Bonfiglioli
Vectron

AXIA VERT
Encoder Module Manual
EMA-ABS-21

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

Bonfiglioli

TABLE OF CONTENTS

1 General Information about the Documentation 5

1.1 Instruction manuals 5

1.2 This document 5

1.3 Warranty and liability 6

1.4 Obligation 6

1.5 Copyright 6

1.6 Storage 6

2 General safety instructions and information on use 7

2.1 Terminology 7

2.2 Designated use 7

2.3 Misuse 8

2.4 Residual risks 8

2.5 Safety and warning signs on frequency inverter 8

2.6 Warning information and symbols 8

2.6.1 Hazard classes 8

2.6.2 Hazard symbols 9

2.6.3 Prohibition signs 9

2.6.4 Personal safety equipment 9

2.6.5 Recycling 9

2.6.6 Grounding symbol 9

2.6.7 ESD symbol 9

2.6.8 Information signs 9

2.6.9 Font style in documentation 10

2.7 Directives and guidelines to be adhered to by the operator 10

2.8 Operator's general plant documentation 10

2.9 Operator's/operating staff's responsibilities 10

2.9.1 Selection and qualification of staff 10

2.9.2 General work safety 10

2.9.3 Ear protectors 10

2.10 Organizational measures 11

2.10.1 General 11

2.10.2 Use in combination with third-party products 11

2.10.3 Handling and installation 11

2.10.4 Electrical connections 11

2.10.5 Safe operation 11

2.10.6 Maintenance and service/troubleshooting 12

2.11 Final decommissioning 12

3 Introduction 14

4 Technical data 15

5 Installation 16

5.1 General 16

5.2 Mechanical installation 16

5.3 Electrical Installation 19

5.3.1 Sockets 19

5.3.2 Cable assembly EnDat 2.2 for BCR/BTD 20

5.3.3 Cable assembly EnDat 2.2 for BMD 21

6 Object Structure 22
7 Commissioning the encoder 23
7.1 General Steps 23
7.2 EnDat 2.2 encoders 24
7.3 Commissioning linear encoders 25
8 Control Input and Output Objects 28
8.1 Encoder input EMA-ABS-21 28
8.2 Actual value display 28
8.2.1 Absolute value encoder - raw data 29
8.2.2 Actual position 29
8.3 Motor temperature 29
9 Annex 30
9.1 Error messages 30
Index 32

1 General Information about the Documentation

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

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 software.

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.

Installation instructions

The installation manual describes the installation and use of devices, complementing the "Quick Start Guide" and the user manual.

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 modules	Installation and commissioning of communication interface modules.
Manuals Extension modules	Installation and commissioning of encoder interface modules.
Safety manual	Safety modules and their functions, commissioning and operation.
Application manuals	Application-specific settings, best practices and preconditions. (pending)
Graphical User Interface Manual	Description of intended use of the GUI. (pending)
Software PLC Manual	(pending)

1.2 This document

This document describes the encoder module EMA-ABS-21 for the frequency inverters of the AXIA series.

The user manual contains 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:

Operating Instructions Document

Functional Safety Manual

1.3 Warranty and liability

BONFIGLIOLI Deutschland GmbH (hereinafter referred to as "manufacturer") states that the contents of this document do not form part of any previous or existing agreement, assurance or legal relationship between the manufacturer and the user of the document (hereinafter referred to as the "User"). Neither are they intended to supplement or replace such agreements, assurances, or legal relationships. 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 the document without prior notice. The manufacturer assumes no responsibility to update the document. 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

Read the document before commissioning and comply with it. 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 this document, the Operating Instructions and, in particular, the safety instructions in order to prevent personal and material losses.

1.5 Copyright

1.6 Storage

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

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 are 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.

During operation, all covers must be installed correctly, and all electrical cabinet doors must be closed to minimize electrical hazards.

When LEDs and other indicating elements on the frequency inverter go out, this does not necessarily mean that the device is deenergized. Before carrying out any Work at the device where contact with energized parts might be possible, it must be checked in any case, i.e. irrespective of the status of any indicating elements that may be installed, if the device is deenergized.

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

2.6.1 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.

2.6.2 Hazard symbols

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

2.6.3 Prohibition signs

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

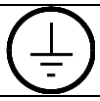
2.6.4 Personal safety equipment

Symbol	Meaning
	Wear body protection
	Wear ear protectors

2.6.5 Recycling

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

2.6.6 Grounding symbol

Symbol	Meaning
	Ground connection

2.6.7 ESD symbol

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

2.6.8 Information signs

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

2.6.9 Font style in documentation

Example	Font style	Use
0x1234	bold	Representation of object numbers
/01	bold, underlined	Representation of sub-index numbers
/d01	bold, underlined	Representation of data set numbers
Object	Italic, Font Times New Roman	Representation of object names
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 object values / object settings

2.7 Directives and guidelines to be adhered to by the operator

The operator must follow 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 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 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, see Chapter 7 "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:

1 Disconnect
2 Secure to prevent restarting
3 check for absence of voltage,
4 carry out earthing and short-circuiting
5 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.

2.11 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.

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

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

For more information about the decommissioning of the device refer to the applicable operating instructions document.

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.

3 Introduction

This document describes the capabilities and the properties of the EMA-ABS-21 encoder module for the frequency inverters of the AXIA device series.

This document exclusively describes the EMA-ABS-21 encoder module. It does not provide basic information on the operation of the AXIA series frequency inverters.

The EMA-ABS-21 encoder module is an optional hardware component to extend the functionality of the frequency inverter. It allows using sensors of the type "Hiperface DSL absolute encoder" with the frequency inverter.

The EMA-ABS-21 encoder module is a separate component and may have to be fitted by the user. "Mechanical Installation".

The EMA-ABS-21 expansion module extends the functionality of the frequency inverters with the following additional functions:

Encoder interface is provided via HD-Sub-D female connector.

Supported encoder types:

EnDat 2.2,

Voltage output for encoder supply is adjusted automatically according to data saved in the encoder.

Depending on the motor and encoder type used there may be restrictions to its usability in some applications.

4 Technical data

When using the EMA-ABS-21 extension module, consider the technical data of the main device.

Encoder and PTC input X412/X422 (HD-Sub-D)	
Encoder input:	**PTC input**
Internal resistance <100 Ω	PTC or temperature sensor: 0…5 kΩ

Function and signal	
Function	**Signal**
Housing	Shield connected with PE
C-/C+	Clock
Data P+/Data P-	Data signal
TM-/Temp+	Motor Temperature Evaluation
V_ABS	Power
V_Sense	Feedback Encoder Voltage

BONFIGLIOLI servo motors of types BCR and BTD are provided with safe isolation to the motor winding.

BONFIGLIOLI recommends connecting an external power supply to the voltage input of the control terminal. This auxiliary voltage enables powering an encoder via the voltage output of the control terminal. Note the encoder manufacturer's input power specifications.

5 Installation

5.1 General

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.
- Comply with the documentation and device specifications 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 mechanical and electrical installation of the EMA-ABS-21 encoder module is to be carried out by qualified personnel according to the general and regional safety and installation directives.

Safe operation of the frequency inverter requires that the documentation and the device specification be complied with during installation and start of operation. For specific areas of application further provisions and guidelines must be complied with where applicable.

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. The electromagnetic interference is to be avoided by expert installation and observation of the specific product information.

For further information, refer to the chapter "Electrical Installation" of the frequency inverter operating instructions.

5.2 Mechanical installation

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.

Before assembly or disassembly of the EMA-ABS-21 encoder module, the frequency inverter must be de-energized.

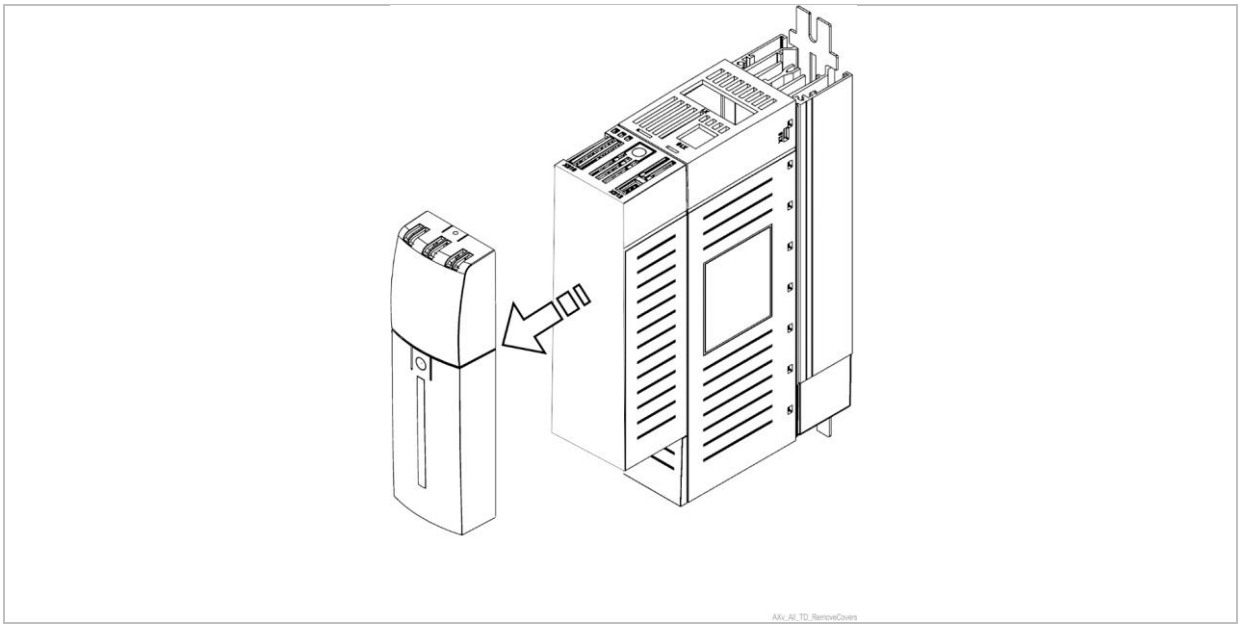
NOTICE

Implementation in double-axis devices

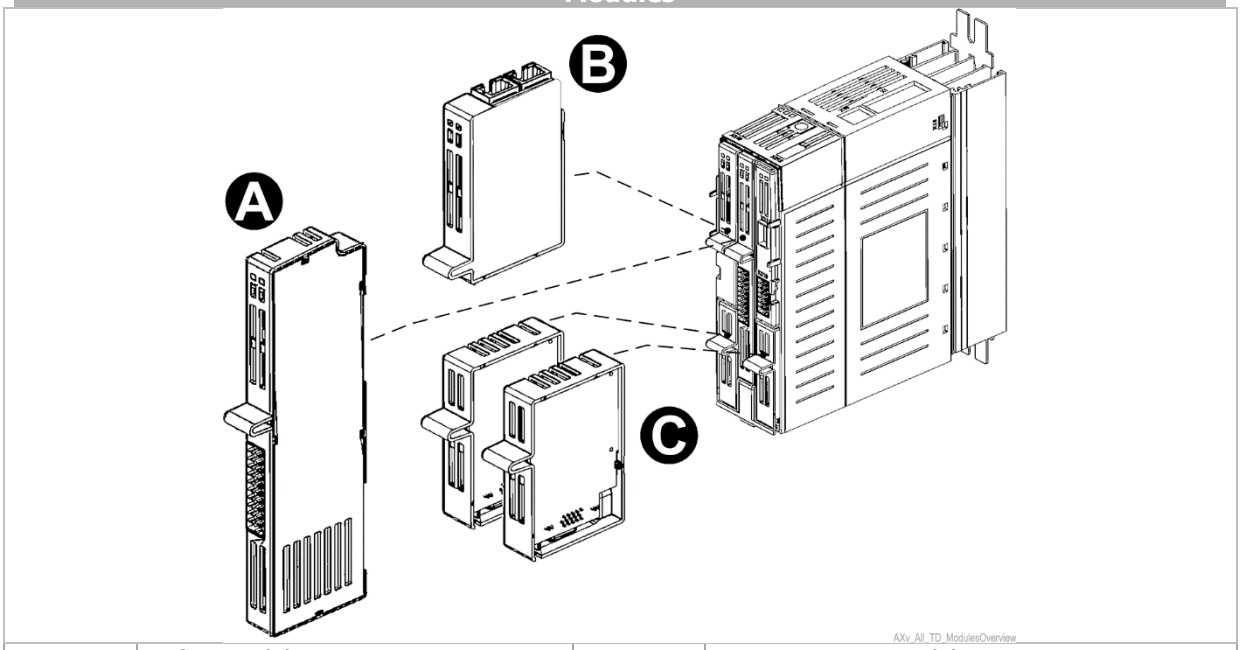
The EMA-ABS-21 module can be implemented in double-axis devices. Then, two of the modules can be installed on the inverter. The second expansion module is installed in the X422 interface. The pinout is identical with the interface X412.

Work steps:

- Disconnect the frequency inverter from the mains voltage and protect it against being energized unintentionally.
- Remove covers of the frequency inverter. The slot for the encoder module is now accessible.



Modules



A	Safety module	**B**	Communication module
C	Encoder modules		

CAUTION!

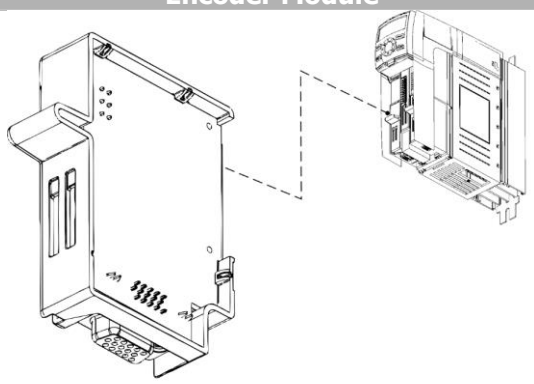
ESD damage

If touched, an ESD can occur in the PCB on the back of the module. This may damage the device.

- Do not touch the PCB visible on the back of the module.
- If possible, take measures to prevent ESD from happening.

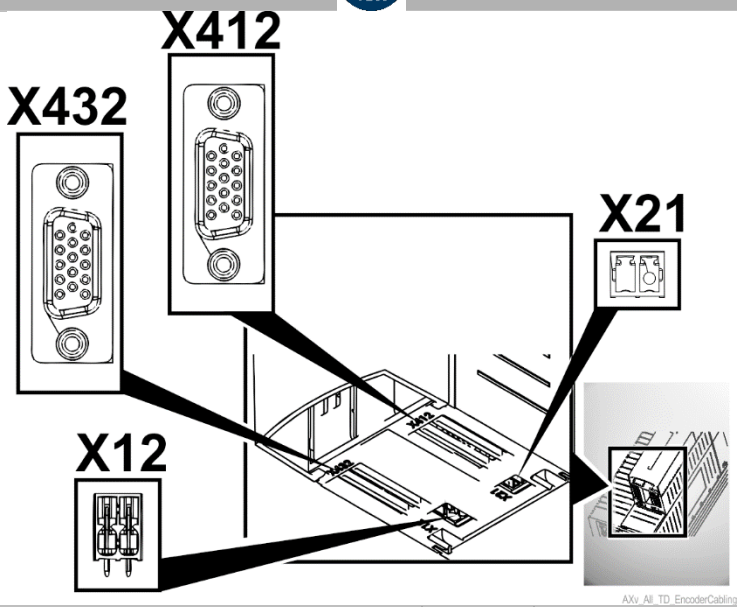
- Insert the module into the slot until it engages audibly.
- In the lower cover of the main device, break out the pre-punched cutout for the interface X412 (X422), if necessary.

Encoder Module



Depending on the application, it is possible to use both encoder slots at once to process additional encoder signals.

- Contact your Bonfiglioli Application Engineering representative for details.



X412/X422	(Optional) D-Sub F Encoder	**X12**	4pol. External 24 V
X432	(Optional) D-Sub F Encoder	**X21**	2pol. Brake output (SBC)

This completes the assembly procedure.
When connected the main device shall identify the EMA-ABS-21 encoder module by its hardware ID. Further action by the user is not necessary.

5.3 Electrical Installation

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.
- Comply with the documentation and device specifications 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.

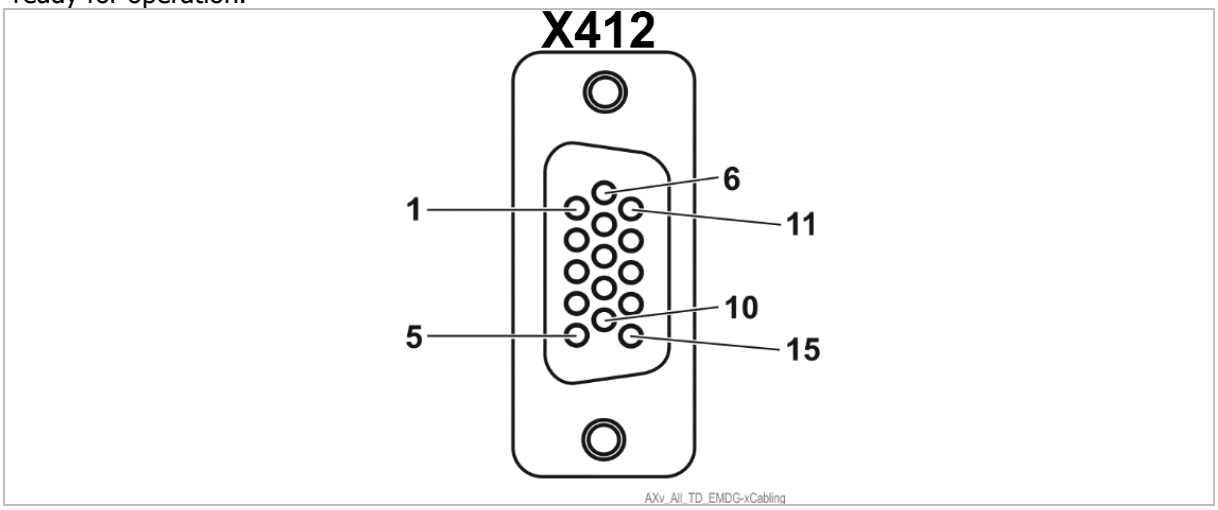
5.3.1 Sockets

CAUTION

Component damage
The control terminals may be energized.

- The unit may only be connected while 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.

When the supply voltage of the frequency inverter is switched on, the EMA-ABS-21 encoder module is ready for operation.



Pin	EnDat 2.2	Pin	EnDat 2.2
1	Clock-	**9**	Data P-
2	Clock+	**10**	-
3	-	**11**	Feedback Encoder Voltage V_Sense
4	-	**12**	-
5	Temp-	**13**	Data+
6	Power V_Abs	**14**	-
7	-	**15**	GND
8	Data-		

NOTICE

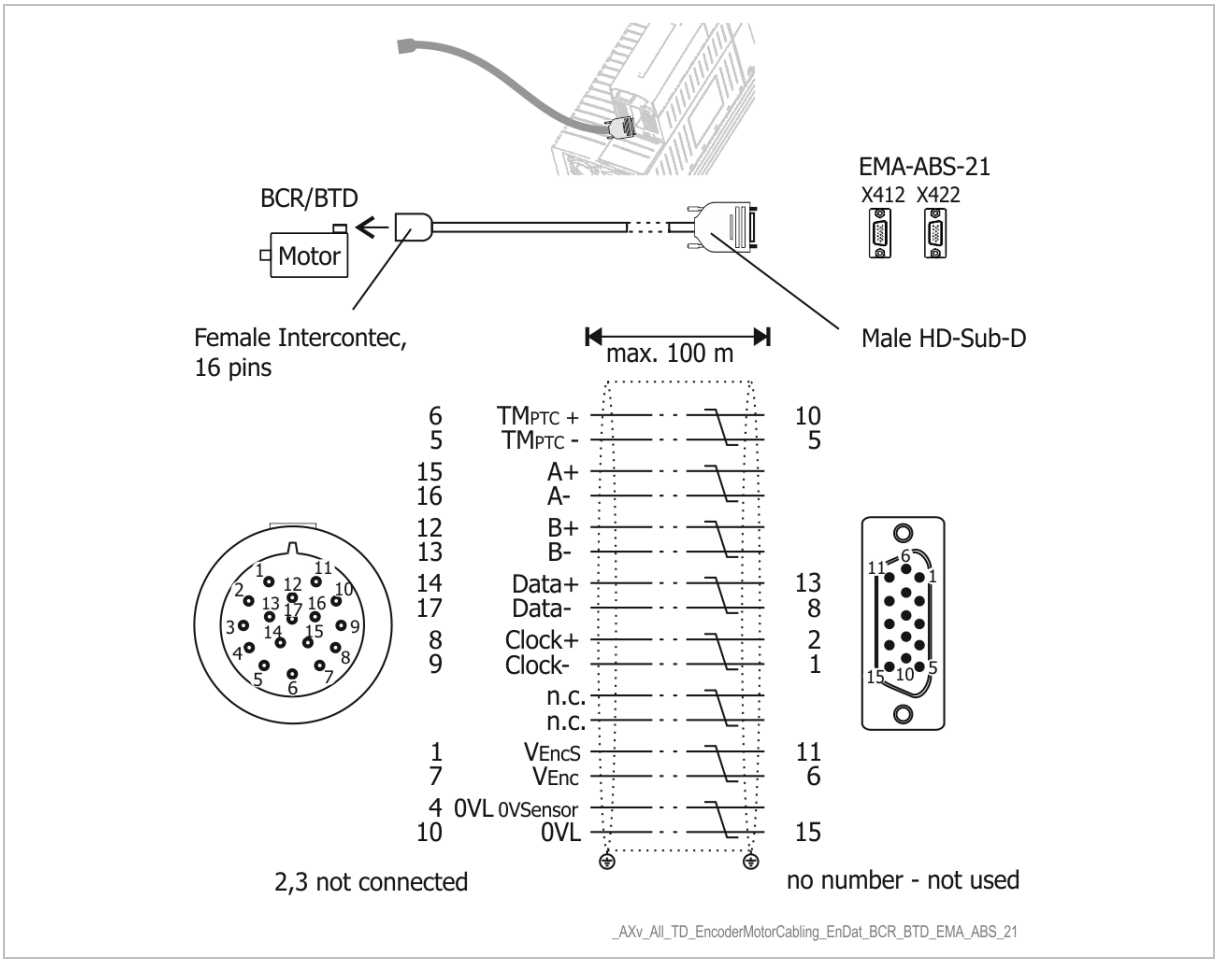
Implementation in double-axis devices
The EMA-ABS-21 module can be implemented in double-axis devices. Then, two of the modules can be installed on the inverter. The second expansion module is installed in the X422 interface. The pinout is identical with the interface shown above.

Check the power demand of the encoder to be connected. The internal power supply unit can only supply a maximum total of 2 W for all consumers connected. In the case of a higher power demand, connect an external DC 24 V supply to X12 (DC 24 V voltage input). BONFIGLIOLI recommends connecting an external power supply.

- Install encoder cables separately from motor cables to minimize interference.
- Upon first commissioning and during operation, make sure that the encoder and other electrical components can acclimatize in order to prevent condensation and resulting malfunction.

5.3.2 Cable assembly EnDat 2.2 for BCR/BTD

Contact assignment BONFIGLIOLI assembled cable for connection of EnDat 2.2 encoders:



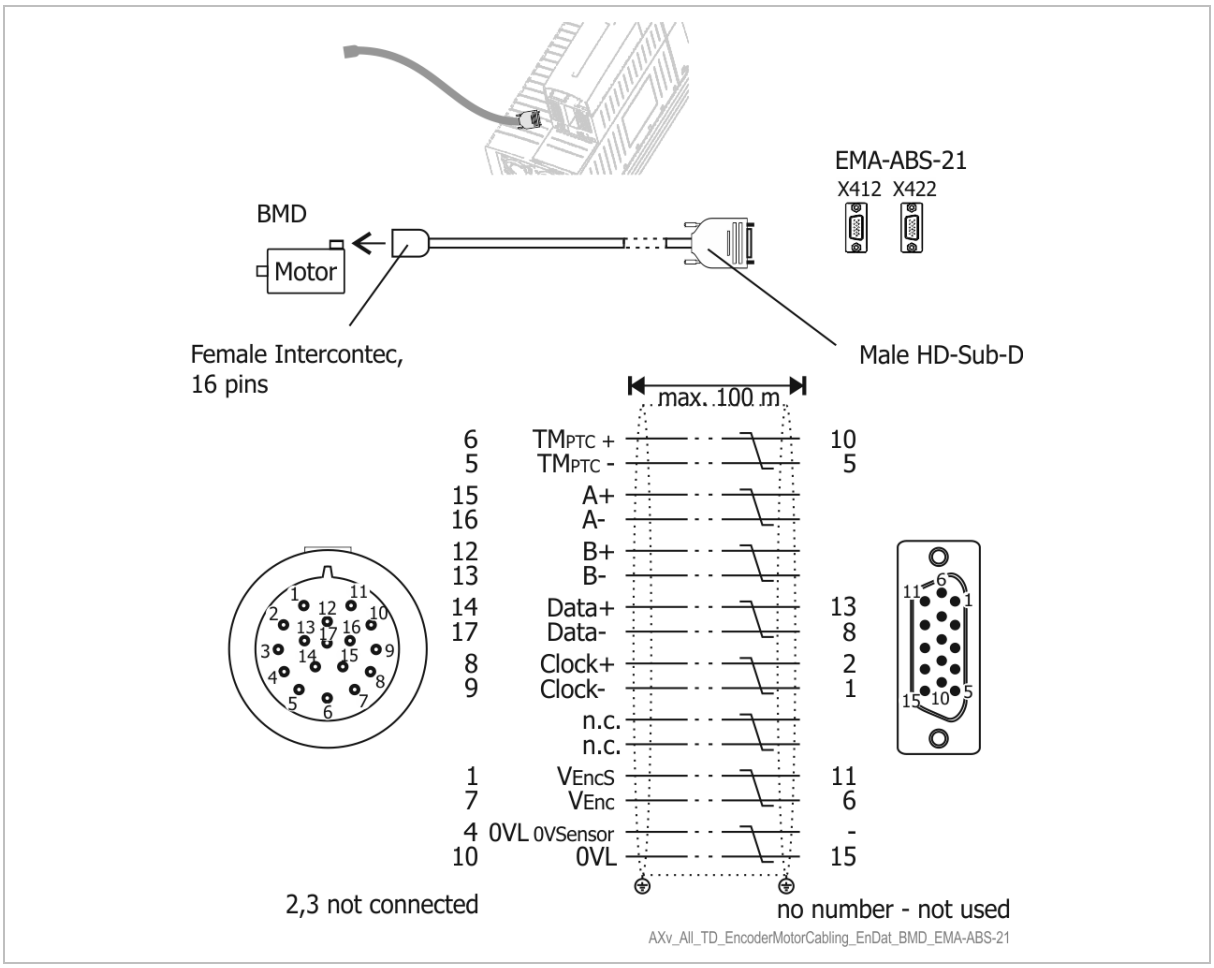
BONFIGLIOLI assembled cable	
Encoder cable	8 twisted two-wire lines
Cable size	0.14 mm^2
Length	3 m, 5 m or 10 m

- Use PTC resistors with safe isolation from motor winding according to EN 61800-5-1.
- Use shielded and twisted cables.
- Install encoder cable separate from motor cable.
- Connect the shield of the encoder line properly on both sides.

BONFIGLIOLI recommends using the pre-assembled cables for synchronous motors of types BCR and BTD.

5.3.3 Cable assembly EnDat 2.2 for BMD

Contact assignment BONFIGLIOLI assembled cable for connection of EnDat 2.2 encoders for BMD motors



BONFIGLIOLI assembled cable	
Encoder cable	8 twisted two-wire lines
Cable size	0.14 mm^2
Length	3 m, 5 m or 10 m

- Use PTC resistors with safe isolation from motor winding according to EN 61800-5-1.
- Use shielded and twisted cables.
- Install encoder cable separate from motor cable.
- Connect the shield of the encoder line properly on both sides.

BONFIGLIOLI recommends using the pre-assembled cables for synchronous motors of type BMD.

6 Object Structure

For more information on objects ☞ 🕮 operating instructions document VEC2en1-.

The available objects are marked with Index and Subindex and must be addressed via this ID.

The following definitions apply:

Access type			
Read only	The PLC can only read data from the frequency inverter.		
Read/Write	The PLC is granted unlimited 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)
Float32	32 Bit value:	$2^{-149}…2^{127}$	(0…16777216)

Object 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:

- DS301 Communication Objects: **0x1000** – **0x1FFF**
- Bonfiglioli-specific objects: **0x2001** – **0x5FFF** with

Axis-dependent object ranges:

- **0x2001** – **0x27FF**
- **0x4000** – **0x47FF**

The Bonfiglioli-specific objects can be subdivided in axis-dependent objects versus axis-independent objects. There is an offset of 800 per axis in the axis-dependent range.

For example:

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

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

are not axis-dependent.

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

7 Commissioning the encoder

This chapter describes how the different encoder types are commissioned.

7.1 General Steps

WARNING

Significant failures of the system

Some absolute value encoder types can "zero" or change the position transmitted by the encoder. Changing the value while the system is in operation can result in significant failures of the system.

- Do not use this function, as this will change the commutation angle in synchronous motors and correct speed control is not guaranteed.

CAUTION

Possible device damage

Via parameter *Change Sense of Rotation* **0x2078/11**, you can change the rotation direction of the motor system. In the case of absolute value encoders, changing **0x2078/11** will result in a jump of actual values. This can lead to device damage of slave drives in an electronic gear configuration.

- Switch off slave drives in an electronic gear upon the time of changeover.

The EMA-ABS-21 module supports both Singleturn and Multiturn encoders. Multiturn encoders must be configured as such, to avoid unwanted effects.

The internal resolution of encoder information is 32 bits, 16 bits for the position in one turn and 16 bits for the number of turns. Encoders with other properties will be converted to this format internally.

NOTICE

Identification of position not guaranteed

In the case of motor encoders with a multiturn portion of **more than** 16 bits, unambiguous identification of the position in the frequency inverter is not guaranteed.

NOTICE

Identification of position not guaranteed

In the case of motor encoders with a multiturn portion of **less than** 16 bits, the free bits are filled up to 16 bits and managed in a fail-safe manner.

Example: An encoder has a multiturn portion of 13 bits. 3 bits are managed additionally in the inverter, thus 8 (=2^3) overflows of the multiturn portion are recognized.

This information may be lost in some situations if the DC link is discharged very quickly due to external conditions.

In positioning applications, the absolute position of the encoder can be used for the reference system directly in user units [u]. Using gear factors, a gear transmission between the encoder and the travel distance can be considered (this does only apply to application encoders with synchronous motors).

NOTICE

Identification of position not guaranteed

The input data of the encoder is evaluated via the reference systems. The evaluated parameters (e.g., motor frequency, drive speed in rev/s, position in rev.) are available for diagnosis via actual value parameters, ☞ 8.2 "Actual value display".

Some AXIA inverters provide further encoder module interfaces per inverter. The second encoder module is then assigned the interface designation "X422". To implement the corresponding encoder control in the firmware, the objects specific to the second encoder module have the index numbers within the range 0xnnnn+0x800 (e.g., 0x2078+0x800=0x2878).

Encoders at the "X432" interface are configured via the object **0x3850/n**, where "n" stands for the same subindexes as with the objects **0x20(8)78**. However, subindexes **/30**…**/39** used with **0x20(8)78** cannot be employed with **0x3850/n**. The subindexes pertaining to the resolver configuration are not available, since the "X432" interface does not support the resolver module.

List of Relevant Objects

Object			Setting		
No.	**Designation**	**Unit**	**Min.**	**Max.**	**Default setting**
0x2078/1	Encoder Type	[-]	Selection		
0x2078/3	Enable Encoder (Supply Mode)	[-]	Selection		
0x2078/4	Boot-Up Delay	[s]	0	30,0	0
0x2078/5	Enc. Data Source	[-]	1-Automatic / 2-Objects		
0x2078/6	Enc. Data Status	[-]	1-El. Type Plate/2-Objects/3-Objects, el. Type Plate available		
0x2078/10	Speed Filter Constant	[s]	0	1	0
0x2078/11	Change Sense of Rotation	[-]	Off	On	Off
0x2078/20	Division Marks	[-]	0	8192	1024
0x2078/21	Z-Track Window	[incr]	0	200	4
0x2078/22	Bits Singleturn	[-]	1	32	1
0x2078/23	Bits Multiturn	[-]	0	32	0
0x2078/60	Theta Mot. Sensor	[-]	Selection		
0x2078/61	Theta AddOn1 Sensor	[-]	Selection		
0x2078/62	Theta AddOn2 Sensor	[-]	Selection		

Initialization of encoder

After mains on, the encoder may require an initialization. This may take up to 5 seconds. To allow the encoder to initialize, the encoder module can delay the position readout. This delay is configured in the object **0x2078/4** *Boot-up delay*.

During operation, the encoders and communication with the encoder are monitored. Critical conditions are reported via device errors. Most error evaluations will only be performed when the power output stage is activated.

Encoder Type 0x2078/1			
00000000	No encoder	00051110	SSI+SinCos, Gray-Code,1000 kBit/s
00001100	Sin/Cos: A/B	00052101	SSI+TTL, Gray-Code, 100 kBit/s
00001500	Sin/Cos: A/B/Z	00052102	SSI+TTL, Gray-Code, 250 kBit/s
00002100	TTL / HTL Inrcemental: A/B	00052105	SSI+TTL, Gray-Code, 500 kBit/s
00002500	TTL / HTL Inrcemental: A/B/Z	00052110	SSI+TTL, Gray-Code, 1000 kBit/s
00010001	EnDat 2.1, 100 kBit/s	00060001	SSI, Binary-Code, 100 kBit/s
00010005	EnDat 2.1, 500 kBit/s	00060002	SSI, Binary-Code, 250 kBit/s
00010010	EnDat 2.1, 1000 kBit/s	00060005	SSI, Binary-Code, 500 kBit/s
00020000	EnDat 2.2	00060010	SSI, Binary-Code, 1000 kBit/s
00030109	Hiperface 9.6kBit/s	00061101	SSI+SinCos, Binary-Code, 100 kBit/s
00050001	SSI, Gray-Code, 100 kBit/s	00061102	SSI+SinCos, Binary-Code, 250 kBit/s
00050002	SSI, Gray-Code, 250 kBit/s	00061105	SSI+SinCos, Binary-Code, 500 kBit/s
00050005	SSI, Gray-Code, 500 kBit/s	00061110	SSI+SinCos, Binary-Code, 1000 kBit/s
00050010	SSI, Gray-Code, 1000 kBit/s	00062101	SSI+TTL, Binary-Code, 100 kBit/s
00051101	SSI+SinCos, Gray-Code, 100 kBit/s	00062102	SSI+TTL, Binary-Code, 250 kBit/s
00051102	SSI+SinCos, Gray-Code, 250 kBit/s	00062105	SSI+TTL, Binary-Code, 500 kBit/s
00051105	SSI+SinCos, Gray-Code, 500 kBit/s	00062110	SSI+TTL, Binary-Code, 1000 kBit/s

Enable Encoder (Supply Mode) 0x2078/3		Theta... 0x2078/60 ../61 ../62	
0	Off	0	No Resistor
1	On (Internal Supply)	1	PT100
2	On (External Supply)	2	PT1000
11	On (Internal Supply with Sense)	3	KTY 84 130
		4	KTY 83 110
		5	PTC Resistor

7.2 EnDat 2.2 encoders

This chapter describes how to commission EnDat 2.2 encoders.

- Install the EMA-ABS-21 as described in chapter 5.2.
- Turn the frequency inverter on for parameter configuration (mains voltage or DC 24 V).
- Configure the frequency inverter according to the following parameters.
  - Adjust *Supply Mode* **0x2078/3** according to the connections to "1-On (internal Supply)" or "2-On (external Supply)".
- Check the encoder for proper function.
- In positioning applications: Carry out referencing operation once.

7.3 Commissioning linear encoders

In addition to the settings described in the previous chapters, the conversion from the rotary to the translatory system must be considered when it comes to commissioning a linear encoder. This conversion is influenced greatly by the diameter of the turning wheel.

The following applies:

Circumference = π * diameter

Linear encoders are normally not suitable for speed control, as the sampling time is too long to allow for good speed control. For this reason, the following descriptions are based on the use as a position encoder in positioning applications.

Linear encoders typically have a fixed resolution (e.g. 1 mm). In some linear encoders, the resolution can be configured. First check the resolution of the linear encoder using the data sheet or the parameter configuration.

The resolution of the linear encoder must be assigned in the frequency inverter at the resolution of the selected user units. This is done using the objects *Bits Singleturn* **0x2078/22**, *Bits Multiturn* **0x2078/23**.

The positioning reference system is always referred to the output side, via the objects contained in the "Application" → "Frame of reference" sublist (**0x6091/1**; ../2, **0x6092/1**; ../2) in the Axia Manager. These parameters must also be considered when configuring the linear encoder.

0x6091/n Gear ratio

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)

The gear ratio defines the ratio of motor shaft revolutions to driving shaft revolutions.

$$\text{Gear ratio} = \frac{\text{0x6091/1 motor shaft revolutions}}{\text{0x6091/2 driving shaft revolutions}}$$

0x6092/n Feed constant

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	Shaft revolutions	1	65535 (= 0x0000 FFFF)

The feed constant defines the feed (in user units) per driving shaft revolutions.

$$\text{Feed constant} = \frac{\text{0x6092/1 feed}}{\text{0x6092/2 driving shaft revolutions}}$$

With linear encoders, the calculation of gear ratio and feed constant translate the feed forward signal of the linear encoder to the length of its linear motion.

For more information ☞ 📖 operating instructions document VEC2en1-.

For linear encoders, Objects *Bits Singleturn* **0x2078/22**, *Bits Multiturn* **0x2078/23** are virtual quantities. They are determined by the mechanical properties of the system. Different properties of the mechanical system (e.g. gear transmission or turning wheel diameter) will require different object settings.

The following data is needed for linear encoder commissioning:

- Gear transmission [-] or input speed / output speed [rpm/rpm]
- Encoder resolution [bits]
- Running wheel diameter [m]
- Required accuracy [m] or resolution [increments/m]

1st step: Identify gear values reference system:

The input speed (motor speed) will determine the setting for parameter *Motor Shaft Revolutions* **0x6091/1**, the output speed will determine the setting for parameter *Driving Shaft Revolutions* **0x6091/2**.

The value should be entered as exactly as possible. Shifting of decimal places or multiplication with appropriate factors can increase accuracy.

Example:

Input speed: 1401 rpm

Output speed: 77.3 rpm i = 18.12

Encoder resolution: 24 Bit

Diameter: 160 mm = 0.16 m

Required accuracy: 0.01 mm = 0.00001 m

Motor Shaft Revolutions **0x6091/1 =** 14010

Driving Shaft Revolutions **0x6091/2 =** 773

2nd step: Identify feed constant reference system:

The feed constant is calculated by multiplying the diameter and π by the resolution. The resolution is the reciprocal of the accuracy.

$$\text{Accuracy [m]} = \frac{1}{\text{Resolution } [\frac{\text{u}}{\text{m}}]}$$

$$\text{Feed constant [u]} = \pi * \text{Diameter [m]} * \text{Resolution } [\frac{\text{u}}{\text{m}}]$$

Example:

Diameter: 0.16 m = 160 mm

Required resolution: 0.00001 m = 0.01 mm

Feed constant = 50265 rev

The calculated feed constant is then set as value for the object *Feed* **0x6092/1**.

3rd step: Calculate auxiliary quantity reference system

In the following step, the ratio of the *Feed* **0x6092/1** to *Driving Shaft Revolutions* **0x6091/2** and *Motor Shaft Revolutions* **0x6091/1** is used in the calculations frequently. For better clarity, auxiliary quantity "R" (=reference system) is calculated now:

$$R = \frac{Feed\ 0x6092/1 \cdot Driving\ Shaft\ Revolutions\ 0x6091/2}{MotorShaftRevolutions\ 0x6091/1}$$

Example:
Feed **0x6092/1 =** 50265 rev
Driving Shaft Revolutions **0x6092/2** = 773
Motor Shaft Revolutions **0x6091/1 =** 14010
R = 2773.365 rev = 50265 x 773 / 14010 rev

4th step: Determine the encoder resolution:

First determine the number of user units per encoder increment. If, for example, the encoder features a resolution of 1 mm and 0.01 is to be used as the "user unit", β = 100.

β = Number of user units per encoder increment

5th step: *Bits Singleturn* **0x2078/22**:

The reference system and the number of user units per encoder increment β determine parameter *Bits Singleturn* **0x2078/22**.

$$Bits/Revolution = \mathrm{Log}_2 \frac{Feed\ 0x6092/1\ \frac{[u]}{U} \cdot \text{Driving Shaft Revolutions } 0x6092/2}{\beta \cdot Motor\ Shaft\ Revolutions\ 0x6091/1 \cdot}$$

or

$$Bits/Revolution = \mathrm{Log}_2 \frac{R}{\beta}$$

$$= \frac{1}{\mathrm{Ln}\ 2} \cdot \mathrm{Ln} \frac{R}{\beta}$$

Round up the value to the next natural number.

With the values above, *Bits Singleturn* **0x2078/22** = 5.

Conversion of logarithm base 2 and other bases:

$$\mathrm{Log}_2 a = \frac{\mathrm{Log}_{10} a}{\mathrm{Log}_{10} 2} = \frac{\mathrm{Ln}\ a}{\mathrm{Ln}\ 2}$$

6th step: *Bits Multiturn* **0x2078/23**:

Bits Multiturn **0x2078/23** is calculated from the subtraction of the total number of position bits of the encoder with the *Bits Singleturn* **0x2078/22** calculated above.

$$Multiturn = Encoder\ Bits - Bits/Revolution$$

With the values above, *Bits Multiturn* **0x2078/23** = 19.

8 Control Input and Output Objects

8.1 Encoder input EMA-ABS-21

The objects in the encoder input subset are used to parameterize the data exchange with the encoder. Depending on the encoder system used, different objects need to be set up by the user. The following table lists the objects for the encoder type.

Object			Encoder type		
No.	**Description**		**EnDat2.2**		
0x2078/1	Encoder Type	[-]	Selection		
0x2078/3	Enable Encoder (Supply Mode)	[-]	Selection		
0x2078/4	Boot-Up Delay	[s]	0	30,0	0
0x2078/5	Enc. Data Source	[-]	1-Automatic / 2-Objects		
0x2078/6	Enc. Data Status	[-]	1-El. Type Plate/2-Objects/3-Objects, el. Type Plate available		
0x2078/10	Speed Filter Constant	[s]	0	1	0
0x2078/11	Change Sense of Rotation	[-]	Off	On	Off
0x2078/22	Bits Singleturn	[-]	1	32	1
0x2078/23	Bits Multiturn	[-]	0	32	0
0x2078/60	Theta Mot. Sensor	[-]	Selection		
0x2078/61	Theta AddOn1 Sensor	[-]	Selection		
0x2078/62	Theta AddOn2 Sensor	[-]	Selection		

The object parameterization is partially automated via the objects **0x2078/5** *Encoder Data Source* and **0x2078/6** *Encoder Data Status* (☞ 7.1):

NOTICE

To ensure proper functioning of the encoder, the user has to check the parameterization of relevant objects after the electronic type plate of the encoder has been read.

Via **0x2078/5** you can select whether the data for **0x2078/20**, **../22**, **../23** is populated automatically according to the electronic type plate of the encoder or if the data entered by the user is used.

The object **0x2078/6** *Encoder Data Status* gives back the actual status of the selection made in **0x2078/5**. **0x2078/6** either shows that the encoder settings are read from the electronic type plate, from the objects manually populated by the user or from the objects manually populated by the user, although there is data available in the electronic type plate.

Whether or not there is an electronic type plate depends on the encoder type and on the individual encoder manufacturer.

8.2 Actual value display

The actual values of the encoder can be read out via the objects **0x4052/n**, **0x4057/n**, **0x4058/n**.

Object		
No.	**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	[-]
0x4052/6	Theta Enc.X412/X422	[°C]
0x4052/7	Theta Mot. Winding X412/X422	[°C]
0x4052/8	Theta AddOn 1 Enc.X412/X422	[°C]
0x4052/9	Theta AddOn 2 Enc.X412/X422	[°C]

Object		
No.	**Designation**	**Unit**
0x4057/1	Division Marks	[-]
0x4057/2	Bits Singleturn	[-]
0x4057/3	Bits Multiturn	[-]
0x4057/4	OEM Data Action	[-]
0x4057/5	OEM Data Raw	[-]

Object		
No.	**Designation**	**Unit**
0x4058/1	Device Type	[-]
0x4058/2	Device Ident. Nr.	[-]
0x4058/3	IP-Core ID	[-]
0x4058/4	Max. Sampling Freq.	[Hz]
0x4058/5	Cable Delay	[s]
0x4058/6	Max. Enc. Temperature	[°C]
0x4058/7	Temperature Sensor Support	[-]
0x4058/8	Max. Enc. Speed	[rpm]
0x4058/9	Max. Acc. Range	[s^{-2}]
0x4258/10	Function Settings	[-]

8.2.1 Absolute value encoder - raw data

For diagnosis, you can check the value transmitted by the absolute value encoder via Object *Abs. Encoder Raw Data* **0x2078/24**.

Depending on the encoder technology used, the actual value parameter is built up as follows:
[EBH]:[POS]:[EBL]

EBH: Extra-Bits (high)
Up to 8 Additional or Info-Bits from the MSB side of the telegram received by the encoder

EBL: Extra-Bits (low)
Up to 8 Additional or Info-Bits from the LSB side of the telegram received by the encoder

POS: Position
Up to 64 Position bits

8.2.2 Actual position

Act. position **0x4052/2**(**0x4852/2)** or **0x5832/2** shows the current actual value (position) in user units [u].

8.3 Motor temperature

The temperature monitoring is a part of the error behavior and warning behavior. The connected load can be monitored by the connection of a measurement resistor (motor PTC resistor / PTC) with a temperature characteristic according to DIN 44081.

The operation mode of the motor PTC port can be selected via objects *Theta Mot. Sensor* **0x2078/60**, *Theta AddOn1 Sensor* **0x2078/61** and *Theta AddOn2 Sensor* **0x2078/62**.

Theta... 0x2078/60 ../61 ../62	
1	No Resistor
2	Wire Wound Resistor
3	PTC Resistor
4	PT100
5	PT1000
6	KTY 84 130
7	KTY 83 110

In operation modes with error-switch-off, the fault message "FAULT" with fault number "F0400" is displayed.

9 Annex

9.1 Error messages

The various control methods and the hardware of the frequency inverter includes functions which continuously monitor the application. The following error messages are activated by the EMA-ABS-21 expansion module.

Error messages and troubleshooting		
F04	00	Excess Temperature Drive Motor Over Temperature Motor temperature too high or temperature evaluation connection defective. Check cables and connections.
F14	30	Incr. Encoder: Division Marks Fault Incorrect number of division marks detected.
	31	Incr. Encoder: Z-Track Missing No z-track detected for more than two encoder revolutions.
	83	Sense Voltage Out Of Range: EMA-ABS-21: No ext. 24V. Via object *Enable Encoder (Supply Mode)* **0x2078/3**, an operation mode with external power supply was selected, but there is no external voltage. Connect external power source or change operation mode.
	84	Encoder Supply Overvoltage: EMA-ABS-21: Ext. 24V voltage level too high. The voltage level of the external power supply is too high, or the external power supply is over-loaded. Check the voltage level of the external power supply.
	85	Encoder Supply Undervoltage: EMA-ABS-21: Int. 24V voltage level too low. The internal power supply to the encoder provided by the frequency inverter is overloaded. Check the connections at the control terminals.
	86	Encoder Over Current: EMA-ABS-21: Current level too high.
	87	Sense Cable Missing: EMA-ABS-21: Via *Enable Encoder (Supply Mode)* **0x2078/3**, an operation mode using a sense measuring line was selected, but no sense line is connected. Connect sense measuring line or select another operation mode. Sense measuring line defective or broken. Check cables and connections.
	88	EMA-ABS-21: Fault correction A/B track. Error during evaluation of A/B track. Required measuring accuracy not reached. The offset and amplification error correction for the A/B track has reached its maximum.
	90	EMA-ABS-21: Fault correction C/D track. Error during evaluation of C/D track. Required measuring accuracy not reached. The offset and amplification error correction for the C/D track has reached its maximum.
	93	EMA-ABS-21: Broken cable. Collective fault message. At least two of the following errors have occurred: F1486 EMA-ABS-21 "No sense line" F1487 EMA-ABS-21 "No A/B track" F1489 EMA-ABS-21 "No C/D track"
	95	EMA-ABS-21: Position monitoring. A non-permissible deviation between the position value of the digital encoder interface and the analog A/B track has occurred
F17	02	Dig. encoder: Signal amplitude The amplitude of the signals used for the encoder-internal position calculation is outside of the permissible range.
	03	Dig. encoder: Position value. The digital position value is incorrect
	16	Dig. Enc.: Unknown Fault
	17	Dig.-Enc.: Init Error Initialization of encoder failed.
	18	Dig. encoder: DeInit Fault An error occured during de-initialization of encoder
	19	Dig. encoder: Protocol error Error in communication with encoder.
	20	Dig. encoder: Electronic Typeplate Error during access to el. type plate. The el. type plate is faulty or not available.
	21	Dig. encoder: Overspeed Error caused by overspeed.
	22	Dig. encoder: Transmitter current Transmitter current in critical range.
	23	Dig. encoder: Overtemperature Encoder temperature too high
F21	nn	Fault report to system bus master in fault in system bus slave nn = Node ID of slave (hex)
F27	80	EnDat Error Recovery Timer
	81	EnDat Error F1F2 Monitoring

Error messages and troubleshooting		
	82	EnDat Error Position Monitoring
	83	EnDat Cycle Time Error Timeout occurred during cycling read of encoder
	84	EnDat CRC Error
	85	EnDat Startup-Error
	86	EnDat Position Error
	87	EnDat Encoder Test
	89	EnDat Quitation Encoder responses with different message ID than requested
	8A	EnDat Fault Type I Encoder has active Type I error flag within status word, please consult EnDat manual
	8B	EnDat Fault Type II Encoder has active Type II error flag within status word, please consult EnDat manual
	8C	EnDat Lighting Encoder lighting has failed or reached the end of its service life
	8D	EnDat Signal Amplitude Signal amplitude isn't high enough to be detected correctly
	8E	EnDat S Pos 1

The error messages described above may occur depending on the encoder connected. Not every error message will be used for every encoder system. Error messages intended for in-depth diagnosis by specialists are not listed.

Additional fault messages are described in the Operating instructions of the frequency inverter.

Index

A

Absolute value encoder - raw data 29
Actual position 29
Actual value display..... 28

C

Cable assembly
  EnDat 2.2..... 20, 21
Comissioning
  EnDat 2.2 encoders 25
  General Steps..... 23
  Initialization of encoder..... 24
Commissioning 23
  Linear encoders..... 25
Control inputs 28
Copyright 6

D

Decommissioning 12
Designated use 7

E

Electrical connections 11
Error messages..... 30

G

Gear ratio.....25
General Information about the Documentation
  5

I

Installation.....16
Instruction manuals 5

M

Motor temperature 29

P

Pin assignment X412/X422 encoder connector
 19

S

Safety
  General 7
Service.....12

T

Technical data.....15

W

Warranty and liability 6

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