

## **AXIA VERT**

### **Expansion Module Manual**

#### **EMA-RES-01**

Frequency inverter 400 V

0,25 kW ... 15 kW





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# 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 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.



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

## 1.2 This document

The present user manual of the resolver module EMA-RES-01 complements the Operating Instructions and the "Quick Start Guide" for the frequency inverters of the AXIA series.

The user manual contains important information on the installation and use of the resolver module EMA-RES-01 in its specified application range. Compliance with user documentation contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service life of the frequency inverter.

For this reason, make sure you read the user manual 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 any problems occur which are not covered by the documentation sufficiently, please contact the manufacturer.



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

- This Operating Instructions Document
- Safety manual "Safety Manual AXV"

This documentation applies to the following frequency inverter series:

- AXIA 210
- AXIA 410

### **1.3 Warranty and liability**

BONFIGLIOLI Deutschland GmbH (hereinafter referred to as “manufacturer”) notes 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

In accordance with applicable law any copyrights relating to this document shall remain with  
BONFIGLIOLI Deutschland GmbH  
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 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.

## 1.7 Final decommissioning

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.



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## 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.

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 10 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 used in the Operating Instructions

### 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
<b>1234</b>	bold	Representation of object index numbers / object numbers
<b><u>1234</u></b>	Bold+underlined	Representation of object sub-index numbers
<i>Parameter</i>	inclined, font: Times New Roman	Representation of parameter names / object designations
<b>P.1234</b>	bold	Representation of object numbers without name, e.g. in formulas
<b>Q.1234</b>	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 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.

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## 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 10 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 AutoStart 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 Introduction

The present document describes the possibilities and the properties of the EMA-RES-01 expansion module for the frequency inverters of the AXIA device series.




This document exclusively describes the EMA-RES-01 expansion module. It does not provide basic information on the operation of the AXIA series frequency inverters.

The EMA-RES-01 expansion module is an optional hardware component to extend the functionality of the frequency inverter. It permits using sensors of the type resolver with the frequency inverter.

The EMA-RES-01 module extends the frequency inverter functionality by the following additional functions:

- **Analog input for temperature probe**  
(bipolar analog input)
- **Resolver input**
- **Repetition frequency output**



The EMA-RES-01 expansion module is a separate component and must be mounted by the user.  3.2 "Mechanical Installation".

### 3 Installation/Disassembly of the expansion module



#### WARNING

##### Device damage

If the expansion module is mounted while the main device is powered, this will lead to device damage or minor injury.

- Only mount the expansion module when the main device is safely disconnected from live voltage.
- Install the expansion module before the main device is commissioned.
- Do not touch the PCB visible on the back of the module, otherwise components may be damaged.

#### 3.1 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.
- 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 mechanical and electrical installation of the EMA-RES-01 expansion 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.



## 3.2 Mechanical installation

### CAUTION



#### Possible dirt ingress

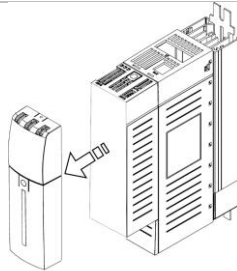
IP20 ingress protection rating is only achieved with terminals plugged and with properly mounted covers. Improperly mounted covers lead to ingress of dirt or foreign objects into the housing of the device and might lead to malfunctions.

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

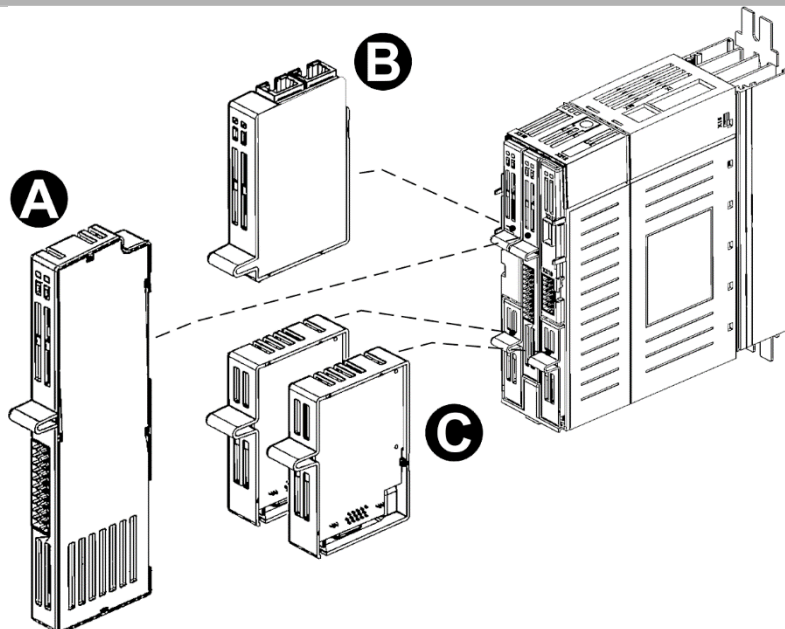
Before assembly or disassembly of the EMA-RES-01 expansion module, the frequency inverter must be de-energized.

#### 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 expansion module is now accessible.



### Modules



<b>A</b>	Safety module	<b>B</b>	Communication module
<b>C</b>	Encoder modules		

## CAUTION!



### ESD damage

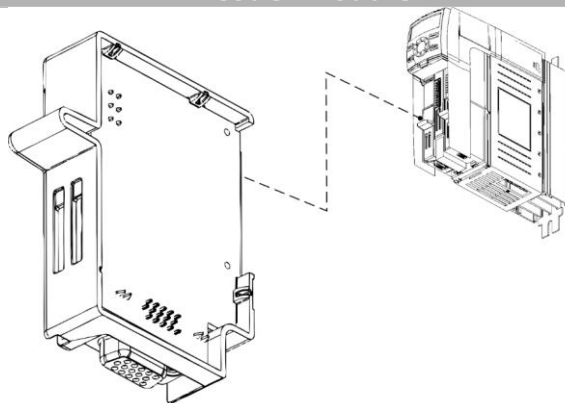
If touched, an ESD can occur in the PCB on the back of the module. This may damage the device.



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

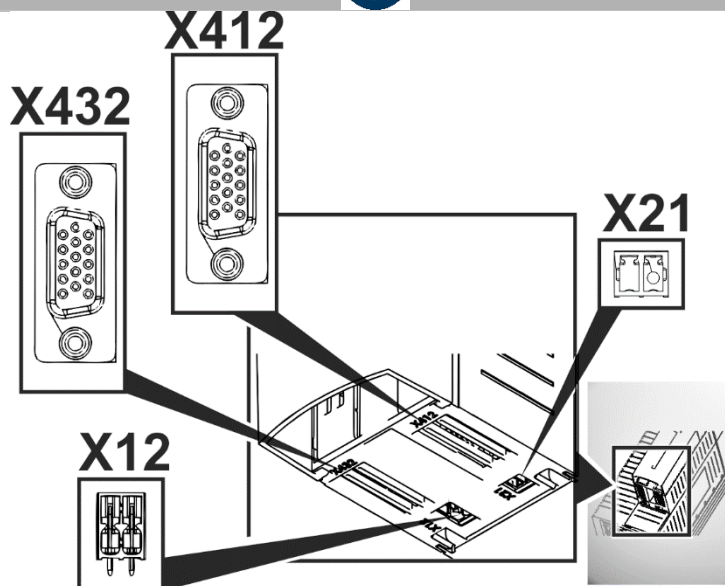
- Insert the module into the slot until it engages audibly.
- In the lower cover of the main device, break out the pre-punched cutout for the interface X412 (X432), if necessary.

## Encoder Module



AXV\_Slot\_TD\_EncoderCabling

This completes the assembly procedure.



AXV\_Alt\_TD\_EncoderCabling

<b>X412</b>	(Optional) D-Sub Encoder	<b>X12</b>	4pol. External 24 V
<b>X432</b>	(Optional) D-Sub Encoder	<b>X21</b>	2pol. Brake output (SBC)



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

- Contact your Bonfiglioli Customer Application Engineering (CAE) representative for details.

## NOTICE

The EMA-RES-01 module installs **only** in the slot **on the right**! For technical reasons it does not function in the left encoder module slot.

### 3.3 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.
- 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.

#### Sockets

#### CAUTION



#### **Component damage**

The control terminals may be energized. This may result in damage to the module.

- Switch off power supply before connecting or disconnecting the control inputs and outputs.
- Verify safe isolation from power supply.

#### 3.3.1 Technical data

##### **Module output:**

##### **Exciter**

Excitation frequency = 9.785 kHz

Impedance: > 65  $\Omega$  at 10 kHz

##### **Module input:**

Input Reference voltage UREF = 2.5 V,

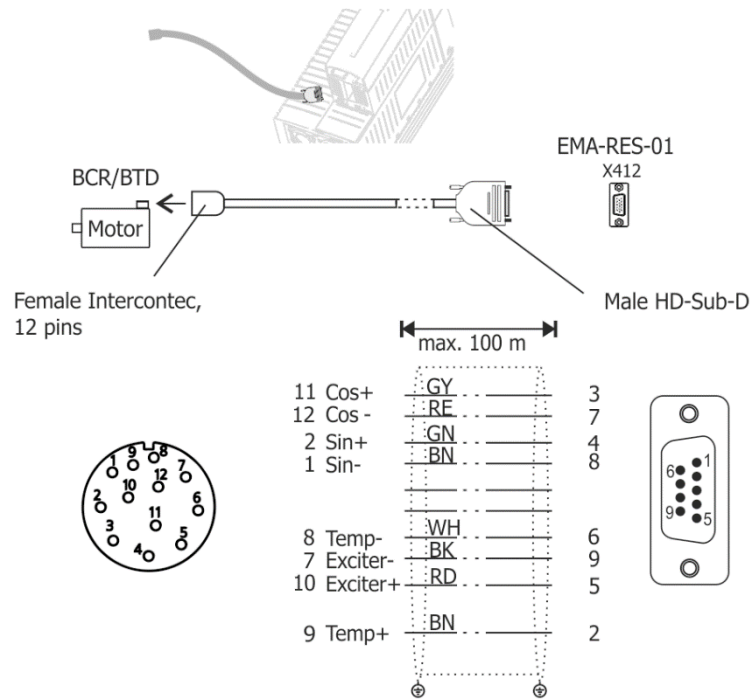
Vmax = 5 V

Transformation ratio =  $\leq 0,5$

##### **Temperature sensor:**

Type = PT100, PT1000, or max. 3 PTCs in a row

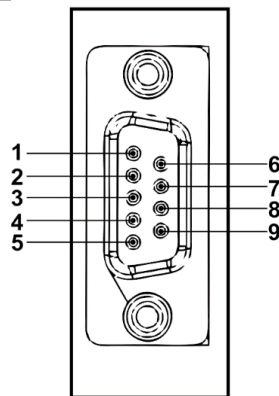
### 3.3.2 Cable assembly



AXv\_All\_TD\_ResolverMotorCabling\_Resolver\_BCR\_BT

### 3.3.3 Interface pinout

#### Resolver connection



AXv\_All\_TD\_EMDG-RES\_C

#### Socket X412

Ter.	Description	Ter.	Description
X412.1	PE	X412.6	Temp-
X412.2	Temp+	X412.7	Cos-
X412.3	Cos+	X412.8	Sin-
X412.4	Sin+	X412.9	Exciter-
X412.5	Exciter+		

### 3.4 Disassembly

- Disconnect the frequency inverter from mains voltage and protect it against being energized unintentionally.
- Remove covers of the frequency inverter, if necessary.

- Disconnect/unplug any connected lines.
- Unplug the expansion module from its slot by
  - Depressing the latch at the top of the module housing (use a thin screw-driver)
  - pulling at the handle at the front of the module housing. Proceed carefully to not damage the module.

## 4 Control inputs and outputs

### 4.1 Resolver input EMA-RES

The resolver input is used for evaluating the position information from the resolver.

If the no. of resolver pole pairs is  $> 1$ , the measured electric angle runs through the range of  $0^\circ \dots 360^\circ$  several times during one mechanical revolution.

For the detection of the position angle of the rotor in a synchronous motor, the ratio of the no. of motor pole pairs to the no. of resolver pole pairs must be an integer.

The no. of pole pairs of the resolver can be adjusted via parameter *Res.: No. of Pole Pairs* **0x2078/3**.

Parameter		Function		
No.	Description	Min.	Max.	Default
0x2078/3	Res.: No. of Pole Pairs	1	10	1

#### 4.1.1 Offset

In order to enable the start of a synchronous machine, the absolute position of the rotor must be known. This information is required in order to actuate the stator windings in the right order depending on the position of the rotor. The position of the rotary field in the synchronous machine must be controlled in order to obtain a continuous movement of the rotor. During first commissioning, the position of the rotor winding of the resolver is adjusted to the rotor displacement angle of the synchronous motor by adjusting the offset. For operating a synchronous machine with resolver, the offset must be adjusted in order to obtain perfectly true running and a maximum torque.

The correct *Res.: Comm. Offset* **0x2078/1** is adjusted, when the *Usd Flux Forming Voltage* **0x4041/1** shows the same values in both rotation directions of the motor and reaches the value 0 as best as possible while the motor is turning.

Parameter		Function		
No.	Description	Min.	Max.	Default
0x2078/1	Res.: Comm. Offset	-360.0°	360.0°	0.0°

The offset can be determined and adjusted as follows:

- During first commissioning Auto-Setup shall be performed.
- Manually enter the machine data indicated on the type plate or the data sheet of the motor. The motor data such as stator inductance, magnetization current and others is stored in the objects **0x2001 - 0x2009**. *No. of Pole pairs* for the motor is configured in **0x2005**.
- Adjust parameter *Res.: No. of Pole Pairs* **0x2078/3** to the number of pole pairs of the resolver.
- Before adjusting the *Res.: Comm. Offset* **0x2078/1**, take the following **safety precautions**:
  - Disable the frequency inverter via digital input (controller release).
  - If possible, uncouple the motor from the load so that the motor shaft turns freely. If installed, release the mechanical brake.
  - If uncoupling is not possible, make sure that the motor is loaded as little as possible.



## WARNING

### Personal or equipment damage!

In certain circumstances, the motor speed may reach high values. If the motor is **not** uncoupled from the load, personal and material damage may result. To avoid such damage, make the following settings in any case.

- Set the max. permissible output frequency of the frequency inverter to a low frequency value via *Freq. Switch-Off Limit* **0x2420**. Select the frequency value such that uncontrolled acceleration of the motor ("overspeeding") is detected at an early stage. This limitation is necessary in order to avoid personal and material damage.
- Set parameter *Current Limit* **0x221C** of the speed controller to a low current value (e.g. 10% of the rated motor current). In this way it is made sure that there are no excessive currents of the offset is set incorrectly.
- Turn motor shaft manually. Check the sense of rotation of the resolver via the actual value *Resolver Speed* **4040/7**. In the case of a clock-wise rotation of the motor shaft, positive values are displayed for the actual frequency value. If the displayed sense of rotation does not correspond to the actual sense of rotation, change the connections SIN+ and SIN- of the frequency inverter.

The *Res.: Comm. Offset* **0x2078/1** must be between 0° and 360°, divided by the number of motor pole pairs. If the number of resolver pole pairs is higher than 1, the possible range is between 0° and the max. offset.

$$\text{Max. Offset} = \frac{360^\circ}{\text{number of motor pole pairs} / \text{number of resolver pole pairs}}$$

If the adjusted value is changed by the max. offset, this does not affect the *Usd Flux Forming Voltage* **0x4041/1**.

- Adjust a low reference speed value (approx. 10% lower than the *Freq. Switch-Off Limit* **0x2420**), and enable the frequency inverter via controller release and start clock-wise operation in order to accelerate the motor.
- Confirm the machine and resolver data. After completion of the guided commissioning, adjust the parameter *Current Limit* **0x221C** to a low value again because this value was overwritten during the guided commissioning.

Depending on the behavior of the motor after start, carry out the following steps:

- Motor does not turn, or the motor shaft only turns to a new position and stops again:
- Check if the parameters *No. of Pole pairs* **0x2005** for the motor and *Res.: No. of Pole Pairs* **0x2078/3** for the resolver are set correctly.

If these values are adjusted correctly, take the following measures complying with the safety instructions.



## 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.

- Exchange two motor phases (e.g. U and V) at the frequency inverter sockets because the senses of rotation of the motor and the resolver do not correspond to each other.
- Switch on the power supply again.
- As described above, adjust a low speed reference value and start the motor.

If the motor does not start despite the phase exchange:

- increase the parameter value for *Res.: Comm. Offset* **0x2078/1** by 90°, divided by the no. of motor pole pairs.
- If the motor still does not turn, exchange the two motor phases (e.g. U and V) again.

The motor turns and accelerates, until it reaches the *Freq. Switch-Off Limit* **0x2420**:

- Check the resolver lines and check the resolver connection contacts.
- in the case of fault message "Overfrequency" F1100: increase the parameter value for *Res.: Comm. Offset* **0x2078/1** by 180°, divided by the no. of motor pole pairs.
- If the motor turns at the adjusted speed and in the right direction, carry out the fine adjustment of the offset:
  - Adjust the parameter value for *Res.: Comm. Offset* **0x2078/1** in small steps (e.g. 2.5°) until the *Usd Flux Forming Voltage* **0x4041/1** is approximately 0.
  - In case the flux-forming voltage deviates from 0 significantly, adjust the offset in bigger steps.
  - In the case of a positive flux-forming voltage, increase the offset.
  - In the case of a negative flux-forming voltage, reduce the offset.
  - Adjust parameters *Freq. Switch-Off Limit* **0x2420** and *Current Limit* **0x221C** to the required values.
  - Repeat the **fine adjustment** of the offset at 50% of the rated frequency.

This completes the offset adjustment.

- Start the Auto-setup. This is required for optimum current control.

### 4.1.2 Actual speed source

Selection of the actual speed source is done via *S. Actual Frequency* **0x4209/6**. If the resolver delivers the actual value signal for the speed controller, **0x00404004** must be selected as the source. In the basic setting, **0x00224003** is used as the actual value source.



## 4.2 Frequency and percentage reference channel

The varied functions for the specification of the reference values are contained in the frequency or percentage reference channel. The *Frequency Reference 1* **0x2511** to *Frequency Reference 4* **0x2514**, and the *Percentage Reference 1* **0x2541** to *Percentage Reference 4* **0x2544** determine additional connection of the available reference sources as a function of the installed hardware. Additional information in the operating instructions of the frequency inverter also applies.

## 4.3 Signal quality monitoring

During continuous operation, the signal quality shall be monitored. This is done by determining the square sum of the sine and cosine signals. If thresholds are exceeded, error messages shall be put out.

For error messages see chapters below.

Parameter		Function		
No.	Description	Min.	Max.	Default
0x2078/7	Res: Signal Lost Threshold	0.5	0.999	0.9
0x2078/8	Res: Signal Degradation Threshold	1.1	1.5	1.1

## 4.4 Angle calculation monitoring

During continuous operation, the angle calculation shall be monitored. If an angle jump of more than 5° occurs, error message shall be put out. This threshold setting cannot be altered.

## 5 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 <sup>32</sup> -1 0...0xFFFF FFFF	
Unsigned16	16 Bit value:	0...2 <sup>16</sup> -1 0...0x FFFF	(0...65535)
Unsigned8	8 Bit value:	0...2 <sup>8</sup> -1 0...0xFF	(0...255)
Integer32	Signed 32 Bit value:	-2 <sup>31</sup> ...2 <sup>31</sup> -1 0x8000 0000...0x7FFF FFFF	
Integer16	Signed 16 Bit value:	2 <sup>15</sup> ...2 <sup>15</sup> -1 0x8000...0x7FFF	(-32768...32767)
Integer8	Signed 8 Bit value: -	2 <sup>7</sup> ...2 <sup>7</sup> -1 0x80...0x7F	(-128...127)
PDO Mapping			
No	This object cannot be used for exchange of PDO. Only SDO can be used.		
Tx	This object can be transmitted from the frequency inverter in a TxPDO.		
Rx	This object can be transmitted to the frequency inverter in a RxPDO.		



“Highest sub index supported” shows the highest subindex supported by the object.

### 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 **0x2321** 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**

Object-no		Group
from	to	
0x2001	0x27FF	Configuration: Axis 1, Settings for Axis 1 Example: 0x2001 for motor type Axis 1
0x2801	0x28FF	Configuration: Axis 2, Settings for Axis 2 Example: 0x2801 for motor type Axis 2
0x3800	0x3FFF	Configuration: Axis independent settings Example: 0x3801 for serial-no. of Axia device
0x4000	0x47FF	Actual Values: Readings for Axis 1 Example: 0x4001 for active dataset Axis1
0x4800	0x4FFF	Actual Values: Readings for Axis 2 Example: 0x4801 for active dataset Axis2
0x5800	0x5FFF	Actual Values: axis independent readings Example: 0x5801 for DC-link Voltage
0x6000	0x67FF	CiA 402 objects Axis 1
0x6800	0x6FFF	CiA 402 objects Axis 2

## 5.1 No. of Pole pairs 0x2005

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2005	255	No. of Pole Pairs	Unsigned32	r/w	No	4

### NOTICE

This setting applies to the rated motor data.

- Observe the correct setting.

## 5.2 0x2078 Encoder Setting

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2078	0	Encoder Setting	Unsigned8	ro	No	-
	1	Res.: Comm. Offset	Float32	r/w	No	0
	2	Inv. Rotat. Direction	Boolean	r/w	No	0
	30	Res.: No.of pole pairs	UInt8	r/w	No	1

### 5.2.1 0x2078/1 Res.: Comm. Offset

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2078	1	Res.: Comm. Offset	Float32	r/w	No	0

### 5.2.2 0x2078/2 Inv. Rotat. Direction

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2078	2	Inv. Rotat. Direction	Boolean	r/w	No	0

### 5.2.3 0x2078/30 Res. No. of pole pairs

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2078	30	Res. No. of pole pairs	UInt8	r/w	No	1

$$\text{Max. Offset} = \frac{360^\circ}{\text{number of motor pole pairs} / \text{number of resolver pole pairs}}$$

**0x2005                      0x2078/30**

## 5.3 Current Limit 0x221C

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x221C	255	Current Limit	Float32	r/w	No	25

## 5.4 Freq. Switch-Off Limit 0x2420

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2420	255	Freq. Switch-Off Limit	Float32	r/w	No	

## 5.5 Frequency Reference 1 0x2511 - Frequency Reference 4 0x2514

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2511	255	Frequency Reference 1	UInt32	r/w	No	
0x2512	255	Frequency Reference 2	UInt32	r/w	No	
0x2513	255	Frequency Reference 3	UInt32	r/w	No	
0x2514	255	Frequency Reference 4	UInt32	r/w	No	

## 5.6 Percentage Reference 1 0x2541 - Percentage Reference 4 0x2544

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x2541	255	Percentage Reference 1	UInt32	r/w	No	
0x2542	255	Percentage Reference 2	UInt32	r/w	No	
0x2543	255	Percentage Reference 3	UInt32	r/w	No	
0x2544	255	Percentage Reference 4	UInt32	r/w	No	

## 5.7 Resolver Speed 0x4040/7

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x4040	7	Resolver Speed	Float32	ro	Tx	-

## 5.8 Usd flux forming voltage 0x4041/1

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x4041	1	Usd flux forming voltage	Float32	ro	Tx	-

## 5.9 S. Actual Frequency 0x4209/6

Index	Sub-index	Meaning	Data type	Access	Map	Default
0x4209	6	S. Actual Frequency	UInt32	r/w	No	

## 6 Error messages

The various control functions and methods and the hardware of the frequency inverter contain functions, which continuously monitor the application. As a supplement to the messages documented in these operating instructions, the following failure keys are activated by the EMA-RES-01 expansion module.

Initialization	
0D06	Resolver Init Failed
Signal	
0D09	Resolver Signal Lose
0D0A	Resolver Signal Degradation
0D0B	Resolver Angle Error

Errors listed above shall shut down the drive.

---

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*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*

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