Bonfiglioli
Vectron

AXIA VERT
Operating Instructions

Frequency inverter 400 V
0,25 kW ... 15 kW

TABLE OF CONTENTS

1 General Information about the documentation

1.1 Instruction manuals

For better clarity, the documentation is structured according to the customer-specific requirements made on the frequency inverter.

Quick Start Guide

The "Quick Start Guide" describes the basic steps required for mechanical and electrical installation of the frequency inverter. The Auto-Setup supports you in the selection of necessary parameters and the configuration of the frequency inverter by the firmware.

Operating Instructions

The Operating Instructions document the complete functionality of the frequency inverter. The parameters required for special purposes, for adjustment to the application and the numerous additional functions are described in detail.

Application manual

The application manual supplements the documentation for purposeful installation and commissioning of the frequency inverter. Information on various topics in connection with the use of the frequency inverter is described in context with the specific application.

If you need a copy of the documentation or additional information, contact your local representative of BONFIGLIOLI.

The following instructions are available for the AXIA series:

AXIA Operating Instructions	Function of frequency inverter.
Quick Start Guide AXIA	Installation and commissioning Supplied with the device.
Manuals Communication interfaces	
Manuals Extension modules	
Safety manual	Safety functions
Application manuals	Application-specific settings, best practices and preconditions
Graphical User Interface Manual	Description of intended use of the GUI

The products for CANopen® communication comply with the specifications of the user organization CiA® (CAN in Automation).

The products for EtherCAT® communication comply with the specifications of the user organization ETG (EtherCAT Technology Group).

The products for ProfiNET® communication comply with the specifications of the user organization "PROFIBUS Nutzerorganisation e. V.".

PROFINET is a registered trademark of PROFIBUS and PROFINET International (PI).

The present documentation was prepared with great care, and it was subjected to extensive and repeated reviews. For reasons of clarity, it was not possible to include all details of all types of the product in the documentation. Neither was it possible to consider all conceivable installation, operation or maintenance situations. If you require further information or if you meet with specific problems which are not dealt with in sufficient detail in the documentation, contact your local BONFIGLIOLI agent.

1.2 This document

This document describes the frequency inverters of the AXIA series.

The Operating Instructions contain important information on the installation and the use of the product in its specified application range. Comply with user documentation to avoid risks, to minimize repair cost and downtimes and to increase the reliability and service life of the frequency inverter.

For this reason, make sure you read the user manual and other relevant documents carefully.

IMPORTANT:
Compliance with the documentation is required to ensure safe operation of the frequency inverter. Bonfiglioli Deutschland GmbH shall not be held liable for any damage caused by any non-compliance with the documentation.

In case you encounter any problems not sufficiently covered by the documentation, please contact the manufacturer.

For safe commissioning and operation of the AXV (AXIA) series, comply with the following documentation:

- The Operating Instructions Document
- Co-applicable Safety manual

This document applies to the following frequency inverter series:

- AXIA 210
- AXIA 410

The AXV series is identified by its label on the case and by the type plate.

The present document has been created in English. Other language versions are translations thereof.

1.3 Warranty and liability

BONFIGLIOLI Deutschland GmbH (hereinafter referred to as "manufacturer") states that the contents of this Operating Instructions document do not form part of any previous or existing agreement, assurance or legal relationship between the manufacturer and the user of the Operating Instructions (hereinafter referred to as the "User"). Neither are they intended to supplement or replace such agreements, assurances or legal relation-ships. Any obligations of the manufacturer shall solely be based on the relevant purchase agreement which also includes the complete and solely valid warranty stipulations. These contractual warranty provisions are neither extended nor limited by the specifications contained in this documentation.

The manufacturer reserves the right to correct or amend the specifications, product information and omissions in these operating instructions without prior notice. The manufacturer assumes no responsibility to update these Operating Instructions. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

In addition, the manufacturer excludes any warranty and disclaims all liability, including without limitation direct, indirect, special, punitive, incidental, exemplary or consequential damages arising out of or in connection with one or more of the following causes:

- inappropriate use of the frequency inverter,
- non-compliance with the instructions, warnings and prohibitions contained in the documentation,
- unauthorized modifications of the frequency inverter,
- insufficient monitoring of parts of the machine/plant which are subject to wear,
- repair work at the machine/plant not carried out properly or in time,
- catastrophes by external impact and Force Majeure.

1.4 Obligation

These Operating Instructions must be read before commissioning and complied with. Anybody entrusted with tasks in connection with the

- transport,
- assembly,
- installation of the frequency inverter and
- operation of the frequency inverter

must have read and understood the Operating Instructions and, in particular, the safety instructions in order to prevent personal and material losses.

1.5 Copyright

In accordance with applicable law any copyrights relating to this document shall remain with

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Europark Fichtenhain B6
47807 Krefeld
Germany

This document is intended for the operator of the frequency inverter. Any disclosure or copying of this document, exploitation and communication of its contents (as hardcopy or electronically) shall be forbidden, unless permitted expressly.

Any non-compliance will constitute an offense against the copyright law, the law against unfair competition and the German Civil Code and may result in claims for damages. All rights relating to patent, utility model or design registration reserved.

1.6 Licensing

1.6.1 lwIP (lightweight IP)

Firmware portions of the lwIP TCP/IP stack are subject to the following:

1.6.2 Mbed TLS

Firmware portions by Mbed TLS are subject to the following:

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      http://www.apache.org/licenses/LICENSE-2.0

   Unless required by applicable law or agreed to in writing, software
   distributed under the License is distributed on an "AS IS" BASIS,
   WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
   See the License for the specific language governing permissions and
   limitations under the License.
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1.7 Storage

The documentation forms an integral part of the frequency inverter. It must be stored such that it is accessible to operating staff at all times. If the frequency inverter is sold on to other users, then the documentation must also be handed over.

1.8 Final decommissioning

After the end of product service life, the user/operator must take the device out of operation.

Disposal requirements under European Union WEEE regulations

The product is marked with the WEEE symbol shown below.

This product cannot be disposed as general household waste. Users responsible for the final disposal must make sure that it is carried out in accordance with the European Directive 2012/19/EU, where required, as well as the relative national transposition rules. Fulfil disposal also in according with any other legislation in force in the country.

2 General safety instructions and information on use

This chapter contains general safety instructions for the Operator and the Operating Staff. At the beginning of certain main chapters, some safety instructions are included which apply to all work described in the relevant chapter. Special work-specific safety instructions are provided before each safety-relevant work step.

2.1 Terminology

According to the documentation, different activities must be performed by certain persons with certain qualifications.

The groups of persons with the required qualification are defined as follows:

Operator

This is the entrepreneur/company who/which operates the frequency inverter and uses it as per the specifications or has it operated by qualified and instructed staff.

Operating staff

The term Operating Staff covers persons instructed by the Operator of the frequency inverter and assigned the task of operating the frequency inverter.

Skilled Personnel

The term Skilled Personnel covers staff that are assigned special tasks by the Operator of the frequency inverter, e.g. installation, maintenance and service/repair and troubleshooting. Based on their qualification and/or know-how, Skilled Personnel must be capable of identifying defects and assessing functions.

Qualified electrician

The term Qualified Electrician covers qualified and trained staff who has special technical know-how and experience with electrical installations. In addition, Qualified Electricians must be familiar with the applicable standards and regulations, they must be able to assess the assigned tasks properly and identify and eliminate potential hazards.

Instructed person

The term Instructed Person covers staff who was instructed and trained about/in the assigned tasks and the potential hazards that might result from inappropriate behavior. In addition, instructed persons must have been instructed in the required protection provisions, protective measures, the applicable directives, accident prevention regulations as well as the operating conditions and verified their qualification.

Expert

The term Expert covers qualified and trained staff who has special technical know-how and experience relating to frequency inverter. Experts must be familiar with the applicable government work safety directives, accident prevention regulations, guidelines and generally accepted rules of technology in order to assess the operationally safe condition of the frequency inverter.

2.2 Designated use

The frequency inverter is designed according to the state of the art and recognized safety regulations.

The frequency inverters are electrical drive components intended for installation in industrial plants or machines. Commissioning and start of operation is not allowed until it has been verified that the machine meets the requirements of the EC Machinery Directive 2006/42/EC and DIN EN 60204-1.

The frequency inverters meet the requirements of the low voltage directive 2014/35/EU and DIN EN 61800-5-1. CE-labelling is based on these standards. Responsibility for compliance with the EMC Directive 2014/30/EU lies with the operator. Frequency inverters are only available at specialized dealers and are exclusively intended for commercial use as per EN 61000-3-2.

No capacitive loads may be connected to the frequency inverter.

The technical data, connection specifications and information on ambient conditions are indicated on the rating plate and in the documentation and must be complied with in any case.

2.3 Misuse

Any use other than that described in "Designated use" shall not be permissible and shall be considered as misuse.

For, example, the machine/plant must not be operated

- by uninstructed staff,
- while it is not in perfect condition,
- without protection enclosure (e.g. covers),
- without safety equipment or with safety equipment deactivated,
- when general requirements, such as operating conditions and technical data, are not met.

The manufacturer shall not be held liable for any damage resulting from such misuse. The sole risk shall be borne by the operator.

Explosion protection

The frequency inverter is an IP 20 ingress protection rating device. For this reason, use of the device in explosive atmospheres is not permitted.

2.4 Residual risks

Residual risks are special hazards involved in handling of the frequency inverter which cannot be eliminated despite the safety-compliant design of the device. Residual risks are not obviously identifiable and can be a potential source of injury or a health hazard.

Typical residual hazards include:

- Electrical hazard
- Danger of contact with energized components due to a defect, opened covers or enclosures or improper working on electrical equipment.
- Danger of contact with energized components in frequency inverter if no external disconnection device was installed by the operator.

To minimize electrical hazards install all covers correctly and close all electrical cabinet doors during operation.

When LEDs and/or other indicating elements on the frequency inverter are not active, the inverter still may be energized.

Before carrying out any work with the device, where contact with energized parts might be possible, always check if the device is deenergized, irrespective of the status of any installed indicating elements.

Charged capacitors in DC link

The DC-link may have dangerous voltage levels even up to 3 minutes after shutdown.

Electrostatic charging

Touching electronic components entails the risk of electrostatic discharges.

Thermal hazards

Risk of accidents by hot machine/plant surfaces, e.g. heat sink, transformer, fuse or sine filter.

Danger of equipment falling down/over, e.g. during transport

Center of gravity is not the middle of the electrical cabinet modules.

2.5 Safety and warning signs on frequency inverter

- Comply with all safety instructions and danger information provided on the frequency inverter.
- Safety information and warnings on the frequency inverter must not be removed.

2.6 Warning information and symbols

Hazard classes

The following hazard identifications and symbols are used to mark particularly important information:

DANGER

Identification of immediate threat holding a **high** risk of death or serious injury if not avoided.

WARNING

Identification of immediate threat holding a **medium** risk of death or serious injury if not avoided.

CAUTION

Identification of immediate threat holding a **low** risk of minor or moderate physical injury if not avoided.

NOTICE

Identification of a threat holding a risk of material damage if not avoided.

Hazard symbols

Symbol	Meaning	Symbol	Meaning
	General hazard		Suspended load
	Electrical voltage		Hot surfaces
	Danger of crushing		

Prohibition signs

Symbol	Meaning
	No switching; it is forbidden to switch the machine/plant, assembly on

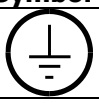
Personal safety equipment

Symbol	Meaning
	Wear body protection
	Wear ear protectors

Recycling

Symbol	Meaning
	Recycling, to avoid waste, collect all materials for reuse

Grounding symbol

Symbol	Meaning
	Ground connection

ESD symbol

Symbol	Meaning
	ESD: Electrostatic Sensitive Devices, i.e. components and assemblies sensitive to electrostatic energy

Information signs

Symbol	Meaning
	Tips and information making using the frequency inverter easier.

Font style in documentation

Example	Font style	Use
1234	bold	Representation of object index numbers / object numbers
1234	Bold+underlined	Representation of object sub-index numbers
Parameter	inclined, font: Times New Roman	Representation of parameter names / object designations
P.1234	bold	Representation of object numbers without name, e.g. in formulas
Q.1234	bold	Representation of source numbers
01234	Courier new	Representation of parameter values / object settings

Object properties table

Abbreviations used

Access: Access type
- r/w: Read/Write
- ro: Read only
- wo: Write only

Rng. Value Range

Default: Default value

2.7 Directives and guidelines to be adhered to by the operator

The operator must adhere to the following directives and regulations:

- Ensure that the applicable workplace-related accident prevention regulations as well as other applicable national regulation are accessible to the staff.
- An authorized person must ensure, before using the frequency inverter, that the device is used in compliance with its designated use and that all safety requirements are met.
- Additionally, comply with the applicable laws, regulations and directives of the country in which the frequency inverter is used.
- For liquid cooled frequency inverters, comply with the cooling water guideline VGB-R 455 P.
- Any additional guidelines and directives that may be required additionally shall be defined by the operator of the machine/plant considering the operating environment.

2.8 Operator's general plant documentation

- In addition to the Operating Instructions, the operator should issue separate internal user manuals for the frequency inverter. The Operating Instructions of the frequency inverter must be included in the Operating Instructions of the whole plant.

2.9 Operator's/operating staff's responsibilities

2.9.1 Selection and qualification of staff

- Any work on the frequency inverter may only be carried out by skilled personnel. The staff must not be under the influence of any drugs. Note the minimum age required by law. Define the staff's responsibility pertaining to all work on the frequency inverter clearly.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering.
- The operating staff must be trained for the relevant work to be performed.

2.9.2 General work safety

- In addition to the Operating Instructions of the machine/plant, any applicable legal or other regulations relating to accident prevention and environmental protection must be complied with. The staff must be instructed accordingly.
  Such regulations and/or requirements may include, for example, handling of hazardous media and materials or provision/use of personal protective equipment.
- In addition to this Operating Instructions, issue any additional directives that may be required to meet specific operating requirements, including supervision and reporting requirements, e.g. directives relating to work organization, workflow and employed staff.
- Unless approved of expressly by the manufacturer, do not modify the frequency inverter in any way, including addition of attachments or retrofits.
- Only use the frequency inverter if the rated connection and setup values specified by the manufacturer are met.
- Provide appropriate tools as may be required for performing all work on the frequency inverter properly.

2.9.3 Ear protectors

- The frequency inverter produces noise. Due to noise development, frequency inverters should only be installed in normally unstaffed areas.
- Noise emission in operation is < 85 dB(A) in the case of sizes 1 through 7.

2.10 Organizational measures

2.10.1 General

- Train your staff in the handling and use of the frequency inverter and the machine/plant as well as the risks involved.
- Use of any individual parts or components of the frequency inverter in other parts of the operator's machine/plant is prohibited.
- Optional components for the frequency inverter must be used in accordance with their designated use and in compliance with the relevant documentation.

2.10.2 Use in combination with third-party products

- Please note that Bonfiglioli Deutschland GmbH will not accept any responsibility for compatibility with third-party products (e.g. motors, cables or filters).
- In order to enable optimum system compatibility Bonfiglioli Deutschland GmbH offers components facilitating commissioning and providing optimum synchronization of the machine/plant parts in operation.
- If you use the frequency inverter in combination with third-party products, you do so at your own risk.

2.10.3 Handling and installation

- Do not commission any damaged or destroyed components.
- Prevent any mechanical overloading of the frequency inverter. Do not bend any components and never change the isolation distances.
- Do not touch any electronic construction elements and contacts. The frequency inverter is equipped with components which are sensitive to electrostatic energy and can be damaged if handled improperly. Any use of damaged or destroyed components will endanger the machine/plant safety and shall be considered as non-compliance with the applicable standards.
- Only install the frequency inverter in a suitable operating environment. The frequency inverter is exclusively designed for installation in industrial environments.
- If seals are removed from the case, this can result in the warranty becoming null and void.

2.10.4 Electrical connections

- The five safety rules must be complied with.
- Never touch live terminals. In sizes 1 through 7, the DC-link may have dangerous voltage levels up to 3 minutes after shutdown.
- When performing any work on/with the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants of the country in which the frequency inverter is used.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.
- Only connect the frequency inverter to suitable supply mains. The frequency inverter may be operated in TN, TT and IT grid types. Precautions must be taken for operation in IT grids, "Electrical installation". Operation in a corner-grounded TN grid shall not be permissible.

The five safety rules

When working on/in electrical plants, always follow the five safety rules:

- Disconnect
- Secure to prevent restarting
- check for absence of voltage,
- carry out earthing and short-circuiting
- cover or shield neighboring live parts

2.10.5 Safe operation

- During operation of the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to the applicable national and international safety directives.
- During operation, all covers must be installed correctly, and all electrical cabinet doors must be closed. During operation, never open the machine/plant.
- No connection work shall be carried out while power supply is on.
- The machine/plant holds high voltage levels during operation, is equipped with rotating parts (fan) and has hot surfaces. Any unauthorized removal of covers, improper use, wrong installation or operation may result in serious injuries or material damage.
- Some components, e.g. the heat sink or braking resistor, may be hot even some time after the machine/plant was shut down. Don't touch any surfaces directly after shutdown. Wear safety gloves where necessary.
- The frequency inverter may hold dangerous voltage levels until the capacitor in the DC link is discharged. After shutdown, wait for at least 3 minutes before starting any electrical or mechanical work on the frequency inverter. Even after this waiting time, make sure that the equipment is deenergized in accordance with the safety rules before starting the work.
- In order to avoid accidents or damage, only skilled personnel and electricians may carry out the work such as installation, commissioning or setup.
- In the case of a defect of terminals and/or cables, immediately disconnect the frequency inverter from mains supply.
- Persons not familiar with the operation of the frequency inverter and children must not have access to the device.
- Do not bypass nor decommission any protective devices.
- The frequency inverter may be connected to power supply every 60 s. This must be considered when operating a mains contactor in jog operation mode. For commissioning or after an emergency stop, a non-recurrent, direct restart is permissible.
- After a failure and restoration of the power supply, the motor may start unexpectedly if the Auto-start function is activated.
  If staff are endangered, a restart of the motor must be prevented by means of external circuitry.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to EN 60204 and applicable the safety directives (e.g. Working Machines Act or Accident Prevention Directives).

2.10.6 Maintenance and service/troubleshooting

- Visually inspect the frequency inverter when carrying out the required maintenance work and inspections at the machine/plant.
- Perform the maintenance work and inspections prescribed for the machine carefully, including the specifications on parts/equipment replacement.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering. Only use original spare parts.
- Unauthorized opening and improper interventions in the machine/plant can lead to personal injury or material damage. Any repair work may only be carried out by the manufacturer or persons approved/licensed by the manufacturer. Any repair work must be carried out by qualified electricians. Check protective equipment regularly.
- Before performing any maintenance work, the machine/plant must be disconnected from mains supply and secured against restarting. The five safety rules must be complied with.

2.10.7 Final decommissioning

Unless separate return or disposal agreements were made, recycle the disassembled frequency inverter components:

- Scrap metal materials
- Recycle plastic elements
- Sort and dispose of other component materials

Electric scrap, electronic components, lubricants and other utility materials must be treated as special waste and may only be disposed of by specialized companies.

In any case, comply with any applicable national disposal regulations as regards environmentally compatible disposal of the frequency inverter. For more details, contact the competent local authorities.

2.11 Safety Instructions on Function "Safe Torque Off" (STO)

The function "Safe Torque Off" (STO) is a functional safety feature, i.e. it protects staff from damage, provided that projecting, installation and operation are performed properly. This function does not disconnect the device from power supply.

In order to disconnect the device from power supply (e.g. for maintenance work), an "Emergency Stop" provision as per EN 60204 must be installed. The STO function requires a safety module (SMA) to be installed in the main device. Product variants without safety module or with a SMA-NOS-11 module do not provide the STO function.

WARNING

Uncontrolled Starting

Improper installation of the safety circuitry may result in uncontrolled starting of the drive. This may cause death, serious injuries and significant material damage.

- Safety functions may only be installed and commissioned by skilled personnel.

The STO function is not suitable for emergency stop as per EN 60204. An emergency stop can be implemented by installing a mains contactor.
An emergency stop according to EN 60204 must be functioning in all operation modes of the frequency inverter. Resetting of an emergency stop must not result in uncontrolled starting of the drive.
The drive is started again when the function STO is no longer requested. In order to comply with EN 60204, ensure by taking external measures that the drive does not start without prior confirmation.
Without a mechanical brake, the drive will not stop immediately but coast to a standstill. If this may result in personal or material damage.

- Take additional safety measures.
- If persons may be endangered after disconnection of the motor power supply by STO, access to the hazard areas must be prevented until the drive has stopped.
- Check the safety function at regular intervals according to the results of your risk analysis. The manufacturer recommends that the check be performed after one year, at the latest.

The STO function is fail-safe for one fault. However, on rare occasions, the occurrence of component defects may cause jerking of the motor shaft (max. 180°/pole pair, e. g. jerk by 90° with 4-pole motor, 180°/2).

- Check if this causes a dangerous movement of the machine.
- If the STO function is used, the special safety instructions, installation instructions and instructions on use shall be complied with.

WARNING

Dangerous voltage!

The safety function "Safe Torque Off" may only be used if mechanical work must be performed on the driven machines, not for work on live components.

After disconnection of an external DC 24 V power supply, the DC link of the frequency inverter is still connected to mains supply.

Even if power supply to the motor is disconnected, and the motor is coasting to a standstill or has already stopped, high voltages may still be present on the motor terminals.

Before working (e. g. maintenance) on live parts, the plant must always be disconnected from mains supply (main switch). This must be documented on the plant.

When the function "Safe Torque Off" is triggered, the motor is not isolated from the DC link of the frequency inverter. High voltage levels may be present at the motor.

- Do not touch live terminals.

The application manual "Functional Safety Manual" must be complied with, particularly if the safety function described there is used.

3 Storage and transport

3.1 Storage

NOTICE

Damage caused by incorrect storage

Wrong or inappropriate storage may result in damage, e.g. due to moisture and dirt.

- Avoid major temperature variations and high air humidity.
- During storage, protect the device against moisture and dirt.

NOTICE

Damage due to incorrect storage duration

Wrong or inappropriate storage may result in damage.

- The duration of storage without connection to the permissible nominal voltage may not exceed one year. After one year of storage, connect the device to mains voltage for 60 minutes.

If the device is stored for more than one year, contact Bonfiglioli before commissioning.

- The frequency inverters must be stored in an appropriate way. During storage, the devices must remain in their original packaging.
- The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to small temperature deviations only. The requirements

of DIN EN 60721-3-1 for storage, DIN EN 60721-3-2 for transport and labeling on the packaging must be met.

3.2 Special safety instructions for heavy devices

WARNING

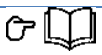


High weight and unusual center of gravity!

Tilting the frequency inverter may result in death or serious injuries. Due to the size and weight of the frequency inverter, there is the risk of accidents during transport. Center of gravity is not the middle of the frequency inverter. The underside of the frequency inverter, due to its design, cannot support the frequency inverter.

- Take utmost care during transport in order to prevent damage and deformation. Transport, attachment and lifting of loads may only be carried out by specially instructed staff who are familiar with the work.
- Only use suitable transport and lifting equipment with sufficient carrying capacity. The lifting cables/chains used must be able to carry the weight of the frequency inverter. Check the ropes or chains for damage.
- Wear appropriate safety clothing.
- When lifting the frequency inverter up ensure that it does not fall over, is displaced, swings out or falls down.
- Before the frequency inverter is lifted up, everybody must have left the work area.
- Before transport, make sure the transport path has sufficient carrying capacity.
- Do not step under suspended loads.
- Do not put the frequency inverter down in upright position without providing a suitable supporting structure.

3.3 Dimensions/weight

For information on the weight and dimensions of the device,  "Technical data" VEC209-.

3.4 Transfer to place of installation

Transfer to the place of installation is done with the product in its original packaging. A forklift truck or crane with crane fork can be used for transfer to the place of installation.

- Apply the fork in the middle of the transport unit.
- Secure the transport unit to prevent it from falling and overturning.
- Lift the transport unit up carefully.
- At the place of installation, put the transport unit down on a level and bearing surface.

3.5 Unpacking the device

- Carefully remove packaging.
- Check if the delivered devices correspond to the order.

- Check the device for transport damage and completeness.
- Any defects/damage must be reported to the supplier immediately.

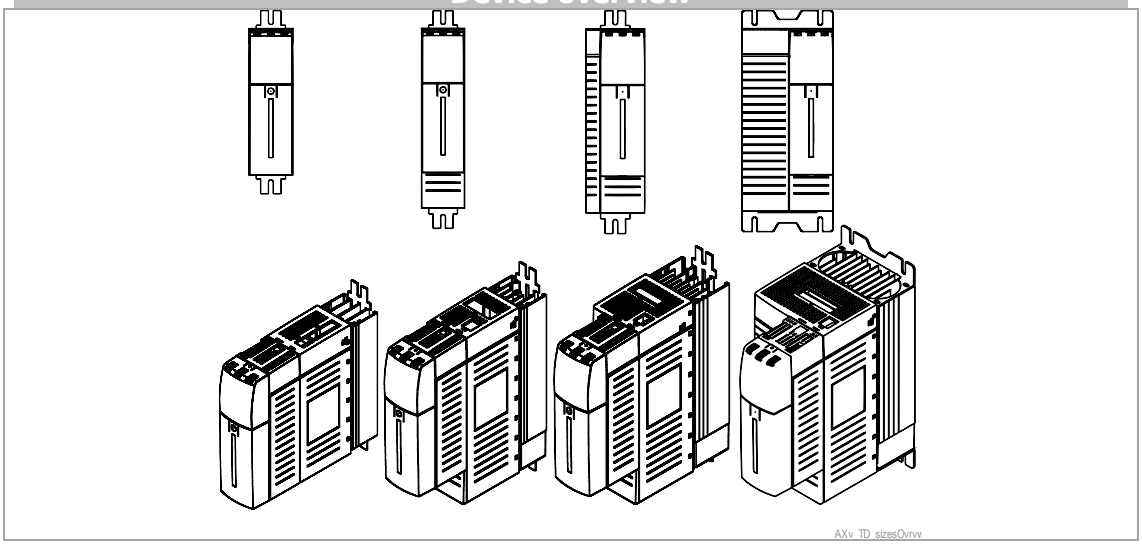
Ensure that all packaging materials are disposed of in an environmentally compatible manner.

4 Device overview

The scope of delivery described can be supplemented by optional components and adapted to the customer-specific requirements.

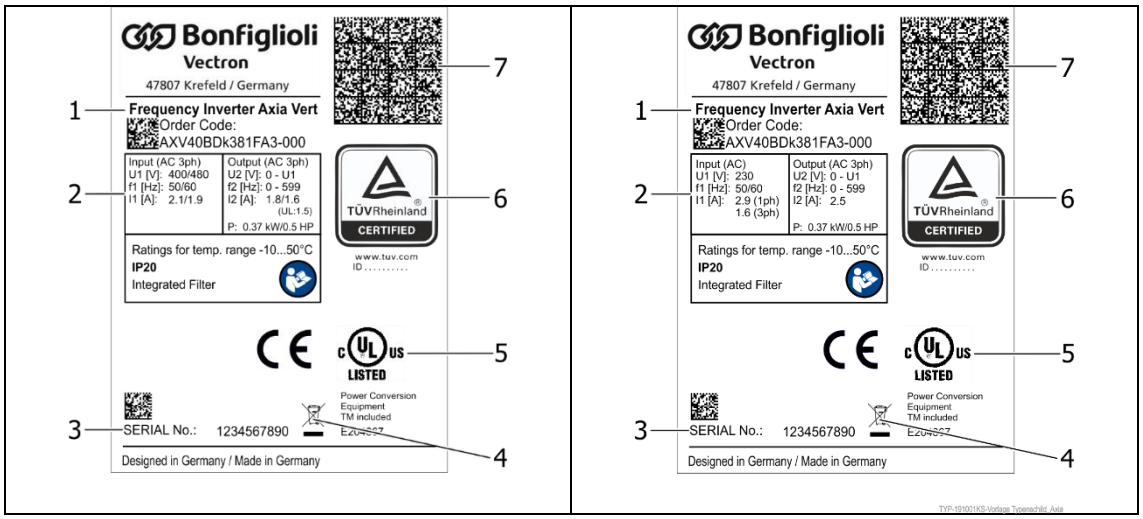
Check incoming goods for quality, quantity and type without delay. Obvious defects such as exterior damage of the packing and/or the unit must be notified to the sender within seven days for insurance reasons.

Device overview



4.1 Type plate

- Identify the type of frequency inverter.
- Check if frequency inverter rated voltage matches the local mains voltage.



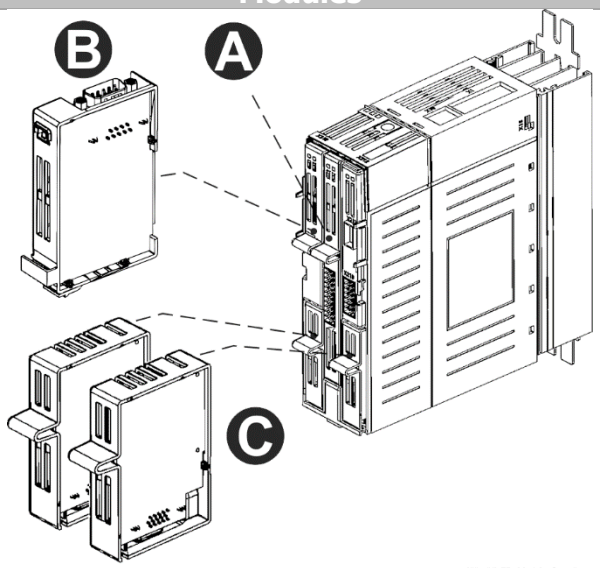
Designation

1	Type identifier e.g. **Frequency Inverter AxiaVert** with the corresponding order code and the data matrix code
2	Rated values (note different voltage ratings)
3	Serial Number with the corresponding data matrix code
4	WEEE symbol
5	Marking for UL61800 (where applicable)
6	Functional Safety marking (where applicable)
7	Data matrix code with relevant information coded

See the Technical data leaflet (VEC209-) for further information.

4.2 Module overview

Modules



A	Safety module (pre-configured)	**B**	Communication module
C	Encoder modules		

The user may not remove or exchange the pre-configured Safety Module.

4.2.1 Communication Module

The table below provides an overview of usable field bus types in relation to the communication expansion modules provided by the manufacturer.

CMA-ETH-01	Communication Ethernet TCP/IP
CMA-IE-01	Communication Industrial Ethernet
CMA-PB-01	Communication Profibus
CMA-CAN-01	Communication CAN
CMA-485-01	Communication RS485/Modbus

For more information ☞ 🕮 communication module manuals.

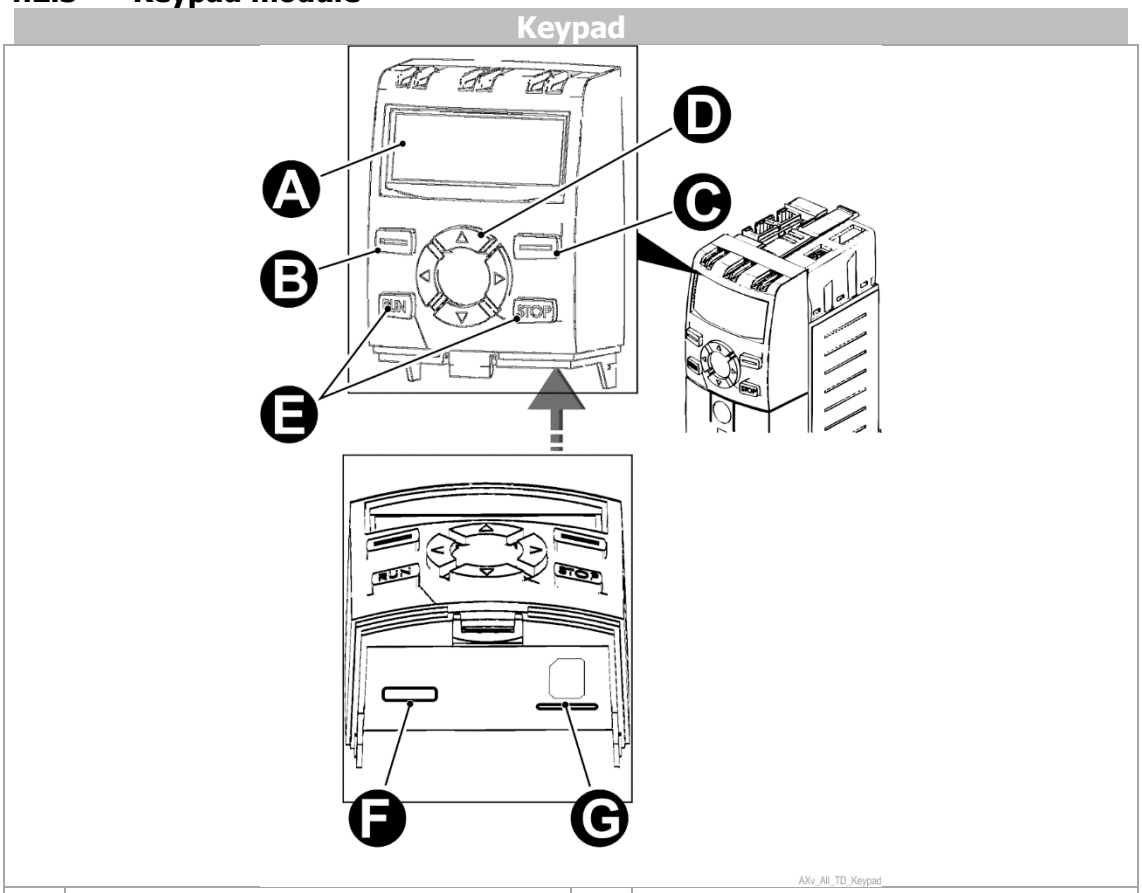
4.2.2 Encoder Module

The table below provides an overview of usable encoder types in relation to the encoder expansion modules provided by the manufacturer.

EMA-ABS-01	TTL, SinCos A/B/C/D/E, SSI, Hiperface, EnDat 2.1
EMA-RES-01	Resolver **(interface X412 only)**
EMA-ENC-11	TTL (500 kHz) + TTL Emulation
EMA-ENC-01	TTL High Performance
EMA-SABS-11	Un-/Safe HDSL Encoder
EMA-SABS-21	Un-/Safe EnDat 2.2 Encoder

For more information ☞ 🕮 encoder module manuals.

4.2.3 Keypad module



A	Display	**B**	Context-dependent function key
C	Context-dependent function key	**D**	Arrow keys
E	RUN and STOP keys	**F**	USB-C Terminal
G	Micro-SD slot		

The Keypad (KPA-DSP-01/KPA-DSP-11) may be mounted/removed during operation. This does not influence the functioning of the inverter.

The Keypad display features:

- Graphic display(176x64 dots)
- Backlight
- 8 digits

For parameterization with the Keypad 7.4.

The KPA-DSP-11 does not include the service interfaces (**F**) USB-C Terminal and (**G**) Micro-SD slot. It provides only the display and the keys as an interface.

Service Interfaces overview (only with KPA-DSP-01)

Micro-SD

The Micro-SD integrated in the **Keypad** module may be used to store data gathered by the inverter (e.g. protocols/logs).

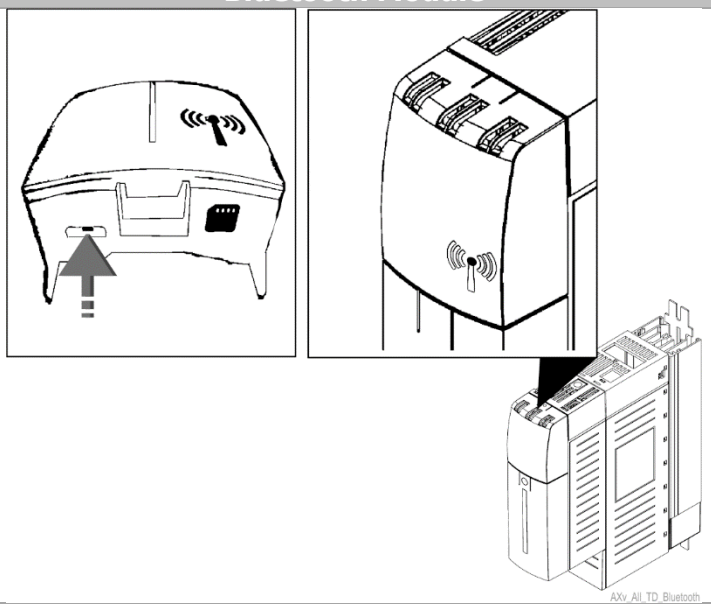
USB-C

Via the USB-C interface integrated in the **Keypad** module, the user can connect the inverter to a PC for configuration/monitoring or for flashing the firmware.

4.2.4 Bluetooth Module (option)

To employ the Bluetooth connection, the **Bluetooth module** (REA-WL-01) must be installed.

Bluetooth Module



↑	Pairing mode button

Via the Bluetooth connection, the user can connect the inverter to a PC or to a mobile device for configuration/monitoring (the mobile device must have the AxiaManager Mobile App installed).

Technical features:

- Bluetooth v4.2 BR/EDR
- Bluetooth Low Energy

For parameterization with the Bluetooth module REA-WL-01 7.5.

5 Mechanical installation

By default, the frequency inverters of degree of protection IP20 are designed for installation in electrical cabinets.

- During installation, comply with the installation and the safety instructions and note the device specifications.

WARNING

Risk of physical injury!

Inappropriate handling of the device may result in serious physical injuries or major material damage.

- To avoid serious physical injuries or major material damage, only qualified persons are allowed to work at the device.

WARNING

Risk of short circuit and fire!

During assembly, make sure that no foreign particles (e.g. chips, dust, wires, screws, tools) can get inside the frequency inverter. Otherwise, there is the risk of short circuits and fire.

- The frequency inverter complies with IP20 ingress protection rating only if the covers, components and terminals are mounted properly.
- Conductive contamination not permissible.
- Mount the device in electrical cabinets with protection class IP54 according to IEC529.
- Overhead installation or installation in horizontal position is not permissible.

5.1 Air circulation

CAUTION

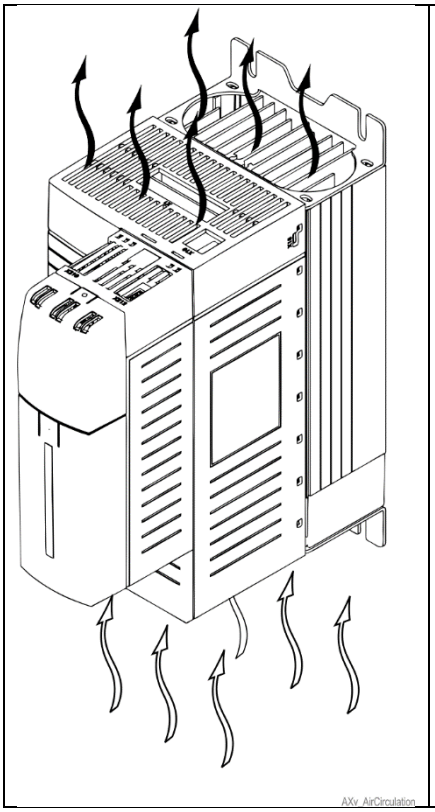
Risk of short circuit and fire!

Insufficient air circulation may result in major material damage, which may in turn result in physical injuries.

- Mount the devices with sufficient top and bottom clearance to other components so that the cooling air can circulate freely.
- Avoid soiling by grease and air pollution by dust, aggressive gases, etc.
- Fan inlet and outlet openings must not be covered.

For information on permissible clearances 5.2.1.

For air cooling:



For cooling the air-cooled frequency inverters, air is taken in through openings in the bottom plate. The air coming from below heats up and escapes through openings in the top of the case.

Another available cooling option is cold plate mounted cooling. Contact your local representative of BONFIGLIOLI for more information.

5.2 Installation process

WARNING

Improper handling

Improper handling may result in serious physical injuries or major material damage.

- To avoid serious physical injuries or major material damage, only qualified persons may work at the device.

CAUTION

Risk of short-circuits and fire

Insufficient air circulation could result in major material damage, which may in turn result in physical injuries.

- Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely.
- Avoid soiling by grease and air pollution by dust, aggressive gases, etc.
- Fan inlet and outlet openings must not be covered.

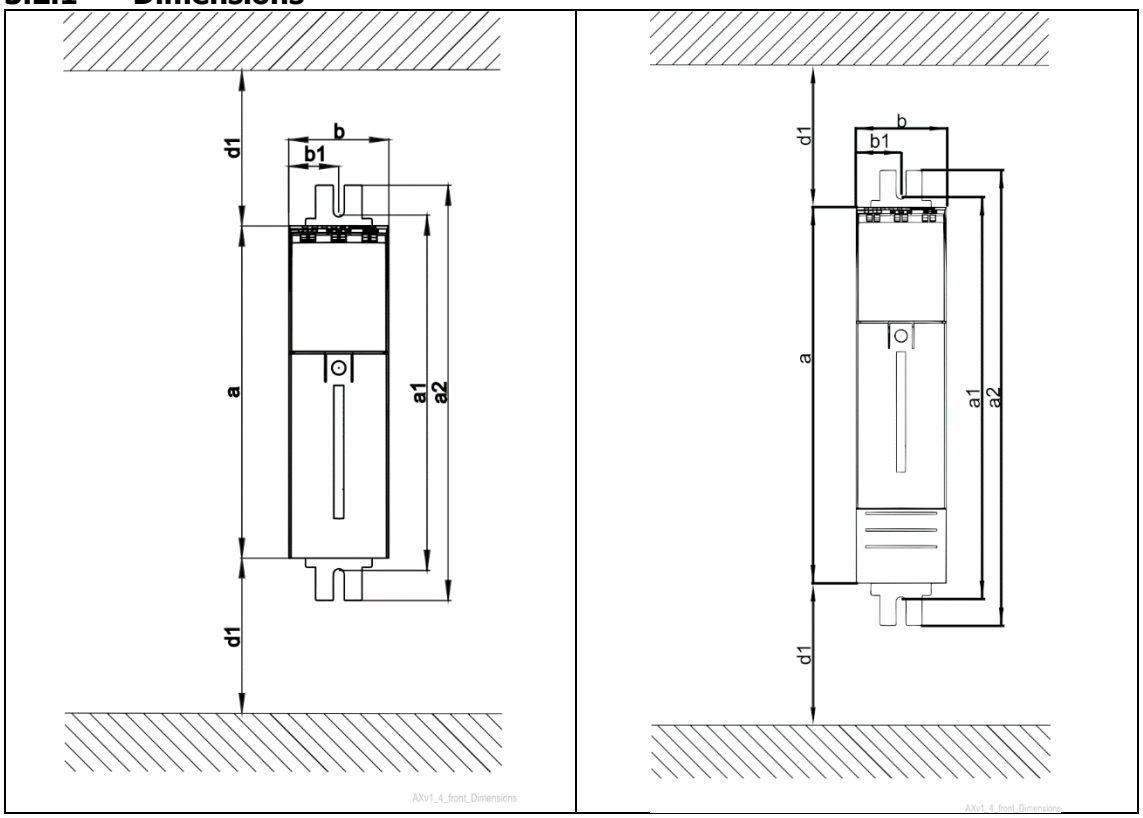
NOTICE

Minor injury/damage

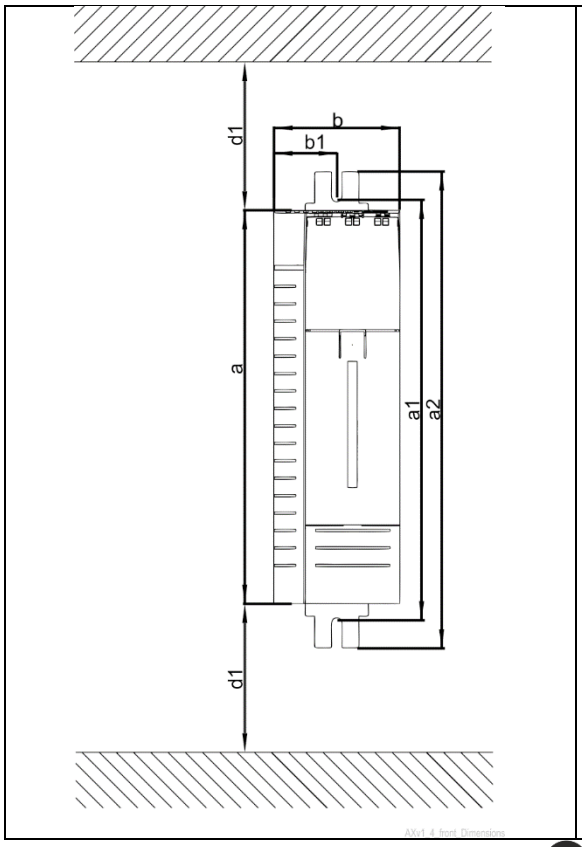
Please note: it is possible to accidentally insert foreign objects or fingers into the ventilator grill at the underside of the device. This may lead to damage of the device and/or to minor injury.

- Avoid inserting foreign objects into the ventilator grill.

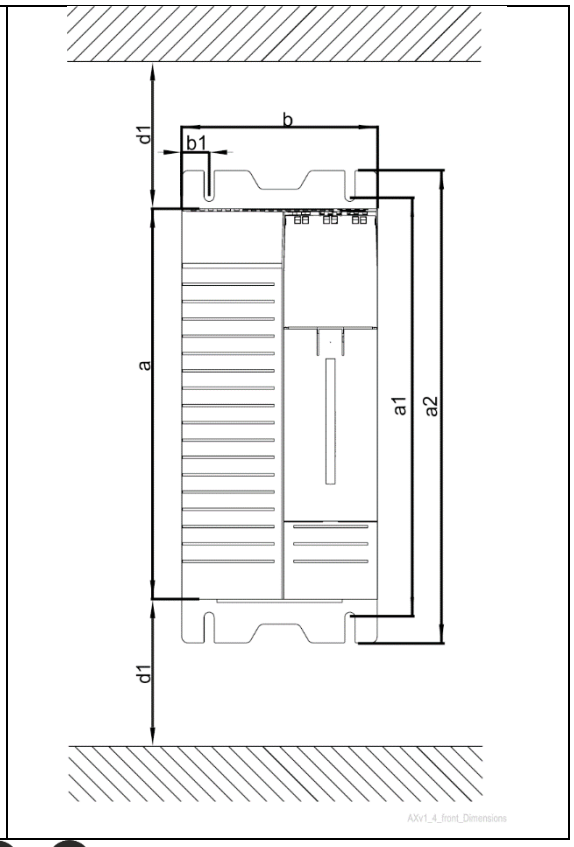
5.2.1 Dimensions



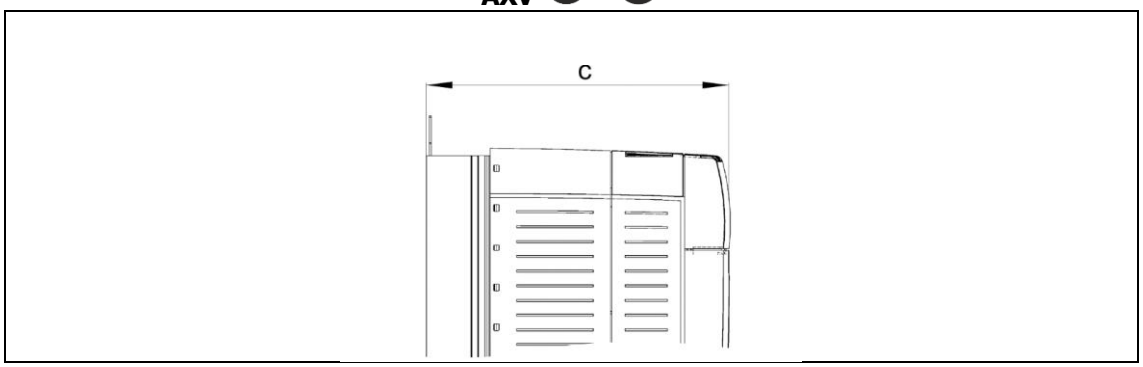
AXv-3



AXv-4

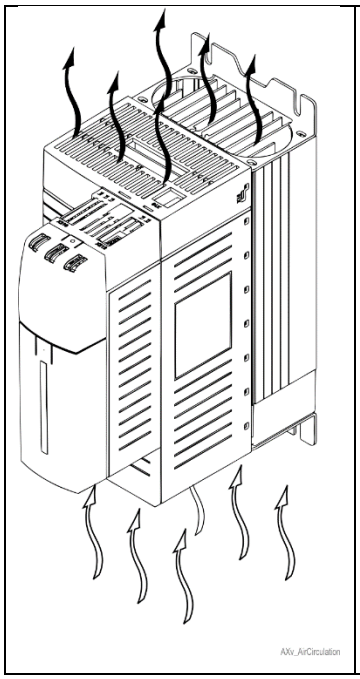


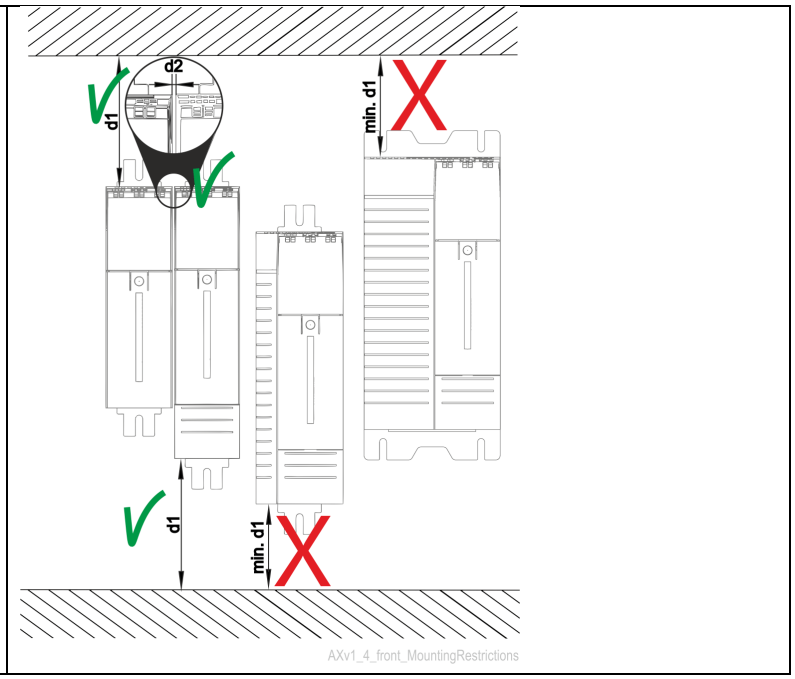
AXv-1 - 4



[mm]:

	a	b	c	a1	a2	b1	x
AXv1	200	60	230	218	230	30	100
AXv2	250	60	230	271	286	30	100
AXv3	250	80	245	271	302.5	40	100
AXv4	250	125	250	271	302.5	17.5	100



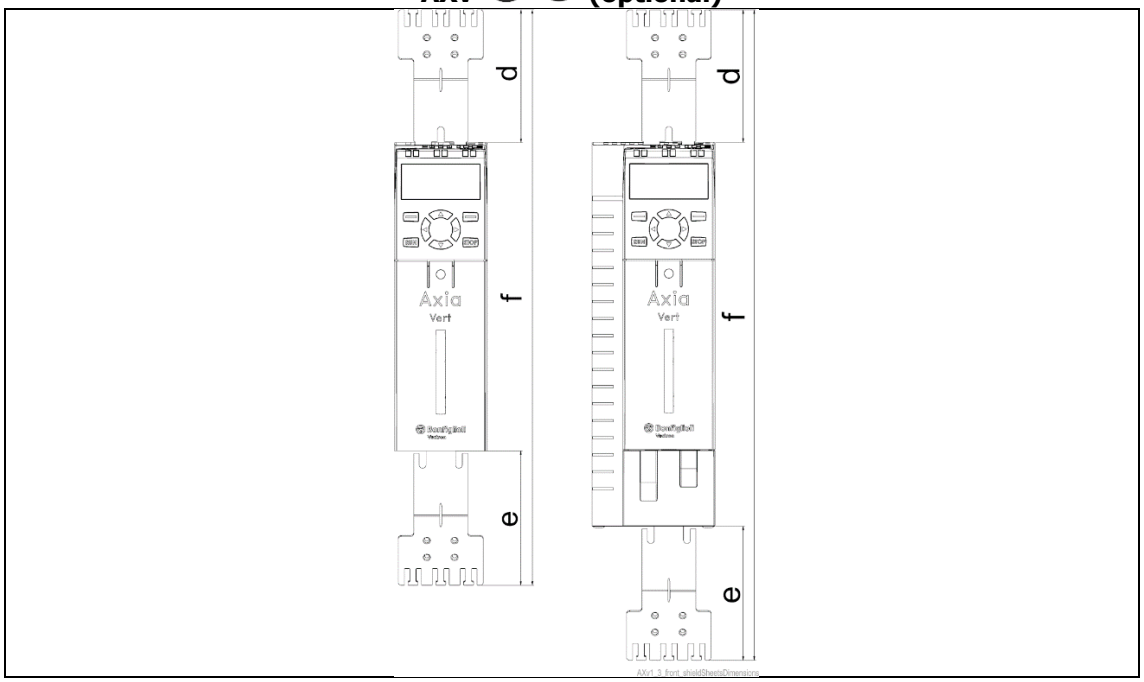


[mm]:

	a	b	c	a1	a2	b1	d1	d2
AXv1	200	60	230	218	230	30	100	0
AXv2	250	60	230	271	286	30	100	0
AXv3	250	80	245	271	302.5	40	100	0
AXv4	250	125	250	271	302.5	17.5	100	0

Variable values above are minimal values

AXv-14 (optional)



[mm]:

	d	e	f
AXv1	86	87	373
AXv2	86	87	423
AXv3	86	87	423
AXv4	86	87	423

5.2.2 Optional components

5.2.2.1 Expansion / Communication modules

The standard and optional modules are recognized during the initialization, and the controller functionality is adjusted automatically. For the information required for installation and handling of the optional modules, refer to the corresponding documentation.

WARNING

High voltage!

The frequency inverter may hold dangerous voltage levels until the capacitor in the DC link is discharged. After shutdown, wait for at least 3 minutes before starting any electrical or mechanical work on the frequency inverter. Even after this waiting time, make sure that the equipment is deenergized in accordance with the safety rules before starting the work.

- The optional hardware modules may only be assembled and disassembled after the frequency inverter has been safely disconnected from power supply.
- The unit may only be connected with the power supply switched off.
- Verify safe isolation from power supply.

To mechanically install any module, insert the module into the corresponding mounting slot until it engages audibly.

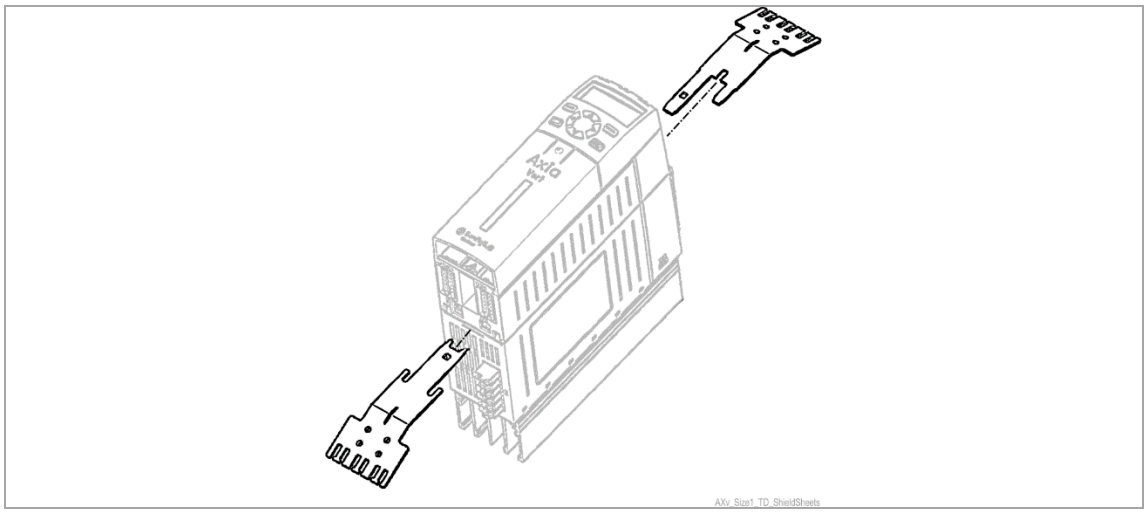
For more information module manuals.

5.2.2.2 Shield sheets

With an optional shield sheet, the shields of cables can be connected to PE potential in order to improve the EMC and EMI characteristics.

Shield sheet for cables

The applicable shield sheets depend on the device size.

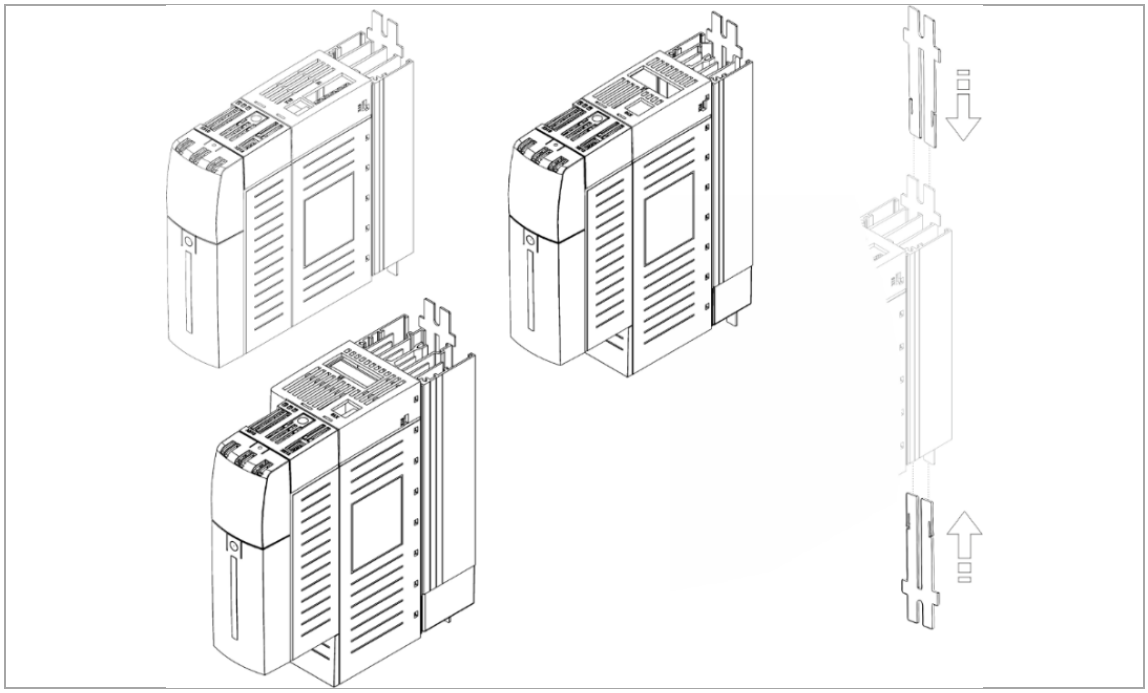


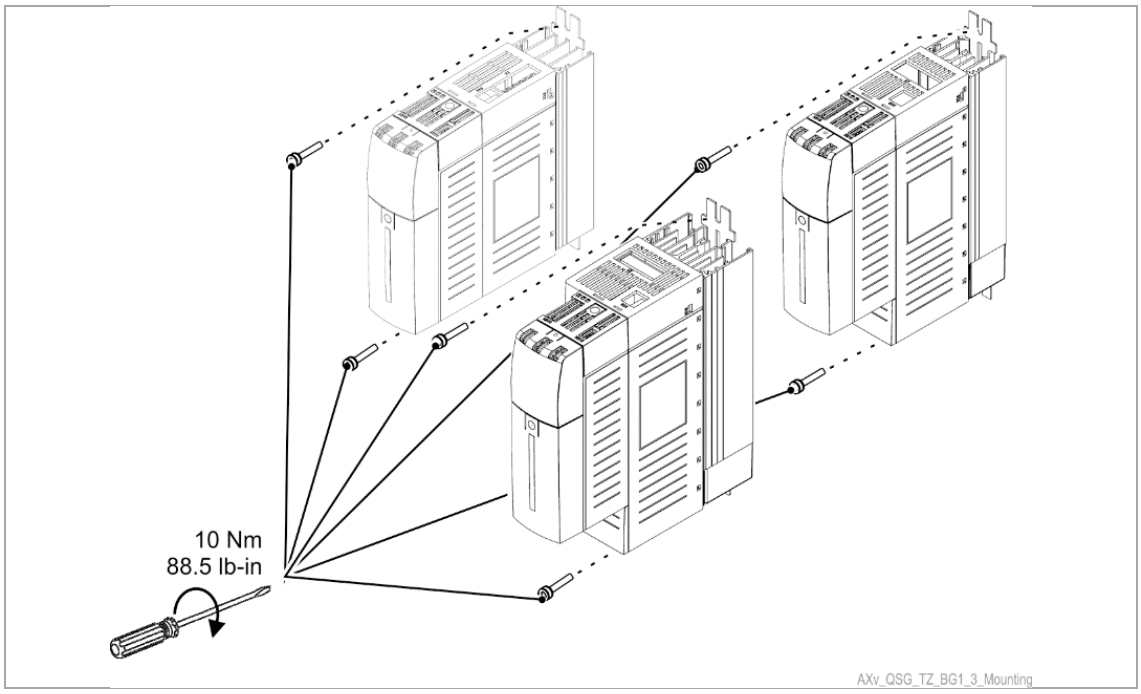
5.2.3 Sizes 1 to 3: AXV 20 (up to 5.5 kW) and 40 (up to 9.2 KW)

The frequency inverter is mounted in a vertical position on the assembly panel by means of the standard fittings. The following illustration shows the different mounting options.

Standard installation

AXv-1 - 3



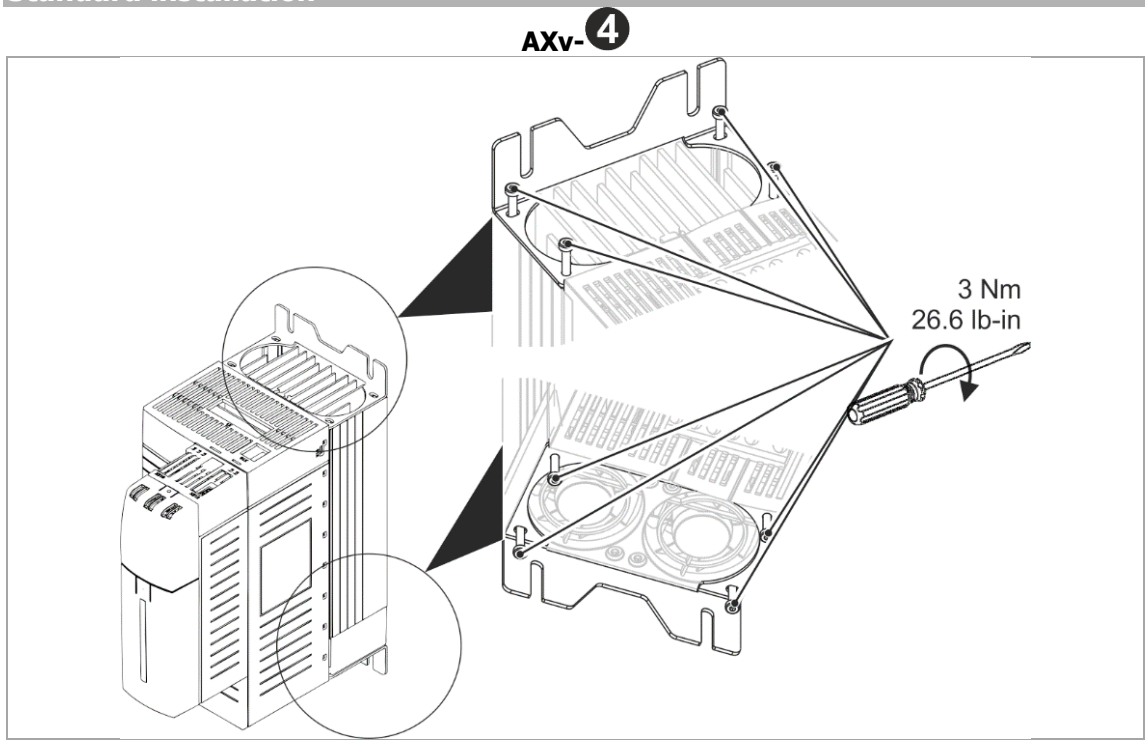


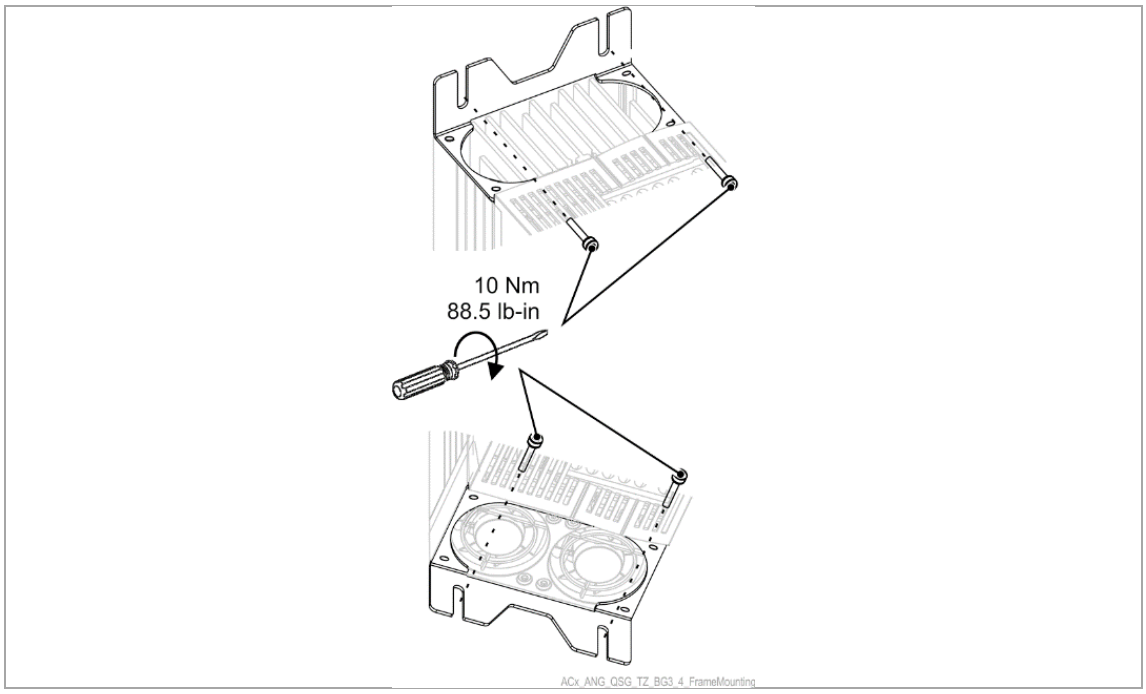
For assembly, insert the long side of the fixing plate in the heat sink and screw to the assembly panel.

5.2.4 Size 4: AXV 20 (7.5 to 9.2 kW) and 40 (11.0 to 15.0 kW)

The frequency inverter is mounted in a vertical position on the assembly panel by means of the standard fittings. The following illustration shows the standard fitting.

Standard installation





For assembly, screw the two fixing brackets to the heat sink of the frequency inverter and the assembly panel.

The frequency inverters are provided with fixing brackets, which are fitted using four thread-cutting screws.

6 Electrical installation

DANGER

Dangerous voltage!

With live mains/DC supply, mains/DC terminals and motor terminals carry dangerous voltage, that will result in high risk of electric shock at contact.

- Adhere to applicable safety rules.
- Before performing any work with the frequency inverter, disconnect the frequency inverter from mains/DC voltage and protect it against being energized unintentionally.
- Verify safe isolation from power supply.
- Before switching mains or DC supply on, re-install any missing covers/terminals.

WARNING

Dangerous voltage!

When the frequency inverter is disconnected from power supply, the mains, DC-link voltage and motor terminals may still be live for some time. Work at the device may only be started once the DC link capacitors have discharged. The time to wait is at least 3 minutes.

- The electrical installation must be carried out by qualified electricians according to the general and regional safety and installation directives.
- The documentation and device specification must be complied with during installation.
- Before any assembly or connection work, discharge the frequency inverter. Verify safe isolation from power supply.
- Do not connect inappropriate voltage sources. The nominal voltage of the frequency inverter must correspond to the supply voltage.
- The frequency inverter must be connected to ground potential.
- Do not remove any covers of the frequency inverter while power supply is on.

The connecting cables must be protected externally, considering the maximum voltage and current values of the fuses. The mains fuses and cable cross-sections must be selected according to EN 602041 and DIN VDE 0298 Part 4 for the nominal operating point of the frequency inverter. Only use copper cables with a temperature range of 60 / 75 °C.

The fuses must be chosen depending on the individual application. The values recommended in the technical data apply for the continuous rated operation without overload.

The frequency inverters must be grounded properly, i.e. with large connection area and with good conductivity. The leakage current of the frequency inverters may exceed AC 3,5 mA or DC 10 mA. According to EN 61800-5-1, a permanent connection must be provided. The protective conductor cross-section required for grounding the fixing plate must be selected according to the size of the unit. In these applications, the cross-section must correspond to the recommended cross-section of the wire.

CAUTION

Possible dirt ingress

IP20 ingress protection rating is only achieved with terminals plugged and with properly mounted covers. Improperly mounted covers lead to ingress of dirt or foreign objects into the housing of the device and might lead to malfunctions.

- Take care to mount all covers correctly and properly.
- Insert all terminal connectors and mount all covers before starting operation.

Connection conditions

- The frequency inverter is suited for connection to the public or industrial supply mains according to the technical data. If the transformer output of the supply mains is ≤ 500 kVA, a mains commutation choke is only necessary for the frequency inverters identified in the technical data. The other frequency inverters are suitable for connection without a mains commutating choke with a relative mains impedance < 1%.
- Verify, based on the specifications of EN 61000-3-2, if the devices can be connected to the public supply means without taking additional measures. The frequency inverters ≤ 9.2 kW with integrated EMC filter comply with the emission limits of the product standard EN 61800-3 up to a motor cable length of 10 m, without additional measures being required. Increased requirements in connection with the specific application of the frequency inverter must be met by means of optional components. Commutating chokes and EMC filters are optionally available for the series of devices.
- Operation on an unearthed mains (IT mains) is admissible when using devices specifically constructed for this purpose. Please contact BONFIGLIOLI for details.
- Interference-free operation with residual current device is guaranteed at a tripping current 30 mA if the following points are observed:
- One-phase power supply (L1/N): Pulse current and alternating current sensitive residual current devices (Type A acc. to EN 61800-5-1)
- Two-phase power supply (L1/L2) or Three-phase power supply (L1/L2/L3): All-current sensitive residual current devices (Type B acc. to EN 61800-5-1)
- Use EMC filters with reduced leakage current or, if possible, do not use EMC filters at all.
- The length of the shielded motor cable is ≤ 10 m and there are no additional capacitive components between the mains or motor cables and PE.

NOTICE

Unexpected current

Please note (according to EN 61800-5-1): This product may cause direct current in the protective earth conductor.

- Where residual current devices (RCD) or residual current monitors (RCM) are used as a protection against direct or indirect contact, only RCDs / RCMs of Type B are permissible on the power supply side of this product.

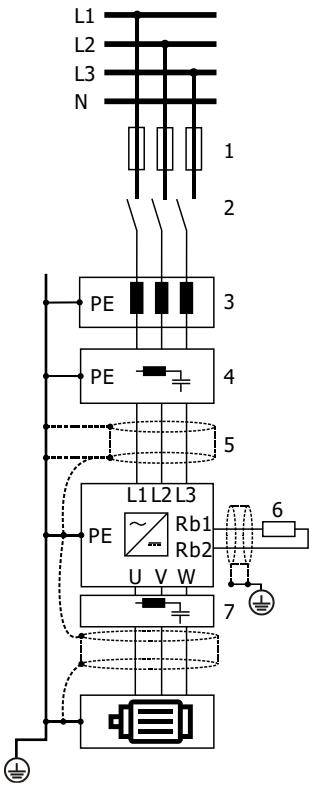
- Select the fuses depending on the specific application. The safety recommendations in the Technical Data are valid for continuous operation without overload.

6.1 EMC information

The frequency inverters are designed according to the requirements and limit values of product standard EN 61800-3 with an interference immunity factor (EMI) for operation in industrial applications. Electromagnetic interference must be avoided by expert installation and observation of the specific product information.

Measures

- Install the frequency inverters and commutating chokes on a metal mounting panel. Ideally, the mounting panel should be galvanized, not painted.
- Provide proper equipotential bonding within the system or plant. Plant components such as electrical cabinets, control panels, machine frames must be connected by means of PE cables, i.e. sufficient area and with good conductivity.
- The shield of the control cables must be connected to ground potential properly, i.e. with good conductivity, on both sides (shield clamp). Mount shield clamps for cable shields close to the unit.
- Connect the frequency inverter, the commutating choke, external filters and other components to an earthing point via short cables.
- Excessive cable length and loosely suspended cabling must be avoided.
- Contactors, relays and solenoids in the electrical cabinet must be provided with suitable interference suppression components.



1 fuse
2 circuit breaker
3 line choke (optional)
4 input filter (optional)
5 cable shield
6 braking resistor (optional)
7 output filter (optional)

Line choke

Line chokes reduce mains harmonics and reactive power. In addition, a longer service life of the frequency inverter is possible. When using a line choke, note that line chokes may reduce the maximum output voltage of the frequency inverter.

The line choke must be installed between the mains connection and the input filter.

Input filter

Input filters reduce grid-bound, high-frequency radio interference voltage.

- Install the input filter on the mains side upstream of the frequency inverter.

The frequency inverters meet the requirements of the low voltage directive 2014/35/EU and the requirements of the EMC Directive 2014/30/EU. The EMC product standard EN 61800-3 relates to the drive system. The documentation provides information on how the applicable standards can be complied if the frequency inverter is a component of the drive system. The declaration of conformity must be issued by the supplier of the drive system.

6.2 Dimensioning of conductor cross-section

The connecting cables must be protected externally, considering the maximum voltage and maximum current values of the fuses. The line fuses and cable cross-sections must be dimensioned according to EN 602041 and DIN VDE 0298 Part 4 for the nominal operating point of the frequency inverter.

The fuses must be chosen depending on the individual application. The values recommended in the technical data apply for the continuous rated operation without overload.

6.2.1 Mains Cable and Motor Cable

The cable dimensions should be selected according to the current load and the expected voltage drop. Select the cable cross-section of the cables such that the voltage drop is as small as possible. If the voltage drop is too great, the motor will not reach its full torque. Also comply with any additional national and application-specific regulations and the separate UL instructions. For typical mains fuses, ☞ 🕮 "Technical data" (document code VEC209-).

According to EN61800-5-1, the cross-sections of the PE conductor shall be dimensioned as follows:

Cable cross-section	Protective conductor
up to 10 mm²	Install two PE conductors of the same cross-section as the cable, or one PE conductor of 10 mm² in cross-section.
10…16 mm²	Install one PE conductor of the same size as the cable.
16…35 mm²	Install one PE conductor of a size of 16 mm².
> 35 mm²	Install one PE conductor of half the size of the cable.

NOTICE

Recommendation

Due to small connector size, the user may not be able to connect two PE connectors at the same terminal. In size 1 and size 2 devices, the manufacturer recommends connecting the PE cables to available PE rails, when needed.

The following tables provide an overview of typical cable cross-sections (copper cable with PVC insulation, 30 °C ambient temperature, continuous mains current max. 100% rated input current, installation variant C). Actual mains cable cross-section requirements may deviate from these values depending on actual operating conditions.

Typical cross-sections (0.25 kW ... 15 kW)

The following tables provide an overview of typical cable cross-sections (copper cable with PVC insulation, 30 °C ambient temperature, continuous mains current max. 100% rated input current, installation variant B2). Actual mains cable cross-section requirements may deviate from these values depending on actual operating conditions.

230 V: Three-phase connection

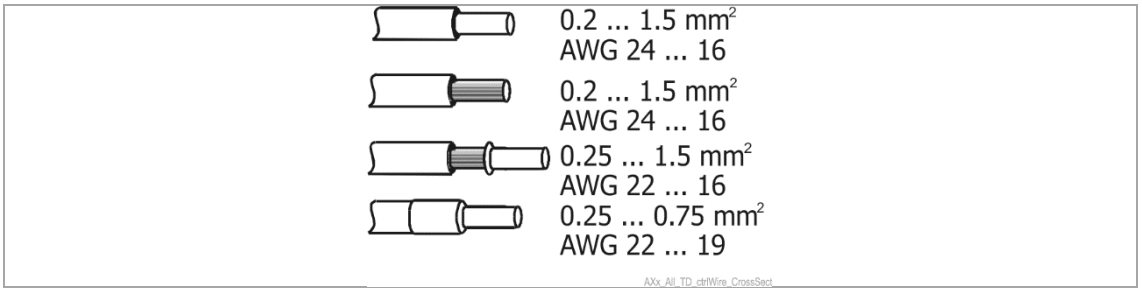
AXV20	Mains cable [mm²]	PE-conductor [mm²]	Motor cable [mm²]	Strip length [mm]	Ferrule length [mm]
0,25 kW 0,37 kW 0,55 kW 0,75 kW 1,1 kW	1,5	2x1,5 or 1x10	1,5	10 / 12	10 /12
1,5 kW 2,2 kW 3 kW					
4 kW 5,5 kW	4	2x4 or 1x10	4	12 /14	12 / 14
7,5 kW	6	2x6 or 1x10	6	12 /14	12 / 14
9,2 kW	10	1x10	10	12 / 15	12 / 15

400V: Three-phase connection

AXV40	Mains cable [mm²]	PE-conductor [mm²]	Motor cable [mm²]	Strip length [mm]	Ferrule length [mm]
0,25 kW 0,37 kW 0,55 kW 0,75 kW 1,1 kW 1,5 kW	1,5	2x1,5 or 1x10	1,5	10 / 12	10 /12
1,85 2,2 kW 3 kW 4 kW					
5,5 kW 7,5 kW	2,5	2x2,5 or 1x10	2,5	12 /14	12 / 14
9,2 kW 11 kW	4	2x4 or 1x10	4	12 /14	12 / 14
15 kW	6	2x6 or 1x10	6	12 /14	12 / 14

6.2.2 Control cable

Type	Ferrule type	Cross section [mm²]
Solid	-	min. 0.2 max. 1.5
Stranded	-	min. 0.2 max. 1.5
Flexible	with ferrule without plastic sleeve	min. 0.25 max. 1.5
Flexible	with ferrule with plastic sleeve	min. 0.25 max. 0.75



6.3 Connecting Mains / DC

DANGER

Dangerous voltage!

When the frequency inverter is disconnected from power supply, the mains, DC-link voltage and motor terminals may still be live for some time. Work with the device may only be started once the DC link capacitors have discharged. The time to wait is at least 3 minutes.

- Disconnect the frequency inverter from mains/DC voltage and protect it against being energized unintentionally.
- Verify safe isolation from power supply.

CAUTION

Device damage possible!

Routing the lines inappropriately may lead to device damage.

- The control, mains and motor lines must be kept physically separate from one another.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.

CAUTION

Device damage possible!

Selecting inappropriate cable quality may lead to device damage.

- The connected cables must withstand at least temperatures of 65 °C in operation.

- The mains fuses and cable cross-sections must be selected according to EN 602041 and DIN VDE 0298 Part 4 for the nominal operating point of the frequency inverter.
- Carry out the electrical installation according to the device specifications and the applicable standards and directives.

For more details concerning the DC interlink the application manual VEC1en55.

6.3.1 AXV20 (≤ 3.0 kW) AXV40 (≤ 4.0 kW)

WARNING

Short-circuit!

Swapping terminals will lead to short-circuit and malfunction!

- Strictly observe the terminals as designated on the connectors.

NOTICE

Connectors swap protection

Please note: the connectors are mechanically coded to fit on the mains side or on the motor side, respectively.

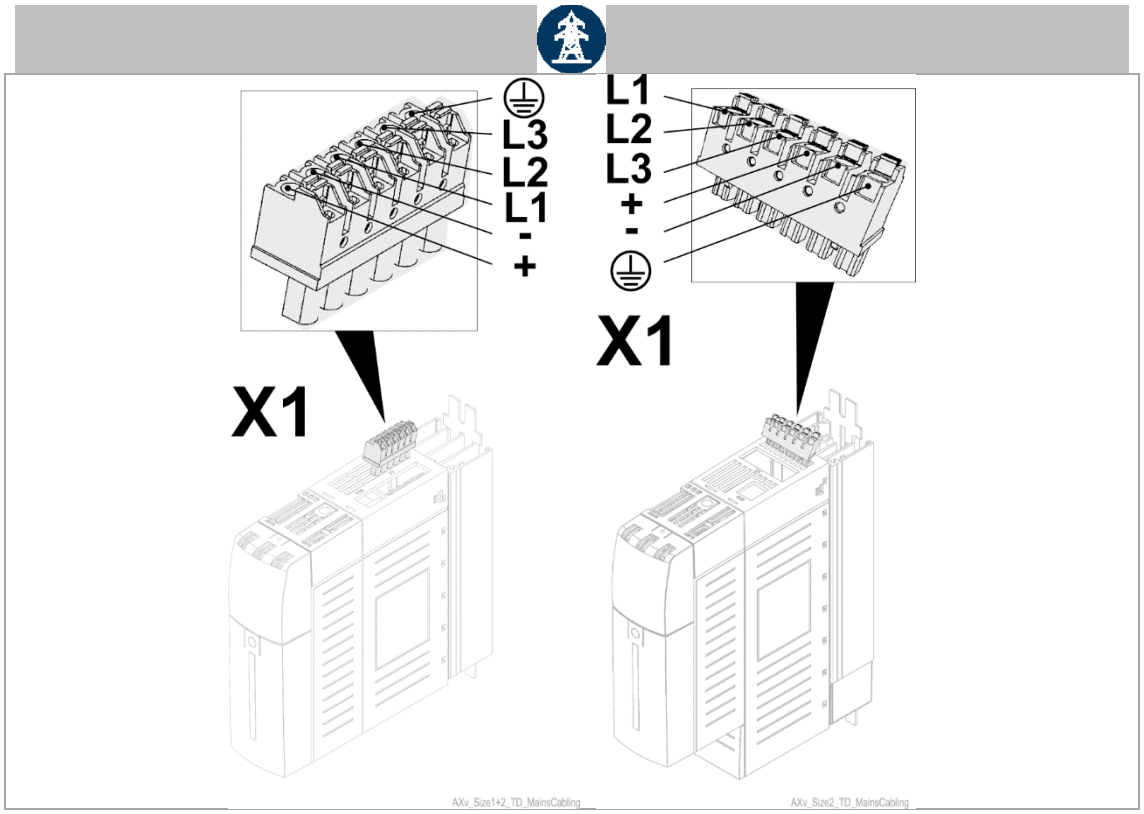
- Observe the connector coding to correctly select the connectors for the intended purpose.

NOTICE

Connectors swap protection

Please note: the connectors for size 1 devices are colored orange to prevent wrong connection.

- Only use orange connectors for size 1 devices.



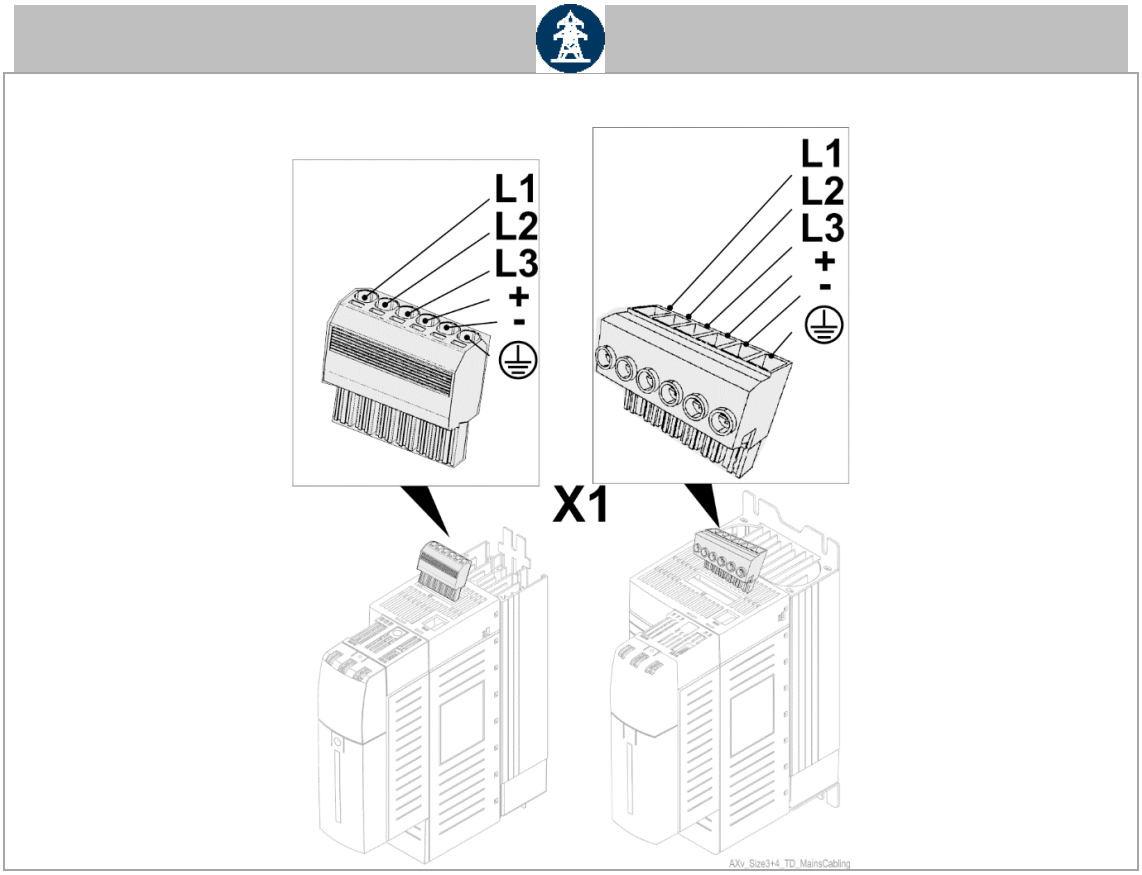
6.3.2 AXV20 (4.0...9.2 kW) AXV40 (5.5...15.0 kW)

NOTICE

Connectors swap protection

Please note: the connectors are mechanically coded to fit on the mains side or on the motor side, respectively.

- Observe the connector coding to correctly select the connectors for the intended purpose.



6.4 Connecting Motor

DANGER

Dangerous voltage!

When the frequency inverter is disconnected from power supply, the mains, DC-link voltage and motor terminals may still be live for some time. Work with the device may only be started once the DC link capacitors have discharged. The time to wait is at least 3 minutes.

- Disconnect the frequency inverter from mains/DC voltage and protect it against being energized unintentionally.
- Verify safe isolation from power supply.

CAUTION

Device damage possible!

Routing the lines inappropriately may lead to device damage.

- The control, mains and motor lines must be kept physically separate from one another.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.

NOTICE

Minor injury/damage

Please note: it is possible to accidentally insert foreign objects or fingers into the ventilator grill at the underside of the device. This may lead to damage of the device and/or to minor injury.

- Avoid inserting foreign objects into the ventilator grill.

The manufacturer recommends using shielded cables for the connection of the motor and the braking resistor to the frequency inverter. The shield must be connected to PE potential properly, i.e. with good conductivity, on both sides. The control, mains and motor lines must be kept physically separate from one another.

- Comply with the applicable limits stipulated in the relevant national and international directives as regards the application, the length of the motor cable and the switching frequency.

6.4.1 Motor cable length, without filter

Without an installed output filter the specified lengths of the motor cables must not be exceeded.

Permissible length of motor cable without output filter

Frequency inverter	unshielded cable	shielded cable
0.25 kW … 1.5 kW	50 m	25 m
1.85 kW … 4.0 kW	100 m	50 m
5.5 kW … 9.2 kW	100 m	50 m
11.0 kW … 15.0 kW	100 m	50 m

Frequency inverters ≤ 9.2 kW with integrated EMC filter comply with the emission limits stipulated in EN 61800-3 if the motor cable is no longer than 10 m. Frequency inverters ≤ 9.2 kW of size 3 with integrated EMC filter comply with EN 61800-3 if the motor cable is no longer than 20 m. Customer-specific requirements can be met using an optional filter.

6.4.2 Motor cable length, with output filter dU/dt

Longer motor cables can be used after taking appropriate technical measures, e.g. use of low-capacitance cables and output filters. The following table contains recommended values for the use of output filters.

Motor cable length with output filter

Frequency inverter	unshielded cable	shielded cable
0.25 kW … 1.5 kW	upon request	upon request
1.85 kW … 4.0 kW	150 m	100 m

Motor cable length with output filter		
5.5 kW … 9.2 kW	200 m	135 m
11.0 kW … 15.0 kW	225 m	150 m

6.4.3 Motor cable length, with sinus filter

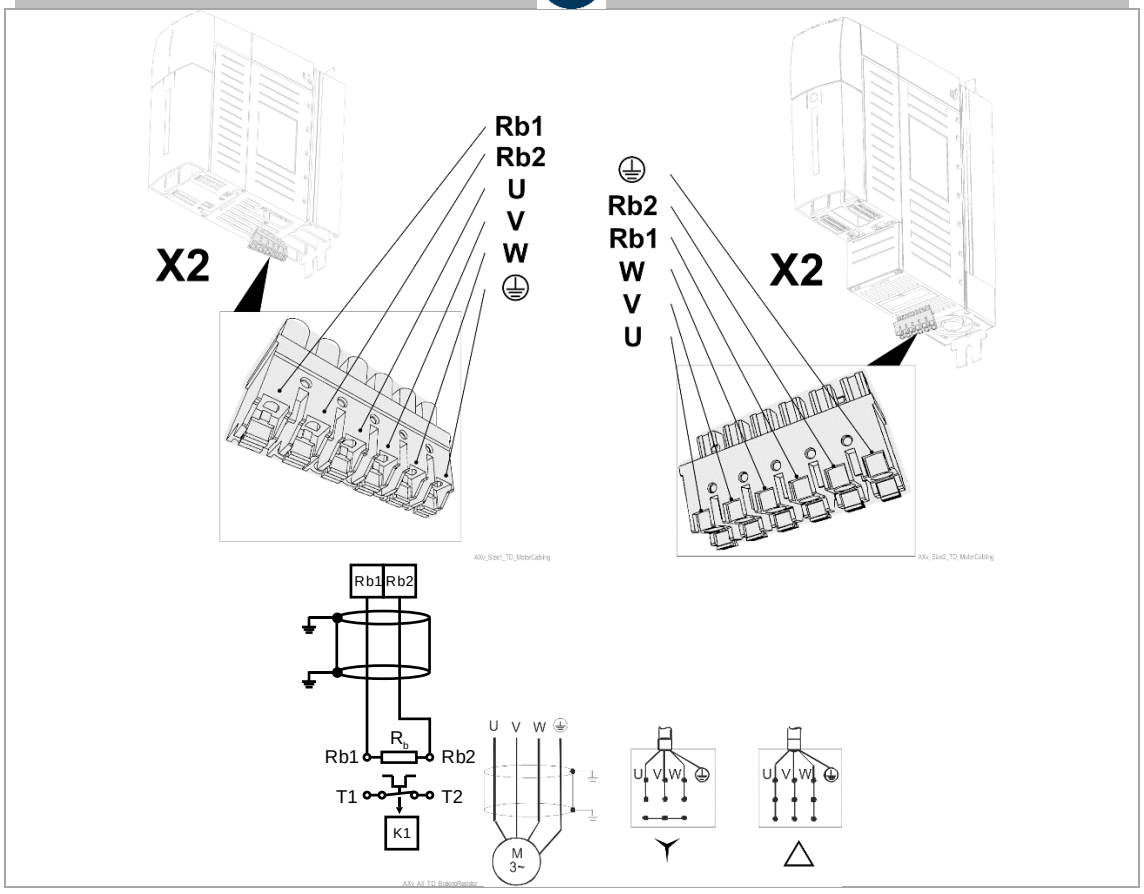
Motor cables can be much longer if sinus filters are used. By conversion in sinus-shaped currents, high-frequency portions which might limit the cable length are filtered out.

- Also consider the voltage drop across the cable length and the resulting voltage drop at the sinus filter. The voltage drop results in an increase of the output current. Check that the frequency inverter can deliver the higher output current. This must be considered in the projecting phase already.
- If the motor cable length exceeds 300 m, please consult the manufacturer.

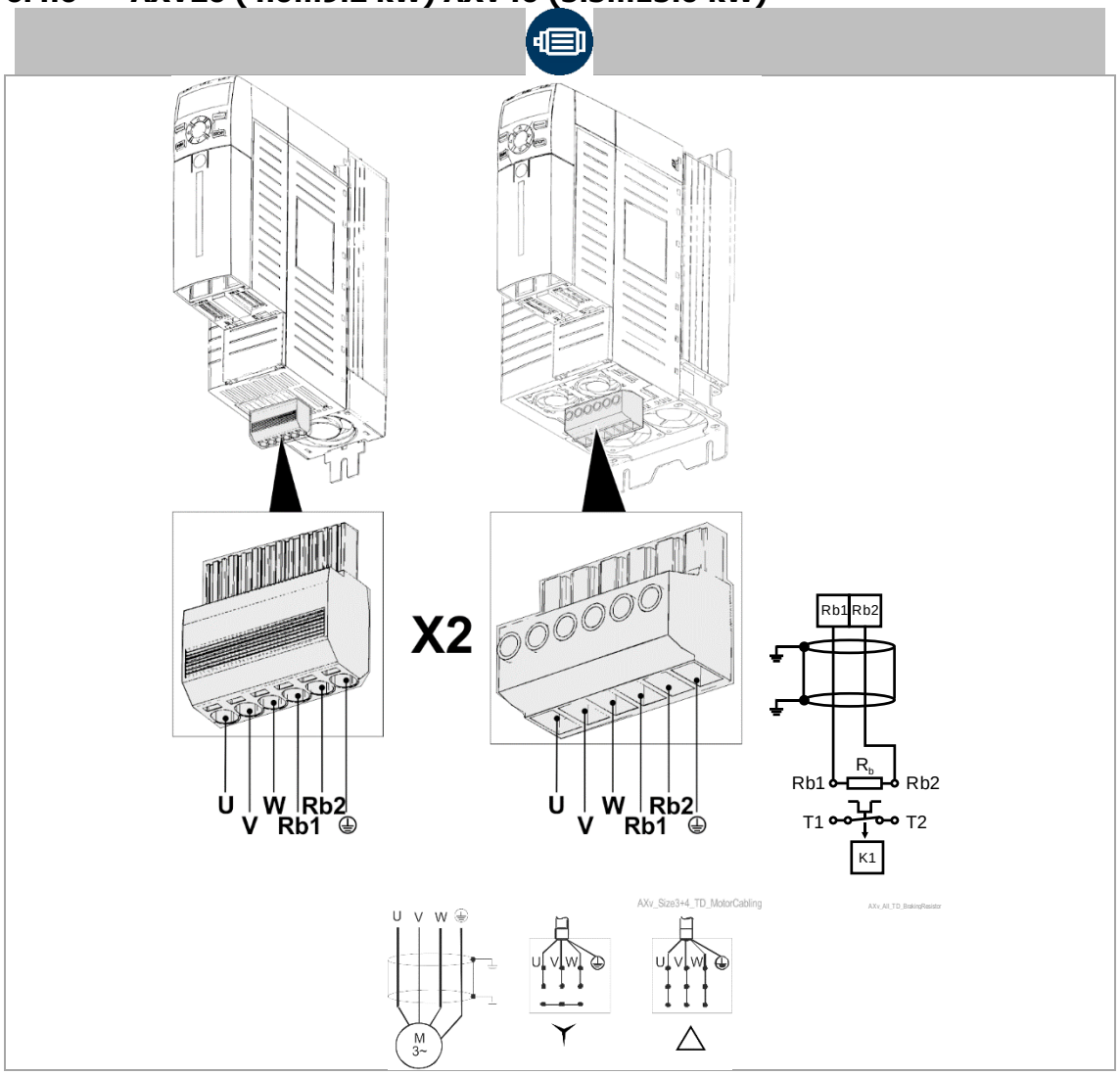
6.4.4 Group drive

- In the case of a group drive (several motors at one frequency inverter), the total length shall be divided across the individual motors according to the value given in the table. Please note that group drive with synchronous servomotors is not possible.
- Use a thermal monitoring element on each motor (e.g. PTC resistor) in order to avoid damage.

6.4.5 AXV20 (≤ 3.0 kW) AXV40 (≤ 4.0 kW)



6.4.6 AXV20 (4.0...9.2 kW) AXV40 (5.5...15.0 kW)



6.5 Connecting Braking Resistor

Install a braking resistor if feedback of regenerative energy is expected. Overvoltage shutdowns can be avoided by this.

DANGER

Dangerous voltage!

When the frequency inverter is disconnected from power supply, the mains, DC-link voltage and motor terminals may still be live for some time. Work at the device may only be started once the DC link capacitors have discharged. The time to wait is at least 3 minutes.

- Disconnect the frequency inverter from mains voltage and protect it against being energized unintentionally.
- Verify safe isolation from power supply.

WARNING

Hot surface

The surface of the braking resistor may reach a high temperature during operation and may remain hot for some time after operation.

- Do not touch the braking resistor while the frequency inverter is in operation or ready for operation. Non-compliance may result in burns.
- Install a safeguard to prevent touching or provide a warning sign.
- Do not install the braking resistor near inflammable or heat-sensitive materials.
- Do not cover the braking resistor.

The manufacturer recommends using a temperature switch. Depending on the resistor selected, the temperature switch is integrated as a standard or available as an option. The temperature switch disconnects the frequency inverter from mains supply if the braking resistor is overloaded/overheated.

Using braking resistors without temperature switches may result in critical situations.

Braking resistors are connected via terminal at the interface X2.

- Limit the length of the braking resistor cables to the necessary minimum.

6.6 Control interfaces

CAUTION

Component damage

The control terminals may be energized.

- The unit may only be connected with the power supply switched off.
- Verify safe isolation from power supply.
- Switch off power supply before connecting or disconnecting the control inputs and outputs. Otherwise, components may be damaged.

The digital inputs can also be used to connect an encoder. For more information on encoder wiring ☞ 6.8.

6.6.1 Basic IO

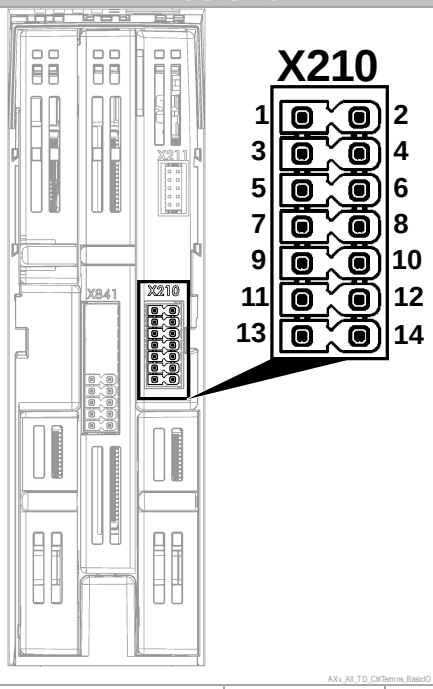
NOTICE

Device damage possible

The digital inputs and the DC 24 V terminal of the electronic control equipment can withstand external voltage up to DC 30 V. Higher voltages may damage the unit.

- Avoid higher voltage levels.
- Use suitable external power supply units with a maximum output voltage of DC 30 V or use appropriate fuses to protect the unit.

Basic IO



1	DC 24 V Out (24Vout)	**2**	GND
3	Digital In 1 (IN1D)	**4**	Digital In 4 (IN4D) (HTL in B)
5	Digital In 2 (IN2D)	**6**	Digital In 5 (IN5D) (HTL in Z)
7	Digital In 3 (IN3D) (HTL in A)	**8**	Digital in/out 6 (IN6D/OUT6D)
9	Analog MFI (MFI2A)	**10**	GND
11	Analog Out (OUT1A)	**12**	GND
13	Analog MFI (MFI1A)	**14**	GND

NOTICE

Incorrect measurement

If incorrectly grounded, the analog signal may lead to an incorrect PTC measurement.

- Please note: **when** connecting an **analog PTC signal** to X210.9, use X210.2 for ground connection.
- For all other analog signals use X210.10, X210.12 or X210.14.

NOTICE

Safe isolation

For PTC measurement at X210.9, the terminal must be isolated from the motor potential.

- Ensure the safe isolation inside the motor.

Technical characteristics: Basic IO terminal X210

Term.	Description
X210.1	Voltage output 24V (-15% / +20%), I_{max}=200 mA
X210.2	Ground / GND 24 V
X210.3	**Digital input**, Umax=30 V, 10 mA at DC 24 V, input resistance: 2.3 kΩ, PLC-compatible, response time approx. 10 ms Low: 0 V … 3 V, High: 12 V … 30 V 24V Digital Input Type3 (IEC0x22B532)
X210.4	
X210.5	
X210.6	
X210.7	

Technical characteristics: Basic IO terminal X210	
Term.	**Description**
X210.8	Digital in/out, Low: 0 V … 3 V, High: 12 V … 30 V, 24V Digital Input Type3 (IEC0x22B532), max. 50 mA
X210.9	Multifunction input MFI2, Analog signal: PT100/PT1000/KTY or PTC (range 50Ω - ca. 4300Ω), -10...+10 V or 0…+10 V, PLC compatible
X210.10	GND
X210.11	Analog signal out: 0…+10V / Output Voltage Reference - resolution 12 bit, ≤ 5 mA (true analog output - not PWM)
X210.12	GND
X210.13	Multifunction input MFI1, Analog signal in: resolution 12 Bit, 0...+10 V (Ri=70 kΩ), or current 0…20 mA (Ri = 250 Ω)
X210.14	GND

The Basic IO interface allows connecting an HTL encoder. When the HTL encoder is connected to the interface, another functionality is not available at the corresponding terminals anymore. Frequency threshold for HTL input is 300 kHz. To power the encoders, you can use the terminal X210.1 or an external voltage source. If the terminal X210.1 is used to power the encoder, observe the max. load capacity of the interface 2 W.

6.6.2 Safety modules (configuration-dependent)

Depending on your product configuration, the inverter may include a Basic Safety Module (SMA-STO-11), a Standard Safety Module (SMA-SS1-11), an Extended Safety Module (SMA-MOT-11) or (SMA-NOS-11) no safety. The following chapter refers to the typical configurations.

DANGER

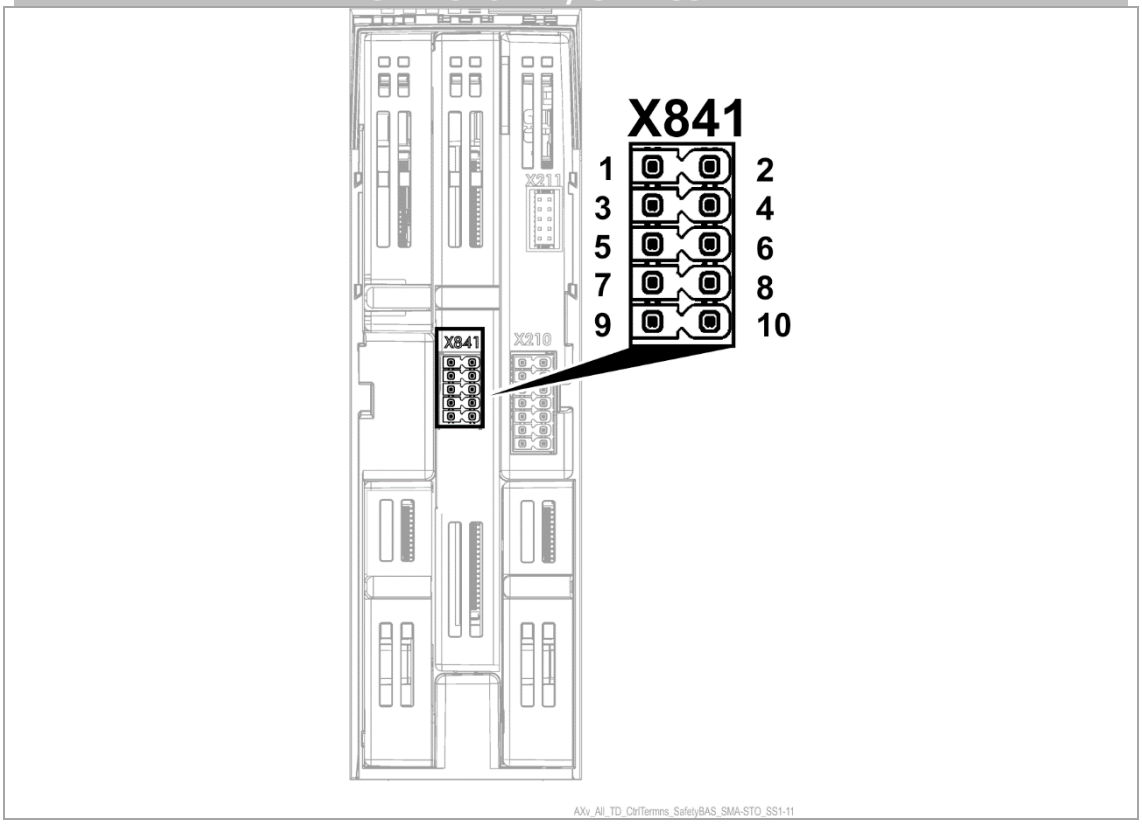
Safety Function Failure

The Safety Module is configured to operate with the specific inverter. If the safety module is exchanged for another module, the safety function will be lost.

- The user may not remove or exchange the pre-configured Safety Module.
- If the inverter was damaged, send the inverter to the manufacturer for repair or replacement.

For further details on functional safety ☞ 📖 VEC2en63 or VEC2en65.

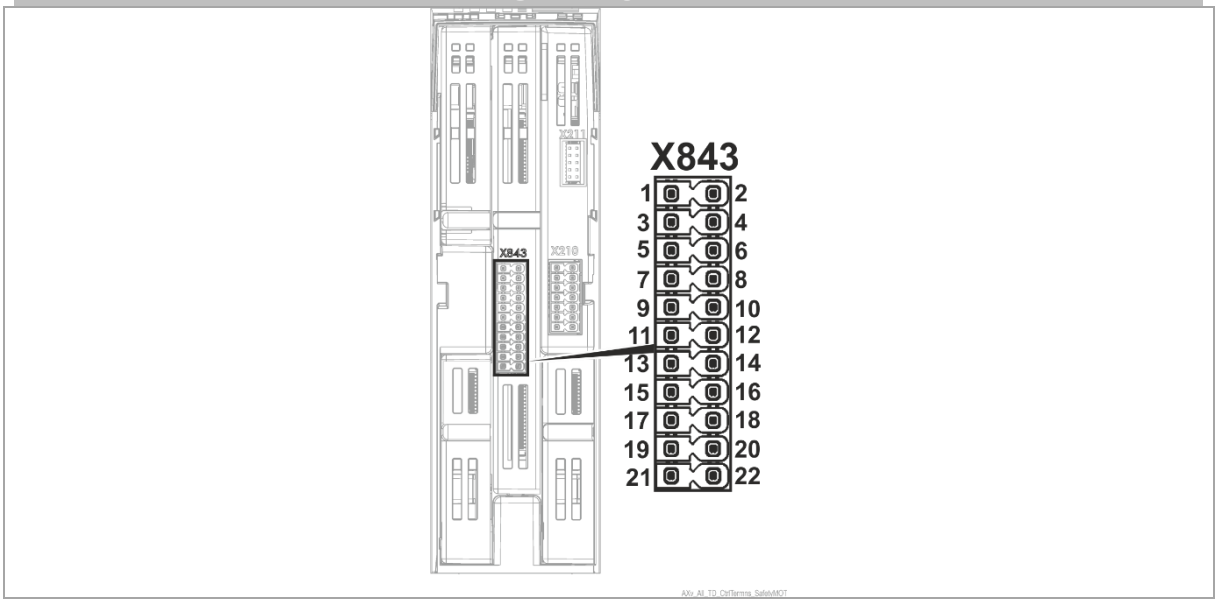
SMA-STO-11 / SMA-SS1-11



OSSD – test pulse output voltage for passive sensors

The 24 V (U_{OSSD}) outputs provide output voltage for the test pulses of external sensors featuring OSSD signals in order to detect external short-circuits between two inputs.

SMA-MOT-11



6.6.3 Relay

The relay interface provides parameterizable multi-purpose output. The relay function is parameterized in the inverter firmware (for more detail 10.2).

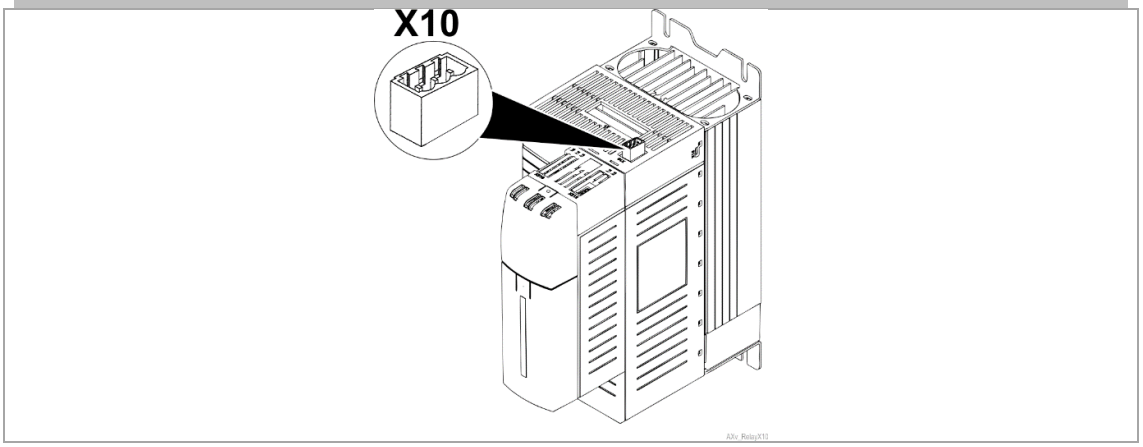
By default, the relay output is linked to the monitoring function. Wiring the relay output is not mandatory for the functioning of the frequency inverter.

NOTICE

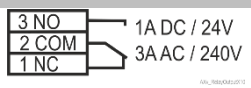
Function limitation

The X10 relay output **cannot be activated** without the mains voltage applied to the inverter.

- Apply mains voltage prior to employing the relay.



Relay output X10



Parameterizable relay output

Control terminal specification

Term.	Designation
1 ... 3	Relay output, floating change-over contact, response time approx. 40 ms, maximum contact load: – make contact: AC 5 A / 250 V, DC 3 A (ohmic) / 30 V – break contact: AC 3 A / 250 V, DC 1 A (ohmic) / 30 V

For further technical parameters 6.2.2.

6.7 Communication interfaces

The information regarding the "X310" communication interface applies only if the appropriate communication module is installed.

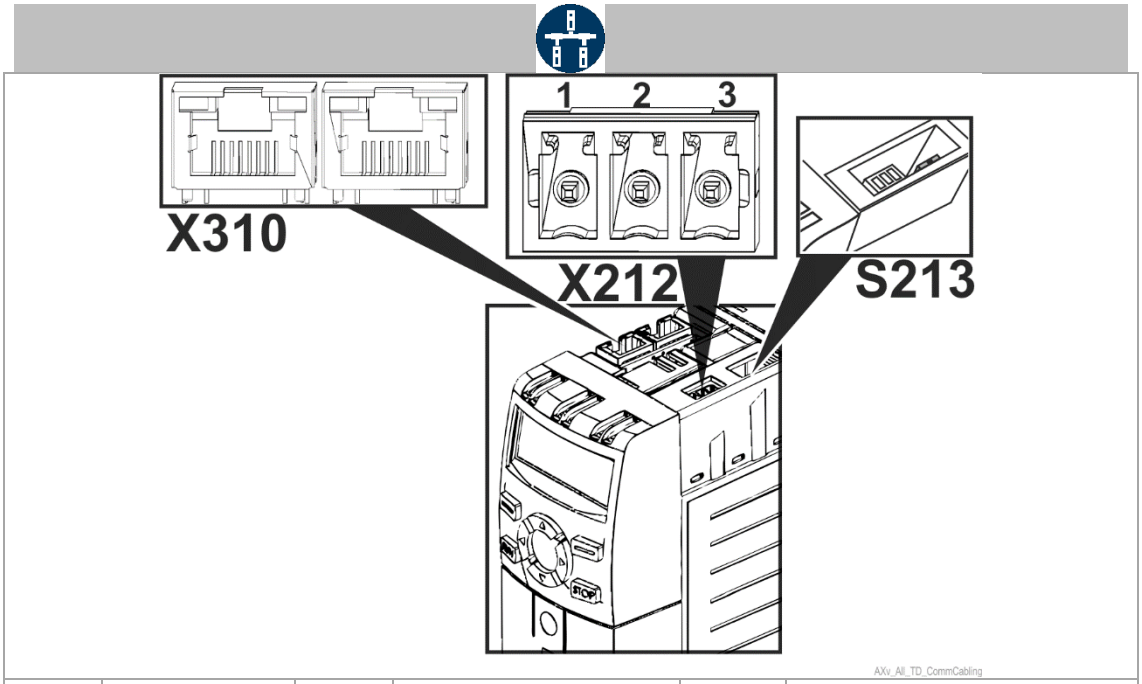
The communication interface has the designation "X310". It is located at the top face of the device. Depending on the communication module used, there are different physical interfaces:

- Network, 9-pole D-Sub F
- Ethernet RJ45

The Ethernet connectors feature LEDs to show the present status of the connection.

The 3-pin interface has the designation "X212". It is implemented for Systembus or CANopen. By default, this interface is configured for Systembus. To use CANopen over the "X212" interface, additional configuration steps are necessary.

To activate the CAN-Systembus termination, toggle the switch S213. Move the switch to the back.



X310	Ethernet, RJ45	**X212**	Systembus / CANo-pen	**S213**	Bus termination

Systembus interface X212

Bus termination switch S213 located behind the X212 terminal. (front ← off / back → on)

Term.	Description
X212.1	CAN_High
X212.2	CAN_Low
X212.3	GND

Line length vs. Baud rate

Operation mode	max. Line length
50 kBaud	1000 meters
100 kBaud	500 meters
125 kBaud	500 meters
250 kBaud	250 meters
500 kBaud	100 meters
800 kBaud	50 meters
1000 kBaud	25 meters

For further technical parameters 6.2.2. For parametrization 9.1.

6.8 Encoder Interfaces / Brake Output Interface

To provide additional functionality, you can install encoder modules into the slots X412/X432. The encoder module to choose depends on the encoder type employed in the application.

The following applies only if encoder interface modules are installed. Otherwise, the encoder interface provided by the Basic-IO can be used to connect HTL encoders. 9.3.3.

The encoder interfaces are located at the bottom of the device, as well as interfaces for connecting external braking resistor and interfaces for the external 24 V power supply.

NOTICE

Malfunction

To be able to use the two-channel 24 V SBC output of the safety module, you have to connect an external DC 24 V voltage to the terminal X12 of the main inverter. The external DC 24 V voltage must be applied before the mains voltage is applied to the inverter. Failure to do so may result in malfunction of the SBC.

- Apply a DC 24 V voltage from an external source at the terminal X12 of the main inverter at least 1 s before applying the mains voltage to the inverter.

NOTICE

Device damage possible

The DC 24 V power supply must be a PELV device. Insufficient power supply may damage the unit.

- Only connect a PELV DC 24 V device to the 24 V interface.

NOTICE

Auto-off possible

The X12 interface is overvoltage protected. At input >30 V the external voltage supply may be interrupted by the overvoltage protection, followed by brake actuation and inverter reset.

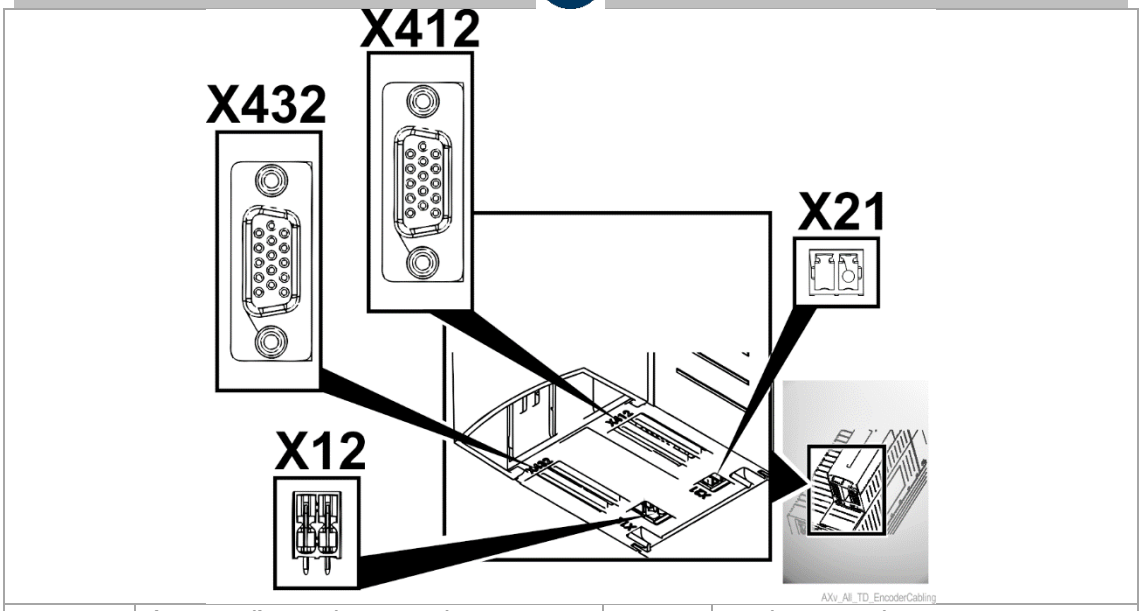
- Observe the operation limits of the interface.

NOTICE

Configuration specifics

In **AXv size 1 devices with functional safety** (i.e. including the safety module), the **X21** interface terminal is coded **yellow**. **In devices without functional safety,** it is coded **black**.

- Observe the correct device/terminal combination.



X412	(Optional) D-Sub F Encoder	**X12**	4pol. External 24 V
X432	(Optional) D-Sub F Encoder	**X21**	2pol. Brake output (SBC)

- Install encoder cables physically separately from motor cables. Comply with the encoder manufacturer's specifications.
- Connect the shield close to the frequency inverter and limit the cable length to the necessary minimum.

For further technical parameters 6.2.2.

6.9 External 24 V power supply interface

CAUTION

Component damage

Indirect EMI surge may damage the device.

- Only connect lines shorter than 30 m.
- Only route lines inside closed buildings

The control interface X12 can be used as a voltage input. By connecting an external power supply of DC 24 V ±10% to X12, the function of inputs and outputs as well as the communication can be parameterized and maintained, even when mains voltage is off.

X12 External 24 V supply interface
24Vin 24Vin — GND GND

Requirements to be met by external power supply	
Input voltage range	20.4 V – 28.8 V (-15% / +20%)
Rated input current	Max. 5.4 A
Peak inrush current	Typically: < 8 A
Peak power	130 W
External fuse	Via standard fuse elements for rated current, characteristic: slow
Safety	Safety extra low voltage (SELV) according to EN 61800-5-1

For further technical parameters 6.2.2.

6.10 Brake output interface

NOTICE

Safety relevant connection

The X21 interface controls a connected brake. The connection is low-active. Therefore, a continuous 24 V DC voltage is required. When the output is interrupted at the X21 interface, the brake shall be actuated.

- Do not short the B+ and B- terminals.
- Observe the operation limits of the interface.
- The interface shall be disabled if overloaded. To reset, deactivate and reactivate the external 24 V supply.
- Further steps may be required to be able to use the SBC interface (e.g. software and hardware release).

NOTICE

Configuration specifics

In **AXv size 1 devices with functional safety** (i.e. including the safety module), the **X21** interface terminal is coded **yellow**. **In devices without functional safety,** it is coded **black**.

- Observe the correct device/terminal combination.

The 2-pole brake output supplies an external brake with the necessary operating voltage.

X21 Brake power supply specification	
Output voltage	DC 24 V
Output current	3 A

For further technical parameters 6.2.2.

The brake output interface is also used in functional safety-related functions. Depending on the safety module, the brake output interface is used for brake control in the corresponding safety applications.

For further details on functional safety VEC2en63 or VEC2en65.

6.11 Motor Thermo-Contact interface

The AXV frequency inverters can evaluate the thermal switch of motor. By default, terminal X210B.1 (IN6D) is configured as an input for this evaluation. Connect the thermal switch to the digital input and the DC 24 V supply unit X210A.1. For parameterization, 9.3.3 and 15.2.

7 Parameterization method

The AXIA frequency inverters are parameterized via the firmware of the inverter and its firmware objects. The object structure follows the CiA 402 standard. The AXIA series inverters provide several ways to access objects for parameterization. You can access objects via

- communication bus (depends on the communication module or onboard CAN bus)
- keypad module (optional)
- COM-Port provided by the keypad module
- Bluetooth module (optional)

To read/write the firmware objects, you need the free-of-charge software AxiaManager GUI. The software (AxiaManager GUI) can be downloaded via the Bonfiglioli homepage (www.bonfiglioli.com).

To be able to use the AxiaManager software, the user requires a Windows PC, which requires a USB interface. To connect the PC to the inverter, the user must either have the Keypad module installed and use the USB-C interface of the Keypad (☞ 4.2.3) or use the onboard CAN interface (☞ 6.7) or have a communication module with a suitable interface installed (☞ 4.2.1).

For more information on communication modules ☞ communication module manuals.

☞ separate user manual VEC1en51 for details on how to use the AxiaManager software.

NOTICE

Object accessibility

Not all firmware objects are accessible at all times via the AxiaManager GUI. The selection of firmware objects available to the user depends on the type of inverter and its expansion modules, the type of motor and on the actual device connected.

- Check the particular configuration to determine your parameterization options.

NOTICE

Choice list accessibility

Not all choice list entries are useful at all times via the AxiaManager GUI. The selection of useful choice list entries depends on the type of inverter and its expansion modules, the type of motor and on the actual device connected. If you select entries unavailable in your configuration, an error message may show up informing you that the choice is unavailable with installed hardware.

- Check your particular configuration to determine your parameterization options.

Access to the object values is done on the basis of the object index. The AxiaManager gives access to the object dictionary of the chosen configuration in offline operation and to the object dictionary of the target device when connected.

When using the AxiaManager GUI to write object values, most values are entered automatically in the EEPROM of the controller.

Handling of cyclic writing of the object values

The data which must be written cyclically are entered in the RAM exclusively without a writing cycle on the EEPROM. In this case, the data is volatile, i.e. it is lost when the supply voltage is switched off. They must be written into the RAM again after the restart.

You can also access the firmware objects via the keys on the keypad 7.4.

7.1 Object Structure

Each object has a defined data structure. For details 19, the objects list.

The objects will be described as follows:

Object			Value Setting		
Index/sub-index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0xabcd/xyz	Object Name	[s]	0	12345	0

Example:

Object			Value Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2010	Rated Magnetizing Current	[A]	0	71,512	0

Some objects have sub-indexes, which are supposed to be recognized as a distinct object.

For example, the settings of the HTL-Encoder (X210) are defined via object **0x3840** and several sub-indexes:

Object No.	Designation
0x3840/1	Encoder Type
0x3840/10	Speed Filter Constant
0x3840/11	Change Sense of Rotation
0x3840/20	Division Marks
0x3840/21	Z-Track Window

Other objects contain 4 datasets which can be used in dataset change-over operations. To access specific datasets of such objects via bus communication, they are treated as sub-indexes in read/write access. When using the AxiaManager GUI, you can enter/modify values in the respective datasets by clicking on them.

For example:

Object No.	Designation	Value1	Value2	Value3	Value4	Default
0x25FB	Homing Speed	60	40	100	50	60

The object **0x25FB** has datasets populated with different values. By default, the first dataset is relevant for operation. However, you can choose to use the *Data Set Change-Over Mode* **0x2103/10** object to configure writing to another dataset. For details 10.1.1.1.

The objects have different data types. The data type definition follows the CiA 402 standard. The data types of the various objects are given in the objects list 19.

7.2 Object Index Grouping

Every object is addressed via a 16 Bit index, which is displayed as a 4-digit hexadecimal number. The object indexes are sorted in groups as follows:

The index range is divided in three main regions:

- DS301 Communication objects (**0x1000** – **0x1FFF**)
- Bonfiglioli specific objects (**0x2001** – **0x5FFF**)
- DS402 Drive Profile objects (**0x6000** – **0x6FFF**)

Axis-dependent object ranges (with 0x0800 offset):

- **0x2001** – **0x27FF** (Axis 1) / **0x2801** – **0x2FFF** (Axis 2)
- **0x4000** – **0x41FF** (Axis 1) / **0x4800** – **0x49FF** (Axis 2)
- **0x6000 –0x67FF** (Axis 1) / **0x6800 –0x6FFF** (Axis 2)

The Bonfiglioli-specific objects have the indexes beginning with the digit "2". The Bonfiglioli-specific objects can be subdivided in axis-dependent objects versus axis-independent objects. There is an index-offset of 800 per axis in the axis-dependent range. For example:

0x2001 *Motor Type Axis 1* on Axis 1 and **0x2801** *Motor Type Axis 2* on Axis 2. The manufacturer-specific objects in the range

- **0x3000** – **0x37FF**
- **0x5800** - **0x5FFF**

are not axis-dependent.

- DS402 Drive Profile objects: **0x6000** – **0x7FFF**

Some objects are reserved for configuration of Functional Safety functions. Some of these are accessible via AxiaManager Safety software, depending on the safety module used in the particular hardware configuration.

Object No.		Group
from	**to**	
0x2001	0x25FF	Configuration: Axis 1, Settings for Axis 1 Example: 0x2001 for motor type Axis 1
0x2600	0x27FF	Safety objects
0x2801	0x2DFF	Configuration: Axis 2, Settings for Axis 2 Example: 0x2**8**01 for motor type Axis 2
0x2E00	0x2FFF	Safety objects
0x3800	0x3DFF	Configuration: Axis independent settings Example: 0x3801 for serial-no. of Axia device
0x3E00	0x3FFF	Safety objects
0x4000	0x47FF	Actual Values: Readings for Axis 1 Example: 0x4001 for active dataset Axis1
0x4800	0x4FFF	Actual Values: Readings for Axis 2 Example: 0x4**8**01 for active dataset Axis2
0x5800	0x5FFF	Actual Values: axis independent readings Example: 0x5801 for DC-link Voltage
0x6000	0x65FF	CiA 402 objects Axis 1
0x6600	0x67FF	Safety objects
0x6800	0x6DFF	CiA 402 objects Axis 2
0x6E00	0x6FFF	Safety objects

7.3 Parameterization via AxiaManager GUI

NOTICE

EEPROM protection

Writing to the EEPROM too frequently may shorten the service life of the inverter. To prevent this, the user receives the error message "Cyclic Write" if more than 50 write attempts to the EEPROM are made per minute.

- The number of permitted consecutive write cycles per minute is limited to 50.
- After the error message, wait for 1 minute before attempting writing or
- Restart the inverter to be able to initiate new write commands.

Prerequisite for object access

To gain access to the firmware objects, you have to ensure one of the following:

- establish a data connection between a Windows PC running the AxiaManager GUI and the inverter
  - via the onboard CANopen interface (X212) or
  - via an installed communication module at the interface X310

To be able to use the bus connection, further settings must be made beforehand. ☞ 8

- install the keypad module on the inverter and establish a data connection via the COM-interface featured on the Keypad module via the USB-C terminal (recommended)
- install the Bluetooth module on the inverter and establish a Bluetooth connection between a Windows PC running the AxiaManager GUI (or a mobile device running the AxiaManager Mobile App) and the inverter (☞ 7.5)

7.3.1 Access via Keypad

For more details on how to use the AxiaManager software ☞ 📖 user manual VEC1en51.

Keypad connection

- Install the Keypad module on the inverter and connect the PC workstation to the Keypad module via the USB-C terminal (only with KPA-DSP-**01**).
- Apply 24 V DC voltage from an external source at the terminal X12 of the main inverter. ☞ 6.9 Alternative: Apply mains voltage to the terminal X1. ☞ 6.3
- Start the AxiaManager GUI on your PC workstation.
- Klick on the `Scan` button in the main window. The `Connection interface` dialogue shows up.
- In the `Connection interface` dialogue, select `USB/COM` on the left.
- In the `Port settings` frame, activate the COM port.
- Now, klick on the `Scan` button on the left to scan for connected inverters.

  The `Devices list` dialogue shows up.
  In the `Devices list` dialogue, klick on `Add` to add the selected inverters.
- Upon successful connection, the `Sync action` dialogue shows up.
- In the `Sync action` dialogue, select the required option.

Connect only:	AxiaManager connects to the inverter without reading or writing objects to the project/inverter.
WRITE ALL parameters to the device:	Load project settings to the inverter.
READ ALL parameters from the device:	Load inverter settings to the project.

- If the communication has been established correctly, the status bar displays `CONNECTED`.

  This concludes the USB connection to the PC.

When connected, you can use the AxiaManager GUI to access and parameterize objects.

☞📖 user manual VEC1en51 for more details on how to connect to the inverter and to use the AxiaManager software.

7.3.2 Access via Bluetooth Module

When connected, the user can use the AxiaManager software on PC or the AxiaManager Mobile App on a mobile device to access and parameterize objects. ☞📄 7.5

Bluetooth Connection

The connection via Bluetooth using the PC and AxiaManager GUI offers the same functionality as the USB connection. Also, the REA-WL-01 Bluetooth module allows to connect with the AxiaManager Mobile App on a mobile device. When connected, the user can use the AxiaManager GUI on a PC workstation or the AxiaManager Mobile App on a mobile device to access and parameterize objects.

Bluetooth pairing

In order to connect, the PC or mobile device need to be paired with the Bluetooth module first.

- Write down the pairing code and the module name located on the back of the wireless module:
  - -6-digit pairing code (last 6 digits in the serial number)
  - -Module NameREA-WL-01-xx:yy:zz", where xx:yy:zz are the last three octets of the MAC address.
- Mount the wireless module on the inverter.
- Apply 24 V DC voltage from an external source at the terminal X12 of the main inverter.
  Alternative: Apply mains voltage to the terminal X1. ☞📄 6.9 ☞📄 6.3
- **With the module installed**, activate the pairing mode by pressing the Pairing Mode Button (see arrow in the figure for the location of the pairing button) at the bottom of the module for more than 3 seconds. The LED shows the respective status by flashing white.

The module has 2 operating modes, Bluetooth Low Energy (pale blue led) for use with mobile device and Bluetooth Classic (deep blue led) for use with PC. By pressing the Pairing Mode Button for 1 second you can change the Bluetooth mode.

Connection to PC

- On your PC, go to the Windows "Device Settings" menu.
- Go to the Bluetooth settings.
- Go to "Further Bluetooth options".
- In the Dialogue window, go to the COM Ports tab.

- Select COM15 for the Bluetooth-to-PC connection. Then confirm with "OK".
- Add the AXIA Bluetooth Module (Module NameREA-WL-01-xx:yy:zz"). For the PIN, enter the 6-digit pairing code (last 6 digits in the serial number) and press "Connect".

  This concludes the pairing with the REA-WL-01 Bluetooth module.
- Start the AxiaManager GUI on your PC workstation.
- Klick on the Scan button in the main window.

  The Connection interface dialogue shows up.
- In the "Connection Interface" area on the right, select "USB/COM".
- Then click on "Scan" to initiate scanning for connected inverters.
- Select the port COM15 of the Bluetooth module where the inverter is connected to and select the port setting as well as global settings.

  The next window will list all frequency inverters connected to your system.
- In the Sync action dialogue, select the required option.

Do nothing:	AxiaManager connects to the inverter without reading or writing objects to the project/inverter.
Write all:	Load project setting to the inverter.
Read all:	Load inverter setting to the project.

- If the communication has been established correctly, the Status bar displays CONNECTED. This concludes the USB connection to the PC.
- When connected, you can use the AxiaManager GUI to access and parameterize objects.

☞📖 separate user manual VEC1en51 for more details on how to connect to the inverter and to use the AxiaManager software.

This concludes the Bluetooth connection to the PC.

7.3.3 Downloading/Uploading Configuration File

The AXIA Manager software for PC workstations allows editing the object values offline (i.e. without permanent connection to the inverter). In order to transfer the modified configuration to the inverter (to upload), proceed as follows:

Assuming you have made all necessary modifications to the firmware objects as required, save the new configuration to a configuration file (*.bfe).

- Electronically connect the inverter.
- Open the configuration file using the AxiaManager.
- Check the user credentials. Adjust if necessary.
- Scan for connected inverters.
- Select the inverters you want to upload the configuration to.
- Connect to your AXIA inverters.

  At connection, the prompt "Sync action" appears.
- Select "WRITE ALL parameters to all devices".

  The modifications from your present configuration file are written to the selected AXIA inverter (s).
  This concludes the upload procedure.

To download the configuration from a given AXIA inverter to your PC workstation proceed as follows:

- Electronically connect the inverter.
- Open the AXIA Manager software.
- Choose the connection port/adapter.
- Scan for connected AXIA inverters. You may have to adjust the port settings.
- From the device list, select the inverters you want to download the data from.
- Connect to your AXIA inverters.

  At connection, the prompt "Sync action" appears.
- Select "READ ALL parameters from all devices".

  The data from your selected AXIA inverter is written to the present configuration file. You will get one object tree per connected device.
- Save the configuration file under a new file name as required.

  This concludes the download procedure.

separate user manual VEC1en51 for details on how to use the AxiaManager software.

7.4 Parameterization via Keypad

By default, the keypad display shows a standard view with monitored objects. To change the initial display parameters, use the object **0x3921/1** *Keypad Actual Value* to set the initial value display.

The function keys have context-dependent function assignments.

- To access a submenu, press the function key on the right.
- Using the UP and DOWN keys, position the cursor on the submenu entry as required and press OK to access the submenu.
- If you are changing a numerical object value, you can use the LEFT and RIGHT keys to position the cursor and then use the UP and DOWN keys to increase or decrease the setting value. The right function key is then pressed to confirm the setting and the left function key is used to abort the action.

  The keypad display shows the available submenu entries and, in the upper left corner of the screen, the submenu title. The function keys' designation changes according to the options available in the present submenu.
- To return to the previous menu level, press the ESC key.

For more details on the Keypad 4.2.3.

7.5 Parameterization via AxiaManager Mobile App

Connection to mobile device

- On your mobile device, go to Bluetooth settings and make sure the Bluetooth mode is active.
- On your mobile device, open the AxiaManager Mobile App.
- In the AxiaManager Mobile App, go to "Connect" > "Bluetooth" and, in the device list, select your AXIA Bluetooth Module.

  The "Bluetooth Pairing Request" dialogue appears.

- In the "Bluetooth Pairing Request" dialogue, enter the previously noted 6-digit pairing code.

  The "Authentication" dialogue appears.
- In the "Authentication" dialogue, tap on "Default credentials" to proceed.

  The Dashboard appears. From there, you can use the AxiaManager Mobile App to view actual data, check any detected faults or warnings and access objects.

☞ separate user manual VEC1en51 for details on how to use the AxiaManager software.

8 Commissioning the inverter

NOTICE

Incorrect parameterization

The rated data of the motor must be entered according to the specifications on the rating plate of the motor. The data must correspond to the actual motor connection type (star or delta connection).

If the data entered deviate from the rating plate, the parameters will not be identified correctly.

- Parameterize the rated data according to the rating plate of the motor for the wiring of the motor winding. Consider the increased rated current of the connected three-phase motor.

NOTICE

Commissioning Prerequisite

To be able to establish a data connection between a PC and any given Axia inverter it is necessary to configure the inverter for the chosen type of data connection. This initial configuration step can be done only when using a KPA-DSP-**01** Keypad module mounted on the inverter. For instance, it is necessary to change the IP-Address of the inverter to be able to integrate the inverter in your TCP network for further configuration steps.

The keypad module features the USB-C service interface, which allows access from a PC to the firmware configuration stored in the inverter.

- Use a KPA-DSP-**01** Keypad module mounted on the inverter with its USB-C service interface to access the TCP configuration.

OR

- Use a KPA-DSP-**01** Keypad module mounted on the inverter to access the TCP configuration via the function keys.
- To set up any Ethernet-Type connection or any CANopen connection, configure connection parameters in the inverter firmware.
- After successfully integrating the inverter in your TCP network, you can

For more details on the Keypad 4.2.3 and 7.4.

As an alternative to using the Keypad module for connection, you can connect via Bluetooth. 4.2.4, 7.5.

Commissioning via AxiaManager

- Start up the AxiaManager software on the PC workstation.
- Connect the PC workstation running the AxiaManager Software Suite to the inverter. 7.4

  When the option `READ ALL parameters from the device` is chosen, the configuration of the inverter presently connected to the PC workstation is loaded into the active AxiaManager project file.
- Configure other firmware settings as required. 8.1 - 8.7

separate user manual VEC1en51 for more details on how to use the AxiaManager GUI software.

Commissioning via Keypad

- Connect the keypad module to the interface X211 of the main device.
- Via the function keys and the arrow keys on the keypad module, access the required submenu.
- Select the object for modification.
- Enter the required values for the objects. 8.1

NOTICE

If filters (e.g. dU/dt filters or sine filters) are used between the frequency inverter and motor, the following must be noted.

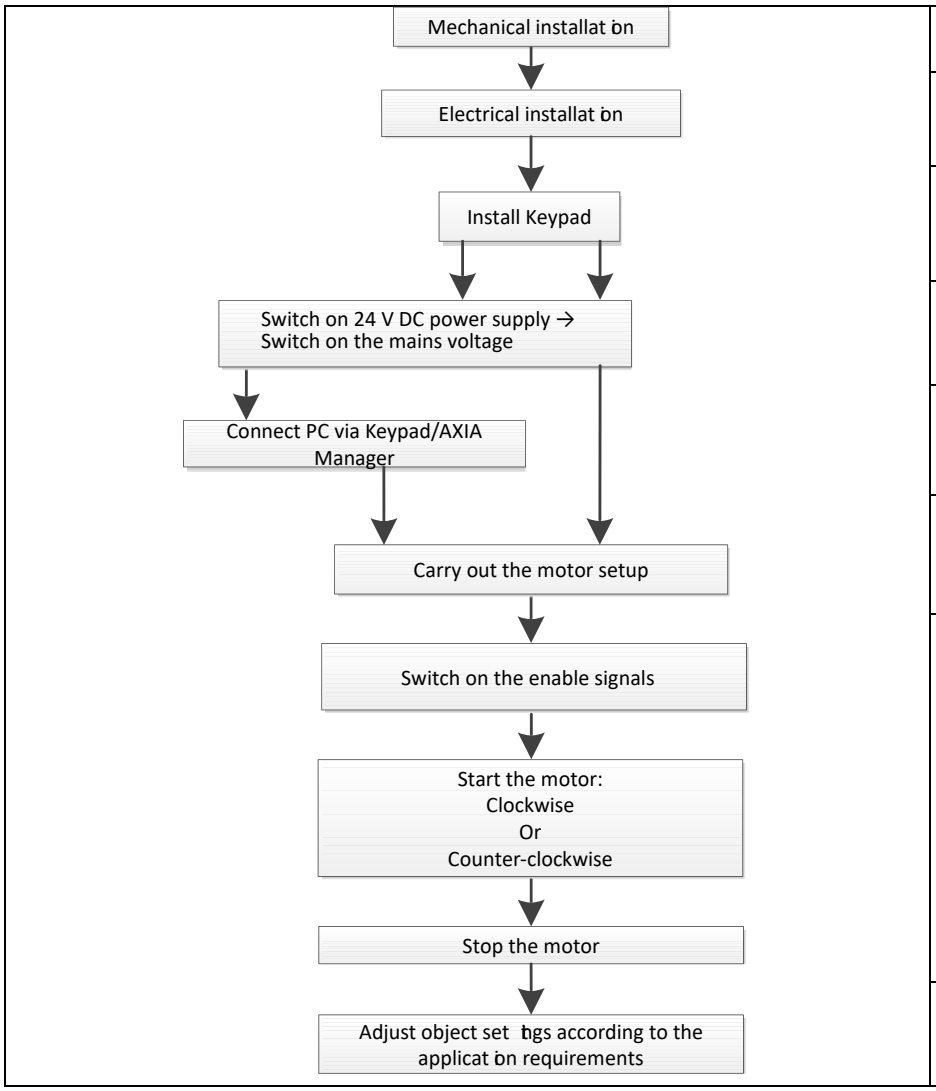
For configurations with encoder feedback:

- Carry out the installation with the filter connected. Note the filter manufacturer's specifications concerning permissible switching frequencies. During setup, note that the filter may be overloaded thermally.

For configurations without encoder feedback:

- Carry out the installation without connected filters. After setup, connect the filters between the frequency inverter and the motor.

The commissioning process runs as follows:



8.1 Firmware Objects Relevant to Commissioning

NOTICE

EEPROM protection

Writing to the EEPROM too frequently may shorten the service life of the inverter. To prevent this, the user receives the error message "Cyclic Write" if more than 50 write attempts to the EEPROM are made per minute.

- The number of permitted consecutive write cycles per minute is limited to 50.
- After the error message, wait for 1 minute before attempting writing or
- Restart the inverter to be able to initiate new write commands.

The manufacturer recommends using the PC software AxiaManager Suite for commissioning. Using the AxiaManager Suite removes the need to browse individual objects via the Keypad to commission the inverter. The `Drive Train` subtree gives access to guided configuration options. The guided configuration populates the correct firmware objects with the selected data.

user manual VEC1en51 for details on how to use the AxiaManager software.

If the user does not use the AxiaManager software, they can access the firmware objects via:

- the installed KPA-DSP module (manually, via the display and the function keys)

Further down in this document it is assumed that the AxiaManager software is used to parameterize firmware objects.

The firmware objects listed in the table below refer to **Basic Setup** of AxiaVert series inverters.

Object	Name	Explanation	Chapter
0x2001	Motor Type	**Setting Motor Type** ASM [Asynchronous Motor] SynRM [Synchronous reluctance motor] PMSM [Permanent Magnet synchronous motor]	8.3.1
0x2002	Rated Voltage	Rated Voltage in Volt [V]	
0x2003	Rated Current	Rated Current in Ampere [A]	
0x2004	Rated Speed	Rated speed in rounds per minute [rpm]	
0x2005	No. of Pole Pairs	Number of pole pairs	
0x2006	Rated Cosinus Phi	Rated active power factor	
0x2007	Rated Frequency	Rated frequency in Hertz [Hz]	
0x2008	Rated Mech. Power	Rated mechanical power in kilo watt [kW]	
0x2009	Rated Torque	Rated Torque in newton meter [Nm]	
0x2080	Motor Control	**Setting of Motor Control** Choose V/f- scalar control for simple ASM-applications. For higher demands on speed or torque accuracy select Field orientated control (FOC) applicable to all types of motors. In addition, the HTL encoder signal can be integrated into the speed or position control.	8.3.2
0x2081	Actual Speed Source		
0x2082	Actual Position Source		
0x20A0	Invert Sense of Rotation		
0x2101/1	Software Release	**Function Assignment for Digital Inputs** Assign the digital inputs to configure the source for release and start command.	10.1.1
0x2101/2	IO Start		
0x2199	Hardware Release		
0x2200	Control Mode	**Control Methods** Choose IOs for controlling the inverter via I/O contacts. The mode of operation can be assigned as the Manufacture Velocity or Torque Mode.	12.1.1
0x2201	Mode of Operation (IO's)		
0x3840/1	Encoder Type	**Setting of HTL encoder data** Irrelevant for sensorless control. If closed-loop control for FOC or motor feedback information are required, an HTL encoder signal (A/B/Z-Track) can be evaluated by Basic I/O (X210.3-5).	8.3.4
0x3840/10	Speed Filter Constant		
0x3840/11	Change Sense of Rotation		
0x3840/20	Division Marks		
0x3840/21	Z-Track Window		
0x2099/1	Auto-Setup Type	**Auto Setup Procedure** Several motor parameters are measured during Auto-Setup. Different modes such as simple or standard tuning can be used either for all or for individual data sets. The Auto-Setup is activated when the external 24 V DC is applied, and the mains voltage is switched on	8.3.6
0x2099/2	Allow Brake Release		
0x2099/6	Auto Setup Data Set		
0x2099/8	Auto-Setup Offset Mode		
0x2099/10	Setup from Datasheet		
0x2099/16	Correct Sense of Rotation		
0x209A	Auto-Setup State		

Object	Name	Explanation	Chapter
0x209B/1 0x209B/5	Auto Setup Error Auto Setup Warning	and the inverter release via the I/O contacts is enabled. Furthermore, the *Mode of Operation IOs* **0x2201** must be set to `Axia Auto-Setup`. The progress is shown in the *Auto- Setup State* **0x209A**.	

Most of the objects above do not require setting specific values other than defaults, in a basic case. However, in some cases, additional adjustments may become necessary.

For more details 9.3.5.

8.2 Switching on Mains Voltage

WARNING

Device damage / personal injuries

Faulty or incorrect parameterization may lead to unwanted device behavior. This may lead to device damage or to personal injuries.

- Parameter settings may only be changed by skilled personnel. Before starting the commissioning process, read the documentation carefully and comply with the safety instructions.

NOTICE

Malfunction

To be able to use the two-channel 24 V SBC output of the safety module, you have to connect an external DC 24 V voltage to the terminal X12 of the main inverter. The external DC 24 V voltage must be applied before the mains voltage is applied to the inverter. Failure to do so may result in malfunction of the SBC.

- Apply a DC 24 V voltage from an external source at the terminal X12 of the main inverter at least 1 s before applying the mains voltage to the inverter.

After completion of the installation work 6, make sure to re-check all control and power connections before switching on the mains voltage. When all electrical connections are correct, make sure that the frequency inverter cannot auto-start at power-up.

- First, apply DC 24 V voltage from an external source.
- Then apply the mains voltage.

  After power-up, the frequency inverter shall perform a self-test.

8.3 Setting up Firmware for Commissioning

separate user manual VEC1en51 for Basic Commissioning (Guided Workflow) procedure.

Follow the steps described in 7.4 to establish a data connection with the inverter and to parameterize basic inverter settings.

- Assuming the inverter parameterization is completed, now parameterize the motor.

8.3.1 Rated Parameters

In the Subtree `Parameters\Installation\Motor\Rated Parameters`, set the values for the following objects according to the specifications of the motor:

Object	Name	Explanation
0x2001	Motor Type	**Setting Motor Type** ASM [Asynchronous Motor] SynRM [Synchronous reluctance motor] PMSM [Permanent Magnet synchronous motor] Grid [Power regeneration]
0x2002	Rated Voltage	Rated Voltage in Volt [V]
0x2003	Rated Current	Rated Current in Ampere [A]
0x2004	Rated Speed	Rated speed in rounds per minute [rpm]
0x2005	No. of Pole Pairs	Number of pole pairs
0x2006	Rated Cosinus Phi	Rated active power factor
0x2007	Rated Frequency	Rated frequency in Hertz [Hz]
0x2008	Rated Mech. Power	Rated mechanical power in kilo watt [kW]
0x2009	Rated Torque	Rated Torque in newton meter [Nm]

8.3.2 Motor Control

In the Subtree `Parameters\Installation\Motor\Control`, set the values for the following objects:

Object	Name	Explanation
0x2080	Motor Control	**Setting of Motor Control** Choose V/f- scalar control for simple ASM- applications. For higher demands on speed or torque accuracy select Field orientated control (FOC) applicable to all types of motors. In addition, the HTL encoder signal can be integrated into the speed or position control.
0x2081	Actual Speed Source	
0x2082	Actual Position Source	
0x20A0	Invert Sense of Rotation	

NOTICE

Possible Error

Depending on the settings of the different datasets of the object **0x2080**, switching the dataset may result in an overcurrent error. To prevent this, the software release must be interrupted before switch-over.

- Interrupt the software release signal before performing the dataset switch-over.

8.3.3 IO Function Assignment

Object	Name	Explanation
0x2101/1	Software Release	**Function Assignment for Digital Inputs** Assign the digital inputs to configure the source for release and start command.
0x2101/2	IO Start	
0x2199	Hardware Release	
0x2200	Control Mode	**Control Methods** Choose IOs for controlling the inverter via I/O contacts. The mode of operation can be assigned as the Manufacture Velocity or Torque Mode.

8.3.4 Encoder

If the setting for the object **0x2081** *Actual Speed Source* is any other than `Sensorless`, you also have to configure the objects in the subtree `Parameters\Installation\Encoder` according to the type of encoder present in the application.

Object	Name	Explanation
0x3840/1	Encoder Type	Settings for the configuration of the HTL Encoder connected at the X210 interface (BasicIO). 6.6.1 9.4
0x3840/10	Speed Filter Constant	
0x3840/11	Change Sense of Rotation	
0x3840/20	Division Marks	
0x3840/21	Z-Track Window	

Object	Name	Explanation
0x2078/1	Encoder Type	encoder module manuals
...	...	
0x2078/n	...	

8.3.5 Brake

If the setting for the object **0x2099/1** *Auto-Setup Type* includes brake activation, you also have to configure the objects in the subtree `Parameters\Installation\Brake` according to the parameters of the brake present in the application.

Object	Name	Explanation
0x2050	Brake Operation Mode	Settings for the configuration of the brake 9.5
0x2051	Brake ReleaseTime	
0x2052	Brake CloseTime	

8.3.6 Auto setup

Via **0x2099/1** *Auto-Setup Type* you set the type of auto-setup.

Auto Setup Type 0x2099/1	Function
0x00000000 Complete Setup	Complete Measurement of Motor Data / **Default**
0x00000001 Motor Parameter Measurement Only	
0x00000002 Encoder Offset Only	Measurement of encoder/ resolver offset
0x00000003 Tuning Current Controller Only	

0x2099/2 – *Allow brake release* (brake shall be disengaged during auto-tuning): `0(def)/1`.

0x2099/8 – *Auto-Setup Offset Mode* 0-3 (1 – default).

Auto-Setup Offset Mode 0x2099/8	Function
0x00000000 – No Offset Measurement	
0x00000001 – Free Shaft Mode (def)	
0x00000002 – Pseudo Static Mode	
0x00000003 – Anisotropic Mode (with Brake)	

8.4 Status messages during commissioning

The actual status of the Auto-setup process is shown in object **0x209A** *Auto-Setup State*.

The following status messages are possible during commissioning (setup):

Status message		Meaning
00000001	Auto-Setup Not Done	Auto setup has not yet been run
00000002	Plausibility Check	During the auto setup, the individual process steps are displayed as status depending on the operating mode selected in object **0x2099/1**. As long as one of these status messages is displayed, the Auto- Setup is still running.
00000003	Nominal Tuning	
00000004	Alignment	
00000005	Tuning Current Controller	
00000006	Meas. Stator Resistor	
00000007	ASM Demagnetization	
00000008	Meas. Stator Inductance part 1	
00000009	Meas. Stator Inductance part 2	
0000000A	Meas. Encoder Offset	
0000000B	Auto-Setup Done	Auto setup was carried out successfully

Whenever there is an error during the setup process, the setup shall halt at the corresponding step. This may facilitate troubleshooting.

8.5 Error messages during commissioning

After completion or during the Auto-Setup, error messages may be displayed via the object **0x4010/1** *Fault Message* which displays the value of **0x209B** *Auto-Setup Error*. The error code indicates the likely source of the issue. Read the table below for troubleshooting recommendations.

Code	Measures / Remedy	
Error messages		
00000000	No Error	
00000001	UNom	Plausibility checks failed. Check motor data (Objects 0x2001-0x2009)
00000002	PolePair	
00000003	ElecPowerBalance	
00000004	LossesPowerBalance	
00000005	MechPowerBalance	
00000006	AdvPowerBalance	
00000007	SpeedMismatch	
00000008	SampleTimeMismatch	
00000009	NomTuning	
0000000A	Align	
0000000B	ITAE	Contact Bonfiglioli Service for assistance.
0000000C	RsTdead	
0000000D	LsHighFreq	
0000000E	LsLowFreq	
0000000F	AutoSetupGlobal	
00000010	CosPhiNom	
00000011	SlipNom	
00000012	Offset	Encoder offset could not be determined. Check and correct encoder settings.
00000013	Sensor not set	Encoder setting incorrect or encoder signal missing. Check and correct encoder settings.
00000014	No Write all for parameters	Not all values could be determined. Check and correct missing values manually.
00000015	Motor Connection	No Motor connected. Check and correct motor conection.

8.6 Status LEDs

NOTICE

Residual risk

When LEDs and/or other indicating elements on the frequency inverter are not active, the inverter still may be energized.

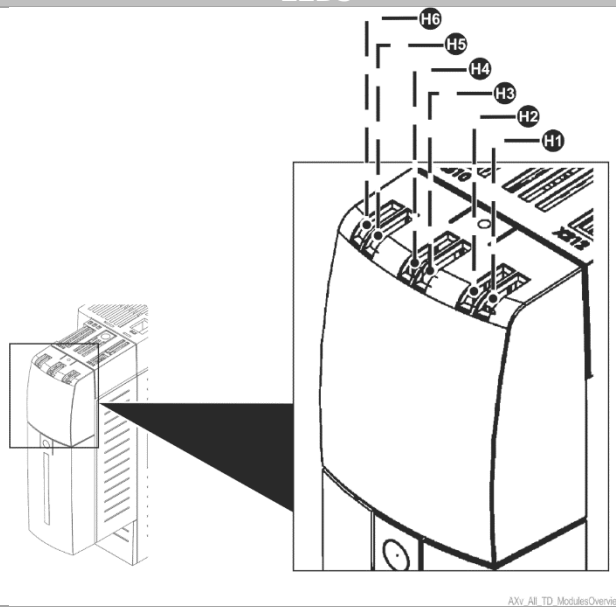
- Before carrying out any work with the device, where contact with energized parts might be possible, always check if the device is deenergized, irrespective of the status of any installed indicating elements.

The total number of available LED signals depends on the installed extension modules.

Status LEDs provide visual feedback on the general status of the corresponding module.

The scope of delivery contains a sticker with "RUN"/"ERR" inscriptions to be applied on the housing next to the LEDs.

LEDs

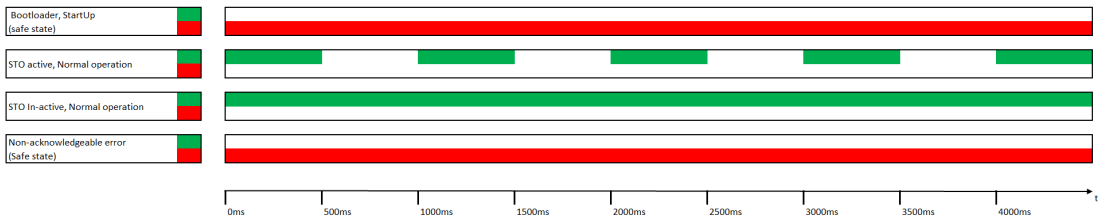


H1-H2	Main device diagnosis LEDs
H3-H4	Safety module diagnosis LEDs
H5-H6	Communication module diagnosis LEDs

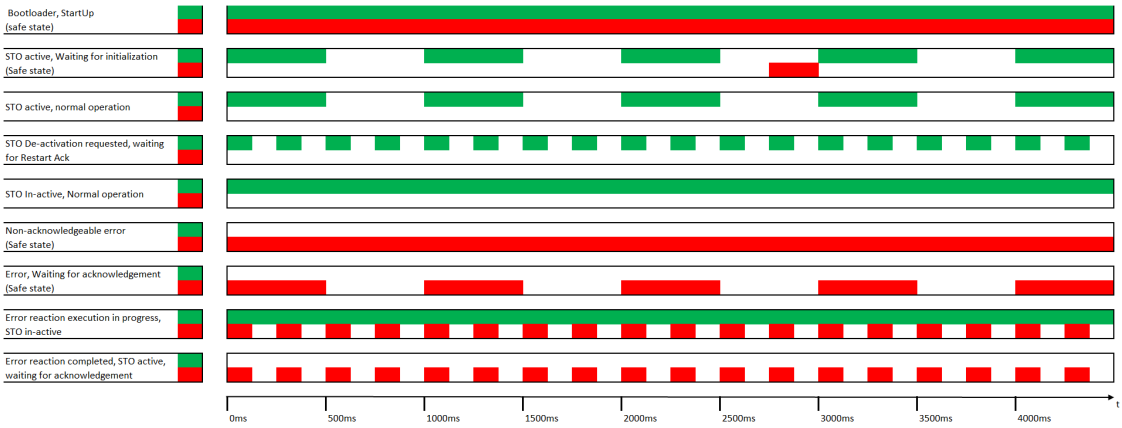
Status output via main unit LEDs (green and red LED) (H1-H2):

Status output via Safety module LEDs (green and red LED) (H3-H4):

for SMA-STO-SS1-11:

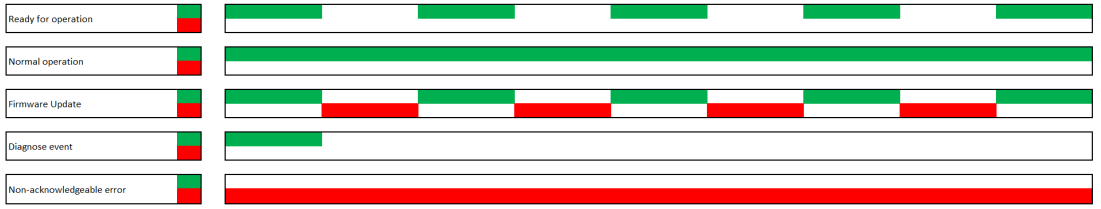


for SMA-MOT-11:



Module LED: Status indicator (H5-H6)

The module LED indicates the current status of the module.



Module Status LED		
LED State	**Description**	**Comments**
Off	Not initialized	No power OR module in SETUP
Green	Normal operation	Normal operation
Green, 1 flash	Diagnostic event(s)	Frequency inverter error
Red	Fault	Major internal error (this indication is combined with a red network status LED)
Alternating Red/green	Firmware update	Do NOT power off the module. Turning the module off during this phase could cause permanent damage.

8.7 Checking direction of rotation

To check if the reference value and the actual direction of rotation of the drive correspond to one another, proceed as follows:

- Operate the drive at low speed, i.e. specify a reference value of approx. 10%.
- Briefly switch on release of frequency inverter:
  Check if the motor shaft turns in the required direction.
  In case the sense of rotation is wrong, exchange two motor phases, e.g. U and V at the terminals of the frequency inverter. The mains-side connection of the

frequency inverter does not affect the sense of rotation of the drive. In addition to checking the drive, the corresponding actual values and operating messages can be read out by means of the operating unit.

If the controller release of the frequency inverter is switched off, the power output stage will be disabled. The motor will coast down or, if installed, a break will be activated.

9 Inverter functionality

NOTICE

Drive damage

The control method of the motor depends on the set motor type **0x2001** *Motor Type* and the motor control **0x2080** *Motor Control*. The motor type setting must correspond to the motor type used, otherwise the motor may be damaged.

- Make sure to enter the motor/machine data according to the rating plate of the motor.
- When the motor/ machine data is specified by the user without using guided start-up/commissioning via Keypad or AxiaManager Drive Train, the nominal data on the motor nameplate or the associated motor data sheet must be used.

9.1 Inverter data

The "Inverter Data" subtree contains objects, which store actual values for the inverters presently connected to the PC workstation. The values are read automatically from the hardware. The objects cannot be edited by the user, they do not require further editing.

9.1.1 Inverter basics

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x20E0	Customer Axis Name	Custom string		
0x3800	Customer Device Name	Custom string		
0x3803/1	Version CBO	Internal ID		
0x3803/3	Version BDM	Internal ID		
0x3804/1	Capability Flags	Commissioning Info		
0x3804/17	Capability Flags	Commissioning Info Code		
0x3908/1	Control Board	Internal ID		
0x3908/2	Basic Drive Module	Internal ID		

9.1.2 Inverter specifics

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3801	Device Serial Number	[-]	Internal ID		
0x3802	Device ID	[-]	Internal ID		
0x3806	Device Part number	[-]	Internal ID		
0x3E21	Safety Module serial-Number	[-]	Internal ID		
0x5840/1	Rated Voltage	[V]	Type Plate Value		
0x5840/2	Rated Current	[A]	Type Plate Value		
0x5840/3	Rated Power	[W]	Type Plate Value		
0x5840/4	Maximum Output Frequency	[Hz]	Type Plate Value		
0x5840/5	Maximum DC-Link Voltage	[V]	Type Plate Value		
0x5840/6	Maximum Heatsink Temperature	[°C]	Type Plate Value		
0x5840/7	Maximum Interior Temperature	[°C]	Type Plate Value		

9.1.3 Optional modules

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3803/2	Version SMA	[-]		Internal ID	
0x3803/4	Version BIO	[-]		Internal ID	
0x3803/5	Version CMA	[-]		Internal ID	
0x3803/6	Version EMA X432	[-]		Internal ID	
0x3803/7	Version EMA X412	[-]		Internal ID	
0x3803/8	Version EMA X422	[-]		Internal ID	
0x3908/2	Communication Module	[-]		Internal ID	
0x3908/4	Basic IO Module	[-]		Internal ID	
0x3908/5	Safety Module	[-]		Internal ID	
0x3908/6	Extension Module X432	[-]		Internal ID	
0x3908/7	Extension Module X412	[-]		Internal ID	
0x3908/8	Extension Module X422	[-]		Internal ID	

9.1.4 Additional software information

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3803/17	Version CBO Bootloader	[-]		Internal ID	
0x3803/18	Version SMA Bootloader	[-]		Internal ID	
0x3803/19	Version BDM Bootloader	[-]		Internal ID	
0x3805/1	SW Part Number CBO	[-]		Internal ID	
0x3805/2	SW Part Number SMA	[-]		Internal ID	
0x3805/3	SW Part Number BDM	[-]		Internal ID	
0x3805/4	SW Part Number BIO	[-]		Internal ID	
0x3805/5	SW Part Number CMA	[-]		Internal ID	
0x3805/6	SW Part No. EMA X432	[-]		Internal ID	
0x3805/7	SW Part No. EMA X412	[-]		Internal ID	
0x3805/8	SW Part No. EMA X422	[-]		Internal ID	
0x3805/17	SW Part Number CBO BL	[-]		Internal ID	
0x3805/19	SW Part Number BDM BL	[-]		Internal ID	

9.2 Communication interface configuration

The frequency inverters can be extended by different options for data communication and can be integrated in an automation and control system. Parameterization and commissioning of the optional communication module is required (for further details ☞ 🕮 the relevant communication module manual).

NOTICE

Communication protocol mismatch

If the X212 interface is configured for CANopen (or if **0x3911/1** *CANopen Node ID* ≠ 0), the Sysbus becomes unavailable on the interface.

- For correct Sysbus configuration, make sure that **0x3907** AND **0x3911/1** are set to 0.

9.2.1 Systembus

9.2.1.1 Basic settings

With object **0x3910/1** *Sysbus Node ID* you can assign an address to the Systembus interface.

NOTICE

Network error

The object **0x3910/1** *Sysbus Node ID* must be set to a value that is unique within the network. Redundant node IDs result in network errors.

- Set **0x3910/1** to a unique value.

With object **0x3910/2** *Sysbus Baudrate* is set.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3907/1	CAN interface Mapping	[-]	Selection		
0x3910/1	Systembus Node ID	[-]	0	1000	1
0x3910/2	Systembus Baudrate	[kBit/s]	50	1000	1000

With object **0x3907/1** *CAN Interface Mapping* the main device systembus interface "X212" can be parameterized to function as either Systembus or CANopen interface.

0x3907/1	Function
0 - CBO Sysbus / CM CANopen	Sysbus on X212 and CANopen on X310 activated
1 - CBO CANopen / CM Sysbus	CANopen on X212 and Sysbus on X310 activated

9.2.1.2 Functions

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3910/5	Systembus Sync Time	[ms]	0	1000	1
0x3910/20	Systembus NMT/Sync Master	[-]	FALSE	TRUE	FALSE
0x3910/21	Systembus Nmt Cycle Time	[s]	0	65	1
0x3910/22	Systembus	[s]	0	65	5

Sync Master

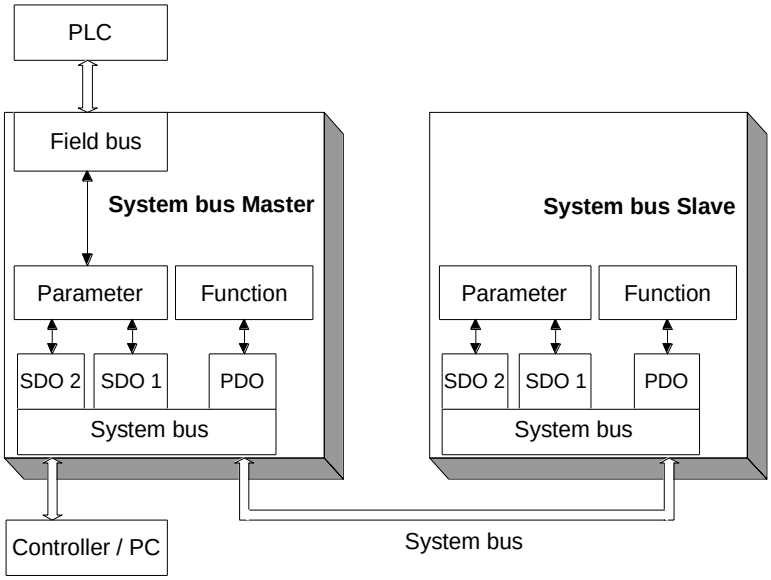
To configure the inverter Systembus node as master, set object **0x3910/20** *Sysbus Nmt/Sync Master* to `TRUE`. The master node then sends the sync telegram at intervals set in **0x3910/5**. If not set to `TRUE`, the node remains set to `FALSE` by default, and thus a slave node.

The Systembus functionality supports the Network Management NMT.

The network management controls the start of all the nodes on the systembus. Nodes can be started or stopped individually or together. For node recognition in a CANopen system, the slaves on the systembus generate a starting telegram (boot-up report).

If a fault occurs, the slaves automatically transmit a fault report (emergency message).

For the functions of the network management, the methods and NMT telegrams (network management telegrams) defined according to CANopen (CiA DS 301) are used.



- Select one inverter in your systembus and set the object **0x3910/20** *Sysbus Nmt/Sync Master* for this inverter to `TRUE`.

  This inverter is now the NMT AND the Sync Master for the systembus network.

You have to reboot the systembus nodes to allow the master to initiate the NMT state machine. The NMT state machine supports all states and transitions according to the DS301 standard. For details on the NMT see free online resources by the CiA group.

The inverter set as NMT Master now:

- controls the start of the network (boot-up)
- Generates SYNC telegram for synchronous PDOs
- Evaluates Emergency messages of the slaves
- Has access to slave parameters via client SDOs

9.2.1.3 PDO Identifier

Each frequency inverter possesses three PDO channels (Rx/Tx) for the exchange of process data.

By default, the identifier assignment for the PDO channel (Rx/Tx) is done according to the **Predefined Connection Set**. This assignment corresponds to an alignment to a central master control.

The Predefined Connection Set as standardized by DS301 employs the assignment of the PDO and SDO channels' COB-IDs (Communication Object Identifier) using the node ID number. The node ID number is increased by a predefined increment and the resulting number is set as the PDO/SDO identifier.

Default Identifiers:

Decimal		**Hexadecimal**
TxPDO1	384 + Node-ID	0x180 + Node-ID
RxPDO1	512 + Node-ID	0x200 + Node-ID
TxPDO2	640 + Node-ID	0x280 + Node-ID
RxPDO2	798 + Node-ID	0x300 + Node-ID
TxPDO3	896 + Node-ID	0x380 + Node-ID
RxPDO3	1024 + Node-ID	0x400 + Node-ID

In order to obtain logical channels between the devices (transverse movement) on the systembus, the amendment of the PDO identifiers for Rx/Tx is necessary.

The setting of the COB-IDs is done via the following objects:

Index/Sub	Designation	Index/Sub	Designation
0x3910/30	Sysbus RxPDO1 ID	0x3910/60	Sysbus TxPDO1 ID
0x3910/35	Sysbus RxPDO2 ID	0x3910/65	Sysbus TxPDO2 ID
0x3910/40	Sysbus RxPDO3 ID	0x3910/70	Sysbus TxPDO3 ID

The values for the COB-IDs are defined within the range of `385` to `1407`.

NOTICE

Network error

The COB-ID of the transmitting node must correspond to the COB-ID of the receiving node. Otherwise, the data is lost.

- On the receiving node, set **0x3910/30** to a value corresponding to the value of **0x3910/60** on the transmitting node. Set the values for the other PDOs accordingly.

9.2.1.4 Timeout

Relevant objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3910/27	Systembus Sync Timeout	[s]	0	65	0
0x3910/32	Systembus RxPDO1 Time	[s]	0	65	0
0x3910/37	Systembus RxPDO2 Time	[s]	0	65	0
0x3910/42	Systembus RxPDO3 Time	[s]	0	65	0

The object **0x3910/27** defines the time interval for receiving a sync telegram from the NMT/Sync master. If the sync telegram is not received within this interval, a sync timeout error is triggered. 9.2.1.2.

The objects **0x3910/32**, ..**/37**, ..**/42** define the time interval for receiving an RxPDO telegram. Accordingly, if the RxPDO telegram is not received within the defined interval, a PDO timeout error is triggered.

9.2.1.5 TxPDO Objects

PDO Mapping

To configure the contents of any given PDO, you have to select input sources from predefined choice lists. This is done via the object **0x3909/n** *TxPDOn* and its subindexes.

Relevant objects:

Index/Sub	Designation	Index/Sub	Designation
0x3909/1 … 8	TxPDO1 8-bit BYTE 1 … 8	0x3909/97	TxPDO2 32-bit DWORD 1
0x3909/17 … 23	TxPDO1 16-bit WORD 1 … 4	0x3909/101	TxPDO2 32-bit DWORD 2
0x3909/33	TxPDO1 32-bit DWORD 1	0x3909/113	TxPDO2 64-bit QWORD 1
0x3909/37	TxPDO1 32-bit DWORD 2	0x3909/129 … 136	TxPDO3 8-bit BYTE 1 … 8
0x3909/49	TxPDO1 64-bit QWORD 1	0x3909/145 … 151	TxPDO1 16-bit WORD 1 … 4
0x3909/65 … 72	TxPDO2 8-bit BYTE 1 … 8	0x3909/161	TxPDO1 32-bit DWORD 1
0x3909/81 … 87	TxPDO2 16-bit WORD 1 … 4	0x3909/165	TxPDO1 32-bit DWORD 2
		0x3909/177	TxPDO1 64-bit QWORD 1

Selection lists:

For *TxPDO1 8-bit BYTE 1 … 8* 0x3909/1…8;

***TxPDO2 8-bit BYTE 1 … 8* 0x3909/65…72;**

***TxPDO3 8-bit BYTE 1 … 8* 0x3909/129…136:**

Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00394001	IN1D (X210.3, X210.1)
0x00000001	true	0x00394002	IN2D (X210.5, X210.3)
0x0021A020	STO	0x00394003	IN3D (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	IN4D (X210.4, X210.7)
0x0021A000	Timer 1 Output	0x00394005	IN5D (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	IN6D (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A220	Logic 3 Output	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x00243503	Neg HW Limit Switch Triggered	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x0025FA01	Axis Positioning Target Reached	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA010/..7	PLC Out UInt8 0/..7
0x003910B0/..7	SB RxPDO3 Int8 0/..7	0x003CA020/..7	PLC Out Int8 0/..7
0x003910F0	Sysbus_EmcySlave_ID	0x00401500	Warning in System
		0x00401510	General Warning

For *TxPDO1 16-bit WORD 1 … 4* 0x3909/17…23; *TxPDO2 16-bit WORD 1 … 4* 0x3909/81…87 *TxPDO3 16-bit WORD 1 … 4* 0x3909/145…151:

Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00391668	PROFIx Tel111/PD2 Rx ui16_0
0x00000005	Debug Sine	0x00391669	PROFIx Tel111/PD2 Rx ui16_1
0x0021B000	Multiplexer Output	0x0039166C	PROFIx Tel111/PD2 Rx i16_0
0x00220402	Control Word Override	0x0039166D	PROFIx Tel111/PD2 Rx i16_1
0x00220403	Control Word Internal	0x003916B8	PROFIx Tel112/PD3 Rx ui16_0
0x00229005	VdcCtrl Status	0x003916B9	PROFIx Tel112/PD3 Rx ui16_1
0x0022B003	ModCtrl Status	0x003916BC	PROFIx Tel112/PD3 Rx i16_0
0x0022B801	FluxCtrl Status	0x003916BD	PROFIx Tel112/PD3 Rx i16_1
0x00382120	Status Digital Outputs	0x003916F8	PROFIx Tel113/PD4 Rx ui16_0
0x00391018/..B	SB RxPDO1 UInt16 0/..3	0x003916F9	PROFIx Tel113/PD4 Rx ui16_1
0x0039101C/..F	SB RxPDO1 Int16 0/..3	0x003916FC	PROFIx Tel113/PD4 Rx i16_0
0x00391068/..B	SB RxPDO2 UInt16 0/..3	0x003916FD	PROFIx Tel113/PD4 Rx i16_1
0x0039106C/..F	SB RxPDO2 Int16 0/..3	0x00394000	Status Digital Inputs Filtered
0x003910B8/..B	SB RxPDO3 UInt16 0/..3	0x003CA030/..7	PLC OUT UInt16 0/..7
0x003910BC/..F	SB RxPDO3 Int16 0/..3	0x003CA040/..7	PLC OUT Int16 0/..7
0x00391618	PROFIx Tel110/PD1 Rx ui16_0	0x00604000	Control Word 6040:00
0x00391619	PROFIx Tel110/PD1 Rx ui16_1	0x00604100	Status Word 6041:00
0x0039161C	PROFIx Tel110/PD1 Rx i16_0		
0x0039161D	PROFIx Tel110/PD1 Rx i16_1		

For *TxPDO1 32-bit DWORD 1 … 2* 0x3909/33/..37;
***TxPDO2 32-bit DWORD 1 … 2* 0x3909/97/..101**
***TxPDO3 32-bit DWORD 1 … 2* 0x3909/161/..165:**

Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00391020	SB RxPDO1 UInt32 0
0x00000004	Hundred percent	0x00391021	SB RxPDO1 UInt32 1
0x00207801	Encoder X4X2: Angle Mech.	0x00391028	SB RxPDO1 Int32 0
0x00207802	Encoder X4X2: Position	0x00391029	SB RxPDO1 Int32 1
0x00207803	Encoder X4X2: Speed	0x00391040	SB RxPDO1 Single 0
0x0021A300	Simple Math 1 Output	0x00391041	SB RxPDO1 Single 1
0x0021A301	Simple Math 1 Output Inverted	0x00391070	SB RxPDO2 UInt32 0
0x0021A310	Simple Math 2 Output	0x00391071	SB RxPDO2 UInt32 1
0x0021A311	Simple Math 2 Output Inverted	0x00391078	SB RxPDO2 Int32 0
0x0021A320	Simple Math 3 Output	0x00391079	SB RxPDO2 Int32 1
0x0021A321	Simple Math 3 Output Inverted	0x00391090	SB RxPDO2 Single 0
0x0021A330	Simple Math 4 Output	0x00391091	SB RxPDO2 Single 1
0x0021A331	Simple Math 4 Output Inverted	0x003910C0	SB RxPDO3 UInt32 0
0x00220502	Mode of Operation Override	0x003910C1	SB RxPDO3 UInt32 1
0x00220503	Mode of Operation Internal	0x003910C8	SB RxPDO3 Int32 0
0x00220900	VAlpha	0x003910C9	SB RxPDO3 Int32 1
0x00220901	VBeta	0x003910E0	SB RxPDO3 Single 0
0x00220A01	Phase Current a	0x003910E1	SB RxPDO3 Single 1
0x00220A02	Phase Current b	0x00391620	PROFIx Tel110/PD1 Rx ui32_0
0x00220A03	Phase Current c	0x00391628	PROFIx Tel110/PD1 Rx i32_0
0x00220A04	IAlpha	0x00391640	PROFIx Tel110/PD1 Rx f32_0
0x00220A05	IBeta	0x00391670	PROFIx Tel111/PD2 Rx ui32_0
0x00220A06	Id	0x00391678	PROFIx Tel111/PD2 Rx i32_0
0x00220A07	Iq	0x00391690	PROFIx Tel111/PD2 Rx f32_0
0x00220A08	I Abs.	0x003916C0	PROFIx Tel112/PD3 Rx ui32_0
0x00220A09	I Abs. Filtered	0x003916C8	PROFIx Tel112/PD3 Rx i32_0
0x00220A0A	Zero Current	0x003916E0	PROFIx Tel112/PD3 Rx f32_0
0x00223002	Magnetizing Current	0x00391700	PROFIx Tel113/PD4 Rx ui32_0
0x00223007	MM Position	0x00391708	PROFIx Tel113/PD4 Rx i32_0
0x00224000	Theta Elec.	0x00391720	PROFIx Tel113/PD4 Rx f32_0
0x00224001	MM Freq. Elec.	0x00397000	Analog Output

Entry Idx	Designation	Entry Idx	Designation
0x00224002	Theta Mech.	0x00398000	MF Analog Input 1
0x00224003	MM Speed	0x00398001	MF Analog Input 1 Voltage
0x00224004	MM Id Ref.	0x00398002	MF Analog Input 1 Current
0x00224005	MM Iq Ref.	0x00398003	MF Analog Input 1 Temperature
0x00224006	MM Freq. Estimated	0x00398010	MF Analog Input 2
0x00224007	Stator Flux Alpha	0x00398011	MF Analog Input 2 Voltage
0x00224008	Stator Flux Beta	0x00398012	MF Analog Input 2 Current
0x00224009	Stator Flux Abs.	0x00398013	MF Analog Input 2 Temperature
0x0022400A	Stator Flux Alpha Ref.	0x003CA050/..7	PLC Out UInt32 0/..7
0x0022400B	Stator Flux Beta Ref.	0x003CA060/..7	PLC Out Int32 0/..7
0x0022400D	MM Slip Freq.	0x003CA070/..7	PLC Out Float32 0/..7
0x00226000	Iq Ref. FOC	0x00401511	Power Warnings
0x00226001	SpdTorqCtrl Saturation Status	0x00401512	Communication Warnings
0x00228000	Speed Ref.	0x00401513	Application Warning
0x00228001	Contouring Error	0x00403200	Percentage Setpoint Ch.
0x00228006	Speed Limit Positioning	0x00403201	Fixed Percentage Value
0x0022B000	ModCtrl Id Ref.	0x00403202	Percentage Motorpoti
0x0022B001	ModCtrl Iq Ref.	0x00403203	Percentage Analog In
0x0022B002	ModCtrl Iq Limit	0x00403204	Percentage MFI Analog
0x0022B800	FluxCtrl Id Ref.	0x00404001	Freq. Elec. Filtered
0x0022B802	FluxCtrl Deviation	0x00404002	Slip Freq. Filtered
0x0022C001	CurrentCtrl Vd Ref.	0x0040400A	Speed Filtered
0x0022C002	CurrentCtrl Vq Ref.	0x00404101	Flux Forming Voltage Filtered
0x0022E000	Multiplexer Id Ref.	0x00404102	Torque Forming Voltage Filtered
0x0022E001	Multiplexer Iq Ref.	0x00404103	V Abs. Filtered
0x0022F500	Magnetizing Current Ref.	0x00404111	Flux Forming Voltage
0x00231200	PID Controller Output	0x00404112	Torque Forming Volt.
0x00240501	Ixt Long Term Overload	0x00404113	V Abs.
0x00240502	Ixt Short Term Overload	0x00404201	Id Filtered
0x00240503	Ixt State	0x00404202	Iq Filtered
0x00241500	I2t Motor 1	0x00404203	IAbs. Filtered
0x00241501	I2t Motor 2	0x00404204	Active Current Filtered
0x00241502	I2t Motor 3	0x00404205	Reactive Current Filtered
0x00241503	I2t Motor 4	0x00404214	Active Current
0x00241504	I2t Winding 1	0x00404215	Reactive Current
0x00241505	I2t Winding 2	0x00404301	Active Power Filtered
0x00241506	I2t Winding 3	0x00404302	Reactive Power Filtered
0x00241507	I2t Winding 4	0x00404303	Apperant Power Filtered
0x00251000	Speed Setpoint Channel	0x00404304	Power Factor Filtered
0x00251001	Fixed Speed	0x00404311	Active Power
0x00251002	Speed Motorpoti	0x00404312	Reactive Power
0x00251003	Speed Analog In (X210.13-14)	0x00404313	Apperant Power
0x00251004	Speed MFI Analog (X210.9-10)	0x00404314	Power Factor
0x00253000	Torque Setpoint	0x00404401	Torque Filtered
0x0025F100	Interpolated Position	0x00404411	Torque
0x0025F101	Interpolated Speed	0x00404501	Flux Filtered
0x00384001	Encoder X210: Angle Mech.	0x00404502	Flux Normalized Filtered
0x00384002	Encoder X210: Position	0x00404511	Flux
0x00384003	Encoder X210: Speed	0x00404512	Flux Normalized
0x00385001	Encoder X432: Angle Mech.	0x00420301	Max. Elec. Freq.
0x00385002	Encoder X432: Position	0x00420302	Max. Speed [u/s]
0x00385003	Encoder X432: Speed	0x00420303	MaxRefSpeed SpeedID
0x00385010	Encoder X432: Supply Volt. Intern	0x00590000	DC-Link Voltage
0x00385011	Encoder X432: Supply Volt. Sense	0x00590001	DC-Link Voltage Filtered
0x00385012	Encoder X432: Supply Volt. Encoder	0x00606000	Mode of Operation

9.2.1.6 TxPDO Functions

Each PDO channel can be operated with time control or SYNC control. In this way, the operation behavior can be set for each PDO channel.

The setting of the operation mode is done via the following objects:

Systembus operation mode configuration:

Index/Sub	Designation	Index/Sub	Designation
0x3910/61	Sysbus TxPDO1 Op. Mode	0x3910/67	Sysbus TxPDO2 Time
0x3910/62	Sysbus TxPDO1 Time	0x3910/71	Sysbus TxPDO3 Op. Mode
0x3910/66	Sysbus TxPDO2 Op. Mode	0x3910/72	Sysbus TxPDO3 Time

Operation Mode	Function
0 - deactivated	no exchange of data via the PDO channel (Rx and/or Tx)
1 - time-controlled	Tx-PDOs cyclically transmit according to the time specification Rx-PDOs are read in with Ta = 1 ms and forward the data received to the application
2 - SYNC controlled	Tx-PDOs transmit the data from the application that are then current after the arrival of the SYNC telegram. Rx-PDOs forward the last data received to the application after the arrival of the SYNC telegram.

PDO structure:

	8 Byte							
Identifier (COB-ID)	data	data	data	data	data	data	data	data

PDO (Process Data Object) messages contain up to 8 bytes of process data.

Process data objects are linked directly to the functions of the frequency inverter.

PDO identifier (COB-ID):

The number of bytes is 1 … 8 and it depends on the mapped objects. The bytes are arranged in the Intel format.

Byte	0	1	2	3	4	5
	16 bit object		32 bit object			
	LSB	MSB	LSB	…	…	MSB

Changing PDO COB-ID

The PDO COB-ID can be changed as required while the systembus is in operation.

- Observe the correct ID assignment between transmitting and receiving nodes.

9.2.1.7 RxPDO Functions

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3910/31	Systembus RxPDO1 Op. Mode	[-]	Selection		
0x3910/36	Systembus RxPDO2 Op. Mode	[-]	Selection		
0x3910/41	Systembus RxPDO3 Op. Mode	[-]	Selection		

Operation Mode	Function
0 - deactivated	no exchange of data via the PDO channel (Rx and/or Tx)
1 - time-controlled	Tx-PDOs cyclically transmit according to the time specification Rx-PDOs are read in with Ta = 1 ms and forward the data received to the application

Operation Mode	Function
2 - SYNC controlled	Tx-PDOs transmit the data from the application that are then current after the arrival of the SYNC telegram. Rx-PDOs forward the last data received to the application after the arrival of the SYNC telegram.

9.2.1.8 Emergency

The Systembus master evaluates the emergency messages of the slaves. Its reaction to an emergency message can be set with the object **0x3910/23** *Systembus Emcy Reaction*.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3910/23	Systembus Emcy Reaction	[-]	Selection		
0x3910/24	Systembus Emcy Slave ID	[-]	Runtime data		
0x3910/25	Systembus Emcy Slave Error	[-]	Runtime data		
0x3910/26	Systembus Emcy Sla. ID List	[-]	Runtime data		

Operation Mode	Function
0 - Error	(Default) An emergency message on a slave triggers an error in the master. In the case of a fault in a systembus slave, an error telegram will be triggered. As soon as the systembus master receives an emergency message, it also performs a fault switch-off as defined in "Error behavior" and stores the ID of the failed node in the object **0x3910/24** *Systembus Emcy Slave ID*. The fault message of the slave is stored in the object **0x3910/25** *Systembus Emcy Slave Error*. If a fault switch-off occurs on a number of slaves, the list of the slaves transmitting emergency messages is stored in the object **0x3910/26** *Systembus Emcy Sla. ID List*.
1 - Warning	An emergency message on a slave triggers a warning in the master. The behavior is analogous to the "Error" option, but the master inverter does not go into "Error" state itself. Instead, a warning is triggered.
2 - Ignore	An emergency message on a slave is ignored by the master.

9.2.2 CANopen

9.2.2.1 Basic Settings

With object **0x3907/1** *CAN Interface Mapping* the main device systembus interface "X212" can be parameterized to function as either Systembus or CANopen interface.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3907/1	CAN interface Mapping	[-]	Selection		

0x3907/1	Function
0 - CBO Sysbus / CM CANopen	Sysbus on X212 and CANopen on X310 activated
1 - CBO CANopen / CM Sysbus	CANopen on X212 and Sysbus on X310 activated

With object **0x3911/1** *CANopen Node ID* you can assign an address to the CANopen interface.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x3911/1	CANopen Node ID	0	127	0

NOTICE

Network error

The object **0x3911/1** *CANopen Node ID* must be set to a value that is unique within the network. Redundant node IDs result in network errors.

- Set **0x3911/1** to a unique value.

With object **0x3911/2** *CANopen Baudrate* is set.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x3911/2	CANopen Baudrate	50 kBit/s	1000 kBit/s	1000 kBit/s

9.2.2.2 Freely mappable objects

Mapping

To configure the contents of the objects listed below, you have to select input sources from predefined selection lists. This is done via the object **0x585n/n** *Src mappable n Bit Obj. 1 … 4* and its subindexes.

The objects named `Mappable n Bit Obj 1 … 4` are status objects, which can only be read.

Relevant objects:

Index/Sub	Designation
0x5850/1 … 4	Src mappable 8 Bit Obj. 1 … 4
0x5850/21 … 24	Mappable 8 Bit Obj 1 … 4
0x5851/1 … 4	Src mappable 16 Bit Obj. 1 … 4
0x5851/21 … 24	Mappable 16 Bit Obj 1 … 4
0x5852/1 … 4	Src mappable 32 Bit Obj. 1 … 4
0x5852/21 … 24	Mappable 32 Bit Obj 1 … 4

For ***Src mappable 8 Bit Obj. 1 … 4*** **0x5850/1…4:**

Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00394001	IN1D (X210.3, X210.1)
0x00000001	true	0x00394002	IN2D (X210.5, X210.3)
0x0021A020	STO	0x00394003	IN3D (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	IN4D (X210.4, X210.7)
0x0021A000	Timer 1 Output	0x00394005	IN5D (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	IN6D (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	IN4D w/o filter (X210.4, X210.7)

Entry Idx	Designation	Entry Idx	Designation
0x0021A220	Logic 3 Output	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x00243503	Neg HW Limit Switch Triggered	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x0025FA01	Axis Positioning Target Reached	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA010/..7	PLC Out UInt8 0/..7
0x003910B0/..7	SB RxPDO3 Int8 0/..7	0x003CA020/..7	PLC Out Int8 0/..7
0x003910F0	Sysbus_EmcySlave_ID	0x00401500	Warning in System
		0x00401510	General Warning

For *Src mappable 16 Bit Obj. 1 … 4* 0x5851/1...4:

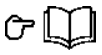
Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00391668	PROFIx Tel111/PD2 Rx ui16_0
0x00000005	Debug Sine	0x00391669	PROFIx Tel111/PD2 Rx ui16_1
0x0021B000	Multiplexer Output	0x0039166C	PROFIx Tel111/PD2 Rx i16_0
0x00220402	Control Word Override	0x0039166D	PROFIx Tel111/PD2 Rx i16_1
0x00220403	Control Word Internal	0x003916B8	PROFIx Tel112/PD3 Rx ui16_0
0x00229005	VdcCtrl Status	0x003916B9	PROFIx Tel112/PD3 Rx ui16_1
0x0022B003	ModCtrl Status	0x003916BC	PROFIx Tel112/PD3 Rx i16_0
0x0022B801	FluxCtrl Status	0x003916BD	PROFIx Tel112/PD3 Rx i16_1
0x00382120	Status Digital Outputs	0x003916F8	PROFIx Tel113/PD4 Rx ui16_0
0x00391018/..B	SB RxPDO1 UInt16 0/..3	0x003916F9	PROFIx Tel113/PD4 Rx ui16_1
0x0039101C/..F	SB RxPDO1 Int16 0/..3	0x003916FC	PROFIx Tel113/PD4 Rx i16_0
0x00391068/..B	SB RxPDO2 UInt16 0/..3	0x003916FD	PROFIx Tel113/PD4 Rx i16_1
0x0039106C/..F	SB RxPDO2 Int16 0/..3	0x00394000	Status Digital Inputs Filtered
0x003910B8/..B	SB RxPDO3 UInt16 0/..3	0x003CA030/..7	PLC OUT UInt16 0/..7
0x003910BC/..F	SB RxPDO3 Int16 0/..3	0x003CA040/..7	PLC OUT Int16 0/..7
0x00391618	PROFIx Tel110/PD1 Rx ui16_0	0x00604000	Control Word 6040:00
0x00391619	PROFIx Tel110/PD1 Rx ui16_1	0x00604100	Status Word 6041:00
0x0039161C	PROFIx Tel110/PD1 Rx i16_0		
0x0039161D	PROFIx Tel110/PD1 Rx i16_1		

For *Src mappable 32 Bit Obj. 1 … 4* 0x5852/1...4:

Entry Idx	Designation	Entry Idx	Designation
0x00000000	0 / null / false /none	0x00391020	SB RxPDO1 UInt32 0
0x00000004	Hundred percent	0x00391021	SB RxPDO1 UInt32 1
0x00207801	Encoder X4X2: Angle Mech.	0x00391028	SB RxPDO1 Int32 0
0x00207802	Encoder X4X2: Position	0x00391029	SB RxPDO1 Int32 1
0x00207803	Encoder X4X2: Speed	0x00391040	SB RxPDO1 Single 0
0x0021A300	Simple Math 1 Output	0x00391041	SB RxPDO1 Single 1
0x0021A301	Simple Math 1 Output Inverted	0x00391070	SB RxPDO2 UInt32 0
0x0021A310	Simple Math 2 Output	0x00391071	SB RxPDO2 UInt32 1
0x0021A311	Simple Math 2 Output Inverted	0x00391078	SB RxPDO2 Int32 0
0x0021A320	Simple Math 3 Output	0x00391079	SB RxPDO2 Int32 1

Entry Idx	Designation	Entry Idx	Designation
0x0021A321	Simple Math 3 Output Inverted	0x00391090	SB RxPDO2 Single 0
0x0021A330	Simple Math 4 Output	0x00391091	SB RxPDO2 Single 1
0x0021A331	Simple Math 4 Output Inverted	0x003910C0	SB RxPDO3 UInt32 0
0x00220502	Mode of Operation Override	0x003910C1	SB RxPDO3 UInt32 1
0x00220503	Mode of Operation Internal	0x003910C8	SB RxPDO3 Int32 0
0x00220900	VAlpha	0x003910C9	SB RxPDO3 Int32 1
0x00220901	VBeta	0x003910E0	SB RxPDO3 Single 0
0x00220A01	Phase Current a	0x003910E1	SB RxPDO3 Single 1
0x00220A02	Phase Current b	0x00391620	PROFIx Tel110/PD1 Rx ui32_0
0x00220A03	Phase Current c	0x00391628	PROFIx Tel110/PD1 Rx i32_0
0x00220A04	IAlpha	0x00391640	PROFIx Tel110/PD1 Rx f32_0
0x00220A05	IBeta	0x00391670	PROFIx Tel111/PD2 Rx ui32_0
0x00220A06	Id	0x00391678	PROFIx Tel111/PD2 Rx i32_0
0x00220A07	Iq	0x00391690	PROFIx Tel111/PD2 Rx f32_0
0x00220A08	I Abs.	0x003916C0	PROFIx Tel112/PD3 Rx ui32_0
0x00220A09	I Abs. Filtered	0x003916C8	PROFIx Tel112/PD3 Rx i32_0
0x00220A0A	Zero Current	0x003916E0	PROFIx Tel112/PD3 Rx f32_0
0x00223002	Magnetizing Current	0x00391700	PROFIx Tel113/PD4 Rx ui32_0
0x00223007	MM Position	0x00391708	PROFIx Tel113/PD4 Rx i32_0
0x00224000	Theta Elec.	0x00391720	PROFIx Tel113/PD4 Rx f32_0
0x00224001	MM Freq. Elec.	0x00397000	Analog Output
0x00224002	Theta Mech.	0x00398000	MF Analog Input 1
0x00224003	MM Speed	0x00398001	MF Analog Input 1 Voltage
0x00224004	MM Id Ref.	0x00398002	MF Analog Input 1 Current
0x00224005	MM Iq Ref.	0x00398003	MF Analog Input 1 Temperature
0x00224006	MM Freq. Estimated	0x00398010	MF Analog Input 2
0x00224007	Stator Flux Alpha	0x00398011	MF Analog Input 2 Voltage
0x00224008	Stator Flux Beta	0x00398012	MF Analog Input 2 Current
0x00224009	Stator Flux Abs.	0x00398013	MF Analog Input 2 Temperature
0x0022400A	Stator Flux Alpha Ref.	0x003CA050/..7	PLC Out UInt32 0/..7
0x0022400B	Stator Flux Beta Ref.	0x003CA060/..7	PLC Out Int32 0/..7
0x0022400D	MM Slip Freq.	0x003CA070/..7	PLC Out Float32 0/..7
0x00226000	Iq Ref. FOC	0x00401511	Power Warnings
0x00226001	SpdTorqCtrl Saturation Status	0x00401512	Communication Warnings
0x00228000	Speed Ref.	0x00401513	Application Warning
0x00228001	Contouring Error	0x00403200	Percentage Setpoint Ch.
0x00228006	Speed Limit Positioning	0x00403201	Fixed Percentage Value
0x0022B000	ModCtrl Id Ref.	0x00403202	Percentage Motorpoti
0x0022B001	ModCtrl Iq Ref.	0x00403203	Percentage Analog In
0x0022B002	ModCtrl Iq Limit	0x00403204	Percentage MFI Analog
0x0022B800	FluxCtrl Id Ref.	0x00404001	Freq. Elec. Filtered
0x0022B802	FluxCtrl Deviation	0x00404002	Slip Freq. Filtered
0x0022C001	CurrentCtrl Vd Ref.	0x0040400A	Speed Filtered
0x0022C002	CurrentCtrl Vq Ref.	0x00404101	Flux Forming Voltage Filtered
0x0022E000	Multiplexer Id Ref.	0x00404102	Torque Forming Voltage Filtered
0x0022E001	Multiplexer Iq Ref.	0x00404103	V Abs. Filtered
0x0022F500	Magnetizing Current Ref.	0x00404111	Flux Forming Voltage
0x00231200	PID Controller Output	0x00404112	Torque Forming Volt.
0x00240501	Ixt Long Term Overload	0x00404113	V Abs.
0x00240502	Ixt Short Term Overload	0x00404201	Id Filtered
0x00240503	Ixt State	0x00404202	Iq Filtered
0x00241500	I2t Motor 1	0x00404203	IAbs. Filtered
0x00241501	I2t Motor 2	0x00404204	Active Current Filtered
0x00241502	I2t Motor 3	0x00404205	Reactive Current Filtered
0x00241503	I2t Motor 4	0x00404214	Active Current
0x00241504	I2t Winding 1	0x00404215	Reactive Current
0x00241505	I2t Winding 2	0x00404301	Active Power Filtered
0x00241506	I2t Winding 3	0x00404302	Reactive Power Filtered
0x00241507	I2t Winding 4	0x00404303	Apperant Power Filtered

Entry Idx	Designation	Entry Idx	Designation
0x00251000	Speed Setpoint Channel	0x00404304	Power Factor Filtered
0x00251001	Fixed Speed	0x00404311	Active Power
0x00251002	Speed Motorpoti	0x00404312	Reactive Power
0x00251003	Speed Analog In (X210.13-14)	0x00404313	Apperant Power
0x00251004	Speed MFI Analog (X210.9-10)	0x00404314	Power Factor
0x00253000	Torque Setpoint	0x00404401	Torque Filtered
0x0025F100	Interpolated Position	0x00404411	Torque
0x0025F101	Interpolated Speed	0x00404501	Flux Filtered
0x00384001	Encoder X210: Angle Mech.	0x00404502	Flux Normalized Filtered
0x00384002	Encoder X210: Position	0x00404511	Flux
0x00384003	Encoder X210: Speed	0x00404512	Flux Normalized
0x00385001	Encoder X432: Angle Mech.	0x00420301	Max. Elec. Freq.
0x00385002	Encoder X432: Position	0x00420302	Max. Speed [u/s]
0x00385003	Encoder X432: Speed	0x00420303	MaxRefSpeed SpeedID
0x00385010	Encoder X432: Supply Volt. Intern	0x00590000	DC-Link Voltage
0x00385011	Encoder X432: Supply Volt. Sense	0x00590001	DC-Link Voltage Filtered
0x00385012	Encoder X432: Supply Volt. Encoder	0x00606000	Mode of Operation

For further CANopen communication function specifics  AXIA CMA-CAN-01 "VEC2en39" document.

9.2.3 Communication modules

Communication modules installed in the Communication Module X310 slot automatically show up in the AxiaManager tree view. The type of module is selected during the initial project setup or is defined by reading the configuration of the inverter connected to the workstation. Depending on the type of communication module installed the configuration options will vary.

For more information  communication module manuals.

9.2.4 Keypad settings configuration

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3921/1	Keypad Actual Value	[-]	Selection		
0x3921/2	Backlight	[-]	Selection		
0x3921/3	Max Visible Role	[-]	Selection		
0x3907/2	Factory Defaults Possible	[-]	False	True	True

For the actual value to be displayed in the keypad, you can choose from the list assigned to the object **0x3921/1**.

The signal source for the activation of the backlight is selected via the list assigned to the object **0x3921/2**. If the signal at the chosen source changes its state, the backlight is activated.

The highest user role to be visible on the keypad is assigned via the object **0x3921/3**.

The object **0x3907/2** sets, whether the keypad allows setting factory defaults.

9.2.5 OS sync

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3906/6	Target Difference	[-]	100	5000	1500
0x3906/7	Target Window Span	[-]	50	3000	1400
0x3906/8	Maximum Correction	[-]	1	30	18
0x3906/9	Max. No. of Missmatches	[-]	1	100	25
0x3906/10	Time Diff. Filter	[-]	0	1000	150
0x3906/11	Drift Measure Time	[-]	500	5000	1000
0x3906/12	Sync P Gain	[-]	0	100	0,5
0x3906/13	Sync I Gain	[-]	0	50	0,0001
0x3906/14	Sync Source	[-]	Selection		
0x3906/16	OS Sync Lost Reaction	[-]	Selection		

The operating system (OS) of the frequency inverter can be synchronized with a PLC or another device. Synchronization of the operating system will improve the operating characteristics of the machine. Synchronization is used to eliminate CPU **phase shifting** between master and slave devices to make sure that calculations are carried out at the same time. The synchronization time must be a natural number (multiple of 1 ms). The synchronization is implemented via a sync telegram.

Synchronization via Systembus:

Sync Slave

By default, the Systembus node of the inverter is configured as slave.

Synchronization can be done with Systembus SYNC telegrams or Systembus RxPDO telegrams.

The sync source is configured in the object

Sync Source **0x3906/14**	
Operation mode	**Function**
0 - Off	The OS is not synchronized with other devices.
1 - Automatic	The synchronization source is selected automatically by the frequency inverter. **Factory setting.**
2 - CM Module	The OS is synchronized via CM-Module.
3 - CANopen®	The OS is synchronized via CANopen®.
4 - Systembus	The OS is synchronized via Systembus
5 - IO Module	The OS is synchronized via IO-Module.

CANopen® active	Systembus active	Synchronization
Yes	Yes	Synchronisation via CANopen®
Yes	No	
No	Yes	Synchronization via Systembus
No	No	No Synchronization activated.

Error behavior

With the object **3906/16** *OS Sync Lost Reaction* you can configure the error behavior if the Systembus OS Sync is lost.

OS Sync Lost Reaction **0x3906/16**	
Operation mode	**Function**
0 - No reaction	There will be no reaction to the loss of sync.
1 - Warning	A warning message will be triggered. **Factory setting.**
2 - Fault	An error message will be triggered.
3 - Warning and fault	Both warning and error messages will be triggered.

9.2.6 Communication interface configuration example

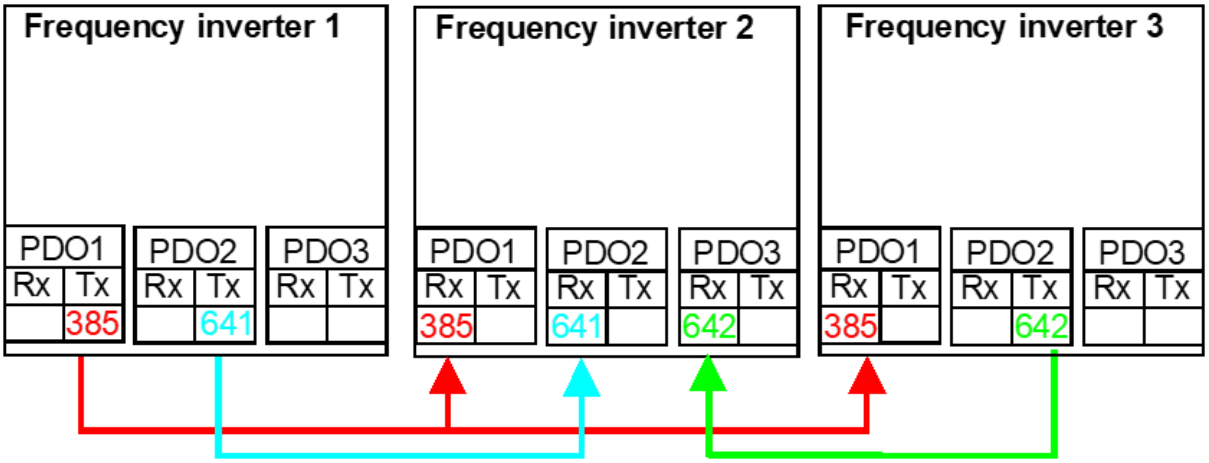
9.2.6.1 Setting up the Systembus

- At the X212 interface, wire the systembus connection between up to 63 inverters.
- Via the USB-C port on the KP-DSP-Module, connect the master inverter to the PC workstation running the AxiaManager GUI software (VEC1en51).
- Using the AxiaManager, connect to the master inverter.
- Access the object **0x3910/1** *Sysbus Node ID* and set the value to a unique number of your choosing within the range of `1` to `63`.
- To configure the inverter Systembus node as master, set object **0x3910/20** *Sysbus Nmt/Sync Master* to `1`.

  The master inverter Systembus node will carry out the NMT processes at the next boot-up.

To prevent Systembus network errors, assign unique numbers to **0x3910/1** *Sysbus Node ID* in all other inverter nodes on the network:

- Using the AxiaManager, connect to the slave inverter of your choosing. Access the object **0x3910/1** *Sysbus Node ID* and set the value to a unique number of your choosing within the range of `1` to `63`.
- Repeat the setting procedure for all slave nodes as required.
- After setting the node addresses, reboot all systembus devices to initiate the NMT by the master.
- If not amended, the PDO COB-IDs are set according to the predefined connection set (9.2.1.3).
- If necessary, set the COB-IDs for the TxPDO and the RxPDO channels.
  - Reboot the required node.



- Make sure that the TxPDO IDs match the RxPDO IDs (COB-ID) as required for the application. In case of mismatch the inverter will trigger an error (`TxPDO Map inconsistent`) and the data will be lost.
- To configure the operation mode of the systembus, set the objects *Sysbus TxPDOn Op. Mode* **0x3910/61** ..**/66** ..**/71** and *Sysbus TxPDOn Time* **0x3910/61** ..**/67** ..**/72** to the required values.

NOTICE

Data error

The load of the Systembus depends on

- number of used TxPDO's - the more in use - the higher the load
- the transmit time per TxPDO's - the lower the time the higher the load
- Baud rate - the lower the baud rate - the higher the load

- If the bus load exceeds 100%, a telegram cannot be dispatched between two transmission times. A load > 80% is not recommended.

9.2.6.2 TxPDO data structure

The data structure of the Process Data Object is compiled as follows:

Objects	Bool /Int8	Int16	Int32	Int64
0x3909	*0x01*	*0x17*	*0x33*	*0x49*
	0x02			
Subindex	*0x03*	*0x19*		
	0x04			
	0x05	*0x21*	*0x37*	
	0x06			
	0x07	*0x23*		
	0x08			

NOTICE

Data error

To ensure coherent data, you have to consider that the data written in the PDO occupies a dedicated range of the package.

For example, if data is written to the 32-bit Long 1 (**0x3909/37**), the 8-Bit BYTE 1 to 4 (**0x3909/1...4**) cannot be populated at the same time in the same TxPDO. Otherwise, the data will be lost. The same applies to TxPDO2 and TxPDO3 accordingly.

- Observe the correct data structure of the PDO.
- Make sure to set conflicting data arrays to 0 whenever necessary.

9.3 Motor configuration

9.3.1 Rated motor parameters

Motor Type 0x2001	Function
0 - ASM	Asynchronous machine/motor
1 - SynRM	Synchronous reluctance motor
2 - PMSM	Permanent Magnet synchronous motor

The motor data to be entered are indicated on the rating plate or the data sheet of the motor/machine. The defaults for the machine parameters are based on the nominal data of the frequency inverter and the corresponding motor. The captured and calculated machine data is checked for plausibility during the Auto-Setup procedure (9.3.5). The user should verify the preset rated data of the motor.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2002	Rated Voltage	[V]	0,0	800	400

0x2003	Rated Current	[A]	0,19	190	19
0x2004	Rated Speed	[rpm]	0	35940	1500
0x2005	No. of Pole Pairs	[-]	1	100	2
0x2006	Rated Cosinus Phi	[-]	0,1	1	0,7
0x2007	Rated Frequency	[Hz]	0,0	599	50
0x2008	Rated Mechanical Power	[W]	0	75000	7500
0x2009	Rated Torque	[Nm]	0	10000	0
0x200B	Maximum Current	[A]	0	190	0
0x200C	Maximum Speed	[rpm]	0	35940	0
0x200D	Maximum Mechanical Power	[W]	0	75000	0

For some motor types it is advisable to use the objects **0x200B** *Maximum Current*, **0x200C** *Maximum Speed* and **0x200D** *Maximum Mechanical Power* to limit the current, speed and power applied to the motor. This is to improve the motor performance in certain applications. If left at the default value `0`, the limitation will not apply.

Specific motor type values

In case of **asynchronous motors (ASM)**, the *Rated Torque* **0x2009** is often missing on the nameplate, which, however, is required for the Auto-Setup procedure (9.3.5). If the rated torque deviates from other motor parameters, the plausibility check will lead to the Auto-Setup process being aborted. The rated torque of the ASM can be calculated as follows:

$$RatedTorque0x2009[Nm] = \frac{9550 * [kW]RatedMech.Power0x2008}{[min^{-1}]RatedSpeed0x2004}$$

Example: BONFIGLIOLI BN 90LA Motor (ASM)

$$RatedTorque0x2009[Nm] = \frac{9550 * 1{,}5kW}{[1410min^{-1}]} = 10{,}16$$

Alternatively, the **value** `0` can be entered as *Rated Torque* **0x2009**, so that the Auto-Setup process can be carried out. The rated torque is then calculated automatically.

In case of **Permanent Magnet Synchronous Motors (PMSM)**, the *Rated Speed* **0x2004** is required for the Auto-Setup procedure (9.3.5). If the *Rated Speed* **0x2004** is missing on the nameplate, it can be calculated as follows:

$$RatedSpeed0x2004[min^{-1}] = \frac{[Hz]RatedFrequency0x2007 * 60}{No.ofPolePairs0x2005}$$

Example: BONFIGLIOLI BMD 82_3,2Nm Motor (PMSM)

$$RatedSpeed0x2004[min^{-1}] = \frac{200Hz * 60}{4} = 3000$$

Alternatively, you can enter the value `0` for *Rated Speed* **0x2004** so that the Auto-Setup process can be carried out. The rated speed is calculated automatically.

Synchronous reluctance motor

The Auto-Setup with a **SynRM** sets the values for relevant objects in an identical way as with other motor types.

Star or delta connection

NOTICE

Wrong parameterization

The rated data of the motor must be entered according to the specifications on the rating plate for the motor connection type used (star or delta connection).

If the data entered deviate from the rating plate, the parameters will not be identified correctly.

- Parameterize the rated data according to the rating plate of the motor for the wiring of the motor winding. Consider the increased rated current of the connected three-phase motor.

In the star motor connection, the nominal voltage and the nominal current behave as follows compared to the delta motor connection:

$$RatedVoltage0x2002[V] = \frac{400_{(Star)}}{\sqrt{3}} = 230_{(Delta)}$$

$$RatedCurrent0x2003[A] = I_{Star} \times \sqrt{3} = I_{(Delta)}$$

Example: BONFIGLIOLI BN 90LA Motor

Object		Star	Delta
0x2002	Rated Voltage	400 V	230 V
0x2003	Rated Current	3,7 A	6,4 A
0x2004	Rated Speed	1410 rpm	1410 rpm
0x2006	Rated Cosinus Phi	0,77	0,77
0x2007	Rated Frequency	50 Hz	50 Hz
0x2008	Rated Mech. Power	1500 W	1500 W

9.3.2 Additional motor parameters

Additional motor parameters include the following:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x200A	Commutation Offset	[deg]	-360	360	0
0x2010	Rated Magnetisation Current	[A]	0	41,8025	0
0x2015	Leakage Coefficient	[-]	0	1	0,01
0x2022	Voltage Constant	[mVmin]	0	1000	0
0x2023	Stator Resistance	[Ohm]	0,001	1000	0,001
0x2024	Stator d-Inductance	[H]	0	10	0
0x2025	Stator q-Inductance	[H]	0	10	0
0x2026	Main Inductance	[H]	0	10	0
0x2027	Rotor Resistance	[Ohm]	0,0	1000	0,0
0x2028	Rotor Time Constant	[s]	0,001	10	0,01
0x202A	Motor Inertia	[kg*m2]	0	1	0

Saturation and thermal dependency of motor data

The rated and the additional motor data characterize the motor around the nominal operation point. These motor data may depend on the operation point of the drive and can be Influenced by the motor temperature and the saturation of inductances.

To track these two physical effects, refer to chapter 9.3.3.

9.3.3 Saturation and thermal dependency

The objects listed in this category are usually set automatically. In standard cases, they do not require parameterization by the user. In special cases, you might need to adapt the settings of these parameters. Please contact the manufacturer if you are not entirely sure about the correct settings.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x223B	Online Optimizat. Performed	[-]	FALSE	TRUE	FALSE
0x2250	Inductance Mode	[-]	Selection		
0x2252	Star Delta Table Config.	[-]	Selection		
0x2254	Temp. Adapt Mode	[-]	Selection		
0x2255	Temperature Coefficient	[1/°C]	0	1	0,0039
0x2256	Adjustment Temperature	[°C]	0	150	35

The motor inductances typically saturate, depending on the operation point. The saturation curve is very individual in every motor. Therefore, the saturation curve of relevant inductances and the rotor time constant is modelled with a look up table.

The look up tables can either be measured with the Auto-Setup Function, provided by the user or read from internally stored tables.

0x2250		Function
0x00000000	Fix Inductance / No Adaption	Nominal motor data is used for inductances and rotor time constant (TauR)
0x00000001	Linear Adaption	Below nominal current, the saturation of the inductances is modelled by a linear curve.
0x00000002	1D Table	One dimensional look up table is used to model inductances and rotor time constant.

The internally stored look up tables are defined for star-connection of the motor (400 V operation). If the motor is connected in delta-connection (230 V operation) the tables need to be adapted. This is done with **0x2252** *Star Delta Table Configuration* and also applies to the look up table for the flux reference (12.3.8).

0x2252		Function
0x00000001	Table + Motor in same Configuration	The look up tables are defined in the same configuration (star or delta) as the motor is connected. The tables are not adapted.
0x00000002	Table in Star Connection Motor in **Delta** Connection	The look up tables are adapted.
0x00000003	Table in Delta Connection Motor in **Star** Connection	The look up tables are adapted.

0x2254		Function
0x00000001	Off	
0x00000002	Motor temperature sensor	Temperature sensor integrated in the motor is used.
0x00000003	Use heatsink temperature	Heatsink temperature sensor is used.
0x00000004	Resistance measurement at start	Temperature is measured via resistance measurement at the start.

9.3.4 Control (Motor Control)

In the Subtree `Parameters\Installation\Motor\Control`, set the values for the following objects:

Object		Function
0x2080	Motor Control	**Setting of Motor Control** Choose V/f- scalar control for simple ASM- applications. For higher demands on speed or torque accuracy, select Field orientated control (FOC) applicable to all types of motors. In addition, the HTL encoder signal can be integrated into the speed or position control.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2081	Actual Speed Source	[-]		Selection	
0x2082	Actual Position Source	[-]		Selection	
0x20A0	Invert Sense of Rotation	[-]		Selection	

Actual Speed Source 0x2081	Function
0x00000000	HTL Encoder via X210
0x00000001	Enc. Module Slot X432
0x00000002	Enc. Module Slot X412
0x00000003	Enc. Module Slot X422
0xFFFFFFFF	Sensorless

Actual Position Source 0x2082	Function
0x00000000	HTL Encoder via X210
0x00000001	Enc. Module Slot X432
0x00000002	Enc. Module Slot X412
0x00000003	Enc. Module Slot X422
0xFFFFFFFF	Sensorless

Via the object **0x20A0** *Invert Sense of Rotation* you can select to invert the sense of rotation signal for the motor only or for the entire drive train. The default setting is `off`.

9.3.5 Auto setup (Axia Automatic Tuning)

Auto-Tuning is the sub-routine of the Auto Setup that performs the measurements determining the most optimal values to be set for the motor.

Prerequisite: 0x2001-0x2009 Motor Data

The rated motor data such as stator inductance, magnetization current and others is stored in the objects **0x2001**-**0x2009**. This data is required as a starting point for Auto-Setup so that the auto-tuning can be carried out. 9.3.1

The auto-tuning values are determined by way of measurement and pre-set accordingly. Auto-tuning should be carried out while the machine is cold, because a part of the machine data depends on the operating temperature.

- In the `Parameters\Controls and Controllers\Controls\Mode` subtree set **0x2201** to "`-10`" (dec)/"`FFFFFFF6`" (hex) which means "`Auto-setup`" 12.1.1

Auto setup configuration

The Auto Setup can be carried out via different operating modes, which can be selected via object **0x2099/1** *Auto Setup Type*.

- Via **0x2099/1** set the type of auto tuning.

Auto Setup Type 0x2099/1	Function
0x00000000 Complete Setup	Complete Measurement of Motor Data / **Default**
0x00000001 Motor Parameter Measurement Only	
0x00000002 Encoder Offset Only	Measurement of encoder/ resolver offset
0x00000003 Tuning Current Controller Only	

With the Tuning Mode `0`, a complete pre-setting is made for the additional motor data and different motor controller types. In mode `1`, only the motor parameters are determined by measurement. Mode `2` only determines the encoder/resolver offset.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2099/1	Auto Setup Type	[-]	Selection		
0x2099/2	Allow Brake Release	[-]	Selection		
0x2099/6	Auto Setup Data Set	[-]	0 - All Data Sets/1 - Actual Data set		
0x2099/7	Cancel Plausibility Check	[-]	0 - OFF / 1 - ON		
0x2099/8	Auto-Setup Offset Mode	[-]	Selection		
0x2099/10	Setup from Datasheet	[-]	TRUE/FALSE		
0x2099/13	Current Dependent Gains	[-]	ON/OFF		
0x2099/15	No Current Ctrl Update	[-]	ON/OFF		
0x2099/16	Correct Sense of Rotation	[-]	ON/OFF		
0x209A	Auto Setup State	[-]	Selection		
0x209B/1	Auto Setup Error	[-]	Actual Value		
0x209B/2	Auto Setup Error Info 1	[-]			
0x209B/3	Auto Setup Error Info 2	[-]			
0x209B/4	Auto Setup Error Info 3	[-]			
0x209B/5	Auto Setup Warning	[-]	Actual Value		

0x2099/2 – *Allow Brake Release* (brake shall be disengaged during auto-tuning) 0/1(def)

0x2099/6 – *Auto Setup Data Set* 0-1 (0 – default; All Data Sets)

0x2099/7 – *Cancel Plausibility Check* 0-1 (0 – default)

0x2099/8 – *Auto-Setup Offset Mode* 0-3 (1 – default)

0x2099/10 –*Setup from Datasheet* 0-1 (0 – default) (the auto-setup function calculates motor values based on data entered from the datasheet, without feeding current into the motor)

0x209A – Auto Setup State 0/-1

When the auto-tuning is finished, the object **0x209A** is set to the value `-1`. This object is used to display the auto-tuning progress.

At completion of the auto-tuning, the device will be reset, which allows the user to select the next configuration step: the selection of the mode of operation.

The **control method** selected in object **0x2080** has no impact on the Auto Setup. However, if the offset of an encoder/resolver must be determined by measurement, the respective encoder settings must be set separately.

The behavior of the brake control during auto-tuning can be set via object **0x2099/2** *Allow Brake Release*. If there is no motor brake installed, set the value to `Brake Release Allowed – Free Shaft`. When using a motor brake, the Auto-Tuning can be carried out either with or without a brake, depending on the application. The setting `No Brake Release – Shaft Blocked` in object **0x2099/2** enables the Auto-Tuning without moving the motor shaft.

General settings for brake control must be carried out beforehand (☞ 9.3.4).

Allow Brake Release 0x2099/2	
Entry	**Function**
0x00000000	No Brake Release – Shaft Blocked
0x00000001	Brake Release Allowed – Free Shaft (default)

The values determined by the Auto-tuning can be stored in four different data sets (☞ 8.1). *Auto-Setup Data Set* can be specified in object **0x2099/6**.

Auto- Setup Data Set 0x2099/6	
dS	**Function**
0	All data sets
1	Actual Data set

If data set `0` is selected, the parameter values saved in data set `0` are copied to data sets `1` through `4`. In this way, all values determined during the Auto-Setup procedure are saved in all data sets. In the factory settings, the frequency inverter uses data set `1` as the active data set.

Process Description for Auto-Setup:

The Auto-Setup procedure can only be carried out if the inverter is supplied with mains voltage. When using a switching relay in the drive train, make sure that the connection to the motor is continuously closed during the measurement process.

- Enter *Motor Data* **0x2001-0x2009** according to motor nameplate or datasheet.
- In the `Parameters\Controls and Controllers\Controls\Mode` subtree, via object **0x2200** *Control Mode*, select the control mode:

0x2200 Control mode	
Entry Idx	**Designation**
0x00000001	**IOs (default)**
0x00000002	**Keypad**
0x00000003	**State machine**
0x0000000B	IOs w/o switch-over in op.
0x0000000C	Keypad w/o switch-over in op.
0x0000000D	State machine w/o switch-over in op.

- Set object **0x2201** *Mode of Op. (IOs)* to `Axia Auto Setup` when **0x2200** is set to `Keypad` or `IOs`. The Auto-Tuning is initiated, if **0x2199** *Hardware Release*, **0x2101/1** *Software Release* and **0x2101/2** *IO Start* is activated.
- If you have set `State Machine` via **0x2200**, in the `Parameters\Motion Control\Profile Objects\` subtree, set object **0x6060** *Mode of Operation* to `Auto-Setup`. The Auto-Tuning is initiated, if **0x2199** *Hardware Release*, **0x2101/1** *Software Release* and the specific starting bit is entered via object **0x6040** *Control Word*.

(For more information ☞ 🕮 respective manuals **CANopen**, **EtherCat**, **ProfiNet**, **Cia402**, **Industrial Ethernet**).

Once the **Auto-Setup** procedure is activated, the motor starts noising, and status can be monitored by object **0x209A** *Auto-Setup State*.

9.3.5.1 Data Set Selection

The data set selection function enables the selection of one of four (or all four) data sets for storing parameter settings.

- Use object **0x2099/6** – *Auto-Setup Data Set* to define the target data set for population with data during auto setup.

By default, the frequency inverter uses "all data sets" (**0x2099/6** = 0) when writing auto-setup data.

Example:

If `1 - Actual Data Set` is selected in **0x2099/6** *Auto-Setup Data Set*, all values determined or entered are saved in the data set selected in the object **0x2103/10**. The other data sets will still contain the default values. For proper operation of the frequency inverter, the pre-selected data set then must be selected as the active data set.

9.3.5.2 Status messages during Auto-Setup

The actual status of the Auto-Setup procedure is shown in object **0x209A** *Auto-Setup State*.

The following status messages are possible during commissioning (Auto- Setup):

Status message		Meaning
00000001	Auto-Setup Not Done	Auto-Setup has not yet been run
00000002	Plausibility Check	During the Auto-Setup, the individual process steps are displayed as status depending on the operating mode selected in object **0x2099/1**. As long as one of these status messages is displayed, the Auto- Setup is still running.
00000003	Nominal Tuning	
00000004	Alignment	
00000005	Tuning Current Controller	
00000006	Meas. Stator Resistor	
00000007	ASM Demagnetization	
00000008	Meas. Stator Inductance part 1	
00000009	Meas. Stator Inductance part 2	
0000000A	Meas. Encoder Offset	
0000000B	Auto-Setup Done	Auto-Setup was carried out successfully

9.3.5.3 Error messages during Auto-Setup:

After completion or during the Auto-Setup, error messages may be displayed. Depending on the error code, the following instructions should be observed, and the measures indicated should be taken. Errors according to the Auto-Setup procedure are shown in object **0x209B/1** *Auto-Setup Error*:

Code	**Measures / Remedy**	
Error messages		**Meaning**
00000000	NoError	No error initiated
00000001	UNom	Plausibility checks failed. Motor data must be checked (Objects **0x2001**-**0x2009**)
00000002	PolePair	
00000003	ElecPowerBalance	
00000004	LossesPowerBalance	
00000005	MechPowerBalance	
00000006	AdvPowerBalance	
00000007	SpeedMismatch	
00000008	SampleTimeMismatch	
0000000B	ITAE	Optimization method for controller setting not converged.
00000010	CosPhiNom	Plausibility checks failed.
00000011	SlipNom	

Code	Measures / Remedy	
Error messages		**Meaning**
00000012	Offset	Encoder offset could not be determined
00000013	Sensor not set	Encoder setting incorrect or encoder signal missing
00000014	No Write all for parameters	Not all values could be determined
00000015	Motor Connection	No Motor connected

9.3.5.4 Warning messages during Auto-Setup:

After completion or during the Auto-Setup, warning messages may be displayed. Warnings according to the Auto-Setup procedure are shown in object **0x209B/5** *Auto Setup Warning*:

Code	Measures / Remedy	
Warning messages		**Meaning**
00000000	NoWarning	No warning initiated
00000001	Nominal Voltage out of Tolerance	
00000002	Mismatch Speed, Freq, PPN	
00000003	Bad Motor Efficiency	
00000004	Mismatch In, Un, Pn	
00000005	Invalid Cosinus Phi	
00000006	Invalid Slip	
00000007	Invalid Time Const (Elec. or Rotor)	
00000008	Mag Current Not Found, Set to 30per	
0000000B	Offset Mode Changed to Anisotropic	

9.4 Encoder

HTL type encoders connect to the Basic IO interface of AxiaVert inverters (6.6.1).

Operation Mode Basic IO Encoder

The following objects are available for HTL encoder configuration via interface X210:

These objects configure the HTL encoders connected to the Basic IO interface:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3840/1	Encoder Type	[-]	Selection		
0x3840/10	Speed Filter Constant	[s]	0	1	0,02
0x3840/11	Change Sense of Rotation	-	Off	On	Off
0x3840/20	Division Marks	[incr]	1	8192	1024
0x3840/21	Z-Track Window	[incr]	0	200	4

Encoder Type 0x3840/1	
0x00000000:	No Encoder
0x00002100:	A/B-Track
0x00002300:	A/B/Z-Track

In addition to tracks A and B, encoders often feature a reference track (also referred to as Z track, zero track, C track). The reference track delivers one pulse per revolution. This track is used for plausibility checking or for additional functions.

Some applications require using several encoders. In order to be able to use two or three encoders with one inverter, encoder interface modules must be installed on the main device. Basic IO encoders and extension module encoders are configured independently from one another. For more information encoder module manuals.

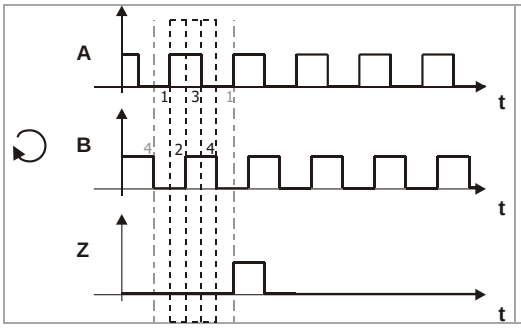
- Set the values in the object **0x3840/1** according to your HTL encoder type.

The following options for HTL encoder evaluation are supported by AXIA:

(A/B-Track)	Two-channel speed sensor with recognition of direction of rotation via track signals A and B; four signal edges are evaluated per division mark.
(A/B/Z-Track)	Two-channel speed sensor with recognition of direction of rotation via track signals A and B, reference track via digital input. Four signal edges are evaluated per division mark.

- Check for proper functioning:
- Scope: set up basic IO encoder position → Let the motor run → Check for the encoder signal
- If there is no signal → check wiring /Hardware

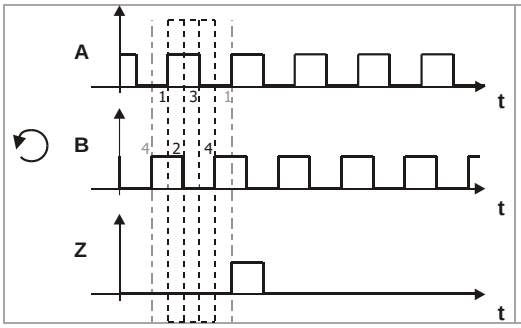
Also, for connection details 6.6.1.



Example:

Each edge 1, 2, 3 and 4 is an evaluated signal within the pulse-pause cycle of Track A. After that, the cycle is restarted. The type of edges indicates the direction of rotation:

Clockwise direction of rotation: A rising edge of A (1) is followed by a rising edge of B (2).



Anticlockwise direction of rotation A rising edge of A (1) is followed by a falling edge of B (2).

Track Z: One pulse per revolution

HTL encoders can be connected to the basic device. For connection of TTL encoders, you will need an EMA-ENC type encoder module. For connection of SinCos encoders or absolute encoders, you will need an EMA-ABS type encoder module.

Division Marks, Basic IO Encoder

The number of increments of the connected speed sensor can be adjusted via parameter *Division Marks* **0x3840/20**. Select the division marks of the speed sensor according to the speed range of the application.

The maximum number of division marks S_{max} is defined by the frequency limit

$$f_{max} = 150 \text{ kHz}$$

of the digital inputs IN5D (track A) and IN4D (track B).

$$S_{max} = f_{max} \cdot \frac{60}{n_{max}}$$

for example:

$$S_{max} = 150000\ Hz \cdot \frac{60s}{1500} = 6000$$

f_{max}	= 150000 Hz
n_{max}	= max. speed of the motor in RPM

To guarantee true running of the drive, an encoder signal must be evaluated at least every 2 ms (signal frequency f = 500 Hz). The minimum number of division marks S_{min} of the incremental encoder for a required minimum speed n_{min} can be calculated from this requirement.

$$S_{min} = f_{min} \frac{60}{A \cdot n_{min}}$$

for example:

$$S_{min} = 500\ Hz \cdot \frac{60\ s}{2 \cdot 10} = 1500$$

n_{min}	= min. speed of the motor in RPM = evaluation (1, 2, 4)
A	

Filter time constant, Basic IO Encoder

Speed Filter Constant **0x3840/10** can be used in order to filter the speed of Basic IO Encoder. This filter can be used in situations where the speed sensor fluctuates (e.g. for mechanical reasons).

The manufacturer recommends changing the value in small steps and checking the individual results.

Encoder Module X412/X422

Encoder modules installed in the Encoder Module X412/X422 slots are configured via the object **0x2078** and its subindexes.

For more information ☞ 🕮 encoder module manuals.

Encoder Module X432

Encoder modules installed in the Encoder Module X432 slots are configured via the object **0x3850** and its subindexes.

For more information ☞ 🕮 encoder module manuals.

9.5 Brake

The stopping behavior of the three-phase machine is defined via object *Brake Operation Mode* **0x2050**.

The selection of the operation modes can vary according to the control method and the available control inputs.

Index	Sub-index	Designation	Data type	Default
0x2050	0	Brake Operation Mode	Int32	0

Via object **0x2050**, two brake operation modes are available.

0x2050		Selection
0 -	Off	Brake control deactivated
1 -	Simple	Brake follows the settings in the Obj. **0x2051** and **0x2052**
2 -	Advanced	Planned function

The brake behavior is controlled via the following objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2050	Brake Operation Mode	[-]	-	-	Off
0x2051	Brake ReleaseTime	[ms]	-3000	3000	0
0x2052	Brake CloseTime	[ms]	0	3000	o

In order to protect the motor holding brake against damage, the motor may only start after the brake has been disenganged. Startup to reference speed is carried out only after the *Brake Release Time* **0x2051** has elapsed. The time should be set such that it is at least as long as the time required for disenganging the holding brake. By using negative values for the parameter, disenganging of the brake is delayed. This can be done in order to prevent loads from falling, for example.

9.6 Application

Frame of Reference

The application data subsection contains objects parameterizing the frame of reference for the inverter in relation to the driving shaft or feed configuration attached. It includes the following objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x6091/1	Motor Shaft Revolutions	[-]	1	2147483647 (0X7FFFFFFF)	1
0x6091/2	Driving Shaft Revolutions	[-]	1	2147483647 (0X7FFFFFFF)	1
0x6092/1	Feed	[-]	1	2147483647 (0X7FFFFFFF)	65536 (0x10000)
0x6092/2	Shaft Revolutions	[-]	1	2147483647 (0X7FFFFFFF)	1

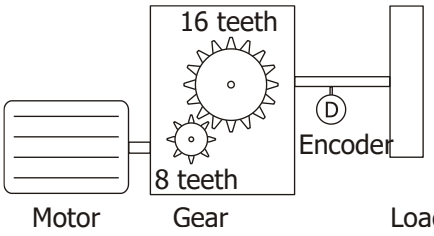
Other parameters must be checked due to the great variety of drive applications and the resulting parameter settings. The parameters queried during the Auto-Setup procedure are selected from standard applications. After completion of commissioning, further parameters can be set.

The following settings define additional parameters for the application and general limit values.

Setting of objects **0x6091/1** *Motor Shaft Revolutions*, **0x6091/2** *Driving Shaft Revolutions*, **0x6092/1** *Feed* and **0x6092/2** *Shaft revolutions* is required if a gearbox is installed between the motor shaft and the driving shaft.

The objects define the mechanical transmission ratio between the speed sensor and the motor side.

Example: The motor shaft turns twice while the load shaft rotates once (16/8).



$$Gearratio = \frac{Revolutionsofmotorshaft}{Revolutionsofdrivingshaft}$$

In this example, **0x6091/1** *Motor Shaft Revolutions* must be set to `16`, **0x6091/2** *Driving Shaft Revolutions* must be set to `8`.

For best motor control, Bonfiglioli recommends installing a speed sensor directly at the motor.

Reference system

The reference system provides the link between the electrical system and the mechanical system. In object **0x6092/1** *Feed*, the user units (u) per **0x6092/2** *Shaft revolutions* are entered. By choosing suitable object settings, the feed value can consider both the mechanical motion distance and the accuracy (resolution) (see example).

9.7 Inverter setup

During Auto-Setup, the inverter performs several measurements to determine the optimized motor settings.

- Before activating the Auto-Setup, ensure that the prerequisites are met.

The Auto-Setup function can be initiated either via IO contacts, via keypad, via AxiaManager or via an external control (state machine).

To initiate the Auto-Setup via the **IO contacts**:

Prerequisite

- Via object **0x2200** Control Mode, select the control mode "IOs": **0x00000001** - IOs → use this setting for Auto-Setup 12.1.1
- Set "Software release" **0x2101/1** and "hardware release" **0x2199**
- Connect the Basic IO interface X.210 to appropriate signal source. 6.6.1
- Start up the AxiaManager software on the PC workstation.
- In the AxiaManager, connect to the inverter.

To initiate the Auto-Setup via the **Keypad**:

On the Keypad, go to

- Parameters --> press OK
- Installation Data --> press OK
- Setup --> press OK
- Auto-Setup --> press OK

To initiate the Auto-Setup via the **AxiaManager**:

- Connect the PC workstation running the AxiaManager software to the inverter.
- Start up the AxiaManager software on the PC workstation.
- In the AxiaManager, connect to the inverter.

To initiate the Auto-Setup via the **AxiaManager**:

- Connect the PC workstation running the AxiaManager software to the inverter.

- Start up the AxiaManager software on the PC workstation.
- In the AxiaManager, connect to the inverter.

10 Control interface configuration (IOs)

This chapter describes the configuration of control inputs and outputs in the AXIA firmware. The described inputs and outputs are featured on the main inverter and do not include any optional hardware modules. 6.6

Settings via AxiaManager

- Connect the PC workstation running the AxiaManager software to the inverter.
- Start the AxiaManager software on the PC workstation.
- Configure the inverter settings as required.

separate user manual VEC1en51 for details on how to use the AxiaManager software.

Settings via keypad

- Connect the keypad module to the interface X211 of the main device.
- Via the function keys and the arrow keys on the keypad module, access the required submenu.
- Select the object for modification.
- Enter the required values in the objects listed below.

10.1 Digital inputs

10.1.1 Functional assignment

The functional assignment allows assigning functions to digital inputs. First, you select the function to be paired with a digital input, then you attribute the digital input from the choice list available.

Objects	
Index/Sub-idx	**Designation**
0x2083	Activate Sensorless
0x2101/1	Software Release
0x2101/2	IO Start
0x2101/3	IO Counter Clockwise Operation
0x2101/4	IO Halt
0x2101/5	IO Quick Stop
0x2101/6	JOG Mode
0x2101/7	JOG Start
0x2101/8	JOG Counter Clockwise Operatio
0x2101/10	External Halt (State-Machine)
0x2101/11	External Quick Stop (State-Mac
0x2101/12	IO Control Word Bit4
0x2101/13	IO Control Word Bit5
0x2101/14	IO Control Word Bit6
0x2101/15	IO Control Word Bit9
0x2101/16	Start Axis Positioning
0x2102	Fault Reset
0x2103/1	Data Set Change-Over 1
0x2103/2	Data Set Change-Over 2
0x2104/1	Fixed Speed Change-Over 1
0x2104/2	Fixed Speed Change-Over 2
0x2104/3	Fixed Speed Change-Over 3
0x2105/1	Fixed Percentage Change-Over 1
0x2105/2	Fixed Percentage Change-Over 2
0x2105/3	Fixed Percentage Change-Over 3
0x2106/1	Motorpoti Up (Speed)

Objects	
Index/Sub-idx	**Designation**
0x2106/2	Motorpoti Down (Speed)
0x2107/1	Motorpoti Up (Perc)
0x2107/2	Motorpoti Down (Perc)
0x2108	HW Home Switch
0x2109	HW Pos Limit Switch Src
0x210A	HW Neg Limit Switch Src
0x2413	Motor Thermal Contact

Any value of the choice list can be matched with every function. The user decides according to the individual application use case.

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x00394001	IN1D (X210.3, X210.1)
0x00000001	true	0x00394002	IN2D (X210.5, X210.3)
0x0021A020	STO	0x00394003	IN3D (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	IN4D (X210.4, X210.7)
0x0021A000	Timer 1 Output	0x00394005	IN5D (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	IN6D (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A220	Logic 3 Output	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x00243503	Neg HW Limit Switch Triggered	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x0025FA01	Axis Positioning Target Reached	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7		

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x003910B0/..7	SB RxPDO3 Int8 0/..7		
0x003910F0	Sysbus_EmcySlave_ID		

NOTICE

Malfunction possible

If the input assigned to object **0x2102** *Fault Reset* is active ("high") prior to starting the inverter, the inverter does not start.

- Ensure that the input assigned to **0x2102** is set to "low" before you try to start the inverter.

10.1.1.1 Data Set Change-Over

The data set change-over function allows switching the data set upon receiving a signal from one of the assignable sources listed in the table below.

- Use the objects **0x2103/1** – *Data Set Change-Over 1* AND **0x2103/2**– *Data Set Change-Over 2* to assign the source for the change-over signal.

By default, the frequency inverter uses data set 1 as the active data set.

By setting **0x2103/1** AND **0x2103/2** to "low" you select the data set 1 as target. By setting **0x2103/1** to "high" AND **0x2103/2** to "low", you select the data set 2 and so on. The following truth table then applies:

0x2103/1	0x2103/2	Result
Low	Low	Dataset 1
High	Low	Dataset 2
Low	High	Dataset 3
High	High	Dataset 4

You achieve the state "high" by activating the digital input assigned to the object.

10.1.1.2 Motor Potentiometer

Via the motor potentiometer function, the motor speed is controlled via

- digital control signals (function Motorpoti MP 13.2.2) or via
- the keys of the control unit KP (Function Motorpoti KP).

Refer to the subchapter "Motorpoti Configuration" in the chapter "Axia Speed Control" 13.2.2 below to learn about further configuration steps.

The control up/down commands are assigned the following functions:

Control				
Motorpoti (MP)		**Motorpoti (KP)**		**Function**
Up	**Down**	**Up**	**Down**	
0	0	–	–	Output signal does not change
1	0	▲	–	Output value rises at set ramp
0	1	–	▼	Output value drops at set ramp
1	1	▲ + ▼		Output value is reset to initial value

0 = Contact open 1 = Contact closed

▲ ▼ = Arrow keys on control unit "KeyPad"

Depending on the active reference value channel, the function is assigned to a digital signal via parameters *Motorpoti Up (Speed)* **0x2106/1**, *Motorpoti Down (Speed)* **0x2106/2** or *Motorpoti Up (Perc)* **0x2107/1**, *Motorpoti Down (Perc)* **0x2107/2**.

Motorpoti (MP)

Reference Speed Channel

Via the digital control inputs, the required functions *Motorpoti Up (Speed)* **0x2106/1** and *Motorpoti Down (Speed)* **0x2106/2** are triggered.

Limitation of the reference values is done via parameters *Minimum Speed Limit* **0x2301** and *Maximum Speed Limit***0x2300**.

It is not possible to control while the keypad is displaying a value. First, access the menu by pressing RUN.

Reference Percentage Channel

Via the digital control inputs, the required functions *Motorpoti Up (Perc)* **0x2107/1** and *Motorpoti Down (Perc)* **0x2107/2** are triggered.

Limitation of the reference values is done via parameters *Minimum Percentage* **0x2311** and *Maximum Percentage* **0x2310**.

10.1.2 Configuration

Object			Setting		
Index	**Sub-idx**	**Designation**	**Min.**	**Max.**	**Default**
0x3940	1	PNP/NPN	Selection		

0x3940/1 PNP/NPN		
Index	**Choice list**	**Designation**
0x3940/1	0x00000001	PNP (active: 24 V)
	0x00000002	NPN (active: 0 V)

10.2 Digital outputs

Object			Setting
Index	**Sub-idx**	**Designation**	**Default**
0x3821	1	Relay Output X10	0x00000000
0x2198		Brake Output	0x00205000

NOTICE

Malfunction possible

The relay output X10 will be **operable only**, if the inverter is connected **to mains**. The 24 VDC power supply will not be sufficient.

- Ensure that the inverter is sufficiently supplied via the mains.

The source for each digital output can be chosen from the following choice list:

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x003910B0/..7	SB RxPDO3 Int8 0/..7
0x00000001	true	0x003910F0	Sysbus_EmcySlave_ID
0x00205000	Brake Output	0x00394001	IN1D (X210.3, X210.1)
0x0021A020	STO	0x00394002	IN2D (X210.5, X210.3)
0x0021A021	STO Inverted	0x00394003	IN3D (X210.7, X210.5)
0x0021A000	Timer 1 Output	0x00394004	IN4D (X210.4, X210.7)
0x0021A001	Timer 1 Output Inverted	0x00394005	IN5D (X210.6, X210.2)

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x0021A010	Timer 2 Output	0x00394006	IN6D (X210.8, X210.4)
0x0021A011	Timer 2 Output Inverted	0x00394007	S7IND (N/A, X210.6)
0x0021A020	Timer 3 Output	0x00394008	S8IND (N/A, X210.8)
0x0021A021	Timer 3 Output Inverted	0x00394009	S9IND (N/A, X210.9)
0x0021A030	Timer 4 Output	0x0039400A	S10IND (N/A, X210.10)
0x0021A031	Timer 4 Output Inverted	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A100	Comparator 1 Output	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A101	Comparator 1 Output Inverted	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A110	Comparator 2 Output	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A111	Comparator 2 Output Inverted	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A120	Comparator 3 Output	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A121	Comparator 3 Output Inverted	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A130	Comparator 4 Output	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A131	Comparator 4 Output Inverted	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A200	Logic 1 Output	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A201	Logic 1 Output Inverted	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A210	Logic 2 Output	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A211	Logic 2 Output Inverted	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A220	Logic 3 Output	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A221	Logic 3 Output Inverted	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A230	Logic 4 Output	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A231	Logic 4 Output Inverted	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021B100	Demultiplexer Output 0	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B101/..F	Demultiplexer Output 1/..15	0x00394049	S9IND w/o filter (N/A, X210.9)
0x00220041	Axis Running	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220042	Axis Fault	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00243501	HW Limit Switch Enable	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243502	Pos HW Limit Switch Triggered	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243503	Neg HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x0025FA01	Axis Positioning Target Reached	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398004	MF Analog Input 1 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA000/..7	PLC Out Bool 0/..7

10.3 Analog inputs

10.3.1 Basic IO

The following objects configure the type of input and processing parameters for analog inputs X210.9 (Multi Function Analog Input 2) and X210.13 (Multi Function Analog Input 1) on the Basic IO interface.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3961	MFAI 1 Filter Time Constant	[s]	0	1	0,004
0x3962	MFAI 1 Operation Mode	-	Selection		
0x3963	MFAI 1 Point X1	[%]	0	100	2
0x3964	MFAI 1 Point Y1	[%]	-100	100	0
0x3965	MFAI 1 Point X2	[%]	0	100	98
0x3966	MFAI 1 Point Y2	[%]	-100	100	100
0x3967	MFAI 1 Tolerance Range	[%]	0	25	2
0x3981	MFAI 2 Filter Time Constant	[s]	0	1	0,004

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3982	MFAI 2 Operation Mode	-	Selection		
0x3983	MFAI 2 Point X1	[%]	0	100	2
0x3984	MFAI 2 Point Y1	[%]	-100	100	0
0x3985	MFAI 2 Point X2	[%]	0	100	98
0x3986	MFAI 2 Point Y2	[%]	-100	100	100
0x3987	MFAI 2 Tolerance Range	[%]	0	25	2

Digital Inputs assignable to MFAI 1/2 Operation Mode	
Entry Idx	**Designation**
0x00000000	Off
0x00000001	Voltage Input 0 ... 10V
0x00000002	Voltage Input -10 ... 10V
0x0000000B	Current Input 0-20mA
0x0000001F	PTC
0x00000020	KTY (General)
0x00000021	PT1000
0x00000022	PT100
0x00000023	KTY 84 130
0x00000024	KTY 84 110

10.3.2 Encoder Slot X4X2

This subtree is only available, if the encoder is selected during project setup.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2111	MFAI 1 Filter Time Constant	[s]	0	1	0,004
0x2112	MFAI 1 Operation Mode	-	Selection		

For the selection entries possible, see above.

10.3.3 Encoder Slot X432

This subtree is only available, if the encoder is selected during project setup.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x39A1	MFAI 1 Filter Time Constant	[s]	0	1	0,004
0x39A2	MFAI 1 Operation Mode	-	Selection		

For the selection entries possible, see above.

10.4 Multi-function in-/outputs

The following objects configure the multi-function input X210.8 on the Basic IO interface.

Object			Setting		
Index	**Sub-idx**	**Designation**	**Min.**	**Max.**	**Default**
0x398A	1	MFIO X210.8 OpMode	0x00000001 Digital Output 0x00000011 Digital Input (def)		
0x398A	2	MFIO X210.8 Dig. Out	Selection		

For the selection entries possible, see above 10.2.

10.5 PWM-Input

The following objects configure the type of input and processing parameters for the signal sources associated with the pulse width modulation inputs.

Object				Setting		
Index	**Sub-idx**	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x39AA	1	X210.3 Operation Mode	[-]	Selection		
0x39AA	2	PWM Input Offset	[%]	-100	100	0
0x39AA	3	PWM Input Gain	[-]	0,05	10	1

11 Logic

11.1 Logic functions

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x21A0/n	Logic Functions Timer	[-]	Selection		
0x21A1/n	Logic Functions Comp.	[-]	Selection		
0x21A2/n	Logic Functions Logic	[-]	Selection		
0x21A3/n	Logic Functions Simple Math.	[-]	Selection		

11.1.1 Logic

The logic functions are configured via the object **0x21A2** and its subindexes. The logic functions can be selected from the following list (applies to object **0x21A2/10**, **../20**, **../30**, **../40**):

Functions assignable to Function Logic 1..4	
Entry Idx	**Designation**
0x00000000	Off
0x00000001	AND
0x00000002	OR
0x00000003	XOR
0x00000004	XOR 1 3
0x00000010	RS FlipFlop
0x00000020	Toggle FlipFlop
0x00000030	D FlipFlop

Via the other objects **0x21A2/n** you can select the input sources for the chosen logic function. The input sources are selected from the following list:

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x003910F0	Sysbus_EmcySlave_ID
0x00000001	true	0x00394001	IN1D (X210.3, X210.1)
0x0021A020	STO	0x00394002	IN2D (X210.5, X210.3)
0x0021A021	STO Inverted	0x00394003	IN3D (X210.7, X210.5)
0x0021A000	Timer 1 Output	0x00394004	IN4D (X210.4, X210.7)
0x0021A001	Timer 1 Output Inverted	0x00394005	IN5D (X210.6, X210.2)
0x0021A010	Timer 2 Output	0x00394006	IN6D (X210.8, X210.4)
0x0021A011	Timer 2 Output Inverted	0x00394007	S7IND (N/A, X210.6)
0x0021A020	Timer 3 Output	0x00394008	S8IND (N/A, X210.8)
0x0021A021	Timer 3 Output Inverted	0x00394009	S9IND (N/A, X210.9)
0x0021A030	Timer 4 Output	0x0039400A	S10IND (N/A, X210.10)
0x0021A031	Timer 4 Output Inverted	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A100	Comparator 1 Output	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A101	Comparator 1 Output Inverted	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A110	Comparator 2 Output	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A111	Comparator 2 Output Inverted	0x00394025	IN5D inverted (X210.6, X210.2)

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x0021A120	Comparator 3 Output	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A121	Comparator 3 Output Inverted	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A130	Comparator 4 Output	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A131	Comparator 4 Output Inverted	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A200	Logic 1 Output	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A201	Logic 1 Output Inverted	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A210	Logic 2 Output	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A211	Logic 2 Output Inverted	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A220	Logic 3 Output	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A221	Logic 3 Output Inverted	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A230	Logic 4 Output	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A231	Logic 4 Output Inverted	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021B100	Demultiplexer Output 0	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B101/..F	Demultiplexer Output 1/..15	0x00394049	S9IND w/o filter (N/A, X210.9)
0x00220041	Axis Running	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220042	Axis Fault	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00243501	HW Limit Switch Enable	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243502	Pos HW Limit Switch Triggered	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243503	Neg HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x0025FA01	Axis Positioning Target Reached	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398004	MF Analog Input 1 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910B0/..7	SB RxPDO3 Int8 0/..7		

11.1.2 Comparator

The comparator functions are configured via the object **0x21A1** and its subindexes. The comparator functions can be selected from the following list (applies to object **0x21A1/10**, **../20**, **../30**, **../40**):

Functions assignable to Function Comp. 1..4	
Entry Idx	**Designation**
0x00000000	Off
0x00000001	Comparator
0x00000011	Comparator Window

Via the other objects **0x21A1/n** you can select the input sources for the chosen comparator function. The input sources are selected from the following list:

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none		
0x00000002	One		
0x00200300/..3	Rated Motor Current Data Set 1/..4		
0x00200700/..3	Rated Motor Freq. Data Set 1/..4		
0x00200800/..3	Rated Mech. Motor Power Data Set 1/..4		
0x00207801	Encoder X4X2: Angle Mech.		
0x00207803	Encoder X4X2: Speed		
0x0021A102/3	Comparator 1 Constant 1/2		
0x0021A112/3	Comparator 2 Constant 1/2		

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x0021A122/3	Comparator 3 Constant 1/2		
0x0021A122/3	Comparator 4 Constant 1/2		
0x0021A300/1	Simple Math. 1 Output/Inverted		
0x0021A310/1	Simple Math. 2 Output/Inverted		
0x0021A320/1	Simple Math. 3 Output/Inverted		
0x0021A330/1	Simple Math. 4 Output/Inverted		
0x00220900/1	VAlpha/VBeta		
0x00220903/4	VAlpha Ref./VBeta Ref.		
0x00220A01/..3	Phase Current a/..c		
0x00220A04/5	IAlpha/IBeta		
0x00220A06/7	Id/Iq		
0x00220A08/9	I Abs./I Abs. Filtered		
0x00220A0A	Zero Current		
0x00224000	Theta Elec.		
0x00224001	MM Freq. Elec.		
0x00224002	Theta Mech.		
0x00224003	MM Speed		
0x00224004	MM Id Ref.		
0x00224005	MM Iq Ref.		
0x00224006	MM Freq. Estimated		
0x00224007	Stator Flux Alpha		
0x00224008	Stator Flux Beta		
0x00224009	Stator Flux Abs.		
0x0022400A	Stator Flux Alpha Ref.		
0x0022400B	Stator Flux Beta Ref.		
0x0022400C	Stator Flux Abs. Ref.		
0x0022400D	MM Slip Freq.		
0x0022400E	Encoder Angle Elec.		
0x0022400F	Theta Estimated		
0x00226000	Iq Ref. FOC		
0x00228000	Speed Ref.		
0x00228006	Speed Limit Positioning		
0x0022B000	ModCtrl Id Ref.		
0x0022B001	ModCtrl Iq Ref.		
0x0022B002	ModCtrl Iq Limit		

11.1.3 Timer

The timer functions are configured via the object **0x21A0** and its subindexes. The timer functions can be selected from the following list (applies to object **0x21A0/10**, **../20**, **../30**, **../40**):

Functions assignable to Function Timer 1..4	
Entry Idx	**Designation**
0x00000000	Off
0x00000001	Normal Pos Edge
0x00000002	Retrigger Pos Edge
0x00000003	AND Pos Edge
0x00000011	Normal Neg Edge
0x00000012	Retrigger Neg Edge
0x00000013	AND Neg Edge
0x00000021	Delay Non Retrigger
0x00000022	Delay Retrigger
0x00000023	Monoflop Non Retrigger
0x00000024	Monoflop Retrigger
0x00000025	Clock Generator

Object				Setting		
Index	**Sub-idx**	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x21A0	13/23/33/43	Timer 1-4 Time 1	[-]	0	30000	10
0x21A0	15/25/35/45	Timer 1-4 Time 2	[-]	0	30000	10

Via the objects **0x21A0/14**, **../16**, **../24**, **../26, ../34**, **../36**, **../44**, **../46**, you can define the time base values (unit) for time 1 and time 2:

Values assignable to Time Base Timer 1..4	
Entry Idx	**Designation**
0x00000001	ms
0x00000002	s
0x00000003	min
0x00000004	h

Via the other objects **0x21A0/n** you can select the input sources (Timer 1-4 Input 1 and Timer 1-4 Input 2) for the chosen timer function. The input sources are selected from the following list:

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x003910F0	Sysbus_EmcySlave_ID
0x00000001	true	0x00394001	IN1D (X210.3, X210.1)
0x0021A020	STO	0x00394002	IN2D (X210.5, X210.3)
0x0021A021	STO Inverted	0x00394003	IN3D (X210.7, X210.5)
0x0021A000	Timer 1 Output	0x00394004	IN4D (X210.4, X210.7)
0x0021A001	Timer 1 Output Inverted	0x00394005	IN5D (X210.6, X210.2)
0x0021A010	Timer 2 Output	0x00394006	IN6D (X210.8, X210.4)
0x0021A011	Timer 2 Output Inverted	0x00394007	S7IND (N/A, X210.6)
0x0021A020	Timer 3 Output	0x00394008	S8IND (N/A, X210.8)
0x0021A021	Timer 3 Output Inverted	0x00394009	S9IND (N/A, X210.9)
0x0021A030	Timer 4 Output	0x0039400A	S10IND (N/A, X210.10)
0x0021A031	Timer 4 Output Inverted	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A100	Comparator 1 Output	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A101	Comparator 1 Output Inverted	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A110	Comparator 2 Output	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A111	Comparator 2 Output Inverted	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A120	Comparator 3 Output	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A121	Comparator 3 Output Inverted	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A130	Comparator 4 Output	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A131	Comparator 4 Output Inverted	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A200	Logic 1 Output	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A201	Logic 1 Output Inverted	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A210	Logic 2 Output	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A211	Logic 2 Output Inverted	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A220	Logic 3 Output	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A221	Logic 3 Output Inverted	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A230	Logic 4 Output	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A231	Logic 4 Output Inverted	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021B100	Demultiplexer Output 0	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B101/..F	Demultiplexer Output 1/..15	0x00394049	S9IND w/o filter (N/A, X210.9)
0x00220041	Axis Running	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220042	Axis Fault	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00243501	HW Limit Switch Enable	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243502	Pos HW Limit Switch Triggered	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243503	Neg HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x0025FA01	Axis Positioning Target Reached	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398004	MF Analog Input 1 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910B0/..7	SB RxPDO3 Int8 0/..7		

11.1.4 Simple math

The simple math functions are configured via the object **0x21A3** and its subindexes. The math functions can be selected from the following list (applies to object **0x21A3/10**, **../20**, **../30**, **../40**):

Functions assignable to Function Comp. 1..4	
Entry Idx	**Designation**
0x00000000	Off
0x00000001	Add
0x00000011	Subs 1
0x00000012	Subs 2
0x00000021	Mult

Via the other objects **0x21A3/n** you can select the input sources for the chosen math function. The input sources are selected from the following list:

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none		
0x00000002	One		
0x00200300/..3	Rated Motor Current Data Set 1/..4		
0x00200700/..3	Rated Motor Freq. Data Set 1/..4		
0x00200800/..3	Rated Mech. Motor Power Data Set 1/..4		
0x00207801	Encoder X4X2: Angle Mech.		
0x00207803	Encoder X4X2: Speed		
0x0021A102/3	Comparator 1 Constant 1/2		
0x0021A112/3	Comparator 2 Constant 1/2		
0x0021A122/3	Comparator 3 Constant 1/2		
0x0021A122/3	Comparator 4 Constant 1/2		
0x0021A300/1	Simple Math. 1 Output/Inverted		
0x0021A310/1	Simple Math. 2 Output/Inverted		
0x0021A320/1	Simple Math. 3 Output/Inverted		
0x0021A330/1	Simple Math. 4 Output/Inverted		
0x00220900/1	VAlpha/VBeta		
0x00220903/4	VAlpha Ref./VBeta Ref.		
0x00220A01/..3	Phase Current a/..c		
0x00220A04/5	IAlpha/IBeta		
0x00220A06/7	Id/Iq		
0x00220A08/9	I Abs./I Abs. Filtered		
0x00220A0A	Zero Current		
0x00224000	Theta Elec.		
0x00224001	MM Freq. Elec.		
0x00224002	Theta Mech.		
0x00224003	MM Speed		

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00224004	MM Id Ref.		
0x00224005	MM Iq Ref.		
0x00224006	MM Freq. Estimated		
0x00224007	Stator Flux Alpha		
0x00224008	Stator Flux Beta		
0x00224009	Stator Flux Abs.		
0x0022400A	Stator Flux Alpha Ref.		
0x0022400B	Stator Flux Beta Ref.		
0x0022400C	Stator Flux Abs. Ref.		
0x0022400D	MM Slip Freq.		
0x0022400E	Encoder Angle Elec.		
0x0022400F	Theta Estimated		
0x00226000	Iq Ref. FOC		
0x00228000	Speed Ref.		
0x00228006	Speed Limit Positioning		
0x0022B000	ModCtrl Id Ref.		
0x0022B001	ModCtrl Iq Ref.		
0x0022B002	ModCtrl Iq Limit		

11.2 Programmable Logic Controller (PLC)

The PLC functions are configured by assigning the signal sources in the `Inputs` subtree and by entering parameter names and numerical values in the `Parameter` subtree.

11.2.1 PLC Inputs

In the `Inputs` subtree, the following objects are available:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3BA0	PLC Inputs (bool)	[-]	Selection		
0x3BA1	PLC Inputs (uint8)	[-]	Selection		
0x3BA2	PLC Inputs (int8)	[-]	Selection		
0x3BA3	PLC Inputs (uint16)	[-]	Selection		
0x3BA4	PLC Inputs (int16)	[-]	Selection		
0x3BA5	PLC Inputs (uint32)	[-]	Selection		
0x3BA6	PLC Inputs (int32)	[-]	Selection		
0x3BA7	PLC Inputs (float32)	[-]	Selection		

All above objects are dataset-switchable.

Depending on the type of input set, the objects have different choicelists containing different sets of assignable sources.

11.2.2 PLC Parameters

In the `Parameter` subtree, the following objects are available:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x393F/2	PLC Enable	[-]	FALSE	TRUE	FALSE
0x3BB0	PLC Parameter-Name (bool)	[-]	User Entry		
0x3BB1	PLC Parameter (bool)	[-]	FALSE	TRUE	FALSE
0x3BB2	PLC Parameter-Name (uint8)	[-]	User Entry		
0x3BB3	PLC Parameter (uint8)	[-]			
0x3BB4	PLC Parameter-Name (int8)	[-]	User Entry		
0x3BB5	PLC Parameter (int8)	[-]			
0x3BB6	PLC Parameter-Name (uint16)	[-]	User Entry		
0x3BB7	PLC Parameter (uint16)	[-]			

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3BB8	PLC Parameter-Name (int16)	[-]	User Entry		
0x3BB9	PLC Parameter (int16)	[-]			
0x3BBA	PLC Parameter-Name (uint32)	[-]	User Entry		
0x3BBB	PLC Parameter (uint32)	[-]			
0x3BBC	PLC Parameter-Name (int32)	[-]	User Entry		
0x3BBD	PLC Parameter (int32)	[-]			
0x3BBE	PLC Parameter-Name (float32)	[-]	User Entry		
0x3BBF	PLC Parameter (float32)	[-]			

11.3 Mux/DeMux

In the `Mux/DeMux` subtree, the following objects are available:

Object				Setting		
Index	**Sub-idx**	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x21B0	1..31	Multiplexer Input 1..32	[-]	Selection		
0x21B0	32	Multiplexer Output Value	[-]	r/o		
0x21B1	1	Demultiplexer Input	[-]	Selection		
0x21B1	32	Demultiplexer Input Value	[-]	r/o		

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x00394001	IN1D (X210.3, X210.1)
0x00000001	true	0x00394002	IN2D (X210.5, X210.3)
0x0021A020	STO	0x00394003	IN3D (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	IN4D (X210.4, X210.7)
0x0021A000	Timer 1 Output	0x00394005	IN5D (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	IN6D (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A220	Logic 3 Output	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00243503	Neg HW Limit Switch Triggered	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x0025FA01	Axis Positioning Target Reached	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7		
0x003910B0/..7	SB RxPDO3 Int8 0/..7		
0x003910F0	Sysbus_EmcySlave_ID		

12 Controls and controllers

The control functions can be parameterized as required and optimized for the application by further functions.

12.1 Controls

12.1.1 Control mode

- In the `Parameters\Controls and Controllers\Controls\Mode` subtree, via object **0x2200** *Control Mode*, you can select the control mode:

0x2200 Control mode		
Object	**Entry Idx**	**Designation**
0x2200	0x00000001	IOs (default)
	0x00000002	Keypad
	0x00000003	State machine
	0x0000000B	IOs w/o switch-over in op.
	0x0000000C	Keypad w/o switch-over in op.
	0x0000000D	State machine w/o switch-over in op.

- Via object **0x2201** *Mode of Operation IOs*, you can select the mode of operation:

0x2201 Mode of operation IOs		
Object	**Entry Idx**	**Designation**
0x2201	0x00000000	No mode (Drive Stopped)
	0x00000006	Homing mode (default)
	0xFFFFFFF6	Auto-Setup
	0xFFFFFFFB	Axia Speed Control
	0xFFFFFFFC	Axia Torque Control
	0xFFFFFFFD	Electronic Gear

- Via object **0x2202** *Mode of Operation Keypad*, you can select the mode of operation for the Keypad control:

0x2202 Mode of operation Keypad		
Object	**Entry Idx**	**Designation**
0x2202	0x00000000	No mode (Drive Stopped)
	0xFFFFFFFA	Axia Jog mode
	0xFFFFFFFB	Axia Speed Control

Data Set Change-Over Mode

The data set change-over function allows switching the data set upon receiving a signal from one of the assignable sources.

- Use the objects **0x2103/10** – *Data Set Change-Over Mode* to assign the target dataset.

0x2103/10 Data Set Change-Over Mode	
Choice List	**Choice List Designation**
0x00000000	Controlled by Contacts
0x00000001	Data Set 1
0x00000002	Data Set 2
0x00000003	Data Set 3
0x00000004	Data Set 4

By default, the frequency inverter uses data set `1` as the active data set.

In order to write specific object values to specific datasets, the external system (GUI, software tools or keypad) must state the target data set in the respective communication telegram via the choice list address (0x00…).

If the setting `Controlled by Contacts` is selected, the target data set is defined by the setting made in the objects **0x2103/1** AND **0x2103/2**. 10.1.1

The object **0x4003** is the internal status of the control word (irrespective of via 0x6040 or digital IOs) and can be used for troubleshooting or maintenance.

12.1.2 State-Machine

In the `Parameters\Controls and Controllers\Controls\State-Machine` subtree, you can use the objects to parameterize sources for control word, mode of operation and other values. The default setting is the control word as defined in the CiA standard. For this, the object **0x6040** is used as source.

So, to use the state machine, you have to set the object **0x2200** *Control Mode* in the `Parameters\Controls and Controllers\Controls\Mode` subtree to `3 - State Machine`.

Object				Setting		
Index	**Sub-idx**	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x25E0		Control Word Source	[-]	Selection		0x00604000
0x25E1		Mode of Operation Source	[-]	Selection		0x00606000
0x25E2		Target Position Source	[-]	Selection		0x00607A00
0x25E3		Profile Velocity Source	[-]	Selection		0x00608100
0x25E4		Profile Acc. Source	[-]	Selection		0x00608300
0x25E5		Profile Dec. Source	[-]	Selection		0x00608400
0x25E6		Target Velocity Source	[-]	Selection		0x0060FF00
0x25E8		VL Target Velocity Source	[-]	Selection		0x00604200
0x25E9		Target Torque Source	[-]	Selection		0x00607100

Selection Entries 0x25E0			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0/Null/false/none	0x00391690	PROFIx Tel112/PD3 Rx ui16_0
0x00391018	SB RxPDO1 UInt16 0	0x00391691	PROFIx Tel112/PD3 Rx ui16_1
0x0039101A	SB RxPDO1 UInt16 2	0x003916D0	PROFIx Tel113/PD4 Rx ui16_0
0x0039101B	SB RxPDO1 UInt16 3	0x003916D1	PROFIx Tel113/PD4 Rx ui16_1
0x00391068/..B	SB RxPDO2 UInt16 0/..3	0x00391710	PROFIx Tel114/PD5 Rx ui16_0
0x003910B8/..B	SB RxPDO3 UInt16 0/..3	0x00391711	PROFIx Tel114/PD5 Rx ui16_1
0x00391610	PROFIx Tel110/PD1 Rx ui16_0	0x00391750	PROFIx Tel115/PD6 Rx ui16_0
0x00391611	PROFIx Tel110/PD1 Rx ui16_1	0x00391751	PROFIx Tel115/PD6 Rx ui16_1
0x00391650	PROFIx Tel111/PD2 Rx ui16_0	0x003CA030/..7	PLC Out UInt16 0/..7
0x00391651	PROFIx Tel111/PD2 Rx ui16_1	0x00604000	SRC: Control Word 6040:00

Selection Entries 0x25E1			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0/Null/false/none	0x00391668	PROFIx Tel111/PD2 Rx i32_0
0x00391028	SB RxPDO1 Int32 0	0x003916A8	PROFIx Tel112/PD3 Rx i32_0
0x00391029	SB RxPDO1 Int32 1	0x003916E8	PROFIx Tel113/PD4 Rx i32_0
0x00391078	SB RxPDO2 Int32 0	0x00391728	PROFIx Tel114/PD5 Rx i32_0
0x00391079	SB RxPDO2 Int32 1	0x00391768	PROFIx Tel115/PD6 Rx i32_0
0x003910C8	SB RxPDO3 Int32 0	0x003CA060	PLC Out Int32 0
0x003910C9	SB RxPDO3 Int32 1	0x003CA062/..7	PLC Out Int32 2/..7
0x00391628	PROFIx Tel110/PD1 Rx i32_0	0x00606000	Mode Of Operation 6060:00

Selection Entries 0x25E2/0x25E6			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0/Null/false/none	0x00391668	PROFIx Tel111/PD2 Rx i32_0
0x00391028	SB RxPDO1 Int32 0	0x003916A8	PROFIx Tel112/PD3 Rx i32_0
0x00391029	SB RxPDO1 Int32 1	0x003916E8	PROFIx Tel113/PD4 Rx i32_0
0x00391078	SB RxPDO2 Int32 0	0x00391728	PROFIx Tel114/PD5 Rx i32_0
0x00391079	SB RxPDO2 Int32 1	0x00391768	PROFIx Tel115/PD6 Rx i32_0
0x003910C8	SB RxPDO3 Int32 0	0x003CA060/..7	PLC Out Int32 0/..7
0x003910C9	SB RxPDO3 Int32 1	0x00607A00	Target Position 607A:00
0x00391628	PROFIx Tel110/PD1 Rx i32_0	0x0060FF00	Target Velocity 60FF:00

Selection Entries 0x25E3-0x25E5			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0/Null/false/none	0x003916A8	PROFIx Tel112/PD3 Rx ui32_0
0x00391020	SB RxPDO1 UInt32 0	0x003916E8	PROFIx Tel113/PD4 Rx ui32_0
0x00391021	SB RxPDO1 UInt32 1	0x00391728	PROFIx Tel114/PD5 Rx ui32_0
0x00391070	SB RxPDO2 UInt32 0	0x00391768	PROFIx Tel115/PD6 Rx ui32_0
0x00391071	SB RxPDO2 UInt32 1	0x003CA050/..7	PLC Out UInt32 0/..7
0x003910C0	SB RxPDO3 UInt32 0	0x00608100	Profile Velocity 6081:00
0x003910C1	SB RxPDO3 UInt32 1	0x00608300	Profile Acceleration 6083:00
0x00391628	PROFIx Tel110/PD1 Rx ui32_0	0x00608400	Profile Deceleration 6084:00
0x00391668	PROFIx Tel111/PD2 Rx ui32_0		

Selection Entries 0x25E8/0x25E9			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0/Null/false/none	0x003916D8	PROFIx Tel113/PD4 Rx i16_0
0x0039101C/..F	SB RxPDO1 Int16 0/..3	0x003916D9	PROFIx Tel113/PD4 Rx i16_1
0x0039106C/..F	SB RxPDO2 Int16 0/..3	0x00391718	PROFIx Tel114/PD5 Rx i16_0
0x003910BC/..F	SB RxPDO3 Int16 0/..3	0x00391719	PROFIx Tel114/PD5 Rx i16_1
0x00391618	PROFIx Tel110/PD1 Rx i16_0	0x00391758	PROFIx Tel115/PD6 Rx i16_0
0x00391619	PROFIx Tel110/PD1 Rx i16_1	0x00391759	PROFIx Tel115/PD6 Rx i16_1
0x00391658	PROFIx Tel111/PD2 Rx i16_0	0x00604000	Control Word 6040:00
0x00391659	PROFIx Tel111/PD2 Rx i16_1	0x00604200	Target Velocity 6042:00
0x00391698	PROFIx Tel112/PD3 Rx i16_0	0x00607100	Target Torque 6071:00
0x00391699	PROFIx Tel112/PD3 Rx i16_1		

12.2 Voltage Controller

The voltage controller contains the functions necessary for monitoring the DC link voltage.

- The DC link voltage, which rises in generator operation or in the braking process of the 3-phase machine, is controlled to the limit value that is set by the voltage controller.
- The power failure regulation uses the rotation energy of the drive to bridge short-term power failures.

The voltage controller operation mode is set in the object *Operation Mode* **0x2291** in accordance with the application.

Operation Mode 0x2291	Function
0x00000000 off	The function is switched off.
0x00000001 U_{dc} limitation	Overvoltage controller switched on.
0x00000002 Mains Support	Mains failure regulation turned on.

0x00000003	Udc-Limit. + Mains Support	Overvoltage controller + power failure regulation active w motor chopper.
0x00000004	Mains Support, NO chopper	Same as "2", but without chopper.
0x00000005	Udc-Limit. & Mains Support, NO chopper	Same as "3", but without chopper.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2291	Operation Mode	[-]	Selection		
0x2292	Max. Speed Rise	[rpm]	0	35940	300
0x2293	Shutdown Threshold	[rpm]	0	35940	600
0x2294	Speed Def. Ramp	[rpm/s]	0	35940	0,0
0x2295	Isq Limit Mains Support	[A]	0	38	38
0x2296	Isq Limit Shutdown	[A]	0	38	38
0x2297	Isq Limit Standstill	[A]	0	38	38
0x2298	Isq Limit Ramp	[A]	0	38	38
0x2299	Min. Imr Shutd. + VdcLim	[A]	-38	38	-38
0x229A	Max. Imr at Shutdown	[A]	-38	38	38
0x229B	Max. Imr at Ramp	[A]	-38	38	38
0x229C	Max. Imr at Standstill	[A]	-38	38	38
0x229D	Speed Trigger Standstill	[rpm]	0	35940	60
0x3A11	Delay Axis 2 (if available)	[s]	-32000	32000	0
0x3A12	Reference DC-Link Limitation	[V]	400	800	780
0x3A13	Reference Shutdown Value	[V]	400	800	720
0x3A14	Reference Mains Support Value	[V]	-240	800	500
0x3A15	Trigger Mains Support	[V]	-240	800	490
0x3A16	Mains Support Mode	[-]	0x…0 – Absolute Trigger and Reference Value 0x…1 – Relative Trigger and Reference Value		
0x3A17	Amplification	[-]	0	1000	3
0x3A18	Integral Time	[s]	0	1000	0,02
0x3A19	I2 Integral Time (Vf-Ctrl)	[s]	0	1000	0

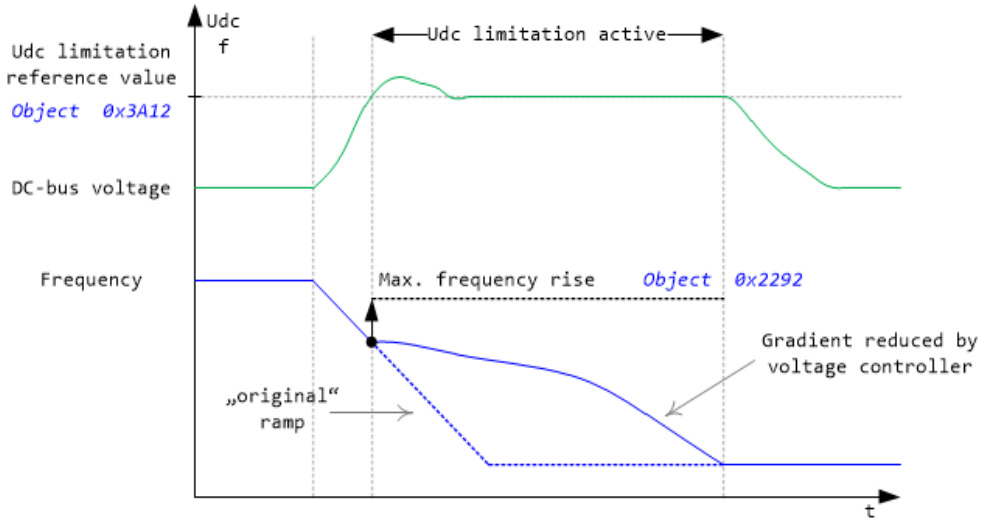
Operation mode Udc limitation

Prerequisite:

- Pulse width modulation must be active.
- The minimum axis rotation frequency must be 1 rpm

Voltage controller: *Operation Mode* **0x2291 =** `1`

In the operation mode `Udc limitation` the inverter limits the DC link voltage.



The overvoltage controller prevents a switch-off of the frequency inverter in generator operation. The reduction of the drive speed by a ramp gradient can lead to an overvoltage in the DC link. If the voltage exceeds the figure set by the parameter *Ref. Value Vdc Limitation* **0x3A12**, the deceleration is reduced in such a way that the DC link voltage is regulated to the set value. If the DC link voltage cannot be regulated to the set reference value by the reduction of the deceleration, the deceleration stops and the output rotation speed (rpm) increases. The output rpm is calculated by addition of the parameter value *Max. Speed Rise* **0x2292** to the rpm at the operating point of the controller intervention.

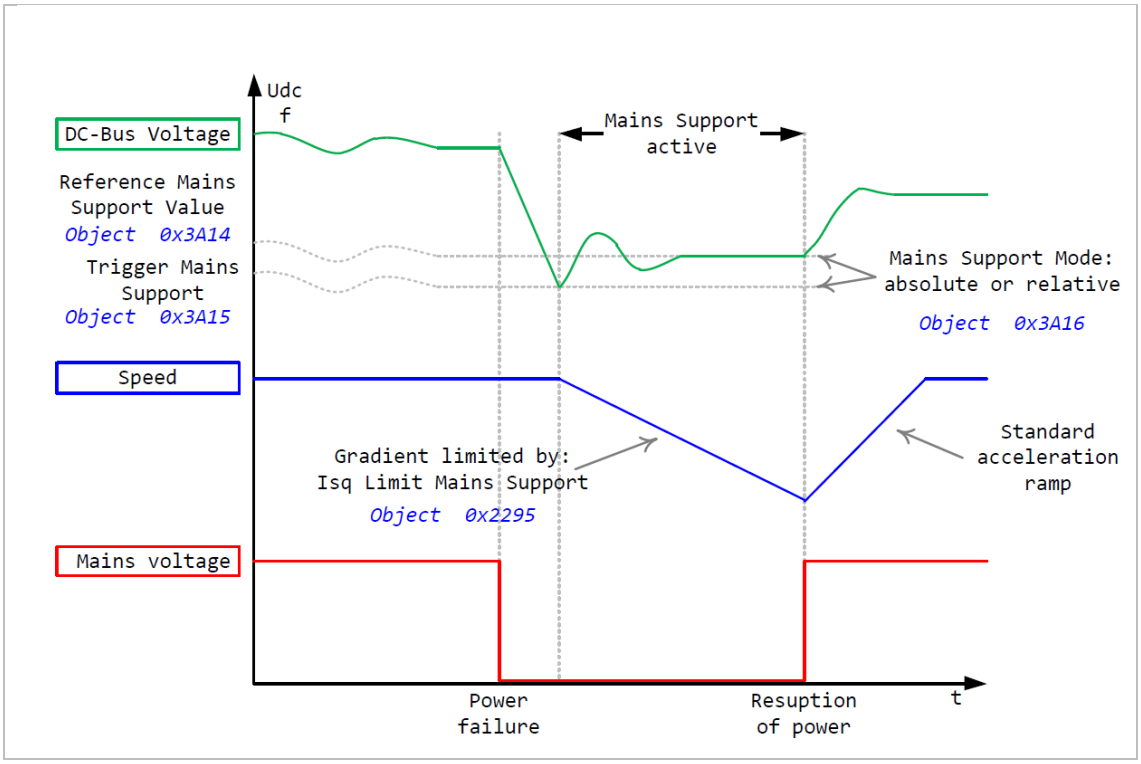
Operation mode Mains support

Prerequisite:

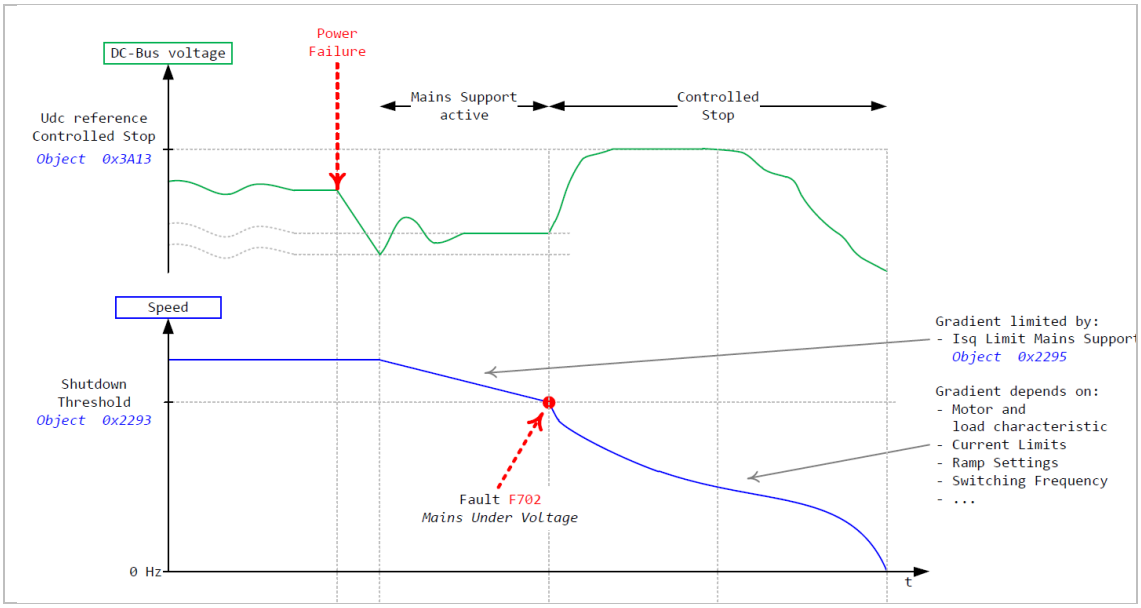
- Pulse width modulation must be active.
- The minimum axis rotation frequency must be 1 rpm

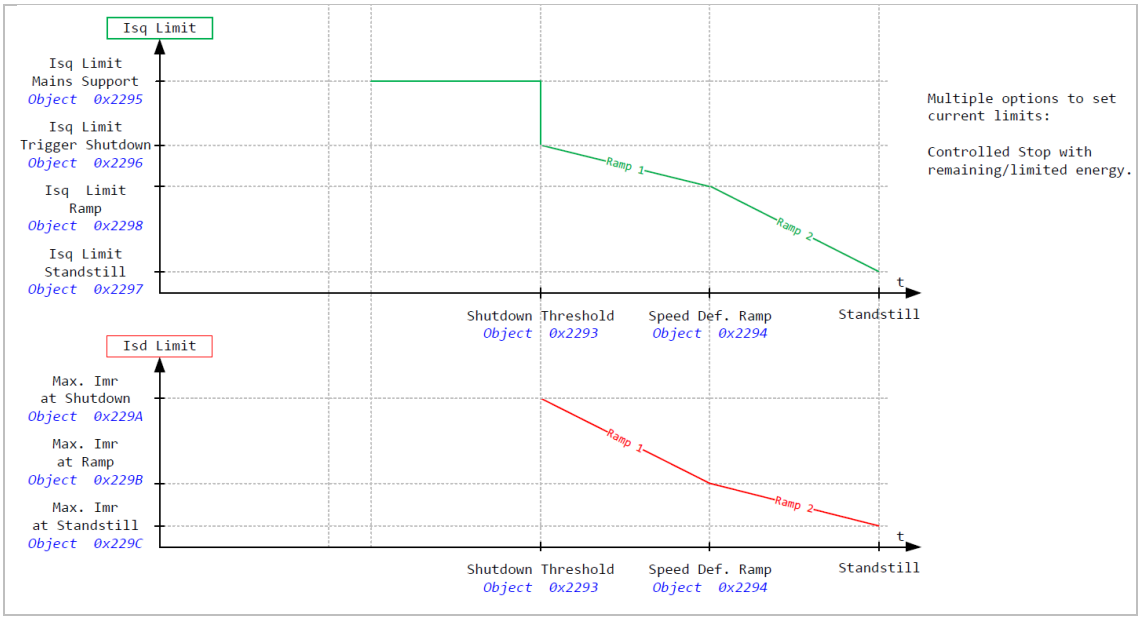
Voltage controller: *Operation Mode* **0x2291 =** `2`

In the operation mode `Mains support` the inverter reduces the speed to bring the motor to generative operation. Then the inverter either resumes the normal operation or performs a controlled stop.



The controlled stop shall be performed, if the error `F702 Mains Under Voltage` occurs.





12.3 Functions of field-oriented control

The field-oriented control systems are based on a cascade control and the calculation of a complex machine model. During the Auto-Setup, a map of the connected machine is produced by the Auto-Setup and transferred to various parameters. Some of these parameters are visible and can be optimized for various operating points.

12.3.1 Sensorless

Current Impression

The current impression subtree allows to configure the rpm thresholds for activation and deactivation of the current impression.

The current impression is maintained while the rotation speed (in rpm) is within the thresholds defined in the objects **0x2030** and **0x2031**. The object **0x2237** configures the ramp which the inverter follows to get to the target rpm speed. The target speed is defined via the settings in `Parameters\Controls and Controllers\Controls\Mode` subtree. Via the object **0x4206/1** a signal source for the triggering of the slip compensation can be configured.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2030	Deactivation Threshold	[rpm]	0	6000	120
0x2031	Activation Threshold	[rpm]	0	6000	150
0x2237	Ramp Threshold	[rpm/s]	0	1000	10
0x4206/1	Slip Compensation	[-]	Selection		

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x00394001	IN1D (X210.3, X210.1)
0x00000001	true	0x00394002	IN2D (X210.5, X210.3)
0x0021A020	STO	0x00394003	IN3D (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	IN4D (X210.4, X210.7)
0x0021A000	Timer 1 Output	0x00394005	IN5D (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	IN6D (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)

Digital Inputs assignable to IO Functions			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	IN1D inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	IN2D inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	IN3D inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	IN4D inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	IN5D inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	IN6D inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	IN1D w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	IN2D w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	IN3D w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	IN4D w/o filter (X210.4, X210.7)
0x0021A220	Logic 3 Output	0x00394045	IN5D w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	IN6D w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	IN1D w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	IN2D w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	IN3D w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	IN4D w/o filter inv. (X210.4, X210.7)
0x00243503	Neg HW Limit Switch Triggered	0x00394065	IN5D w/o filter inv. (X210.6, X210.2)
0x0025FA01	Axis Positioning Target Reached	0x00394066	IN6D w/o filter inv. (X210.8, X210.4)
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7		
0x003910B0/..7	SB RxPDO3 Int8 0/..7		
0x003910F0	Sysbus_EmcySlave_ID		

12.3.2 Speed and torque controller

The speed controller can derive the actual values from the machine model. The prerequisite for the speed and torque controller to function correctly is that the Auto-Setup (9.3.5) is carried out properly.

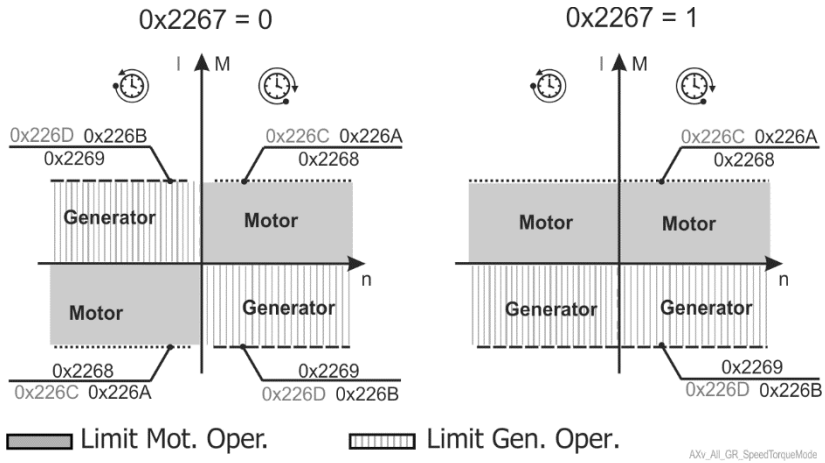
The following objects are relevant for the speed and torque controller:

Index	Designation	Index	Designation
0x2261	Switch-over Limit	0x2271	Integral Time High Speed
0x2262	Switch-over Hysteresis	0x2272	Amplification Torque
0x2263	Overspeed	0x2273	Integral Time Torque
0x2264	Underspeed	0x2274	Fact. Acc. Feed Forward
0x2265	Speed Hysteresis	0x2275	Speed Difference Limit
0x2266	Torque Hysteresis	0x2276/1	Speed Integrator
0x2267	Limitation Type	0x2276/2	Speed Integrator (Init)
0x2268	Power Limit Motor	0x2277	Factor Speed Limit
0x2269	Power Limit Generator	0x2278	Online Tuning
0x226A	Torque Limit Motor	0x2279	Online Tuning Min. Ramp
0x226B	Torque Limit Generator	0x4209/1	Factor Torque Limit Motor

0x226C	Current Limit Motor	0x4209/2	Factor Torque Limit Generator
0x226D	Current Limit Generator	0x4209/3	Factor Current Limit Motor
0x226E	Amplification Low Speed	0x4209/4	Factor Current Limit Generator
0x226F	Integral Time Low Speed	0x4209/9	Factor Overspeed
0x2270	Amplification High Speed	0x4209/10	Factor Underspeed

The control of the current components is done in the outer control loop by the speed controller. Via parameter *Limitation type* **0x2267**, you can select the operation mode for the speed controller. The operation mode defines the use of the parameterizable limits. These are referred to the direction of rotation and the direction of the torque and depend on the selected configuration.

Limitation type 0x2267	Function
0 - Limits for Motor/Generator Op.	The limitation of the speed controller assigns the upper limit to the motor operation of the drive. Independent of the direction of rotation, the same limit is used. The same applies in the case of regenerative operation with the lower limit.
1 - Limits for pos./neg. values	The absolute limit is assigned irrespective of the motor or generator operating modes of the drive. The positive limitation is done by the upper limit. The lower limit is regarded as a negative limitation.



If limitation type **0x2267** = 1 is chosen, the objects for **motor operation** are used for the upper limit and objects for **generator operation** are used for the lower limit. Out of all limit values, the smallest absolute value applies.

Limitation of speed controller

The output signal of the speed controller is the torque-forming current component Isq. The output and the I portion of the speed controller can be limited via parameters *Torque Limit Generator* **0x226B**, *Current Limit Generator* **0x226D**, *Power Limit Generator* **0x2269**, and *Torque Limit Motor* **0x226A**, *Current Limit Motor* **0x226C**, *Power Limit Motor* **0x2268**.

To avoid unwanted speeds (in most cases excessive speed, but sometimes low speeds, too, and to avoid current impression), the speed is limited by the speed controller via *Maximum Speed Limit* **0x2300** and *Minimum Speed Limit* **0x2301**.

The torque controller enables sensor-less torque control in addition to speed control.

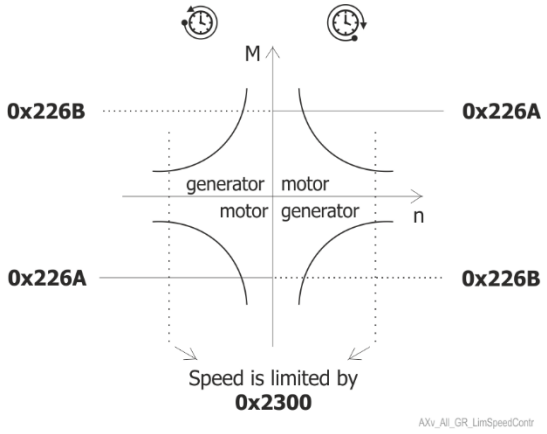
Upper and lower speed limit in torque control

NOTICE

Unexpected dynamic behavior

If torque control is activated while the torsional speed is outside of the range between *Torque Limit Motor* **0x226A** and *Torque Limit Generator* **0x226B**, (e.g. when a machine is started from standstill or a quickly rotating machine is stopped quickly), the permissible torque range will be approached without ramps by means of the speed/torque controller. Then, the torque is only limited by the limitations of the speed controller (current and torque). For this reason, there may be unexpected dynamic behavior.

- Consider this when planning.



In many situations, the speed must be limited at operating points with reduced or without load torque, as the speed is adjusted according to the preset torque and the load behavior. To avoid unwanted speeds (in most cases excessive speed, but sometimes low speeds, too, and to avoid current impression), the speed is limited by the speed controller via *Maximum Speed Limit* **0x2300** and *Minimum Speed Limit* **0x2301**.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2300	Maximum Speed	[rpm]	0	35940	3000
0x2301	Minimum Speed	[rpm]	0	35940	0

12.3.3 Position Controller

The position controller evaluates the positioning operation (target/actual position) and tries to control the drive such that it comes as close as possible to the specifications. For this purpose, an additional rotation speed is calculated for compensation of position deviations. By setting the corresponding parameter, this speed can be limited. The parameter settings of the position controller determine how quick and to what extent position deviations must be compensated.

Via parameter *Gain Pos. Ctrl.* **0x2280**, you can define the maximum time in which the position deviation will be compensated.

Via parameter *Speed Limit* **0x2281**, you can define to which value the speed is limited for compensation of the position deviation.

NOTICE

The Output of the Position Controller is not limited by *Maximum Speed* **0x2300**. *Maximum Speed* **0x2300** limits the value of the Motion Profile generation. Caused by the addition of the Profile generator reference speed and the output of the Position Controller higher speeds than *Maximum Speed* **0x2300** can occur.

Maximum Speed **0x2300** and *Speed Limit* **0x2281** must be set to fitting values during the commissioning.

Bonfiglioli recommends:

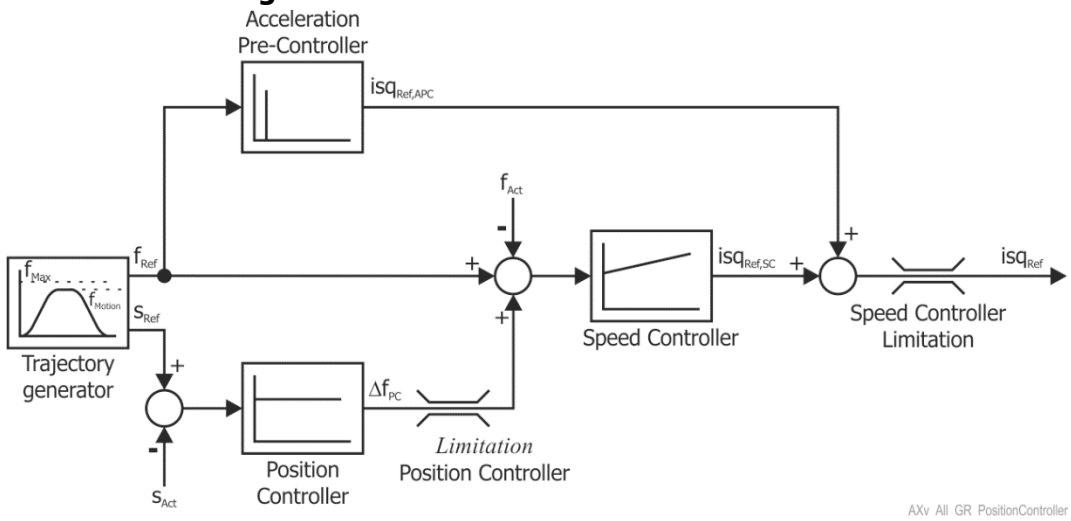
- Set *Maximum Speed* **0x2300** to 90 % of the mechanical rated speed and
- *Speed Limit* **0x2281** of the Position Controller to 10 % of the Max. speed.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2280	Gain Pos. Ctrl.	[1/s]	0	1000	1
0x2281	Speed Limit	[rpm]	0	35940	6000
0x2282	Contouring Fault Threshold	[-]	0	2147483647	2147483647
0x2283	Contouring Fault Delay	[s]	0	60	1

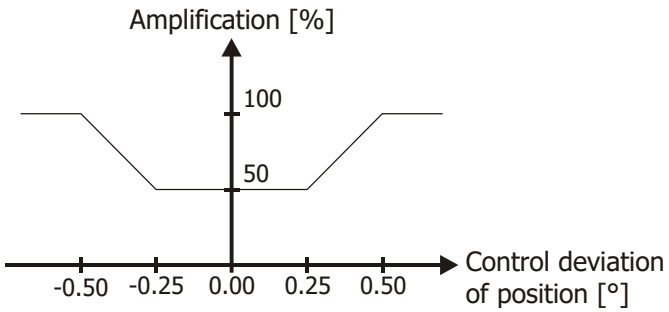
Example:

Position deviates by 1 motor shaft revolution, *Gain Pos. Ctrl.* is set to `1` [1/s]. The position controller will increase the motor speed by `1/60` rpm in order to compensate for the position deviation. Object *Speed Limit* **0x2281** must be set accordingly.

Controller block diagram



To avoid oscillations of the drive while it is at standstill, amplification is reduced to 50 % of the parameterized value for small position deviations



The following behavior may indicate that the controller parameters are not configured properly:

- drive is very loud
- drive vibrates
- frequent contouring errors
- inexact control

For the setting options of other control parameters, e.g. speed controller 13.

NOTICE

Optimize the settings in actual operating conditions, as control parameters for speed controller and acceleration pilot control depend on actual load. Optimize with different load types to obtain a good control behavior in all situations.

12.3.4 Current controller

The following objects are relevant for the current controller:

Index	Designation	Index	Designation
0x22C0	Amplification d-Axis 2kHz	0x22C8	Amplification d-Axis 8kHz
0x22C1	Integral Time d-Axis 2kHz	0x22C9	Integral Time d-Axis 8kHz
0x22C2	Amplification q-Axis 2kHz	0x22CA	Amplification q-Axis 8kHz

0x22C3	Integral Time q-Axis 2kHz	0x22CB	Integral Time q-Axis 8kHz
0x22C4	Amplification d-Axis 4kHz	0x22CC	Amplification d-Axis 16kHz
0x22C5	Integral Time d-Axis 4kHz	0x22CD	Integral Time d-Axis 16kHz
0x22C6	Amplification q-Axis 4kHz	0x22CE	Amplification q-Axis 16kHz
0x22C7	Integral Time q-Axis 4kHz	0x22CF	Integral Time q-Axis 16kHz

0x22D0	Adaptive Gain Mode	0x22D9	Gain Fact. Medium Current (q-Axis)
0x22D1	Low Current Threshold	0x22DA	Gain Fact. High Current (q-Axis)
0x22D2	Medium Current Threshold (Min.)	0x22DB	Crosscoupling Factor
0x22D3	Medium Current Threshold (Max.)	0x22DC	Back EMF Factor
0x22D4	High Current Threshold	0x22DD	Max. Output Voltage
0x22D5	Gain Fact. Low Current (d-Axis)	0x22DE	Activate Smith Predictor
0x22D6	Gain Fact. Medium Current (d-Axis)	0x22E0	Reference Current Filter Type
0x22D7	Gain Fact. High Current (d-Axis)	0x22E1	Bandwidth Frequency
0x22D8	Gain Fact. Low Current (q-Axis)	0x22E2	Center Frequency

Using the object **0x22D0** *Adapt. Gain Mode*, the gain mode can be selected. The following options are available:

`1 - Constant gain` (default)

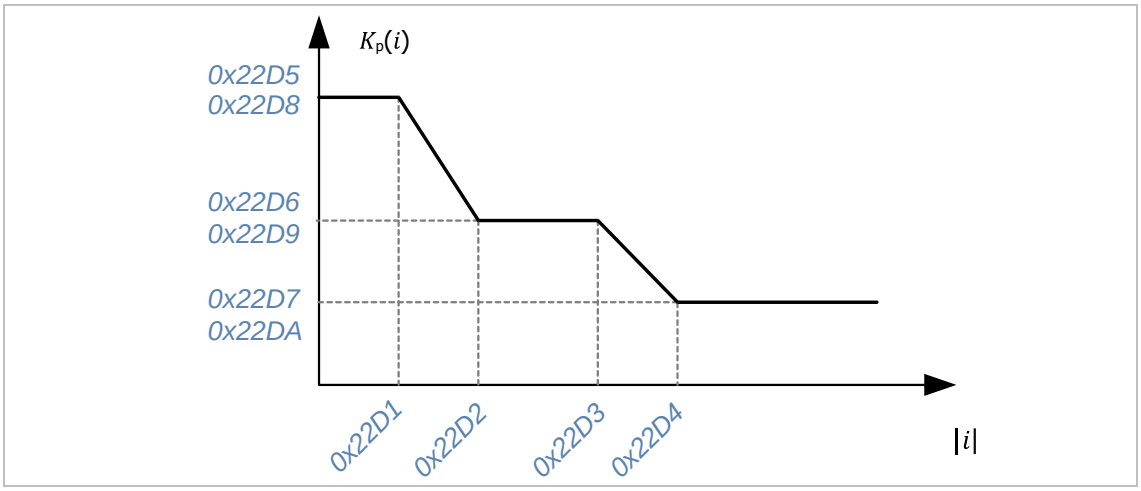
`2 - Absolute Current Dependent Gain`

`3 - Dq-Axis individual gain`

When using `1 - Constant gain`, the inverter uses the settings of the parameter **0x22D6 -** *d-Axis Factor Medium Current*.

The field-oriented control impresses the motor current into the machine via the following components to be controlled.

- the flux-forming current value I_{sd}
- the torque-forming current value I_{sq}



By separate regulation of these two parameters, a decoupling of the system equivalent to an externally excited direct current machine is achieved.

The Auto-Setup has selected the parameters of the current controller in such a way that they can be used without having to be changed in most applications.

The settings of the current controllers should not be too dynamic in order to ensure a sufficient reserve range. The control tends to increase oscillations if the reverse range is reduced.

In some machines, it may be necessary to set different amplification factors for different current ranges.

The parameters are changed during motor Auto-Setup.

Current controller functions specific to SynRM

The current controller has separate P-gain settings for low, medium and high current in each of the two axes (d-axis and q-axis), because of the magnetic anisotropy of the rotor.

In order to provide sufficient control performance in every load point, the selected rated current must meet the load conditions.

- If **0x2003** *Rated Current* is selected higher than the motor ratings, the setup will find correct P-gain values for high currents, but is not as precise at very low currents.
- If MTPA is used (currents are reduced at low load), it is important to check the setting of the P-gain for low currents (**0x22D5** and **0x22D8**) and increase, if needed.

12.3.5 Acceleration Feed Forward

The acceleration feed forward is used to achieve smooth current profile while accelerating drive trains with larger inertia. The acceleration feed forward is active in the speed-controlled configurations and can be activated via parameter *Operation Mode* **0x22F1**.

Operation Mode 0x22F1		
	0 -	Off
	1 -	Total Inertia
	2 -	Variable torque constant

The acceleration feed forward together with the speed controller reduce the time to react to a change in reference values of the drive system.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x22F2	Minimum acceleration	0 rpm/s	35940 rpm/s	60
0x2274	Fact. Acc. Feed Forward	0	2	1

With *Operation Mode* **0x22F1** = `1 - Total Inertia`, the acceleration feed forward function uses a fixed values for the inertia. To achieve correct functionality, enter the motor inertia in the object **0x202A** Motor Inertia. Alternatively, you can use **0x40D2/1** *Estimated Inertia* (read only), which is set via torque control online tuning.

The ratio of the actual torque and torque forming current is represented via a torque constant. However, this ratio can vary in the field weakening range or with flux reduction. For this scenario, select *Operation Mode* **0x22F1** = `2 - Variable torque constant`.

The acceleration feed forward activates only when the acceleration ramp of the drive exceeds the value set in *Minimum Acceleration* **0x22F2**. To ensure that the acceleration feed forward does activate, set the value to less than half the set acceleration ramp. This way it is ensured that the acceleration feed forward does activate. To intensify or to decrease the effect of the acceleration feed forward, use the object **0x2274**. The additional acceleration moment of the acceleration feed forward will be multiplied with the value set in **0x2274**.

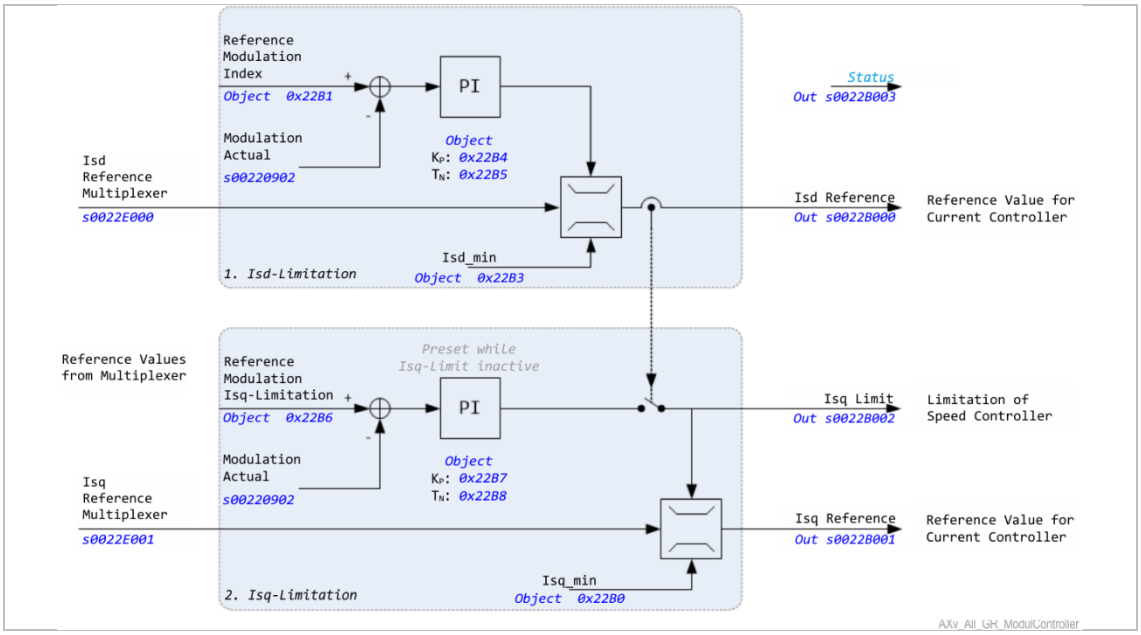
12.3.6 Modulation controller

The modulation controller, which is designed as an I regulator, automatically adapts the output value of the frequency inverter to the machine behavior in the basic speed area and in the field weakening area. If the modulation index exceeds the value set with object *Ref. modulation index* **0x22B1**, the field-forming current component and thus the

flux/Isd in the machine are reduced. The integrating part of the modulation controller shall be set via parameter *Integral TimeIsd* **0x22B5**.

If the flx/Isd is at its minimum value, Isq and the speed controller will be limited.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x22B0	Isq Limit Min	[A]	0,05911	59,11	0,2955
0x22B1	Ref. Modulation Index	[-]	0,0	1,50	0,95
0x22B3	Isd Limit Min	[A]	-59,11	59,11	0,00
0x22B4	Amplification Isd	[-]	0,0	1000,00	0,1
0x22B5	Integral Time Isd	[s]	0,00	1000,00	0,002
0x22B6	Isq Limit Ref. Mod.	[-]	0	10	1,1
0x22B7	Amplification Isq Limiter	[-]	0,001	1000,00	0,1
0x22B8	Integral Time Isq Limiter	[s]	0,00	1000,00	0,002
0x22B9	Controller Status	[-]	r/o		



Via this load-dependent control, the modulation controller ensures that the drive system is not overloaded. The control behavior of the modulation controller is set via the proportional component, object *Amplification Isd* **0x22B4**, and the integrating component, object *Integral Time Isd* **0x22B5**.

The percentage setting of the *Ref. Modulation Index* **0x22B1** is basically a function of the leakage inductance of the machine. The default value was selected such that the remaining deviation is sufficient as a reserve range for the current controller in most cases. For the optimization of the controller parameters, the drive is accelerated with a flat ramp into the area of field weakening, so that the modulation controller intervenes. The limit is set via object **0x22B1**. You can assess the controlling process of the modulation controller by capturing the flux-forming current component via an oscillography measurement on the analog output of the frequency inverter. The course of the signal of the flux-forming current I_{sd} should reach the stationary value after overshooting without oscillation. An oscillating of the current can be dampened by increasing the integral time. Object **0x22B5** should roughly correspond to the value of *Rotor Time Constant* **0x2028** .

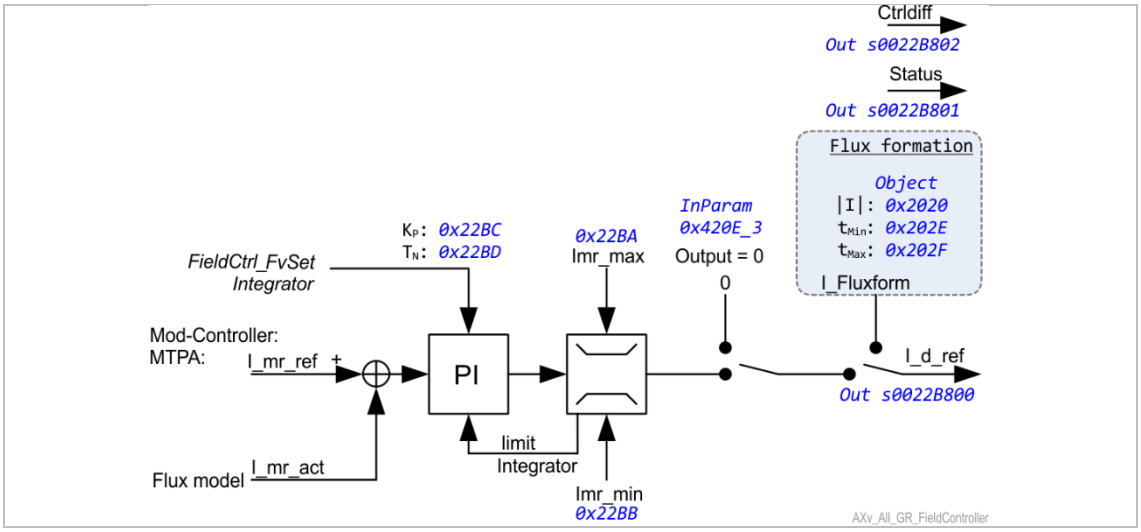
12.3.7 Field controller

The flux-forming current component is controlled by the field controller. The Auto-Setup optimizes the parameters of the field controller by measuring the time constant and magnetizing curve of the connected asynchronous motor. The parameters of the field controller are selected such that they can be used without changes in most applications. The proportional and the integrating part of the field controller are set via objects *Amplification* **0x22BC** and *Integral Time* **0x22BD**.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x420E/3	S. Disable Flux Controller	[-]	Selection		
0x22BA	Isd Upper Limit	[A]	-41,8025	41,8025	41,8025
0x22BB	Isd Lower Limit	[A]	-41,8025	41,8025	0,0
0x22BC	Amplification	[-]	0,0	1000,0	1,0
0x22BD	Integral Time	[s]	0,0	1000,0	0,0

NOTICE

Please note that any changes of the field controller should only be made in the base speed range.



12.3.8 for details on flux formation.

If the field controller must be optimized, set:

Integral Time **0x22BD** = *Rotor Time Constant* **0x2028***0,5

i.e. half the rotor time constant. In most applications, this change will be sufficient.

If additional optimization is required, proceed as follows:

- First set the output speed (e.g. via reference speed) such that the actual value *Act. Modulation Index* **0x2209/6** = 80...90 % *Ref. Modulation Index* **0x22B1**.
- Adjust parameters *Amplification* **0x22BC** and *Integral Time* **0x22BD** according to the application requirements.

If a quick transition into field weakening is necessary for the application, the integral time should be reduced.

For good dynamic behavior, choose a relatively high value for *Amplification* **0x22BC** of the controller. Note that high overshoot is necessary for good control behavior in controlling of a load with low-pass behavior, for example a 3-phase machine.

Limitation of field controller output

The output signal of the field controller, the integrating and proportional component are limited via parameters *Maximum Current* **0x22BA** and *Minimum Current* **0x22BB**. During Auto-Setup, parameter *Maximum Current* **0x22BA** is set according to parameter *Rated Current* **0x2003**.

The limits of the field controller define not only the maximum current occurring, but also the dynamic properties of the controller. The upper and lower limits restrict the modification speed of the machine flux and the torque resulting from it. In particular, the speed area above the nominal speed should be observed for the modification of the flux-forming component.

12.3.8 Flux reference generation

In general, motor efficiency can be increased when flux is reduced at partial load and when flux is increased at overload.

In field-oriented control, the vector product of flux and torque forming current (Isq) is proportional to the torque generated at the shaft of the motor. At most motor types, the flux can be influenced by the so-called flux forming current (Isd). Flux is generated by Isd at asynchronous and synchronous reluctance motors. At synchronous motors with surface mounted magnets the flux can only be influenced to a limited extent. When magnets are buried, flux can be externally influenced.

In motors where flux is generated by Isd, losses due to flux generation are involved. There is an optimal locus, an optimal curve, with lowest total current and maximum torque output. This curve is called MTPA (Maximum Torque Per Ampere) and can be defined by a look up table or approximated by a current angle.

The current angle is defined by **0x22F8** *Current angle*.

Relevant objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x22F5	Flux Reference Mode	[-]	Selection		
0x22F6	Min Flux Forming Current	[A]	-59,11	59,11	set by auto tuning
0x22F7	Max Flux Forming Current	[A]	-59,11	59,11	set by auto tuning
0x22F8	Current angle	[deg]	-89	89	45
0x22F9	Minimum speed	[rpm]	0	35940	300
0x22FA	Speed Hysteresis	[rpm]	0	35940	2
0x22FB	Table Selection	[-]	Selection		
0x22FC	Flux reference table	[A]	0	10000	1
0x22FD	Scaling of Table	[-]	0	10	1

There are several ways to generate the reference value for the flux-forming current:

0x22F5		Function
0x00000000	Nominal Flux / No Flux Reduction	The nominal flux, defined in object *Magnetisation Current* **0x2020**, is applied.
0x00000001	Fix Current Angle	A fix angle between Isd and Isq is defined by *Current Angle* **0x22F8**.
0x00000002	Look Up Table	The look up table defined by *Selection of Flux Ref.Table* **0x22FB** is used.

The flux reference is limited by a minimum and maximum value and only activated above a minimum speed. Within the span of the hysteresis around the minimum speed the minimum flux level is linear interpolated to *Magnetisation Current* **0x2020**.

If poor control performance is observed at very low flux, crosscheck with the setting of the current controller, especially the adaptive gain setting for low current.

The look up table used for flux reference generation is selected by *Selection of Flux Reference Table* **0x22FB**. The setting of *Star Delta Table Configuration* **0x2252** also applies to the look up tables for the flux reference value (9.3.3). *Flux Reference Table* **0x22FC** applies to any table used.

0x22FB		Function
0x00000000	Object for Flux Table	The table stored in *Flux Reference Table* **0x22FC** is used for motor control. This object can either be written by the user or by the Auto-Setup Function.
0x00000001	Flux Table ASM Motor 1	
0x00000002	Flux Table ASM Motor 2	
0x00000003	Flux Table PMSM Motor 1	
0x00000004	Flux Table PMSM Motor 2	
0x00000005	Flux Table SynRM Motor 1	
0x00000006	Flux Table SynRM Motor 2	

12.3.9 Synchronous Machine

Incremental Encoder

The objects in the subtree `Parameters\Controls and Controllers\Field Oriented control\Synchronous machine\Incremental Encoder` configure the settings for emulating an incremental encoder.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2240	Z-Pulse Emulation	[-]	FALSE	TRUE	FALSE
0x2241	Z-Pulse Emulation Min Speed	[Hz]	0	658,9	658,9
0x223D	Deviation Filter Time	[s]	0	10	0,01
0x223E	Deviation Correction Time	[s]	0	100	0,1
0x223F	Deviation Correction Threshold	[deg]	0	45	0

12.4 Pulse width modulation

The motor noise can be reduced by switching parameter *Switching Frequency* **0x2209/1**. The switching frequency should be reduced to a maximum ratio of 1:10 to the frequency of the output signal for a sine-shaped output signal. The maximum possible switching frequency depends on the drive output and the ambient conditions. For the required technical data refer to the corresponding table and the device type diagrams.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2209/1	Switching frequency	[kHz]	2	16	4
0x2209/2	Minimum Switching Freq.	[kHz]	2	16	2

The heat losses increase proportionally to the load point of the frequency inverter and the switching frequency. The automatic reduction adjusts the switching frequency to the current operating state of the frequency inverter to provide the output performance required for the drive task at the greatest possible dynamics and a low noise level.

The switching frequency is adjusted between the limits set with parameters *Switching Frequency* **0x2209/1** and *Min. Switching Freq.* **0x2209/2**. If **0x2209/2** is higher or equal to the **0x2209/1**, automatic reduction will be disabled.

10.5 for details on PWM control input configuration.

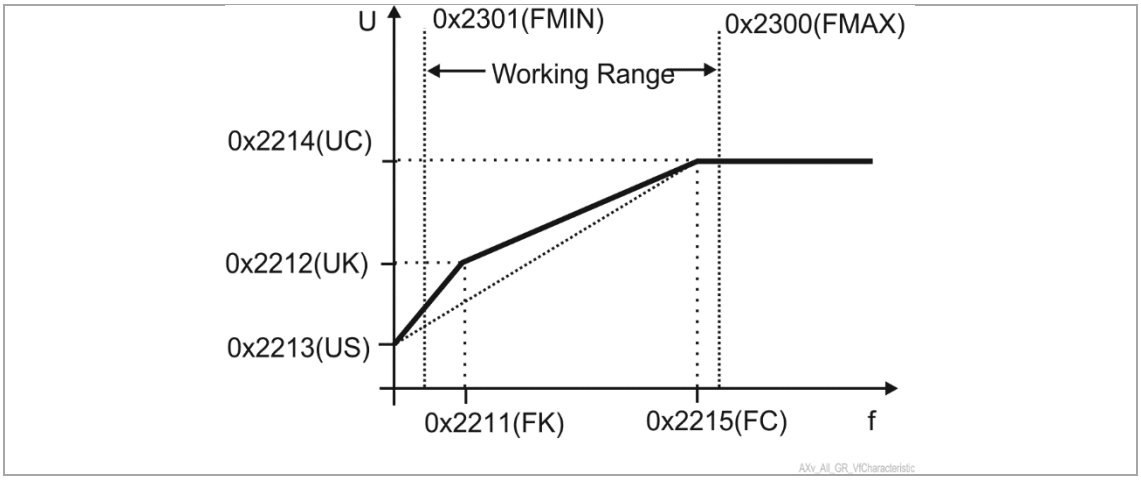
12.5 V/f control

12.5.1 V/f Characteristic

To use the V/f-characteristic, first set the machine parameters, such as the number of pole pairs, Stator impedance, Rotor impedance. To set the values for the Current impression best use the Auto-setup.

By setting the V/f-characteristic, the voltage of the connected 3-phase motor is controlled according to the frequency. The torque to be applied by the motor at the corresponding operating point demands the control of the output voltage proportional to the frequency. At a constant output voltage / output frequency ratio of the frequency inverter, the magnetization is constant in the nominal operating range of the 3-phase motor. The rating point of the motor or end point of the V/f-characteristic is set via the Auto-Setup or with parameter *Cut-Off Voltage* **0x2214** and parameter *Cut-Off Frequency* **0x2215**.

The lower frequency range, where an increased voltage is necessary for the start of the drive, is critical. The voltage at output frequency = `zero` is set with the parameter *Starting Voltage* **0x2213**. A voltage increase deviating from the linear course of the V/f characteristic can be defined by parameters *Ku* **0x2212** and *Kf* **0x2211**. The parameter value percentage is calculated from the linear V/f characteristic. Via parameters *Minimum Speed Limit* **0x2301** and *Maximum Speed Limit* **0x2300**, the working range and/or V/f characteristic are defined.



(FMIN): *Minimum Speed Limit* **0x2301**, (FMAX): *Maximum Speed Limit* **0x2300**,
(US): *Starting Voltage* **0x2213**,
(UK): *Ku Voltage Rise* **0x2212**, (FK): *Kf Rise Frequency* **0x2211**
(UC): *Cut-Off Voltage* **0x2214**, (FC): *Cut-Off Frequency* **0x2215**

V/f Starting Mode 0x2210	Function
0 - UF	Default V/f characteristic
1 - UF with Magnet.	As in 0, with magnetization
2 - UF with Magnet. with Current Imp.	As in 0, with magnetization and with current impression

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2029	Maximum Slip	[%]	0	1000	330
0x2210	Starting Mode	[-]	0	2	0

0x2211	Rise Frequency	[%]	0 %	100 %	20 %
0x2212	Voltage Rise	[%]	0 %	100 %	0 %
0x2213	Starting voltage	[V]	0.0 V	100.0 V	5.0 V
0x2214	Cut-off voltage	[V]	60.0 V	560.0 V	400.0 V
0x2215	Cut-off frequency	[Hz]	0.00 Hz	599.00 Hz	50.00 Hz
0x221D	Slip compensat. factor	[-]			
0x221E	Curve Type	[-]			
0x221F	Quadratic Factor	[-]			
0x4214/1	Current Damper Activation	[-]			
0x4214/2	RI Compensation Activation	[-]			
0x4214/3	Slip Compensation Activation	[-]			

NOTICE

EEPROM protection

Writing to the EEPROM too frequently may shorten the service life of the inverter. To prevent this, the user receives the error message "Cyclic Write" if more than 50 write attempts per minute are made.

- After the error message, wait for 1 minute before attempting writing or
- Restart the inverter

to be able to initiate new write commands.

The Auto-Setup takes the parameterized rated motor values and reference data of the frequency inverter into account when it comes to pre-setting the V/f-characteristic. In the case of asynchronous machines, the speed can be increased at a constant torque if the motor winding can be switched over from star to delta connection. If the data for delta connection indicated on the rating plate of the three-phase motor were entered, the cut-off frequency is increased automatically by the square root of three.

The default *Cut-Off Voltage* **0x2214** (UC) and *Cut-Off Frequency* **0x2215** (FC) are derived from the motor data *Rated Voltage* **0x2002** and *Rated Frequency* **0x2007**. With the parameterized *Starting Voltage* **0x2213** (US), the linear equation of the V/f-characteristic results.

$$U = \left(\frac{UC - US}{FC - 0}\right) \cdot f + US = \left(\frac{400{,}0\ V - 5{,}0\ V}{50{,}00\ Hz - 0{,}00\ Hz}\right) \cdot f + 5{,}0\ V$$

The *Kf* **0x2211** (FK) is entered as a percentage of the *Cut-Off Frequency* **0x2215** (FC), the default value is f=`10 Hz`. The output voltage for the default *Ku* **0x2212** (UK) is calculated as U=`92.4 V`.

$$U = \left[\left(\frac{UC - US}{FC - 0}\right) \cdot (FK \cdot FC) + US\right] \cdot (1 + UK) = \left[\left(\frac{400\ V - 5\ V}{50\ Hz - 0\ Hz}\right) \cdot (0{,}2 \cdot 50\ Hz) + 5\ V\right] \cdot 1{,}1 = \underline{\underline{92{,}4\ V}}$$

12.5.2 V/f Current Limitation

The current limitation described below pertains only to V/f-control. In specific control modes other limiting parameters apply.

Behavior in motor operation:

If the current set via parameter *Current Limit* **0x2216** is exceeded, the activated current limit value controller will reduce the output frequency until the current limit is no longer

exceeded. The output speed is reduced to *Maximum Speed* **0x2300**. If the current value drops below the *Current Limit* **0x2216**, the output speed is increased to the setpoint again.

Behavior in generator operation:

If the current set via parameter *Current Limit* **0x2216** is exceeded, the activated current limit value controller will increase the output frequency until the current limit is no longer exceeded. The output speed is increased, to the *Maximum Speed* **0x2300**. If the current value drops below the *Current Limit* **0x2216**, the output speed is reduced to the required reference value again.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2216	Current Limit	[A]	0,0	o·I_{FIN}	o·I_{FIN}
0x2217	kp Current Limit.	[-]	0	10	0,25
0x2218	Ti Current Limit.	[s]	0	10	1
0x2219	Ti2 Current Limit.	[s]	0	10	1
0x221A	Minimum Speed	[rpm]	0	35940	0

12.5.3 V/f Stall Mode

The stall mode objects listed below set the current limits for the acceleration, the deceleration and for the steady state in operation of the V/f characteristic.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2220	Current Lim. Acc	[A]	-1	1	0,5
0x2221	Current Lim. SteadyState	[A]	-1	1	0,5
0x2222	Current Lim. Dec	[A]	-1	1	0,5

12.5.4 V/f Current Impression

The V/f current controller is governed by the objects listed below. These objects apply only for the V/f characteristic operation.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x221B	Amplification Damper	[-]	-100	100	-1
0x221C	Filter Time Constant	[s]	0	100	0,1
0x2226	Type of Cur. Impression	[-]	Id Control	Imax Control	Id Control
0x2227	Amplification	[-]	0	100	20
0x2228	Integral Time	[s]	0	1000	1

13 Motion Control

13.1 Operating behavior

The user adapts the operating behavior of the frequency inverter to the application by appropriately setting the objects designed for this purpose. Additionally, features such as "Auto-start", the synchronization functions and positioning functions facilitate the integration in the application.

13.1.1 Starting behavior

The start of the 3-phase machine can be parameterized in accordance with the control functions and methods. In contrast to the open-loop control method, the field-oriented control methods only require the definition of the limit values *Max Flux-Formation Time* **0x202F** and *Magnetisation Current* **0x2020** for the adjustment of the acceleration behavior.

13.1.2 Starting behavior of open-loop control system

Depending on the parameterization, the machine is magnetized first, or a starting current is impressed. The voltage dropping across the stator resistance, which reduces the torque in the lower frequency range, can be compensated by the IxR compensation.

To ensure the correct function of the IxR compensation, the stator resistance is determined during the Auto-Setup. The IxR compensation is only activated when the stator resistance was determined correctly.

off	During startup, at an output speed of `0 rpm`, the voltage is set via parameter *Starting Voltage* **0x2213**. (☞ 12.5.1) After this, the output voltage and the output speed are changed according to the control method. The break-away torque and the current at the start is determined by the adjusted starting voltage. It may be necessary to optimize the starting behavior via the parameter *Starting Voltage* **0x2213**.
Magnetization	In this operation mode, the *Magnetisation Current* **0x2020** for magnetization is impressed into the motor after release. The output speed is kept at `0 rpm` for the duration set in the *Max Flux-Formation Time* **0x202F**. After this time has expired, the output speed follows the set V/f characteristic. (see above: mode `0- Off`)
Magnetisation+Current Impr.	In this operation mode, once the *Max Flux-Formation Time* **0x202F** has elapsed, the output speed is increased according to the set acceleration. If the output speed reaches the value set with the object *Deactivation Threshold* **0x2030** (☞ 12.3.1) the *Starting Current* **0x2021** is withdrawn. There is a smooth transition to 1.4 times the speed limit to the set V/f characteristic. As from this operating point, the output current depends on the load.
Magnetization +IxR compensation	Operation mode `3` includes operation mode `1` of the start function. When the output speed reaches the value set with parameter *Freq. Switch* **0x2030**, the increase of the output voltage by the IxR compensation becomes effective. The V/f characteristic is displaced by the portion of voltage which depends on the stator resistance.

Magnetization +current impr.+I*R-Comp.	In this operation mode, the current set with the parameter *Flux-Formation Current* **0x2020** is impressed into the motor for magnetization after release. The output speed is kept at 0 rpm for the *Max. Flux-Format. Time* **0x202F**. Once this time has elapsed, the output speed is increased according to the set acceleration. Once the output speed reaches the value set with parameter *Deactivation Threshold* **0x2030**, the *Starting Current* **0x2021** is withdrawn. There is a smooth transition to the V/f characteristic, and a load-dependent output current is obtained. At the same time, the increase of the output voltage by the IxR compensation becomes effective as from this output speed. The V/f characteristic is displaced by the portion of voltage which depends on the stator resistance.
Magn.+ Curr.ImP. w. Ramp Stop	This operation mode contains an additional function to guarantee a starting behavior under difficult conditions. The magnetization and starting current impression are done according to operation mode "Magnetization and current impression". The ramp stop takes the current consumption of the motor at the corresponding operating point into account and controls the speed and voltage change by stopping the ramp.
Magn.+ Curr.ImP. w. RS.+ I*R-Comp.	In this operation mode, the functions of the operation mode above are extended by the compensation of the voltage drop across the stator resistance. When the output speed reaches the value set with parameter *Deactivation Threshold* **0x2030**, the increase of the output voltage by the IxR compensation becomes effective. The V/f characteristic is displaced by the portion of voltage which depends on the stator resistance.

In contrast to field-oriented control systems, open-loop control systems feature a current controller which controls the starting behavior. The PI controller controls the current impression of parameter *Starting Current* **0x2021**.

Starting current

The *Starting Current* **0x2021** ensures, particularly for high-torque start, a sufficient torque until the *Activation Threshold* **0x2031** (☞ 12.3.1) is reached.

Applications in which high current is permanently needed at a low speed must be realized using forced-ventilated motors to prevent thermal overload.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2021	Starting current	0,0 A	oIFIN	IFIN

IFIN = Rated frequency inverter output current
o: Overload capacity of frequency inverter.

Speed Limit

The *Starting Current* **0x2021** is impressed until the *Deactivation Threshold* **0x2030** (☞ 12.3.1) is reached. Permanent operating points below the speed limit are only permissible if forced-ventilated motors are used.

The object **0x2031** is set automatically during guided motor commissioning.

Flux formation

Field-oriented control is based on separate regulation of the flux-forming and torque-forming current components. Upon startup, the machine is magnetized, and a current is impressed first. With parameter *Magnet. Current* **0x2020**, the magnetization current I_{sd} is set. With parameter *Max. Flux-Format. Time* **0x202F** the maximum current impression time is set.

The current impression is done until the reference value of the rated magnetizing current is reached or the *Max. Flux-Format. Time* **0x202F** is exceeded.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x202E	Min Flux-Formation Time	0 s	10 s	0,001 s
0x202F	Max Flux-Formation Time	0 s	10 s	0,50 s
0x2020	Magnetisation Current	-0,7072 I_{FIN}	0,7072 I_{FIN}	0

The magnetizing current changes according to the rotor time constant of the motor. By setting the parameters *Max. Flux-Format. Time* **0x202F** and *Min. Flux-Formation Time* **0x202E** a constant flux formation time can be achieved. With parameter *Min. Flux-Formation Time* **0x202E** the minimum time for flux-forming current can be set. This enables a defined time between start signal and run-up of the drive. For an optimum setting of the parameters the rotor time constant, consider the required starting torque and *Magnet. Current* **0x2020**.

Min. Flux-Formation Time **0x202E** = 0	Flux formation is stopped as soon – as reference flux value or – as maximum flux formation time is reached
Min. Flux-Formation Time **0x202E** > 0	Current is impressed for flux formation at least for this time even if the reference flux value was reached.
Min. Flux-Formation Time **0x202E** = Max. Flux-Format. Time **0x202F**	Flux formation is stopped after the set flux formation time, regardless of whether the reference flux value was reached or not.
Min. Flux-Formation Time **0x202E** > Max. Flux-Format. Time **0x202F**	Flux formation is stopped after the maximum flux formation time.

13.1.3 Start Mode

WARNING

Moving parts

Due to an active auto-start function, portions of the system can start moving unexpectedly. This may lead to injuries or to system damage.

- Comply with VDE provision 0100 part 227 and provision 0113, in particular Sections 5.4, protection against automatic after main line voltage failure and voltage recovery, and Section 5.5 "Undervoltage protection".
- Take appropriate measures to exclude any risk for staff, machines and production goods.
- In addition, comply with all specific regulations relevant to the application as well all national directives.
- When the auto-start function is activated, the operator, in accordance with DIN EN 61800-5-1, shall provide a clear warning/sign in the plant, indicating automatic restart.

The auto-start function is suitable for applications which permit starting at mains voltage by their function. By activation of the auto-start function via parameter *Autostart (IOs)* **0x2208**, the frequency inverter accelerates the drive immediately at application of the mains voltage. Control signals for release and the start command are required as per the regulations. When the motor is switched on, it is accelerated according to the parameterization and the reference value signal.

Autostart (IOs) 0x2208	Function
0 - off	No auto-start. The drive is accelerated, after the mains voltage is applied, as soon as the release and the start command are present (edge based).
1 - On	The drive is accelerated by the frequency inverter immediately, as soon as the mains voltage is applied (level based).

Flying Start

The synchronization to a drive is necessary in applications, which drive the motor by their behavior or in which the drive is still rotating after an error switch-off. Via *Flying Start* **0x2207**, the motor speed is synchronized to the current motor speed without an "Overcurrent" error signal. After this, the motor is accelerated to the reference speed at the set acceleration. This synchronization function determines the current rotary speed of the drive via a search run.

For operation of a synchronous motor, the flux direction can be determined in order to prevent alignment of the motor shaft (jerking) during start-uP. This method is not suitable for very dynamic drives since the torque pulses result in a rotation of the drive and consequently in wrong measurements. Once the flux direction has been determined, the flux is built up in order to improve the starting behavior.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2207	Flying Start	[-]	Selection		
0x2208	Autostart (IOs)	[-]	Selection		
0x203A	Pulse Height Factor	[-]			
0x203B	Pulse Duration Factor	[-]			
0x203C	Voltage Threshold	[-]			

Flying start 0x2207		Function
0 -	off	No flying start.
1 -	Rotor position at standstill	Rotor position of a motor at standstill shall be determined.
2 -	Search run	Synchronization to a running motor.
3 -	Search run CW	Same as option 2, but limited to clockwise rotation.
4 -	Search run CCW	Same as option 2, but limited to counter-clockwise rotation.

13.1.4 Stopping behavior

Switch-Off Threshold

NOTICE

Switch-off threshold too low

If the motor builds up a stopping torque, the switch-off threshold stop function may not be reached due to the slip speed and the standstill of the drive is not recognized.

- In this case, increase the value of the *Switch-off threshold* **0x253A**.

The *Switch-off threshold* **0x253A** defines the speed at which the standstill of the drive is recognized. This percentage parameter value is relative to the set *Speed Switch-Off Limit* **0x2420**.

The switch-off threshold must be adjusted according to the load behavior of the drive and the device output, as the drive must be controlled to a speed below the switch-off threshold.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x203D	Holding Current	[A]	0	41797	0
0x20A6	Quickstop Ramp Down Time	[s]	0,01	1000	0,1
0x253A	Switch-Off Threshold	[%]	0	100	1
0x253B	Holding time	[s]	0	600	1

Holding Time

The *Holding Time* **0x253B** is considered in stopping behavior. Control to Zero speed results in the motor heating up and should only be done for a short period in the case of internally ventilated motors.

The *Holding Current* **0x203D** is considered in stopping behavior.

The *Quickstop Ramp Down Time* **0x20A6** defines the duration given for the inverter to reach standstill.

13.1.5 Encoder Speed Limit

The subtree `Parameters\Motion Control\Operational Behaviour\Encoder Speed Limit` permits to set a threshold and a hysteresis for the sensorless operation. This may become necessary, if the rotation speed of the drive supersedes the operation limits of the encoder employed in the particular application.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2239	Threshold Sensorless Operation	[rpm]	0	39534	39534
0x223A	Hysteresis Sensorless Operation	[rpm]	0	39940	0

13.2 Axia Modes of Operation

13.2.1 Axia Jog Mode

The Jog mode is intended for finetuning, testing and commissioning purposes. You can activate the JOG mode by selecting in the In the `Parameters\Controls and Controllers\Controls\Mode` subtree, in the object **0x2200** *Control Mode* the entry `0x00000002 Keypad`. Then, in the object **0x2202** *Mode of Operation Keypad*, select `0xFFFFFFFA Axia Jog mode`. With these settings, the JOG Mode is operated via the Keypad. You can then use the Keypad to make the drive move clockwise or counterclockwise. When active, the JOG mode will operate according to the parameterization of the following objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2500	JOG Speed	[rpm]	0	35940	1500
0x2501	JOG Acceleration	[rpm/s]	0	60000	300
0x2502	JOG Deceleration	[rpm/s]	0	60000	300

An alternative activation option is via the digital inputs (10.1.1). There, you can use the objects **0x2101/6** *JOG Mode*, **0x2101/7** *JOG Start*, **0x2101/8** *JOG Counter Clockwise Operation* to assign digital inputs to the functions of the JOG mode. Using the digital inputs, you can also make the drive move clockwise or counterclockwise.

When activated, the Axia JOG Mode also can be controlled via the **0x6040** *Control Word* and be monitored via the internal control word **0x4003** *Control Word (internal)* or **0x6041** *Status Word*.

The object **0x4003** is the internal status of the control word and can be used for troubleshooting or maintenance.

In Axia Jog mode, the mode-specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	Run clockwise
5	Run counter-clockwise
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	
13	
14	
15	

13.2.2 Axia Speed Control

The Axia Speed Control mode can be selected via object 0x6060 Mode of operation = `-5 (0xFFFFFFFB)`.

Motion Control Definition

For the full function of the Motion Control Interface, you will have to set **0x2200** *Control Mode* = "`3 - State-machine`". In all other operation modes of parameter **0x2200** *Control Mode*, there are major restrictions.

The Axia Speed Control Mode is selected via objects:

0x2200 = `1 - IOs` AND

0x2201 = `-5 - Axia Speed Control`

Relevant objects:

Index	Designation	Index	Designation
0x2301	Minimum Speed	0x2536	Deceleration Anticlockwise
0x2300	Maximum Speed	0x2537	Ramp Fall Time Anticlockwise
0x2510	Operation Mode	0x2538	Reference Value Reached
0x2511-0x2514	Speed Reference 1-4	0x2539	Reference Value Reached Time
0x2518	Operation Mode	0x253A	Switch-Off Threshold
0x2519	Motor-Poti Ramp	0x253B	Holding Time
0x2521-0x2528	Fixed Speed 1-8	0x253D	Quick Stop Ramp
0x2530	Acceleration Clockwise	0x255B	Fixed Time Ramp Enable
0x2531	Ramp Rise Time Clockwise	0x255C	Fixed Time Ramp Acceleration
0x2532	Deceleration Clockwise	0x255D	Fixed Time Ramp Deceleration

Index	Designation	Index	Designation
0x2533	Ramp Fall Time Clockwise	0x255E	Fixed Time Ramp Hysteresis
0x2534	Acceleration Anticlockwise	0x255F	Ramp 1/2 Switch-Over
0x2535	Ramp Rise Time Anticlockwise		

Reference Configuration:

- **0x2510** Operation Mode for Axia Speed Control
- **0x2511 - 0x2514** Speed reference configuration

Index	Designation	
0x2510	Operation Mode	Selection
0x2511	Speed Reference 1	Up to four speed reference sources per object can be selected. (Fixed speed values, analog, MFI analog, motor poti) See below for full list
0x2512	Speed Reference 2	
0x2513	Speed Reference 3	
0x2514	Speed Reference 4	

0x2510 Operation Mode		Function
0x00000000	Stop	No Speed Control
0x00000001	Normal	Standard operation according to settings made
0x00000002	Only Positive	Speed control only for clockwise direction
0x00000003	Inverted	Inverted operation

For each speed reference there are four data sets.

Per data set, the following choice list of signal sources is available:

0x2511 - 0x2514 Speed reference source (value 1 to value 4)			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x00251002	Speed Motorpoti
0x0021A300	Simple Math. 1 Output	0x00251003	Speed MFAI 1 (X210.13)
0x0021A301	Simple Math. 1 Output Inverted	0x00251004	Speed MFAI 2 (X210.9)
0x0021A310	Simple Math. 2 Output	0x00251005	Speed PWM-Input (IN1D)
0x0021A311	Simple Math. 2 Output Inverted	0x00253012	Target Speed
0x0021A320	Simple Math. 3 Output	0x0025F101	Interpolated Speed
0x0021A321	Simple Math. 3 Output Inverted	0x00260020	Safe Speed
0x0021A330	Simple Math. 4 Output	0x00260021	SLS-SL Speed Setpoint
0x0021A331	Simple Math. 4 Output Inverted	0x00384003	Encoder X210: Speed
0x0021F010	PROFIx_TargetVelocity	0x00385003	Encoder X432: Speed
0x0021F508	CIP Speed Ref	0x00391040	SB RxPDO1 Single 0
0x00224003	MM Speed	0x00391041	SB RxPDO1 Single 1
0x00228000	Speed Ref.	0x00391090	SB RxPDO2 Single 0
0x00228006	Speed Limit Positioning	0x00391091	SB RxPDO2 Single 1
0x00228100	Speed Limit Obj2281	0x003910E0	SB RxPDO3 Single 0
0x00231200	PID Controller Output	0x003910E1	SB RxPDO3 Single 1
0x00251000	Speed Setpoint Channel	0x003CA070..7	PLC Out Float32 0..7
0x00251001	Fixed Speed		

Thus, for each of the objects **0x2511 - 0x2514**, there are up to four signal sources available.

Switching between preset sources is done via the dataset change-over function.

16.4 for details on how to use the fixed speed.

10.1.1 and 10.1.1.1 for details on how to configure the data set change-over, how to use the motor potentiometer and for other related information.

In the case of an error that needs to be reset, use object **0x2102** *Fault reset* to reset errors (this does not apply to all possible errors).

Motorpoti Configuration

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2518	Operation Mode	[-]	Selection		Stop
0x2519	Motor-Poti Ramp	[rpm/s]	0	60000	120

To use the Motorpoti function, set :

0x2200 = `2 - Keypad` AND

0x2201 = `-5 - Axia Speed Control`

0x2511 = `0x00251002 SRC: Speed Motorpoti`

If the motorpoti key is pressed or the digital input is set to `TRUE` for 1 second, the reference speed will increase/decrease by 120 rpm.

Fixed Reference Values

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2521	Fixed Speed 1	[rpm]	-35940	35940	0
...	...	...	...	...	...
0x2528	Fixed Speed 8	[rpm]	-35940	35940	0

Ramps

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2530	Acceleration Clockwise	[rpm/s]	0,1	600000	300
0x2531	Ramp Rise Time Clockwise	[s]	0,001	5	0,005
0x2532	Deceleration Clockwise	[rpm/s]	0,1	600000	300
0x2533	Ramp Fall Time Clockwise	[s]	0,001	5	0,005
0x2534	Acceleration Anticlockwise	[rpm/s]	0,1	600000	300
0x2535	Ramp Rise Time Anticlockwise	[s]	0,001	5	0,005
0x2536	Deceleration Anticlockwise	[rpm/s]	0,1	600000	300
0x2537	Ramp Fall Time Anticlockwise	[s]	0,001	5	0,005
0x2538	Reference Value Reached	[%]	0	100	1
0x2539	Reference Value Reached Time	[s]	0	0,1	0,005
0x253D	Quick Stop Ramp	[rpm/s]	0	600000	300

Timed Ramps

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x255B	Fixed Time Ramp Enable	[-]	Selection		
0x255C	Fixed Time Ramp Acceleration	[s]	0,1	30	1
0x255D	Fixed Time Ramp Deceleration	[s]	0	30	1
0x255E	Fixed Time Ramp Hysteresis	[rpm]	5	1000	10
0x255F	Ramp 1/2 Switch-Over	[-]	Selection		

Limits

Limitation of the reference values is done via parameters *Minimum Speed* **0x2301** and *Maximum Speed* **0x2300**.

Example:

1	**0x2200** = 1 – IOs	Inverter behavior shall be controlled via the IO interface.
2	**0x2201** = -5 – Axia Speed Control Mode	Inverter controls the motor rpm speed.
3	**0x2518** = 0 – Stop	Motor poti function not used.
4	**0x2104/1** = IN2D	Fixed Speed Change-Over assigned to Digital Input IN2D.
	0x2104/2 = IN3D	Fixed Speed Change-Over assigned to Digital Input IN3D.
	0x2104/3 = IN4D	Fixed Speed Change-Over assigned to Digital Input IN4D.
5	**0x2510** = Normal	Ref. Speed Op.-Mode is set to "Normal".
	0x2511– **0x2514** = De-fault	Speed reference sources are set to default values.
	0x253A = 1%	Switch-off threshold is set to the default value.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2521	Fixed Speed 1	-35940 rpm	35940 rpm	0.00 rpm
0x2522	Fixed Speed 2	-35940 rpm	35940 rpm	0.00 rpm
0x2523	Fixed Speed 3	-35940 rpm	35940 rpm	0.00 rpm
0x2524	Fixed Speed 4	-35940 rpm	35940 rpm	0.00 rpm
0x2525	Fixed Speed 5	-35940 rpm	35940 rpm	0.00 rpm
0x2526	Fixed Speed 6	-35940 rpm	35940 rpm	0.00 rpm
0x2527	Fixed Speed 7	-35940 rpm	35940 rpm	0.00 rpm
0x2528	Fixed Speed 8	-35940 rpm	35940 rpm	0.00 rpm

The Axia Speed Control mode also can be controlled via the **0x6040** *Control Word* and be monitored via the internal control word **0x4003** *Control Word (internal)* or **0x6041** *Status Word*.

The object **0x4003** is the internal status of the control word and can be used for troubleshooting or maintenance.

In Axia Speed Control mode, the mode-specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	Run clockwise
5	Run counter-clockwise
6	
7	Fault reset
8	Halt
9	
10	
11	Start Axis Positioning
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	Axis positioning active
9	Remote
10	Target reached
11	Internal limit active
12	Stop reached
13	
14	
15	

13.2.3 Axia Torque Control

The Axia torque control mode is selected via objects:

0x2200 = `1 - IOs` AND

0x2201 = `-4 - Axia Torque Control`

Relevant objects:

Index	Designation	Index	Designation
0x2310	Maximum Percentage	0x2549	Percentage Motor-Poti Ramp
0x2311	Minimum Percentage	0x2551-8	Fixed Percentage 1-8
0x2540	Operation Mode	0x2559	Percentage Ramp-Up Gradient
0x2541-4	Percentage Reference 1-4	0x255A	Percentage Ramp-Down Gradient
0x2548	Operation Mode		

Reference Configuration:

- **0x2541 - 0x2544** Percentage Reference

16.4 for details on how to use the fixed percentages.
16.6 for details on how to use percentage value ramps.
10.1.1 for details on how to configure the data set change-over, the motor potentiometer and for other related information.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2540	Operation Mode	[-]	Selection		
0x2541-4	Percentage Reference 1-4	[-]	Selection		

0x2541 - 0x2514 Percentage Reference source (value 1 to value 4)			
Entry Idx	**Designation**	**Entry Idx**	**Designation**
0x00000000	0 / null / false /none	0x00391090	SB RxPDO2 Single 0
0x0021A300	Simple Math 1 Output	0x00391091	SB RxPDO2 Single 1
0x0021A301	Simple Math 1 Output Inverted	0x003910E0	SB RxPDO3 Single 0
0x0021A310	Simple Math 2 Output	0x003910E1	SB RxPDO3 Single 1
0x0021A311	Simple Math 2 Output Inverted	0x0039AA00	PWM-Input 1 (X210.3)
0x0021A320	Simple Math 3 Output	0x003CA070/..7	PLC Out Float32 0/..7
0x0021A321	Simple Math 3 Output Inverted	0x00403200	Percentage Setpoint Ch.
0x0021A330	Simple Math 4 Output	0x00403202	Percentage Motorpoti
0x0021A331	Simple Math 4 Output Inverted	0x00403203	Percentage Analog In
0x0021F50E	CIP Process Ref	0x00403204	Percentage MFI Analog
0x00231200	PID Controller Output	0x00403205	Percentage PWM-Input
0x00391040	SB RxPDO1 Single 0	0x00403B00	Pos. Torque Limit
0x00391041	SB RxPDO1 Single 1		

0x2540 / 0x2548	Function
0 - Stop	Percentage channel deactivated
1 - Normal (Default)	Percentage reference shall be taken over as entered.
2 - Only Positive	Only absolute value of the percentage reference shall be taken over.
3 - Inverted	The inverted value of the percentage reference shall be taken over.

Motorpoti

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2548	Operation Mode	[-]	Selection		
0x2549	Percentage Motor-Poti Ramp	[%/s]	0	100	5

Fixed Reference Values

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2551-8	Fixed Percentage 1-8	[%]	-1000	1000	0; 10; 20;…; 100

Ramps

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2559	Percentage Ramp-Up Gradient	[%/s]	0	1000	0
0x255A	Percentage Ramp-Down Gradient	[%/s]	0	1000	0

Limits

Limitation of the reference values is done via parameters *Minimum Percentage* **0x2311** and *Maximum Percentage* **0x2310**.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2310	Maximum Percentage	[%]	0	1000	100
0x2311	Minimum Percentage	[%]	0	1000	0

The Axia Torque Control mode also can be controlled via the **0x6040** *Control Word* and be monitored via the internal control word **0x4003** *Control Word (internal)* or **0x6041** *Status Word*.

The object **0x4003** is the internal status of the control word and can be used for troubleshooting or maintenance.

In Axia Torque Control mode, the mode-specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	Run clockwise
5	Run counter-clockwise
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	
13	
14	
15	

13.3 CiA Modes of operation

Positioning is done in operation mode "Reference positioning" via the definition of the positioning distance or in operation mode "Axis positioning" via the definition of the position angle.

Reference positioning uses a digital reference signal from a selectable signal source for positioning the drive independent of the speed.

Axis positioning uses a digital reference signal from a speed sensor.

13.3.1 Profile Position Mode

Profile position mode can be selected via object 0x6060 Mode of operation = `1`.

In profile position mode the inverter receives a target position, followed by the command to travel to this target.

WARNING

Dangerous state due to new mode!

If 0x6060 mode of operation is changed during operation (control word = `0xnnnF`), a dangerous state may occur in the new mode.

- Before changing 0x6060 mode of operation, check the status word (e.g. for state `0xnn33`).

Relevant objects:

Index	Designation	Index	Designation
0x6040	Control word	0x6081	Profile velocity
0x6041	Status word	0x6083	Profile acceleration
0x6060	Mode of operation	0x6084	Profile deceleration
0x6061	Mode of operation display	0x6085	Quick stop deceleration
0x607A	Target position	0x60FF	Target Velocity

The ramp times are specified via object 0x6086 Motion Profile Type.

Options available:

`0 - Linear`

`1 - Predictive`

`2 - Speed forward`

`3 - Mono Spline`

In profile position mode, the mode-specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	New set-point
5	Change set immediately
6	Abs/rel
7	Fault reset
8	Halt
9	Change on set-point
10	
11	
12	
13	
14	
15	

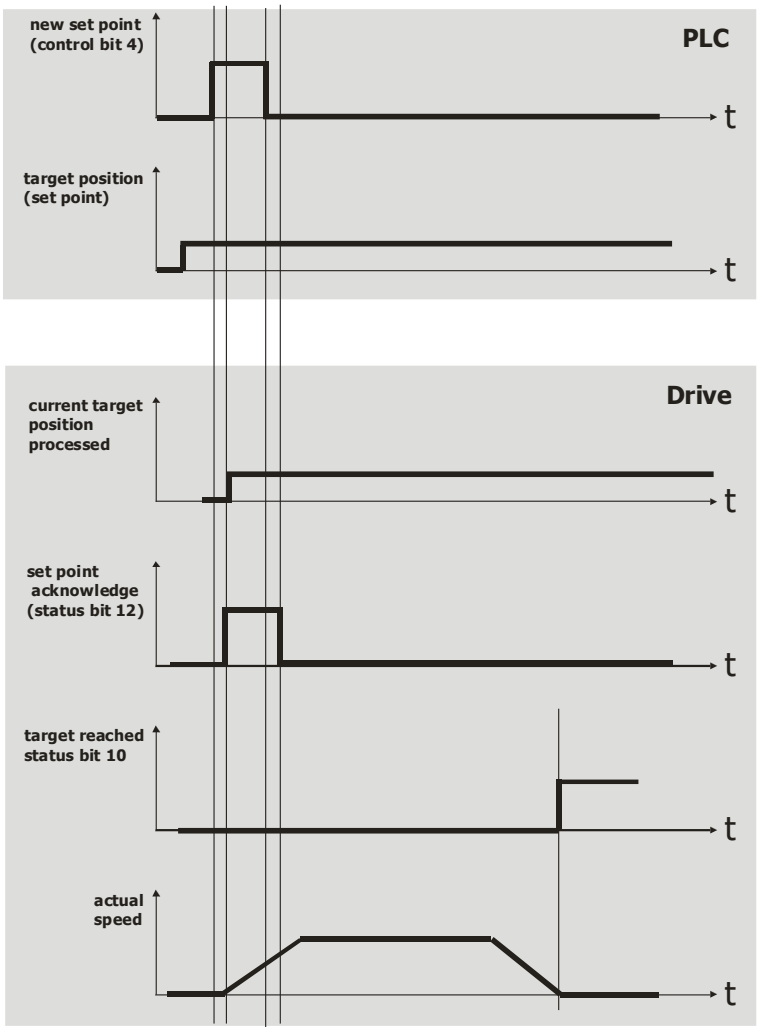
Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	Set-point acknowledge
13	Following error
14	
15	Warning 2

Example: single set-point

control bit change on set-point = 0

control bit change set immediately = 0

Once a reference value has been transmitted to the drive, the controller signals a permissible value in the control word by a rising signal edge for the bit "New set-point". The drive responds by setting the bit "Set-point acknowledge" and starts moving to the new vl target position. After that, the controller resets the bit "New set-point", and the drive resets the bit "Set-point acknowledge". Once the bit "Set-point acknowledge" has been reset, the drive is ready for receiving a new vl target position.

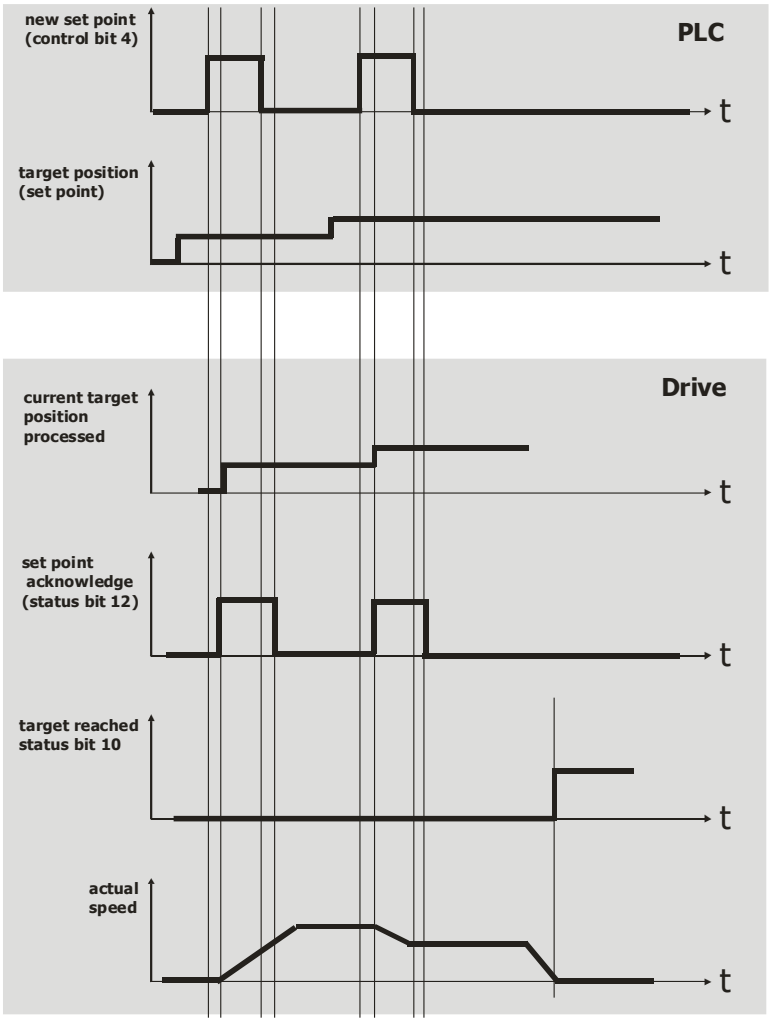


Example: single set-point

control bit change on set-point = 0

control bit change set immediately = 1

A new reference value is confirmed by the control bit "New reference value" (rising edge) while a reference value is being processed. The new reference value is processed immediately.



Example: set of set-points

control bit change on set-point = **0/1**

control bit change set immediately = **0**

The travel profile is changed during an active positioning operation.

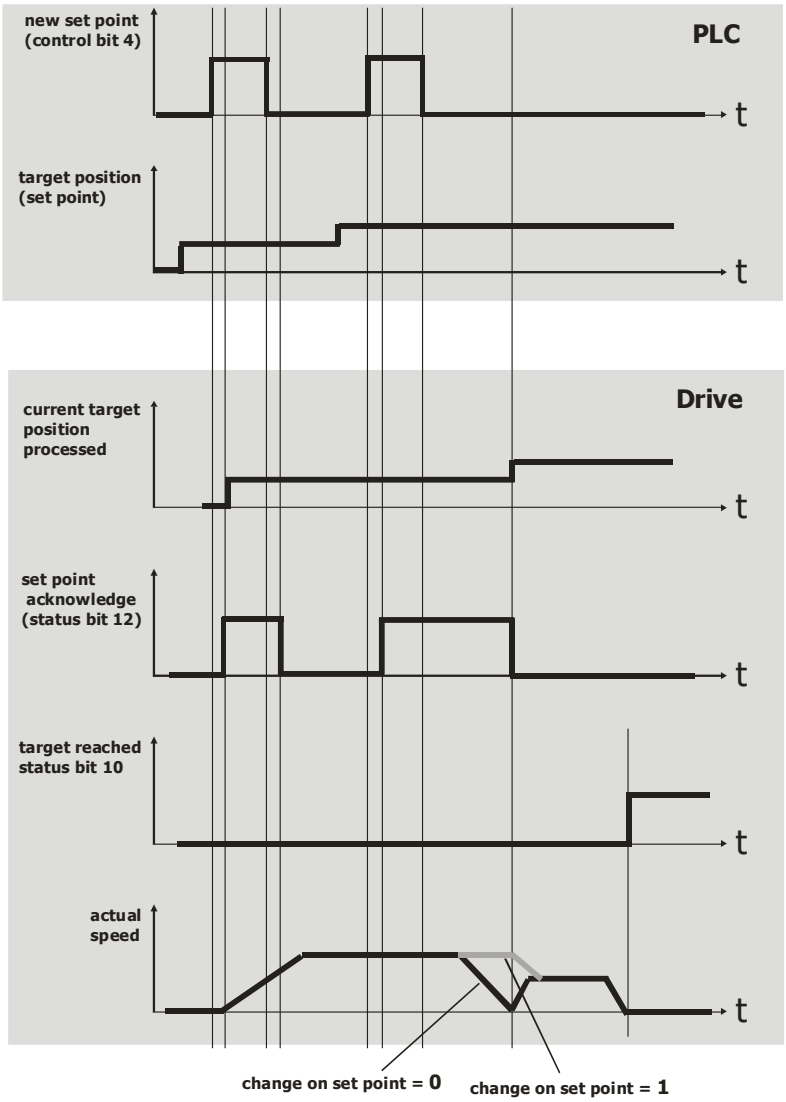
Change on set point = 0

The current target position is approached with a `Stop`. Once the position has been reached, the new reference value is set.

Change on set point = 1

The current target position is approached at the active speed. Once the current vl target position has been reached, the new reference value is applied without reducing the speed to zero.

The gray line in the segment "`Actual speed`" shows the speed behaviors when the control bit "`Switch at reference value`" is set to `1`.



Example Sequence

In order to start "Profile position mode", the correct sequence must be sent by the PLC.

1	Control word =	0x0000	Disable voltage
1	Status word =	0x0050	Activation disabled
2	Modes of Operation =	1	Profile position mode
3	Control word =	0x0006	Stop
	Status word =	0x0031	Ready for activation
4	Control word =	0x0007	Start
	Status word =	0x0033	Active
5	Control word =	0x0007 ↓ 0x000F	Enable operation. Positioning operation is not started.
	Status word =	0xnn37	Operation enabled
6a	Control word =	0x0007 or 0x000F → 0x001F	Operation enabled, start **absolute** positioning with profile[1)]. If a positioning operation is already in process, this operation will be completed. Then, the new profile will be used.

	Status word =	0xnn37	Operation enabled
6b	Control word =	0x0007 or 0x000F → 0x005F	Operation enabled, start **relative** positioning with profile[1]. If a positioning operation is already in process, this operation will be completed. Then, the new profile will be used.
	Status word =	0xnn37	Operation enabled
6c	Control word =	0x0007 or 0x000F → 0x003F	Operation enabled, start **absolute** positioning with profile[1]. Running positioning operations will change and apply the new profile
	Status word =	0xnn37	Operation enabled
6d	Control word =	0x0007 or 0x000F → 0x007F	Operation enabled, start **relative** positioning with profile[1]. Running positioning operations will change and apply the new profile
	Status word =	0xnn37	Operation enabled
7	Control word =	0x01nF	HALT: The drive is stopped with ramp 0x6049 *vl velocity deceleration*.
	Status word =	0xnn37	Operation enabled

[1]: A profile consists of the following entries. If a value is not changed, the old value remains active.

Control word

Change on set-point Bit 9	Change set-point immediately Bit 5	New set-point Bit 4	Designation
0	0	0 → 1	Once the sequence of the first four status words has been processed correctly, the Inverter is ready for operation (dark table area).
X	1	0 → 1	In state "operation enabled" (0xnnnF), the state of the Motion Control can be changed (white table area).
1	0	0 → 1	With control word transition from 0xnnnF to 0x0007, "Profile position mode" will be stopped. Then, the mode can be restarted via 0xnnnF.

Identification	Value	Designation
Abs/rel Bit 6	0	The target position is an absolute value
	1	The target position is a relative value
Halt Bit 8	0	Execute positioning operation.
	1	Stop axle with profile deceleration (if not supported by profile acceleration), the frequency inverter will remain in status "Operation enabled".

Status word

Identification	Value	Designation
Vl target reached Bit 10	0	Stop = 0:target position (still) not reached
		Stop = 1: Axis decelerated
	1	Stop = 0: target position reached
		Stop = 1: Speed of axis is 0
Set-point acknowledge Bit 12	0	The travel profile calculation has not applied the position value (yet).
	1	The travel profile calculation has applied the position value.
Following error Bit 13	0	No following error
	1	Following error

In order to start a profile, you don't have to set the control word to `0x0007` first before switching to `0xnnnF`.

Once a profile has been processed, a new profile can be started with the bit "New Setpoint" (bit 4) in control word = `0xnnnF`.

While a profile is being processed, you can start a new profile without stopping by using the bits "Change Setpoint immediately" (bit 5) and "New Setpoint" (bit 4).

13.3.2 Velocity Mode

Velocity mode can be selected via object 0x6060 *Mode of operation* = `2`.

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state `0xnn33`).

Motion Control Definition

For the full function of the Motion Control Interface, you will have to set **0x2200** *Control Mode* = "`3 - State-machine`". In all other operation modes of parameter **0x2200** *Control Mode*, there are major restrictions. The descriptions in this chapter and of all objects used are based on the setting **0x2200** *Control Mode* = "`3 - State-machine`".

The function of the state machine describes the basic operating behavior of the frequency inverter with position control. The objects **0x6040** *controlword* and **0x6041** *statusword* described above support the bits marked as operation mode-specific.

These bits and bit "`Target reached`" has different meanings in the different position control operation modes – defined by 0x6060 *mode of operation*. The following chapters describe the application of the operation mode specific bits in the **0x6040** *controlword* and **0x6041** *statusword*, depending on the different position control operation modes. Default value: 0x6060 *mode of operation* = `2 - velocity mode`.

Relevant objects:

0x6040	Control word
0x6041	Status word
0x6042	target velocity
0x6043	Velocity demand
0x6044	actual velocity
0x6060	Mode of operation
0x6061	Mode of operation display
0x25E7	Special Function Generator

Basic functions:

The state machine must be set to "`operation enabled`", before the position command can be issued via the operation mode specific bits of the **0x6040** *controlword*.

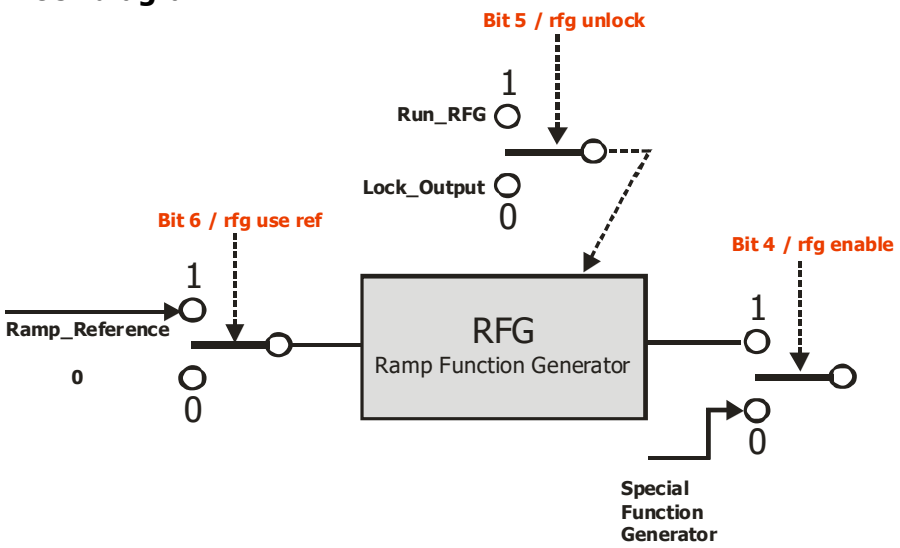
Once a `mode of operation` has been set by the PLC, no commands will be accepted for this operation mode until this operation mode is displayed in the **0x6061** *mode of operation display* object.

The bits in the **0x6040** *controlword* and **0x6041** *statusword* marked as operation mode-specific are only supported in configurations with position control.

Control word		Status word	
Bit		**Bit**	
0	Switch on	**0**	Ready to switch on
1	Enable voltage	**1**	Switched on
2	Quick stop (Low active)	**2**	Operation enabled
3	Enable operation	**3**	Fault
4	Rfg enable	**4**	Voltage enabled
5	Rfg unlock	**5**	Quick stop (Low Active)
6	Rfg use ref	**6**	Switch on disabled
7	Fault reset	**7**	Warning
8	Halt	**8**	
9		**9**	Remote
10		**10**	Target reached (not used)
11		**11**	Internal limit active
12		**12**	
13		**13**	
14		**14**	
15		**15**	Warning 2

In velocity mode, the "operation mode-specific" bits of the **0x6040** *controlword* control the ramp generator (RFG – Ramp Function Generator). The block diagram illustrates the function.

Block diagram



Bit 4/rfg enable

Rfg enable = 0 the reference speed comes from a manufacturer-specific special function.

Rfg enable = 1 The reference speed corresponds to the ramp output.

Bit 5/rfg unlock

Rfg unlock = 0 The last speed will be maintained and used.

Rfg unlock = 1 The ramp function is active and changes according to the reference value and the ramp.

Bit 6/rfg use ref

Rfg use ref = 0 Reference value "0" is used.

Rfg use ref = 1 The setpoint of 0x6042 *target Velocity* is used.

Bit 8 Halt

HALT = 0 → Execute positioning.

HALT = 1 → Stop axis. (The frequency inverter remains enabled in "Operation enabled" state.)

Example Sequence

In order to start "velocity mode", the correct sequence must be sent by the PLC.

1	Control word =	0x0000	Disable voltage
1	Status word =	0x0050	Switch On Disabled
2	Mode of operation =	2	(Velocity mode)
3	Control word =	0x0006	Shutdown
	Status word =	0x0031	Ready to switch on
4	Control word =	0x0007	Switch On
	Status word =	0x0033	Switched On
5	Control word =	0x000F	Enable Operation, no change to previous state if already enabled.
	Status word =	0xnn37	Operation enabled
6a	Control word =	0x007F	Start Velocity mode with Reference speed from object 0x6042 *vl* target velocity.
	Status word =	0xnn37	Operation enabled
6b	Control word =	0x006F	Start "Velocity mode" with reference value from Object 0x6042 *vl* target velocity.
	Status word =	0xnn37	Operation enabled
6c	Control word =	0x003F	Starts "Velocity mode" with reference value "0".
	Status word =	0xnn37	Operation enabled
6d	Control word =	0x002F	Starts "Velocity mode" with reference value "0".
	Status word =	0xnn37	Operation enabled
6e	Control word =	0x005F	Starts "Velocity mode" at current speed – current ramps will be canceled.
	Status word =	0xnn37	Operation enabled
6f	Control word =	0x004F	Starts "Velocity mode" with actual speed – a running ramp is interrupted.
	Status word =	0xnn37	Operation enabled
7	Control word =	0x01xx	HALT: The drive is stopped with ramp 0x6049 *vl velocity deceleration*.
	Status word =	0xnn37	Operation enabled

13.3.3 Profile Velocity Mode

The profile velocity mode can be selected via object 0x6060 *Mode of operation* = 3.

In profile velocity mode the inverter receives a reference speed in [u/s].

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

Relevant objects

0x6040	Control word
0x6041	Status word
0x6060	Mode of operation
0x6061	Mode of operation display
0x606C	Velocity Actual value
0x606D	Velocity Window
0x606E	Velocity Window Time

0x606F	Velocity Threshold
0x6070	Velocity Threshold Time
0x6083	Profile acceleration
0x6084	Profile deceleration
0x6085	Quick stop deceleration
0x6086	Motion Profile Type
0x60F8	Max Slippage
0x60FF	Target Velocity

The ramp times are specified via object 0x6086 Motion Profile Type.

Options available:

0 – Linear

1 – Predictive

2 – Speed forward

3 – Mono Spline

In profile velocity mode, the operation mode specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	
5	
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	Velocity
13	Max Slippage
14	
15	Warning 2

The Profile Velocity Mode is used to set the reference speed in user units [u/s]. The reference speed 0x60FF *Target Velocity* is taken over in mode "operation enabled" immediately (0xnn37). The acceleration and deceleration ramp are specified by objects 0x6083 *Profile acceleration* and 0x6084 *Profile deceleration*.

Setting Bit 8 "Halt" of the control word delays the drive with ramp 0x6084 *Profile deceleration* and holds the drive at standstill. Resetting Bit 8 results in an acceleration with ramp 0x6083 *Profile acceleration* to the actual reference velocity.

Control word Bit 8: Halt

HALT = 0 → Execute Profile Velocity Mode.

HALT = 1 → Halt Axis. (The Frequency inverter remains in state "Operation enabled".)

The actual velocity in [u/s] can be displayed in a PLC via map able Object 0x606D.

Via Objects 0x606D *Velocity Window* and 0x606E *Velocity Window time* Bit 10 "Target reached" of the status word is set.

Via Objects 0x606F *Velocity Threshold* and 0x6070 *Velocity Threshold time* Bit 12 "Velocity" of the status word is set.

Via Object 0x60F8 *Max Slippage* a slip monitoring via Bit 13 "Max Slippage" of the status word can be set up.

Status word Bit 10: Target reached

Target reached = 0

→ The actual velocity does not match the reference velocity.

Target reached = 1

→ The actual velocity matches the reference velocity.

The actual velocity differs at least from the defined time period in object 0x606E *Velocity Window time* up to the defined amount [us] in Object 0x606D *Velocity Window*.

Status word Bit 12: Velocity

Velocity= 0

→ The Actual Velocity matches the comparison speed.

The Actual Velocity has exceeded for a defined time (Object 0x6070 *Velocity Threshold time*) a defined Velocity in user units per seconds [u/s] (Object 0x606F *Velocity Threshold*) .

Velocity= 1

→ The Actual Velocity does not match the Comparison Velocity.

Status word Bit 13: Maximum Slippage

Maximum Slippage = 0

→ The actual Slippage speed is smaller than defined. The comparison value of the slippage speed is defined Object 0x60F8 *Max Slippage*.

Maximum Slippage = 1

→ The actual Slippage speed is bigger than defined. The comparison value of the slippage speed is defined Object 0x60F8 *Max Slippage*.

Once the sequence of the first four status words has been processed correctly, the Inverter is ready for operation (dark table area).

In state "operation enabled" (`0xnnnF`), the state of the Motion Control can be changed (white table area).

With control word transition from `0xnnnF` to `0x0007`, "Profile position mode" will be stopped. Then, the mode can be restarted via `0xnnnF`.

While `0x0007` is active, it is also possible to change the mode of operation without any danger. After changing 0x6060 *mode of operation* to another value you can start the new operation mode with the according sequence.

Example Sequence

To start the Profile Velocity mode, the correct sequence has to be sent from the PLC.

1	Control word =	0x0000	Disable voltage
1	Status word =	0x0050	Switch On Disabled
2	Modes of Operation =	3	(Profile Velocity mode)
3	Control word =	0x0006	Shutdown
	Status word =	0x0031	Ready to switch on
4	Control word =	0x0007	Switch On
	Status word =	0x0033	Switched On
5	Control word =	0x0007 ↓ 0x000F	Enable Operation, no change to previous state if already enabled. The Profile Velocity mode is started with reference velocity 0x60FF *Target Velocity* and Ramp profile 0x6084 *Profile acceleration* and 0x6084 *Profile deceleration*. Changes to Target Velocity and Ramps are taken over immediately.
	Status word =	0xnn37	Operation enabled

1) A profile consists of the following entries. If a value is not changed, the old value will still be active.

13.3.4 Profile Torque Mode

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

The torque profile mode can be selected via **0x6060** *Mode of operation* = −4.

In the torque mode the inverter receives the target torque value, which it then operates at according to further settings, such as 12.3.2.

NOTICE

Unexpected dynamic behavior

If torque control is activated while the torsional frequency is outside the range between *Torque Limit Mot. Oper.* **0x2269** and *Torque Limit Gen. Oper.* **0x226A**, (e.g. when a machine is started from standstill or a quickly rotating machine is stopped quickly), the permissible torque range will be approached without ramps by means of the speed/torque controller. In this case, the torque is only limited by the limitations of the speed controller (current and torque). For this reason, there may be unexpected dynamic behavior.

Motion Control Definition

For the full function of the Motion Control Interface, you will have to set **0x2200** *Control Mode* = "3 - State-machine". In all other operation modes of parameter **0x2200** *Control Mode*, there are major restrictions. The descriptions in this chapter and of all objects used are based on the setting **0x2200** *Control Mode* = "3 - State-machine".

Relevant objects:

0x6040	Control word
0x6041	Status word
0x6071	target torque
0x6077	Torque actual value
0x6060	Mode of operation
0x6061	Mode of operation display

13.3.5 Homing Mode

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

Homing mode can be selected via object 0x6060 Mode of operation = 6. In homing mode, the frequency inverter moves the drive to a reference position. The method used for this movement is defined by parameter 0x6098 homing method.

Relevant objects:

0x6040	Control word
0x6041	Status word
0x6060	Mode of operation
0x6061	Mode of operation display
0x6098	Homing method
0x6099	Homing speeds
0x609A	Homing acceleration

In homing, the mode-specific bits of the control word and the status word are used as follows:

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	Homing operation start
5	
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	Homing attained
13	Homing error
14	
15	Warning 2

Control word

Identification	Value	Designation
Homing operation start **Bit 4**	0	Homing not active
	0 → 1	Start homing
	1	Homing active
	1 → 0	Stop homing
Halt **Bit 8**	0	Execute command from bit 4 "Start homing"
	1	Stop axis with acceleration value (as deceleration) for homing. (The frequency inverter remains enabled in "Operation enabled" status.)

Status word

Identification	Value	Designation
Vl target reached **Bit 10**	0	Stop = 0: Home position (still) not reached
		Stop = 1: Axle decelerated
	1	Stop = 0: Home position reached
		Stop = 1: Axle has speed 0
Homing attained **Bit 12**	0	Homing not completed yet
	1	Homing completed successfully
Homing error **Bit 13**	0	No homing error
	1	Homing error occurred, homing not completed successfully

Once the sequence of the first four status words has been processed correctly, the Inverter is ready for operation (dark table area).

In state "operation enabled" (`0xnnnF`), the state of the Motion Control can be changed (white table area).

With control word transition from `0x0007` (or `0x000F`) to `0x001F` the homing operation is started. Bit "Homing attained" (Bit 12) returns the status in the status word.

As long as `0x0007` is active, the mode of operation can also be changed safely. Once `mode of operation` has been set to another value, operation can be started with a corresponding sequence.

Example Sequence

In order to start "homing mode", the correct sequence must be sent by the PLC.

1	Control word =	0x0000	Disable voltage
1	Status word =	0x0050	Switch On Disabled
2	Mode of operation =	6	(Homing)
3	Control word =	0x0006	Shutdown
	Status word =	0x0031	Ready to switch on
4	Control word =	0x0007	Switch On
	Status word =	0x0033	Switched On
5	Control word =	0x000F	Enable Operation.
	Status word =	0xnn37	Operation enabled
6a	Control word =	0x001F	Enable Operation and start Homing.
	Status word =	0x1n37	Operation enabled and homing attained.

13.3.6 Cyclic Sync Position Mode

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

Always ensure that a valid Position is contained in "Target Position". It is recommended to copy the Actual Position into the "Target Position" before starting.

The Cyclic Synchronous position mode is selected via object 0x6060 *Mode of operation* = `8`. In this mode the inverter receives a target position at equidistant time intervals.

Relevant objects:

0x6040	Controlword
0x6041	Statusword
0x6060	Mode of operation
0x6061	Mode of operation display
0x607A	Target Position
0x6085	Quick stop deceleration

In `Cyclic Synchronous position mode` only the 4 lowest bits are used for control.

Control word	Status word

Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	
5	
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	
11	Internal limit active
12	Target Position ignored
13	Following error
14	
15	Warning 2

Status word

Identification	Value	Designation
Target position ignored **Bit 12**	0	Target Position is ignored.
	1	Target Position is used as Reference value.
Following error **Bit 13**	0	No following error
	1	Following error

No ramp limits are active in the frequency inverter. Limit the dynamic actions by the PLC as suitable.

- Before the Start, copy the actual position from **0x6064** to the target position in the PLC.
- Start the Control Sequence in the PLC (0x0, 0x6, 0x7, 0xF).
- Wait until in the Status word, Bit 12, is active.
- Now update the target Position in the PLC program.

Once the sequence of the first four status words has been processed correctly, the Inverter is ready for operation (dark table area).

In state "operation enabled" (`0xnnnF`), the state of the Motion Control can be changed (white table area).

With control word transition from `0x0007` (or `0x000F`) to `0x001F` the homing operation is started. Bit "Homing attained" (Bit 12) returns the status in the status word.

As long as `0x0007` is active, the mode of operation can also be changed safely. Once `mode of operation` has been set to another value, operation can be started with a corresponding sequence.

Example Sequence

To start "Cyclic synchronous position mode", the correct sequence has to be sent from the PLC.

1	Control word =	0x0000	Disable voltage
1	Status word =	0x0050	Switch On Disabled
2	Mode of operation =	8	(Cyclic synchronous position mode)
3	Control word =	0x0006	Shutdown
	Status word =	0x0031	Ready to switch on
4	Control word =	0x0007	Switch On
	Status word =	0x0033	Switched On
5	Control word =	0x000F	Enable Operation.
	Status word =	0xnn37	Operation enabled

13.3.7 Cyclic Sync Velocity Mode

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

The Cyclic Synchronous Velocity mode is selected via object 0x6060 Mode of operation = 9. In this mode the inverter receives a reference speed in equidistant time intervals.

Relevant objects:

0x6040	Controlword
0x6041	Statusword
0x6060	Mode of operation
0x6061	Mode of operation display
0x6085	Quick stop deceleration
0x60FF	Target Velocity

In the Cyclic Synchronous velocity mode only the 4 lowest bits are used for control.

Control word		Status word	
Bit		**Bit**	
0	Switch on	**0**	Ready to switch on
1	Enable voltage	**1**	Switched on
2	Quick stop (Low active)	**2**	Operation enabled
3	Enable operation	**3**	Fault
4		**4**	Voltage enabled
5		**5**	Quick stop (Low Active)
6		**6**	Switch on disabled
7	Fault reset	**7**	Warning
8	Halt	**8**	
9		**9**	Remote
10		**10**	
11		**11**	Internal limit active
12		**12**	Drive follows reference value
13		**13**	
14		**14**	
15		**15**	Warning 2

Status word

Identification	Value	Designation
Drive follows reference value	0	Drive does not follow the reference value.
Bit 12	1	Drive follows the reference value.
Following error	0	No following error
Bit 13	1	Following error

No ramp limits are active inside the frequency inverter. Limit the dynamic actions suitable by the PLC.

- Start the Control Sequence in the PLC (0x00, 0x06, 0x07, 0x0F).
- Wait until in the Status word Bit 12 is active.
- Now update the Reference speed in the PLC program.

Example Sequence

To start "Cyclic Synchronous Velocity mode", the correct sequence has to be sent from the PLC.

1	Control word = Status word =	0x0000	0x0050	Disable voltage Switch On Disabled
2	Mode of operation =	9		(Cyclic Synchronous Velocity mode)
3	Control word = Status word =	0x0006	0x0031	Shutdown Ready to switch on
4	Control word = Status word =	0x0007	0x0033	Switch On Switched On
5	Control word = Status word =	0x000F	0xnn37	Enable Operation. Operation enabled

After the sequence of the first four Control word s was processed correctly, the Inverter is enabled (dark marked table area).

With the control word transition from `0xnnnF` to `0x0007` the "Cyclic Synchronous Velocity mode" is stopped. After that it is possible to start again with `0xnnnF`.

While `0x0007` is active, it is also possible to change the mode of operation without any danger. After changing 0x6060 mode of operation to another value you can start the new operation mode with the according sequence.

13.3.8 Cyclic Sync Torque Mode

WARNING

Dangerous state due to new mode!

If 0x6060 *mode of operation* is changed during operation (control word = 0xnnnF), a dangerous state may occur in the new mode.

- Before changing 0x6060 *mode of operation*, check the status word (e.g. for state 0xnn33).

The Cyclic Synchronous Torque mode is selected via object 0x6060 Mode of operation = `A`. In this mode the inverter receives a reference torque in equidistant time intervals.

Relevant objects:

0x6040	Controlword
0x6041	Statusword
0x6060	Mode of operation
0x6061	Mode of operation display
0x6085	Quick stop deceleration
0x6071	Target Torque

In the Cyclic Synchronous Torque mode only the 4 lowest bits are used for control.

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	
5	
6	
7	Fault reset
8	Halt
9	
10	
11	
12	
13	
14	
15	

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	
9	Remote
10	
11	Internal limit active
12	Drive follows reference value
13	
14	
15	Warning 2

Status word

Identification	Value	Designation
Drive follows reference value	0	Drive does not follow the reference value.
Bit 12	1	Drive follows the reference value.
Following error	0	No following error
Bit 13	1	Following error

No ramp limits are active inside the frequency inverter. Limit the dynamic actions suitable by the PLC.

- Start the Control Sequence in the PLC (0x00, 0x06, 0x07, 0x0F).
- Wait until in the Status word Bit 12 is active.
- Now update the Reference speed in the PLC program.

Example Sequence

To start "Cyclic Synchronous Torque mode", the correct sequence has to be sent from the PLC.

1	Control word =	0x0000		Disable voltage
1	Status word =		0x0050	Switch On Disabled
2	Mode of operation =	A		(Cyclic Synchronous Torque mode)
3	Control word =	0x0006		Shutdown
	Status word =		0x0031	Ready to switch on
4	Control word =	0x0007		Switch On

	Status word =	0x0033	Switched On
5	Control word =	0x000F	Enable Operation.
	Status word =	0xnn37	Operation enabled

After the sequence of the first four Control word s was processed correctly, the Inverter is enabled (dark marked table area).

With the control word transition from `0xnnnF` to `0x0007` the "Cyclic Synchronous Torque mode" is stopped. After that it is possible to start again with `0xnnnF`.

While `0x0007` is active, it is also possible to change the mode of operation without any danger. After changing 0x6060 mode of operation to another value you can start the new operation mode with the according sequence.

14 Add-On Functions

14.1 Brake Chopper

The frequency inverters may feature an internal brake chopper with brake resistor. An external brake resistor must be connected to terminals Rb1 and Rb2.

The settings of the brake chopper and the motor chopper may influence each other. Keep this in mind when setting the respective object values.

The following objects configure the functioning of the brake chopper.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3948/1	Activate Brake Chopper	[-]		Selection	
0x3948/2	Trigger Threshold	[V]	620	800	750
0x3948/6	Only Active in Operation	[-]		Selection	

Source choice list for 0x3948/1, 0x3948/6	
0x00000000	SRC: 0 / null / false / none
0x00000000	SRC: 0 / null / false / none
0x00000001	SRC: true
0x00205000	SRC: Brake Command
0x00205001	SRC: Brake Status
0x00210001	SRC: STO
0x00210021	SRC: STO inv.
0x0021A000	SRC: Timer 1 Output
0x0021A001	SRC: Timer 1 Output Inv.
0x0021A010	SRC: Timer 2 Output
0x0021A011	SRC: Timer 2 Output Inv.
0x0021A020	SRC: Timer 3 Output
0x0021A021	SRC: Timer 3 Output Inv.
0x0021A030	SRC: Timer 4 Output
0x0021A031	SRC: Timer 4 Output Inv.
0x0021A100	SRC: Comparator 1 Output
0x0021A101	SRC: Comparator 1 Output Inv.
0x0021A110	SRC: Comparator 2 Output
0x0021A111	SRC: Comparator 2 Output Inv.
0x0021A120	SRC: Comparator 3 Output
0x0021A121	SRC: Comparator 3 Output Inv.
0x0021A130	SRC: Comparator 4 Output
0x0021A131	SRC: Comparator 4 Output Inv.
…	…

10.2 for full list.

The operator is required to ensure that the chosen values are appropriate for the particular drive system and suitable for the intended purposes.

The manufacturer recommends the following formula for the calculation of suitable parametrization:

$$U_{grid} * 1{,}1 * \sqrt{2} < U_{dBC} < U_{dmax}$$

The object **0x3948/1** *Activate Brake Chopper* defines the source for the activation signal of the brake chopper function. In most cases, this function is active by default. The object **0x3948/2** *Trigger Threshold* defines the voltage limit for the DC link voltage, above

which the brake chopper operation is triggered. The object **0x3948/6** *Only Active in Operation* is used when it is required to restrict the activation of the brake chopper to the times when the inverter is released and active. Otherwise, the brake chopper will be activated even when the inverter is not in operation at the moment.

14.2 Motor Chopper

The frequency inverters may feature a motor chopper function. The motor chopper function provides parameters for dissipating the rising voltage in the DC link as heat inside the connected motor(s). This allows dynamic speed changes at minimum system costs.

The settings of the brake chopper and the motor chopper may influence each other. Keep this in mind when setting the respective object values.

The operator is required to ensure that the chosen values are appropriate for the particular drive system and suitable for the intended purposes.

The manufacturer recommends the following formula for the calculation of suitable parametrization:

$$U_{grid} * 1{,}1 * \sqrt{2} < U_{dMC} < U_{dmax}$$

The following objects configure the functioning of the motor chopper.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x420E/4	Activate Motor Chopper	[-]	Selection, 10.2 for full list		
0x22A0	Trigger Threshold	[V]	624	1000	750
0x22A1	Maximum Current	[A]	0	59,11	29,56
0x22A2	Excitation Frequency	[Hz]	0	3	0,1666
0x22A3	Amplification	[-]	0	1000	1
0x22A4	Relative Excitation	[-]	0	10	0

14.3 Intelligent Current Limits

The function extends the current controller available in the control system. The specified overload reserve of the frequency inverter can be utilized using the intelligent current limits, particularly in applications with dynamic load changes. The selection in the object **0x2325/1** *Operation Mode* defines the criteria for the intelligent current limit. The object **0x2326** *Power Limit* sets the percentage threshold for the criteria chosen in the object **0x2325/1** *Operation Mode* (e.g. **0x2325/1** = `0x00000011` means 80 % of the max. heat sink temperature Tc AND current overload Ixt of the inverter). The object **0x2327** *Limitation Time* defines the duration of the limitation.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2325/1	Operation Mode	[-]	Selection		
0x2326	Power Limit	[%]	40	95	80
0x2327	Limitation Time	[min]	5	300	15

Selection choice list for 0x2325/1	
0x00000000	Off
0x00000001	Ixt
0x00000010	Tc
0x00000011	Tc + Ixt

Selection choice list for 0x2325/1	
0x00000020	Motortemp
0x00000021	Motortemp + Ixt
0x00000030	Motortemp + Tc
0x00000031	Motortemp + Tc + Ixt

14.4 Axis Positioning

WARNING

Personal injury or material damage possible

During the positioning operation, the direction of rotation of the drive may change, regardless of the general direction of rotation definition.

- Make sure that the change of the direction of rotation cannot result in any personal or material damage.

For axle positioning, a speed feedback system is required. The positioning is started if a start signal is received (**0x2101/16** *Start Axis Positioning* 10.1.1) and the speed drops below an adjustable **0x25FD** *Speed Threshold*. The machine stops with the selected stopping behavior at the defined "Reference Orientation". The speed for the adjustment of the orientation is defined in object **0x25FB** *Homing Speed*.

To ensure the correct function of the axis positioning, the speed controller should be optimized after the guided commissioning.

Via **0x25FE**, the permissible max. deviation from the **0x25FA** *Reference orientation* can be set. The object **0x25FF** *Target Window Time* sets for how long the **0x25FE** *Target Window* has to be maintained by the drive.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x25FA	Reference Orientation	[deg]	0	359,9	0
0x25FB	Homing Speed	[rpm]	0	35940	60
0x25FC	Position Direction	[-]	Selection		
0x25FD	Speed Threshold	[rpm]	0	35940	1500
0x25FE	Target Window	[deg]	0	180	1
0x25FF	Target Window Time	[s]	0	30	0,01

Selection choice list for 0x25FC	
0x00000000	Optimized
0x00000001	Clockwise
0x00000002	Counter-Clockwise

14.5 PID Controller

The PID controller operates based on three main components: proportional, integral, and derivative control. The PID controller combines these three components by summing their outputs to calculate and adjust the control effort in real-time. The result is a refined control signal that strives to minimize the deviation between the process variable and the desired setpoint.

Proportional Control (P): In proportional control, the controller generates a control output proportional to the difference between the measured process variable and the desired setpoint. The proportional gain determines this relationship. A higher gain increases the controller's response to any deviation, resulting in a faster correction but potentially

introducing overshoot. The object **0x2315** *Amplification* sets the value for the proportional control component.

Integral Control (I): The integral control component calculates and accumulates the cumulative error between the measured value and the setpoint over time. By integrating the error, the controller reduces and eliminates steady-state errors that cannot be corrected by proportional control alone. The integral gain determines the response speed and magnitude of the correction applied over time. However, excessive integral gain may lead to instability. The object **0x2316** *Integral Time* sets the timespan for the integral control component.

Derivative Control (D): The derivative control component anticipates future trends in the error by calculating the rate of change. It aims to dampen the system's response to changes in the error signal. The derivative gain determines the weight given to the rate of change and helps in reducing overshoot and response time. However, implementing derivative control alone can amplify sensor noise or introduce instability. The object **0x2317** *Derivative Time* sets the timespan for the integral control component.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2312	PID Fixed Percentage Setpoint	[-]	-1000	1000	0
0x2313	PID Setpoint Source	[-]	Selection		
0x2314	PID Actual Value Source	[-]	Selection		
0x2315	Amplification	[-]	-15	15	0,2
0x2316	Integral Time	[s]	0	30	0,0007
0x2317	Derivative Time	[s]	0	10	0
0x2318	Output Limiter max.	[%]	0	1000	100
0x2319	Output Limiter min.	[%]	-1000	0	-100
0x2320	Back Calculation Gain	[-]	0	100	1
0x2321	PID Operation Mode	[-]	Selection		
0x2322	Output Factor Custom Setup	[-]	-1000	1000	1
0x2323	PID Reset	[-]	Selection		

14.6 Electronic Gear

The function "Electronic Gear" emulates a geared transmission without mechanical transmission elements such as shafts or clutches. To be able to use this function, you have to use at least two inverters interconnected via a suitable fieldbus (e.g. Systembus or CANopen bus). One of the interconnected inverters must be configured as the sync master inverter (9.2), allowing it to transfer input reference values to the slave inverter. The other inverter(s) must be correctly configured as slave inverters for this function to work properly.

Via the "Phasing" objects, you can correct/adjust the axis offset of the slave inverter(s) relative to the master inverter.

The function activates via a signal from a source chosen in object **0x4231** *Gearing Enable*. The object **0x4233/1** *Master Position Source* defines the source for the position signal of the master inverter.

The speed reference is set up in the master inverter. The slave inverter follows the master inverter based on the values set in the following objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2561	Gear Factor Numerator	[-]	-1000	1000	1
0x2562	Gear Factor Denominator	[-]	1	1000	1
0x2566	Phasing Offset	[u]	-2147483	2147483	0
0x2567	Phasing Speed	[u/s]	1	2147483	65536
0x2568	Phasing Acceleration	[u/s²]	1	2147483	65536
0x4231	Gearing Enable	[-]	Selection		
0x4233/1	Master Position Source	[-]	Selection		

Source choice list for 0x4231	
0x00000000	SRC: 0 / null / false / none
0x00000000	SRC: 0 / null / false / none
0x00000001	SRC: true
0x00205000	SRC: Brake Command
0x00205001	SRC: Brake Status
0x00210001	SRC: STO
0x00210021	SRC: STO inv.
0x00211004	SRC: MFAI 1 PTC (X4X2)
0x0021A000	SRC: Timer 1 Output
0x0021A001	SRC: Timer 1 Output Inv.
0x0021A010	SRC: Timer 2 Output
0x0021A011	SRC: Timer 2 Output Inv.
0x0021A020	SRC: Timer 3 Output
0x0021A021	SRC: Timer 3 Output Inv.
0x0021A030	SRC: Timer 4 Output
0x0021A031	SRC: Timer 4 Output Inv.
0x0021A100	SRC: Comparator 1 Output
0x0021A101	SRC: Comparator 1 Output Inv.
0x0021A110	SRC: Comparator 2 Output
0x0021A111	SRC: Comparator 2 Output Inv.
0x0021A120	SRC: Comparator 3 Output
0x0021A121	SRC: Comparator 3 Output Inv.
0x0021A130	SRC: Comparator 4 Output
0x0021A131	SRC: Comparator 4 Output Inv.
…	…
	10.2 for full list.

Selection list for 0x4233/1	
0x00000001	Off
0x00000002	Enc. Module Slot X432
0x00000003	Enc. Module Slot X412
0x00000004	Enc. Module Slot X422
0x00000005	HTL Encoder via X210
0x00000006	RxPDO1 DWORD 1
0x00000007	RxPDO1 DWORD 2
0x00000008	RxPDO2 DWORD 1
0x00000009	RxPDO2 DWORD 2
0x0000000A	RxPDO3 DWORD 1
0x0000000B	RxPDO3 DWORD 2

The following formula helps with determining the needed gear factor:

$$Gear\ Factor = \frac{Gear\ Factor\ Numerator\ 0x2561}{Gear\ Factor\ Denominator\ 0x2562}$$

14.7 Predictive Maintenance

The predictive maintenance subsection refers to the predictive maintenance of the gearbox. You can activate/deactivate the model using the object **0x2580/1** *Enable Model*. The source for the ambient temperature input is set in the object **0x2580/4** *Ambient Temp. Input*. The object **0x2580/5** *Eta* sets a factor for the gearbox.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2580/1	Enable Model	[-]	FALSE	TRUE	FALSE
0x2580/4	Ambient Temp. Input	[-]	Selection		
0x2580/5	Eta	[-]	0	10	0

15 Error behavior and warning behavior

Operation of the frequency inverter and the connected load are monitored continuously. The monitoring functions must be parameterized with the corresponding limit values specific to the application. If the limits were set below the switch-off limit of the frequency inverter, an error switch-off can be prevented by suitable measures if a warning message is issued.

Some objects are only accessible in higher access levels ("Advanced" and above).

15.1 Inverter Error and Warning Behavior

15.1.1 Temperature

You can configure several parameters to set the error and warning behavior regarding the inverter internal temperature:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2400	Warning Threshold Heat Sink	[°C]	-25	0	-5
0x2406	Over Temp. Threshold IGBT	[°C]	120	180	145
0x2425	Freq. Red. Timing Hysteresis	[-]	0	86400	60
0x3C00/1	Warning Threshold Interior	[°C]	-25	0	-5
0x3C00/2	Warning Threshold PCB	[°C]	-25	0	-5
0x3C00/3	Warning Threshold Capacitor	[°C]	-25	0	-5
0x3C00/4	Warning Threshold Hysteresis	[°C]	0	20	5
0x3C00/5	Error Threshold Hysteresis	[°C]	0	20	5
0x3C00/6	Heat Sink Fan Switch On	[°C]	0	100	55
0x3C00/7	Heat Sink Fan Hysteresis	[°C]	0	20	5
0x3C00/8	Heat Sink Fan Max. Speed	[°C]	0	100	80
0x3C00/9	Interior Fan Switch On	[°C]	0	100	40
0x3C00/10	Interior Fan Max. Speed	[°C]	0	100	50
0x3C00/11	Interior Fan Hysteresis	[°C]	0	20	5
0x3C00/12	Temperature Filter Time	[s]	0	60	10

15.1.2 Overload Ixt

The admissible load behavior depends on various technical data of the frequency inverters and the ambient conditions.

The selected *Switching Frequency* **2209/1** defines the rated current and the available overload for one second and sixty seconds, respectively. The *Ixt Short Term Threshold* **0x2405/2** and *Ixt Long Term Threshold* **0x2405/1** must be parameterized accordingly.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2405/1	Ixt Long Term Threshold	[%]	0	100	75
0x2405/2	Ixt Short Term Threshold	[%]	0	100	80
0x2407	Operation Mode Ixt	[-]	Selection		

Operation Mode Ixt 0x2407	
0x00000001	Use Ixt
0x00000002	Use Thermal Model

15.1.3 DC Link voltage

The voltage limits in the DC link are set in the following objects:

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3C01/1	Udc Warning Lower Limit	[V]	0	800	400
0x3C01/2	Udc Warning Upper Limit	[V]	0	800	700
0x3C01/3	Udc Warning Threshold Hys.	[V]	8	50	8
0x3C01/4	Udc Error Threshold Hys.	[V]	0	50	8

15.1.4 Supply Voltage

You can configure the monitoring of external 24V DC to activate any of the output signals listed below.

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x3C02	External 24V DC Monitoring	[-]	Selection		

External 24V DC Monitoring 0x3C02			
0x00000000	0 / null / false /none	0x00394001	S1IND (X210.3, X210.1)
0x00000001	true	0x00394002	S2IND (X210.5, X210.3)
0x0021A020	STO	0x00394003	S3IND (X210.7, X210.5)
0x0021A021	STO Inverted	0x00394004	S4IND (X210.4, X210.7)
0x00211004	MFAI 1 PTC (X4X2)		
0x0021A000	Timer 1 Output	0x00394005	S5IND (X210.6, X210.2)
0x0021A001	Timer 1 Output Inverted	0x00394006	S6IND (X210.8, X210.4)
0x0021A010	Timer 2 Output	0x00394007	S7IND (N/A, X210.6)
0x0021A011	Timer 2 Output Inverted	0x00394008	S8IND (N/A, X210.8)
0x0021A020	Timer 3 Output	0x00394009	S9IND (N/A, X210.9)
0x0021A021	Timer 3 Output Inverted	0x0039400A	S10IND (N/A, X210.10)
0x0021A030	Timer 4 Output	0x00394021	S1IND inverted (X210.3, X210.1)
0x0021A031	Timer 4 Output Inverted	0x00394022	S2IND inverted (X210.5, X210.3)
0x0021A100	Comparator 1 Output	0x00394023	S3IND inverted (X210.7, X210.5)
0x0021A101	Comparator 1 Output Inverted	0x00394024	S4IND inverted (X210.4, X210.7)
0x0021A110	Comparator 2 Output	0x00394025	S5IND inverted (X210.6, X210.2)
0x0021A111	Comparator 2 Output Inverted	0x00394026	S6IND inverted (X210.8, X210.4)
0x0021A120	Comparator 3 Output	0x00394027	S7IND inverted (N/A, X210.6)
0x0021A121	Comparator 3 Output Inverted	0x00394028	S8IND inverted (N/A, X210.8)
0x0021A130	Comparator 4 Output	0x00394029	S9IND inverted (N/A, X210.9)
0x0021A131	Comparator 4 Output Inverted	0x0039402A	S10IND inverted (N/A, X210.10)
0x0021A200	Logic 1 Output	0x00394041	S1IND w/o filter (X210.3, X210.1)
0x0021A201	Logic 1 Output Inverted	0x00394042	S2IND w/o filter (X210.5, X210.3)
0x0021A210	Logic 2 Output	0x00394043	S3IND w/o filter (X210.7, X210.5)
0x0021A211	Logic 2 Output Inverted	0x00394044	S4IND w/o filter (X210.4, X210.7)
0x0021A220	Logic 3 Output	0x00394045	S5IND w/o filter (X210.6, X210.2)
0x0021A221	Logic 3 Output Inverted	0x00394046	S6IND w/o filter (X210.8, X210.4)
0x0021A230	Logic 4 Output	0x00394047	S7IND w/o filter (N/A, X210.6)
0x0021A231	Logic 4 Output Inverted	0x00394048	S8IND w/o filter (N/A, X210.8)
0x0021B100	Demultiplexer Output 0	0x00394049	S9IND w/o filter (N/A, X210.9)
0x0021B101/..F	Demultiplexer Output 1/..15	0x0039404A	S10IND w/o filter (N/A, X210.10)
0x00220041	Axis Running	0x00394061	S1IND w/o filter inv. (X210.3, X210.1)
0x00220042	Axis Fault	0x00394062	S2IND w/o filter inv. (X210.5, X210.3)
0x00243501	HW Limit Switch Enable	0x00394063	S3IND w/o filter inv. (X210.7, X210.5)
0x00243502	Pos HW Limit Switch Triggered	0x00394064	S4IND w/o filter inv. (X210.4, X210.7)
0x00243503	Neg HW Limit Switch Triggered	0x00394065	S5IND w/o filter inv. (X210.6, X210.2)
0x00253001	Percentage Ramp Enable		
0025301B	Holding Active		

External 24V DC Monitoring 0x3C02			
0x0025FA01	Axis Positioning Target Reached	0x00394066	S6IND w/o filter inv. (X210.8, X210.4)
0x00260000/..3	Safe Digital Input 1/..4		
0x00260004	Safe Torque Off		
0x00260005	Safe Brake Control		
0x00260006	Safe Stop 1		
0x00260007	Safe Stop 2		
0x00260008	Safe Operational Stop		
0x00260009			
0x0026000A			
0x0026000B			
0x0026000C			
0x0026000D			
0x0026000E			
0x0026000F			
0x00260010			
0x00260011			
0x00260012			
0x00260013			
0x00260014			
0x00260015			
0x00260016			
0x00260017			
0x00260018			
0x00391000/..7	SB RxPDO1 Bool 0/..7	0x00394067	S7IND w/o filter inv. (N/A, X210.6)
0x00391008/..F	SB RxPDO1 UInt8 0/..7	0x00394068	S8IND w/o filter inv. (N/A, X210.8)
0x00391010/..7	SB RxPDO1 Int8 0/..7	0x00394069	S9IND w/o filter inv. (N/A, X210.9)
0x00391050/..7	SB RxPDO2 Bool 0/..7	0x0039406A	S10IND w/o filter inv. (N/A, X210.10)
0x00391058/..F	SB RxPDO2 UInt8 0/..7	0x00398004	MF Analog Input 1 PTC
0x00391060/..7	SB RxPDO2 Int8 0/..7	0x00398014	MF Analog Input 2 PTC
0x003910A0/..7	SB RxPDO3 Bool 0/..7	0x003CA000/..7	PLC Out Bool 0/..7
0x003910A8/..F	SB RxPDO3 UInt8 0/..7	0x003CA010/..7	PLC Out UInt8 0/..7
0x003910B0/..7	SB RxPDO3 Int8 0/..7	0x003CA020/..7	PLC Out Int8 0/..7
0x003910F0	Sysbus_EmcySlave_ID		

15.2 Motor protection

In order to protect the motor against excessive heat-up, monitoring mechanisms are required which will identify potential thermal overloading in due time to prevent the motor from damage. The thermal condition of a motor can be identified in different ways.

15.2.1 Motor Temperature Monitoring

Direct monitoring via temperature sensors in the winding

- PTC
- KTY
- PT1000
- Thermocontact

Object			Setting		
Index	**Designation**	**Unit**	**Min.**	**Max.**	**Default**
0x2409	Motor Temperature Source	[-]	Selection		
0x2410	Over Temperature Mode	[-]	Selection		
0x2411	Over Temperature Warning	[°C]	0	300	120
0x2412	Over Temperature Error	[°C]	0	300	150

Motor Temperature Source 0x2409	
0x00000000	none
0x00207804	Encoder X4X2: Motor Winding Temperature Digital
0x00211003	MFAI 1 Temperature (X4X2)
0x00241100	Motor Thermal Contact Temperature
0x00385004	Encoder X432: Motor Winding Temperature Digital
0x00398003	MFAI 1 Temperature (X210)
0x00398013	MFAI 2 Temperature (X210)
0x0039A003	MFAI 1 Temperature (X432)

Over Temperature Mode 0x2410	
0x00000001	Off
0x00000002	Only Warning No Fault Trigger
0x00000003	Warning + Fault Trigger
0x00000004	Warning + 1 min Delay Fault Trigger
0x00000005	Warning + 5 min Delay Fault Trigger
0x00000006	Warning + 10 min Delay Fault Trigger

15.2.2 Overload I2t

Indirect monitoring of motor temperature

Modeling of motor heat-up by consideration of temperature-relevant factors via a mathematical model I^2t:

The thermal monitoring method is selected based on the type and operating conditions of the motor. Generally, any of the available methods is sufficient for reliable motor protection. A combination of methods from both groups (one from each group) and parallel execution is possible.

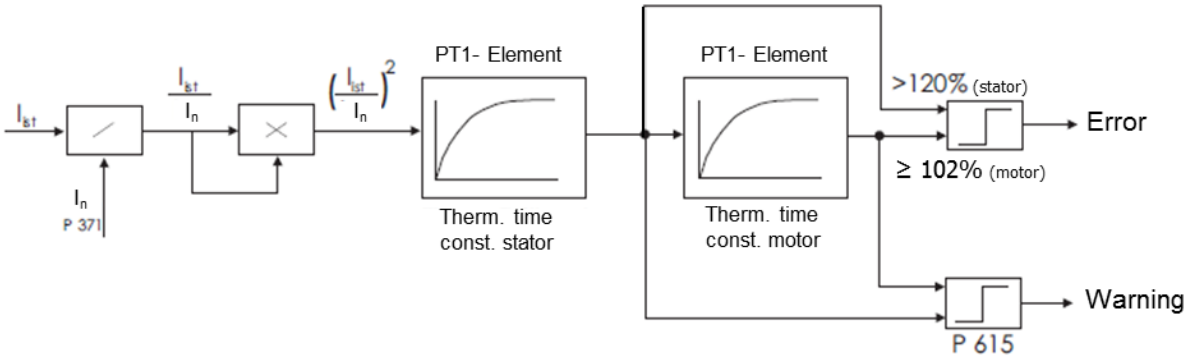
Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2415	I2t Operation Mode I2t	Selection		
0x2416	Thermal Tau Motor	1 s	3600,0 s	1800 s
0x2417	Thermal Tau Winding	1 s	3600,0 s	31 s
0x2418	I2t Warning Threshold	6%	100%	80%

I2t monitoring is another way to protect the motor against thermal overload. This motor protection method is mainly used in servo systems.

Wherever synchronous servomotors are used, I2t monitoring is a proven alternative to motor circuit breakers. By integrating measurable or known motor parameters, heat-up is modeled based on a mathematical model.

The I2t monitoring feature can be selected via *I2t Operation Mode* **0x2415**. The settings are data set change-over settings. I^2t monitoring is done, as shown in the illustration, via $(Iact/Irated)^2$.

The monitored variable is valued via a PT1 element with the thermal time constant of the stator. If the PT1 element output exceeds 120%, an error message will be triggered and the inverter will shut down. The 120% threshold ensures the overshooting will not result in immediate shutdown. Permanent exceeding of the 100% load of the stator winding should be avoided in the application.



The output of the first PT1 element is connected to the input of the second PT1 element which contains the thermal time constant of the motor. This output may be loaded at 100% permanently. This corresponds to full thermal loading of the motor. Once 102% are reached, the inverter will shut down and an error will be reported. Both outputs are linked to an adjustable *Warning Limit*.

I2t Operation Mode 0x2415	Function
0 - I²t Off	The I²t load of the motor is not monitored.
1 - MultiMotFail	In each of the four data sets, the I²t load of the motors is monitored based on the corresponding rated values. Once the fixed error threshold of **0x2416** (**0x2417**) is exceeded, there will be an error shutdown "F0401".
2 - SingleMotFail	The I²t load of the motor is monitored via the rated values from the active data set. Once the set *I2t Warning Threshold* **0x2418** is reached, a warning "A0200" will be triggered by the active data set.
3 - MultiMotWarn	
4 - SingleMotWarn	
5 - MultiMotWarnFail	In each of the four data sets, the I²t load of the motors is monitored based on the corresponding rated values. Once the set *I2t Warning Threshold* **0x2418** is reached, a warning "A0200" will be triggered. Once the fixed error threshold of **0x2416** (**0x2417**) is exceeded, there will be an error shutdown "F0401". Both events will be triggered by the active data set.
6 - SingleMotWarnFail	The I²t load of the motor is monitored via the rated values from the active data set. Once the set *I2t Warning Threshold* **0x2418** is reached, a warning "A0200" will be triggered. Once the fixed error threshold of **0x2416** (**0x2417**) is exceeded, there will be an error shutdown "F0401". Both events will be triggered by the active data set.

The thermal time constant for the motor is in the range between a couple of minutes and several hours. This motor-specific parameter is set via **0x2416** *Thermal Tau Motor*.

The thermal time constant of the stator is much smaller. To protect the stator winding, additional monitoring is required and defined via the **0x2417** *Thermal Tau Winding*. For the time constant values, refer to the relevant motor datasheets. If time constants are estimated, optimum motor protection cannot be guaranteed.

Warning thresholds give the user the chance to respond to imminent I²t error shutdown. Via *I2t Warning Threshold* **0x2418**, you can choose a value between 6% and 100% of thermal load.

15.3 Speed Limit

The max. permissible output speed of the frequency inverter can be set to a low value via parameter *Speed Switch-Off Limit* **0x2420**. If this speed limit is exceeded by the *Stator Frequency (Elec.)* **0x4040/1** , the frequency inverter is switched off and error signal `F1100` is displayed.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2420	Speed Switch-Off Limit	0 rpm	35940 rpm	35940 rpm
0x2421	Speed Warning Threshold	0 rpm	35940 rpm	33000 rpm

15.4 Application

15.4.1 User-Defined Errors

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2432/1	User Error 1 Source	Selection		
0x2432/11	User Error 2 Source	Selection		

10.2 for full selection list.

15.4.2 User-Defined Warnings

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2431/1	User Warning 1 Source	Selection		
0x2431/11	User Warning 2 Source	Selection		

10.2 for full selection list.

15.4.3 Hardware Limit-Switches

The signal source for the hardware limit switches is set in objects **0x2108**, **0x2109** and **0x210A**. 10.1.1

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2435	Fault Reaction	0x00000001- Fault / 0x00000010 – Warning / 0x00000000 - Off (default)		

15.4.4 Software Limit-Switches

In this subsection, you can define the values for software limit switches in user units and the SLS fault reaction. The drive will move the load away from a triggered limit switch position to the permissible travel range. The direction of rotation of the drive depends on the active limit switch: If the positive limit switch is active, the drive moves to negative direction and vice versa.

Relevant objects:

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2437	SLS Fault Reaction	0x00000001- Fault / 0x00000010 – Warning / 0x00000000 - Off (default)		
0x2438	Pos SW Lim Switch	-2147483648 u	2147483647 u	65536 u
0x2439	Neg SW Lim Switch	-2147483648 u	2147483647 u	-65536 u
0x243A	SW Lim Switch Hysteresis	0 u	2147483647 u	5000 u

Output signals

Reaching of warning limits is reported via digital signals.

15.4.5 Automatic Fault Acknowledgement

Relevant objects:

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2450	Operation Mode	0x00000001- Fault Switch-Off 0x00000002 – Shutdown, Fault 0x00000003 – Quick Stop, Fault 0x00000000 - Off (default)		
0x2451	Allowed No. of Acknowledgements	0	20	0
0x2452	Restart Delay	0 s	15 s	0,02 s

15.5 Brake Resistor I2t Monitoring

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x3C20/1	Monitoring	Selection		
0x3C20/2	Type Of Resistor	Selection		
0x3C20/3	Tmax Cycle	0	1200	120
0x3C20/4	Resistance	0 Ω	1000000 Ω	0 Ω
0x3C20/5	Positive Tolerance	0 %	100 %	0 %
0x3C20/6	Negative Tolerance	0 %	100 %	0 %
0x3C20/7	PTC Resistance Minimum	0 Ω	1000000 Ω	0 Ω
0x3C20/8	Nominal Power	0 W	1000000 W	0 W
0x3C20/9	Cooling Time Constant	0 s	1000000 s	0 s
0x3C20/10	Overload Characteristic X0	0 %	100 %	0 %
…				
0x3C20/25	Overload Characteristic X15	0 %	100 %	0 %
0x3C20/26	Overload Characteristic Y0	0 W	1000000 W	0 W
…				
0x3C20/41	Overload Characteristic Y15	0 W	1000000 W	0 W

Dimensioning of brake resistor

CAUTION

Device damage!

Inappropriate resistance values may result in device damage.

- The resistance of the brake resistor must not be less than the minimum value $R_{b\ min}$ -10%. The values for $R_{b\ min}$ are listed in the technical Data.

The following values must be known for dimensioning:

- Peak braking power $P_{b\ Peak}$ in W
- Resistance R_b in Ω
- On time OT in %

Calculation of peak braking power $P_{b\ Peak}$

$$P_{b\,Spitze} = \frac{J \cdot \left(n_1^{\,2} - n_2^{\,2}\right)}{182 \cdot t_b}$$

$P_{b\ Peak}$ = Peak braking power in W
J = Moment of inertia of drive system kgm²
n_1 = Speed of drive system before the braking operation in rpm
n_2 = Speed of drive system after the braking operation in rpm
t_b = Braking time in s

Calculation of resistance R_b

$$R_b = \frac{U_{d\,BC}^{\,2}}{P_{b\,Spitze}}$$

R_b = Resistance in Ω
$U_{d\ BC}$ = Switch-on threshold in V
$P_{b\ Peak}$ = Peak braking power in W

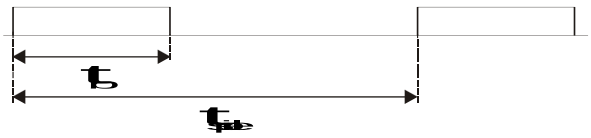
The switch-on threshold $U_{d\ BC}$ is the DC link voltage at which the brake resistor is switched on.

If the calculated resistance R_b of the brake resistor is between two standard series values, the lower resistance shall be selected.

Calculation of On Time OT

$$ED = \frac{t_b}{t_Z}$$

OT = On Time
t_b = Braking time
t_Z = Cycle time



Example:

t_b = 48 s, t_Z = 120 s

$$ED = \frac{t_b}{t_Z} = 0{,}4 = 40\%$$

In the case of infrequent short braking operations, typical values of the On Time OT are at 10%, for long braking operations (> 120 s) typical values are at 100%. In the case of frequent deceleration and acceleration operations, it is recommended that the On Time OT be calculated according to the above formula.

The calculated values for Pb Peak, Rb and OT can be used by the resistor manufacturers for determining the resistor-specific permanent power.

15.6 Fault Reaction

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x6007	Abort Conn. option code	Selection		
0x605E	Fault reaction option code	Selection		

Object *Abort conn. option code* defines the operating characteristics of the frequency inverter in the case of an error in the bus connection due to BusOff, RxPDO length error or NMT state change (leaving of NMT state "Operational").

Depending on the setting of **0x2200** *Control Mode*, the response of the setting of object **0x6007** will change as shown in the following table.

Object 0x6007		
Operation mode	**Function with "Control via Statemachine"**	**Function in "Other control"**
0 No action	Operating point is maintained.	Operating point is maintained.
1 Fault signal	"Fault" status will be activated immediately. **Default**.	The controller (statemachine) switches to "Fault" state immediately.
2 Disable voltage command	Control command "Disable voltage" and switch to "switch on disabled" status.	
3 Quick Stop command	Control command "Quick stop" and switch to "switch on disabled" status.	
-1 Slow Down Ramp, Fault	Control command "Disable operation" and switch to "Error" status once the drive has been shut down.	
-2 Quick Down Ramp, Fault	Control command "Quick stop" and switch to "Error" status once the drive has been shut down.	

When object **0x6007** was written and a parameter saving instruction (Object 0x1010) was generated after that, the value of **0x6007** will be saved in the non-volatile memory.

16 Reference Values

16.1 Frequency Limits

The output frequency of the frequency inverter and thus the speed setting range are defined by the parameters *Minimum Speed Limit* **0x2301** and *Maximum Speed Limit* **0x2300**. The relevant control methods use the two limit values for scaling and limiting the frequency.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2300	Maximum Speed Limit	0,00 Hz	599,00 Hz	50,00 Hz
0x2301	Minimum Speed Limit	0,00 Hz	599,00 Hz	3,50 Hz
				0,00 Hz

16.2 Slip Limit

In field-oriented control methods, the torque-forming current component and the slip frequency of the 3-phase machine depend on the required torque. The field-oriented control method also includes the parameter *Slip Limit* **0x2029** to limit the torque in the calculation of the machine model. The rated slip calculated from the rated motor parameters is limited in accordance with the *Slip Limit* **0x2029** which is parameterized as a percentage.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2029	Slip Limit	0 Hz	3300 Hz	3300 Hz

16.3 Percentage Value Limits

The percentage adjusting range is defined by parameters **0x2311** *Minimum Percentage Limit* and **0x2310** *Maximum Reference Percentage*. The relevant control methods use the two limit values for scaling and limiting of percentages.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2311	Minimum Percentage Limit	0,00 %	300,00 %	0,00 %
0x2310	Maximum Percentage Limit	0,00 %	300,00 %	100,00 %

16.4 Fixed reference values

The fixed reference values must be parameterized as fixed frequencies or fixed percentages according to the configuration and function.

The signs of the fixed reference values determine the sense of rotation. A positive sign means clockwise rotation, a negative sign means anticlockwise rotation. The sense of rotation can also be stated with the digital signal sources assigned to the object *IO Counter Clockwise Operation* **0x2101/3**.

The fixed reference values must be parameterized in four data sets and are assigned to further sources via the reference value channel. The use of the functions *Data Set Change-Over 1* **0x2103/1** and *Data Set Change-Over 2* **0x2103/2** thus enables the setting of 16 fixed reference values.

16.4.1 Fixed Speed

The eight fixed frequencies define reference values, which are selected via the *Fixed Speed Change-Over 1* **0x2104/1**, *Fixed Speed Change-Over 2* **0x2104/2** and *Fixed Speed Change-Over 3* **0x2104/3**.

By combining the logic states of the fixed frequency change-over modes 1, 2 and 3, fixed frequencies 1 through 8 can be selected:

Selection of fixed frequencies			
Fixed Speed Change-Over 1 **0x2104/1**	*Fixed Speed Change-Over 2* **0x2104/2**	*Fixed Speed Change-Over 3* **0x2104/3**	**Function / active fixed value**
0	0	0	Fixed Speed 1
1	0	0	Fixed Speed 2
1	1	0	Fixed Speed 3
0	1	0	Fixed Speed 4
0	1	1	Fixed Speed 5
1	1	1	Fixed Speed 6
1	0	1	Fixed Speed 7
0	0	1	Fixed Speed 8

0 = Contact open 1 = Contact closed

13.2.2 for details on fixed speed.

10.1.1 and 10.1.1.1 for details on how to configure the data set change-over, the motor potentiometer settings and for other related information.

16.4.2 Fixed percentages

The four fixed percentages define reference values which are selected via the *Fixed Percentage Switch-Over 1* **0x2105/1**, *Fixed Percentage Switch-Over 2* **0x2105/2** and *Fixed Percentage Switch-Over 3* **0x2105/3**.

By combining the logic states of the fixed percentage switch-over modes 1 and 2, fixed percentages 1 through 8 can be selected:

Fixed percentage control			
Fixed Percentage Switch-Over 1 **0x2105/1**	*Fixed Percentage Switch-Over 2* **0x2105/2**	*Fixed Percentage Switch-Over 3* **0x2105/3**	**Function / active fixed value**
0	0	0	Fixed Percentage 1
1	0	0	Fixed Percentage 2
1	1	0	Fixed Percentage 3
0	1	0	Fixed Percentage 4
0	1	1	Fixed Percentage 5
1	1	1	Fixed Percentage 6
1	0	1	Fixed Percentage 7
0	0	1	Fixed Percentage 8

0 = Contact open 1 = Contact closed

13.2.3 for details on fixed frequencies.

10.1.1 and 10.1.1.1 for details on how to configure the data set change-over, the motor potentiometer settings and for other related information.

16.5 Frequency ramps

The ramps determine how quickly the frequency value is changed if the reference value changes or after a start, stop or brake command. The maximum admissible ramp gradient can be selected according to the application and the current consumption of the motor.

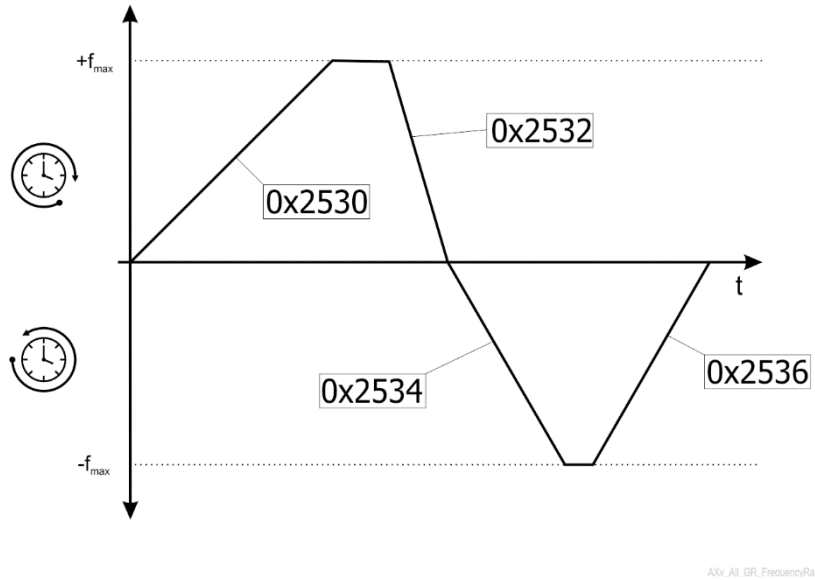
If the settings of the frequency ramps are identical for both directions of rotation, the parameterization via the parameters *Acceleration Clockwise* **0x2530** and *Deceleration Clockwise* **0x2532** is sufficient. The values of the frequency ramps are applied to *Acceleration Counter-Clockwise* **0x2534** and *Deceleration Counter-Clockwise* **0x2536** if these have been parameterized to the factory setting of -0.01 Hz/s.

The parameter value of 0.00 Hz/s for the acceleration blocks the corresponding direction of rotation.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2530	Acceleration Clockwise	0.00 Hz/s	9999.99 Hz/s	5.00 Hz/s
0x2532	Deceleration Clockwise	0.01 Hz/s	9999.99 Hz/s	5.00 Hz/s
0x2534	Acceleration Counter-Clockwise	- 0.01 Hz/s [1)]	9999.99 Hz/s	- 0.01 Hz/s
0x2536	Deceleration Counter-Clockwise	- 0.01 Hz/s [2)]	9999.99 Hz/s	- 0.01 Hz/s

[1)] Value -0.01 Hz/s means that the value of *Acceleration Clockwise* **0x2530** is used.
[2)] Value -0.01 Hz/s means that the value of *Deceleration Clockwise* **0x2532** is used.

Setting 0.00 Hz/s will not accelerate nor decelerate the drive due to the limitation of the ramp.

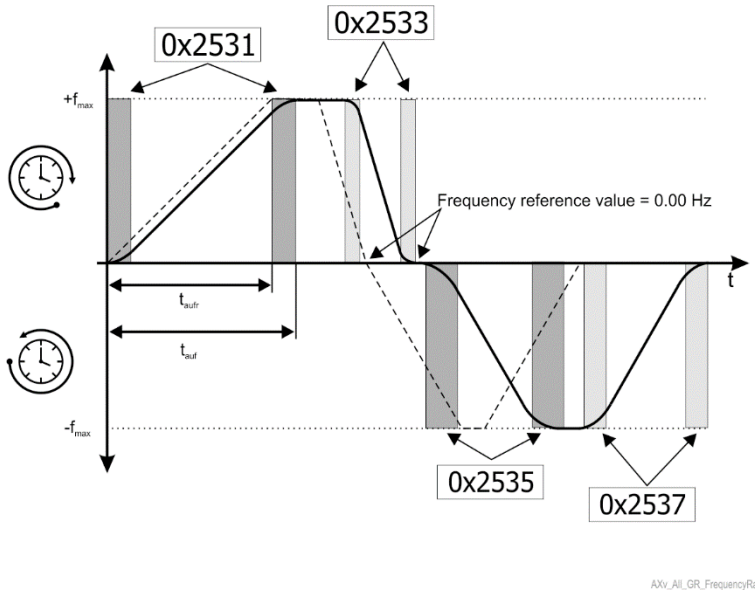


The load occurring in a linear acceleration of the drive is reduced by the adjustable modification speeds (S curve). The non-linear course of the frequency is defined as a ramp and states the time range in which the frequency shall be guided to the set ramp. The values set with parameters **0x2530** to **0x2536** are maintained regardless of the selected ramp times.

Setting the ramp rise time to 0 ms deactivates the function S curve and enables the use of the linear ramps. The data set change-over of the parameters within an acceleration

phase of the drive mechanism demands the defined take-over of the values. The controller calculates the values required in order to reach the reference value from the ratio of the acceleration to the ramp time and uses it until the acceleration phase is complete. With this method, exceeding the reference values is avoided and a data set change-over between extremely deviating values becomes possible.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2531	Ramp Rise Time Acc. Clockwise	0 ms	65000 ms	0 ms
0x2533	Ramp Fall Time Dec. Clockwise	0 ms	65000 ms	0 ms
0x2535	Ramp Rise Time Acc. Counter-Clockwise	0 ms	65000 ms	0 ms
0x2537	Ramp Fall Time Dec. Counter-Clockwise	0 ms	65000 ms	0 ms



Example:

Calculation of the acceleration time in clockwise rotation with an acceleration from 20 Hz to 50 Hz (f_{max}) and an acceleration ramp of 2 Hz/s for parameter *Acceleration (Clockwise)* **0x2530**. The *Ramp Rise Time Acc. Clockwise* **0x2531** is set to 100 ms.

$$t_{aufr} = \frac{\Delta f}{a_r}$$

$$t_{aufr} = \frac{50\,\text{Hz} - 20\,\text{Hz}}{2\,\text{Hz/s}} = 15\,\text{s}$$

$$t_{auf} = t_{aufr} + t_{Vr}$$

$$t_{auf} = 15\,\text{s} + 100\,\text{ms} = 15{,}1\,\text{s}$$

t_{aufr} = acceleration time clockwise rotary field

Δf = change of frequency acceleration ramp

a_r = Acceleration Clockwise

t_{Vr} = Ramp Rise Time Clockwise

t_{auf} = Acceleration time + Ramp rise time

16.6 Percentage Value Ramps

The percentage value ramps scale the change of the reference value (in percent) for the corresponding input function. The acceleration and deceleration of the drive are parameterized via the frequency ramps **0x2559** *Perc. Ramp-Up Gradient* and **0x255A** *Perc. Ramp-Down Gradient*.

The behavior corresponds to a function which takes the time behavior of the drive system into account. If the parameter is set to 0 %/s, this function is deactivated and a direct reference value modification for the following function is obtained.

Object		Setting		
Index	**Designation**	**Min.**	**Max.**	**Default**
0x2559	Perc. Ramp-Up Gradient	0 %/s	100 %/s	0 %/s
0x255A	Perc. Ramp-Down Gradient	0 %/s	100 %/s	0 %/s

17 Status Information

The various control functions and methods include electrical control variables and various calculated actual values of the machine or system. The different actual values can be read out for operational and error diagnosis via a communication interface or in the AxiaManager (Mobile) Software UI or displayed on a Keypad.

Below, you can view the list of actual value objects as grouped in the AxiaManager Software UI. These objects are read-only, therefore no Min/Max settings are included.

17.1 Inverter

General		
Index	**Designation**	**Unit**
0x3913/1	Date / Time Str	[-]
0x3913/2	Date / Time unix	[s]
0x3913/3	Date / Time unix set	[s]
0x4000/3	Working Time	[-]
0x4001	Active Data-Set	[-]
0x4002/1	Ready to switch on	[-]
0x4002/2	Release State Info	[-]
0x4047/1	Modulation Index	[%]
0x4049	Switching Frequency	[Hz]
0x5800	Operating Time	[-]
0x5801/1	DC-Link Voltage	[V]
0x5801/2	External 24V Voltage	[V]
0x5802/2	Internal 24V Voltage	[V]

Temperature		
Index	**Designation**	**Unit**
0x4005	Heat Sink Temperature	[°C]
0x5805/1	Inside Temperature	[°C]
0x5805/2	PCB Temperature	[°C]
0x5805/3	Capacitor Temperature	[°C]
0x5806/1	Internal Fan Speed	[rpm]
0x5806/2	HeatSink Fan 1 Speed	[rpm]
0x5806/3	HeatSink Fan 2 Speed	[rpm]

Digital I/O		
Index	**Designation**	**Unit**
0x5820/1	Status Digital Inputs String	[-]
0x5820/2	Status Digital Inputs	[-]
0x5820/3	PWM-Input 1 Duty Cycle	[-]
0x5821/1	Status Digital Outputs String	[-]
0x5821/2	Status Digital Outputs	[-]

Analog I/O		
Index	**Designation**	**Unit**
0x4310/13	X4X2 Temperature	[°C]
0x5822/10	MFAI 1 Percentage	[%]
0x5822/11	MFAI 1 Voltage	[V]
0x5822/12	MFAI 1 Current	[A]

Analog I/O		
Index	**Designation**	**Unit**
0x5822/20	MFAI 2 Percentage	[%]
0x5822/21	MFAI 2 Voltage	[V]
0x5822/23	MFAI 2 Temperature	[°C]
0x5823/1	Analog Output X210.11	[V]
0x5824/13	X432 Temperature	[°C]

Setpoints		
Index	**Designation**	**Unit**
0x4030	Reference Speed	[rpm]
0x4031	Reference Torque	[Nm]
0x4032	Actual Reference Speed	[rpm]
0x403A/1	Limiting Speed Source	[-]
0x403A/2	Actual Frequency Limit	[Hz]
0x403A/3	Actual Speed Limit	[rpm]
0x403A/4	Actual Speed Limit	[u/s]
0x403B/1	Positive Torque Limit	[%]
0x403B/2	Positive Torque Limit Source	[-]
0x403B/3	Negative Torque Limit	[%]
0x403B/4	Negative Torque Limit Source	[-]

Warnings		
Index	**Designation**	**Unit**
0x4015/17	Groups Warning Message	[-]
0x4015/18	Warning Message Power	[-]
0x4015/19	Warning Message Communication	[-]
0x4015/20	Warning Message Application	[-]
0x4015/21	Warning Message Encoder	[-]

Faults		
Index	**Designation**	**Unit**
0x3930/1	Total Number of Faults	[-]
0x3930/2	Faults in Fault History	[-]
0x3930/3	Automatic Acknowledged Faults	[-]
0x4010/1	Fault Message	[-]
0x4010/3	Additional Fault Info 1	[-]
0x4010/4	Additional Fault Info 2	[-]
0x4010/5	Additional Fault Info 3	[-]
0x4010/6	Additional Fault Info 4	[-]
0x4010/7	Fault Code	[-]
0x4100/1	Automatic Acknowledged Faults	[-]
0x4100/2	Automatic Acknowledged F0500	[-]
0x4100/3	Automatic Acknowledged F0507	[-]
0x4100/4	Automatic Acknowledged F0700	[-]
0x4100/11	Acknowledged in 10 Min	[-]
0x4100/12	Acknowledged F0500 in 10 Min	[-]
0x4100/13	Acknowledged F0507 in 10 Min	[-]
0x4100/14	Acknowledged F0700 in 10 Min	[-]

17.2 Motor

Motor		
Index	**Designation**	**Unit**
0x4040/1	Stator Frequency	[Hz]
0x4040/2	Slip Frequency	[Hz]
0x4040/10	Mechanical Speed	[rpm]
0x4041/1	Flux Forming Voltage Usd	[V]
0x4041/2	Torque Forming Voltage Usq	[V]
0x4041/3	Output Voltage	[V]
0x4042/1	Flux Forming Current Isd	[A]
0x4042/2	Torque Forming Current Isq	[A]
0x4042/3	RMS Current	[A]
0x4042/4	Active Current	[A]
0x4042/5	Reactive Current	[A]
0x4043/1	Active Power	[W]
0x4043/2	Reactive Power	[var]
0x4043/3	Apparent Power	[VA]
0x4043/4	Power Factor	[-]
0x4044/1	Torque	[Nm]
0x4045/1	Flux	[Vs]
0x4045/2	Flux Normalized	[%]
0x4046/1	Rotor Time Constant	[s]
0x4048/1	Motor Temperature	[°C]
0x40B0	I2t Winding	[%]
0x40B1	I2t Motor	[%]
0x40C0	Brake Status	[-]

17.3 Encoders

The values available in this subtree depend in part on your actual configuration. The data below serve as an example. For your actual status information, refer to the Axia-Manager software or check via the keypad module.

HTL Actual Values		
Index	**Designation**	**Unit**
0x5830/1	Encoder Speed X210	[rpm]
0x5830/2	Encoder Position X210	[-]
0x5830/3	Encoder Status X210	[-]
0x5830/4	Encoder Fault X210	[-]
0x5830/5	Encoder Warning X210	[-]

X412/X422 Actual Values		
Index	**Designation**	**Unit**
0x4052/1	Encoder Speed X412/X422	[rpm]
0x4052/2	Encoder Position X412/X422	[-]
0x4052/3	Encoder Status X412/X422	[-]
0x4052/4	Encoder Fault X412/X422	[-]
0x4052/5	Encoder Warning X412/X422	[-]

X412/X422 Electronic Name Plate		
Index	**Designation**	**Unit**
0x4059/1	ENP: Motor Type	[-]
0x4059/2	ENP: Rated Voltage	[-]
0x4059/3	ENP: Rated Current	[-]
0x4059/4	ENP: Rated Speed	[-]
0x4059/5	ENP: No of Pole Pairs	[-]
0x4059/6	ENP: Rated Cos Phi	[-]
0x4059/7	ENP: Rated Frequency	[-]
0x4059/8	ENP: Rated Mech Power	[-]
0x4059/9	ENP: Rated Torque	[-]
0x4059/10	ENP: Commutation Offset	[-]
0x4059/16	ENP: Rated Magnet Current	[-]
0x4059/21	ENP: Leakage Coefficient	[-]
0x4059/34	ENP: Voltage Constant	[-]
0x4059/35	ENP: Stator Resistance	[-]
0x4059/36	ENP: Stator d Inductance	[-]
0x4059/37	ENP: Stator q Inductance	[-]
0x4059/38	ENP: Main Inductance	[-]
0x4059/39	ENP: Rotor Resistance	[-]
0x4059/40	ENP: Rotor Time Constant	[-]
0x4060/1	ENP: Motor Label	[-]
0x4060/2	ENP: Motor Code	[-]

X432 Actual Values		
Index	**Designation**	**Unit**
0x5832/1	Encoder Speed X432	[rpm]
0x5832/2	Encoder Position X432	[-]
0x5832/3	Encoder Status X432	[-]
0x5832/4	Encoder Fault X432	[-]
0x5832/5	Encoder Warning X432	[-]
0x5832/6	Theta Encoder X432	[°C]
0x5832/7	Theta Motor Winding X432	[°C]

17.4 Communication

Systembus Status			
Index	**Designation**	**Index**	**Designation**
0x3910/6	Sysbus Sync Count	0x3910/68	Sysbus TxPDO2 Value
0x3910/7	Sysbus CAN State	0x3910/73	Sysbus TxPDO3 Value
0x3910/8	Sysbus CAN Last Error	0x3911/5	CANopen Sync Time
0x3910/9	Sysbus Nmt State	0x3911/6	CANopen Sync Count
0x3910/33	Sysbus RxPDO1 Value	0x3911/7	CANopen CAN State
0x3910/38	Sysbus RxPDO2 Value	0x3911/8	CANopen CAN Last Error
0x3910/43	Sysbus RxPDO3 Value	0x3911/9	CANopen Nmt State
0x3910/63	Sysbus TxPDO1 Value		

CANopen Bus Status	
Index	**Designation**
0x3911/5	CANopen Sync Time
0x3911/6	CANopen Sync Count
0x3911/7	CANopen CAN State
0x3911/8	CANopen CAN Last Error
0x3911/9	CANopen Nmt State

Mapping	
Index	**Designation**
0x4080/1	RxPDO Mapping
0x4081/1	TxPDO Mapping

OS Sync Status	
Index	**Designation**
0x3906/1	Synctime
0x3906/2	Synctime Measured
0x3906/3	Sync State
0x3906/15	Active Sync Source

17.5 Safety Module

The values available in this subtree depend in part on your actual configuration. The data below serve as an example. For your actual status information, refer to the Axia-Manager software or check via the keypad module.

Safe Digital Inputs		
Index	**Designation**	**Unit**
0x3E60	Safe DI Debounce Time	[ms]
0x3E61	Safe DI Discrepancy Time	[ms]

Safe Stop 1		
Index	**Designation**	**Unit**
0x2613	STO Min.Time after SS1	[ms]
0x6651/1	SS1 Time to STO	[ms]
0x6658/1	SS1 Activate SBC	[-]

Process Values		
Index	**Designation**	**Unit**
0x6640	STO Status	[-]
0x6650/1	SS1 Status	[-]
0x6660/1	SBC Status	[-]

Errors		
Index	**Designation**	**Unit**
0x3E25	Fault Code	[-]

17.6 Application

The values available in this subtree depend in part on your actual configuration. The data below serve as an example. For your actual status information, refer to the Axia-Manager software or check via the keypad module.

Axis Positioning		
Index	**Designation**	**Unit**
0x4056	Actual Orientation	[deg]

17.7 Controller

Speed Controller Online Tuning		
Index	**Designation**	**Unit**
0x40D2/1	Estimated Inertia	[kg*m²]
0x40D2/2	Kp tuned	[-]
0x40D2/3	Tn tuned	[-]

Current Controller		
Index	**Designation**	**Unit**
0x22DF	Controller Status	[-]

17.8 Predictive Maintenance

The values available in this subtree depend in part on your actual configuration. The data below serve as an example. For your actual status information, refer to the Axia-Manager software or check via the keypad module.

Gearbox Status		
Index	**Designation**	**Unit**
0x2589/1	Oil Temperature	[-]
0x2589/2	Overload Status	[-]
0x2589/3	Overload Time Perc.	[%]

17.9 Programmable Logic Controller (PLC)

PLC		
Index	**Designation**	**Unit**
0x393F/1	PLC Available	[-]
0x393F/3	PLC Running	[-]
0x3BC0	PLC Actual Values (bool)	[-]
0x3BC1	PLC Actual Values (uint8)	[-]
0x3BC2	PLC Actual Values (int8)	[-]
0x3BC3	PLC Actual Values (uint16)	[-]
0x3BC4	PLC Actual Values (int16)	[-]
0x3BC5	PLC Actual Values (uint32)	[-]
0x3BC6	PLC Actual Values (int32)	[-]
0x3BC7	PLC Actual Values (float32)	[-]

17.10 Profile Objects

General		
Index	**Designation**	**Unit**
0x603F	Error Code	[-]
0x6041	Status Word	[-]
0x6061	Modes of Operation Display	[-]
0x6502	Supported Drive Modes	[-]
0x67FF	Single device type	

Velocity		
Index	**Designation**	**Unit**
0x6043	vl velocity demand	[-]
0x6044	vl velocity actual value	[-]
0x606C	Velocity Actual Value	[-]

Position		
Index	**Designation**	**Unit**
0x6064	Position Actual Value	[-]
0x60F4	Following error actual value	[-]

Torque		
Index	**Designation**	**Unit**
0x6077	Torque actual value	[-]

Touch Probe		
Index	**Designation**	**Unit**
0x60B9	Touch probe Status	[-]
0x60BA	Touch probe 1 positive edge	[-]
0x60BB	Touch probe 1 negative edge	[-]
0x60BC	Touch probe 2 positive edge	[-]
0x60BD	Touch probe 2 negative edge	[-]
0x60D0/1	Touch probe 1 Source	[-]
0x60D0/2	Touch probe 2 Source	[-]
0x60D1	Touch probe time stamp 1 positive value	[-]
0x60D2	Touch probe time stamp 1 negative value	[-]
0x60D3	Touch probe time stamp 2 positive value	[-]
0x60D4	Touch probe time stamp 2 negative value	[-]
0x60D5	Touch probe 1 positive edge counter	[-]
0x60D6	Touch probe 1 negative edge counter	[-]
0x60D7	Touch probe 2 positive edge counter	[-]
0x60D8	Touch probe 2 negative edge counter	[-]

17.11 Actual Value Memory

Actual Value Memory		
Index	**Designation**	**Unit**
0x4090	Memory Reset	[-]
0x4091/	Peak Ixt Long Term	[%]
0x4091/2	Peak Ixt Short Term	[%]
0x4091/10	Peak RMS Current	[A]

Actual Value Memory		
Index	**Designation**	**Unit**
0x4091/20	Peak Active Power Positive	[W]
0x4091/21	Peak Active Power Negative	[W]
0x4091/30	Peak Heatsink Temperature	[W]
0x4091/31	Peak Inside Temperature	[W]
0x4091/32	Peak Cap. Temperature	[W]
0x4091/33	Peak PCB Temperature	[W]
0x4091/40	Peak DC Link Voltage	[W]
0x4092/10	Average RMS Current	[A]
0x4092/20	Average Active Power	[W]
0x4092/30	Average Heatsink Temperature	[W]
0x4092/31	Average Inside Temperature	[W]
0x4092/32	Average Cap. Temperature	[W]
0x4092/33	Average PCB Temperature	[W]
0x4092/40	Average DC Link Voltage	[W]
0x4093/1	Total Energy Positive	[Wh]
0x4093/2	Total Energy Negative	[Wh]

18 Maintenance and Repair

18.1 Modifications to the device

Hardware modifications

Any **hardware** modifications to the device may only be done by BONFIGLIOLI or its authorized service providers.

Firmware modifications

Any **firmware** modifications to the device may only be done by BONFIGLIOLI or its authorized service providers.

18.2 Warranty

If the device is manipulated by the user without prior authorization by BONFIGLIOLI the safety certification and any right to claim under warranty shall become void.

18.3 Maintenance

Maintenance frequency and procedures depend on the particular operation environment.

- To determine when and how to execute maintenance on your device, contact your local representative of BONFIGLIOLI.

18.4 Repair

Only BONFIGLIOLI or its authorized service providers may perform repair on the device.

- If repair is required, contact your local representative of BONFIGLIOLI.

19 Object List

The objects are designated with Index, Sub-index and designation. The objects listed below are a relevant selection and do not comprise all objects defined within the CiA standard. Refer to the relevant CiA documentation for more information.

19.1 Object Types Overview

The objects are listed in tables. The following definitions apply:

Access type			
Read only	The PLC/user can only read data from the frequency inverter.		
Read/Write	The PLC/user is granted access (reading and writing) to the frequency inverter data.		
Data type			
Unsigned32	32 Bit value:	0…2^{32}-1 0…0xFFFF FFFF	
Unsigned16	16 Bit value:	0…2^{16}-1 0…0x FFFF	(0…65535)
Unsigned8	8 Bit value:	0…2^{8}-1 0…0xFF	(0…255)
Integer32	Signed 32 Bit value:	-2^{31}…2^{31}-1 0x8000 0000…0x7FFF FFFF	
Integer16	Signed 16 Bit value:	2^{15}…2^{15}-1 0x8000…0x7FFF	(-32768…32767)
Integer8	Signed 8 Bit value: -	2^{7}…2^{7}-1 0x80…0x7F	(-128…127)
Boolean		FALSE…TRUE	0…1
Float32	Floating-point number with 4 digits after the point	-2^{31}…2^{31}-1 0x8000 0000…0x7FFF FFFF	
Visible string	String up to 99 characters long. Transmission via Segmented Transfer.		

19.2 Communication Objects (0x1nnn)

Communication objects **0x1nnn** contain all objects for communication.

Abbreviations used

- r/w: Read/Write
- ro: Read only
- wo: Write only
- Default: Default value

The headings are displayed in the format *Index/Sub-index Object name*.

0x1000 Device Type

Index	Sub-index	Designation	Data type	Access	Default
0x1000	0	Device Type	Unsigned 32	ro	0

The device identification is carried out upon network startup. The information about the device type and functionality (type) is defined by the CANopen® DS402 standard.

Object 0x1000					
Additional Information				**Device Profile Number**	
Mode Bits		**Type**			
31	24	23	16	15	0

The standard device profile "Drives and Motion Control" used by the frequency inverter is shown as device profile number 402. The other information specifies the device functionality of the frequency inverter.

Device Profile Number	= 402	drives and motion control
Type	= 0x41	Frequency inverter
Mode bits	= 0	unused

0x1001 Error Register

Index	Sub-index	Designation	Data type	Access	Default
0x1001	0	Error Register	Unsigned 8	ro	0

Object **0x1001** is the error register for internal frequency inverter errors. Status "no error" (**0x1001** = 0) or "Error" (**0x1001** ≠ 0) is displayed.

In case of an error, the PLC can evaluate detailed information via the Emergency Message (0 "0x603F Error Register").

Object 0x1001	
Bit	
0	Generic error
1	Current
2	Voltage
3	Temperature
4	Communication error
5	Device profile specific error
6	Reserved
7	Manufacturer specific error

0x1003 Pre-Defined Error Field

Index	Sub-index	Designation	Data type	Access	Default
0x1003	0	Pre-defined error field	Unsigned32	ro	0

Sub-index 0 gives the number of stored errors (max 5) and is 8 Bit wide. The other sub-indexes give the stored errors as 32 bit variables.

0x1008 Manufacturer Device Name

Index	Sub-index	Designation	Data type	Access	Default
0x1008	0	Manufacturer Device name	Visible string	ro	See Text

The device name is displayed as a sequence of ASCII characters.

Example: "AxiaVert Single Axis"

0x1009 Manufacturer Hardware Version

Index	Sub-index	Designation	Data type	Access	Default
0x1009	0	Manufacturer Hardware version	Visible string	ro	See Text

The device version is displayed as a sequence of ASCII characters.

Example: "AXV 123 456 789"

0x100A Manufacturer Software Version

Index	Sub-index	Designation	Data type	Access	Default
0x100A	0	Manufacturer Software version	Visible string	ro	See Text

The software version is displayed as a sequence of ASCII characters.

Example: V4.00

0x100C Guard Time

Index	Sub-index	Designation	Data type	Access	Default
0x100C	0	Guard Time	Unsigned16	r/w	See Text

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0x100D Lifetime Factor

Index	Sub-index	Designation	Data type	Access	Default
0x100D	0	Lifetime Factor	Unsigned8	r/w	See Text

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0x1010 Store Parameters

Index	Sub-index	Designation	Data type	Access	Default
0x1010	1	Store Parameters	Unsigned32	r/w	See text

With object **0x1010** object/object settings can be stored to non-volatile memory.

Writing "save" in **0x1010** saves all application objects (**0x6nnn**) in the non-volatile memory.

Writing the "save" instruction

LSB			MSB
"**s**"	"**a**"	"**v**"	"**e**"
0x73	0x61	0x76	0x65

Writing values other than "save" will result in cancellation of SDO. The store command is **not** processed.

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0x1011 Restore Default Parameters

Index	Sub-index	Designation	Data type	Access	Default
0x1011	1	Restore Default Parameters	Unsigned32	r/w	See text

With object **0x1011**, you can reset objects to the default values.

Writing of "load" in **0x1011** restores all application objects (**0x6nnn**).

Writing the "load" instruction

LSB			MSB
"**l**"	"**o**"	"**a**"	"**d**"
0x6C	0x6F	0x61	0x64

Writing values other than "load" will result in cancellation of SDO. The restore defaults command is **not** processed.

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0x1014 COB-ID EMCY

Index	Sub-index	Designation	Data type	Access	Default
0x1014	0	COB-ID EMCY	Unsigned32	rw	0

Possible values:

0x80 + NodeID,

0x80-0x100, 0x200, 0x280, 0x300, 0x380 0x400, 0x480, 0x500, 0x580, 0x600, 0x680-0x6DF

For more information ☞ DS301 standard.

0x1016 Consumer heartbeat time

Index	Sub-index	Designation	Data type	Access	Default
0x1016	0	Consumer heartbeat time	Unsigned32	rw	0

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0x1017 Producer heartbeat time

Index	Sub-index	Designation	Data type	Access	Default
0x1017	0	Producer heartbeat time	Unsigned16	rw	0

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0x1018/n Identity Object

The *identity object* provides information about the device manufacturer and the device.

Index	Sub-index	Designation	Data type	Access	Default
0x1018	1	Identity Vendor ID	Unsigned32	ro	See text
	2	Identity Product code	Unsigned32	ro	See text
	3	Identity Revision number	Unsigned32	ro	See text
	4	Identity Serial number	Unsigned32	ro	See text

"Vendor ID" "**0xD5**" refers to manufacturer **BONFIGLIOLI DEUTSCHLAND GmbH**.

This "Vendor ID" is assigned by the CANopen® user organization "CAN in Automation" (CiA) (*www.can-cia.org*).

Product code:

shows the type ID of the frequency inverter. `0x0001.0001` for AxiaVert Single Axis

Revision number:

shows the revision level of the CANopen® system of the frequency inverter.

Serial number:

shows the serial number of the frequency inverter.

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0x1029 Error behavior

Index	Designation	Data type	Access	Default
0x1029	Error behavior	Unsigned8	rw	0

Guarding and heartbeat fault behavior:

- 0 enter pre-operational ,
- 1 no change ,
- 2 stop

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0x1200 SDO server parameter

Index	Sub-Index	Designation	Data Type	Access	Default
0x1200	0	Highest sub-index supported	Unsigned8	ro	2
	1	COB-ID client → server (Rx)	Unsigned32	ro	See text
	2	COB-ID server → client (Tx)	Unsigned32	ro	See text

Object **0x1200** defines the SDO server parameters. The values are read-only and pre-defined according to the device node address.

COB-ID client → server (Rx) = 1536 + Node Address

COB-ID server → client (Tx) = 1408 + Node Address

Object 0x1200/1, 2				
Bit 31	Bit 30	Bit 29	Bit 11 ... 28	Bit 0 ... 10
valid	**0**	frame	**0**	11 Bit CAN-ID

Bit 31:	**0** = SDO exists / valid
Bit 29:	**0** = 11 Bit ID
Bit 0 ... 10:	11 Bit CAN-ID

Example:					
	COB ID	CB	Index	SI	Data
Read Request	601	40	00 12	02	00 00 00 00
Response	581	43	00 12	02	81 05 00 00

CB: Control byte SI: Sub-Index All values in hexadecimal without leading "0x"

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0x140n/n, RxPDO Communication Objects

Index	Sub-index	Designation	Data type	Access	Default
0x1400 0x1401 0x1402	0	RPDO n comm parameter	Unsigned8	ro	2
	1	RPDO n COB ID	Unsigned32	rw	See text
	2	RPDO n Transmission type	Unsigned8	rw	See text
	3	RPDO n Inhibit time	Unsigned16	rw	See text
	5	RPDO n Event timer	Unsigned16	rw	See text

RxPDO Communication objects:

- 0x1400/n RxPDO1 COB-ID Default value: 0x200 (=512) +Node ID
- 0x1401/n RxPDO2 COB-ID Default value: 0x300 (=768) +Node ID
- 0x1402/n RxPDO3 COB-ID Default value: 0x400 (=1024) +Node ID

These communication objects define the COB-ID and transmission type used by the RxPDOs. Only sub-index **1**, **2** and **5** are used for RxPDOs. The default setting for the used COB-ID depends on the Node ID and can be changed. The default value for transmission type is 255 (event driven) and can also be changed (see table).

Object 0x1400/0x1401/0x1402 COB-ID				
Bit 31	Bit 30	Bit 29	Bit 11 ... 28	Bit 0 ... 10
valid	**0**	frame	**0**	11 bit CAN-ID

Bit 31:0 = PDO existent/valid

1 = PDO non-existent/not valid

Bit 29:0 = 11 Bit ID

1 = 29 Bit ID **NOT ALLOWED**

Bit 0 ... 10: 11 bit CAN-ID

RxPDO1 Default = valid

RxPDO2/3 Default = not valid

Object 0x1400/0x1401/0x1402 transmission type		
Value	**Designation**	**Description**
0	synchronous	Update RxPDO data on **each** SYNC
1 ... 240	synchronous	Update RxPDO data on **each** SYNC
241 ... 251	reserved	Value not allowed
252	synchronous/RTR	Value not allowed
253	asynchronous/RTR	Value not allowed
254	asynchronous	Event driven (manufacturer specific)
255	asynchronous	Event driven (profile specific) **default value**

Values 254 & 255 are handled identically. Update RxPDO data on each Rx.

Inhibit time:

The inhibit time for RxPDO is without function. Values can be entered, but they are without further function.

Event time:

The event time is used as monitoring function for RxPDOs. If during the set time no RxPDO is received, one of the following faults is triggered:

- 202A Fault RxPDO1
- 202B Fault RxPDO2
- 202C Fault RxPDO3

Example*:

	COB ID	CB	Index	SI	Data
Read Request	601	40	00 14	02	00
Reply	581	4F	00 14	02	FF
Read Request	601	40	00 14	01	00
Reply	581	4F	00 14	01	01 02 00 00
Write Access	601	23	00 14	01	01 02 00 80
Reply *	581	60	00 14	01	00 00 00 00
Write Access	601	2F	00 14	02	05
Reply *	581	60	00 14	02	00
Write Access	601	23	00 14	01	01 02 00 00
Reply *	581	60	00 14	01	00 00 00 00

CB: Control byte SI: Sub Index All values in hexadecimal without leading 0x

* Note, that Object 1400/1 Highest has to be deactivated first for the correct Write access for Object 1400/2.

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0x160n/n, RxPDOn Mapping Object

Index	Sub-index	Designation	Data type	Access	Default
0x160n	0	RxPDOn	Unsigned8	rw	2
	1	1st mapped obj.	Unsigned32	rw	See text
	2	2nd mapped obj.	Unsigned8	rw	See text
	3	3rd mapped obj.	Unsigned8	rw	See text
	4	4th mapped obj.	Unsigned8	rw	See text
	5	5th mapped obj.	Unsigned8	rw	See text
	6	6th mapped obj.	Unsigned8	rw	See text
	7	7th mapped obj.	Unsigned8	rw	See text
	8	8th mapped obj.	Unsigned8	rw	See text

RxPDO Mapping objects:

- 0x1600/n RxPDO1
- 0x1601/n RxPDO2
- 0x1602/n RxPDO3
- 0x1600/0 = 0 = no object mapped
- 0x1600/0 = 1 … 8 = 1 … 8 mapped objects

Mapping entry:

MSB			LSB
Object index		Sub-index	Length (no. of bits)
High byte	Low byte	si	ll

Examples:

Mapping of 0x6040/0 Control word (unsigned16 = `10hex`) to 1st mapped object in RxPDO1:

0x1600/1 = 0x60400010

Mapping of 0x60C1/1 interpolation data record 1 (integer32 = 20hex) to 2nd mapped object in RxPDO1:

0x1600/2 = 0x60C10120

Default mapping

RxPDO1	0x1600/0	0x1600/1	0x1600/2	0x1600/3…8
	2	0x6040 Control word	0x6042 *v*/target velocity	0x00000000
RxPDO2	0x1601/0	0x1601/1…8		
	1	0x6040 Control word		
RxPDO3	0x1602/0	0x1602/1…8		
	1	0x6040 Control word		

Example*:

	COB ID	CB	Index	SI	Data
Read Request	601	40	00 16	01	00 00 00 00
Reply	581	43	00 16	01	10 00 40 60
Write Access	601	2F	00 16	00	00
Reply *	581	60	00 16	00	00 00

CB: Control byte SI: Sub Index All values in hexadecimal without leading 0x

* Note, that Object 1400/1 Highest bit has to be deactivated first for the correct Write access for Object 1600/n. See also the Mapping sequence described in the following.

Mapping Sequence

The mapping sequence requires five steps:

Step 1:

Set PDO to "not valid" (0x1400, Sub-index 1, Bit 31 = 1)

Step 2:

Set sub-index 0 to 0 (deactivate current mapping, 0x1600, Sub-index 0 = 0)

Step 3:

Set sub-index 1 … n to the new objects (0x1600, Sub-index 1..n = new object)

Step 4:

Set sub-index 0 to the number of mapped objects (activate new mapping, 0x1600, Sub-index 0 = n)

Step 5:

Set PDO valid (0x1400, Sub-index 1, Bit 31 = 0)

TxPDO 0x1600 is used exemplary above. The same procedure applies to 0x1601 and 0x1602. In these cases, 0x1400 has to be substituted accordingly with 0x1401 or 0x1402.

Example (Node ID = 1):

	COB ID	**Control byte**	**Index** LSB MSB	**Sub-index** Sub-index	**Data** LSB …	**Data** … MSB
Step 1:	601	23	00 14	01	01 02	00 80
Response	581	60	00 14	01	00 00	00 00
Step 2:	601	2F	00 16	00	00	
Response	581	60	00 16	00	00	
Step 3.1:	601	23	00 16	01	10 00	42 60
Response	581	60	00 16	01	00 00	00 00

	COB ID	Control byte	Index	Sub-index	Data	Data
Step 3.2	601	23	00 16	02	10 00	40 60
Response	581	60	00 16	02	00 00	00 00
Step 3.3	601	23	00 16	03	08 00	60 60
Response	581	60	00 16	03	00 00	00 00
Step 4:	601	2F	00 16	00	03	
Response	581	60	00 16	00	00	
Step 5:	601	23	00 14	01	01 02	00 00
Response	581	60	00 14	01	00 00	00 00

Resulting mapping

Target velocity (0x6042)	Control word (0x6040)	Modes of operation (0x6060)
00 00	00 00	00

This example shows the necessary telegrams with the according responses of the device.

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0x180n/n, TxPDO Communication Objects

Index	Sub-index	Designation	Data type	Access	Default
0x1800 0x1801 0x1802	0	TPDO n comm parameter	Unsigned8	ro	5
	1	TPDO n comm parameter	Unsigned32	rw	See text
	2	TPDO n COB ID	Unsigned8	rw	255
	3	TPDO n Transmission type	Unsigned16	rw	See text
	5	TPDO n Inhibit time	Unsigned16	rw	See text

TxPDO Communication objects:

0x1800/n TxPDO1

COB-ID Default value: 0x180 (=384) +Node ID

0x1801/n TxPDO2

COB-ID Default value: 0x280 (=640) +Node ID

0x1802/n TxPDO3

COB-ID Default value: 0x380 (=896) +Node ID

These communication objects define the COB-ID and transmission type used by the TxPDOs. The default setting for the COB-ID depends on the Node ID and can be changed. The default value for the transmission type is 255 (event driven) and can also be changed (see table).

Object 0x1800/0x1801//1802 COB-ID				
Bit 31	Bit 30	Bit 29	Bit 11 ... 28	Bit 0 ... 10
valid	**0**	frame	**0**	11 bit CAN-ID

Bit 31:0 = PDO existent / valid

1 = PDO non-existent / not valid

Bit 29:0 = 11 Bit ID

1 = 29 Bit ID **NOT ALLOWED**

Bit 0 ... 10:

11 bit CAN-ID

TxPDO1 Default = valid

TxPDO2/3 Default = not valid

Object 0x1800/0x1801/0x1802 transmission type		
Value	**Designation**	**Description**
0	Synchronous	Update TxPDO data and send on SYNC **only** when data has changed
1 … 240	Synchronous	Update TxPDO data and send on **each** "n" SYNC
~~241 … 251~~	Reserved	Value not allowed
252	synchronous/RTR	Update TxPDO data on SYNC and send **on following** RTR
253	asynchronous/RTR	Update TxPDO data and send on RTR
254	asynchronous	Event driven (manufacturer specific)
255	asynchronous	Event driven (profile-specific) **default value**

Values `254` and `255` are handled identically. Send TxPDO on data change or event time.

Inhibit time:

The inhibit time is the minimum time distance between two consecutive TxPDOs for asynchronous TxPDOs. During the inhibit time, the TxPDO is not sent again. Therefore, a value change occurring in this time is sent only after the inhibit time has elapsed. The value range is `0…65535`.

The inhibit time is set in hundreds of microseconds, e.g. a value of `300` is `300 *100 us = 30 ms`.

The device internal time resolution for the inhibit time is in milliseconds, the last digit is always converted to "0". An inhibit time value = `37` is truncated to `30` [3.7 ms → 3 ms].

Values less than `10` are interpreted as `0`.

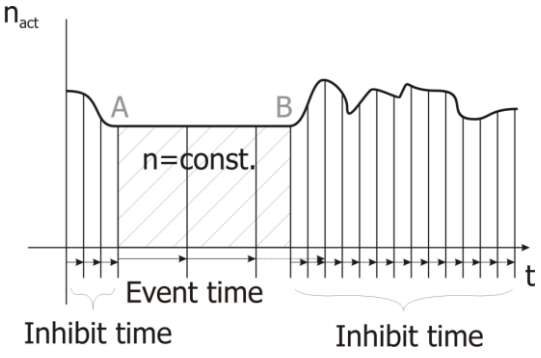
Event time:

The event time is the time distance between two consecutive TxPDOs whenever the TxPDO data has not changed (cycle time). If the inhibit time is set to `0`, the TxPDO is only sent on a change of the TxPDO's data. The value range is `0…65535`.

The event time is set in milliseconds, e.g. a value of `2000 = 2000 ms`.

Example Event time & Inhibt time:

The actual speed value is transferred via TxPDO. The value is updated after the inhibit time has elapsed. At time A, the value remains constant. During this time, the value is updated after the Event time has elapsed. At time B, the value changes and is transmitted via TxPDO. The value changes again frequently and is only updated after the inhibit time has elapsed



Sub-index 4:

Sub-index 4 is included for compatibility reasons. An SDO read/write access to sub-index 4 results in an SDO abort.

Example*:

	COB ID	CB	Index	SI	Data
Read Request	601	40	00 18	02	00
Reply	581	4F	00 18	02	FF
Read Request	601	40	00 18	01	00
Reply	581	4F	00 18	01	81 01 00 00
Write Access	601	23	00 18	01	81 01 00 80
Reply *	581	60	00 18	01	00 00 00 00
Write Access	601	2F	00 18	02	05
Reply *	581	60	00 18	02	00
Write Access	601	23	00 18	01	81 01 00 00
Reply *	581	60	00 18	01	00 00 00 00

CB: Control byte SI: Sub Index All values in hexadecimal without leading 0x

* Note, that Object 1800/1 highest bit has to be deactivated first for the correct Write access for Object 1800/2.

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0x1A00/n, TxPDO Mapping Object

Index	Sub-index	Designation	Data type	Access	Default
0x1A00	0	Number of mapped objects	Unsigned8	rw	2
	1	1st mapped obj.	Unsigned32	rw	See text
	2	2nd mapped obj.	Unsigned32	rw	See text
	3	3rd mapped obj.	Unsigned32	rw	See text
	4	4th mapped obj.	Unsigned32	rw	See text
	5	5th mapped obj.	Unsigned32	rw	See text
	6	6th mapped obj.	Unsigned32	rw	See text
	7	7th mapped obj.	Unsigned32	rw	See text
	8	8th mapped obj.	Unsigned32	rw	See text

TxPDO Mapping objects:

- 0x1A00/n TxPDO1
- 0x1A00/0 = 0 = no object mapped
- 0x1A00/0 = 1 … 8 = 1 … 8 mapped objects

Mapping entry:

MSB			LSB
Object index		Sub-index	Length (no. of bits)
High byte	Low byte	si	ll

Examples:

Mapping of 0x6041/0 Statusword (unsigned16) to "1st mapped obj." in TxPDO1:

0x1A00/1 = 0x60410010

Mapping of 0x6064/0 Position actual value (integer32) to "2nd mapped obj." in TxPDO1:

0x1A00/2 = 0x60640020

Default mapping

TxPDO1	0x1A00/0	0x1A00/1	0x1A00/2	0x1A00/3…8

	2	0x6041 Status word	0x6044 *v*/ velocity actual value	0x00000000
TxPDO2	0x1A01/0	0x1A01/1		
	0	0x6041 Status word		
TxPDO3	0x1A02/0	0x1A02/1		
	0	0x6041 Status word		

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0x1F51, Program Control

Index	Designation	Data type	Access	Default
0x1F51	Program Control	Unsigned8	rw	1

This object allows changing and querying the state of a program.

The `clear` command is only allowed for the state `Stopped/StoppedReset/NoProg` (Flash must be present and no write or delete process is active). If `clear` is transmitted via CANopen, the file addressed in the sub-index shall be deleted. The object is then prepared for the block programming. If transmitted via protocols other than CANopen, the `clear` command shall be ignored.

```
1     CANopen_EProgramControl_Stop  = 0,
2     CANopen_EProgramControl_Start = 1,
3     CANopen_EProgramControl_Reset = 2,
4     CANopen_EProgramControl_Clear = 3,
5
6     CANopen_EProgramState_Stopped      = 0,
7     CANopen_EProgramState_Started      = 1,
8     CANopen_EProgramState_StoppedReset = 2,
9     CANopen_EProgramState_NoProg       = 3,
```

`Stop`, `Start` and `Reset` may always be written. They do not have consequences for the inverter functionality.

The write process is started with the command `CANopen_EProgramControl_Clear`.

Depending on the Sub-index of **0x1F51** the corresponding program is opened. This deletes the memory array. The process takes 30 s to complete.

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0x1F56 Program software identification

This object gives back either the version of the file addressed via the Sub-index, or `0`, if there is no valid file.

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0x1F57 Flash status register

The object displays by the value 0 that no error is present. During data transmission the value is 1. In the case of transmission abort the value is a combination of the inverter error code and the CANopen error code.

The following error messages are defined in CANopen for the file download. The error code is transmitted in 7 Bits of the object.

```
10    CANopen_EErr1F57_NoErr                    = 0,
11    CANopen_EErr1F57_NoValidProgramAvailable  = 1,
12    CANopen_EErr1F57_DataFormatUnknown        = 2,
13    CANopen_EErr1F57_DataFormatOrCrcErr       = 3,
14    CANopen_EErr1F57_FlashNotCleared          = 4,
15    CANopen_EErr1F57_FlashWriteErr            = 5,
16    CANopen_EErr1F57_GeneralAddressErr        = 6,
17    CANopen_EErr1F57_FlashSecured             = 7,
18    CANopen_EErr1F57_UnspecifiedErr           = 63,
19    CANopen_EErr1F57_ManufErr0Timeout         = 64,
20    CANopen_EErr1F57_ManufErr1ClientAbort     = 65,
```

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19.3 Axia objects (0x2nnn)

Handling of data sets/cyclic writing of the parameters

The parameter values are accessed based on the parameter number and the required dataset. There are parameters which only have one value (data set 0), as well as parameters which have four values (data sets 1...4). The latter are used for the data set change-over of a parameter.

NOTE

The values are entered automatically in the EEPROM of the controller. However, only a limited number of write cycles is permissible for the EEPROM (approx. 1 million cycles). When this number is exceeded, the EEPROM will be destroyed.

The number of consecutive write cycles per minute is limited to `10`.

19.4 Axia objects (0x3000 ... 0x5FFF)

In addition to the device profile objects the following manufacturer specific objects are implemented.

19.5 Device Profile Objects (0x6nnn)

0x603F Error Register

Index	Sub-index	Designation	Data type	Access	Default
0x603F	0	Error code	Unsigned16	ro	

In object **0x603F** *error register*, the last error that has occurred will be saved.

According to CANopen® DS402, a great number of possible error messages is specified. The following list shows the relation between the error code displayed by the frequency inverter on the control panel and the error saved in object *error register*.

Error reports

Device Error		DS402 Error code		Designation
F00	xx	00	00	No error has occurred
Overload				
F01	xx	23	10	Frequency inverter was overloaded

Case				
F02	xx	42	10	Case temperature outside the temperature limits
Inside				
F03	xx	41	10	Inside temperature outside of temperature limits
Motor connection				
F04	xx	43	10	Motor temperature too high or sensor defective
Output current				
F05	xx	23	40	Motor phase current above current limit
DC link voltage				
F07	xx	32	10	DC link voltage outside the voltage range
Electronic voltage				
F08	xx	51	11	Electronic voltage outside the voltage range
Motor connection				
F13	xx	23	30	Earth fault on frequency inverter output
Generic error				
Fyy	xx	10	00	Other error messages

For the error code assignment table of the relevant messages, refer to the operating instructions.

In the emergency message, the error code of the frequency inverter is transmitted in bytes 4...7 and the DS402 error code in bytes 0 and 1.

0x6040 Control word

Index	Sub-index	Designation	Data type	Access	Default
0x6040	0	Control word	Unsigned16	rw	0

Object *controlword* **0x6040** is relevant to the frequency inverter if parameter *Control Mode* **0x2200** is set to "`3 - Control via statemachine`". When using CANopen® use object **0x6040** *controlword*.

Control word	
Bit	
0	Switch on
1	Enable voltage
2	Quick stop (Low active)
3	Enable operation
4	Operation mode specific
5	Operation mode specific
6	Operation mode specific
7	Fault reset
8	Halt
9	Operation mode specific
10	Reserved
11	Manufacturer specific
12	Manufacturer specific
13	Manufacturer specific
14	Manufacturer specific
15	Manufacturer specific

Bits 4, 5, 6 and 9…15 are used in motion control configurations only.

0x6041 Status word

Index	Sub-index	Designation	Data type	Access	Default
0x6041	0	Status word	Unsigned16	ro	

Object *statusword* **0x6041** shows the current state of the frequency inverter.

Status word	
Bit	
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop (Low Active)
6	Switch on disabled
7	Warning
8	Manufacturer specific
9	Remote
10	Target reached
11	Internal limit active
12	Operation mode specific
13	Operation mode specific
14	Manufacturer specific
15	Manufacturer specific, Warning2

Bits 8, 12, 13 and 14 are used in motion control configurations only.

0x6042 *vl* target velocity [rpm]

Index	Sub-index	Designation	Data type	Access	Default
0x6042	0	Vl target velocity	Integer16	rw	0

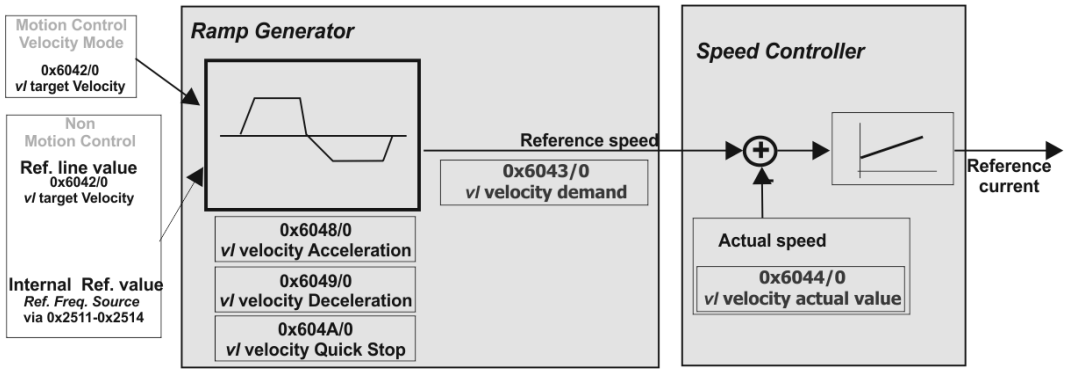
The object *vl target velocity* is the reference speed for the frequency inverter. *vl target velocity* is interpreted as a rotational speed with unit min^{-1}. The internal reference frequency of the frequency inverter is calculated from the target velocity in rpm considering parameter *No. of pole pairs* **0x2005**.

Parameter *No. of pole pairs* **0x2005** has four different datasets. In applications with Motion control, only data set 1 is used.

In applications without Motion Control, more than one motor is connected to the frequency inverter in many cases (only one motor will be active at a time, switched via contactor). These motors can have different numbers of pole pairs. In this case, the entry in parameter *No. of pole pairs* **0x2005** will be different in the four datasets. Upon switching to a motor, object *vl target* velocity must be written at least once in order to enable calculation of the reference frequency of the frequency inverter with the right number of pole pairs.

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6042	*vl* target velocity	-32768	32767

In Non motion Control configurations, the *vl target velocity* reference value is product-internally connected to the Reference line value. This reference value is combined with the internal reference frequency value from the frequency reference value channel in the input of the ramp function.



AXv-FD-TargVel-V02

0x6043 *vl* velocity demand [rpm]

Index	Sub-index	Designation	Data type	Access	Default
0x6043	0	*vl* velocity demand	Integer16	ro	

Object *vl velocity demand* is the output quantity of the ramp function in unit min^{-1}. The object has the same notation as object *vl target velocity* and can be read as an actual value. For calculation of *vl velocity demand*, parameter *No. of pole pairs* **0x2005** is considered (in the same way as described for object *vl target velocity*).

0x6044 *vl* velocity actual value

Index	Sub-index	Designation	Data type	Access	Default
0x6044	0	Vl velocity actual value	Integer16	ro	

Object *vl velocity actual value* is the current speed of the drive in min^{-1}. The object has the same notation as object *vl target velocity* and can be read as an actual value. For calculation of *vl velocity actual value demand*, parameter *No. of pole pairs* **0x2005** is considered (in the same way as described for object *vl target velocity*).

0x6046/n *vl* velocity min max amount

Index	Sub-index	Designation	Data type	Access	Default
0x6046	1	*vl* velocity min amount (RPM)	Unsigned32	rw	See text
	2	*vl* velocity max amount (RPM)	Unsigned32	rw	See text

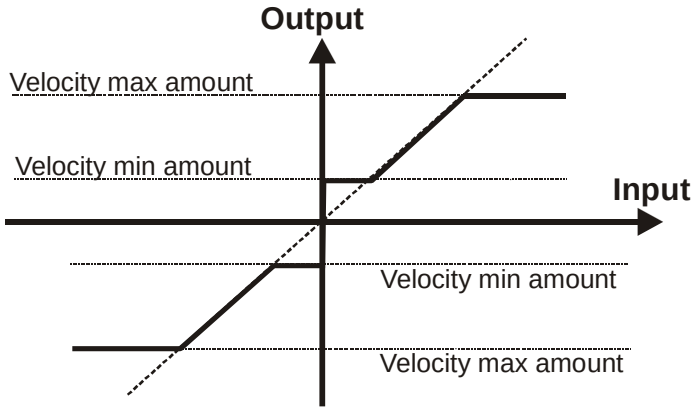
Object *vl velocity min max amount* comprises **0x6046/1** *vl velocity min amount* and **0x6046/2** *vl velocity max amount*.

The unit of **0x6046/n** *vl velocity min max amount* is min^{-1} (positive values only).

The default setting depends on the motor settings used.

When the reference value specified with object **0x6042** *vl target velocity* is smaller than object value **0x6046/1** *vl velocity min amount* or greater than **0x6046/2** *vl velocity max amount*, 0x6042 *vl target velocity* is limited to the relevant values.

No.	Object	Min.	Max.
0x6046/1	*vl* velocity min amount (RPM)	1	32767 (= 0x7FFF)
0x6046/2	*vl* velocity max amount (RPM)	1	32767 (= 0x7FFF)



When objects **0x6046/1** or **0x6046/2** are written and a save parameters instruction is generated after that (object **0x1010**), the object values in the non-volatile memory will be saved.

In Positioning applications, the overall speed can fall below or exceed the limits defined by Minimum and Maximum frequency due to the influence of the Position controller.

0x6048/n *vl* velocity acceleration

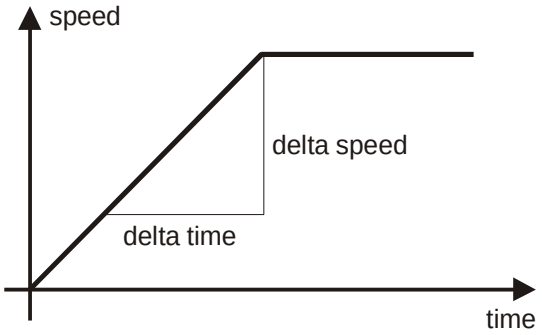
Index	Sub-index	Designation	Data type	Access	Default
0x6048	0	Highest sub-index supported	Unsigned8	ro	2
	1	Delta speed (min^{-1})	Unsigned32	rw	0x96
	2	Delta time (sec)	Unsigned16	rw	1

With object **0x6048** *vl velocity acceleration* the change of speed and startup time is set in velocity mode. Object **0x6048** *vl velocity acceleration* comprises *delta speed* in min^{-1} and *delta time* in seconds.

The frequency gradient during startup is written to parameters *Acceleration clockwise* **0x2530** and *Acceleration anticlockwise* **0x2534** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The values of parameters **0x2530** and **0x2534** are converted to a value in unit frequency/second, considering parameter *No. of pole pairs* **0x2005** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

No.	Object	Min.	Max.
0x6048/1	Delta speed (RPM)	1	32767 (= 0x7FFF)
0x6048/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects **0x6048**/1 or **0x6048**/2 are written and a save parameters instruction is generated after that (object **0x1010**), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Acceleration clockwise* **0x2530** and *Acceleration anticlockwise* **0x2534**.

0x6049/n *vl* velocity deceleration

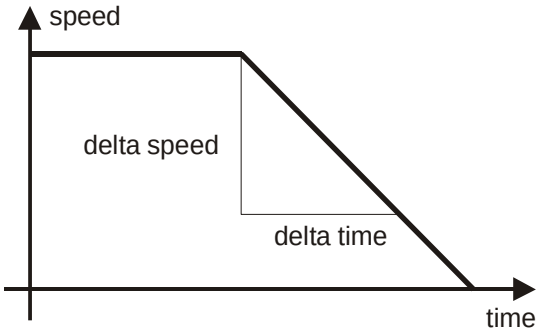
Index	Sub-index	Designation	Data type	Access	Default
0x6049	0	Highest sub-index supported	Unsigned8	ro	2
	1	Delta speed (min^{-1})	Unsigned32	rw	0x96
	2	Delta time (sec)	Unsigned16	rw	1

With object **0x6049** *vl velocity deceleration* the change of speed and shutdown time is set. Object **0x6049** *vl velocity deceleration* comprises *delta speed* in min^{-1} and *delta time* in seconds.

The frequency gradient during shutdown is written to parameters *Deceleration clockwise* **0x2532** and *Deceleration anticlockwise* **0x2536** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The values of parameters *Deceleration clockwise* **0x2532** and *Deceleration* anticlockwise **0x2536** are converted to a value in unit frequency/second, considering parameter *No. of pole pairs* **0x2005** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6049/1	Delta speed (RPM)	1	32767 (= 0x7FFF)
0x6049/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects **0x6049/1** or **0x6049/2** are written and a save parameters instruction is generated after that (object **0x1010**), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Deceleration clockwise* **0x2532** and *Deceleration* anticlockwise **0x2536**.

0x604A/n *vl* velocity quick stop

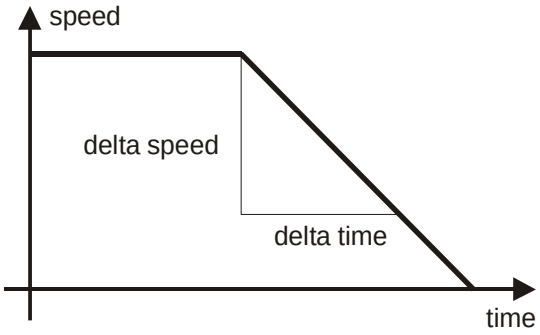
Index	Sub-index	Designation	Data type	Access	Default
0x604A	0	Highest sub-index supported	Unsigned8	ro	2
	1	Delta speed (min^{-1})	Unsigned32	rw	0x96
	2	Delta time (sec)	Unsigned16	rw	1

With object **0x604A** *vl velocity quick stop*, you can set the quick stop deceleration. Object **0x604A** *vl velocity quick stop* comprises speed change in min^{-1} and shutdown time in seconds.

The frequency gradient during shutdown is written to parameters *Deceleration clockwise* **0x2532** and *Deceleration anticlockwise* **0x2536** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The values of parameters *Deceleration clockwise* **0x2532** and *Deceleration* anticlockwise **0x2536** are converted to a value in unit frequency/second, considering parameter *No. of pole pairs* **0x2005** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x604A/1	Delta speed (rpm)	1	32767 (= 0x7FFF)
0x604A/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects **0x6049/1** or **0x6049/2** are written and a save parameters instruction is generated after that (object **0x1010**), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Deceleration clockwise* **0x2532** and *Deceleration* anticlockwise **0x2536**.

0x6060 Modes of operation

Index	Sub-index	Designation	Data type	Access	Default
0x6060	0	Modes of operation	Integer8	wo	2

With object **0x6060** *modes of operation*, you set the designated operation mode of the inverter. Depending on the configuration of the inverter, there are different choices.

Available values for *modes of operation* with inverter in motion control configuration (**0x2200** *Control Mode* = `1 – Control via Statemachine`)

Modes of operation		
Dec. Hex.		**Mode**
1 0x01	–	Profile position mode
2 0x02	–	Velocity mode (Default)
3 0x03	–	Profile velocity mode
4 0x04	–	Torque profile mode
6 0x06	–	Homing mode
7 0x07	–	Interpolated position mode
8 0x08	–	Cyclic sync position mode
9 0x09	–	Cyclic sync velocity mode
-1 0xFF	–	Axia Table travel record (manufacturer specific mode)
-2 0xFE	–	Axia Move away from Limit switch (manufacturer specific mode)
-3 0xFD	–	Axia Electronic Gear (manufacturer specific mode)
-4 0xFC	–	Axia Torque mode (manufacturer specific mode)
-5 0xFB	–	Axia Speed Control (manufacturer specific mode)
-6 0xFA	–	Axia Jog mode (manufacturer specific mode)
-10 0xF6	–	Auto-setup

Object **0x6060** *modes of operation* is limited, as described in the table.

The inverter in non-motion control configuration ignores all settings other than "2". When accessing via SDO, an SDO fault message is generated, that prompts the invalid value.

0x6061 Modes of operation display

Index	Sub-index	Designation	Data type	Access	Default
0x6061	0	Modes of operation display	Integer8	ro	

Object **0x6061** *modes of operation display* acknowledges the previously set value of *modes of operation* by displaying the same value as *modes of operation*.

After setting **0x6060** *modes of operation*, the PLC must wait for this acknowledgement before sending any other command to the inverter.

0x6064 Position actual value

Index	Sub-index	Designation	Data type	Access	Default
0x6064	0	Position actual value	Integer32	ro	

Object **0x6064** *position actual value* represents the actual value of the position measurement device in user units.

The dimension of the user units is defined by **0x6091** *Gear ratio* and **0x6092** *Feed constant*.

0x6065 Following error window

Index	Sub-index	Designation	Data type	Access	Default
0x6065	0	Following error window	Unsigned32	rw	0xFFFF FFFF

Object **0x6065** *Following error window* is used to set the threshold of a device warning when the following error becomes too big.

In the application manual "Positioning", the term "Contouring error" is used instead of the CANopen® term "Following error".

Object **0x6065** *Following error window* defines a range of tolerated position values symmetrical to the *position demand value* defined in user units.

The valid value range of object **0x6065** is `0 … 0xFFFF FFFF (2^32-1)`.

If the value of the *following error window* is set to `0xFFFF FFFF (2^32-1)`, the *Following error window* is switched off.

The actual following error is displayed in object 0x60F4 Following error actual value.

The warning is triggered if the *Following error window* was exceeded for the time specified in Object 0x6066 *following error time out*. The bit 13 ("following error") in the status word is set to `one`. No device fault is triggered.

If object **0x6065** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x6066 Following error time out

Index	Sub-index	Designation	Data type	Access	Default
0x6066	0	Following error time out	Unsigned16	rw	0xA (=10)

When a following error (Object 0x6065 *following error window*) occurs longer than the defined value of object **0x6066** *following error time out* given in milliseconds, the corresponding bit in the Status word (bit 13 "following error") is set to `one`. Additionally, a warning is triggered. No device fault is triggered.

If object **0x6066** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

0x6067 Position window

Index	Sub-index	Designation	Data type	Access	Default
0x6067	0	Position window	Unsigned32	rw	0xFFFF FFFF

The signal "target position reached" can be changed in accuracy with Object **0x6067** *Position window* for the modes which use Status Word Bit 10 "Target reached" as "Target Position reached" like "Profile Positioning Mode" and "Table Travel Record Mode".

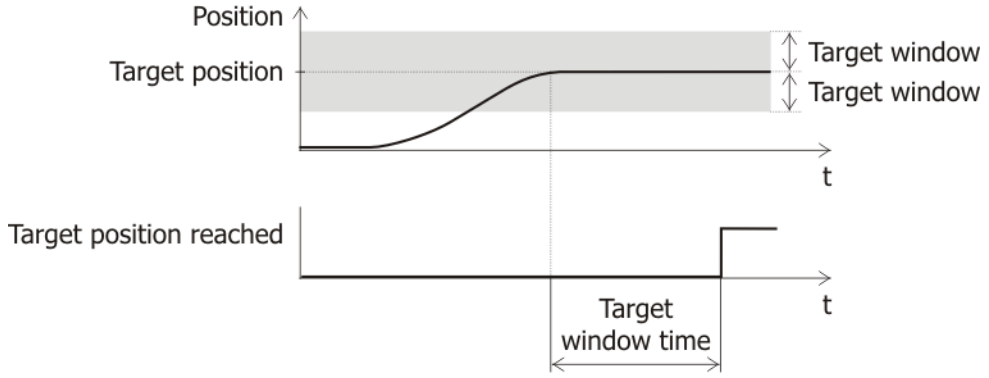
Object **0x6067** *position window* defines a symmetrical range of accepted positions relative to the target position in user units. If the actual value of the position measurement device is within the position window, the target position is regarded as reached. "Target

reached" is displayed in Bit 10 of the status word. The actual position must be inside the position window during the time specified in Object **0x6068** *Position window* time.

If the actual position drifts outside the target window or if a new target position is set, the "Target reached" Bit is reset until the position and time conditions are met again.

The valid value range of object **0x6067** *position window* is `0 … 0x7FFF FFFF (231-1)`. Writing a value of `0x8000 0000 (231)… 0xFFFF FFFE (232-2)` results in an SDO abort (value range).

If the value of *Position window* is set to `0xFFFF FFFF (232-1)` OR `0`, the position window control is switched off.



If object **0x6067** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x6068 Position window time

Index	Sub-index	Designation	Data type	Access	Default
0x6068	0	Position window time	Unsigned16	rw	0xA (=10)

When the actual position is within the *Position window* during the defined *Position window time* (given in milliseconds), then the corresponding bit in the Status word (bit 10 "target reached") is set to one. This is considered in modes, which are using Status Word Bit 10 "Target reached" as "Target Position reached" like "Profile Positioning Mode" and "Table Travel Record Mode".

If object **0x6068** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

0x606C Velocity actual value [u/s]

Index	Sub-index	Designation	Data type	Access	Default
0x606C	0	velocity actual value	Integer32		

The actual velocity value in [u/s] is displayed.

0x606D Velocity Window

Index	Sub-index	Designation	Data type	Access	Default
0x606D	0	Velocity Window	Unsigned16	rw	1000

Object **0x606D** *Velocity window* is used to define the threshold of Bit 10 "Target reached" of the Status word in Profile Velocity mode.

Object **0x606D** *Velocity window* defines the symmetric range around the value of Object **0x60FF** *Target Velocity* in user units/s.

Bit 10 "Target reached" is set in the Status word when the difference between 0x60FF *Target Velocity* and 0x606C *Velocity Actual value* is smaller than the 0x606D *Velocity Window* for a longer time than 0x606E *Velocity Window Time*.

The value range of Object **0x606D** *Velocity Window* is `0 … 65535 u/s`.

If the value of **0x606D** *Velocity Window* is set to 0, bit 10 "Target reached" of the Status word is only set with the exact equality of actual speed and reference speed. It is recommended to set the value large enough to get a reliable status information of Bit 10 "Target reached".

If object **0x606D** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x606E Velocity Window Time

Index	Sub-index	Designation	Data type	Access	Default
0x606E	0	Velocity Window time	Unsigned16	rw	0

Object 0x606E *Velocity window Time* defines the time, for which at least reference velocity and Actual velocity must be similar enough to set Bit 10 "Target reached" of the Status word. The similarity ("Hysteresis") is defined via 0x606D *Velocity Window*.

0x606D *Velocity window* defines the symmetric range around the value of Object **0x60FF** *Target Velocity* in user units/s.

Bit 10 "Target reached" is set in the Status word when the difference between **0x60FF** *Target Velocity* and 0x606C *Velocity Actual value* is smaller than the 0x606D *Velocity window* for a longer time than 0x606E *Velocity Window Time*.

If both conditions are not met at the same time, bit 10 "Target reached" of the Status word is reset.

The value range of Object **0x606E** *Velocity Window Time* is `0 … 65535 ms`.

If object **0x606D** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x606F Velocity Threshold

Index	Sub-index	Designation	Data type	Access	Default
0x606F	0	Velocity Threshold	Unsigned16	rw	100

Object **0x606F** *Velocity Window Threshold* defines a threshold to change Bit 12 "Velocity" of the Status word in Profile Velocity mode. If the absolute value of the Actual Velocity lies for the time given over **0x6070** *Velocity Threshold Time* above the threshold **0x606F** *Velocity Threshold*, the bit is reset. If the Actual Velocity falls below the defined threshold of **0x606F** *Velocity Threshold*, bit 12 "Velocity" of the Status word is set.

The value range of Object **0x606F** *Velocity Window Threshold* is 0 … 65535 u/s.

If object **0x606F** *Velocity Threshold* was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x6070 Velocity Threshold Time

Index	Sub-index	Designation	Data type	Access	Default
0x6070	0	Velocity Threshold Time	Unsigned16	rw	0

If the absolute value of the Actual Velocity lies for the time given over **0x6070** *Velocity Threshold Time* above the threshold **0x606F** *Velocity Threshold*, the bit is reset. If the Actual Velocity falls below the defined threshold of 0x606F *Velocity Threshold*, bit 12 "Velocity" of the Status word is set.

The value range of Object **0x6070** *Velocity Window Time* is `0 … 65535 ms`.

If object **0x606F** *Velocity Threshold* was written and then a save parameters command (object **0x1010**) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by **0x6091** *Gear ratio* and **0x6092** *Feed constant*.

0x6071 Target Torque

Index	Sub-index	Designation	Data type	Access	Default
0x6071	0	Target Torque	Integer16	rw	0

The value `0x3E8` (=1000) is the rated motor torque (100.0 %).

By default, object **0x6071** is not linked to a device function. In order to use object **0x6071**, at least one device function must be linked to the object by setting the relevant parameters.

The value range of object **0x6071** is limited from `-3000` to `3000` (= `-300.0…300.0` %).

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6071	Target Torque	-3000 (= 0xF448)	3000 (= 0x0BB8)

Hexadecimal value 0x6071	Decimal value 0x6071	Percentage of Target Torque
0x03E8	1000	100.0
0x0064	100	10.0
0x0001	1	0.1
0xFF18	-1000	-100.0
0xFF9C	-100	-10.0
0xFFFF	-1	-0.1

0x6077 Torque actual value

Index	Sub-index	Designation	Data type	Access	Default
0x6077	0	Torque actual value	Integer16	ro	

Object **0x6077** *Torque actual value* shows the actual torque (see object *Target torque* **0x6071**).

The value `0x3E8` (=1000) is the rated motor torque (100.0 %). Please also note object 0x6071.

0x6078 Current actual value

Index	Sub-index	Designation	Data type	Access	Default
0x6078	0	Current actual value	Integer16	ro	

Object **0x6078** *Current actual value* shows the actual current value.

The value `0x3E8` (=1000) is the rated motor current (100.0 %). The rated motor current is set during commissioning in parameter **0x2003** *Rated current*.

0x6079 DC link circuit voltage

Index	Sub-index	Designation	Data type	Access	Default
0x6079	0	DClink circuit voltage	Integer32	ro	

Object **0x6079** *DC link circuit voltage* shows the actual value of the DC link voltage in mV. Value `0x0001 86A0` (=100 000) is equivalent to 100.000 V (three decimal places).

0x607A Target position

Index	Sub-index	Designation	Data type	Access	Default
0x607A	0	Target position	Integer32	rw	0

Object **0x607A** *target position* defines the position (in user units) that the drive should move to in profile position mode.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x607C Home offset

Index	Sub-index	Designation	Data type	Access	Default
0x607C	0	Target position	Integer32	rw	0

Object **0x607C** *home offset* defines the offset between the zero position of the position measurement device found during homing and the zero position of the application. All subsequent movements are in relation to the application zero position.

If object **0x607C** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x6081 Profile velocity [u/s]

Index	Sub-index	Designation	Data type	Access	Default
0x6081	0	Profile velocity	Unsigned32	rw	0x5 0000

Object **0x6081** *profile velocity* is the velocity (in user units per second) at the end of the acceleration ramp in profile position mode.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

The values of Object **0x6081** are limited to 1 to 0x7FFF FFFF.

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6081	Profile velocity (u/s)	1	2147483647 (= 0x7FFF FFFF)

0x6083 Profile acceleration

Index	Sub-index	Designation	Data type	Access	Default
0x6083	0	Profile acceleration	Unsigned32	rw	0x5 0000

Object **0x6083** *profile acceleration* is the acceleration in user units per second² [u/s²] in profile position mode.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

The values of Object **0x6083** are limited to 1 to 0x7FFF FFFF (2^{31}-1).

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6083	Profile acceleration (u/s²)	1	2147483647 (= 0x7FFF FFFF)

0x6084 Profile deceleration

Index	Sub-index	Designation	Data type	Access	Default
0x6084	0	Profile deceleration	Unsigned32	rw	0x50000

Object **0x6084** *profile deceleration* is the deceleration in u/s².

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

The values of Object **0x6083** are limited to 1 to 0x7FFF FFFF (2^{31}-1).

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6084	Profile deceleration (u/s²)	1	2147483647 (= 0x7FFF FFFF)

0x6085 Quick stop deceleration

Index	Sub-index	Designation	Data type	Access	Default
0x6085	0	Quick stop deceleration	Unsigned32	rw	0xA 0000

Object **0x6085** *quick stop deceleration* is the deceleration (in user units per second²) in profile position mode for quick stop mode (Control word bit 2 = 0).

If object **0x6085** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

The values of Object **0x6085** are limited to 1 to 0x7FFF FFFF (2^{31}-1).

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6085	Quick stop deceleration (u/s²)	1	2147483647 (= 0x7FFF FFFF)

0x6086 Motion profile type

Index	Sub-index	Designation	Data type	Access	Default
0x6086	0	Motion profile type	Integer16	rw	3

Object **0x6086** *motion profile type* defines the ramp behavior for acceleration/deceleration.

Supported values for *motion profile type*:

0 - Linear
1 - Predictive
2 - Feed Forward
3 - Mono spline

The Ramp Rise/Fall time in `Homing mode` is defined via parameter **0x2598**.

The Ramp Rise/Fall times in these modes are independent of the settings of object **0x6086**.

0x6091/n Gear ratio

Index	Sub-index	Designation	Data type	Access	Default
0x6091	0	Highest sub-index supported	Unsigned8	ro	2
	1	Motor shaft revolutions	Unsigned32	rw	1
	2	Driving shaft revolutions	Unsigned32	rw	1

Object **0x6091** *gear ratio* defines the ratio of motor shaft revolutions to driving shaft revolutions.

$$\text{Gear ratio} = \frac{\text{0x6091/1 motor shaft revolutions}}{\text{0x6091/2 driving shaft revolutions}}$$

If object **0x6091/1** or **../2** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

Object	
0x6091/1	Motor Shaft revolutions
0x6091/2	Driving Shaft revolutions

The values of Objects **0x6091/1** and **0x6091/2** are limited as follows:

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6091/1	Motor shaft revolutions	1	65535 (= 0x0000 FFFF)
0x6091/2	Driving shaft revolutions	1	65535 (= 0x0000 FFFF)

0x6092/n Feed constant

Index	Sub-index	Designation	Data type	Access	Default
0x6092	0	Highest sub-index supported	Unsigned8	ro	2
	1	Feed	Unsigned32	rw	0x1 0000
	2	(Driving) shaft revolutions	Unsigned32	rw	1

Object **0x6092** *feed constant* defines the feed (in user units) per driving shaft revolutions.

$$\text{Feed constant} = \frac{\text{0x6092/1 feed}}{\text{0x6092/2 driving shaft revolutions}}$$

The allowed value for **0x6092/2** *driving shaft revolutions* is 1 only. Writing values other than 1, results in an SDO abort response.

If object **0x6092/1** or **0x6092/2** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The values of Object **0x6092/1** and **0x6092/2** are limited as follows:

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6092/1	Feed	1	65535 (= 0x0000 FFFF)
0x6092/2	(Driving) shaft revolutions	1	1

0x6098 Homing method

Index	Sub-index	Designation	Data type	Access	Default
0x6098	0	Homing method	Integer8	rw	0

Object **0x6098** *homing method* determines the method that will be used during homing. For a detailed description of the different homing modes ☞ 🕮 application manual "Positioning".

If object **0x6098** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

Homing Method 0x6098		Function
0 -	No Homing	**Default.** No homing; the current position value is not changed. The current position value is the value saved upon the last disconnection of the power supply.
1 -	Neg. Limit Switch & Ref. -Signal	Homing to negative HW limit switch with detection of encoder ref. signal.
2 -	Pos. Limit Switch & Ref. -Signal	Homing to positive HW limit switch with detection of encoder ref. signal.
3 -	Pos. Home-Sw., Ref.-Signal left of Edge	Homing to positive home switch with detection of encoder ref. signal. Home position is the first encoder ref. signal to the left of the edge of the home switch signal.
4 -	Pos. Home-Sw., Ref.-Signal right of Edge	Homing to positive home switch with detection of encoder ref. signal. Home position is the first encoder ref. signal to the right of the edge of the home switch signal.
5 -	Neg. Home-Sw., Ref.-Signal right of Edge	Homing to negative home switch with detection of encoder ref. signal. Home position is the first encoder ref. signal to the right of the edge of the home switch signal.
6 -	Neg. Home-Sw.: Ref.-Signal left of Edge	Homing to negative home switch with detection of encoder ref. signal. Home position is the first encoder ref. signal to the left of the edge of the home switch signal.
7 -	Pos. Lim.-Sw., Ref.-Sig. left of left Edge of Home-Sw.	Homing to home switch with detection of encoder ref. signal. Homing direction positive (clockwise). Reversal of direction of rotation when positive HW limit switch is reached. Home position is the first encoder ref. signal to the left or right of the left or right edge of the home switch signal.
8 -	Pos. Lim.-Sw., Ref.-Sig. right of left Edge of Home-Sw.	
9 -	Pos. Lim.-Sw., Ref.-Sig. left of right Edge of Home-Sw.	
10 -	Pos. Lim.-Sw., Ref.-Sig. right of right Edge of Home-Sw.	

Homing Method 0x6098		Function
11 -	Neg. Lim.-Sw., Ref.-Sig. right of right Edge of Home-Sw.	Homing to home switch with detection of encoder ref. signal. Homing direction negative (anticlockwise). Reversal of direction of rotation when negative HW limit switch is reached. Home position is the first encoder ref. signal to the left or right of the left or right edge of the home switch signal.
12 -	Neg. Lim.-Sw., Ref.-Sig. left of right Edge of Home-Sw.	
13 -	Neg. Lim.-Sw., Ref.-Sig. right of left Edge of Home-Sw.	
14 -	Neg. Lim.-Sw., Ref.-Sig. left of left Edge of Home-Sw.	
17 ... 30: like 1 ... 14, but without encoder ref. signal		
17 -	Neg. Limit Switch	Homing to negative HW limit switch.
18 -	Pos. Limit Switch	Homing to positive HW limit switch.
19 -	Pos. Home-Sw., left of Edge	Homing to positive home switch. Home position is at the left of the edge of the home switch signal.
20 -	Pos. Home-Sw., right of Edge	Homing to positive home switch. Home position is at the right of the edge of the home switch signal.
21 -	Neg. Home-Sw., right of Edge	Homing to negative home switch. Home position is at the right of the edge of the home switch signal.
22 -	Neg. Home-Sw., left of Edge	Homing to negative home switch. Home position is at the left of the edge of the home switch signal.
23 -	Pos. Lim.-Sw., left of left Edge of Home-Sw.	Homing to home switch. Homing direction positive (clockwise). Reversal of direction of rotation when positive HW limit switch is reached. Home position is at the left or right of the left or right edge of the home switch signal.
24 -	Pos. Lim.-Sw., right of left Edge of Home-Sw.	
25 -	Pos. Lim.-Sw., left of right Edge of Home-Sw.	
26 -	Pos. Lim.-Sw., right of right Edge of Home-Sw.	
27 -	Neg. Lim.-Sw., right of right Edge of Home-Sw.	Homing to home switch. Homing direction negative (anticlockwise). Reversal of direction of rotation when negative HW limit switch is reached. Home position is at the left or right of the left or right edge of the home switch signal.
28 -	Neg. Lim.-Sw., left of right Edge of Home-Sw.	
29 -	Neg. Lim.-Sw., right of left Edge of Home-Sw.	
30 -	Neg. Lim.-Sw., left of left Edge of Home-Sw.	

33 -	Ref.-Signal left of act. pos.	Home position is the first encoder ref. signal in negative (operation mode 33) or positive (operation mode 34) direction.
34 -	Ref.-Signal right of act. pos.	
35 -	Current Position	Current position is home position. Home offset (Parameter *Home-Offset* **0x607C**) is taken over as actual position value.

0x6099/n Homing speeds

Index	Sub-index	Designation	Data type	Access	Default
0x6099	0	Highest sub-index supported	Unsigned8	ro	2
	1	speed during search for switch	Unsigned32	rw	0x5 0000
	2	speed during search for zero	Unsigned32	rw	0x2 0000

Object **0x6099/1** *speed during search for switch* defines the speed (in user units per second) during search for switch.

Object **0x6099/2** *speed during search for zero* defines the speed (in user units per second) during search for zero. This speed is also used as reference value in the "*Move away from Limit Switch*" mode.

The values of Object **0x6099/1** and **0x6099/2** are limited as follows:

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x6099/1	speed during search for switch	1	2147483647 (= 0x7FFF FFFF)
0x6099/2	speed during search for zero	1	2147483647 (= 0x7FFF FFFF)

If object **0x6099/1** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

If object **0x6099/2** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is set via objects 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x609A Homing acceleration

Index	Sub-index	Designation	Data type	Access	Default
0x609A	0	Homing acceleration	Unsigned32	rw	0x5 0000

Object **0x609A** *homing acceleration* defines acceleration and deceleration (in user units per second^2) during homing.

The set value is also used as reference acceleration and deceleration value in "Move away from Limit Switch" mode.

If object **0x609A** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is set via objects 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

The values of Object **0x609A** are limited as follows:

Object		Setting	
Index	**Object**	**Min.**	**Max.**
0x609A	Homing acceleration	1	2147483647 (= 0x7FFF FFFF)

0x60C1/1 Interpolation data record

Index	Sub-index	Designation	Data type	Access	Default
0x60C1	0	Highest sub-index supported	Unsigned8	ro	1
	1	Interpolation data record 1	Integer32	rw	0

Object **0x60C1/1** *interpolation data record 1* is the target position (in user units) used in interpolation position mode.

Always ensure that a valid position is stored in the Interpolated Data Record.

It is recommended to copy the actual position to the Data Record before starting the Interpolated mode.

Interpolation position mode uses synchronous RxPDOs. The last received value for object **0x60C1/1** is activated with the next SYNC.

The dimension of the user units is set via objects 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

Mapping of object **0x60C1/1** *interpolation data record 1* is not via a selection list. If a sub-index were selected via a selection list, conformity inconsistencies in the test specification would be the result.

Mapping of object **0x60C1/1** *interpolation data record 1* is done manually.

0x60F4 Following error actual value

Index	Sub-index	Designation	Data type	Access	Default
0x60F4	0	Following error actual value	Integer32	ro	

In the application manual "Positioning", the term "Contouring error" is used instead of the CANopen® term "Following error".

Object **0x60F4** shows the *following error actual value*.

The allowed following error is defined by object 0x6065 *Following error window*.

The Contouring error can be monitored internally to trigger a device fault if a set threshold was reached.

0x60F8 Max Slippage [u/s]

Index	Sub-index	Designation	Data type	Access	Default
0x60F8	0	Max Slippage	Integer32	rw	0

Object **0x60F8** *Max Slippage* can be used to trigger a warning in bit 13 "maximum slip fault" in the status word when a too high slip occurs. When the difference of stator frequency and actual speed exceeds the value set in **0x60F8** *Max Slippage*, Bit 13 "Max Slippage" of the Status word is set, otherwise reset.

If object **0x60F8** was written and then a save parameters command (object 0x1010) processed, the object value is stored in non-volatile memory.

The dimension of the user units is defined by 0x6091 *Gear ratio* and 0x6092 *Feed constant*.

0x60FF Target Velocity [u/s]

Index	Sub-index	Designation	Data type	Access	Default
0x60FF	0	Target Velocity	Integer32	rw	0

Object **0x60FF** *Target Velocity* defines the reference velocity in Profile velocity mode and Cyclic Synchronous Velocity mode.

0x6502 Supported drive modes

Index	Sub-Index	Designation	Data Type	Access	Default
0x6502	0	Supported drive modes	Unsigned32	ro	

Object **0x6502** *Supported drive modes* displays the supported 0x6060 Modes of Operation.

The value 0x00000202 means:

Bit 0 Profile Positioning mode" is supported.
Bit 1 Velocity mode" is supported.
Bit 2 Profile Velocity mode" is supported.
Bit 5 Homing mode" is supported.
Bit 6 "Interpolated Position mode" is supported.
Bit 7 Cyclic Synchronous Positioning mode" is supported.
Bit 8 Cyclic Synchronous Velocity mode" is supported.

Bit 16 Manufacturer mode -1 "Axia Table Travel record" mode is supported.
Bit 17 Manufacturer mode -2 "Axia Move away from limit switch" is supported.
Bit 18 Manufacturer mode -3 "Axia Electronic Gear " is supported.

Example:

	COB ID	CB	Index	SI	Data
Read Request	601	40	02 65	00	00 00 00 00
Response	581	43	02 65	00	02 02 00 00

CB: Control byte SI: Sub-Index All values in hexadecimal without leading "0x"

20 Annex

INDEX

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Abbiamo un'inflessibile dedizione per l'eccellenza, l'innovazione e la sostenibilità. Il nostro Team crea, distribuisce e supporta soluzioni di Trasmissioni e Controllo di Potenza per mantenere il mondo in movimento

We have a relentless commitment to excellence, innovation & sustainability. Our team creates, distributes and services world-class power transmission & drive solutions to keep the world in motion.

Wir verpflichten uns kompromisslos zu Qualität, Innovation und Nachhaltigkeit. Unser Team entwickelt, vertreibt und wartet erstklassige Energieübertragungs- und Antriebslösungen, um die Welt in Bewegung zu halten

Notre engagement envers l'excellence, l'innovation et le développement durable guide notre quotidien. Notre Équipe crée, distribue et entretient des solutions de transmission de puissance et de contrôle du mouvement contribuant ainsi à maintenir le monde en mouvement.

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