19.21.1 FSoE connection

Parameter

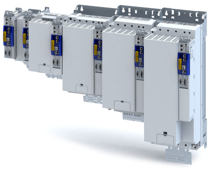
Address	Name / setting range / [default setting]	Info
0xE901:002	FSoE communication Parameters: Safety address • Read only	

19.22 Connection to the applications

19.22.1 Inputs

Parameter

Address	Name / setting range / [default setting]		Info
0x2118:001	SD-In: Sensor type: SD-In1: Sensor type • Read only		
	0	Input disabled	
	1	Passive sensor	
	2	Active sensor	
0x2118:002	SD-In: Sensor type: SD-In2: Sensor type • Read only		
	0	Input disabled	
	1	Passive sensor	
	2	Active sensor	
0x2118:003	SD-In: Sensor type: SD-In3: Sensor type • Read only		
	0	Input disabled	
	1	Passive sensor	
	2	Active sensor	
0x2118:004	SD-In: Sensor type: SD-In4: Sensor type • Read only		
	0	Input disabled	
	1	Passive sensor	
	2	Active sensor	
0x2119:001	SD-In: Discrepancy time: SD-In1: Discrepancy time • Read only: x ms		
0x2119:002	SD-In: Discrepancy time: SD-In2: Discrepancy time • Read only: x ms		
0x2119:003	SD-In: Discrepancy time: SD-In3: Discrepancy time • Read only: x ms		
0x2119:004	SD-In: Discrepancy time: SD-In4: Discrepancy time • Read only: x ms		
0x211A:001	SD-In: Input delay: SD-In1: Input delay • Read only: x ms		
0x211A:002	SD-In: Input delay: SD-In2: Input delay • Read only: x ms		
0x211A:003	SD-In: Input delay: SD-In3: Input delay • Read only: x ms		
0x211A:004	SD-In: Input delay: SD-In4: Input delay • Read only: x ms		
0x211B	Input image • Read only		
	Bit 0	SD-In1 channel A	
	Bit 1	SD-In1 channel B	
	Bit 2	SD-In2 channel A	
	Bit 3	SD-In2 channel B	
	Bit 4	SD-In3 channel A	
	Bit 5	SD-In3 channel B	
	Bit 6	SD-In4 channel A	
	Bit 7	SD-In4 channel B	
	Bit 16	AIE	
	Bit 17	AIS	
	Bit 24	IRS	
	Bit 25	IRL	
	Bit 31	Button S82	



19.22.2 Outputs

Parameter

Address	Name / setting range / [default setting]		Info
0x2120:001	SD-Out: Source S-Bus: SD-Out1: Source S-Bus • Read only		
	0	Deactivated	
	1	Activated	
0x2121:001	SD-Out logic function: SD-Out1 logic function • Read only		
	0	OR	
	1	AND	
0x2122	Output image • Read only		
	Bit 0	SD-Out1 channel A	
	Bit 1	SD-Out1 channel B	

19.22.3 Internal communication

19.22.4 Control signals

Parameter

Address	Name / setting range / [default setting]		Info
0x2129:001	S-bus: Control bits: SD-Out1 • Read only		
0x2870:001	SafetyInterface: SafetyInterface Control • Read only		
	Bit 0	STO active	
	Bit 1	SS1 active	
	Bit 2	SS2 active	
	Bit 3	SOS active	
	Bit 4	SLS1 active	
	Bit 5	SLS2 active	
	Bit 6	SLS3 active	
	Bit 7	SLS4 active	
	Bit 8	SDIpos active	
	Bit 9	SDIneg active	
	Bit 10	SLI active	
	Bit 11	SSE active	
	Bit 12	ES active	
	Bit 13	OMS active	
	Bit 14	RMS active	
	Bit 15	SBC active	

Address	Name / setting range / [default setting]		Info
0x2874	S bus: Display of control data • Read only		
	Bit 0	STO	
	Bit 1	SS1	
	Bit 2	SS2	
	Bit 3	SLS1	
	Bit 4	SLS2	
	Bit 5	SLS3	
	Bit 6	SLS4	
	Bit 7	SDIpos	
	Bit 8	SDIneg	
	Bit 9	ES	
	Bit 10	SLI	
	Bit 11	OMS	
	Bit 12	SLP1	
	Bit 13	SLP2	
	Bit 14	SLP3	
	Bit 15	SLP4	
	Bit 16	AIS	
	Bit 17	AIE	
	Bit 18	SOS	
	Bit 19	RMS	
	Bit 20	SHOM_Start	
	Bit 21	SHOM_Load	
	Bit 22	PDSS	
	Bit 23	SSE	
	Bit 24	SD-Out1	
	Bit 25	SBC	
0x2875:001	S bus control bits: STO • Read only		
0x2875:002	S bus control bits: SS1 • Read only		
0x2875:003	S bus control bits: SS2 • Read only		
0x2875:004	S bus control bits: SLS1 • Read only		
0x2875:005	S bus control bits: SLS2 • Read only		
0x2875:006	S bus control bits: SLS3 • Read only		
0x2875:007	S bus control bits: SLS4 • Read only		
0x2875:008	S bus control bits: SDIpos • Read only		
0x2875:009	S bus control bits: SDIneg • Read only		
0x2875:011	S bus control bits: SLI • Read only		
0x2875:013	S bus control bits: SLP1 • Read only		
0x2875:014	S bus control bits: SLP2 • Read only		
0x2875:015	S bus control bits: SLP3 • Read only		
0x2875:016	S bus control bits: SLP4 • Read only		
0x2875:017	S bus control bits: AIS • Read only		

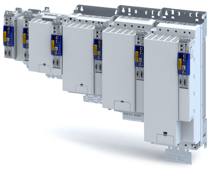
Address	Name / setting range / [default setting]	Info
0x2875:018	S bus control bits: AIE • Read only	
0x2875:021	S bus control bits: SHOM_Start • Read only	
0x2875:022	S bus control bits: SHOM_Load • Read only	
0x2875:023	S bus control bits: PDSS • Read only	
0x2875:024	S bus control bits: SSE • Read only	
0x2875:026	S bus control bits: SBC • Read only	

19.22.5 Status signals

Parameter

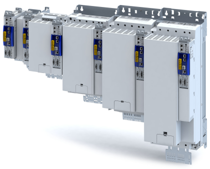
Address	Name / setting range / [default setting]	Info
0x211C:001	Status bits of inputs: SD-In1 • Read only	
0x211C:002	Status bits of inputs: SD-In2 • Read only	
0x211C:003	Status bits of inputs: SD-In3 • Read only	
0x211C:004	Status bits of inputs: SD-In4 • Read only	
0x211C:005	Status bits of inputs: AIS Dig-In • Read only	
0x211C:006	Status bits of inputs: AIE Dig-In • Read only	
0x211C:007	Status bits of inputs: IRS Dig-In • Read only	
0x211C:008	Status bits of inputs: IRL Dig-In • Read only	
0x2123:001	Status bits of outputs: SD-Out1 • Read only	
0x2132	Safety module status • Read only	

Address	Name / setting range / [default setting]		Info
0x2870:002	SafetyInterface: SafetyInterface State • Read only		
	Bit 0	SLS1 monitored	
	Bit 1	SLS2 monitored	
	Bit 2	SLS3 monitored	
	Bit 3	SLS4 monitored	
	Bit 4	SMS monitored	
	Bit 5	SSM within limits	
	Bit 6	SDI positive monitored	
	Bit 7	SDI negative monitored	
	Bit 8	SLP1 monitored	
	Bit 9	SLP2 monitored	
	Bit 10	SLP3 monitored	
	Bit 11	SLP4 monitored	
	Bit 12	SCA1 within limits	
	Bit 13	SCA2 within limits	
	Bit 14	SCA3 within limits	
	Bit 15	SCA4 within limits	
	Bit 16	PDSS positive monitored	
	Bit 17	PDSS negative monitored	
	Bit 18	SOS monitored	
	Bit 19	SBC active	
	Bit 20	SHOM active	
	Bit 21	SHOM available	
	Bit 22	Sichere velocity OK	
	Bit 23	Speed = 0	
	Bit 24	Positive travel direction	
	Bit 25	Slip > 25 %	
	Bit 26	Slip > 50 %	
	Bit 27	Slip > 75%	
	Bit 31	Fault active	



Address	Name / setting range / [default setting]	Info
0x2870:003	SafetyInterface: SafetyInterface IOState • Read only	
	Bit 0 SD-In1	
	Bit 1 SD-In2	
	Bit 2 SD-In3	
	Bit 3 SD-In4	
	Bit 4 AIS SD-In	
	Bit 5 AIE SD-In	
	Bit 6 IRS SD-In	
	Bit 7 IRL SD-In	
	Bit 8 AIS S-Bus	
	Bit 9 AIE S-Bus	
	Bit 10 SHOM_Start S bus	
	Bit 11 SHOM_Load S bus	
	Bit 12 SD-Out1	
	Bit 16 SD-In1 channel A	
	Bit 17 SD-In1 channel B	
	Bit 18 SD-In2 channel A	
	Bit 19 SD-In2 channel B	
	Bit 20 SD-In3 channel A	
	Bit 21 SD-In3 channel B	
	Bit 22 SD-In4 channel A	
	Bit 23 SD-In4 channel B	
	Bit 24 SD-Out1 channel A	
	Bit 25 SD-Out1 channel B	
0x2871:001	SafetyInterface bits: STO active • Read only	
0x2871:002	SafetyInterface bits: SS1 active • Read only	
0x2871:003	SafetyInterface bits: SS2 active • Read only	
0x2871:004	SafetyInterface bits: SOS active • Read only	
0x2871:005	SafetyInterface bits: SLS1 active • Read only	
0x2871:006	SafetyInterface bits: SLS2 active • Read only	
0x2871:007	SafetyInterface bits: SLS3 active • Read only	
0x2871:008	SafetyInterface bits: SLS4 active • Read only	
0x2871:009	SafetyInterface bits: SDIpos active • Read only	
0x2871:010	SafetyInterface bits: SDIneg active • Read only	
0x2871:011	SafetyInterface bits: SLI active • Read only	
0x2871:012	SafetyInterface bits: SSE active • Read only	
0x2871:013	SafetyInterface bits: ES active • Read only	
0x2871:014	SafetyInterface bits: OMS active • Read only	
0x2871:015	SafetyInterface bits: RMS active • Read only	
0x2871:016	SafetyInterface bits: SBC active • Read only	

Address	Name / setting range / [default setting]	Info
0x2871:033	SafetyInterface bits: SLS1 observed • Read only	
0x2871:034	SafetyInterface bits: SLS2 observed • Read only	
0x2871:035	SafetyInterface bits: SLS3 observed • Read only	
0x2871:036	SafetyInterface bits: SLS4 observed • Read only	
0x2871:037	SafetyInterface bits: SMS observed • Read only	
0x2871:038	SafetyInterface bits: SSM within limits • Read only	
0x2871:039	SafetyInterface bits: SDIpos observed • Read only	
0x2871:040	SafetyInterface bits: SDIneg observed • Read only	
0x2871:041	SafetyInterface bits: SLP1 observed • Read only	
0x2871:042	SafetyInterface bits: SLP2 observed • Read only	
0x2871:043	SafetyInterface bits: SLP3 observed • Read only	
0x2871:044	SafetyInterface bits: SLP4 observed • Read only	
0x2871:045	SafetyInterface bits: SCA1 within limits • Read only	
0x2871:046	SafetyInterface bits: SCA2 within limits • Read only	
0x2871:047	SafetyInterface bits: SCA3 within limits • Read only	
0x2871:048	SafetyInterface bits: SCA4 within limits • Read only	
0x2871:049	SafetyInterface bits: PDSSpos observed • Read only	
0x2871:050	SafetyInterface bits: PDSSneg observed • Read only	
0x2871:051	SafetyInterface bits: SOS observed • Read only	
0x2871:052	SafetyInterface bits: SBC activated • Read only	
0x2871:053	SafetyInterface bits: SHOM active • Read only	
0x2871:054	SafetyInterface bits: SHOM available • Read only	
0x2871:055	SafetyInterface bits: Safe speed OK • Read only	
0x2871:056	SafetyInterface bits: n=0 • Read only	
0x2871:057	SafetyInterface bits: Positive direction • Read only	
0x2871:058	SafetyInterface bits: Slip > 25% • Read only	
0x2871:059	SafetyInterface bits: Slip > 50% • Read only	
0x2871:060	SafetyInterface bits: Slip > 75% • Read only	
0x2871:064	SafetyInterface bits: Error active • Read only	
0x2871:073	SafetyInterface bits: AIS S bus • Read only	



Address	Name / setting range / [default setting]	Info
0x2871:074	SafetyInterface bits: AIE S bus • Read only	
0x2871:075	SafetyInterface bits: SHOM_Start S bus • Read only	
0x2871:076	SafetyInterface bits: SHOM_Load S bus • Read only	

19.23 Safe parameter setting

19.23.1 Safety address

The safety address is set using the 0xF980 parameter (safety address). Via the parameter, addresses in the range of 1 ... 65534 can be set.

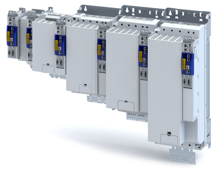
Parameter

Address	Name / setting range / [default setting]	Info
0xF980:001	Safety address: FSoE address • Read only	
0xF980:002	Safety address: Safety address • Read only	

19.23.2 Parameter set information

Parameter

Address	Name / setting range / [default setting]		Info
0x2114:001	Parameter set Identification: Parameter set version • Read only		
	1003	i950 (Extended Safety) V1.0	
0x2114:002	Parameter set Identification: Parameter set CRC 0 ... [**0**] ... 4294967295		
0x2115:001	Parameter set information: Parameter set status • Read only		
	0	No parameter set	
	1	Valid parameter set	
	4	CRC error	
	5	Version error	
	7	Plausibility error	
	8	Assignment error	
	9	Local read error	
	10	Communication error with basic device	
	11	Faulty release	
	12	Different CRCs	
	13	Changed parameter set	
0x2115:002	Parameter set information: Safety module CRC • Read only		
0x2115:003	Parameter set information: Last valid CRC • Read only		
0x2115:004	Parameter set information: Parameter setting time stamp • Read only: x s		
0x2115:005	Parameter set information: Parameter set error information 1 • Read only		
0x2115:006	Parameter set information: Parameter set error information 2 • Read only		
0x2115:007	Parameter set information: Parameter set error information 3 • Read only		



19.24 Response times

The overall system must be taken into account when determining the response time following a safety function request.

Parameter set acceptance from the SD card

Safe parameter set acceptance is supported by means of a safe parameter set saved in the device.

The following are all crucial in determining the response time:

- Response time of the connected safety sensor technology
- Input delay of safety inputs
- Internal processing time
- When using a safety bus:
  - Monitoring time for cyclic services
  - Monitoring time in the safety PLC
  - Processing time in the safety PLC
- Delay times due to additional modules

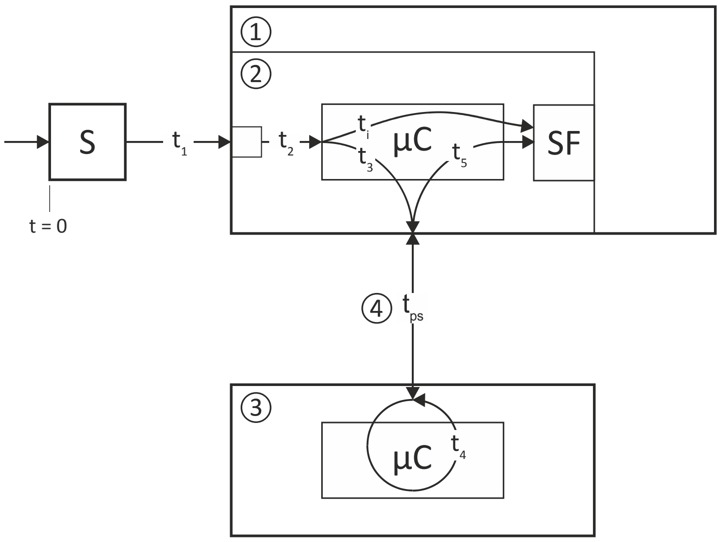


Fig. 66: Response times to the request of a safety function

1	Standard device	μC	Microcontroller
2	Integrated safety	S	Safety sensors
3	Safety PLC	SF	Safety function triggered
4	Safety bus		

Response times of inputs

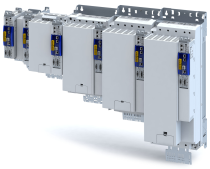
Response time when reacting to an event in the safety sensor technology		[ms]
t_1	Response time of the safety sensor technology	According to manufacturer information
t_2	Input delay of safe inputs	
	0x211A:002	0...100
	Input filter	2
t_i	Processing time in the integrated safety sensor technology	4
	Safety function begins after	Σ

Tab. 3: Response time when reacting to an event in the safety sensor technology

Response time of safe output

Response time of safe output to a safety function		[ms]
	Safe output SD-Out 1 switches after	4

Tab. 4: Response time of safe output



Response time of the safety bus

Response time when reacting to an event in the safety sensor technology (input data)			[ms]
t_1	Response time of the safety sensor technology		See manufacturer information
t_2	Input delay of safe inputs		
		0x211A:002	0...100
		Input filter	2
t_3	Processing time in the integrated safety system		
	Main task cycle time	Technology application	1
		PLC project	According to the setting
	Internal transmission time		40
Input data ready for transmission			$t_1 + t_2 + t_3$
t_{ps}	PROFINET cycle time		See manufacturer information
Input data ready for processing in the safety PLC			$t_1 + t_2 + t_3 + t_{ps}$

Tab. 5: Response time when reacting to an event in the safety sensor technology

Response time when reacting to a control word (output data)			[ms]
t_4	Processing time in the safety PLC		Calculate
t_{ps}	PROFINET cycle time		See manufacturer information
t_5	Processing time in the integrated safety system		
	Main task cycle time	Technology application	1
		PLC project	According to the setting
	Internal transmission time		108
	Safety cycle time		4
Safety function begins after			$t_4 + t_{ps} + t_5$

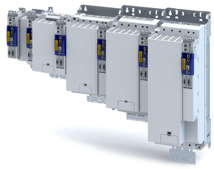
Tab. 6: Response time when reacting to a request via the safety bus

Information on how the processing time is calculated and on the safety bus transmission time can be found in the documentation of the safety PLC you are using.

If the safety bus communication is faulty after the safety bus monitoring time (F_WD_Time) expires, the system switches to the fail-safe state. The safety bus communication is passivated.

Example

- After an event on a safe input, the message is looped back to the integrated safety system via the safety PLC.
- The integrated safety system then triggers a safety function.
- The maximum response time to the event is then calculated as follows:2
  - $t_{max} = t_1 + t + t_3 + \max(F\_WD\_Time; t_{ps} + t_4 + t_{ps} + t_5)$
  - Include the times of the safety functions into the calculation. For instance, for SS1 the stopping time until STO is active. 0x2894:001



Acknowledging the parameter set or the safety address

The parameter set and the safety address are acknowledged by the same procedure.

The parameter set transfer is aborted if the response time of 2.5 seconds is exceeded.

The parameter set transfer must be repeated.

How to acknowledge the parameter set or the safety address.

- The "RDY" LED is lit.
- The "ERR" LED is blinking.

1. Press and hold the S82 button.
   The "RDY" LED starts blinking.
2. The "RDY" LED goes off after 3 seconds.
3. Release the S82 button within the space of 2.5 seconds.
   The "RDY" LED is lit.
4. Press and hold the S82 button within the space of 2.5 seconds.
   The "RDY" LED starts blinking.
5. The "RDY" LED goes off after 3 seconds.
6. Release the S82 button within the space of 2.5 seconds.
   The new parameter set or new safety address has been acknowledged.

The action is recorded in the inverter logbook.

If the parameter set is invalid, an error is reported and the "ERR" LED starts blinking.

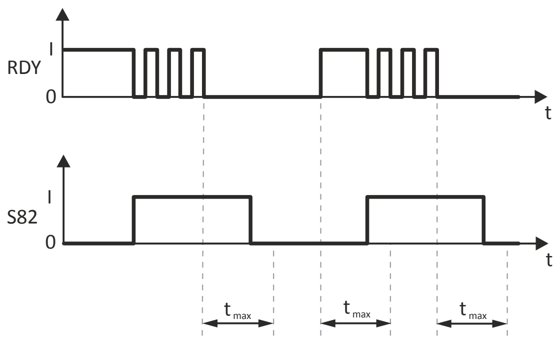
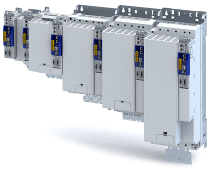


Fig. 67: Sequence of the acknowledgement procedure

RDY	"RDY" LED
S82	S82 button
t	Time axis
tmax	Maximum permissible response time

Response time of encoder monitoring			**[ms]**
	Time required to detect faults via continuous signal errors on the encoder interface.		12
		Parametrisable via 0x2878:004	12/50/100

The minimum response time that is required must be evaluated for the system concerned. A longer response time results in increased system availability if, for example, the nature of the process is such that short-term step changes in speed occur during a Safe Operating Stop while in setting-up operation.



19.25 Diagnostics

19.25.1 LED status display

On its front, the inverter indicates the "STO active" device state via the right "RDY" LED.

You can gather the meaning of the "RDY" and "ERR" LEDs (left side) from the following two tables:

LED "RDY" (yellow)	State	Meaning
off	-	No status message active
On (yellow)	-	Restart acknowledgement requested
Blinking yellow 2 Hz	SOS active	
Blinking yellow 1 Hz	Service state	Parameter set transfer requested.

"ERR" LED (red)	State	Meaning
off	-	The device is working correctly.
on (red)	Critical device error	The device is defective and must be replaced.
Blinking red 2 Hz	Bus error	Safety communication interrupted.
Blinking red 1 Hz	Error detection in the safety system	One of the following errors has been detected: • Speed exceeded • Discrepancy of the inputs • Acknowledgable errors

19.25.1.1 LED status during parameter set transfer

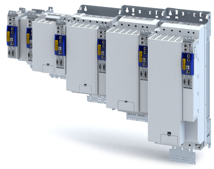
LED "RDY" (yellow)	"ERR" LED (red)	Meaning
On	Blinking 1Hz	At start-up, a modified parameter set has been detected. Acknowledge with button S82.

LED "RDY" (yellow)	"ERR" LED (red)	Meaning
on	Blinking 2 Hz	A modified safety address has been detected during the parameter set transfer in the "Init" state. Acknowledge with button S82.

19.25.2 Error history buffer

Parameter

Address	Name / setting range / [default setting]		Info
0x2130:001	Fault history: Actual fault type • Read only		
	0	No response	
	1	Fault > CiA402	
	2	Warning	

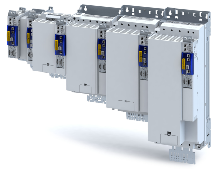


Address	Name / setting range / [default setting]		Info
0x2130:002	Fault history: Fault history 1 • Read only		
	Bit 0		
0x2130:003	Fault history: Fault history 2 • Read only		
	Bit 0		
0x2130:004	Fault history: Fault history 3 • Read only		
	Bit 0		
0x2130:005	Fault history: Fault history 4 • Read only		
	Bit 0		
0x2130:006	Fault history: Fault history 5 • Read only		
	Bit 0		
0x2130:007	Fault history: Fault history 6 • Read only		
	Bit 0		
0x2130:008	Fault history: Fault history 7 • Read only		
	Bit 0		
0x2130:009	Fault history: Fault history 8 • Read only		
	Bit 0		
0x2130:010	Fault history: Fault history 9 • Read only		
	Bit 0		
0x2130:011	Fault history: Fault history 10 • Read only		
	Bit 0		
0x2130:012	Fault history: Fault history 11 • Read only		
	Bit 0		
0x2130:013	Fault history: Fault history 12 • Read only		
	Bit 0		
0x2130:014	Fault history: Fault history 13 • Read only		
	Bit 0		
0x2130:015	Fault history: Fault history 14 • Read only		
	Bit 0		
0x2130:016	Fault history: Fault history 15 • Read only		
	Bit 0		
0x2130:017	Fault history: Fault history 16 • Read only		
	Bit 0		

19.25.3 Diagnostic parameters

Parameter

Address	Name / setting range / [default setting]		Info
0x212C:001	Safety: Software: Safety: Software version • Read only		
0x212D:001	Safety: Hardware: Safety: Hardware version • Read only		
0x212D:002	Safety: Hardware: Safety: Type • Read only		
0x212D:003	Safety: Hardware: Safety: Serial number • Read only		
0x212D:004	Safety: Hardware: Safety: Production date • Read only		
0x2131:001	Safety: Operating time: Safety: Operating time • Read only: x s		
0x28E8:001	Diagnostic values configuration: Diagnostic value 1 configuration		
	0	Not used	
	1	**PDSS**	
	2	SS1, SS2	
	10	Internal actual speed nSD	
	11	Internal actual speed nSD	
0x28E8:002	Diagnostic values configuration: Diagnostic value 2 configuration		
	0	Not used	
	1	PDSS	
	2	**SS1, SS2**	
	10	Internal actual speed nSD	
	11	Internal actual speed nBD	
0x28E9:001	Diagnostic values: Diagnostic value 1 • Read only		
0x28E9:002	Diagnostic values: Diagnostic value 2 • Read only		



20 Technical data

20.1 Standards and operating conditions

20.1.1 Conformities/approvals

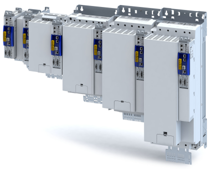
Conformity		
CE	2006/42/EC	Machinery Directive
	2014/30/EU	EMC Directive (reference: CE-typical drive system)
RoHS	2011/65/EU	Restrictions for the use of specific hazardous materials in electric and electronic devices
Approval		
UL	UL 61800-5-1	for USA and Canada (requirements of the CSA 22.2 No. 274)
		File No. E132659
		up to 75 kW

20.1.2 Protection of persons and device protection

Enclosure		
IP20	EN 60529	Information applies to the mounted and ready-for-use state. It does not apply to the wire range of the terminals
	NEMA 250	only protection against accidental contact acc. to type 1
Open type		Only in UL-approved systems
Insulation resistance		
Overvoltage category III	EN 61800-5-1	0 … 2000 m a.m.s.l.
Overvoltage category II	EN 61800-5-1	above 2000 m a.m.s.l.
Control circuit isolation		
Safe mains isolation by double/reinforced insulation	EN 61800-5-1	
Protective measures against		
Short circuit		
Earth fault		Earth fault strength depends on the operating status
Motor overtemperature		PTC or thermal contact, I^2xt monitoring
Overvoltage		
Motor stalling		
Leakage current		
> 3.5 mA AC, > 10 mA DC	EN 61800-5-1	Observe regulations and safety instructions!
Starting current		
≤ 3 x rated mains current		

20.1.3 EMC data

Actuation on public supply systems		
Implement measures to limit the radio interference to be expected:		The machine or plant manufacturer is responsible for compliance with the requirements for the machine/plant!
< 1 kW: with mains choke	EN 61000-3-2	
> 1 kW at mains current ≤ 16 A: without additional measures		
Mains current > 16 A: with mains choke or mains filter, with dimensioning for rated power.	EN 61000-3-12	
Noise emission		
Category C2	EN 61800-3	see rated data
Category C3	EN 61800-3	see rated data
Noise immunity		
Meets requirement in compliance with	EN 61800-3	



20.1.4 Motor connection

Requirements to the shielded motor cable		
Capacitance per unit length		
C-core-core/C-core-shield < 75/150 pF/m		≤ 2.5 mm² / AWG 14
C-core-core/C-core-shield < 150/300 pF/m		≥ 4 mm² / AWG 12
Electric strength		
Uo/U = 0.6/1.0 kV		Uo = r.m.s. value external conductor to PE
		U = r.m.s. value external conductor/external conductor
U ≥ 600 V	UL	U = r.m.s. value external conductor/external conductor

20.1.5 Environmental conditions

Energy efficiency		
Class IE2	EN 50598-2	
Climate		
1K3 (-25 ... +60 °C)	EN 60721-3-1	Storage
2K3 (-25 ... +70 °C)	EN 60721-3-2	Transport
3K3 (-10 ... +55 °C)	EN 60721-3-3	Ensuring
		Operation at a switching frequency of 2 or 4 kHz: above +45° C, reduce rated output current by 2.5 %/°C
		Operation at a switching frequency of 8 or 16 kHz: above +40° C, reduce rated output current by 2.5 %/°C
Site altitude		
0 … 1000 m a.m.s.l.		
1000 … 4000 m a.m.s.l.		Reduce rated output current by 5 %/1000 m
Pollution		
Degree of pollution 2	EN 61800-5-1	
	UL 61800-5-1	
Vibration resistance		
Transport		
2M2 (sine, shock)	EN 60721-3-2	in original packaging
		up to 45 kW
Ensuring		
Amplitude 1 mm	Germanischer Lloyd	5 ... 13.2 Hz
acceleration resistant up to 0.7 g		13.2 ... 100 Hz
		up to 15 kW
Amplitude 0.075 mm	EN 61800-5-1	10 ... 57 Hz
Acceleration resistant up to 1 g		57 ... 150 Hz

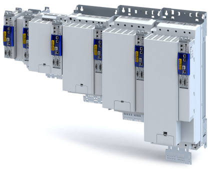
20.1.6 Electrical supply conditions

Permissible mains systems		
TT		Voltage against earth: max. 300 V
TN		Voltage against earth: max. 300 V
IT		Apply the measures described for IT systems!
		IT systems are not relevant for UL-approved systems

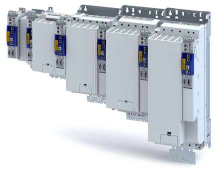
20.2 3-phase mains connection 400 V

20.2.1 Rated data

Inverters		**I95AE155F**	**I95AE175F**	**I95AE222F**	**I95AE240F**	**I95AE275F**	**I95AE311F**	**I95AE315F**
Rated power	**kW**	**0.55**	**0.75**	**2.2**	**4**	**7.5**	**11**	**15**
Rated power	**hp**	**0.75**	**1**	**3**	**5**	**10**	**15**	**20**
Mains voltage range		3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz						
Output voltage		3 AC 0-400 V						
Rated mains current								
without mains choke	A	2.5	3.3	7.8	12.5	20	28.4	-
with mains choke	A	2	2.6	5.3	9	15.7	22.3	28.8
Apparent output power	kVA	1.2	1.6	3.8	6.4	11	16	22
Rated output current								
2 kHz	A	1.8	2.4	5.6	9.5	16.5	23.5	32
4 kHz	A	1.8	2.4	5.6	9.5	16.5	23.5	32
8 kHz	A	1.8	2.4	5.6	7.1	16.5	23.5	23.5
16 kHz	A	1.2	1.6	2.6	2.9	11	12	11
Power loss								
2 kHz	W	38	44	76	116	186	256	342
4 kHz	W	39	46	80	122	197	272	363
8 kHz	W	45	54	99	154	252	351	471
16 kHz	W	45	54	99	154	252	351	471
at inverter disable	W	20	20	20	20	20	20	20
Cyclic mains switching		3 times per minute						
Max. motor cable length shielded								
Category C2 (2 kHz, 4 kHz, 8 kHz)	m	20	20	20	20	20	20	20
Category C3 (2 kHz, 4 kHz, 8 kHz)	m	35	35	35	35	35	35	35
without EMC category	m	50	50	50	50	100	100	100
Weight	kg	1.6	1.6	1.6	1.6	3.9	3.9	3.9
Weight	lb	3.5	3.5	3.5	3.5	8.6	8.6	8.6



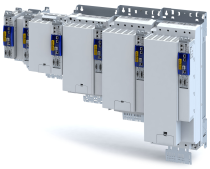
Inverters		**I95AE322F**	**I95AE330F**	**I95AE345F**	**I95AE355F**	**I95AE375F**	**I95AE390F**	**I95AE411F**
Rated power	**kW**	**22**	**30**	**45**	**55**	**75**	**90**	**110**
Rated power	**hp**	**30**	**40**	**60**	**75**	**100**	**125**	**150**
Mains voltage range		3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz						
Output voltage		3 AC 0-400 V						
Rated mains current								
without mains choke	A	-	-	-	-	-	-	-
with mains choke	A	42	54.9	80	99	135	168	198
Apparent output power	kVA	32	41	60	75	100	121	142
Rated output current								
2 kHz	A	47	61	89	110	150	180	212
4 kHz	A	47	61	89	110	150	180	212
8 kHz	A	47	61	89	110	150	162	191
16 kHz	A	31.3	40.6	59.3	76.6	95	99	106
Power loss								
2 kHz	W	505	653	934	1151	1553	1855	2177
4 kHz	W	536	694	994	1224	1654	1975	2319
8 kHz	W	694	898	1292	1593	2157	2326	2731
16 kHz	W	694	898	1292	1593	2157	2326	2731
at inverter disable	W	32	39	39	44	44	44	44
Cyclic mains switching		3 times per minute			1 time per minute			
Max. motor cable length shielded								
Category C2 (2 kHz, 4 kHz, 8 kHz)	m	20	20	20	20	20	20	20
Category C3 (2 kHz, 4 kHz, 8 kHz)	m	35	35	35	100	100	100	100
without EMC category	m	100	100	100	200	200	200	200
Weight	kg	10.7	16.7	16.7	24	24	35.6	35.6
Weight	lb	23.6	37	37	53	53	78.5	78.5



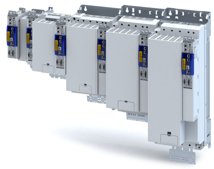
20.3 3-phase mains connection 480 V

20.3.1 Rated data

Inverters		**I95AE155F**	**I95AE175F**	**I95AE222F**	**I95AE240F**	**I95AE275F**	**I95AE311F**	**I95AE315F**
Rated power	**kW**	**0.55**	**0.75**	**2.2**	**4**	**7.5**	**11**	**15**
Rated power	**hp**	**0.75**	**1**	**3**	**5**	**10**	**15**	**20**
Mains voltage range		3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz						
Output voltage		3 AC 0-480 V						
Rated mains current								
without mains choke	A	2.1	2.8	6.5	10.5	16.6	23.7	-
with mains choke	A	1.7	2.2	4.4	7.5	13.1	18.6	24
Apparent output power	kVA	1.2	1.6	3.8	6.4	11	16	22
Rated output current								
2 kHz	A	1.6	2.1	4.8	8.2	14	21	27
4 kHz	A	1.6	2.1	4.8	8.2	14	21	27
8 kHz	A	1.6	2.1	4.8	6.2	14	21	19.8
16 kHz	A	1.1	1.4	2.2	2.5	7.8	7.8	7.2
Power loss								
2 kHz	W	38	44	76	116	186	256	342
4 kHz	W	39	46	80	122	197	272	363
8 kHz	W	45	54	99	154	252	351	471
16 kHz	W	45	54	99	154	252	351	471
at inverter disable	W	20	20	20	20	20	20	20
Cyclic mains switching		3 times per minute						
Max. motor cable length shielded								
Category C2 (2 kHz, 4 kHz, 8 kHz)	m	20	20	20	20	20	20	20
Category C3 (2 kHz, 4 kHz, 8 kHz)	m	35	35	35	35	35	35	35
without EMC category	m	50	50	50	50	100	100	100
Weight	kg	1.6	1.6	1.6	1.6	3.9	3.9	3.9
Weight	lb	3.5	3.5	3.5	3.5	8.6	8.6	8.6



Inverters		I95AE322F	I95AE330F	I95AE345F	I95AE355F	I95AE375F	I95AE390F	I95AE411F
Rated power	**kW**	**22**	**30**	**45**	**55**	**75**	**90**	**110**
Rated power	**hp**	**30**	**40**	**60**	**75**	**100**	**125**	**150**
Mains voltage range		3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz						
Output voltage		3 AC 0-480 V						
Rated mains current								
without mains choke	A	47.4	-	-	-	-	-	-
with mains choke	A	35.3	45.7	66.7	83	113	146	168
Apparent output power	kVA	32	41	60	75	100	121	142
Rated output current								
2 kHz	A	40.4	52	77	96	124	156	180
4 kHz	A	40.4	52	77	96	124	156	180
8 kHz	A	40.4	52	77	96	124	140	162
16 kHz	A	26.9	34.6	51.3	66.8	78.5	85.8	90
Power loss								
2 kHz	W	505	653	934	1151	1553	1855	2177
4 kHz	W	536	694	994	1224	1654	1975	2319
8 kHz	W	694	898	1292	1593	2157	2326	2731
16 kHz	W	694	898	1292	1593	2157	2326	2731
at inverter disable	W	32	39	39	44	44	44	44
Cyclic mains switching		3 times per minute			1 time per minute			
Max. motor cable length shielded								
Category C2 (2 kHz, 4 kHz, 8 kHz)	m	20	20	20	20	20	20	20
Category C3 (2 kHz, 4 kHz, 8 kHz)	m	35	35	35	100	100	100	100
without EMC category	m	100	100	100	200	200	200	200
Weight	kg	10.7	16.7	16.7	24	24	35.6	35.6
Weight	lb	23.6	37	37	53	53	78.5	78.5



21 Appendix

21.1 Parameter attribute list

The parameter attribute list in particular contains some information required for reading and writing parameters via network.

- The parameter attribute list contains all parameters of the inverter.
- The parameter attribute list is sorted by addresses (index:subindex) in ascending order.

How to read the parameter attribute list:

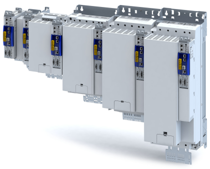
Column	Meaning		
Address	Address of the parameter in the object directory. Format: Index:Subindex		
Designation	Parameter name		
Default setting	Default setting of the parameter		
Data type	Data type of the parameter:		
	I8	INTEGER_8	1 byte, with sign
	I16	INTEGER_16	2 bytes with sign
	I32	INTEGER_32	4 bytes with sign
	I64	INTEGER_64	8 bytes with sign
	U8	UNSIGNED_8	1 byte without sign
	U16	UNSIGNED_16	2 bytes without sign
	U32	UNSIGNED_32	4 bytes without sign
	U64	UNSIGNED_64	8 bytes without sign
	STRING[xx]	VISIBLE_STRING	ASCII string (with character length xx)
	OCTET[xx]	OCTET_STRING	OCTET string (with xx bytes)
	IDX		4 bytes without sign. Is used specially for addressing parameters.
Factor	Factor for data transmission via network, depending on the number of decimal positions:		
	1	No decimal positions	
	10	1 decimal position	
	100	2 decimal positions	
	1000	3 decimal positions	
	10000	4 decimal positions	
A	Attributes (combinations of several attributes also possible):		
	C	Setting can only be changed if the inverter is inhibited.	
	E	Value is displayed as IP address.	
	H	Value is displayed in hexadecimal form.	
	I	Parameter is not displayed.	
	C	Parameter is not displayed.	
	O	Parameter can be recorded with the oscilloscope function.	
	P	Setting is saved in the memory module.	
	X	Parameter is not displayed in the engineering tools.	
M	Mapping:		
	r	Receive mapping permissible.	
	t	Transmit mapping permissible.	
	rt	Receive and transmit mapping permissible.	
	-	Mapping not permissible.	

Parameter attribute list (short overview of all parameter indexes)

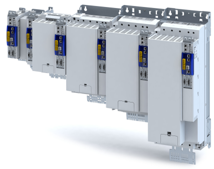
Address	Designation	Default setting	Data type	Factor	A	M
0x1000	Device type	- (Read only)	U32	1	X	
0x1001	EtherCAT error register	- (Read only)	U8	1	X	●
0x1008	Manufacturer device name	- (Read only)	STRING[50]		X	
0x1009	Manufacturer hardware version	- (Read only)	STRING[50]		X	
0x100A	Manufacturer software version	- (Read only)	STRING[50]		X	
0x1018:001	Identity object: Vendor ID	- (Read only)	U32	1	X	
0x1018:002	Identity object: Product ID	- (Read only)	U32		X	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x1018:003	Identity object: Revision number	- (Read only)	U32	1	X	
0x1018:004	Identity object: Serial number	- (Read only)	U32	1	X	
0x10F1:001	Error settings: Local error reaction	**Device specific state [2]**	U32		X	
0x10F1:002	Error settings: Sync error counter limit	**20**	U32	1	-	
0x10F3:001	History buffer: Max. number of messages	- (Read only)	U8	1	X	
0x10F3:002	History buffer: Latest message	- (Read only)	U8	1	X	
0x10F3:003	History buffer: Latest acknowledged message	**0**	U8	1	X	
0x10F3:004	History buffer: New active message	- (Read only)	U8	1	X	•
0x10F3:005	History buffer: Control bits	**0**	U16	1	X	
0x10F8	Actual time stamp	x ns (Read only)	U64	1	TX	•
0x2000:001	Device data: Product code	- (Read only)	STRING[50]		X	
0x2000:002	Device data: Serial number	- (Read only)	STRING[50]		X	
0x2000:003	Device data: Production date	- (Read only)	STRING[50]		X	
0x2000:004	Device data: CU firmware version	- (Read only)	STRING[50]		X	
0x2000:006	Device data: CU bootloader version	- (Read only)	STRING[50]		X	
0x2000:008	Device data: Object directory version	- (Read only)	U32	1	X	
0x2000:019	Device data: Safety module version	- (Read only)	STRING[50]		X	
0x2001	Device name	**"Device"**	STRING[128]		-	
0x2002:001	Device module: Safety module	- (Read only)	STRING[50]		X	
0x2002:006	Device module: CU serial number	- (Read only)	STRING[50]		X	
0x2002:007	Device module: PU serial number	- (Read only)	STRING[50]		X	
0x2002:010	Device module: Type communication module	- (Read only)	STRING[50]		X	
0x2002:011	Device module: Serial number communication module	- (Read only)	STRING[50]		X	
0x2002:012	Device module: Hardware version communication module	- (Read only)	STRING[50]		X	
0x2002:013	Device module: Type encoder 1	- (Read only)	STRING[50]		X	
0x2002:014	Device module: Serial number encoder 1	- (Read only)	STRING[50]		X	
0x2002:015	Device module: Hardware version encoder 1	- (Read only)	STRING[50]		X	
0x2002:016	Device module: Type encoder 2	- (Read only)	STRING[50]		X	
0x2002:017	Device module: Serial number encoder 2	- (Read only)	STRING[50]		X	
0x2002:018	Device module: Hardware version encoder 2	- (Read only)	STRING[50]		X	
0x2010:001	Device event monitor: EreignisortEvent location	- (Read only)	U8		X	
0x2010:002	Device event monitor: Event type	- (Read only)	U8		X	
0x2010:003	Device event monitor: Event status	- (Read only)	U8		X	
0x2010:005	Device event monitor: Number of current event	- (Read only)	U32		HX	
0x2010:006	Device event monitor: Time stamp of current event	x ns (Read only)	U64	1	TX	
0x2012:001	Device information: SD card status	- (Read only)	U8		X	
0x2012:002	Device information: Application Credit available	- (Read only)	U16	1	X	
0x2013:001	Application information: Active application	- (Read only)	U16		X	
0x2013:002	Application information: Application Credit required	- (Read only)	U16	1	X	
0x2020:001	EoE information: Virtual MAC address	- (Read only)	STRING[32]		X	
0x2020:002	EoE information: IP adress	- (Read only)	STRING[32]		X	
0x2020:003	EoE information: Subnet mask	- (Read only)	STRING[32]		X	
0x2020:004	EoE information: Standard gateway	- (Read only)	STRING[32]		X	
0x2020:005	EoE information: DNS server	- (Read only)	STRING[32]		X	
0x2020:006	EoE information: DNS name	- (Read only)	STRING[50]		X	
0x2020:007	EoE information: Received packages		U32	1	X	
0x2020:008	EoE information: Transmitted packages		U32	1	X	
0x2021:001	Optical tracking: Start detection	**Stop [0]**	U8		X	
0x2021:002	Optical tracking: Blinking duration	**5 s**	U16	1	X	
0x2022:001	Device commands: Load default settings	**Off / ready [0]**	U8		X	
0x2022:003	Device commands: Save user data	**Off / ready [0]**	U8		X	
0x2022:015	Device commands: Delete logbook	**Off / ready [0]**	U8		X	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2022:035	Device commands: Restart Device	**Off / ready [0]**	U8		X	
0x2022:036	Device commands: Export Logbook	**Off / ready [0]**	U8		X	
0x2022:037	Device commands: Delete Logfiles	**Off / ready [0]**	U8		X	
0x2022:038	Device commands: Activate loaded application	**Off / ready [0]**	U8		X	
0x2022:039	Device commands: Load TA default settings	**Off / ready [0]**	U8		X	
0x2022:040	Device commands: Parameter-Backup	**Off / ready [0]**	U8		CX	
0x2022:041	Device commands: Restart extended safety	**Off / ready [0]**	U8		X	
0x2022:042	Device commands: Upload application	**Off / ready [0]**	U8		X	
0x2022:043	Device commands: Restore	**Off / ready [0]**	U8		CX	
0x2030	CRC parameter set	- (Read only)	U32	1	X	
0x2100:001	Brand protection: PIN set	**0**	I32	1	X	
0x2100:002	Brand protection: PIN input	**0**	I32	1	X	
0x2100:003	Brand protection: Encryption	**0**	U8	1	X	
0x2110:014	SHOM: Delete home position	**Off / ready [0]**	U8		X	
0x2114:001	Parameter set Identification: Parameter set version	- (Read only)	U16		-	
0x2114:002	Parameter set Identification: Parameter set CRC	**0**	U32	1	-	
0x2115:001	Parameter set information: Parameter set status	- (Read only)	U8		X	
0x2115:002	Parameter set information: Safety module CRC	- (Read only)	U32	1	X	
0x2115:003	Parameter set information: Last valid CRC	- (Read only)	U32	1	X	
0x2115:004	Parameter set information: Parameter setting time stamp	x s (Read only)	U32	1	X	
0x2115:005	Parameter set information: Parameter set error information 1	- (Read only)	U32	1	X	
0x2115:006	Parameter set information: Parameter set error information 2	- (Read only)	U32	1	X	
0x2115:007	Parameter set information: Parameter set error information 3	- (Read only)	U32	1	X	
0x2118:001	SD-In: Sensor type: SD-In1: Sensor type	- (Read only)	U8		-	
0x2118:002	SD-In: Sensor type: SD-In2: Sensor type	- (Read only)	U8		-	
0x2118:003	SD-In: Sensor type: SD-In3: Sensor type	- (Read only)	U8		-	
0x2118:004	SD-In: Sensor type: SD-In4: Sensor type	- (Read only)	U8		-	
0x2119:001	SD-In: Discrepancy time: SD-In1: Discrepancy time	x ms (Read only)	U16	1	-	
0x2119:002	SD-In: Discrepancy time: SD-In2: Discrepancy time	x ms (Read only)	U16	1	-	
0x2119:003	SD-In: Discrepancy time: SD-In3: Discrepancy time	x ms (Read only)	U16	1	-	
0x2119:004	SD-In: Discrepancy time: SD-In4: Discrepancy time	x ms (Read only)	U16	1	-	
0x211A:001	SD-In: Input delay: SD-In1: Input delay	x ms (Read only)	U16	1	-	
0x211A:002	SD-In: Input delay: SD-In2: Input delay	x ms (Read only)	U16	1	-	
0x211A:003	SD-In: Input delay: SD-In3: Input delay	x ms (Read only)	U16	1	-	
0x211A:004	SD-In: Input delay: SD-In4: Input delay	x ms (Read only)	U16	1	-	
0x211B	Input image	- (Read only)	U32		HX	
0x211C:001	Status bits of inputs: SD-In1	- (Read only)	BOOLEAN	1	X	●
0x211C:002	Status bits of inputs: SD-In2	- (Read only)	BOOLEAN	1	X	●
0x211C:003	Status bits of inputs: SD-In3	- (Read only)	BOOLEAN	1	X	●
0x211C:004	Status bits of inputs: SD-In4	- (Read only)	BOOLEAN	1	X	●
0x211C:005	Status bits of inputs: AIS Dig-In	- (Read only)	BOOLEAN	1	X	
0x211C:006	Status bits of inputs: AIE Dig-In	- (Read only)	BOOLEAN	1	X	
0x211C:007	Status bits of inputs: IRS Dig-In	- (Read only)	BOOLEAN	1	X	
0x211C:008	Status bits of inputs: IRL Dig-In	- (Read only)	BOOLEAN	1	X	
0x2120:001	SD-Out: Source S-Bus: SD-Out1: Source S-Bus	- (Read only)	U8		-	
0x2121:001	SD-Out logic function: SD-Out1 logic function	- (Read only)	U8		-	
0x2122	Output image	- (Read only)	U16		HX	
0x2123:001	Status bits of outputs: SD-Out1	- (Read only)	BOOLEAN	1	X	●
0x2124	CAS: Quelle SD-In	- (Read only)	U8		-	
0x2125:001	CAS: Cascading: CAS: Stop delay	x ms (Read only)	U16	1	X	
* Default setting depending on the size.						

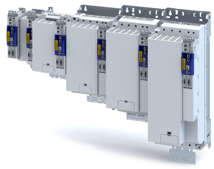


Address	Designation	Default setting	Data type	Factor	A	M
0x2128	S-bus: Configuration	- (Read only)	U8		-	
0x2129:001	S-bus: Control bits: SD-Out1	- (Read only)	BOOLEAN	1	X	●
0x212C:001	Safety: Software: Safety: Software version	- (Read only)	STRING[50]		X	
0x212D:001	Safety: Hardware: Safety: Hardware version	- (Read only)	STRING[50]		X	
0x212D:002	Safety: Hardware: Safety: Type	- (Read only)	STRING[50]		X	
0x212D:003	Safety: Hardware: Safety: Serial number	- (Read only)	STRING[50]		X	
0x212D:004	Safety: Hardware: Safety: Production date	- (Read only)	STRING[50]		X	
0x2130:001	Fault history: Actual fault type	- (Read only)	U8		X	
0x2130:002	Fault history: Fault history 1	- (Read only)	U16		HX	
0x2130:003	Fault history: Fault history 2	- (Read only)	U16		HX	
0x2130:004	Fault history: Fault history 3	- (Read only)	U16		HX	
0x2130:005	Fault history: Fault history 4	- (Read only)	U16		HX	
0x2130:006	Fault history: Fault history 5	- (Read only)	U16		HX	
0x2130:007	Fault history: Fault history 6	- (Read only)	U16		HX	
0x2130:008	Fault history: Fault history 7	- (Read only)	U16		HX	
0x2130:009	Fault history: Fault history 8	- (Read only)	U16		HX	
0x2130:010	Fault history: Fault history 9	- (Read only)	U16		HX	
0x2130:011	Fault history: Fault history 10	- (Read only)	U16		HX	
0x2130:012	Fault history: Fault history 11	- (Read only)	U16		HX	
0x2130:013	Fault history: Fault history 12	- (Read only)	U16		HX	
0x2130:014	Fault history: Fault history 13	- (Read only)	U16		HX	
0x2130:015	Fault history: Fault history 14	- (Read only)	U16		HX	
0x2130:016	Fault history: Fault history 15	- (Read only)	U16		HX	
0x2130:017	Fault history: Fault history 16	- (Read only)	U16		HX	
0x2131:001	Safety: Operating time: Safety: Operating time	x s (Read only)	U32	1	X	
0x2132	Safety module status	- (Read only)	U16	1	X	
0x231F:001	Module ID: Active module ID	- (Read only)	U8		X	
0x231F:002	Module ID: Module ID connected	- (Read only)	U8		X	
0x2371:009	EtherCAT on board: Interface mode	**Slave [0]**	U8		C	
0x2372:009	Systembus EtherCAT-Informationen: Active interface mode	- (Read only)	U8		-	
0x2378	Network status	- (Read only)	U16		X	●
0x2379	Network error	- (Read only)	U16	1	-	
0x2380	PROFINET communication	**No action/no error [0]**	U8		X	
0x2381:001	PROFINET settings: IP address	**0.0.0.0**	U32		E	
0x2381:002	PROFINET settings: Subnet	**0.0.0.0**	U32		E	
0x2381:003	PROFINET settings: Gateway	**0.0.0.0**	U32		E	
0x2381:004	PROFINET settings: Station name		STRING[240]		-	
0x2381:005	PROFINET settings: I&M1 System designation		STRING[32]		-	
0x2381:006	PROFINET settings: I&M1 Installation site		STRING[22]		-	
0x2381:007	PROFINET settings: I&M2 Installation date		STRING[16]		-	
0x2381:008	PROFINET settings: I&M3 additional information		STRING[54]		-	
0x2381:009	PROFINET settings: I&M4 signature code	"**000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000**"	OCTET[54]		-	
0x2382:001	Active PROFINET settings: IP address	- (Read only)	U32		EX	
0x2382:002	Active PROFINET settings: Subnet	- (Read only)	U32		EX	
0x2382:003	Active PROFINET settings: Gateway	- (Read only)	U32		EX	
0x2382:004	Active PROFINET settings: Station name	- (Read only)	STRING[240]		X	
0x2382:005	Active PROFINET settings: MAC Address	- (Read only)	OCTET[6]		X	
0x2388	PROFINET status	- (Read only)	U16		HX	
0x2389:001	PROFINET error: Error 1	- (Read only)	U16		X	
0x2389:002	PROFINET error: Error 2	- (Read only)	U16		HX	
* Default setting depending on the size.						



Address	Designation	Default setting	Data type	Factor	A	M
0x243C:001	Device: Ethernet commands: Device: Start firmware update	**Off/Ready [0]**	U8		CX	
0x2450	Engineering port control	**No action/No error [0]**	U8		X	
0x2451:001	Engineering port settings: IP address	**0.0.0.0**	U32		E	
0x2451:002	Engineering port settings: Subnet	**0.0.0.0**	U32		E	
0x2451:003	Engineering port settings: Gateway	**0.0.0.0**	U32		E	
0x2451:004	Engineering port settings: DHCP	**Enabled [1]**	U8		-	
0x2452:001	Active engineering port settings: IP address	- (Read only)	U32		EX	
0x2452:002	Active engineering port settings: Subnet	- (Read only)	U32		EX	
0x2452:003	Active engineering port settings: Gateway	- (Read only)	U32		EX	
0x2452:005	Active engineering port settings: MAC address	- (Read only)	OCTET[6]		X	
0x245A:001	NTP server addresses: Activate NTP server addresses	**No action/no error [0]**	U8		X	
0x245A:002	NTP server addresses: NTP server address 1	**0.0.0.0**	U32		E	
0x245A:003	NTP server addresses: NTP server address 2	**0.0.0.0**	U32		E	
0x245A:004	NTP server addresses: NTP server address 3	**0.0.0.0**	U32		E	
0x245A:005	NTP server addresses: NTP server address 4	**0.0.0.0**	U32		E	
0x245B:001	System time: Time base	**NTP [0]**	U8		X	
0x245B:002	System time: Current time	**ns**	U64	1	TX	
0x2500	Touch probe filter time	**0 us**	U16	1	-	
0x2539:001	Hardware-Diagnose: 24 V supply actual voltage	x.x V (Read only)	U16	10	X	
0x2539:002	Hardware-Diagnose: Control board temperature	x.x °C (Read only)	I16	10	X	
0x2540:001	Mains settings: Rated mains voltage	**400 Veff [1]**	U8		-	
0x2540:002	Mains settings: Undervoltage warning threshold	**430 V**	U16	1	-	
0x2540:003	Mains settings: Undervoltage error threshold	x V (Read only)	U16	1	-	
0x2540:004	Mains settings: Undervoltage reset threshold	x V (Read only)	U16	1	-	
0x2540:005	Mains settings: Overvoltage warning threshold	**795 V**	U16	1	-	
0x2540:006	Mains settings: Overvoltage error threshold	x V (Read only)	U16	1	-	
0x2540:007	Mains settings: Overvoltage reset threshold	x V (Read only)	U16	1	-	
0x2540:008	Mains settings: DC link voltage critical	- (Read only)	U8	1	X	•
0x2541:003	Brake energy management: Reduced threshold	**0 V**	U16	1	-	
0x2550:001	Brake resistor: Minimum resistance	x.x Ω (Read only)	U16	10	X	
0x2550:002	Brake resistor: Resistance value	**180.0 Ω**	U16	10	-	
0x2550:003	Brake resistor: Rated power	**5600 W**	U32	1	-	
0x2550:004	Brake resistor: Maximum thermal load	**485 kWs**	U32	1	-	
0x2550:006	Brake resistor: Reference resistance	**Minimum resistance [0]**	U8		-	
0x2550:007	Brake resistor: Thermal load	x.x % (Read only)	U16	10	X	
0x2550:008	Brake resistor: Warning threshold	**90.0 %**	U16	10	-	
0x2550:010	Brake resistor: Response to warning	**Warning [2]**	U8		-	
0x2550:011	Brake resistor: Response to error	**No response [0]**	U8		-	
0x2580:001	Distributed Clocks: Real time status	- (Read only)	U8		X	
0x2580:002	Distributed Clocks: First setting time	x ns (Read only)	U64	1	TX	
0x2580:003	Distributed Clocks: Newest setting time	x ns (Read only)	U64	1	TX	
0x2580:004	Distributed Clocks: Current time	x ns (Read only)	U64	1	TX	
0x2590:003	Energy saving: State of actual energy saving mode	- (Read only)	U8		HX	
0x261C:001	Favorites settings: Parameter 1		U32	1	-	
0x261C:002	Favorites settings: Parameter 2		U32	1	-	
0x261C:003	Favorites settings: Parameter 3		U32	1	-	
0x261C:004	Favorites settings: Parameter 4		U32	1	-	
0x261C:005	Favorites settings: Parameter 5		U32	1	-	
0x261C:006	Favorites settings: Parameter 6		U32	1	-	
0x261C:007	Favorites settings: Parameter 7		U32	1	-	
0x261C:008	Favorites settings: Parameter 8		U32	1	-	
0x261C:009	Favorites settings: Parameter 9		U32	1	-	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x261C:010	Favorites settings: Parameter 10		U32	1	-	
0x261C:011	Favorites settings: Parameter 11		U32	1	-	
0x261C:012	Favorites settings: Parameter 12		U32	1	-	
0x261C:013	Favorites settings: Parameter 13		U32	1	-	
0x261C:014	Favorites settings: Parameter 14		U32	1	-	
0x261C:015	Favorites settings: Parameter 15		U32	1	-	
0x261C:016	Favorites settings: Parameter 16		U32	1	-	
0x261C:017	Favorites settings: Parameter 17		U32	1	-	
0x261C:018	Favorites settings: Parameter 18		U32	1	-	
0x261C:019	Favorites settings: Parameter 19		U32	1	-	
0x261C:020	Favorites settings: Parameter 20		U32	1	-	
0x261C:021	Favorites settings: Parameter 21		U32	1	-	
0x261C:022	Favorites settings: Parameter 22		U32	1	-	
0x261C:023	Favorites settings: Parameter 23		U32	1	-	
0x261C:024	Favorites settings: Parameter 24		U32	1	-	
0x261C:025	Favorites settings: Parameter 25		U32	1	-	
0x261C:026	Favorites settings: Parameter 26		U32	1	-	
0x261C:027	Favorites settings: Parameter 27		U32	1	-	
0x261C:028	Favorites settings: Parameter 28		U32	1	-	
0x261C:029	Favorites settings: Parameter 29		U32	1	-	
0x261C:030	Favorites settings: Parameter 30		U32	1	-	
0x261C:031	Favorites settings: Parameter 31		U32	1	-	
0x261C:032	Favorites settings: Parameter 32		U32	1	-	
0x261C:033	Favorites settings: Parameter 33		U32	1	-	
0x261C:034	Favorites settings: Parameter 34		U32	1	-	
0x261C:035	Favorites settings: Parameter 35		U32	1	-	
0x261C:036	Favorites settings: Parameter 36		U32	1	-	
0x261C:037	Favorites settings: Parameter 37		U32	1	-	
0x261C:038	Favorites settings: Parameter 38		U32	1	-	
0x261C:039	Favorites settings: Parameter 39		U32	1	-	
0x261C:040	Favorites settings: Parameter 40		U32	1	-	
0x261C:041	Favorites settings: Parameter 41		U32	1	-	
0x261C:042	Favorites settings: Parameter 42		U32	1	-	
0x261C:043	Favorites settings: Parameter 43		U32	1	-	
0x261C:044	Favorites settings: Parameter 44		U32	1	-	
0x261C:045	Favorites settings: Parameter 45		U32	1	-	
0x261C:046	Favorites settings: Parameter 46		U32	1	-	
0x261C:047	Favorites settings: Parameter 47		U32	1	-	
0x261C:048	Favorites settings: Parameter 48		U32	1	-	
0x261C:049	Favorites settings: Parameter 49		U32	1	-	
0x261C:050	Favorites settings: Parameter 50		U32	1	-	
0x2632:001	Inversion of digital inputs: Digital input 1	**Not inverted [0]**	U8		-	
0x2632:002	Inversion of digital inputs: Digital input 2	**Not inverted [0]**	U8		-	
0x2632:003	Inversion of digital inputs: Digital input 3	**Not inverted [0]**	U8		-	
0x2632:004	Inversion of digital inputs: Digital input 4	**Not inverted [0]**	U8		-	
0x2633:001	Digital input debounce time: Digital input 1	**0 ms**	U8	1	-	
0x2633:002	Digital input debounce time: Digital input 2	**0 ms**	U8	1	-	
0x2633:003	Digital input debounce time: Digital input 3	**0 ms**	U8	1	-	
0x2633:004	Digital input debounce time: Digital input 4	**0 ms**	U8	1	-	
0x2635:002	Inversion of digital outputs: Digital output 1	**Not inverted [0]**	U8		-	
0x2636:001	Analog input 1: Input range	**0 ... 10 VDC [0]**	U8		-	
0x2636:006	Analog input 1: Filter time	**10 ms**	U16	1	-	
0x2636:007	Analog input 1: Dead band	**0.0 %**	U16	10	-	
0x2636:010	Analog input 1: Error response	**No response [0]**	U8		-	
* Default setting depending on the size.						

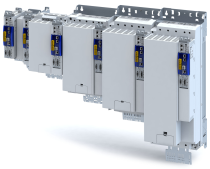


Address	Designation	Default setting	Data type	Factor	A	M
0x2636:013	Analog input 1: Minimum value for scaling	**0.0 %**	I16	10	-	
0x2636:014	Analog input 1: Maximum value for scaling	**100.0 %**	I16	10	-	
0x263B:001	Digital inputs internal control: Activation	**Aus [0]**	U8		X	
0x263B:002	Digital inputs internal control: DI1 internal control	**Aus [0]**	U8		X	
0x263B:003	Digital inputs internal control: DI2 internal control	**Aus [0]**	U8		X	
0x263B:004	Digital inputs internal control: DI3 internal control	**Aus [0]**	U8		X	
0x263B:005	Digital inputs internal control: DI4 internal control	**Aus [0]**	U8		X	
0x263C:001	Digital outputs internal control: Activation	**Aus [0]**	U8		X	
0x263C:002	Digital outputs internal control: DO1 internal control	**Aus [0]**	U8		X	
0x263D:001	Analog inputs internal control: Activation	**Aus [0]**	U8		X	
0x263D:002	Analog inputs internal control: AI1 internal control	**100.00 %**	I16	100	X	
0x2820:001	Holding brake control: Brake mode	**Off [2]**	U8		-	●
0x2820:002	Holding brake control: Brake closing time	**100 ms**	U16	1	-	
0x2820:003	Holding brake control: Brake opening time	**100 ms**	U16	1	-	
0x2820:004	Holding brake control: Brake detection	- (Read only)	U16		X	
0x2820:005	Holding brake control: Brake polarity	**Normal [0]**	U8		-	
0x2820:006	Holding brake control: Brake error response	**Fault [1]**	U8		-	
0x2820:009	Holding brake control: Starting torque source	**Torque in 0x2820:010 [1]**	U16		-	
0x2820:010	Holding brake control: Starting torque	**0.0 %**	I16	10	-	●
0x2820:011	Holding brake control: Override of the brake control	**No override active [0]**	U8		X	●
0x2820:013	Holding brake control: Holding load ramptime	**0 ms**	U16	1	-	
0x2820:015	Holding brake control: Brake status	- (Read only)	U8		X	
0x2820:019	Holding brake control: Brake opening time test signal	**500 ms**	U16	1	X	
0x2820:020	Holding brake control: Brake control word	**0x00**	U8		HX	
0x2820:021	Holding brake control: Detected actual torque	x.x % (Read only)	I16	10	X	
0x2820:022	Holding brake control: Versorgungsspannung Haltebremse	**Absenkung auf 75% [75]**	U8		-	
0x2822:001	Axis commands: Enable inverter	**Inverter enabled [1]**	U8		X	
0x2822:003	Axis commands: Reset error	**Off/Ready [0]**	U8		X	
0x2822:021	Axis commands: Load default Lh saturation characteristic	**Off/Ready [0]**	U8		X	
0x2822:022	Axis commands: Load default inverter characteristic	**Off/Ready [0]**	U8		X	
0x2822:023	Axis commands: Estimate optimum magnetizing current	**Off/Ready [0]**	U8		X	
0x2822:024	Axis commands: Estimate motor parameter based on rated data	**Off/Ready [0]**	U8		X	
0x2822:025	Axis commands: Get motor encoder characteristic (resolver)	**Off/Ready [0]**	U8		X	
0x2822:026	Axis commands: Get motor encoder information (Hiperface)	**Off/Ready [0]**	U8		X	
0x2822:029	Axis commands: Get load encoder/master encoder characteristic (resolver)	**Off / ready [0]**	U8		X	
0x2822:030	Axis commands: Get load encoder/master encoder information (Hiperface)	**Off/Ready [0]**	U8		X	
0x2823	Status of axis commands	- (Read only)	U8	1	X	
0x2824	Control selection	**Keypad [1]**	U8		C	
0x2825	Drive mode selection	**CiA402 operating modes [0]**	U8		C	
0x2826	Time-out for error response	**4 s**	U32	1	-	
0x282A:001	Status words: Cause of disable	- (Read only)	U32		HX	●
0x282C:001	I/O diagnostic: Application level of the digital inputs	- (Read only)	U32		HX	●
0x2830	Inverter control word	**0x0000**	U16		HX	●
0x2831	Inverter-Statuswort	- (Read only)	U16		HX	●
0x2832	Motor identification status	- (Read only)	U16		HX	
0x2833	Inverter status word 2	- (Read only)	U16		HX	●

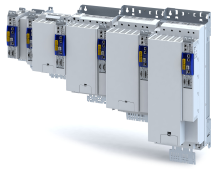
* Default setting depending on the size.

Address	Designation	Default setting	Data type	Factor	A	M
0x2835:001	Manual test mode: Current setpoint	**0 %**	I16	1	X	●
0x2835:002	Manual test mode: Frequency	**0.0 Hz**	I16	10	X	●
0x2835:003	Manual test mode: Starting angle	**0.0 °**	I16	10	X	
0x2836:001	Manual control mode: Current setpoint	**30 %**	U16	1	X	●
0x2836:002	Manual control mode: Frequency	**0.0 Hz**	I16	10	X	●
0x2836:003	Manual control mode: Ramp time (current)	**0 ms**	U16	1	-	
0x2836:004	Manual control mode: Ramp time (frequency)	**500 ms**	U16	1	-	
0x2836:005	Manual control mode: Time monitoring (frequency)	**2500 ms**	U32	1	-	
0x2836:006	Manual control mode: Current controller gain	**20.00 V/A**	U32	100	-	
0x2836:007	Manual control mode: Current controller reset time	**20.00 ms**	U32	100	-	
0x2840	Error reset time	x ms (Read only)	I32	1	X	
0x2841	Reset error	**0**	U8	1	X	
0x284F	Current error	- (Read only)	OCTET[64]		X	
0x2859:001	PROFINET monitoring: Watchdog elapsed	**Warning [2]**	U8		-	
0x2859:002	PROFINET monitoring: Data exchange exited	**No response [0]**	U8		-	
0x2859:003	PROFINET monitoring: Invalid configuration	**Warning [2]**	U8		-	
0x2859:004	PROFINET monitoring: Initialisation error	**Warning [2]**	U8		-	
0x2859:005	PROFINET monitoring: Invalid process data	**Warning [2]**	U8		-	
0x285A:001	Diagnostic settings: Alarm supression	**0x0000**	U16		H	
0x285B:001	EtherCAT system bus monitoring: Watchdog abgelaufen	**Fault > CiA402 [1]**	U8		-	
0x285B:002	EtherCAT system bus monitoring: EtherCAT role check	**Warning [2]**	U8		-	
0x2870:001	SafetyInterface: SafetyInterface Control	- (Read only)	U32		HX	●
0x2870:002	SafetyInterface: SafetyInterface State	- (Read only)	U32		HX	●
0x2870:003	SafetyInterface: SafetyInterface IOState	- (Read only)	U32		HX	●
0x2871:001	SafetyInterface bits: STO active	- (Read only)	BOOLEAN	1	X	●
0x2871:002	SafetyInterface bits: SS1 active	- (Read only)	BOOLEAN	1	X	●
0x2871:003	SafetyInterface bits: SS2 active	- (Read only)	BOOLEAN	1	X	●
0x2871:004	SafetyInterface bits: SOS active	- (Read only)	BOOLEAN	1	X	●
0x2871:005	SafetyInterface bits: SLS1 active	- (Read only)	BOOLEAN	1	X	●
0x2871:006	SafetyInterface bits: SLS2 active	- (Read only)	BOOLEAN	1	X	●
0x2871:007	SafetyInterface bits: SLS3 active	- (Read only)	BOOLEAN	1	X	●
0x2871:008	SafetyInterface bits: SLS4 active	- (Read only)	BOOLEAN	1	X	●
0x2871:009	SafetyInterface bits: SDIpos active	- (Read only)	BOOLEAN	1	X	●
0x2871:010	SafetyInterface bits: SDIneg active	- (Read only)	BOOLEAN	1	X	●
0x2871:011	SafetyInterface bits: SLI active	- (Read only)	BOOLEAN	1	X	●
0x2871:012	SafetyInterface bits: SSE active	- (Read only)	BOOLEAN	1	X	●
0x2871:013	SafetyInterface bits: ES active	- (Read only)	BOOLEAN	1	X	●
0x2871:014	SafetyInterface bits: OMS active	- (Read only)	BOOLEAN	1	X	●
0x2871:015	SafetyInterface bits: RMS active	- (Read only)	BOOLEAN	1	X	●
0x2871:016	SafetyInterface bits: SBC active	- (Read only)	BOOLEAN	1	X	●
0x2871:033	SafetyInterface bits: SLS1 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:034	SafetyInterface bits: SLS2 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:035	SafetyInterface bits: SLS3 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:036	SafetyInterface bits: SLS4 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:037	SafetyInterface bits: SMS observed	- (Read only)	BOOLEAN	1	X	●
0x2871:038	SafetyInterface bits: SSM within limits	- (Read only)	BOOLEAN	1	X	●
0x2871:039	SafetyInterface bits: SDIpos observed	- (Read only)	BOOLEAN	1	X	●
0x2871:040	SafetyInterface bits: SDIneg observed	- (Read only)	BOOLEAN	1	X	●
0x2871:041	SafetyInterface bits: SLP1 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:042	SafetyInterface bits: SLP2 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:043	SafetyInterface bits: SLP3 observed	- (Read only)	BOOLEAN	1	X	●
0x2871:044	SafetyInterface bits: SLP4 observed	- (Read only)	BOOLEAN	1	X	●
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2871:045	SafetyInterface bits: SCA1 within limits	- (Read only)	BOOLEAN	1	X	●
0x2871:046	SafetyInterface bits: SCA2 within limits	- (Read only)	BOOLEAN	1	X	●
0x2871:047	SafetyInterface bits: SCA3 within limits	- (Read only)	BOOLEAN	1	X	●
0x2871:048	SafetyInterface bits: SCA4 within limits	- (Read only)	BOOLEAN	1	X	●
0x2871:049	SafetyInterface bits: PDSSpos observed	- (Read only)	BOOLEAN	1	X	●
0x2871:050	SafetyInterface bits: PDSSneg observed	- (Read only)	BOOLEAN	1	X	●
0x2871:051	SafetyInterface bits: SOS observed	- (Read only)	BOOLEAN	1	X	●
0x2871:052	SafetyInterface bits: SBC activated	- (Read only)	BOOLEAN	1	X	●
0x2871:053	SafetyInterface bits: SHOM active	- (Read only)	BOOLEAN	1	X	●
0x2871:054	SafetyInterface bits: SHOM available	- (Read only)	BOOLEAN	1	X	●
0x2871:055	SafetyInterface bits: Safe speed OK	- (Read only)	BOOLEAN	1	X	●
0x2871:056	SafetyInterface bits: n=0	- (Read only)	BOOLEAN	1	X	●
0x2871:057	SafetyInterface bits: Positive direction	- (Read only)	BOOLEAN	1	X	●
0x2871:058	SafetyInterface bits: Slip > 25%	- (Read only)	BOOLEAN	1	X	
0x2871:059	SafetyInterface bits: Slip > 50%	- (Read only)	BOOLEAN	1	X	
0x2871:060	SafetyInterface bits: Slip > 75%	- (Read only)	BOOLEAN	1	X	
0x2871:064	SafetyInterface bits: Error active	- (Read only)	BOOLEAN	1	X	●
0x2871:073	SafetyInterface bits: AIS S bus	- (Read only)	BOOLEAN	1	X	
0x2871:074	SafetyInterface bits: AIE S bus	- (Read only)	BOOLEAN	1	X	
0x2871:075	SafetyInterface bits: SHOM_Start S bus	- (Read only)	BOOLEAN	1	X	
0x2871:076	SafetyInterface bits: SHOM_Load S bus	- (Read only)	BOOLEAN	1	X	
0x2874	S bus: Display of control data	- (Read only)	U32		HX	
0x2875:001	S bus control bits: STO	- (Read only)	BOOLEAN	1	X	●
0x2875:002	S bus control bits: SS1	- (Read only)	BOOLEAN	1	X	●
0x2875:003	S bus control bits: SS2	- (Read only)	BOOLEAN	1	X	●
0x2875:004	S bus control bits: SLS1	- (Read only)	BOOLEAN	1	X	●
0x2875:005	S bus control bits: SLS2	- (Read only)	BOOLEAN	1	X	●
0x2875:006	S bus control bits: SLS3	- (Read only)	BOOLEAN	1	X	●
0x2875:007	S bus control bits: SLS4	- (Read only)	BOOLEAN	1	X	●
0x2875:008	S bus control bits: SDIpos	- (Read only)	BOOLEAN	1	X	●
0x2875:009	S bus control bits: SDIneg	- (Read only)	BOOLEAN	1	X	●
0x2875:010	S bus control bits: ES	- (Read only)	BOOLEAN	1	X	●
0x2875:011	S bus control bits: SLI	- (Read only)	BOOLEAN	1	X	●
0x2875:012	S bus control bits: OMS	- (Read only)	BOOLEAN	1	X	●
0x2875:013	S bus control bits: SLP1	- (Read only)	BOOLEAN	1	X	●
0x2875:014	S bus control bits: SLP2	- (Read only)	BOOLEAN	1	X	●
0x2875:015	S bus control bits: SLP3	- (Read only)	BOOLEAN	1	X	●
0x2875:016	S bus control bits: SLP4	- (Read only)	BOOLEAN	1	X	●
0x2875:017	S bus control bits: AIS	- (Read only)	BOOLEAN	1	X	●
0x2875:018	S bus control bits: AIE	- (Read only)	BOOLEAN	1	X	●
0x2875:019	S bus control bits: SOS	- (Read only)	BOOLEAN	1	X	●
0x2875:020	S bus control bits: RMS	- (Read only)	BOOLEAN	1	X	●
0x2875:021	S bus control bits: SHOM_Start	- (Read only)	BOOLEAN	1	X	●
0x2875:022	S bus control bits: SHOM_Load	- (Read only)	BOOLEAN	1	X	●
0x2875:023	S bus control bits: PDSS	- (Read only)	BOOLEAN	1	X	●
0x2875:024	S bus control bits: SSE	- (Read only)	BOOLEAN	1	X	●
0x2875:026	S bus control bits: SBC	- (Read only)	BOOLEAN	1	X	●
0x2878:001	Motor encoder: Motor encoder system	- (Read only)	U8		-	
0x2878:002	Motor encoder: SinCos encoder increments	- (Read only)	U16	1	-	
0x2878:003	Motor encoder: Number of resolver pole pairs	- (Read only)	U8	1	-	
0x2878:004	Motor encoder: Encoder monitoring response time	ms (Read only)	U8		-	
0x2879:001	Mechanical data: Motor mounting direction	- (Read only)	U8		-	
0x287A:001	Load encoder: Load encoder system	- (Read only)	U8		-	
* Default setting depending on the size.						



Address	Designation	Default setting	Data type	Factor	A	M
0x287A:003	Load encoder: Load encoder gearbox factor numerator	- (Read only)	U16	1	-	
0x287A:004	Load encoder: Load encoder gearbox factor denominator	- (Read only)	U16	1	-	
0x287A:005	Load encoder: Load encoder mounting direction	- (Read only)	U8		-	
0x287A:006	Load encoder: Load encoder position	**0**	I32	1	X	●
0x287A:007	Load encoder: Status of load encoder position	**Invalid [0]**	U8		X	●
0x287B:001	Velocity monitoring: Tolerance window (n=0)	x rpm (Read only)	U16	1	-	
0x287B:002	Velocity monitoring: Velocity comparison tolerance	x rpm (Read only)	U16	1	-	
0x287B:003	Velocity monitoring: Actual velocity n_safe	x rpm (Read only)	I16	1	X	●
0x287B:004	Velocity monitoring: Internal actual velocity nSD	x rpm (Read only)	I16	1	X	
0x287B:005	Velocity monitoring: Internal actual velocity nBD	x rpm (Read only)	I16	1	X	
0x287B:006	Velocity monitoring: Actual velocity difference nSD-nBD	x rpm (Read only)	I16	1	X	
0x287C:001	Position monitoring: Position comparison tolerance	- (Read only)	I32	1	-	
0x287C:002	Position monitoring: Actual Position p_safe	- (Read only)	I32	1	X	●
0x287C:003	Position monitoring: Internal actual position pSD	- (Read only)	I32	1	X	
0x287C:004	Position monitoring: Internal actual position pBD	- (Read only)	I32	1	X	
0x287C:005	Position monitoring: Current pos. difference pSD-pBD	- (Read only)	I32	1	X	
0x2880:001	SHOM_Start settings: SHOM_Start: Source	- (Read only)	U8		-	
0x2880:002	SHOM_Start settings: SHOM_Start: Edge trigger IRS	- (Read only)	U8		-	
0x2881:001	SHOM_Load settings: SHOM_Load: Source	- (Read only)	U8		-	
0x2881:002	SHOM_Load settings: SHOM_Load: Edge trigger IRL	- (Read only)	U8		-	
0x2882:001	Safe homing (SHOM): SHOM: Home position	- (Read only)	I32	1	-	
0x2882:002	Safe homing (SHOM): SHOM: Timeout	x ms (Read only)	U16	1	-	
0x2882:003	Safe homing (SHOM): SHOM: SLS homing	- (Read only)	U8		-	
0x2882:004	Safe homing (SHOM): SHOM: Restart condition	- (Read only)	U8		-	
0x2882:005	Safe homing (SHOM): SHOM: Tolerance - starting position	- (Read only)	I32	1	-	
0x2882:006	Safe homing (SHOM): SHOM status	- (Read only)	U8		X	
0x2882:007	Safe homing (SHOM): SHOM: Saved position	- (Read only)	I32	1	X	
0x2883	SHOM: Diagnostic positions source	- (Read only)	U8		-	
0x2884:001	SHOM diagnostic positions: SHOM: Detection diag position	- (Read only)	U8		-	
0x2884:002	SHOM diagnostic positions: SHOM: Lower diagnostic position	- (Read only)	I32	1	-	
0x2884:003	SHOM diagnostic positions: SHOM: Upper diagnostic position	- (Read only)	I32	1	-	
0x2884:004	SHOM diagnostic positions: SHOM: Tolerance diag positions	- (Read only)	I32	1	-	
0x2884:005	SHOM diagnostic positions: SHOM: Error response diag positions	- (Read only)	U8		-	
0x2884:006	SHOM diagnostic positions: SHOM: Current difference diagnostic position	- (Read only)	I32	1	X	
0x2885:001	SHOM: Slip compensation: SHOM: Maximally compensated slip	- (Read only)	I32	1	-	
0x2885:002	SHOM: Slip compensation: SHOM: Slip compensation end area	- (Read only)	U8		-	
0x2886	SHOM: SHOM active output	- (Read only)	U8		-	
0x2887	SHOM: SHOM available output	- (Read only)	U8		-	
0x2890	STO: Source SD-In	- (Read only)	U8		-	
0x2891	STO: Source S-Bus	- (Read only)	U8		-	
0x2892:001	STO: STO: Restart	- (Read only)	U8		-	
0x2893	STO active: Output	- (Read only)	U8		-	
0x2894:001	SS1, SS2: SS1, SS2: Stopping time	x ms (Read only)	U16	1	-	
* Default setting depending on the size.						



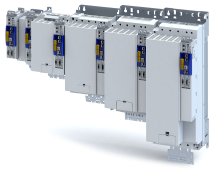
Address	Designation	Default setting	Data type	Factor	A	M
0x2894:002	SS1, SS2: SS1, SS2: Ramp Monitoring	- (Read only)	U8		-	
0x2894:003	SS1, SS2: SS1, SS2: Ramp smoothing time	x % (Read only)	U8	1	-	
0x2894:004	SS1, SS2: SS1, SS2: Ramp Offset Mode	- (Read only)	U8		-	
0x2894:005	SS1, SS2: SS1, SS2: Ramp Start Offset relative	x % (Read only)	U8	1	-	
0x2894:006	SS1, SS2: SS1, SS2: Ramp Start Offset absolute	x rpm (Read only)	U16	1	-	
0x2894:007	SS1, SS2: SS1, SS2: Actual ramp speed	x rpm (Read only)	U16	1	X	
0x2894:008	SS1, SS2: SS1, SS2: Minimal speed differerence	x rpm (Read only)	I16	1	X	
0x2895	SS1: Source SD-In	- (Read only)	U8		-	
0x2896	SS1: Source S-Bus	- (Read only)	U8		-	
0x2897:001	SS1: SS1: Mode	- (Read only)	U8		-	
0x2897:002	SS1: SS1: Deceleration STO after n=0	x ms (Read only)	U16	1	-	
0x2898	SS1 active: Output	- (Read only)	U8		-	
0x2899	SS2: Source SD-In	- (Read only)	U8		-	
0x289A	SS2: Source S-Bus	- (Read only)	U8		-	
0x289B:001	SS2: SS2: Mode	- (Read only)	U8		-	
0x289C	SS2 active: Output	- (Read only)	U8		-	
0x289D	SOS: Source SD-In	- (Read only)	U8		-	
0x289E	SOS: Source S-Bus	- (Read only)	U8		-	
0x289F:001	SOS: SOS: Tolerance window (Delta p=0)	- (Read only)	I32	1	-	
0x289F:002	SOS: SOS: Restart	- (Read only)	U8		-	
0x289F:003	SOS: SOS: Maximal Change of Position	- (Read only)	I32	1	X	
0x28A0	SOS monitored: Output	- (Read only)	U8		-	
0x28A1	SSE: Source SD-In	- (Read only)	U8		-	
0x28A2	SSE: Source S-Bus	- (Read only)	U8		-	
0x28A3:001	SSE: SSE: Emergency Stop function	- (Read only)	U8		-	
0x28A4	SSE active: Output	- (Read only)	U8		-	
0x28A8	OMS: Source	- (Read only)	U8		-	
0x28A9:001	OMS: OMS: Stop function	- (Read only)	U8		-	
0x28A9:002	OMS: OMS: Movement function	- (Read only)	U8		-	
0x28A9:003	OMS: OMS: Function at Low Level	- (Read only)	U8		-	
0x28AA	OMS active: Output	- (Read only)	U8		-	
0x28AB	RMS: Source	- (Read only)	U8		-	
0x28AC:001	RMS: RMS: Stop function	- (Read only)	U8		-	
0x28AD	RMS active: Output	- (Read only)	U8		-	
0x28AE	ES: Source	- (Read only)	U8		-	
0x28AF	ES active: Output	- (Read only)	U8		-	
0x28B0:001	SMS: SMS: Maximum Speed Nmax	x rpm (Read only)	U16	1	-	
0x28B0:002	SMS: SMS: Reaction (n>Nmax)	- (Read only)	U8		-	
0x28B1	SMS monitored: Output	- (Read only)	U8		-	
0x28B2:001	SSM parameters: SSM: Monitored speed	x rpm (Read only)	U16	1	-	
0x28B3	SSM within limits	- (Read only)	U8		-	
0x28B8:001	SDI: Source SD-In: SDIpos: Source SD-In	- (Read only)	U8		-	
0x28B8:002	SDI: Source SD-In: SDIneg: Source SD-In	- (Read only)	U8		-	
0x28B9:001	SDI: Source S-Bus: SDIpos: Source S-Bus	- (Read only)	U8		-	
0x28B9:002	SDI: Source S-Bus: SDIneg: Source S-Bus	- (Read only)	U8		-	
0x28BA:001	SDI: SDI: Monitoring normal operation	- (Read only)	U8		-	
0x28BA:002	SDI: SDI: Delay time	x ms (Read only)	U16	1	-	
0x28BA:003	SDI: SDI: Tolerance threshold	- (Read only)	I32	1	-	
0x28BA:004	SDI: SDI: Error reaction	- (Read only)	U8		-	
0x28BA:005	SDI: SDI: Maximal change of Position	- (Read only)	I32	1	X	
0x28BB:001	SDI monitored: Output: SDIpos monitored: Output	- (Read only)	U8		-	
0x28BB:002	SDI monitored: Output: SDIneg monitored: Output	- (Read only)	U8		-	
0x28C0:001	SLS: Source SD-In: SLS1: Source SD-In	- (Read only)	U8		-	
0x28C0:002	SLS: Source SD-In: SLS2: Source SD-In	- (Read only)	U8		-	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x28C0:003	SLS: Source SD-In: SLS3: Source SD-In	- (Read only)	U8		-	
0x28C0:004	SLS: Source SD-In: SLS4: Source SD-In	- (Read only)	U8		-	
0x28C1:001	SLS: Source S-Bus: SLS1: Source S-Bus	- (Read only)	U8		-	
0x28C1:002	SLS: Source S-Bus: SLS2: Source S-Bus	- (Read only)	U8		-	
0x28C1:003	SLS: Source S-Bus: SLS3: Source S-Bus	- (Read only)	U8		-	
0x28C1:004	SLS: Source S-Bus: SLS4: Source S-Bus	- (Read only)	U8		-	
0x28C2:001	SLS: Limited Speed Nlim: SLS1: Limited Speed Nlim1	x rpm (Read only)	U16	1	-	
0x28C2:002	SLS: Limited Speed Nlim: SLS2: Limited Speed Nlim2	x rpm (Read only)	U16	1	-	
0x28C2:003	SLS: Limited Speed Nlim: SLS3: Limited Speed Nlim3	x rpm (Read only)	U16	1	-	
0x28C2:004	SLS: Limited Speed Nlim: SLS4: Limited Speed Nlim4	x rpm (Read only)	U16	1	-	
0x28C3:001	SLS: Braking time Nlim: SLS1: Braking time Nlim1	x ms (Read only)	U16	1	-	
0x28C3:002	SLS: Braking time Nlim: SLS2: Braking time Nlim2	x ms (Read only)	U16	1	-	
0x28C3:003	SLS: Braking time Nlim: SLS3: Braking time Nlim3	x ms (Read only)	U16	1	-	
0x28C3:004	SLS: Braking time Nlim: SLS4: Braking time Nlim4	x ms (Read only)	U16	1	-	
0x28C4:001	SLS: Permitted direction: SLS1: Permitted direction	- (Read only)	U8		-	
0x28C4:002	SLS: Permitted direction: SLS2: Permitted direction	- (Read only)	U8		-	
0x28C4:003	SLS: Permitted direction: SLS3: Permitted direction	- (Read only)	U8		-	
0x28C4:004	SLS: Permitted direction: SLS4: Permitted direction	- (Read only)	U8		-	
0x28C5:001	SLS: Reaction (n>Nlim): SLS1: Reaction (n>Nlim1)	- (Read only)	U8		-	
0x28C5:002	SLS: Reaction (n>Nlim): SLS2: Reaction (n>Nlim2)	- (Read only)	U8		-	
0x28C5:003	SLS: Reaction (n>Nlim): SLS3: Reaction (n>Nlim3)	- (Read only)	U8		-	
0x28C5:004	SLS: Reaction (n>Nlim): SLS4: Reaction (n>Nlim4)	- (Read only)	U8		-	
0x28C6:001	SLS active: Output: SLS1 active: Output	- (Read only)	U8		-	
0x28C6:002	SLS active: Output: SLS2 active: Output	- (Read only)	U8		-	
0x28C6:003	SLS active: Output: SLS3 active: Output	- (Read only)	U8		-	
0x28C6:004	SLS active: Output: SLS4 active: Output	- (Read only)	U8		-	
0x28C7:001	SLS Monitored: Output: SLS1 Monitored: Output	- (Read only)	U8		-	
0x28C7:002	SLS Monitored: Output: SLS2 Monitored: Output	- (Read only)	U8		-	
0x28C7:003	SLS Monitored: Output: SLS3 Monitored: Output	- (Read only)	U8		-	
0x28C7:004	SLS Monitored: Output: SLS4 Monitored: Output	- (Read only)	U8		-	
0x28C8	SLI: Source SD-In	- (Read only)	U8		-	
0x28C9	SLI: Source S-Bus	- (Read only)	U8		-	
0x28CA:001	SLI: SLI: Increment size normal operation	- (Read only)	I32	1	-	
0x28CA:002	SLI: SLI: Error reaction normal operation	- (Read only)	U8		-	
0x28CA:003	SLI: SLI: Increment size exceptional operation	- (Read only)	I32	1	-	
0x28CA:004	SLI: SLI: Maximum change of Position	- (Read only)	I32	1	X	
0x28CB	SLI active: Output	- (Read only)	U8		-	
0x28D0:001	SLP: Source SD-In: SLP1: Source SD-In	- (Read only)	U8		-	
0x28D0:002	SLP: Source SD-In: SLP2: Source SD-In	- (Read only)	U8		-	
0x28D0:003	SLP: Source SD-In: SLP3: Source SD-In	- (Read only)	U8		-	
0x28D0:004	SLP: Source SD-In: SLP4: Source SD-In	- (Read only)	U8		-	
0x28D1:001	SLP: Source S-Bus: SLP1: Source S-Bus	- (Read only)	U8		-	
0x28D1:002	SLP: Source S-Bus: SLP2: Source S-Bus	- (Read only)	U8		-	
0x28D1:003	SLP: Source S-Bus: SLP3: Source S-Bus	- (Read only)	U8		-	
0x28D1:004	SLP: Source S-Bus: SLP4: Source S-Bus	- (Read only)	U8		-	
0x28D2:001	SLP: Lower Postion limit: SLP1: Lower Postion limit	- (Read only)	I32	1	-	
0x28D2:002	SLP: Lower Postion limit: SLP2: Lower Postion limit	- (Read only)	I32	1	-	
0x28D2:003	SLP: Lower Postion limit: SLP3: Lower Postion limit	- (Read only)	I32	1	-	
0x28D2:004	SLP: Lower Postion limit: SLP4: Lower Postion limit	- (Read only)	I32	1	-	
0x28D3:001	SLP: Upper Postion limit: SLP1: Upper Postion limit	- (Read only)	I32	1	-	
0x28D3:002	SLP: Upper Postion limit: SLP2: Upper Postion limit	- (Read only)	I32	1	-	
0x28D3:003	SLP: Upper Postion limit: SLP3: Upper Postion limit	- (Read only)	I32	1	-	
0x28D3:004	SLP: Upper Postion limit: SLP4: Upper Postion limit	- (Read only)	I32	1	-	
0x28D4:001	SLP: Error reaction: SLP1: Error reaction	- (Read only)	U8		-	
* Default setting depending on the size.						

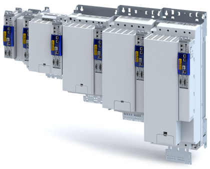
Address	Designation	Default setting	Data type	Factor	A	M
0x28D4:002	SLP: Error reaction: SLP2: Error reaction	- (Read only)	U8		-	
0x28D4:003	SLP: Error reaction: SLP3: Error reaction	- (Read only)	U8		-	
0x28D4:004	SLP: Error reaction: SLP4: Error reaction	- (Read only)	U8		-	
0x28D5:001	SLP monitored: Output: SLP1 monitored: Output	- (Read only)	U8		-	
0x28D5:002	SLP monitored: Output: SLP2 monitored: Output	- (Read only)	U8		-	
0x28D5:003	SLP monitored: Output: SLP3 monitored: Output	- (Read only)	U8		-	
0x28D5:004	SLP monitored: Output: SLP4 monitored: Output	- (Read only)	U8		-	
0x28D8:001	SCA: Lower Postion limit: SCA1: Lower Postion limit	- (Read only)	I32	1	-	
0x28D8:002	SCA: Lower Postion limit: SCA2: Lower Postion limit	- (Read only)	I32	1	-	
0x28D8:003	SCA: Lower Postion limit: SCA3: Lower Postion limit	- (Read only)	I32	1	-	
0x28D8:004	SCA: Lower Postion limit: SCA4: Lower Postion limit	- (Read only)	I32	1	-	
0x28D9:001	SCA: Upper Postion limit: SCA1: Upper Postion limit	- (Read only)	I32	1	-	
0x28D9:002	SCA: Upper Postion limit: SCA2: Upper Postion limit	- (Read only)	I32	1	-	
0x28D9:003	SCA: Upper Postion limit: SCA3: Upper Postion limit	- (Read only)	I32	1	-	
0x28D9:004	SCA: Upper Postion limit: SCA4: Upper Postion limit	- (Read only)	I32	1	-	
0x28DA:001	SCA inbetween limits: Output: SCA1 inbetween limits: Output	- (Read only)	U8		-	
0x28DA:002	SCA inbetween limits: Output: SCA2 inbetween limits: Output	- (Read only)	U8		-	
0x28DA:003	SCA inbetween limits: Output: SCA3 inbetween limits: Output	- (Read only)	U8		-	
0x28DA:004	SCA inbetween limits: Output: SCA4 inbetween limits: Output	- (Read only)	U8		-	
0x28DC	PDSS: Source SD-In	- (Read only)	U8		-	
0x28DD	PDSS: Source S bus	- (Read only)	U8		-	
0x28DE:001	PDSS parameters: PDSS: Permanent activation	- (Read only)	U8		-	
0x28DE:002	PDSS parameters: PDSS: Lower position limit	- (Read only)	I32	1	-	
0x28DE:003	PDSS parameters: PDSS: Upper position limit	- (Read only)	I32	1	-	
0x28DE:004	PDSS parameters: PDSS: Lower SCS limit	- (Read only)	I32	1	-	
0x28DE:005	PDSS parameters: PDSS: Upper SCS limit	- (Read only)	I32	1	-	
0x28DE:006	PDSS parameters: PDSS: SCS from lower limit	x rpm (Read only)	U16	1	-	
0x28DE:007	PDSS parameters: PDSS: SCS from upper limit	x rpm (Read only)	U16	1	-	
0x28DE:008	PDSS parameters: PDSS: Max. speed	x rpm (Read only)	U16	1	-	
0x28DE:009	PDSS parameters: PDSS: Max. delay - lower limit	- (Read only)	U16	1	-	
0x28DE:010	PDSS parameters: PDSS: Max. delay - upper limit	- (Read only)	U16	1	-	
0x28DE:011	PDSS parameters: PDSS: Error response	- (Read only)	U8		-	
0x28DE:012	PDSS parameters: PDSS: Currently monitored speed	x rpm (Read only)	U16	1	X	
0x28DE:013	PDSS parameters: PDSS: Min difference monitored speed	x rpm (Read only)	I16	1	X	
0x28DF	PDSS: PDSSpos monitored output	- (Read only)	U8		-	
0x28E0	PDSS: PDSSneg monitored output	- (Read only)	U8		-	
0x28E8:001	Diagnostic values configuration: Diagnostic value 1 configuration	**PDSS [1]**	U16		X	
0x28E8:002	Diagnostic values configuration: Diagnostic value 2 configuration	**SS1, SS2 [2]**	U16		X	
0x28E9:001	Diagnostic values: Diagnostic value 1	- (Read only)	I16	1	X	●
0x28E9:002	Diagnostic values: Diagnostic value 2	- (Read only)	I16	1	X	●
0x2900:001	Speed controller settings: Gain	**0.00033 Nm/rpm**	U32	100000	-	
0x2900:002	Speed controller settings: Reset time	**17.6 ms**	U16	10	-	
0x2900:003	Speed controller settings: Rate time	**0.00 ms**	U16	100	-	
0x2901	Speed controller gain adaption	**100.00 %**	U16	100	-	●
0x2902	I component load value	**0.0 %**	I16	10	-	●
0x2903	Speed setpoint filter time	**0.0 ms**	U16	10	-	
0x2904	Actual speed filter time	**0.3 ms**	U16	10	-	
0x2907:001	Additional speed limitation	**0 rpm**	U32	1	X	●
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2910:001	Inertia settings: Motor moment of inertia	**0.14 kg cm^2**	U32	100	-	
0x2910:002	Inertia settings: Load moment of inertia	**0.00 kg cm^2**	U32	100	-	
0x2910:003	Inertia settings: Coupling	**Stiff [0]**	U8		-	
0x2910:004	Inertia settings: Mechanical natural frequency	**0.0 Hz**	U16	10	-	
0x2910:005	Inertia settings: Load moment of inertia (elastic coupled)	**0.00 kg cm^2**	U32	100	-	
0x2939	Switching frequency	**4 kHz variable / drive-optimised [1]**	U8		-	
0x2941	Current controller feedforward control	**Disable [0]**	U8		-	
0x2942:001	Current controller parameters: Gain	**148.21 V/A**	U32	100	-	
0x2942:002	Current controller parameters: Reset time	**3.77 ms**	U32	100	-	
0x2943	Current setpoint filter time	**0.00 ms**	U16	100	-	
0x2944:001	Torque setpoint notch filter: Frequency notch filter 1	**200.0 Hz**	U16	10	-	
0x2944:002	Torque setpoint notch filter: Bandwidth notch filter 1	**20.0 Hz**	U16	10	-	
0x2944:003	Torque setpoint notch filter: Damping notch filter 1	**0 dB**	U8	1	-	
0x2944:004	Torque setpoint notch filter: Frequency notch filter 2	**400.0 Hz**	U16	10	-	
0x2944:005	Torque setpoint notch filter: Bandwidth notch filter 2	**40.0 Hz**	U16	10	-	
0x2944:006	Torque setpoint notch filter: Damping notch filter 2	**0 dB**	U8	1	-	
0x2945	Torque setpoint jerk limitation	**400.0 %**	U16	10	-	
0x2946:001	Speed limitation: Upper speed limit	**0 rpm**	I32	480000 /2^{31}	-	●
0x2946:002	Speed limitation: Lower speed limit	**0 rpm**	I32	480000 /2^{31}	-	●
0x2947:001	Inverter characteristic: Value y1	**0.00 V**	U16	100	-	
0x2947:002	Inverter characteristic: Value y2	**0.00 V**	U16	100	-	
0x2947:003	Inverter characteristic: Value y3	**0.00 V**	U16	100	-	
0x2947:004	Inverter characteristic: Value y4	**0.00 V**	U16	100	-	
0x2947:005	Inverter characteristic: Value y5	**0.00 V**	U16	100	-	
0x2947:006	Inverter characteristic: Value y6	**0.00 V**	U16	100	-	
0x2947:007	Inverter characteristic: Value y7	**0.00 V**	U16	100	-	
0x2947:008	Inverter characteristic: Value y8	**0.00 V**	U16	100	-	
0x2947:009	Inverter characteristic: Value y9	**0.00 V**	U16	100	-	
0x2947:010	Inverter characteristic: Value y10	**0.00 V**	U16	100	-	
0x2947:011	Inverter characteristic: Value y11	**0.00 V**	U16	100	-	
0x2947:012	Inverter characteristic: Value y12	**0.00 V**	U16	100	-	
0x2947:013	Inverter characteristic: Value y13	**0.00 V**	U16	100	-	
0x2947:014	Inverter characteristic: Value y14	**0.00 V**	U16	100	-	
0x2947:015	Inverter characteristic: Value y15	**0.00 V**	U16	100	-	
0x2947:016	Inverter characteristic: Value y16	**0.00 V**	U16	100	-	
0x2947:017	Inverter characteristic: Value y17	**0.00 V**	U16	100	-	
0x294A:001	Torque limits offset: Torque offset	**0.0 %**	I16	10	-	
0x294A:002	Torque limits offset: Resulting positive torque limit	x.x % (Read only)	I16	10	X	
0x294A:003	Torque limits offset: Resulting negative torque limit	x.x % (Read only)	I16	10	X	
0x2980	Position controller gain	**28.40 Hz**	U32	100	-	
0x2981	Position controller gain adaption	**100.00 %**	U16	100	-	●
0x2982	Position controller output signal limitation	**480000.00 rpm**	U32	480000 /2^{31}	-	●
0x2983	Actual position start value	**0 pos. unit**	I32	1	-	●
0x2984	Mode for setting the actual position	**Absolute [0]**	U8		-	
0x2986	Resulting gain adaption	x.xx % (Read only)	U32	100	X	
0x29C0:001	Field controller settings: Gain	**165.84 A/Vs**	U32	100	-	
0x29C0:002	Field controller settings: Reset time	**15.1 ms**	U16	10	-	
0x29E0:001	Field weakening controller settings: Gain (ASM)	**0.000 Vs/V**	U32	1000	-	

* Default setting depending on the size.

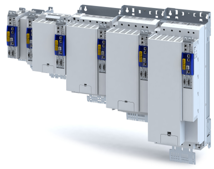


Address	Designation	Default setting	Data type	Factor	A	M
0x29E0:002	Field weakening controller settings: Reset time (ASM)	**2000.0 ms**	U32	10	-	
0x29E1	Field weakening controller Field limitation	**100.00 %**	U16	100	-	●
0x29E2	DC-bus filter time	**25.0 ms**	U16	10	-	
0x29E3	Motor voltage filter time	**25.0 ms**	U16	10	-	
0x29E4	Voltage reserve range	**5 %**	U8	1	-	
0x2B00	V/f characteristic shape	**Linear [0]**	U8		C	
0x2B01:001	V/f shape data: Base voltage	**225 V**	U16	1	-	
0x2B01:002	V/f shape data: Base frequency	**270 Hz**	U16	1	-	
0x2B02:001	Frequency grid points (x) user V/f characteristic: x1 = f01	**-50 Hz**	I16	1	-	
0x2B02:002	Frequency grid points (x) user V/f characteristic: x2 = f02	**-40 Hz**	I16	1	-	
0x2B02:003	Frequency grid points (x) user V/f characteristic: x3 = f03	**-30 Hz**	I16	1	-	
0x2B02:004	Frequency grid points (x) user V/f characteristic: x4 = f04	**-20 Hz**	I16	1	-	
0x2B02:005	Frequency grid points (x) user V/f characteristic: x5 = f05	**-10 Hz**	I16	1	-	
0x2B02:006	Frequency grid points (x) user V/f characteristic: x6 = f06	**0 Hz**	I16	1	-	
0x2B02:007	Frequency grid points (x) user V/f characteristic: x7 = f07	**10 Hz**	I16	1	-	
0x2B02:008	Frequency grid points (x) user V/f characteristic: x8 = f08	**20 Hz**	I16	1	-	
0x2B02:009	Frequency grid points (x) user V/f characteristic: x9 = f09	**30 Hz**	I16	1	-	
0x2B02:010	Frequency grid points (x) user V/f characteristic: x10 = f10	**40 Hz**	I16	1	-	
0x2B02:011	Frequency grid points (x) user V/f characteristic: x11 = f11	**50 Hz**	I16	1	-	
0x2B03:001	Voltage grid points (y) user V/f characteristic: y1 = U01 (x = f01)	**400.00 V**	U32	100	-	
0x2B03:002	Voltage grid points (y) user V/f characteristic: y2 = U02 (x = f02)	**320.00 V**	U32	100	-	
0x2B03:003	Voltage grid points (y) user V/f characteristic: y3 = U03 (x = f03)	**240.00 V**	U32	100	-	
0x2B03:004	Voltage grid points (y) user V/f characteristic: y4 = U04 (x = f04)	**160.00 V**	U32	100	-	
0x2B03:005	Voltage grid points (y) user V/f characteristic: y5 = U05 (x = f05)	**80.00 V**	U32	100	-	
0x2B03:006	Voltage grid points (y) user V/f characteristic: y6 = U06 (x = f06)	**0.00 V**	U32	100	-	
0x2B03:007	Voltage grid points (y) user V/f characteristic: y7 = U07 (x = f07)	**80.00 V**	U32	100	-	
0x2B03:008	Voltage grid points (y) user V/f characteristic: y8 = U08 (x = f08)	**160.00 V**	U32	100	-	
0x2B03:009	Voltage grid points (y) user V/f characteristic: y9 = U09 (x = f09)	**240.00 V**	U32	100	-	
0x2B03:010	Voltage grid points (y) user V/f characteristic: y10 = U10 (x = f10)	**320.00 V**	U32	100	-	
0x2B03:011	Voltage grid points (y) user V/f characteristic: y11 = U11 (x = f11)	**400.00 V**	U32	100	-	
0x2B04	V/f boost controller - current setpoint	**0.00 A**	U32	100	-	
0x2B05:001	V/f boost controller settings: Gain	**148.21 V/A**	U32	100	-	
0x2B05:002	V/f boost controller settings: Reset time	**3.77 ms**	U32	100	-	
0x2B06	Voltage boost	**0.0 V**	U16	10	-	
0x2B07:001	Load adaption: Direction of rotation	**Passive load [0]**	U8		C	
* Default setting depending on the size.						

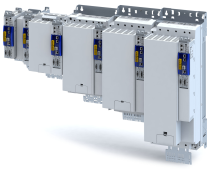


Address	Designation	Default setting	Data type	Factor	A	M
0x2B07:002	Load adaption: Load adaption value	**20.00 %**	U32	100	-	
0x2B08:001	V/f Imax controller: Gain	**0.001 Hz/A**	U32	1000	-	
0x2B08:002	V/f Imax controller: Reset time	**100.0 ms**	U32	10	-	
0x2B09:001	Slip compensation: Gain	**0.00 %**	I16	100	-	
0x2B09:002	Slip compensation: Filter time	**2000 ms**	U16	1	-	
0x2B0A:001	Oscillation damping: Gain	**20 %**	I16	1	-	
0x2B0A:002	Oscillation damping: Filter time	**5 ms**	U16	1	-	
0x2B0A:003	Oscillation damping: Limitation	**0.2 Hz**	U16	10	-	
0x2B0A:004	Oscillation damping: Final ramp frequency	**0 %**	U8	1	-	
0x2B0B	Frequency setpoint	x.x Hz (Read only)	I16	10	X	●
0x2B0C	Override field weakening	**0.0 Hz**	I16	10	-	
0x2B80	Current for DC-injection braking	**0.00 A**	U16	100	-	
0x2BA0	Activate flying restart	**Off [0]**	U8		-	
0x2BA1	Flying restart circuit	**15 %**	U16	1	-	
0x2BA2	Start frequency	**20.0 Hz**	I16	10	-	
0x2BA3	Integration time	**600 ms**	U16	1	-	
0x2BA4	Minimum deviation	**5.00 °**	U16	100	-	
0x2BA5	Delay time	**0 ms**	U16	1	-	
0x2BA6:001	Result: Determined speed [rpm]	x rpm (Read only)	I16	1	X	●
0x2BA6:002	Result: Determined speed [n unit]	rpm (Read only)	I32	480000 /2^{31}	X	●
0x2C00	Motor control mode	**Servoregelung (SC-PSM) [1]**	U8		C	
0x2C01:001	Motor parameters: Number of pole pairs	- (Read only)	U8	1	X	
0x2C01:002	Motor parameters: Stator resistance	**13.5000 Ω**	U32	10000	-	
0x2C01:003	Motor parameters: Stator leakage inductance	**51.000 mH**	U32	1000	-	
0x2C01:004	Motor parameters: Rated speed	**4050 rpm**	U16	1	-	
0x2C01:005	Motor parameters: Rated frequency	**270.0 Hz**	U16	10	-	
0x2C01:006	Motor parameters: Rated power	**0.25 kW**	U16	100	-	
0x2C01:007	Motor parameters: Rated voltage	**225 V**	U16	1	-	
0x2C01:008	Motor parameters: Cosine phi	**0.80**	U16	100	-	
0x2C01:009	Motor parameters: Insulation class	**F (cut-off temperature = 155 °C) [4]**	U8		-	
0x2C01:010	Motor parameters: Motor name	"**MCS06C41**"	STRING[50]		-	
0x2C02:001	Motor parameter (ASM): Rotor resistance	**0.0000 Ω**	U32	10000	-	
0x2C02:002	Motor parameter (ASM): Mutual inductance	**0.0 mH**	U32	10	-	
0x2C02:003	Motor parameter (ASM): Magnetising current	**0.00 A**	U16	100	-	
0x2C03:001	Motor parameter (PSM): Back EMF constant	**41.8 V/1000rpm**	U32	10	-	
0x2C03:002	Motor parameter (PSM): Resolver pole position	**-90.0 °**	I16	10	-	
0x2C03:003	Motor parameter (PSM): Magnets temperature coefficient (kTN)	**-0.110 %/°C**	I16	1000	-	
0x2C03:004	Motor parameter (PSM): Encoder pole position	**0.0 °**	I16	10	-	
0x2C04:001	Inductance grid points (y) Lss saturation characteristic: y1 = L01 (x = 0.00 %)	**165 %**	U16	1	-	
0x2C04:002	Inductance grid points (y) Lss saturation characteristic: y2 = L02 (x = 6.25 %)	**200 %**	U16	1	-	
0x2C04:003	Inductance grid points (y) Lss saturation characteristic: y3 = L03 (x = 12.50 %)	**146 %**	U16	1	-	
0x2C04:004	Inductance grid points (y) Lss saturation characteristic: y4 = L04 (x = 18.75 %)	**117 %**	U16	1	-	
0x2C04:005	Inductance grid points (y) Lss saturation characteristic: y5 = L05 (x = 25.00 %)	**97 %**	U16	1	-	
0x2C04:006	Inductance grid points (y) Lss saturation characteristic: y6 = L06 (x = 31.25 %)	**82 %**	U16	1	-	
0x2C04:007	Inductance grid points (y) Lss saturation characteristic: y7 = L07 (x = 37.50 %)	**71 %**	U16	1	-	

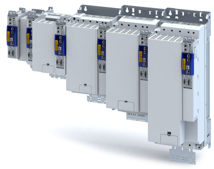
* Default setting depending on the size.



Address	Designation	Default setting	Data type	Factor	A	M
0x2C04:008	Inductance grid points (y) Lss saturation characteristic: y8 = L08 (x = 42.75 %)	**62 %**	U16	1	-	
0x2C04:009	Inductance grid points (y) Lss saturation characteristic: y9 = L09 (x = 50.00 %)	**55 %**	U16	1	-	
0x2C04:010	Inductance grid points (y) Lss saturation characteristic: y10 = L10 (x = 56.25 %)	**50 %**	U16	1	-	
0x2C04:011	Inductance grid points (y) Lss saturation characteristic: y11 = L11 (x = 62.50 %)	**46 %**	U16	1	-	
0x2C04:012	Inductance grid points (y) Lss saturation characteristic: y12 = L12 (x = 68.75 %)	**43 %**	U16	1	-	
0x2C04:013	Inductance grid points (y) Lss saturation characteristic: y13 = L13 (x = 75.00 %)	**42 %**	U16	1	-	
0x2C04:014	Inductance grid points (y) Lss saturation characteristic: y14 = L14 (x = 81.25 %)	**41 %**	U16	1	-	
0x2C04:015	Inductance grid points (y) Lss saturation characteristic: y15 = L15 (x = 87.50 %)	**41 %**	U16	1	-	
0x2C04:016	Inductance grid points (y) Lss saturation characteristic: y16 = L16 (x = 93.25 %)	**41 %**	U16	1	-	
0x2C04:017	Inductance grid points (y) Lss saturation characteristic: y17 = L17 (x = 100.00 %)	**41 %**	U16	1	-	
0x2C04:018	Inductance grid points (y) Lss saturation characteristic: Activation Lss saturation characteristic	**Adjustment on [1]**	U16		-	
0x2C05	Reference for current grid points (x) Lss saturation characteristic	**5.4 A**	U16	10	-	
0x2C06:001	Grid points for magnet characteristic (current): x1 = i01/iN	**0 %**	U16	1	-	
0x2C06:002	Grid points for magnet characteristic (current): y1 = kT01/kTN	**100 %**	U16	1	-	
0x2C06:003	Grid points for magnet characteristic (current): x2 = i02/iN	**100 %**	U16	1	-	
0x2C06:004	Grid points for magnet characteristic (current): y2 = kT02/kTN	**100 %**	U16	1	-	
0x2C06:005	Grid points for magnet characteristic (current): x3 = i03/iN	**200 %**	U16	1	-	
0x2C06:006	Grid points for magnet characteristic (current): y3 = kT03/kTN	**100 %**	U16	1	-	
0x2C06:007	Grid points for magnet characteristic (current): x4 = i04/iN	**415 %**	U16	1	-	
0x2C06:008	Grid points for magnet characteristic (current): y4 = kT04/kTN	**72 %**	U16	1	-	
0x2C07:001	Inductance grid points (y) Lh saturation characteristic: y1 = L01 (x = 0.00 %)	**118 %**	U16	1	-	
0x2C07:002	Inductance grid points (y) Lh saturation characteristic: y2 = L02 (x = 6.25 %)	**118 %**	U16	1	-	
0x2C07:003	Inductance grid points (y) Lh saturation characteristic: y3 = L03 (x = 12.50 %)	**118 %**	U16	1	-	
0x2C07:004	Inductance grid points (y) Lh saturation characteristic: y4 = L04 (x = 18.75 %)	**117 %**	U16	1	-	
0x2C07:005	Inductance grid points (y) Lh saturation characteristic: y5 = L05 (x = 25.00 %)	**116 %**	U16	1	-	
0x2C07:006	Inductance grid points (y) Lh saturation characteristic: y6 = L06 (x = 31.25 %)	**114 %**	U16	1	-	
0x2C07:007	Inductance grid points (y) Lh saturation characteristic: y7 = L07 (x = 37.50 %)	**111 %**	U16	1	-	
0x2C07:008	Inductance grid points (y) Lh saturation characteristic: y8 = L08 (x = 43.75 %)	**107 %**	U16	1	-	
0x2C07:009	Inductance grid points (y) Lh saturation characteristic: y9 = L09 (x = 50.00 %)	**100 %**	U16	1	-	
* Default setting depending on the size.						

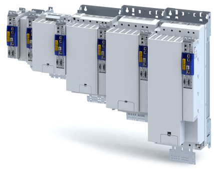


Address	Designation	Default setting	Data type	Factor	A	M
0x2C07:010	Inductance grid points (y) Lh saturation characteristic: y10 = L10 (x = 56.25 %)	**93 %**	U16	1	-	
0x2C07:011	Inductance grid points (y) Lh saturation characteristic: y11 = L11 (x = 62.50 %)	**86 %**	U16	1	-	
0x2C07:012	Inductance grid points (y) Lh saturation characteristic: y12 = L12 (x = 68.75 %)	**78 %**	U16	1	-	
0x2C07:013	Inductance grid points (y) Lh saturation characteristic: y13 = L13 (x = 75.00 %)	**71 %**	U16	1	-	
0x2C07:014	Inductance grid points (y) Lh saturation characteristic: y14 = L14 (x = 81.25 %)	**64 %**	U16	1	-	
0x2C07:015	Inductance grid points (y) Lh saturation characteristic: y15 = L15 (x = 87.50 %)	**57 %**	U16	1	-	
0x2C07:016	Inductance grid points (y) Lh saturation characteristic: y16 = L16 (x = 93.75 %)	**50 %**	U16	1	-	
0x2C07:017	Inductance grid points (y) Lh saturation characteristic: y17 = L17 (x = 100.00 %)	**42 %**	U16	1	-	
0x2C08	Method for setting motor parameters	**Select from catalogue (Lenze motors) [1]**	U8		-	
0x2C40	Motor encoder type	**SinCos encoder [1]**	U8		C	
0x2C41:001	Motor encoder settings (Hiperface): Type code detected	- (Read only)	U8	1	X	
0x2C41:002	Motor encoder settings (Hiperface): Type code manual input	**0**	U8	1	C	
0x2C41:003	Motor encoder settings (Hiperface): No. of periods manual input	**1**	U16	1	C	
0x2C41:004	Motor encoder settings (Hiperface): Error response	**Fault > CiA402 [1]**	U8		-	
0x2C41:005	Motor encoder settings (Hiperface): Serial number	- (Read only)	STRING[50]		X	
0x2C41:006	Motor encoder settings (Hiperface): Actual position (raw data)	- (Read only)	U32	1	X	●
0x2C41:007	Motor encoder settings (Hiperface): No. of periods detected	- (Read only)	U16	1	X	●
0x2C41:008	Motor encoder settings (Hiperface): Type code verification	- (Read only)	U8		X	●
0x2C41:009	Motor encoder settings (Hiperface): Encoder type	- (Read only)	U8		X	●
0x2C41:010	Motor encoder settings (Hiperface): No. of periods linear encoder	x nm (Read only)	U32	1	X	●
0x2C42:001	Encoder settings: Increments/revolution	**1024**	U32	1	C	
0x2C42:002	Encoder settings: Supply voltage	**5.0 V**	U8	10	C	
0x2C42:003	Encoder settings: Angle drift	x.x ° (Read only)	I16	10	X	●
0x2C42:004	Encoder settings: Actual amplitude signal quality	x % (Read only)	U8	1	X	
0x2C43	Motor encoder resolver number of pole pairs	**1**	U8	1	C	
0x2C44:001	Motor encoder identification (Resolver): Angle	**0**	I16	1	-	
0x2C44:002	Motor encoder identification (Resolver): Cosine track gain	**100 %**	U16	1	-	
0x2C44:003	Motor encoder identification (Resolver): Sine track gain	**100 %**	U16	1	-	
0x2C44:006	Motor encoder identification (Resolver): Identification status	- (Read only)	U16		HX	
0x2C45	Encoder-error response	**Fault > CiA402 [1]**	U8		-	
0x2C46	Number of the absolute ascertainable revolutions of motor encoder	- (Read only)	U16	1	X	
0x2C47	Open circuit detection sensitivity of motor encoder	**100 %**	U8	1	-	
0x2C4A:001	Protokoll-Parameter Motorgeber (SSI): Übertragungsrate	**300 kbps**	U16	1	C	
0x2C4A:002	Protokoll-Parameter Motorgeber (SSI): Telegrammlänge	**25**	U8	1	C	
0x2C4A:003	Protokoll-Parameter Motorgeber (SSI): Bits/Umdrehung	**13**	U8	1	C	
* Default setting depending on the size.						



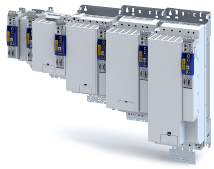
Address	Designation	Default setting	Data type	Factor	A	M
0x2C4A:004	Protokoll-Parameter Motorgeber (SSI): Startbit Positionsdaten	**0**	U8	1	C	
0x2C4A:005	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 1	**0**	U8	1	C	
0x2C4A:006	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 2	**0**	U8	1	C	
0x2C4A:007	Protokoll-Parameter Motorgeber (SSI): Startbit Datenpaket 3	**0**	U8	1	C	
0x2C4A:008	Protokoll-Parameter Motorgeber (SSI): Länge Positionsdaten	**0**	U8	1	C	
0x2C4A:009	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 1	**0**	U8	1	C	
0x2C4A:010	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 2	**0**	U8	1	C	
0x2C4A:011	Protokoll-Parameter Motorgeber (SSI): Länge Datenpaket 3	**0**	U8	1	C	
0x2C4A:012	Protokoll-Parameter Motorgeber (SSI): Codierung Positionsdaten	**Binär [0]**	U8		C	
0x2C4A:013	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 1	**Binär [0]**	U8		C	
0x2C4A:014	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 2	**Binär [0]**	U8		C	
0x2C4A:015	Protokoll-Parameter Motorgeber (SSI): Codierung Datenpaket 3	**Binär [0]**	U8		C	
0x2C4A:016	Protokoll-Parameter Motorgeber (SSI): Rohdaten Position	- (Read only)	U32	1	X	●
0x2C4A:017	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 1	- (Read only)	U32	1	X	●
0x2C4A:018	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 2	- (Read only)	U32	1	X	●
0x2C4A:019	Protokoll-Parameter Motorgeber (SSI): Rohdaten Datenpaket 3	- (Read only)	U32	1	X	●
0x2C4F	Parameter CRC of motor encoder	- (Read only)	U32	1	X	
0x2C50	Load encoder/master encoder type	**SinCos encoder [1]**	U8		C	
0x2C51:001	Hiperface load encoder/master encoder settings: Type code detected	- (Read only)	U8	1	X	
0x2C51:002	Hiperface load encoder/master encoder settings: Type code manual input	**0**	U8	1	C	
0x2C51:003	Hiperface load encoder/master encoder settings: No. of periods manual input	**1**	U16	1	C	
0x2C51:004	Hiperface load encoder/master encoder settings: Error response	**Fault > CiA402 [1]**	U8		-	
0x2C51:005	Hiperface load encoder/master encoder settings: Serial number	- (Read only)	STRING[50]		X	
0x2C51:006	Hiperface load encoder/master encoder settings: Actual position (raw data)	- (Read only)	U32	1	X	●
0x2C51:007	Hiperface load encoder/master encoder settings: No. of periods detected	- (Read only)	U16	1	X	●
0x2C51:008	Hiperface load encoder/master encoder settings: Type code verification	- (Read only)	U8		X	●
0x2C51:009	Hiperface load encoder/master encoder settings: Encoder type	- (Read only)	U8		X	●
0x2C51:010	Hiperface load encoder/master encoder settings: No. of periods linear encoder	x nm (Read only)	U32	1	X	●
0x2C52:001	Load encoder/master encoder settings (encoder): Increments/revolution	**1024**	U32	1	C	
0x2C52:002	Load encoder/master encoder settings (encoder): Supply voltage	**5.0 V**	U8	10	C	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2C52:003	Load encoder/master encoder settings (encoder): Angle drift	x.x ° (Read only)	I16	10	X	●
0x2C52:004	Load encoder/master encoder settings (encoder): Actual amplitude signal quality	x % (Read only)	U8	1	X	
0x2C53	Load encoder/master encoder resolver number of pole pairs	**1**	U8	1	C	
0x2C54:001	Load encoder/master encoder identification (Resolver): Angle	**0**	I16	1	-	
0x2C54:002	Load encoder/master encoder identification (Resolver): Cosine track gain	**100 %**	U16	1	-	
0x2C54:003	Load encoder/master encoder identification (Resolver): Sine track gain	**100 %**	U16	1	-	
0x2C54:006	Load encoder/master encoder identification (Resolver): Identification status	- (Read only)	U16		HX	
0x2C55	Load encoder/master encoder error response	**Fault > CiA402 [1]**	U8		-	
0x2C56	Number of the absolute ascertainable revolutions of load encoder/master encoder	- (Read only)	U16	1	X	
0x2C57	Open circuit detection sensitivity of load encoder/ master encoder	**100 %**	U8	1	-	
0x2C5A:001	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Übertragungsrate	**300 kbps**	U16	1	C	
0x2C5A:002	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Telegrammlänge	**25**	U8	1	C	
0x2C5A:003	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Bits/ Umdrehung	**13**	U8	1	C	
0x2C5A:004	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Positionsdaten	**0**	U8	1	C	
0x2C5A:005	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 1	**0**	U8	1	C	
0x2C5A:006	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 2	**0**	U8	1	C	
0x2C5A:007	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Startbit Datenpaket 3	**0**	U8	1	C	
0x2C5A:008	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Positionsdaten	**25**	U8	1	C	
0x2C5A:009	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 1	**0**	U8	1	C	
0x2C5A:010	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 2	**0**	U8	1	C	
0x2C5A:011	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Länge Datenpaket 3	**0**	U8	1	C	
0x2C5A:012	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Positionsdaten	**Binär [0]**	U8		C	
0x2C5A:013	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 1	**Binär [0]**	U8		C	
0x2C5A:014	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 2	**Binär [0]**	U8		C	
0x2C5A:015	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Codierung Datenpaket 3	**Binär [0]**	U8		C	
0x2C5A:016	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Position	- (Read only)	U32	1	X	●
0x2C5A:017	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 1	- (Read only)	U32	1	X	●
0x2C5A:018	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 2	- (Read only)	U32	1	X	●
0x2C5A:019	Protokoll-Parameter Lastgeber/Leitgeber (SSI): Rohdaten Datenpaket 3	- (Read only)	U32	1	X	●
0x2C5F	Parameter CRC of load encoder/master encoder	- (Read only)	U32	1	X	
0x2C60	PPI monitoring: Reaction	**Fault > CiA402 [1]**	U8		-	
* Default setting depending on the size.						



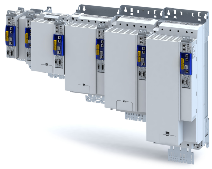
Address	Designation	Default setting	Data type	Factor	A	M
0x2C61:001	Pole position identification (360°) settings: Current amplitude	**100 %**	U16	1	C	
0x2C61:002	Pole position identification (360°) settings: Ramp time	**40 s**	U16	1	C	
0x2C61:003	Pole position identification (360°) settings: Direction of rotation	**CW [0]**	U8		C	
0x2C61:004	Pole position identification (360°) settings: Error tolerance	**20 °**	U8	1	-	
0x2C61:005	Pole position identification (360°) settings: Absolute current amplitude	x.xx A (Read only)	U32	100	X	
0x2C62:001	Pole position identification (min. movement) settings: Current amplitude	**25 %**	U16	1	C	
0x2C62:002	Pole position identification (min. movement) settings: Ramp time	**10 s**	U16	1	C	
0x2C62:003	Pole position identification (min. movement) settings: Gain	**0 %**	U16	1	-	
0x2C62:004	Pole position identification (min. movement) settings: Reset time	**62.5 ms**	U16	10	-	
0x2C62:005	Pole position identification (min. movement) settings: Max. move permitted	**20 °**	U8	1	-	
0x2C62:006	Pole position identification (min. movement) settings: Absolute current amplitude	x.xx A (Read only)	U32	100	X	
0x2C63:001	PPI without movement: Execution	**Deactivated [0]**	U8		C	
0x2D00:001	Touch probe (TP) delay time: Touch probe 1 delay time	**0.000 ms**	U16	1000	-	
0x2D00:002	Touch probe (TP) delay time: Touch probe 2 delay time	**0.000 ms**	U16	1000	-	
0x2D00:003	Touch probe (TP) delay time: Touch probe 3 delay time	**0.000 ms**	U16	1000	-	
0x2D00:004	Touch probe (TP) delay time: Touch probe 4 delay time	**0.000 ms**	U16	1000	-	
0x2D01:001	Touch probe (TP) time stamp: Touch probe 1-rising edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:002	Touch probe (TP) time stamp: Touch probe 1-falling edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:003	Touch probe (TP) time stamp: Touch probe 2-rising edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:004	Touch probe (TP) time stamp: Touch probe 2-falling edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:005	Touch probe (TP) time stamp: Touch probe 3-rising edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:006	Touch probe (TP) time stamp: Touch probe 3-falling edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:007	Touch probe (TP) time stamp: Touch probe 4-rising edge time stamp	x ns (Read only)	U32	1	X	•
0x2D01:008	Touch probe (TP) time stamp: Touch probe 4-falling edge time stamp	x ns (Read only)	U32	1	X	•
0x2D02:001	Touch probe diagnostics: Touch probe 3/4 function	**0x0000**	U16		H	•
0x2D02:002	Touch probe diagnostics: Touch-Probe 3/4 status	- (Read only)	U16		HX	•
0x2D03:001	Touch probe position: Touch probe 3 position rising edge	x pos. unit (Read only)	I32	1	X	•
0x2D03:002	Touch probe position: Touch probe 3 position falling edge	x pos. unit (Read only)	I32	1	X	•
0x2D03:003	Touch probe position: Touch probe 4 position rising edge	x pos. unit (Read only)	I32	1	X	•
0x2D03:004	Touch probe position: Touch probe 4 position falling edge	x pos. unit (Read only)	I32	1	X	•
0x2D40:001	Device utilisation ixt: Power unit actual utilisation	x % (Read only)	U16	1	X	•
0x2D40:002	Device utilisation ixt: Power unit warning threshold	**95 %**	U16	1	-	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2D40:003	Device utilisation ixt: Power unit error threshold	x % (Read only)	U16	1	X	
0x2D40:004	Device utilisation ixt: Device actual utilisation	x % (Read only)	U16	1	X	●
0x2D40:005	Device utilisation ixt: Device warning threshold	**95 %**	U16	1	-	
0x2D40:006	Device utilisation ixt: Device error threshold	x % (Read only)	U16	1	X	
0x2D40:007	Device utilisation ixt: Actual total utilisation	x % (Read only)	U16	1	X	●
0x2D40:008	Device utilisation ixt: Total utilisation warning threshold	**95 %**	U16	1	-	
0x2D40:009	Device utilisation ixt: Total utilisation error threshold	x % (Read only)	U16	1	X	
0x2D44:001	Overspeed monitoring: Threshold	**8000 rpm**	U16	1	-	
0x2D44:002	Overspeed monitoring: Response	**Fault > CiA402 [1]**	U8		-	
0x2D45:001	Motor phase failure detection: Response - Motor phase 1	**No response [0]**	U8		-	
0x2D45:002	Motor phase failure detection: Current threshold	**5.0 %**	U8	10	-	
0x2D45:003	Motor phase failure detection: Voltage threshold	**10.0 V**	U16	10	-	
0x2D45:004	Motor phase failure detection: Response - Motor phase 2	**No response [0]**	U8		-	
0x2D46:001	Overcurrent monitoring: Threshold	**5.4 A**	U16	10	-	
0x2D46:002	Overcurrent monitoring: Response	**Fault > CiA402 [1]**	U8		-	
0x2D48:002	PTC temperature sensor monitoring: Error response	**Fault > CiA402 [1]**	U8		-	
0x2D49:001	Motor temperature monitoring: Temperature sensor type	**PT1000 [5]**	U8		-	
0x2D49:002	Motor temperature monitoring: Response	**Fault > CiA402 [1]**	U8		-	
0x2D49:003	Motor temperature monitoring: Warning threshold	**145.0 °C**	I16	10	-	
0x2D49:004	Motor temperature monitoring: Error threshold	**155.0 °C**	I16	10	-	
0x2D49:005	Motor temperature monitoring: Actual motor temperature	x.x °C (Read only)	I16	10	X	●
0x2D49:006	Motor temperature monitoring: Spec. characteristic temperature grid point 1	**25.0 °C**	I16	10	-	
0x2D49:007	Motor temperature monitoring: Spec. characteristic temperature grid point 2	**150.0 °C**	I16	10	-	
0x2D49:008	Motor temperature monitoring: Spec. characteristic resistance grid point 1	**1000 Ω**	I16	1	-	
0x2D49:009	Motor temperature monitoring: Spec. characteristic resistance grid point 2	**2225 Ω**	I16	1	-	
0x2D49:010	Motor temperature monitoring: Temperature sensor feedback type	**KTY83-110 [0]**	U8		-	
0x2D49:011	Motor temperature monitoring: Motor temperature (Motor encoder)	x.x °C (Read only)	I16	10	X	●
0x2D49:012	Motor temperature monitoring: Motor temperature (load encoder)	x.x °C (Read only)	I16	10	X	●
0x2D4C:001	Thermisches Modell Motorauslastung (i^2xt): Motor utilisation (i^2xt)	**60 s**	U16	1	-	
0x2D4C:002	Thermisches Modell Motorauslastung (i^2xt): Thermal time constant - laminations	**852 s**	U16	1	-	
0x2D4C:003	Thermisches Modell Motorauslastung (i^2xt): Winding influence	**27 %**	U8	1	-	
0x2D4C:004	Thermisches Modell Motorauslastung (i^2xt): Starting value	**0 %**	U16	1	-	
0x2D4D:001	Motor utilisation (i^2xt) - specific characteristic: x1 = n01/nN (n01 ~ 0)	**0 %**	U16	1	-	
0x2D4D:002	Motor utilisation (i^2xt) - specific characteristic: y1 = i01/iN (x1)	**100 %**	U16	1	-	
0x2D4D:003	Motor utilisation (i^2xt) - specific characteristic: x2 = n02/nN (n02 = limit reduced cooling)	**0 %**	U16	1	-	
0x2D4D:004	Motor utilisation (i^2xt) - specific characteristic: y2 = i02/iN (x2)	**100 %**	U16	1	-	
0x2D4D:005	Motor utilisation (i^2xt) - specific characteristic: x3 = n03/nN (n03 = rated speed)	**100 %**	U16	1	-	
* Default setting depending on the size.						



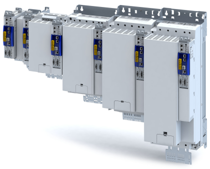
Address	Designation	Default setting	Data type	Factor	A	M
0x2D4D:006	Motor utilisation (i²xt) - specific characteristic: y3 = i03/iN (x3)	**100 %**	U16	1	-	
0x2D4D:007	Motor utilisation (i²xt) - specific characteristic: x4 = n04/nN (n04 = limit field weakening)	**100 %**	U16	1	-	
0x2D4D:008	Motor utilisation (i²xt) - specific characteristic: y4 = i04/iN (x4)	**100 %**	U16	1	-	
0x2D4E	Motor utilisation (i²xt) - warning threshold	**100 %**	U16	1	-	
0x2D4F	Motor utilisation (i²*t)	x % (Read only)	U16	1	X	●
0x2D50:001	Motor utilisation (i²xt) - monitoring: Error response	**Fehler > CiA402 [1]**	U8		-	
0x2D50:002	Motor utilisation (i²xt) - monitoring: Error threshold	**105 %**	U16	1	-	
0x2D51:001	Position error/speed error - monitoring: Speed error - error threshold	**50 rpm**	U32	1	-	
0x2D51:002	Position error/speed error - monitoring: Speed error - min. time for error	**0 ms**	U16	1	-	
0x2D51:003	Position error/speed error - monitoring: Speed error - error response	**No response [0]**	U8		-	
0x2D51:004	Position error/speed error - monitoring: Position error - error threshold	**360 °**	U32	1	-	
0x2D51:005	Position error/speed error - monitoring: Position error - min. time for error	**0 ms**	U16	1	-	
0x2D51:006	Position error/speed error - monitoring: Position error - error response	**No response [0]**	U8		-	
0x2D66:001	Mains failure control: Enable function	**Disabled [0]**	U8		-	
0x2D66:002	Mains failure control: DC-bus activation level	**75 %**	U8	1	-	
0x2D66:011	Mains failure control: Filter time	**0.00 s**	U16	100	-	
0x2D66:012	Mains failure control: Ramp max. torque	**30.0 %**	U16	10	-	
0x2D66:013	Mains failure control: Ramp time	**1.00 s**	U16	100	-	
0x2D66:014	Mains failure control: Actual DC-bus voltage	x.xxx V (Read only)	U32	1000	X	
0x2D81:001	Life-diagnosis: Operating time	x s (Read only)	U32	1	X	
0x2D81:002	Life-diagnosis: Power-on time	x s (Read only)	U32	1	X	
0x2D81:004	Life-diagnosis: Main switching cycles	- (Read only)	U32	1	X	
0x2D81:006	Life-diagnosis: Short-circuit counter	- (Read only)	U32	1	X	
0x2D81:007	Life-diagnosis: Earth fault counter	- (Read only)	U32	1	X	
0x2D81:009	Life-diagnosis: Fan operating time	x s (Read only)	U32	1	X	
0x2D82	Motor actual voltage (Veff)	x.x V (Read only)	U32	10	X	●
0x2D83:001	Motor-Phasenströme: Zero system current	x.xx A (Read only)	I32	100	X	●
0x2D83:002	Motor-Phasenströme: Phase U current	x.xx A (Read only)	I32	100	X	●
0x2D83:003	Motor-Phasenströme: Phase V current	x.xx A (Read only)	I32	100	X	●
0x2D83:004	Motor-Phasenströme: Phase W current	x.xx A (Read only)	I32	100	X	●
0x2D84:001, 004, 006	Heatsink temperature: Heatsink temperature	x.x °C (Read only)	I16	10	X	
0x2D84:002	Heatsink temperature: Warning threshold	**90.0 °C**	I16	10	-	
0x2D8A	Actual speed error	x rpm (Read only)	I32	1	X	●
0x2DA2:001	Output power: Effective power	x.xxx kW (Read only)	I32	1000	X	●
0x2DA3:003	Output energy: Warning	**0.00 kWh**	I32	100	X	
0x2DA4:001	Diagnostics of analog input 1: Value in percent	x.x % (Read only)	I16	10	X	
0x2DA4:005	Diagnostics of analog input 1: Scaled percent value	x.xx % (Read only)	I16	100	X	●
0x2DA4:016	Diagnostics of analog input 1: Status	- (Read only)	U16		HX	●
0x2DD0:001	Field values: Actual value	x % (Read only)	U16	1	X	●
0x2DD0:002	Field values: Setpoint value	x % (Read only)	U16	1	X	●
0x2DD1:001	Motor currents: Actual D-current (id)	x.xx A (Read only)	I32	100	X	●
0x2DD1:002	Motor currents: Actual Q-current (iq)	x.xx A (Read only)	I32	100	X	●
0x2DD1:003	Motor currents: Setpoint D-current (id)	x.xx A (Read only)	I32	100	X	●
0x2DD1:004	Motor currents: Setpoint Q-current (iq)	x.xx A (Read only)	I32	100	X	●
0x2DD1:005	Motor currents: Motor current (Ieff)	x.xx A (Read only)	I32	100	X	●
0x2DD2	Target position interpolated	x pos. unit (Read only)	I32	1	X	●
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x2DD3:001	Speed setpoints: Speed setpoint	x rpm (Read only)	I32	1	X	●
0x2DD3:002	Speed setpoints: Speed setpoint 2	x rpm (Read only)	I32	1	X	●
0x2DD3:003	Speed setpoints: Speed setpoint limited	x rpm (Read only)	I32	1	X	●
0x2DD4:001	Speed controller output signals: Output signal 1	x.x % (Read only)	I16	10	X	●
0x2DD4:002	Speed controller output signals: Output signal 2	x.x % (Read only)	I16	10	X	●
0x2DD5	Torque setpoint	x.xx Nm (Read only)	I32	100	X	●
0x2DD6:001	Torque filter cascade: Starting value	x.x % (Read only)	I16	10	X	●
0x2DD6:002	Torque filter cascade: Notch filter 1 input value	x.x % (Read only)	I16	10	X	●
0x2DD6:003	Torque filter cascade: Notch filter 2 input value	x.x % (Read only)	I16	10	X	●
0x2DD6:004	Torque filter cascade: Torque setpoint filtered	x.x % (Read only)	I16	10	X	●
0x2DD7:001	Voltage values: Actual voltage (motor voltage limit)	x.x V (Read only)	I16	10	X	●
0x2DD7:002	Voltage values: Output signal D current controller	x.x V (Read only)	I16	10	X	●
0x2DD7:003	Voltage values: Output signal Q current controller	x.x V (Read only)	I16	10	X	●
0x2DD7:004	Voltage values: D voltage (magnetisation)	x.x V (Read only)	I16	10	X	●
0x2DD7:005	Voltage values: Q voltage (torque)	x.x V (Read only)	I16	10	X	●
0x2DD7:006	Voltage values: Phases U-V	x.x V (Read only)	I16	10	X	●
0x2DD7:007	Voltage values: Phases V-W	x.x V (Read only)	I16	10	X	●
0x2DD7:008	Voltage values: Phases W-U	x.x V (Read only)	I16	10	X	●
0x2DD7:009	Voltage values: Phase U	x.x V (Read only)	I16	10	X	●
0x2DD7:010	Voltage values: Phase V	x.x V (Read only)	I16	10	X	●
0x2DD7:011	Voltage values: Phase W	x.x V (Read only)	I16	10	X	●
0x2DDC	Actual slip value	x.x Hz (Read only)	I16	10	X	●
0x2DDD	Output frequency	x.x Hz (Read only)	I16	10	X	●
0x2DDE	Actual rotor angle position	- (Read only)	I16	1	X	●
0x2DDF:001	Axis information: Rated current	x.xx A (Read only)	U16	100	X	●
0x2DDF:002	Axis information: Maximum current	x.xx A (Read only)	U16	100	X	●
0x2DDF:005	Axis information: Motor encoder	- (Read only)	U8		X	●
0x2DDF:006	Axis information: Load encoder/master encoder	- (Read only)	U8		X	●
0x2DE0:001	Current controller identification settings	**Automatisch [0]**	U8		X	
0x2DE0:003	Resolver - position detection dynamics	**100 %**	U16	1	-	
0x2DE0:004	Resolver - 8 kHz safety signal	**Automatisch durch Gerätetyp [0]**	U8		X	
0x2DE0:006	OEM service Data - SN	- (Read only)	U32	1	X	
0x2DE0:007	Use measured voltage	**Ein [1]**	U8		-	
0x2E00:041	Set position for load encoder	**Off [0]**	U8		X	
0x2E00:042	Voltage offset compensation	**On [1]**	U8		X	
0x4000	Application selection	**"Table Positioning" technology application [20]**	U16		C	
0x4001	Interface selection	**Fieldbus network [0]**	I16		-	
0x4016:005	Digital output 1: Terminal state	- (Read only)	U8		X	
0x500A:004	PLCopen status	- (Read only)	U16		X	
0x500A:005	Status word	- (Read only)	U32		HX	
0x500A:010	Actual position	- (Read only)	I32	10000	X	
0x500A:011	Actual velocity	- (Read only)	I32	10000	X	
0x500A:012	Actual acceleration	- (Read only)	I32	100	X	
0x500A:013	Actual torque	x.xx Nm (Read only)	I32	100	X	
0x500A:014	Position setpoint	- (Read only)	I32	10000	X	
0x500A:015	Velocity setpoint	- (Read only)	I32	10000	X	
0x500A:016	Acceleration setpoint	- (Read only)	I32	100	X	
0x500A:017	Torque setpoint	x.xx Nm (Read only)	I32	100	X	
0x500A:025	Additional gearbox factor - numerator	**1**	U32	1	C	
0x500A:026	Additional gearbox factor - denominator	**1**	U32	1	C	
0x500A:029	Virtual mode	**0**	BOOLEAN		C	
0x500A:030	Travel range	**Limited [1]**	U16		C	
0x500A:031	Cycle length	**360.0000**	I32	10000	C	
* Default setting depending on the size.						



Address	Designation	Default setting	Data type	Factor	A	M
0x500A:032	Feed constant	**360.0000**	I32	10000	C	
0x500A:033	Gearbox factor - nominator	**1**	U32	1	C	
0x500A:034	Gearbox factor - denominator	**1**	U32	1	C	
0x500A:035	Motor mounting direction	**0**	BOOLEAN		C	
0x500A:037	Load moment of inertia	**0.00 kg cm²**	I32	100	-	
0x500A:045	Max. velocity	**0.0000**	I32	10000	-	
0x500A:046	Max. acceleration	**0.00**	I32	100	-	
0x500A:047	Max. jerk	**0.00**	I32	100	-	
0x500A:048	Application quick stop - deceleration	**3600.00**	I32	100	-	
0x500A:049	Application quick stop - jerk	**0.00**	I32	100	-	
0x500A:050	Enable software limit switches	**0**	BOOLEAN		-	
0x500A:051	Software limit switch positive	**0.0000**	I32	10000	-	
0x500A:052	Software limit switch negative	**0.0000**	I32	10000	-	
0x500A:053	Action after "software limit switch reached"	**Stop at software limit switch [1]**	U16		-	
0x500A:054	Following error monitoring	**1**	BOOLEAN		-	
0x500A:055	Following error: Warning threshold	**180.0000**	I32	10000	-	
0x500A:056	Following error: Error threshold	**360.0000**	I32	10000	-	
0x500A:057	Actual following error	- (Read only)	I32	10000	X	
0x500A:058	Max. following error	- (Read only)	I32	10000	X	
0x500A:059	Response to following error	**Fault > Application quick stop > Quick stop [20]**	U8		-	
0x500A:070	Homing mode	**SetPositionDirect [0]**	I16		-	
0x500A:071	Action after "Home position detected"	**Stop positioning [0]**	I16		-	
0x500A:072	Homing: Set position	**0.0000**	I32	10000	-	
0x500A:073	Homing: Set position	**360.0000**	I32	10000	-	
0x500A:074	Homing : Velocity 2	**0.0000**	I32	10000	-	
0x500A:075	Homing : Acceleration 1	**720.00**	I32	100	-	
0x500A:076	Homing : Acceleration 2	**360.00**	I32	100	-	
0x500A:077	Homing : Jerk	**7200.00**	I32	100	-	
0x500A:078	Homing : Torque limit	**0.10 Nm**	I32	100	-	
0x500A:079	Homing : Blocking time	**1.000 s**	I32	1000	-	
0x500A:080	Homing : Touch probe configuration	**TP1 - positive edge [1]**	U32		-	
0x500A:081	Keep home position after mains switching	**0**	BOOLEAN		-	
0x500A:082	Max. angle of rotation after mains switching	**0.0000000000 °**	I32	1	-	
0x500A:084	Home position	**0.0000**	I32	10000	-	
0x500A:090	Default control mode	**Position control via motor encoder [0]**	U16		C	
0x500A:091	Actual control mode	- (Read only)	U16		X	
0x500A:092	Load encoder selection	**[-]**	STRING[80]		C	
0x500A:093	Position controller gain	**20.0000 1/s**	I32	10000	-	
0x500A:094	Load encoder output limit	**100000.0000**	I32	10000	-	
0x500A:095	Position controller output	- (Read only)	I32	10000	X	
0x500A:104	Response to hardware limit switch error	**Fault > Application quick stop > Quick stop [19]**	U8		-	
0x500A:105	Response to software limit switch error	**Fault > Application quick stop > Quick stop [19]**	U8		-	
0x500A:106	Response to error "max. values exceeded"	**Warning [2]**	U8		-	
0x500A:107	Response to inverter disable during operation	**No response [0]**	U8		-	
0x500A:128	Positive torque limit	**200.0 %**	I16	10	-	
0x500A:129	Negative torque limit	**200.0 %**	I16	10	-	
0x500A:130	Position window size	**0.0000**	I32	10000	-	
0x500A:131	Position window dwell time	**0.000 s**	I32	1000	-	
0x500A:132	Standstill window size (motor encoder)	**0.0000**	I32	10000	-	
0x500A:135	Modulo positioning tolerance window	**0.0000**	I32	10000	-	

* Default setting depending on the size.

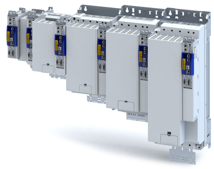


Address	Designation	Default setting	Data type	Factor	A	M
0x500A:136	Tolerance window actual position=set position upper limit	**0.0000**	I32	10000	-	
0x500A:137	Tolerance window actual position=set position lower limit	**0.0000**	I32	10000	-	
0x500A:150	SLS1	**0.0000**	I32	10000	-	
0x500A:151	SLS1 - deceleration time	**0.000 s**	I32	1000	-	
0x500A:152	SLS2	**0.0000**	I32	10000	-	
0x500A:153	SLS2 - deceleration time	**0.000 s**	I32	1000	-	
0x500A:154	SLS3	**0.0000**	I32	10000	-	
0x500A:155	SLS3 - deceleration time	**0.000 s**	I32	1000	-	
0x500A:156	SLS4	**0.0000**	I32	10000	-	
0x500A:157	SLS4 - deceleration time	**0.000 s**	I32	1000	-	
0x500A:159	Compensation velocity of SLS	**0.0000**	I32	10000	-	
0x500A:160	Follower - Response to SLS	**0**	BOOLEAN		-	
0x500A:161	Speed controller limitation (SLS)	**0**	BOOLEAN		-	
0x500A:162	Deactivate safety functions	**0x00000000**	U32		H	
0x500A:163	Limiter status	- (Read only)	U32		HX	
0x500A:181	Manual jog velocity	**360.0000**	I32	10000	-	
0x500A:182	Manual jog acceleration	**720.00**	I32	100	-	
0x500A:183	Manual jog deceleration	**1440.00**	I32	100	-	
0x500A:184	Manual jog jerk	**0.00**	I32	100	-	
0x500A:186	Deceleration of Halt	**1800.00**	I32	100	-	
0x500A:187	Jerk of Halt	**0.00**	I32	100	-	
0x500B:005	Status word	- (Read only)	U32		HX	
0x500B:010	Actual position	- (Read only)	I32	10000	X	
0x500B:011	Actual velocity	- (Read only)	I32	10000	X	
0x500B:012	Actual acceleration	- (Read only)	I32	100	X	
0x500B:030	Travel range	**Limited [1]**	U16		C	
0x500B:031	Cycle length	**360.0000**	I32	10000	C	
0x500B:032	Feed constant	**360.0000**	I32	10000	C	
0x500B:033	Gearbox factor - nominator	**1**	U32	1	C	
0x500B:034	Gearbox factor - denominator	**1**	U32	1	C	
0x500B:035	Load encoder mounting direction	**0**	BOOLEAN		C	
0x500B:065	Filter cycles of actual velocity	**1**	U16	1	-	
0x500B:066	Filter cycles of actual position	**1**	U16	1	-	
0x500B:081	Keep home position after mains switching	**0**	BOOLEAN		-	
0x500B:082	Max. angle of rotation after mains switching	**0.0000000000 °**	I32	1	-	
0x500B:132	Standstill window size (load encoder)	**0.0000**	I32	10000	-	
0x5020:004	Source of positive hardware limit switch	**Digital input 4 [5]**	I16		-	
0x5020:005	Source of negative hardware limit switch	**Digital input 3 [4]**	I16		-	
0x5020:006	Source of homing switch for touch probe	**Digital input 1 [2]**	I16		-	
0x5020:007	Application quick stop source	**FALSE [0]**	I16		-	
0x5020:008	Source of fault reset	**FALSE [0]**	I16		-	
0x5020:010	Control word	**FALSE [0]**	I16		-	
0x5020:011	TP1 source	**Digital input 2, positive edge [11]**	I16		-	
0x5020:030	Source of digital output 1	**Ready to switch on [0]**	I16		-	
0x5021:150	System bus diagnostics: Cycle length (input value)	- (Read only)	I32	10000	X	
0x5021:151	System bus diagnostics: Position (input value)	- (Read only)	I32	10000	X	
0x5021:152	System bus diagnostics: Velocity (input value)	- (Read only)	I32	10000	X	
0x5021:153	System bus diagnostics: Acceleration (input value)	- (Read only)	I32	100	X	
0x5021:154	System bus diagnostics: Torque (input value)	x.xx Nm (Read only)	I32	100	X	
0x5021:155	System bus diagnostics: Time stamp (input value)	x ns (Read only)	U32	1	X	
0x5021:156	System bus diagnostics: Input data word 6	- (Read only)	U32	1	X	
0x5021:157	System bus diagnostics: Input data word 7	- (Read only)	U32	1	X	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x5021:160	System bus diagnostics: Cycle length (output value)	- (Read only)	I32	10000	X	
0x5021:161	System bus diagnostics: Position (output value)	- (Read only)	I32	10000	X	
0x5021:162	System bus diagnostics: Velocity (output value)	- (Read only)	I32	10000	X	
0x5021:163	System bus diagnostics: Acceleration (output value)	- (Read only)	I32	100	X	
0x5021:164	System bus diagnostics: Torque (output value)	x.xx Nm (Read only)	I32	100	X	
0x5021:165	System bus diagnostics: Time stamp (output value)	x ns (Read only)	U32	1	X	
0x5021:166	System bus diagnostics: Output data word 6	- (Read only)	U32	1	X	
0x5021:167	System bus diagnostics: Output data word 7	- (Read only)	U32	1	X	
0x5030:001	Simulation of control signals	**0x00**	U8		HX	
0x5030:003	Effect of external torque limit	**Positive and negative direction [0]**	I16		-	
0x5030:006	Display value 1	**None [0]**	I16		-	
0x5030:008	Activate flying homing	**FALSE [0]**	I16		-	
0x5030:009	Activate "Positive stop positioning"	**FALSE [0]**	I16		-	
0x5030:010	Control signals	**0x00000000**	U32		HX	
0x5030:011	External velocity override	**0.00 %**	I32	100	X	
0x5030:012	External velocity	**0.0000**	I32	10000	X	
0x5030:014	External acceleration	**0.00**	I32	100	X	
0x5030:015	External deceleration	**0.00**	I32	100	X	
0x5030:016	External jerk	**0.00**	I32	100	X	
0x5030:017	External torque limit	**0.00 %**	I32	100	X	
0x5030:023	External position setpoint	**0.0000**	I32	10000	X	
0x5030:101	Simulation of status signals	**0x00**	U8		HX	
0x5030:110	Status signals	**0x00000000**	U32		HX	
0x5030:111	Status signals limiter	**0x00000000**	U32		HX	
0x5030:112	Actual velocity	**0.0000**	I32	10000	X	
0x5030:114	Error code	**0**	I32	1	X	
0x5030:115	Actual torque	**0.00 Nm**	I32	100	X	
0x5030:116	Display value 1	**0**	U32	1	X	
0x5030:117	Status word 7	**0**	U32	1	X	
0x5030:123	Actual position	**0.0000**	I32	10000	X	
0x5030:150	Read external profile data in edge-controlled manner	**FALSE [0]**	I16		-	
0x5031:021, 032, 043, 054, 065, 076, 087, 098, 109, 120, 131, 142, 153, 164, 175	Positioning mode	**absolute [0]**	I16		-	
0x5031:022, 033, 044, 055, 066, 077, 088, 099, 110, 121, 132, 143, 154, 165, 176	Profile position	**360.0000**	I32	10000	-	
0x5031:023, 034, 045, 056, 067, 078, 089, 100, 111, 122, 133, 144, 155, 166, 177	Profile velocity	**360.0000**	I32	10000	-	
0x5031:024, 035, 046, 057, 068, 079, 090, 101, 112, 123, 134, 145, 156, 167, 178	Profile acceleration	**720.00**	I32	100	-	
* Default setting depending on the size.						

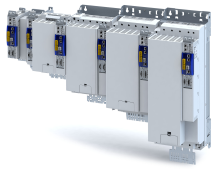
Address	Designation	Default setting	Data type	Factor	A	M
0x5031:025, 036, 047, 058, 069, 080, 091, 102, 113, 124, 135, 146, 157, 168, 179	Profile deceleration	**720.00**	I32	100	-	
0x5031:026, 037, 048, 059, 070, 081, 092, 103, 114, 125, 136, 147, 158, 169, 180	Profile jerk	**7200.00**	I32	100	-	
0x5031:027, 038, 049, 060, 071, 082, 093, 104, 115, 126, 137, 148, 159, 170, 181	Final velocity	**0.0000**	I32	10000	-	
0x5031:028, 039, 050, 061, 072, 083, 094, 105, 116, 127, 138, 149, 160, 171, 182	Profile TP window - lower limit	**0.0000**	I32	10000	-	
0x5031:029, 040, 051, 062, 073, 084, 095, 106, 117, 128, 139, 150, 161, 172, 183	Profile TP window - upper limit	**0.0000**	I32	10000	-	
0x5031:030, 041, 052, 063, 074, 085, 096, 107, 118, 129, 140, 151, 162, 173, 184	Sequence profile after TP	**0**	U16	1	-	
0x5031:031, 042, 053, 064, 075, 086, 097, 108, 119, 130, 141, 152, 163, 174, 185	Sequence profile	**0**	U16	1	-	
0x5032:012	Active profile: acceleration setpoint	- (Read only)	I32	100	X	
0x5032:013	Active profile: deceleration setpoint	- (Read only)	I32	100	X	
0x5032:014	Active profile: jerk setpoint	- (Read only)	I32	100	X	
0x5032:015	Active profile: Velocity setpoint	- (Read only)	I32	10000	X	
0x5032:020	Active profile: position setpoint	- (Read only)	I32	10000	X	
0x5032:025	Selected profile	- (Read only)	U16	1	X	
0x5032:027	Velocity override setpoint	- (Read only)	I32	100	X	
0x5810:001	Diagnose Applikation: Application state	- (Read only)	U8		X	
0x5850:001	Kommandos für Systembus EtherCAT-Master: Kommunikation neu starten	**No action/no error [0]**	U16		X	
0x5851:001	EtherCAT master diagnosis: EtherCAT master state	- (Read only)	U16		X	
0x5851:002	EtherCAT master diagnosis: EtherCAT master state summary	- (Read only)	U32		HX	
0x5851:003	EtherCAT master diagnosis: EtherCAT error	- (Read only)	U16	1	X	
0x5851:004	EtherCAT master diagnosis: Bus scan match	- (Read only)	U8	1	X	
0x5851:005	EtherCAT master diagnosis: Configured cycle time	x us (Read only)	U32	1	X	
0x5851:006	EtherCAT master diagnosis: Connected slaves	- (Read only)	U16	1	X	
0x5851:007	EtherCAT master diagnosis: Configured slaves	- (Read only)	U16	1	X	

* Default setting depending on the size.



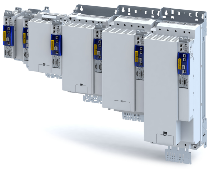
Address	Designation	Default setting	Data type	Factor	A	M
0x5860:001	EtherCAT slaves station addresses: Station address slave 1	- (Read only)	I16	1	X	
0x5860:002	EtherCAT slaves station addresses: Station address slave 2	- (Read only)	I16	1	X	
0x5860:003	EtherCAT slaves station addresses: Station address slave 3	- (Read only)	I16	1	X	
0x5860:004	EtherCAT slaves station addresses: Station address slave 4	- (Read only)	I16	1	X	
0x5860:005	EtherCAT slaves station addresses: Station address slave 5	- (Read only)	I16	1	X	
0x5860:006	EtherCAT slaves station addresses: Station address slave 6	- (Read only)	I16	1	X	
0x5860:007	EtherCAT slaves station addresses: Station address slave 7	- (Read only)	I16	1	X	
0x5860:008	EtherCAT slaves station addresses: Station address slave 8	- (Read only)	I16	1	X	
0x5860:009	EtherCAT slaves station addresses: Station address slave 9	- (Read only)	I16	1	X	
0x5860:010	EtherCAT slaves station addresses: Station address slave 10	- (Read only)	I16	1	X	
0x5860:011	EtherCAT slaves station addresses: Station address slave 11	- (Read only)	I16	1	X	
0x5860:012	EtherCAT slaves station addresses: Station address slave 12	- (Read only)	I16	1	X	
0x5860:013	EtherCAT slaves station addresses: Station address slave 13	- (Read only)	I16	1	X	
0x5860:014	EtherCAT slaves station addresses: Station address slave 14	- (Read only)	I16	1	X	
0x5860:015	EtherCAT slaves station addresses: Station address slave 15	- (Read only)	I16	1	X	
0x5860:016	EtherCAT slaves station addresses: Station address slave 16	- (Read only)	I16	1	X	
0x5861:001	EtherCAT slaves device names: Device name slave 1	- (Read only)	STRING[128]		X	
0x5861:002	EtherCAT slaves device names: Device name slave 2	- (Read only)	STRING[128]		X	
0x5861:003	EtherCAT slaves device names: Device name slave 3	- (Read only)	STRING[128]		X	
0x5861:004	EtherCAT slaves device names: Device name slave 4	- (Read only)	STRING[128]		X	
0x5861:005	EtherCAT slaves device names: Device name slave 5	- (Read only)	STRING[128]		X	
0x5861:006	EtherCAT slaves device names: Device name slave 6	- (Read only)	STRING[128]		X	
0x5861:007	EtherCAT slaves device names: Device name slave 7	- (Read only)	STRING[128]		X	
0x5861:008	EtherCAT slaves device names: Device name slave 8	- (Read only)	STRING[128]		X	
0x5861:009	EtherCAT slaves device names: Device name slave 9	- (Read only)	STRING[128]		X	
0x5861:010	EtherCAT slaves device names: Device name slave 10	- (Read only)	STRING[128]		X	
0x5861:011	EtherCAT slaves device names: Device name slave 11	- (Read only)	STRING[128]		X	
0x5861:012	EtherCAT slaves device names: Device name slave 12	- (Read only)	STRING[128]		X	
0x5861:013	EtherCAT slaves device names: Device name slave 13	- (Read only)	STRING[128]		X	
0x5861:014	EtherCAT slaves device names: Device name slave 14	- (Read only)	STRING[128]		X	
0x5861:015	EtherCAT slaves device names: Device name slave 15	- (Read only)	STRING[128]		X	
0x5861:016	EtherCAT slaves device names: Device name slave 16	- (Read only)	STRING[128]		X	
0x5862:001	EtherCAT slaves device types: Device type slave 1	- (Read only)	STRING[50]		X	
0x5862:002	EtherCAT slaves device types: Device type slave 2	- (Read only)	STRING[50]		X	
0x5862:003	EtherCAT slaves device types: Device type slave 3	- (Read only)	STRING[50]		X	
* Default setting depending on the size.						

Address	Designation	Default setting	Data type	Factor	A	M
0x5862:004	EtherCAT slaves device types: Device type slave 4	- (Read only)	STRING[50]		X	
0x5862:005	EtherCAT slaves device types: Device type slave 5	- (Read only)	STRING[50]		X	
0x5862:006	EtherCAT slaves device types: Device type slave 6	- (Read only)	STRING[50]		X	
0x5862:007	EtherCAT slaves device types: Device type slave 7	- (Read only)	STRING[50]		X	
0x5862:008	EtherCAT slaves device types: Device type slave 8	- (Read only)	STRING[50]		X	
0x5862:009	EtherCAT slaves device types: Device type slave 9	- (Read only)	STRING[50]		X	
0x5862:010	EtherCAT slaves device types: Device type slave 10	- (Read only)	STRING[50]		X	
0x5862:011	EtherCAT slaves device types: Device type slave 11	- (Read only)	STRING[50]		X	
0x5862:012	EtherCAT slaves device types: Device type slave 12	- (Read only)	STRING[50]		X	
0x5862:013	EtherCAT slaves device types: Device type slave 13	- (Read only)	STRING[50]		X	
0x5862:014	EtherCAT slaves device types: Device type slave 14	- (Read only)	STRING[50]		X	
0x5862:015	EtherCAT slaves device types: Device type slave 15	- (Read only)	STRING[50]		X	
0x5862:016	EtherCAT slaves device types: Device type slave 16	- (Read only)	STRING[50]		X	
0x5863:001	Mandatory EtherCAT slaves: Slave 1 is mandatory	- (Read only)	U8		X	
0x5863:002	Mandatory EtherCAT slaves: Slave 2 is mandatory	- (Read only)	U8		X	
0x5863:003	Mandatory EtherCAT slaves: Slave 3 is mandatory	- (Read only)	U8		X	
0x5863:004	Mandatory EtherCAT slaves: Slave 4 is mandatory	- (Read only)	U8		X	
0x5863:005	Mandatory EtherCAT slaves: Slave 5 is mandatory	- (Read only)	U8		X	
0x5863:006	Mandatory EtherCAT slaves: Slave 6 is mandatory	- (Read only)	U8		X	
0x5863:007	Mandatory EtherCAT slaves: Slave 7 is mandatory	- (Read only)	U8		X	
0x5863:008	Mandatory EtherCAT slaves: Slave 8 is mandatory	- (Read only)	U8		X	
0x5863:009	Mandatory EtherCAT slaves: Slave 9 is mandatory	- (Read only)	U8		X	
0x5863:010	Mandatory EtherCAT slaves: Slave 10 is mandatory	- (Read only)	U8		X	
0x5863:011	Mandatory EtherCAT slaves: Slave 11 is mandatory	- (Read only)	U8		X	
0x5863:012	Mandatory EtherCAT slaves: Slave 12 is mandatory	- (Read only)	U8		X	
0x5863:013	Mandatory EtherCAT slaves: Slave 13 is mandatory	- (Read only)	U8		X	
0x5863:014	Mandatory EtherCAT slaves: Slave 14 is mandatory	- (Read only)	U8		X	
0x5863:015	Mandatory EtherCAT slaves: Slave 15 is mandatory	- (Read only)	U8		X	
0x5863:016	Mandatory EtherCAT slaves: Slave 16 is mandatory	- (Read only)	U8		X	
0x5864:001	EtherCAT slaves initialisation status: Initalisation status slave 1	- (Read only)	U16		X	
0x5864:002	EtherCAT slaves initialisation status: Initalisation status slave 2	- (Read only)	U16		X	
0x5864:003	EtherCAT slaves initialisation status: Initalisation status slave 3	- (Read only)	U16		X	
0x5864:004	EtherCAT slaves initialisation status: Initalisation status slave 4	- (Read only)	U16		X	
0x5864:005	EtherCAT slaves initialisation status: Initalisation status slave 5	- (Read only)	U16		X	
0x5864:006	EtherCAT slaves initialisation status: Initalisation status slave 6	- (Read only)	U16		X	
0x5864:007	EtherCAT slaves initialisation status: Initalisation status slave 7	- (Read only)	U16		X	
0x5864:008	EtherCAT slaves initialisation status: Initalisation status slave 8	- (Read only)	U16		X	
0x5864:009	EtherCAT slaves initialisation status: Initalisation status slave 9	- (Read only)	U16		X	
0x5864:010	EtherCAT slaves initialisation status: Initalisation status slave 10	- (Read only)	U16		X	
0x5864:011	EtherCAT slaves initialisation status: Initalisation status slave 11	- (Read only)	U16		X	
0x5864:012	EtherCAT slaves initialisation status: Initalisation status slave 12	- (Read only)	U16		X	
0x5864:013	EtherCAT slaves initialisation status: Initalisation status slave 13	- (Read only)	U16		X	
* Default setting depending on the size.						

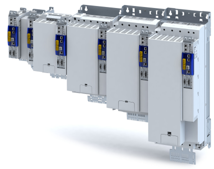


Address	Designation	Default setting	Data type	Factor	A	M
0x5864:014	EtherCAT slaves initialisation status: Initalisation status slave 14	- (Read only)	U16		X	
0x5864:015	EtherCAT slaves initialisation status: Initalisation status slave 15	- (Read only)	U16		X	
0x5864:016	EtherCAT slaves initialisation status: Initalisation status slave 16	- (Read only)	U16		X	
0x5865:001	EtherCAT slaves device status: Device status slave 1	- (Read only)	U16		X	
0x5865:002	EtherCAT slaves device status: Device status slave 2	- (Read only)	U16		X	
0x5865:003	EtherCAT slaves device status: Device status slave 3	- (Read only)	U16		X	
0x5865:004	EtherCAT slaves device status: Device status slave 4	- (Read only)	U16		X	
0x5865:005	EtherCAT slaves device status: Device status slave 5	- (Read only)	U16		X	
0x5865:006	EtherCAT slaves device status: Device status slave 6	- (Read only)	U16		X	
0x5865:007	EtherCAT slaves device status: Device status slave 7	- (Read only)	U16		X	
0x5865:008	EtherCAT slaves device status: Device status slave 8	- (Read only)	U16		X	
0x5865:009	EtherCAT slaves device status: Device status slave 9	- (Read only)	U16		X	
0x5865:010	EtherCAT slaves device status: Device status slave 10	- (Read only)	U16		X	
0x5865:011	EtherCAT slaves device status: Device status slave 11	- (Read only)	U16		X	
0x5865:012	EtherCAT slaves device status: Device status slave 12	- (Read only)	U16		X	
0x5865:013	EtherCAT slaves device status: Device status slave 13	- (Read only)	U16		X	
0x5865:014	EtherCAT slaves device status: Device status slave 14	- (Read only)	U16		X	
0x5865:015	EtherCAT slaves device status: Device status slave 15	- (Read only)	U16		X	
0x5865:016	EtherCAT slaves device status: Device status slave 16	- (Read only)	U16		X	
0x603F	Error code	- (Read only)	U16		HX	●
0x6040	CiA: Controlword	**0x0000**	U16		HX	●
0x6041	CiA: Statusword	- (Read only)	U16		HX	●
0x6042	Target velocity	**0 rpm**	I16	1	X	●
0x6043	Velocity demand	x rpm (Read only)	I16	1	X	●
0x6044	Velocity actual value	x rpm (Read only)	I16	1	X	●
0x6046:001	Velocity min max amount: Velocity min amount	**0 rpm**	U32	1	X	●
0x6046:002	Velocity min max amount: Velocity max amount	**2147483647 rpm**	U32	1	X	●
0x6048:001	Velocity acceleration: Delta speed	**0 rpm**	U32	1	-	●
0x6048:002	Velocity acceleration: Delta time	**10 s**	U16	1	-	●
0x6049:001	Velocity deceleration: Delta speed	**0 rpm**	U32	1	-	●
0x6049:002	Velocity deceleration: Delta time	**10 s**	U16	1	-	●
0x605A	Quick stop option code	**Quick stop ramp > switch-on inhibited [2]**	I16		-	
0x605B	Shutdown option code	**Disable drive function [0]**	I16		-	
0x605E	Fault reaction option code	**DC braking [-2]**	I16		-	
0x6060	Modes of operation	**No mode change/no mode assigned [0]**	I8		-	●
0x6061	Modes of operation display	- (Read only)	I8		X	●
0x6062	Position demand value	x pos. unit (Read only)	I32	1	X	
0x6063	Position actual internal value	x incr. (Read only)	I32	1	X	●
0x6064	Position actual value	x pos. unit (Read only)	I32	1	X	●
0x6065	Following error window	**1000 pos. unit**	U32	1	-	●
0x6066	Following error time out	**0 ms**	U16	1	-	●
0x6067	Position window	**1000 pos. unit**	U32	1	-	
0x6068	Position window time	**0 ms**	U16	1	-	
0x606C	Velocity actual value	rpm (Read only)	I32	480000 /2^{31}	X	●
0x6071	Target torque	**0.0 %**	I16	10	X	●
0x6072	Max torque	**250.0 %**	U16	10	-	●
0x6073	Max current	**150.0 %**	U16	10	-	
0x6074	Torque demand value	x.x % (Read only)	I16	10	X	
0x6075	Motor rated current	**1.300 A**	U32	1000	C	

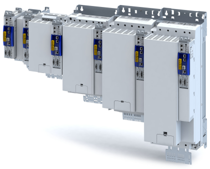
* Default setting depending on the size.



Address	Designation	Default setting	Data type	Factor	A	M
0x6076	Motor rated torque	**0.600 Nm**	U32	1000	C	
0x6077	Torque actual value	x.x % (Read only)	I16	10	X	●
0x6078	Current actual value	x.x % (Read only)	I16	10	X	●
0x6079	DC link circuit voltage	x.xxx V (Read only)	U32	1000	X	●
0x607A	Target position	**0 pos. unit**	I32	1	X	●
0x607E	Polarity	**0**	U8	1	C	
0x6080	Max motor speed	**6075 rpm**	U32	1	-	●
0x6085	Quick stop deceleration	**2147483647**	U32	1	-	
0x608F:001	Position encoder resolution: Encoder increments	**16 bit [65536]**	U32		C	
0x608F:002	Position encoder resolution: Motor revolutions	**1**	U32	1	C	
0x6090:001	Velocity encoder resolution: Encoder increments per second	**33554432**	U32	1	C	
0x6090:002	Velocity encoder resolution: Motor revolutions per second	**125**	U32	1	C	
0x60B1	Velocity offset	**0.00 rpm**	I32	480000 /2^{31}	-	●
0x60B2	Torque offset	**0.0 %**	I16	10	-	●
0x60B8	Touch probe function	**0x0000**	U16		H	●
0x60B9	Touch probe status	- (Read only)	U16		HX	●
0x60BA	Touch probe pos1 pos value	x pos. unit (Read only)	I32	1	X	●
0x60BB	Touch probe pos1 neg value	x pos. unit (Read only)	I32	1	X	●
0x60BC	Touch probe pos2 pos value	x pos. unit (Read only)	I32	1	X	●
0x60BD	Touch probe pos2 neg value	x pos. unit (Read only)	I32	1	X	●
0x60C0	Interpolation sub mode select	**Quadratic Interpolation [-1]**	I16		-	●
0x60C2:001	Interpolation time period: Interpolation time period value	**1**	U8	1	-	
0x60C2:002	Interpolation time period: Interpolation time index	**-3**	I8	1	-	
0x60E0	Positive torque limit	**100.0 %**	U16	10	-	●
0x60E1	Negative torque limit	**100.0 %**	U16	10	-	●
0x60E4:001	Additional position actual value: Load encoder/ master encoder - actual position	x pos. unit (Read only)	I32	1	X	●
0x60E5:001	Additional velocity actual value: Load encoder/ master encoder - actual speed	rpm (Read only)	I32	480000 /2^{31}	X	●
0x60E6:001	Additional position encoder resolution - encoder increments: Load encoder/master encoder - number of increments	**16 Bit [65536]**	U32		C	
0x60EB:001	Additional position encoder resolution - motor revolutions: Load encoder/master encoder - resolution of motor revolutions	**1**	U32	1	C	
0x60F4	Following error actual value	x pos. unit (Read only)	I32	1	X	●
0x60FA	Control effort	rpm (Read only)	I32	480000 /2^{31}	X	●
0x60FC	Position demand internal value	x incr. (Read only)	I32	1	X	
0x60FD	Digital inputs	- (Read only)	U32		HX	●
0x60FE:001	Digital outputs: Digital outputs	**0x00000000**	U32		HX	●
0x60FF	Target velocity	**0.00 rpm**	I32	480000 /2^{31}	X	●
0x6404	Motor manufacturer	**"Lenze"**	STRING[50]		-	
0x6502	Supported drive modes	- (Read only)	U32		HX	
0x67FF	Device profile number	- (Read only)	U32	1	X	
0xA200:001	Systembus output data: Systembus data output 1	- (Read only)	U32	1	X	●
0xA200:002	Systembus output data: Systembus data output 2	- (Read only)	U32	1	X	●
0xA200:003	Systembus output data: Systembus data output 3	- (Read only)	U32	1	X	●
0xA200:004	Systembus output data: Systembus data output 4	- (Read only)	U32	1	X	●
0xA200:005	Systembus output data: Systembus data output 5	- (Read only)	U32	1	X	●
* Default setting depending on the size.						



Address	Designation	Default setting	Data type	Factor	A	M
0xA200:006	Systembus output data: Systembus data output 6	- (Read only)	U32	1	X	●
0xA200:007	Systembus output data: Systembus data output 7	- (Read only)	U32	1	X	●
0xA200:008	Systembus output data: Systembus data output 8	- (Read only)	U32	1	X	●
0xA200:009	Systembus output data: Systembus data output 9	- (Read only)	U32	1	X	●
0xA200:010	Systembus output data: Systembus data output 10	- (Read only)	U32	1	X	●
0xA200:011	Systembus output data: Systembus data output 11	- (Read only)	U32	1	X	●
0xA200:012	Systembus output data: Systembus data output 12	- (Read only)	U32	1	X	●
0xA200:013	Systembus output data: Systembus data output 13	- (Read only)	U32	1	X	●
0xA200:014	Systembus output data: Systembus data output 14	- (Read only)	U32	1	X	●
0xA200:015	Systembus output data: Systembus data output 15	- (Read only)	U32	1	X	●
0xA200:016	Systembus output data: Systembus data output 16	- (Read only)	U32	1	X	●
0xA680:001	Systembus input data: Systembus data input 1	**0**	U32	1	X	●
0xA680:002	Systembus input data: Systembus data input 2	**0**	U32	1	X	●
0xA680:003	Systembus input data: Systembus data input 3	**0**	U32	1	X	●
0xA680:004	Systembus input data: Systembus data input 4	**0**	U32	1	X	●
0xA680:005	Systembus input data: Systembus data input 5	**0**	U32	1	X	●
0xA680:006	Systembus input data: Systembus data input 6	**0**	U32	1	X	●
0xA680:007	Systembus input data: Systembus data input 7	**0**	U32	1	X	●
0xA680:008	Systembus input data: Systembus data input 8	**0**	U32	1	X	●
0xA680:009	Systembus input data: Systembus data input 9	**0**	U32	1	X	●
0xA680:010	Systembus input data: Systembus data input 10	**0**	U32	1	X	●
0xA680:011	Systembus input data: Systembus data input 11	**0**	U32	1	X	●
0xA680:012	Systembus input data: Systembus data input 12	**0**	U32	1	X	●
0xA680:013	Systembus input data: Systembus data input 13	**0**	U32	1	X	●
0xA680:014	Systembus input data: Systembus data input 14	**0**	U32	1	X	●
0xA680:015	Systembus input data: Systembus data input 15	**0**	U32	1	X	●
0xA680:016	Systembus input data: Systembus data input 16	**0**	U32	1	X	●
0xE901:002	FSoE communication Parameters: Safety address	- (Read only)	U16	1	X	
0xF980:001	Safety address: FSoE address	- (Read only)	U16	1	X	
0xF980:002	Safety address: Safety address	- (Read only)	U16	1	-	
* Default setting depending on the size.						



21.2 Glossary

Abbreviation	Meaning
AIE	Acknowledge In Error, error acknowledgement
AIS	Acknowledge In Stop, restart acknowledgement
OFF state	Triggered signal status of the safety sensors
CCF	Common Cause Error (also β-value)
EC_FS	Error Class Fail Safe
EC_SS1	Error-Class Safe Stop 1
EC_SS2	Error-Class Safe Stop 2
EC_STO	Error-Class Safe Torque Off Stop 0
ON − status	Signal status of the safety sensor in normal operation
FIT	Failure In Time, 1 FIT = 10-9 Error/h
FMEA	Failure Mode and Effect Analysis
FSoE	Fail Safe over EtherCAT, Safety over EtherCAT
GSDML	Device description file with PROFINET-specific data for integrating the configuration software of a PROFINET controller.
HFT	Hardware Failure Tolerance
Cat.	Category in accordance with EN ISO 13849-1
OSSD	Output Signal Switching Device, tested signal output
PELV	Protective Extra Low Voltage
PL	Performance Level (in accordance with ISO 13849)
PM	Plus−Minus − switched signal paths
PP	Plus−Plus − switched signal paths
PS	PROFIsafe
PWM	Pulse width modulation
SCS	Safe Crawling Speed
SD−In	Safe Digital Input, safe input
SD−Out	Safe Digital Output, safe output
SELV	Safety Extra Low Voltage
SFF	Safe Failure Fraction
SIL	Safety Integrity Level in accordance with IEC 61508

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