Bonfiglioli
Vectron

AXIA VERT

Installation Manual
ColdPlate Mounting

Frequency inverter 230 V / 400 V
0,25 kW ... 15 kW

Bonfiglioli

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1 General Information about the Documentation

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

The present manual was created in the German language. The German manual is the original version. Other language versions are translated.

Quick Start Guide

The "Quick Start Guide" describes the basic steps required for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary objects and the configuration of the software of the frequency inverter.

User manual

The user manual documents the complete functionality of the frequency inverter. The objects required for special purposes, for adjustment to the application and the numerous additional functions are described in detail.

Separate user manuals are supplied for optional components for the frequency inverter. These manuals complement the operating instructions and the "Quick Start Guide" for the frequency inverter.

Application manual

The application manual complements the documentation to ensure goal-directed 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 manual

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

1.1 This document

The present installation manual for mounting the devices with ColdPlate cooling variant complements the Operating Instructions and the "Quick Start Guide" for the frequency inverters of the AXIA device series.

Compliance with user documentation contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service live 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 AXIA series, the following documentation must be complied with:

- The Operating Instructions Document
- Safety manual "Functional Safety Manual"

1.2 Warranty and liability

BONFIGLIOLI Deutschland GmbH (hereinafter referred to as "manufacturer") notes that the contents of this Operating Instructions document do not form part of any previous or existing agreement, assurance or legal relationship between the manufacturer and the user of these Operating Instructions (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 these operating instructions without prior notice. The manufacturer assumes no responsibility to update these Operating Instructions. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

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

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

1.3 Obligation

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

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

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

1.4 Copyright

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

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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 shall 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 are reserved.

1.5 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.

2 General safety instructions and information on use

The chapter "General safety instructions and information on use" 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 that 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 that 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 that has special technical know-how and experience relating to the 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" is not 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.

Electrostatic charging

Touching electronic components bears the risk of electrostatic discharges.

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

Charged capacitors in DC link
The DC link may have dangerous voltage levels even up to three minutes after shutdown.

Danger of equipment falling down/over, e.g. during transport
Center of gravity is not the middle of the electric cabinet modules.

2.5 Safety and warning signs on the 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 user manual

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

2.6.3 Prohibition signs

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

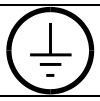
2.6.4 Personal safety equipment

Symbol	Meaning
	Wear body protection

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 Discharge (can damage components and assemblies)

2.6.8 Information signs

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

Font style in documentation

Example	Font style	Use
1234	bold	Representation of object 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 firmware 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.
- Any 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 user manual, the operator should issue separate internal operating instructions for the frequency inverter. The Operating Instructions of the frequency inverter must be included in the user manual 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 qualified technical staff. The staff must not be under the influence of any drugs. Note the minimum age required by law. Define the staff's responsibility in connection with 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 user manual 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 user manual, 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.

2.10 Organizational measures

2.10.1 General

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

2.10.2 Use in combination with third-party products

- Please note that BONFIGLIOLI Deutschland GmbH will not accept any responsibility for compatibility with third-party products (e.g. motors, cables or filters).
- In order to enable optimum system compatibility, BONFIGLIOLI Deutschland GmbH office 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 this at your own risk.

2.10.3 Transport and storage

- The frequency inverters must be transported and stored in an appropriate way. During transport and storage the devices must remain in their original packaging.
- The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to small temperature deviations only. The requirements of DIN EN 60721-3-1 for storage, DIN EN 60721-3-2 for transport and labeling on the packaging must be met.
- The duration of storage without connection to the permissible nominal voltage may not exceed one year.

2.10.4 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 a 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.

2.10.5 Electrical connections

- The five safety rules must be complied with.
- Never touch live terminals. The DC link may have dangerous voltage levels even up to three 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 five safety rules

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

1 Isolate
2 Secure to prevent restarting
3 Check isolation
4 Earth and short-circuit,
5 Cover or shield neighboring live parts.

2.10.6 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, never open the machine/plant
- Do not connect/disconnect any components/equipment during operation.
- 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 brake 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. Wait for at least 3 minutes after shutdown before starting 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 qualified staff 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 frequency inverters must not have access to the frequency inverter. Do not bypass nor decommission any protective facilities.
- 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).

2.10.7 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. Repairs on the frequency inverters may only be carried out by the manufacturer or persons authorized by the manufacturer. 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.

2.10.8 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.

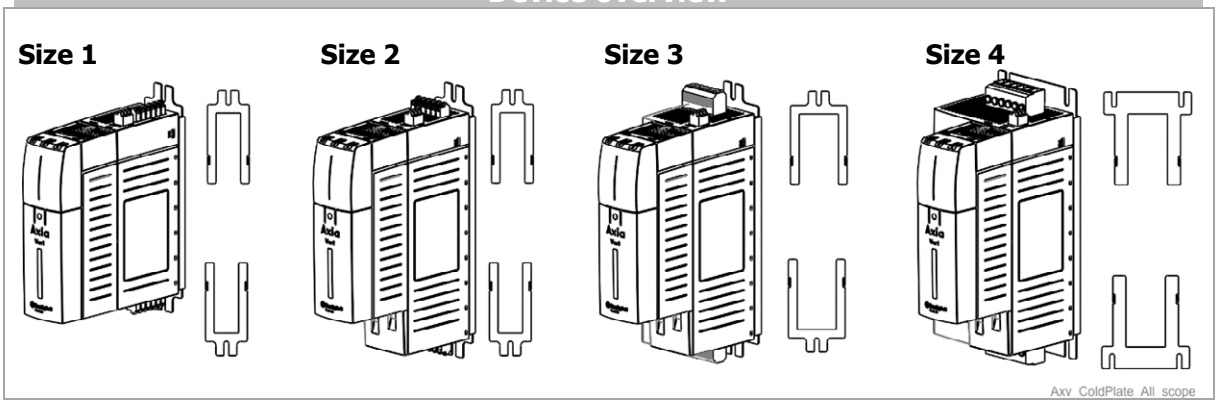
This product cannot be disposed as general household waste. Users responsible for the final disposal must make sure that it is carried out in accordance with the European Directive 2012/19/EU, where required, as well as the relative national transposition rules. Fulfil disposal also in according with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

3 Device overview

The scope of delivery of the "ColdPlate" variant differs from the scope described in the documents referring to the standard devices. The difference lies in the construction of the heat sink and also in different mounting materials.

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

Device overview



3.1 Accessory Parts for Coldplate Mounting

The mounting kit is part of delivery for ColdPlate devices.

The optional thermally conductive foil is engineered to optimize thermal transition performance between the device's backside and the thermal connection with the application.

Mounting kit	Scope of delivery in Coldplate variant
MKA-CP1&2-01	Frame size 1 and 2
MKA-CP3-01	Frame size 3
MKA-CP4-01	Frame size 4
Thermally conductive foil	**Optional**
MKA-CPF1&2-01	Frame size 1 and 2
MKA-CPF3-01	Frame size 3
MKA-CPF4-01	Frame size 4

4 Technical Data

The following tables contain the technical data for the frequency inverters of the AxiaVert device series in the "ColdPlate" variant. The recommended motor shaft power is applicable for the respective nominal voltage of the frequency inverter at a switching frequency of 4 kHz. The technical data differs from those mentioned in the instructions in terms of weights and dimensions. The dimensions are valid for the frequency inverter without terminals and with a cold plate in the device variant "ColdPlate".

For further technical data ☞ 🕮 operating instructions and related documents.

4.1 AXV40 (0.25 to 1.5 kW, 400 V)

Type								
AXV40			**k25**	**k37**	**k55**	**k75**	**1k1**	**1k5**
Output, motor side								
Recommended motor shaft power	P	kW	0.25	0.37	0.55	0.75	1.1	1.5
Mechanical								
Dimensions	HxWxD	mm	200x60x193					
Weight (approx.)	m	kg	1.4					
Protection rating	-	-	IP20 (EN60529)					
Form of assembly	-	-	Vertical					
Ambient Conditions								
Power dissipation (@2 kHz switching frequency)	P	W	23.3	27.4	29.9	33.8	40.5	50.1
Coolant temperature	Tn	°C	0 ... 40 (3K3 DIN IEC 721-3-3)					

4.2 AXV40 (1.9 to 4.0 kW, 400 V)

Type						
AXV40			**1k9**	**2k2**	**3k0**	**4k0**
Output, motor side						
Recommended motor shaft power	P	kW	1.85	2.2	3.0	4.0
Mechanical						
Dimensions	HxWxD	mm	250x60x193			
Weight (approx.)	m	kg	1.8			
Protection rating	-	-	IP20 (EN60529)			
Form of assembly	-	-	Vertical			
Ambient Conditions						
Power dissipation (@2 kHz switching frequency)	P	W	47.8	53.4	98.9	85.3
Coolant temperature	Tn	°C	0 ... 40 (3K3 DIN IEC 721-3-3)			

4.3 AXV40 (5.5 to 15 kW, 400 V)

Type							
AXV 40			**5k5**	**7k5**	**9k2**	**11k**	**15k**
Output, motor side							
Recommended motor shaft power	P	kW	5.5	7.5	9.2	11.0	15.0
Mechanical							
Dimensions	HxWxD	mm	250x80x194			250x125x194	
Weight (approx.)	m	kg	2.7			4.0	
Protection rating	-	-	IP20 (EN60529)				
Form of assembly	-	-	Vertical				
Ambient Conditions							
Power dissipation (@2 kHz switching frequency)	P	W	125.6	166.9	202.4	208.9	275.6
Coolant temperature	T_n	°C	0 … 40 (3K3 DIN IEC 721-3-3)				

5 Range of Application

WARNING

Hot surfaces

During operation, the heat sink can reach a temperature of up to 75°C.

The heat sink may be hot even some time after the frequency inverter was switched off.

- Do not touch the heat sink during operation.
- Do not touch the heat sink within an appropriate time after switch-off.

The "Cold Plate" variant enables installation of the frequency inverter on suitable surfaces which have sufficient thermal conductivity to dissipate the heat developing during the operation of the frequency inverter.

This enables the use of the frequency inverter in the following applications:

- Installation in a housing, where a high type of protection is required but the volume of the housing limits thermal compensation.
- Use in highly polluted cooling air affecting the function and service life of the fan.
- Use of several frequency inverters in limited space conditions, e. g. installation of frequency inverters on a liquid-cooled plate (sum cooler).
- Direct assembly on (or in) a machine case, with parts of the machine constructions taking over the cooling function.

NOTICE

Frequency inverters with a continuous output >15 kW require an improvement of the efficiency of the heat sink by means of suitable fans, liquid cooling or other measures improving the cooling capacity of the heat sink.

6 Thermal Properties of the Heat Sink

The heat in the frequency inverter due to the energy dissipation of the electronic components (rectifier and IGBT) must be dissipated to a heat sink via the cold plate of the frequency inverter.

The capacity to dissipate this heat mainly depends on the size of the heat sink surface, the ambient temperature and the heat transmission resistance. An increase of the heat transmission rate can only be realized to a certain extent by increasing the surface of the heat sink. An additional increase of the heat dissipation by increasing the heat sink is not possible.

The frequency inverter should be mounted with the cold plate on a heat sink with the lowest thermal resistance possible.

6.1 Thermal Resistance

The thermal resistance R_{th} is calculated from the difference between the maximum heat sink temperature and the ambient temperature, referred to the energy dissipation of the frequency inverter. The ambient temperature to be considered refers to the immediate environment of the frequency inverter.

$$R_{th} = \frac{T_{k\,max} - T_u}{P_v}$$

Max. permissible heat sink temperature of the frequency inverter	$T_{k\,max}$ = 85°C
Ambient temperature of the cold plate of the frequency inverter	T_U = 45°C
Difference between the maximum heat sink temperature and the ambient temperature ($T_{k\,max} - T_U$)	ΔT = 40 K
Energy to be dissipated by the heat sink	P_v = depends on type

NOTICE

During installation, the following items must be considered in order to minimize the thermal resistance:

- The installation surface must at least be as large as the cold plate surface.
- The contact surface must be plane and have a good thermal conductivity.
- The thermal limits of the frequency inverter and the cold plate must be considered when determining the dimensions.

For the max. permissible thermal resistance R_{th} and the device-specific energy dissipation P_v, refer to the following table. The thermal resistance R_{th} is given in the unit Kelvin per Watt (K/W). Additionally, the thermal radiation of the frequency inverter is indicated.

6.1.1 AXV40 (0.25 to 1.5 kW, 400 V)

Type								
AXV40			**k25**	**k37**	**k55**	**k75**	**1k1**	**1k5**
Output, motor-side								
Recommended motor shaft power	P	kW	0.25	0.37	0.55	0.75	1.1	1.5
Input, mains side								
Nominal voltage	U	V	400					
Energy dissipation [@2 kHz switching frequency]	P_V	W	23.3	27.4	29.9	33.8	40.5	50.1
Thermal resistance								
Thermal resistance	R_{th}	K/W	1.72	1.46	1.34	1.18	0.99	0.80
Mechanical								
Conductive foil	HxW	mm	$241^{\pm 0.5}$ x $37.5^{\pm 0.3}$ (optional)					
Heat sink	HxW	mm	190 x 60					
$T_{k\,max} - T_U$	ΔT	K	40					

6.1.2 AXV40 (1.9 to 4.0 kW, 400 V)

Type						
AXV40			**1k9**	**2k2**	**3k0**	**4k0**
Output, motor-side						
Recommended motor shaft power	P	kW	1.85	2.2	3.0	4.0
Input, mains side						
Nominal voltage	U	V	400			
Energy dissipation [@2 kHz switching frequency]	P_V	W	47.8	53.4	98.9	85.3
Thermal resistance						
Thermal resistance	R_{th}	K/W	0.84	0.75	0.40	0.47
Mechanical						
Conductive foil	HxW	mm	$241^{\pm 0.5}$ x $37.5^{\pm 0.3}$ (optional)			
Heat sink	HxW	mm	240.5 x 60			
$T_{k\,max} - T_U$	ΔT	K	40			

6.1.3 AXV40 (5.5 to 15 kW, 400 V)

Type							
AXV40			**5k5**	**7k5**	**9k2**	**11k**	**15k**
Output, motor-side							
Recommended motor shaft power	P	kW	5.5	7.5	9.2	11.0	15.0
Input, mains side							
Nominal voltage	U	V	400				
Energy dissipation [@2 kHz switching frequency]	P_V	W	125.6	167.0	202.4	208.9	275.6
Thermal resistance							
Thermal resistance	R_{th}	K/W	0.32	0.24	0.20	0.19	0.15
Mechanical							
Conductive foil (optional)	HxW	mm	$241^{\pm 0.5}$ x $57.5^{\pm 0.3}$			$241^{\pm 0.5}$ x $90^{\pm 0.3}$	
Heat sink	HxW	mm	240.5 x 80			240.5 x 125	
$T_{k\,max} - T_U$	ΔT	K	40				

The thermal resistance values and the technical data referring to the cooling concept of the "Cold Plate" variant indicated in the above table apply in the following conditions:

- No airflow.
- Clearance of approx. 300 mm above and below as well as 100 mm on both the left and right side of the frequency inverter.
- The energy dissipation values are valid for a switching frequency of 2 kHz. The energy dissipation values are also valid for the other switching frequencies, as at these operating points, the output current is reduced. For the output current reduction to be considered, ☞🕮 Technical Data sheet included in the scope of supply.

6.2 Fan and Liquid Cooling

The size of the heat sinks can be reduced if fans are installed or a liquid cooling system is used in addition to the "Cold Plate" technology.

The size of the heat sink can be reduced proportionally to the increase in the flow rate of the cooling medium.

In the following a fan cooling system is described as an example. For calculating the maximum permissible heat resistance $R_{th\ enforced}$ for cooling by means of a fan, a proportionality factor is introduced. This factor describes the increase of the max. permissible thermal resistance at increasing flow rate of the cooling air.

The max. permissible thermal resistance $R_{th\ enforced}$ for enforced air cooling can be calculated as follows:

$$R_{th\ enforced} = \frac{R_{th}}{a}$$

R_{th}: max. permissible thermal resistance with free circulation of air; calculate according to the formula for R_{th} in chapter 6.1 or use the value indicated in the table, a: proportionality factor.

Example: The relation is shown, as an example, in the following table for the AXV4015K frequency inverter.

Thermal resistance for enforced air cooling

R_{th} [K/W]	V_{air} [m/s]	a	$R_{th\ enforced}$ [K/W]
0.15	0	1	0.15
0.15	1	0.65	0.23
0.15	2	0.45	0.33
0.15	4	0.28	0.54
0.15	6	0.20	0.75

7 Application Notes

- Note the operating diagrams for power reductions (derating) in the Technical Data sheet included in the scope of supply.
- The temperature of the cold plates of the frequency inverters must not exceed $T_{k\,max}$ = 85°C for a nominal power of 0.55 … 3.0 kW and $T_{k\,max}$ = 70°C for a nominal power of 4.0 … 18.5 kW.
- Additional power losses $P_{v\,int}$ are dissipated as heat into the interior of a control cabinet. These losses may amount to 30% of the total energy dissipation and must be considered in the calculation of the volume of the control cabinet. The values are listed in the tables ☞ 6.1.
- If several frequency inverters or other heat-producing devices are mounted on a common heat sink (sum cooler), the losses of all devices must be added up. Calculate the max. permissible thermal resistance R_{th} using the formula (☞ 6.1).
- The contact surface of the heat sink must at least be as large as the contact surface of the cold plate of the frequency inverter.
- The contact surfaces of the heat sink and the cold plate of the frequency inverter must be plane.
- Black anodized heat sinks are particularly suitable. If free convection is guaranteed, these heat sinks have a thermal resistance which is 5 … 10% lower than that of untreated heat sinks.

8 Mechanical Installation

The frequency inverters in the "Cold Plate" variant are designed for installation on surfaces which comply with the specifications listed in these installation instructions.

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

WARNING

Risk of physical injury

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

- Only qualified persons are allowed to work at the device.

WARNING

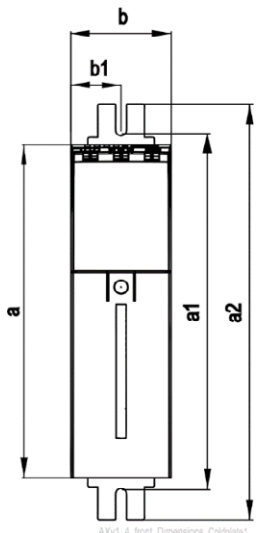
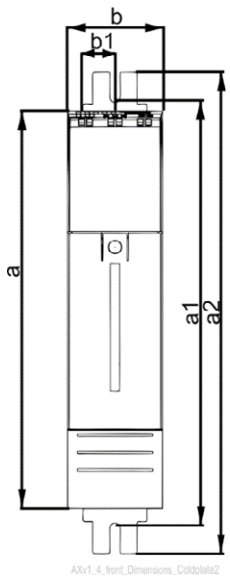
Short circuits and fire

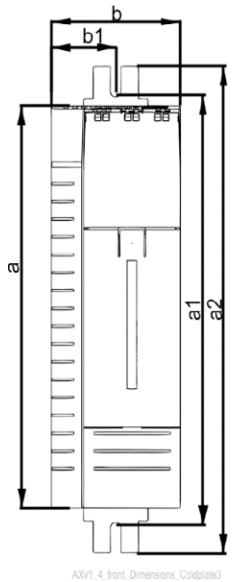
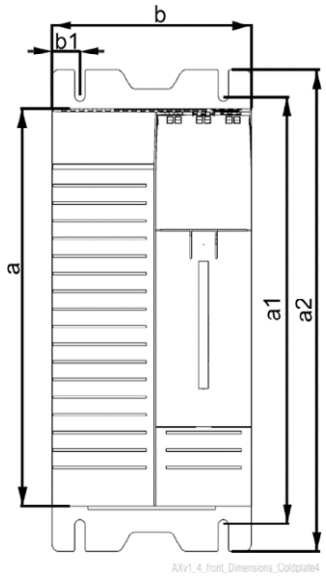
Foreign particles (e.g. chips, dust, wires, screws, tools) inside the frequency inverter!

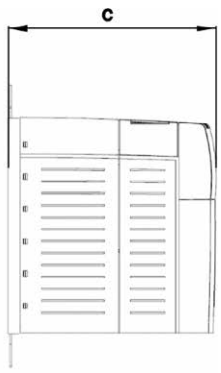
- Make sure that no foreign particles (e. g. chips, dust, wires, screws, tools) can get inside the frequency inverter during assembly.
- Avoid conductive contamination.
- Mount the device in electrical cabinets with protection class IP54 according to IEC529.
- Overhead installation or installation in horizontal position is not permissible.

The frequency inverter complies with IP20 ingress protection rating only if the covers, components and terminals are mounted properly.

8.1 Dimensions

Size 1	Size 2
	

Size 3	Size 4
	

Sizes 1–2	Sizes 3–4
	

Dimensions [mm]

Frequency inverter	a	b	c	a1	a2	b1
Size 1 (k25 – 1k5)	200	60	193	218,5 … 240	250.0	30.0
Size 2 (1k9 – 4k0)	250	60	193	270 … 290	300.5	30.0
Size 3 (5k5 – 9k2)	250	80	194	270 … 290	300.5	40.0
Size 4 (11k – 15k)	250	125	194	270 … 290	300.5	17.5

8.2 Installation Process

WARNING

Risk of physical injury

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

- Only qualified persons may work at the device.

WARNING

Risk of short circuit and fire!

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

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

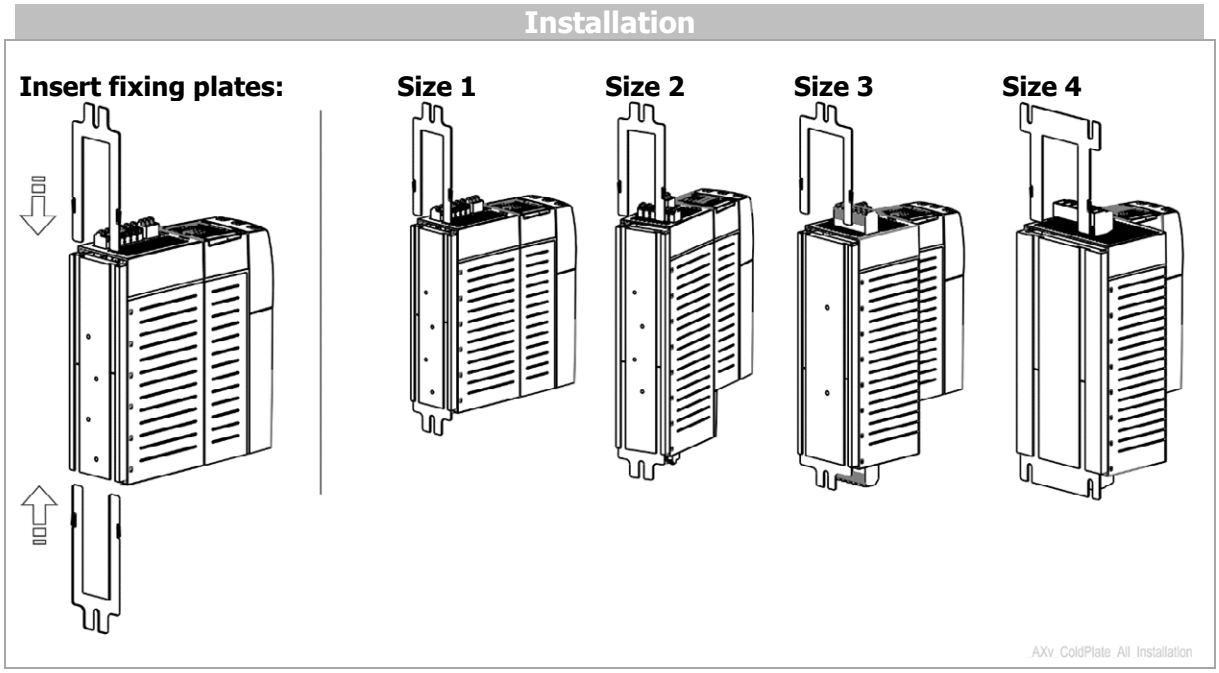
CAUTION

Minor injury and/or damage of the device

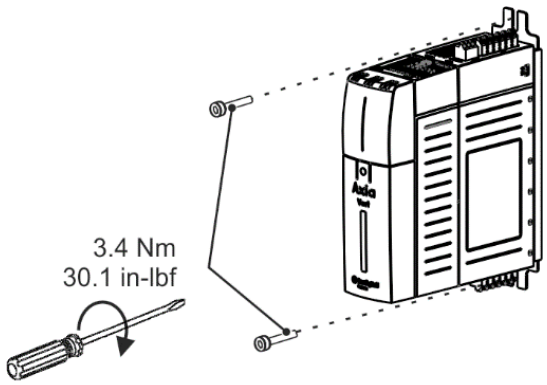
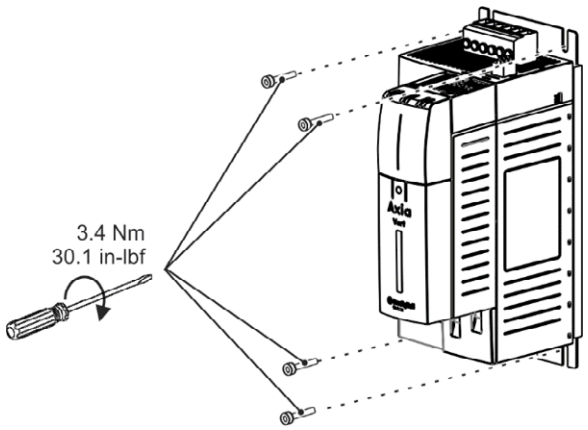
Rotating ventilator grill at the underside of the device.

- Avoid inserting fingers and/or foreign objects into the ventilator grill.

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



- For assembly, insert the long side of the fixing plates in the heat sink.

Sizes 1-3	Size 4
	

- For fixing the frequency inverter, drill threaded holes M6 in the installation surface. For the installation dimensions, refer to 8.1.
- Clean the contact surfaces of the cold plate and the heat sink.
- Optionally, apply the thermally conductive foil on the cold plate.
  Note: The conductive foil must be positioned centrally under the converter.

The thermally conductive foil compensates the roughness of the contact surfaces and thus the thermal transmission resistance between the cold plate and the heat sink. In this way, the cooling efficiency is increased.

- Mount the frequency inverter vertically on the heat sink using M6 bolts. The bolts must have a minimum length of 20 mm. Tighten all bolts uniformly.

The maximum tightening torque of the fixing bolts in a typical construction is 3.4 Nm.

After the mechanical installation continue with the electrical installation according to the Operating instructions VEC2en1. Comply with the safety instructions provided there.

9 Temperature Monitoring

The operation of the frequency inverter and the connected load is continuously monitored. The monitoring functions as well as the corresponding limit values are to be parameterized depending on the specific application. If the limits are set below the switch-off limit of the frequency inverter, a warning message can be triggered and, provided that appropriate measures are taken, an error switch-off can be avoided. After commissioning of the frequency inverter, the thermal operating conditions of the frequency inverter can be monitored:

- The heat sink temperature and the interior temperature can be displayed in the actual value menu. For detailed information, ☞ 🕮 Operating Instructions VEC2en1, chapter "Status Information".
- Alarm limits can be set up in order to trigger alarms indicating a temperature increase of the heat sink or the control cabinet interior and in order to avoid an error switch-off of the frequency inverter.
  By default, these two limits are set to -5°C. This means that an alarm is triggered if the maximum heat sink or interior temperature minus 5°C is reached. For detailed information, ☞ 🕮 Operating Instructions VEC2en1, chapter "Error behavior and warning behavior".
- When the maximum heat sink temperature or the maximum interior temperature (minus the alarm limit) is reached, an alarm message is triggered. The red LED flashes and the message "WARN" is displayed in the control unit. The warning message can be output via a digital control output. For detailed information, ☞ 🕮 Operating Instructions VEC2en1, chapter " Error behavior and warning behavior".

NOTICE

The switch-off limits of the frequency inverter are 80°C for the heat sink temperature and 65°C for the interior temperature.

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