



Bonfiglioli

Vectron

Mains Unit AEC

Operating Instructions



TABLE OF CONTENTS

1	General Information about the Documentation	6
1.1	This document	7
1.2	Warranty and liability	7
1.3	Obligation	8
1.4	Copyright	8
1.5	Storage	8
2	General safety instructions and information on use	9
2.1	Terminology	9
2.2	Designated use	10
2.3	Misuse	10
2.3.1	Explosion protection	10
2.4	Residual risks	11
2.5	Safety and warning signs	11
2.6	Warning information and symbols used in the Operating Instructions	11
2.6.1	Hazard classes	11
2.6.2	Hazard symbols	12
2.6.3	Prohibition signs	12
2.6.4	Personal safety equipment	12
2.6.5	Recycling	12
2.6.6	Grounding symbol	12
2.6.7	ESD symbol	12
2.6.8	Information signs	13
2.7	Directives and guidelines to be adhered to by the operator	13
2.8	Operator's general plant documentation	13
2.9	Operator's/operating staff's responsibilities	13
2.9.1	Selection and qualification of staff	13
2.9.2	General work safety	13
2.10	Organizational measures	14
2.10.1	General	14
2.10.2	Use in combination with third-party products	14
2.10.3	Transport and storage	14
2.10.4	Handling and installation	14
2.10.5	Electrical connection	14
2.10.6	The five safety rules	15
2.10.7	Safe operation	15
2.10.8	Maintenance and service / repair of defects	16
2.10.9	Final decommissioning	16
3	Scope of supply	17
3.1	AEC 401-22 (size 3) and AEC 401-25 (size4)	17
3.2	AEC 401-31 (size 5)	18
3.3	AEC 401-39 (size 6)	19
3.4	AEC 401-49 (size 7)	20

4	Product description Mains unit for sinusoidal feed-back	21
5	Technical data	22
5.1	General technical data	22
5.2	Technical Data – Control Electronic Equipment	23
5.3	Technical date AEC	24
5.3.1	Sizes 3 and 4	24
5.3.2	Size 5	25
5.3.3	Size 6	26
5.3.4	Size 7	27
5.4	Operation diagrams	29
6	Mains unit – type	30
7	Mechanical installation	31
7.1	AEC 401-22 (Size 3) und AEC 401-25 (Size 4)	32
7.2	AEC 401-31 (Size 5)	33
7.3	AEC 401-39 (Size 6)	34
7.4	AEC 401-49 (Size 7)	35
8	Electrical installation	36
8.1	Circuit diagram as per VDEW publication	38
8.2	EMC information	39
8.3	Block diagram	40
8.4	Optional components	41
8.5	Connection of Unit	42
8.5.1	Conductor cross-sections	42
8.5.2	Fuses	44
8.6	Connection of types	45
8.6.1	AEC 401-22 (size 3) and AEC 401-25 (size 4)	46
8.6.2	AEC 401-31 (size 5)	47
8.6.3	AEC 401-39 (size 6)	48
8.6.4	AEC 401-49 (size 7)	49
8.7	DC-link connection ACU frequency inverter with AEC mains unit	50
8.8	Precharging circuit	50
8.9	Sine filter	51
8.10	Line choke	51
8.11	Radio interference filter	51
8.12	Recommended accessories	52
8.13	Connection of frequency inverter to AEC	53
8.14	Control terminals	58
8.14.1	External DC 24 V power supply	59
8.14.2	Relay output	60
8.14.3	Wiring diagram	60

9	Commissioning of mains unit	61
10	List of parameters.....	62
10.1	Actual value menu (VAL)	62
10.2	Parameter menu (PARA)	64
10.3	AEC-relevant parameters.....	67
10.3.1	Description of parameters.....	67
10.3.1.1	Adjustable parameters	67
10.3.1.2	Actual value parameters.....	68
10.3.2	Parameter setting options	68
11	AEC as feed-back unit.....	70
11.1	Installation instructions	70
11.1.1	Precharging circuit.....	71
11.1.2	Start-up procedure	71
Index	72

1 General Information about the Documentation

Installation Instructions

These Installation Instructions describe the AEC mains unit, as well as feed-in and feed-back of electrical energy with the following application options and properties:

- Conversion of regenerative energy to electrical energy
- High power factor
- No line compensation requirements (power factor correction)
- Increased drive torque yield
- Application manual

Application manual

The application manual complements the documentation for target-oriented installation and commissioning of the mains unit. Various subjects relating to the use of the mains unit are covered application-specifically.

For a copy of the documentation and additional information contact your local Bonfiglioli Vectron agency.

1.1 This document

The Installation Instructions contain important information on the installation and use of the AEC mains unit in its specified application range. Compliance with these instructions contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service life of the mains unit.

For this reason, make sure you read the Installation Instructions carefully.



WARNING

Compliance with the documentation is required for safe operation of the mains unit. Bonfiglioli Vectron 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.

1.2 Warranty and liability

Bonfiglioli Vectron GmbH would like to point out that the contents of these Operating Instructions do not form part of any previous or existing agreement, assurance or legal relationship. 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 notice. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

Furthermore, Bonfiglioli Vectron GmbH excludes any warranty/liability claims for any personal and/or material damage if such damage is due to one or more of the following causes:

- inappropriate use of the AEC mains unit,
- non-compliance with the instructions, warnings and prohibitions contained in the documentation,
- unauthorized modifications of the AEC mains unit,
- 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

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

- transport,
- assembly,
- installation of the AEC mains unit and
- operation of the AEC mains unit

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

1.4 Copyright

In accordance with applicable law against unfair competition, these Operating Instructions shall be considered to be a certificate. Any copyrights relating to it shall remain with

Bonfiglioli Vectron GmbH
Europark Fichtenhain B6
47807 Krefeld
Deutschland

These Operating Instructions are intended for the operator of the AEC mains unit. 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 dated 09 September 1965, the law against unfair competition and the Civil Code and may result in claims for damages. All rights relating to patent, utility model or design registration reserved.

1.5 Storage

The documentation form an integral part of the AEC mains unit. It must be stored such that it is accessible to operating staff at all times. If the AEC mains unit is sold on to other users, then these Operating Instructions 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 AEC mains unit 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 mains unit and assigned the task of operating the AEC mains unit.

Skilled Personnel

The term Skilled Personnel covers staff that are assigned special tasks by the Operator of the mains unit, 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 have 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 are 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 have special technical know-how and experience relating to AEC mains unit. 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 AEC mains unit.

2.2 Designated use

The AEC mains unit is designed according to the state of the art and recognized safety regulations.

The AEC mains units 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 AEC mains units meet the requirements of the low voltage directive 2006/95/EEC and DIN EN 61800-5-1. CE-labeling is based on these standards. Responsibility for compliance with the EMC Directive 2004/108/EC lies with the operator. The AEC mains units 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 AEC mains unit.

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 at all times.

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.

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

2.3.1 Explosion protection

The AEC mains unit is an IP20 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 AEC mains unit 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 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 mains unit if no external disconnection device was installed by the operator.

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


- Comply with all safety instructions and danger information provided on the AEC mains unit.
- Safety information and warnings on the AEC mains unit 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.


NOTE

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 AEC mains unit easier.

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 AEC mains unit, 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 AEC mains unit is used.
- 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 operating instructions for the AEC mains unit. The Installation Instructions of the AEC mains unit 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 AEC mains unit 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 in connection with all work on the AEC mains unit 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 these 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 AEC mains unit in any way, including addition of attachments or retrofits.
- Only use the AEC mains unit 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 AEC mains unit properly.

2.10 Organizational measures

2.10.1 General

- Train your staff in the handling and use of the AEC mains unit and the machine/plant as well as the risks involved.
- Use of any individual parts or components of the AEC mains unit in other parts of the operator's machine/plant is prohibited.
- Optional components for the AEC mains unit 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 Vectron 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 Vectron GmbH offers components facilitating commissioning and providing optimum synchronization of the machine/plant parts in operation.
- If you use the AEC mains unit 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 AEC mains unit. Do not bend any components and never change the isolation distances.
- Do not touch any electronic construction elements and contacts. The AEC mains unit 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 AEC mains unit in a suitable operating environment. The AEC mains unit 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 connection

- 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 AEC mains unit, 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 AEC mains unit may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.
- Only connect the AEC mains unit to suitable supply mains.

2.10.6 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.

2.10.7 Safe operation

- During operation of the mains unit, 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 AEC mains unit 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 AEC mains unit. 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 AEC mains unit from mains supply.
- Persons not familiar with the operation of the mains units must not have access to the AEC mains unit. Do not bypass nor decommission any protective facilities.
- The AEC mains unit 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 the applicable safety directives (e.g. Working Machines Act or Accident Prevention Directives).

2.10.8 Maintenance and service / repair of defects

- Visually inspect the mains unit 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 AEC mains unit 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.

2.10.9 Final decommissioning

Unless separate return or disposal agreements were made, recycle the disassembled mains unit 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.

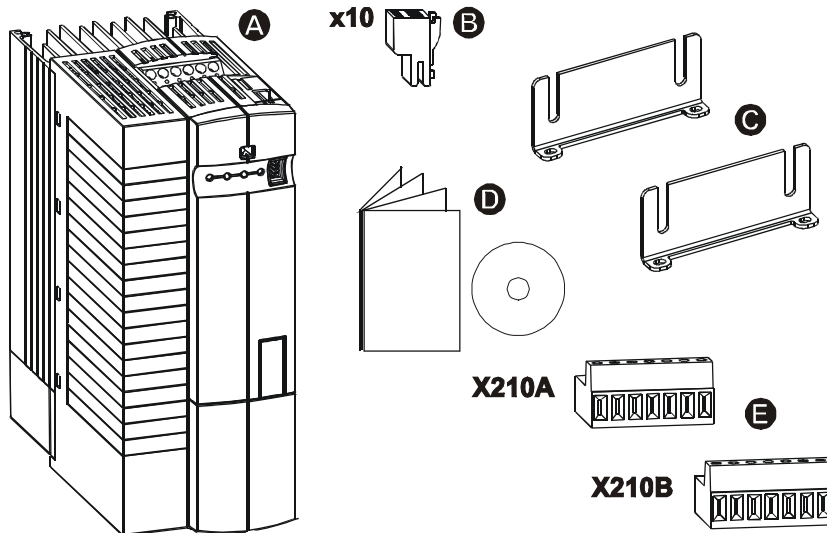


In any case, comply with any applicable national disposal regulations as regards environmentally compatible disposal of the AEC mains unit. For more details, contact the competent local authorities.

3 Scope of supply

Thanks to the modular hardware components, the mains unit can be integrated in the automation concept easily. The scope of delivery described can be supplemented by optional components and adapted to the customer-specific requirements.

3.1 AEC 401-22 (size 3) and AEC 401-25 (size4)



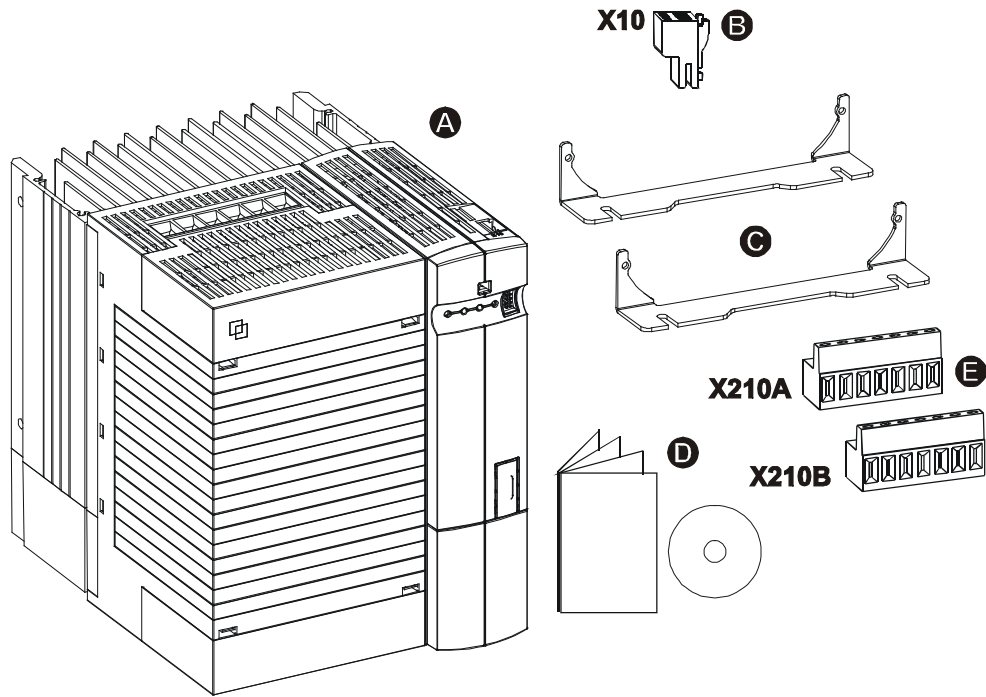
Scope of supply

A	Mains unit
B	Terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
C	Standard fittings with fitting screws (M4x20, M4x60) for vertical assembly
D	Installation Instructions and Operating Instructions on CD ROM
E	Control terminals X210A / X210B (Wieland DST85/RM3.5) Plug-in terminal for connection of the control signals

NOTE

Please check incoming goods for quality, quantity and nature immediately. 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.

3.2 AEC 401-31 (size 5)



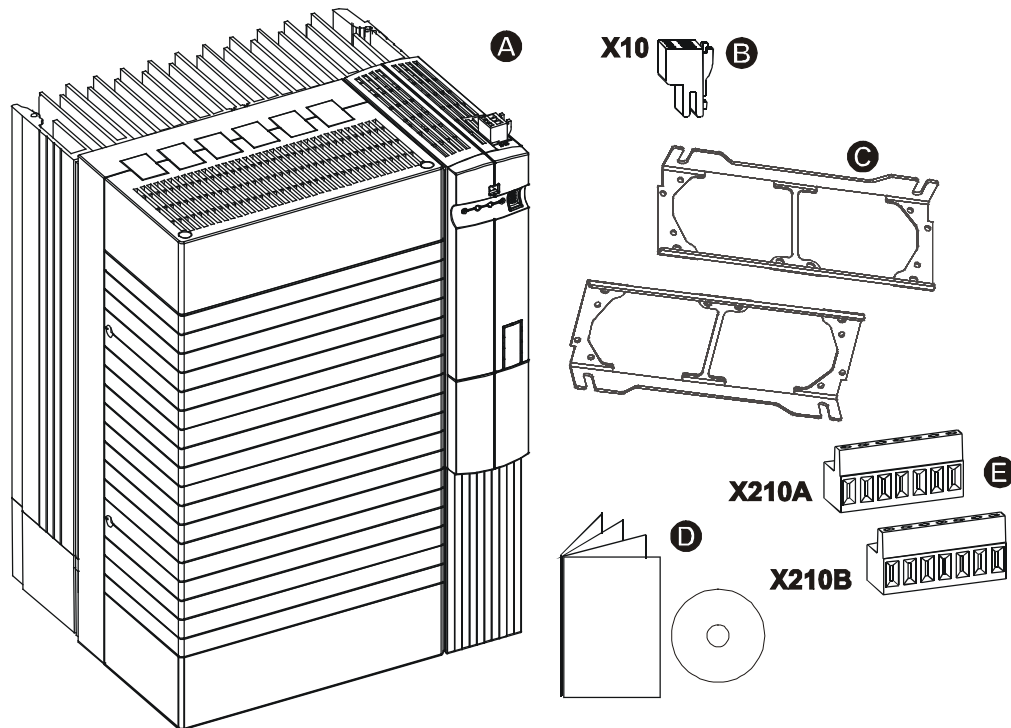
Scope of supply

A	Mains unit
B	Terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
C	Standard fittings with fitting screws (M4x20, M4x70) for vertical assembly
D	Installation Instructions and Operating Instructions on CD ROM
E	Control terminals X210A / X210B (Wieland DST85/RM3.5) Plug-in terminal for connection of the control signals

NOTE

Please check incoming goods for quality, quantity and nature immediately. 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.

3.3 AEC 401-39 (size 6)



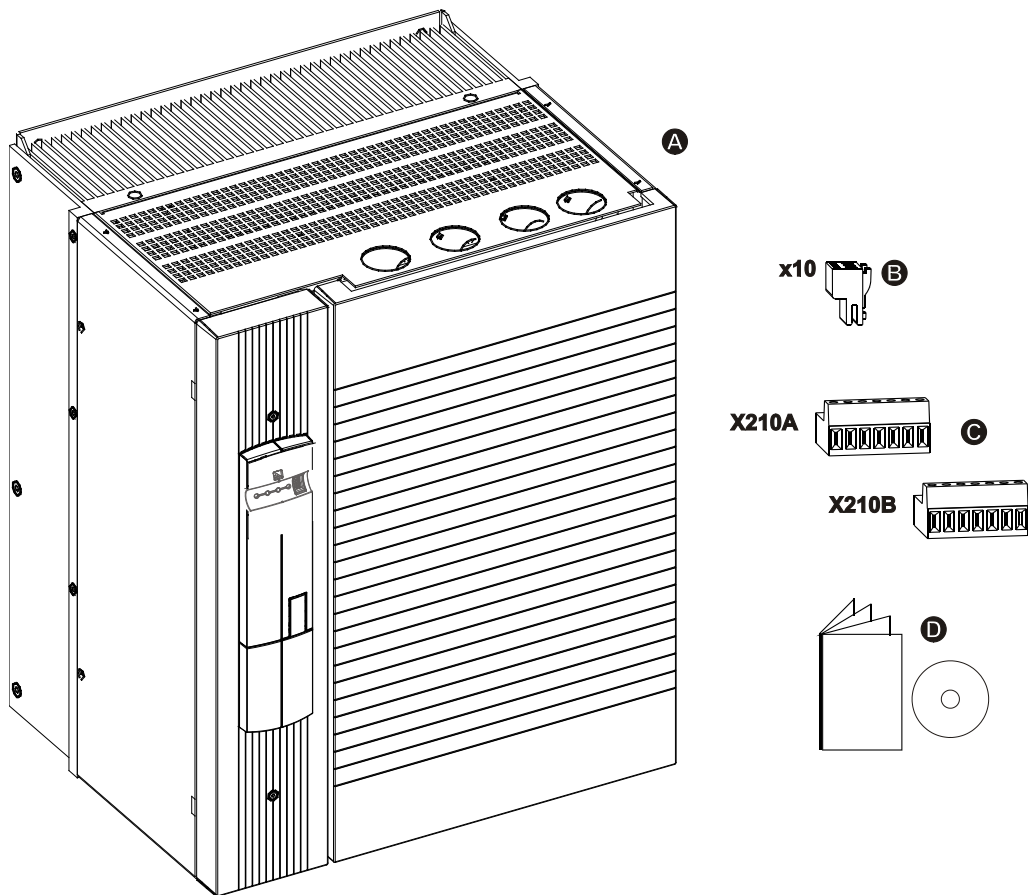
Scope of supply

A	Mains unit
B	Terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
C	Standard fittings with fitting screws (M5x20) for vertical assembly
D	Installation Instructions and Operating Instructions on CD ROM
E	Control terminals X210A / X210B (Wieland DST85/RM3.5) Plug-in terminal for connection of the control signals

NOTE

Please check incoming goods for quality, quantity and nature immediately. 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.

3.4 AEC 401-49 (size 7)



Scope of supply

A	Mains unit
B	Terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
C	Control terminals X210A / X210B (Wieland DST85/RM3.5) Plug-in terminal for connection of the control signals
D	Installation Instructions and Operating Instructions on CD ROM

NOTE

Please check incoming goods for quality, quantity and nature immediately. 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.

4 Product description Mains unit for sinusoidal feed-back

The energy produced in many processes by regenerative operation, cannot be fed back into the supply mains by frequency inverters directly. Instead of losing the energy that is converted to unusable heat, the energy can be fed back into the supply mains by the AEC mains unit for re-use. Supply and feed-back by the mains unit does not produce any mains disturbances thanks to a special control method. One or more frequency inverters can be connected to the DC-link of the mains unit.

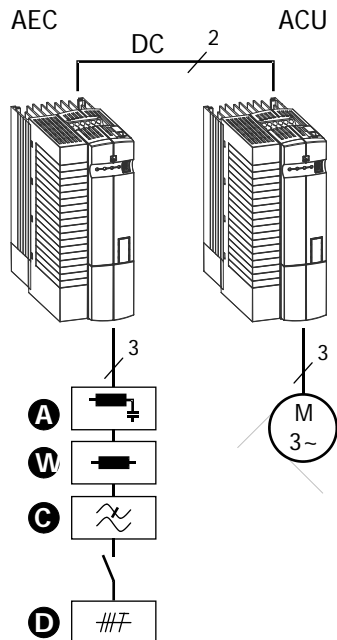
The mains units are integrated in a drive system typically comprising the following components:

- AEC mains unit
- Sine filter
- Line choke
- Radio interference filter
- ACU frequency inverter
- Asynchronous motor or synchronous motor
- (shielded) mains cable
- shielded motor cable
- shielded control cables
- metal mounting plate

In addition to the components listed above, a precharging circuit must be provided.

The equipment required by the local electric utility for parallel operation with the low or medium voltage mains must be integrated in the application separately, i.e. independent of AEC mains unit.

Principle



- A** Sine filter
- B** Line choke
- C** Radio interference filter
- D** Mains (L1/L2/L3/PE)
- AEC Mains unit
- ACU Frequency inverter

5 Technical data

5.1 General technical data

Designation	Description
CE conformity	The AEC mains unit meets the requirements of the Low Voltage Directive 2006/95/EEC and EN 50178 / DIN VDE 0160 and EN 61800-2.
EMC directive	For proper installation of the mains unit in order to meet the requirements of EN 61800-3, please comply with the installation instructions in these Installation Instructions.
Interference immunity	The AEC mains unit meets the requirements of EN 61800-3 for use in industrial environments.
UL Approval	The frequency inverters are also marked with the UL label according to UL508c, which proves that they also meet the requirements of the CSA Standard C22.2-No. 14-95.
Ambient temperature	Operation: 0...55 °C; as from 40 °C power reduction should be considered.
Environmental class	Operation: 3K3 (EN60721-3-3) Relative humidity 15...85%, no water condensation
Ingress protection rating	IP20 if covers and connection terminals are used properly.
Altitude of installation	Up to 1000 m at rated specifications. Up to 4000 m at reduced power.
Storage	Storage according to EN 50178. Bonfiglioli Vectron recommends that the unit be connected to rated voltage for 60 minutes after one year, at the latest.
Overload capacity	Continuous operation 100% I_N Up to 150% I_N for 60 s Up to 200% I_N for 1 s Overload capacity can be used every 10 minutes.
Parameterization	Freely programmable digital inputs and outputs. Four separate data sets

5.2 Technical Data – Control Electronic Equipment

Control terminal X210A		Control terminal X210B	
X210A.1	DC 20 V output ($I_{max}=180$ mA) or DC 24 V $\pm 10\%$ input for external power supply	X210B.1	Digital inputs ²⁾
X210A.2	GND 20 V/ GND 24 V (ext.)	X210B.2 ³⁾	Digital input S1IND
X210A.3	Digital input S1IND for release and acknowledging errors ¹⁾	X210B.3	Digital output ²⁾
X210A.4	Digital inputs ²⁾	X210B.4	Multifunction output ²⁾
X210A.5		X210B.5	DC 10 V output ($I_{max}=4$ mA)
X210A.6		X210B.6	multifunction input ²⁾
X210A.7		X210B.7	Ground 10 V

Relay output X10	
X10	Wiring with precharging circuit. See Chapter 8.8 "Precharging circuit".

¹⁾ Release of mains unit: Contact at X210A.3 closed.

²⁾ Control terminals are freely configurable.

³⁾ In order to release the mains unit, contact X210B.2 must be closed.



By default, the different configurations occupy the control terminals with certain settings. These settings can be adjusted to the specific application, and various functions can be assigned freely to the control terminals.

Technical data of control terminals

Digital inputs (X210A.3...X210B.2): PLC compatible

Low signal: DC 0 V ... 3 V, High signal: DC 12 V ... 30 V, input resistance: 2,3 k Ω , response time: 2 ms, except for X210A.3 and X210B.2 response time: 10 ms

Digital output (X210B.3):

Low signal: DC 0 V ... 3 V, High signal: DC 12 V ... 30 V, maximum output current: 50 mA, PLC compatible

Relay output (X10):

Change-over contact, response time approx. 40 ms
make contact AC 5 A / 240 V, DC 5 A (ohmic) / 24 V,
break contact AC 3 A / 240 V, DC 1 A (ohmic) / 24 V

For connection of a coupler relay for controlling power contactors. Note the technical data of the existing customer-provided components.

Multifunction output (X210B.4):

Analog signal: DC 19 ... 28 V, maximum output current: 50 mA, pulse-width modulated ($f_{PWM}=116$ Hz),

Digital signal: Low signal: DC 0 V ... 3 V, High signal: DC 12 V ... 30 V, output current: 50 mA, PLC compatible,

Frequency signal: Output voltage: DC 0 V ... 24 V, maximum output current: 40 mA, maximum output frequency: 150 kHz

Multifunction input (X210B.6):

Analog signal: input voltage: DC 0... 10 V ($R_i=70$ k Ω), input current: DC 0 mA ... 20 mA ($R_i=500$ Ω),
Digital signal: Low signal: DC 0 V ... 3 V, High signal: DC 12 V...30 V, response time: 4 ms, PLC compatible

Conductor cross-section:

The signal terminals are suitable for the following cable sizes:

with ferrule: 0.25 mm² ... 1.0 mm²

without ferrule: 0.14 mm² ... 1.5 mm²

5.3 Technical data AEC

5.3.1 Sizes 3 and 4

Type							
AEC 401		-19	-21	-22	-23	-25	
Size		3	3	3	4	4	
Output, mains side, at 400 V mains voltage							
Output power ¹	kVA	9.7	12.5	15.2	17.3	22.2	
Rated output current	A	14	18	22	25	32	
Recommended mot. shaft power ²	kW	5.5	7.5	9.2	11.0	15.0	
Voltage	V	320 ... 460					
Frequency	Hz	45 ... 66					
Protection		Short circuit / earth fault proof					
Distortion factor	%	< 3%					
Displacement factor	-	cos ϕ adjustable ³					
Switching frequency	kHz	4, 8, 12, 16					
Line fuses	-	external					
Output, braking resistor							
Min. braking resistance	Ω	48	48	48	32	32	
Recommended braking resistance (U _{dBC} = 770 V)	Ω	80	58	48	48	32	
Mechanical							
Dimensions	H	mm	250	250	250	250	250
	W	mm	100	100	100	125	125
	D	mm	200	200	200	200	200
Weight approx.	kg	3	3	3	3.7	3.7	
Connection terminals	mm ²	0.2 ... 6	0.2 ... 6	0.2 ... 6	0.2 ... 16	0.2 ... 16	
Ingress protection rating	-	IP20 (EN60529)					
Form of assembly	-	vertical					
Ambient conditions							
Energy dissipation (4 kHz switching frequency)	W	160	210	260	280	365	
Coolant temperature	°C	0 ... 40 (3K3 DIN IEC 721-3-3)					
Storage temperature	°C	-25 ... 55					
Transport temperature	°C	-25 ... 70					
Rel. humidity	%	15 ... 85, not condensing					
DC-link							
DC rated current	A	17	19	27	31	39	
Max. DC input voltage	VDC	Overvoltage shutdown at >800 VDC					
Optional components							
Line choke (u _k =4%)	-	external					
Radio interference filter	-	external					
Sine filter (u _k =8%)	-	external					
Control unit or Interface adapter	-	Control via buttons on device or VPLUS PC User Interface					
communication modules	-	RS232, RS485, Profibus-DP, CANopen					
Extension modules	-	Control inputs and outputs, System Bus					



The actual specifications of the device can differ from the data listed here.

¹ at 400 V mains voltage

² The recommended motor shaft power considers the maximum regenerative mains power of asynchronous three-phase a.c. motors.

³ via parameter *Fixed Percentage 1 520*

5.3.2 Size 5

Type						
AEC 401		-27	-29	-31	-	-
Size		5	5	5	-	-
Output, mains side, at 400 V mains voltage						
Output power ¹	kVA	27.7	31.2	41.6	-	-
Rated output current	A	40	45	60	-	-
Recommended mot. shaft power ²	kW	18.5	22.0	30.0	-	-
Voltage	V	320 ... 460				
Frequency	Hz	45 ... 66				
Protection		Short circuit / earth fault proof				
Distortion factor	%	< 3%				
Displacement factor	-	cos ϕ adjustable ³				
Switching frequency	kHz	4/8				
Line fuses	-	external				
Output, brake resistor						
Min. braking resistance	Ω	16	16	16	-	-
Recommended braking resistance (U _{dBC} = 770 V)	Ω	26	22	16	-	-
Mechanical						
Dimensions	H		250	250	250	-
	W	mm	200	200	200	-
	D		260	260	260	-
Weight approx.	kg	8	8	8	-	-
Connection terminals	mm ²	up to 25	up to 25	up to 25	-	-
Ingress protection rating	-	IP20 (EN60529)				
Form of assembly	-	vertical				
Ambient conditions						
Energy dissipation (4 kHz switching frequency)	W	420	475	655	-	-
Coolant temperature	°C	0 ... 40 (3K3 DIN IEC 721-3-3)				
Storage temperature	°C	-25 ... 55				
Transport temperature	°C	-25 ... 70				
Rel. humidity	%	15 ... 85 not condensing				
DC-link						
DC rated current	A	47	53	71	-	-
Max. DC input voltage	VDC	Overvoltage shutdown at >800 VDC				
Optional components						
Line choke (u _k =4%)	-	external				
Radio interference filter	-	external				
Sine filter (u _k =8%)	-	external				
Control unit or Interface adapter	-	Control via buttons on device or VPLUS PC User Interface				
communication modules	-	RS232, RS485, Profibus-DP, CANopen				
Extension modules	-	Control inputs and outputs, System Bus				



The actual specifications of the device can differ from the data listed here.

¹ at 400 V mains voltage

² The recommended motor shaft power considers the maximum regenerative mains power of asynchronous three-phase a.c. motors.

³ via parameter *Fixed Percentage 1 520*

5.3.3 Size 6

Type							
AEC 401		-33	-35	-37	-39	-	
Size		6	6	6	6	-	
Output, mains side, at 400 V mains voltage							
Output power ¹	kVA	52.0	62.3	76.2	86.6	-	
Rated output current	A	75	90	110	125	-	
Recommended mot. shaft power ²	kW	37.0	45.0	55.0	65.0	-	
Voltage	V	320 ... 460					
Frequency	Hz	45 ... 66					
Protection		Short circuit / earth fault proof					
Distortion factor	%	< 3%					
Displacement factor	-	cos ϕ adjustable ³					
Switching frequency	kHz	4/8					
Line fuses	-	external					
Output, brake resistor							
Min. braking resistance	Ω	7.5	7.5	7.5	7.5	-	
Recommended braking resistance (U _{dBC} = 770 V)	Ω	13	11	9	7.5	-	
Mechanical							
Dimensions	H	mm	400	400	400	400	-
	W	mm	275	275	275	275	-
	D	mm	260	260	260	260	-
Weight approx.	kg	20	20	20	20	-	
Connection terminals	mm ²	up to 70	up to 70	up to 70	up to 70	-	
Ingress protection rating	-	IP20 (EN60529)					
Form of assembly	-	vertical					
Ambient conditions							
Energy dissipation (4 kHz switching frequency)	W	760	915	1140	1315	-	
Coolant temperature	°C	0 ... 40 (3K3 DIN IEC 721-3-3)					
Storage temperature	°C	-25 ... 55					
Transport temperature	°C	-25 ... 70					
Rel. humidity	%	15 ... 85 not condensing					
DC-link							
DC rated current	A	90	109	132	152	-	
Max. DC input voltage	VDC	Overvoltage shutdown at >800 VDC					
Optional components							
Line choke (u _k =4%)	-	external					
Radio interference filter	-	external					
Sine filter (u _k =8%)	-	external					
Control unit or Interface adapter	-	Control via buttons on device or VPLUS PC User Interface					
communication modules	-	RS232, RS485, Profibus-DP, CANopen					
Extension modules	-	Control inputs and outputs, System Bus					



The actual specifications of the device can differ from the data listed here.

¹ at 400 V mains voltage

² The recommended motor shaft power considers the maximum regenerative mains power of asynchronous three-phase a.c. motors.

³ via parameter *Fixed Percentage 1 520*

5.3.4 Size 7

Type						
AEC 401		-43	-45	-47	-49	-
Size		7	7	7	7	-
Output, mains side, at 400 V mains voltage						
Output power ¹	kVA	103.9	124.7	145.5	173.2	-
Rated output current	A	150	180	210	250	-
Recommended mot. shaft power ²	kW	75.0	90.0	110.0	132.0	-
Voltage	V	320 ... 460				
Frequency	Hz	45 ... 66				
Protection		Short circuit / earth fault proof				
Distortion factor	%	< 3%				
Displacement factor	-	cos ϕ adjustable ³				
Switching frequency	kHz	4, 8				
Line fuses	-	external				
Output, brake resistor						
Min. braking resistance	Ω	4.5	4.5	3.0	3.0	-
Recommended braking resistance (U _{DBC} = 770 V)	Ω	6.1	5.1	4.1	3.8	-
Mechanical						
Dimensions	H	mm	510	510	510	510
	W	mm	412	412	412	412
	D	mm	351	351	351	351
Weight approx.	kg	48	48	48	48	-
Connection terminals	mm ²	up to 2 x 95				
Ingress protection rating	-	IP20 (EN60529)				
Form of assembly	-	vertical				
Ambient conditions						
Energy dissipation (4 kHz switching frequency)	W	1650	1975	2270	2785	-
Coolant temperature	°C	0 ... 40 (3K3 DIN IEC 721-3-3)				
Storage temperature	°C	-25 ... 55				
Transport temperature	°C	-25 ... 70				
Rel. humidity	%	15 ... 85 not condensing				
DC-link						
DC rated current	A	212	- ⁴	- ⁴	- ⁴	-
Max. DC input voltage	VDC	Overvoltage shutdown at >800 VDC				
Optional components						
Line choke (u _k =4%)	-	external				
Radio interference filter	-	external				
Sine filter (u _k =8%)	-	external				
Control unit or Interface adapter	-	Control via buttons on device or VPLUS PC User Interface				
communication modules	-	RS232, RS485, Profibus-DP, CANopen				
Extension modules	-	Control inputs and outputs, System Bus				



The actual specifications of the device can differ from the data listed here.

¹ at 400 V mains voltage

² The recommended motor shaft power considers the maximum regenerative mains power of asynchronous three-phase a.c. motors.

³ via parameter *Fixed Percentage 1 520*

⁴ upon request

If required by the customer, the switching frequency may be increased if the output current is reduced at the same time. Comply with the applicable standards and regulations for this operating point.

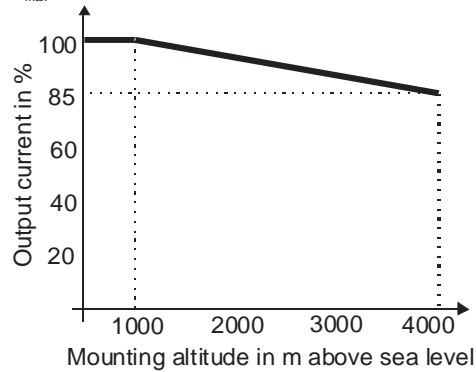
Mains unit output power	Output current			
	Switching frequency			
	4 kHz	8 kHz	12 kHz	16 kHz
9.7 kVA	14,0 A	14,0 A	11,8 A	9,5 A
12.5 kVA	18,0 A	18,0 A	15,1 A	12,2 A
15.2 kVA	22,7 A	22,0 A	18,5 A	15,0 A
17.3 kVA	25,0 A	25,0 A	21,0 A	17,0 A
22.2 kVA	32,0 A	32,0 A	26,9 A	21,8 A
27.7 kVA	40,0 A	40,0 A	-	-
31.2 kVA	45,0 A	45,0 A	-	-
41.6 kVA	60,0 A	60,0 A	-	-
52.0 kVA	75,0 A	75,0 A	-	-
62.3 kVA	90,0 A	90,0 A	-	-
76.2 kVA	110,0 A	110,0 A	-	-
86.6 kVA	125,0 A	125,0 A	-	-
103.9 kVA	150,0 A	150,0 A	-	-
124.7 kVA	180,0 A	180,0 A	-	-
145.5 kVA	210,0 A	210,0 A	-	-
173.2 kVA	250,0 A	250,0 A	-	-

5.4 Operation diagrams

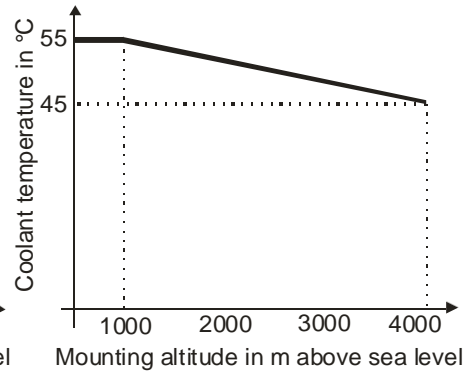
The technical data of the mains unit refer to the nominal point which was selected to enable a wide range of applications. A functionally and efficient dimensioning (derating) of the mains unit is possible based on the following diagrams.

Installation height

Power reduction (Derating),
5%/1000 m above sea level,
 $h_{\max} = 4000$ m

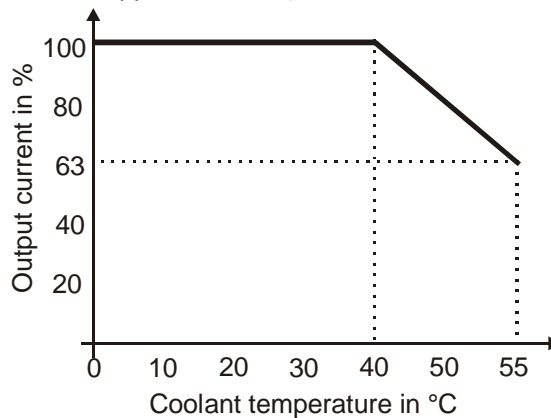


max. coolant temperature,
3.3 °C/1000 m above sea level,



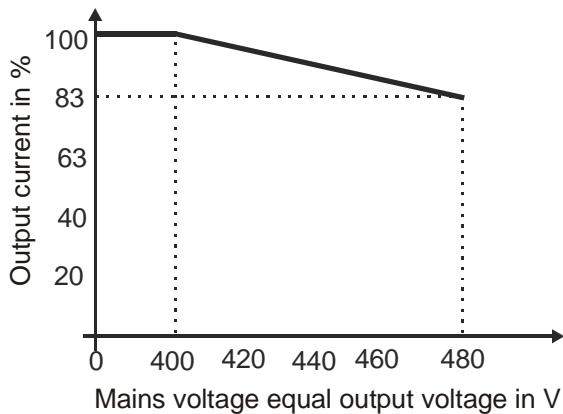
Coolant temperature

Power reduction (Derating)
2.5%/K upper 40 °C, $T_{\max} = 55$ °C



Mains voltage

Reduction of output current at constant output power (Derating)
0.22%/V upper 400 V, $U_{\max} = 480$ V



6 Mains unit – type

- Identify the type of mains unit.
- Check if mains input rated voltage matches the local mains voltage

Type designation
AEC-401-21

Rated voltage
401 400 V

Recommended power

Part number & serial number

Warning! Components sensitive to electrostatic energy.

Warning! High leakage current.

Warning! Dangerous voltage. Danger of electric shock.

Warning! Hot surfaces.

[1] Marking for UL508c (where applicable).

Identifier	Size	Recommended power
		AEC 401: AC 3x400 V
- 19	3	9.7 kVA
-21		12.5 kVA
-22		15.2 kVA
-23	4	17.3 kVA
-25		22.2 kVA
-27		27.7 kVA
-29	5	31.2 kVA
-31		41.6 kVA
-33		52 kVA
-35	6	62.3 kVA
-37		76.2 kVA
-39		86.6 kVA
-41	7	103.9 kVA
-43		124.7 kVA
-45		145.5 kVA
-47		173.2 kVA

7 Mechanical installation

The ingress protection rating IP20 mains units are designed, as a standard, for installation in electrical cabinets.

During installation, both the installation and the safety instructions as well as the device specifications must be complied with.



WARNING

To avoid serious physical injuries or major material damage, only qualified persons are allowed to work on the devices.



WARNING

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

The mains unit meets the IP20 ingress protection rating requirements only if the covers and terminals are mounted properly.

Overhead Installation or installation in horizontal position is not permissible.



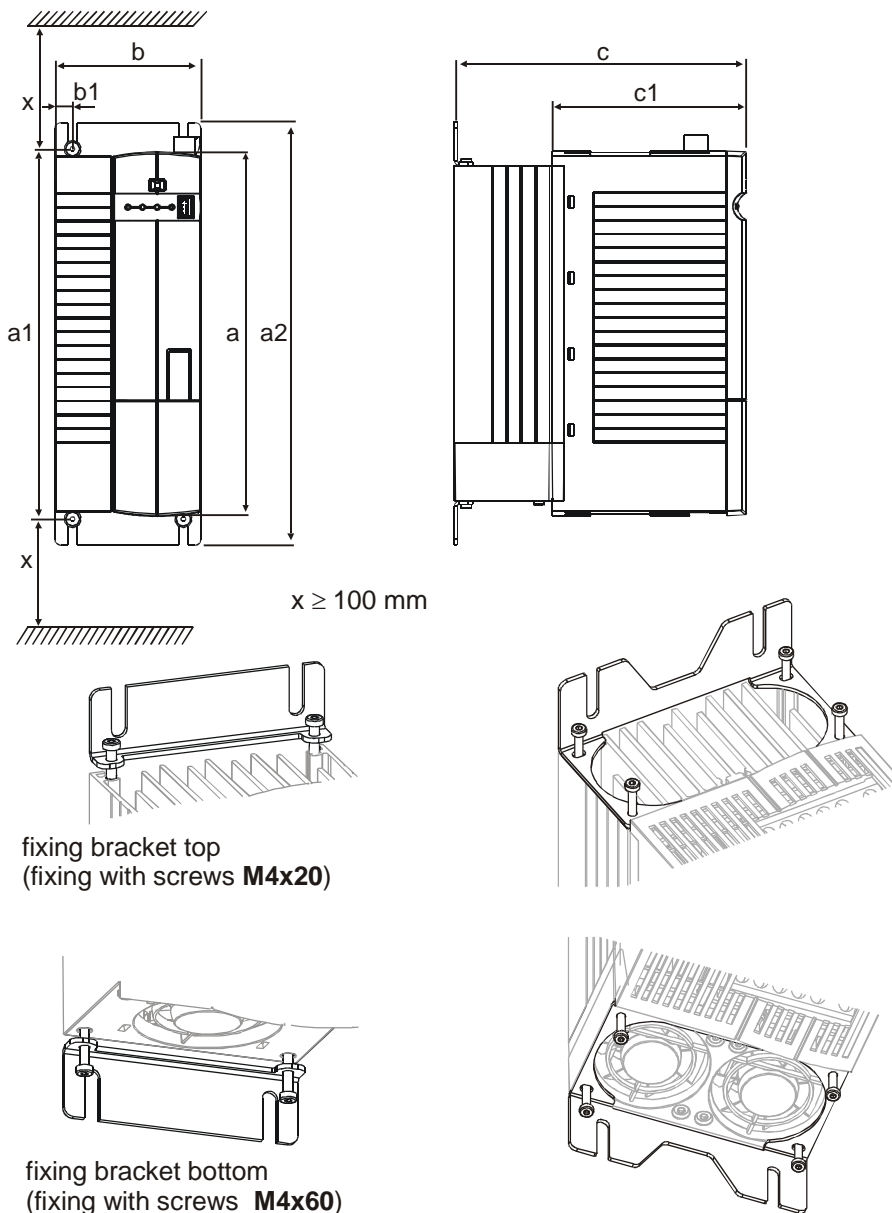
CAUTION

Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution such as dust, aggressive gases, etc.

7.1 AEC 401-22 (Size 3) und AEC 401-25 (Size 4)

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

Standard installation



Screw fixing brackets to heat sink of the mains unit and mounting plate.

The mains unit is provided with fixing brackets, which are fitted using four thread-cutting screws. The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

AEC 401	Dimensions [mm]			Assembly dimensions [mm]			
	a	b	c	a1	a1	b1	c1
-19	250	100	200	270 ... 290	315	12	133
-21	250	100	200	270 ... 290	315	12	133
-22	250	100	200	270 ... 290	315	12	133
-23	250	125	200	270 ... 290	315	17.5	133
-25	250	125	200	270 ... 290	315	17.5	133

CAUTION

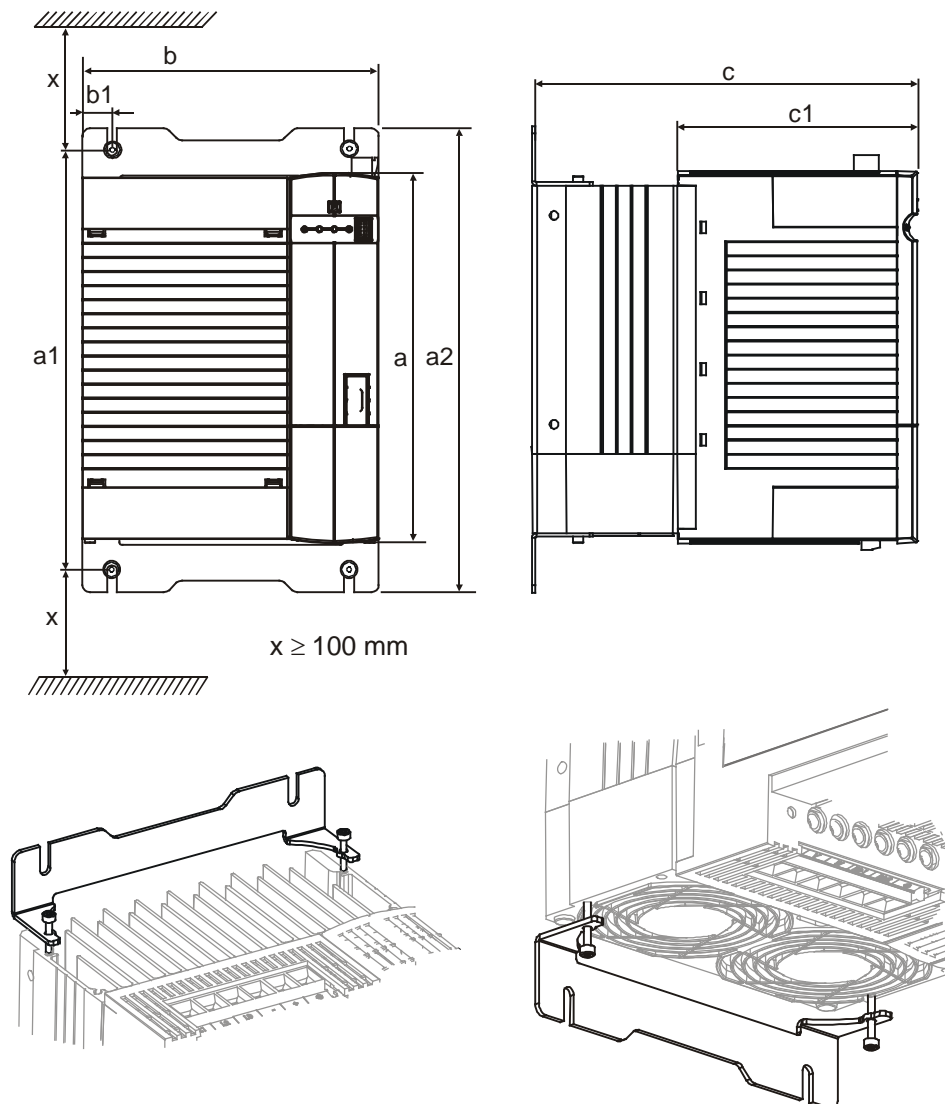


Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution such as dust, aggressive gases, etc.

7.2 AEC 401-31 (Size 5)

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

Standard installation



fixing bracket top
(fixing with screws **M4x20**)

fixing bracket bottom
(fixing with screws **M4x70**)

Screw fixing brackets to heat sink of the mains unit and mounting plate.

The mains unit is provided with fixing brackets, which are fitted using four thread-cutting screws. The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

	Dimensions [mm]			Assembly dimensions [mm]			
AEC 401	a	b	c	a1	a1	b1	c1
-27	250	200	260	270 ... 290	315	20	160
-29	250	200	260	270 ... 290	315	20	160
-31	250	200	260	270 ... 290	315	20	160



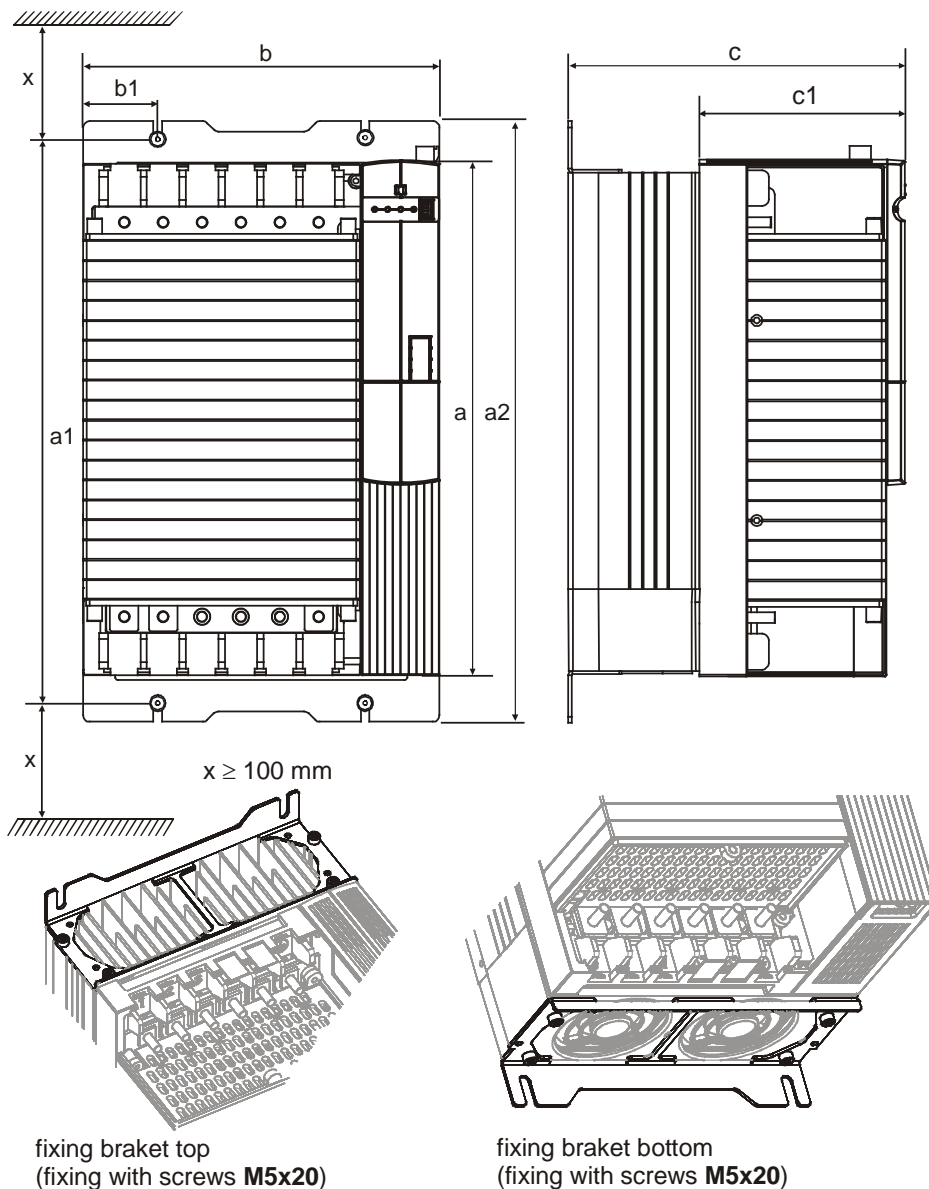
CAUTION

Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution such as dust, aggressive gases, etc.

7.3 AEC 401-39 (Size 6)

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

Standard installation



fixing bracket top
(fixing with screws **M5x20**)

fixing bracket bottom
(fixing with screws **M5x20**)

Screw fixing brackets to heat sink of the mains unit and mounting plate.

The mains unit is provided with fixing brackets, which are fitted using four thread-cutting screws. The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

	Dimensions [mm]			Assembly dimensions [mm]			
AEC 401	a	b	c	a1	a1	b1	c1
-33	400	275	260	425 ... 445	470	20	160
-35	400	275	260	425 ... 445	470	20	160
-37	400	275	260	425 ... 445	470	20	160
-39	400	275	260	425 ... 445	470	20	160

⚠ CAUTION

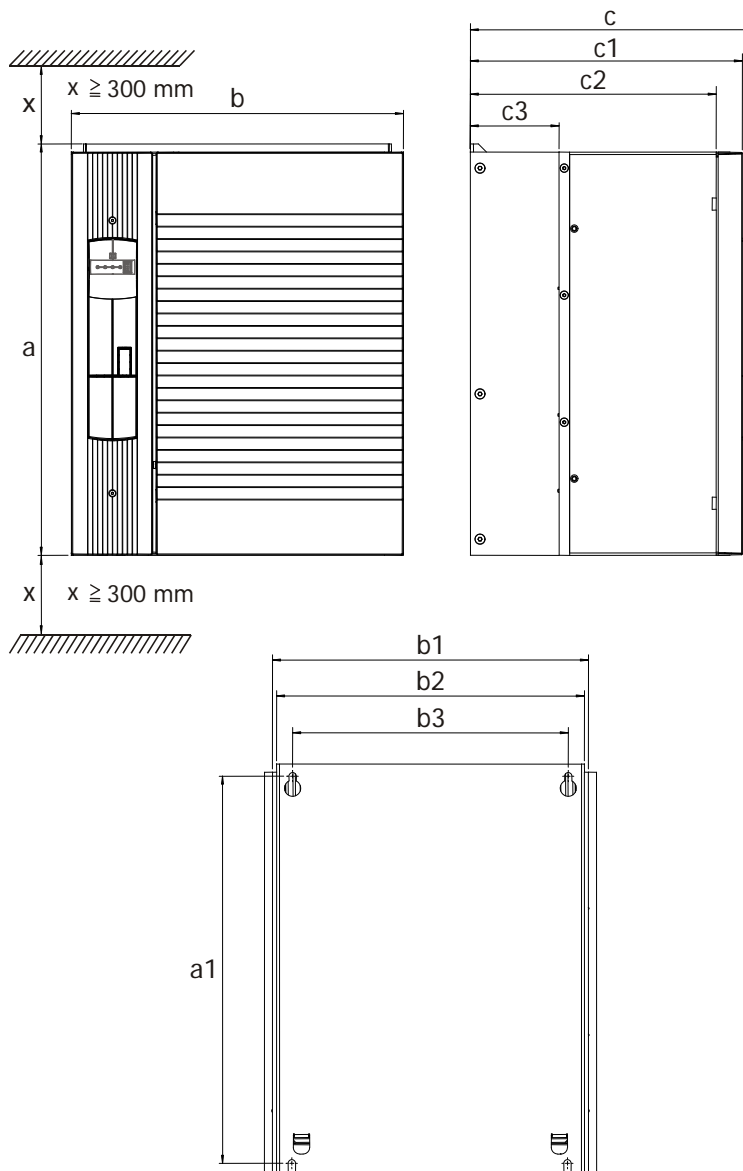


Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution such as dust, aggressive gases, etc.

7.4 AEC 401-49 (Size 7)

The frequency inverter is mounted in a vertical position on the assembly panel. The following illustration shows the standard installation.

Standard installation



The diameter of the fixing holes is 9 mm.

Screw the rear wall of the mains unit heat sink to the mounting plate.

The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

	Dimensions [mm]			Assembly dimensions [mm]						
AEC 401	a	b	c	a1	b1	b2	b3	c1	c2	c3
-43	510	412	351	480	392	382	342	338	305	110
-45	510	412	351	480	392	382	342	338	305	110
-47	510	412	351	480	392	382	342	338	305	110
-49	510	412	351	480	392	382	342	338	305	110

CAUTION



Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution such as dust, aggressive gases, etc.

8 Electrical installation

The electrical installation must be carried out by qualified staff according to the general and regional safety and installation directives. For a safe operation of the mains unit, it is necessary that the documentation and the device specifications be complied with during installation and commissioning. In the case of special applications, you may also have to comply with further guidelines and instructions.



DANGER

When the mains unit is disconnected from power supply, the mains, DC-link voltage and precharging terminals may still be live for some time. Wait for some minutes until the DC link capacitors have discharged before starting to work at the unit.

The connecting cables must be protected externally, considering the maximum voltage and current values of the fuses. The mains fuses and cable cross-sections are to be selected according to EN 602041 and DIN VDE 0298 Part 4 for the nominal operating point of the mains unit. According to UL/CSA, the mains unit is suitable for operation with a supply mains of a maximum of 480 VAC which delivers a maximum symmetrical current of 5000 A (effective value) if protected by fuses of class RK5. Only use copper cables with a temperature range of 60/75 °C.



WARNING

The mains unit is to be grounded properly, i.e. large connection area and with good conductivity. The leakage current of the mains unit may be > 3.5 mA. According to EN 50178 a permanent connection must be provided. The protective conductor cross-section required for grounding the fixing plate must be selected according to the size of the unit. In these applications, the cross-section must correspond to the recommended cross-section of the wire.

Degree of protection IP20 is only achieved with terminals plugged and properly mounted covers.

Connection conditions

The mains unit is suited for connection to the public or industrial supply mains according to the technical data.

The Directive on Parallel Operation of Private Generation Systems with the Electric Utility Mains was issued by the association of German electric utilities (Elektrizitätsversorgungsunternehmen - EVU), (3rd edition 1991, reprint 1996). The local EVU will use this directive for the design, operation and modification of private generation systems when the generation system is enrolled.

The private generation system is to be installed, considering the applicable directives and regulations, in a way that guarantees that it is suitable for parallel operation with the EVU mains and that disturbance of the EVU mains or the systems of other customers is impossible.

- Mains connection shall be via a switch point with disconnection function which is readily accessible to EVU staff at any time.
- In private generation systems equipped with three-phase monitors, this switch point is not required. Voltage drop protectors and voltage surge protectors shall be used in combination with the AEC mains unit as agreed with the EVU.
- It must be checked, based on the specifications of EN 61000-3-2, if connection to the public electric mains is possible.
- The mains unit must be connected to the mains such that it can be disconnected from the mains by means of disconnecting elements (e.g. main switch, contactor, circuit breaker)
- While the system is operating, disconnection of the frequency inverters connected to the DC-link terminals of the mains unit is only possible by means of appropriate DC switches.
- Use all-current sensitive circuit breakers or circuit breakers with adjustable tripping delay.
- In systems capable of islanding operation, it must be made sure that the safety measures as per DIN VDE 0100 are also guaranteed even in islanding mode.

The conditions for connection of the AEC mains unit to the EVU mains depend on the safety equipment installed and/or the switch point implemented.

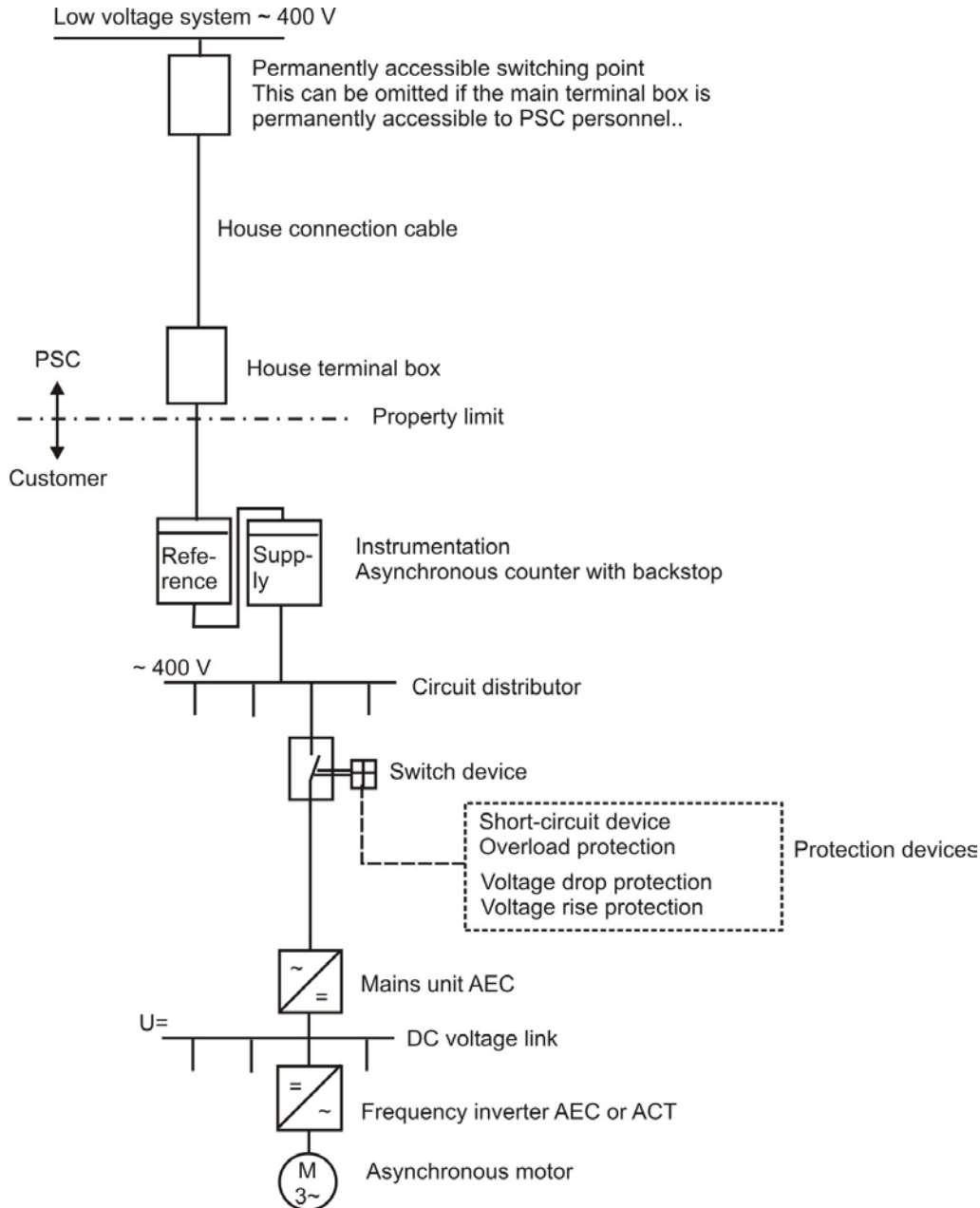
NOTE

Residual current circuit breakers (r.c.c.b.) can be used in combination with mains units to a limited extent only. An all-current sensitive residual current relay with leakage current separation must be used. There are two reasons for this:

1. All rectifier loads (i.e. not just mains units) can produce a direct current in the mains feeders which can reduce sensitivity of the circuit breaker.
2. When radio interference filters are used, high leakage currents might trip the r.c. circuit breaker too soon which would result in unwanted failure of the mains unit.

8.1 Circuit diagram as per VDEW publication

The example shows the connection of a private generation plant with inverter in parallel operation – three-phase supply –. The electrical installation is to be done according to the national and international norms and directives. The circuit diagram is to be adapted to the relevant local electric utility's (EVU) requirements.



Source of example:

The Directive on Parallel Operation of Private Generation Systems with the Low Voltage Mains of Electric Utility Mains of Electric Utility (EVU); 3rd edition 1991, reprint 1996)

Verenigung Deutscher Elektrizitätswerke – VDEW – e.V. (Association of German Electric Utilities)



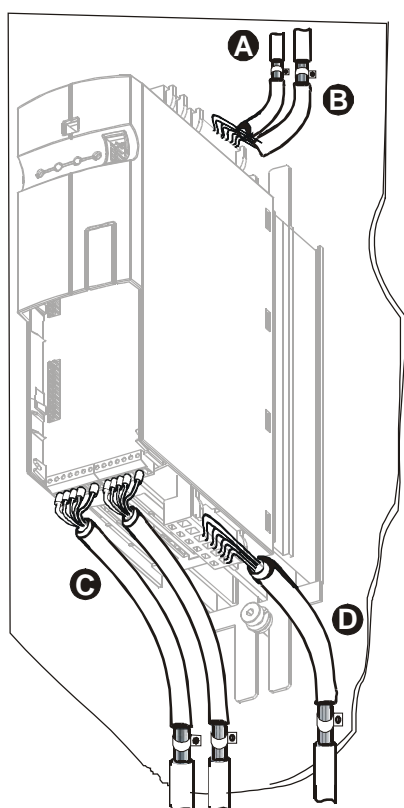
The frequency inverters connected to the DC-link of the AEC mains unit required high electric strength. Appropriate ACU frequency inverters are to be ordered.

8.2 EMC information

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

Measures

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



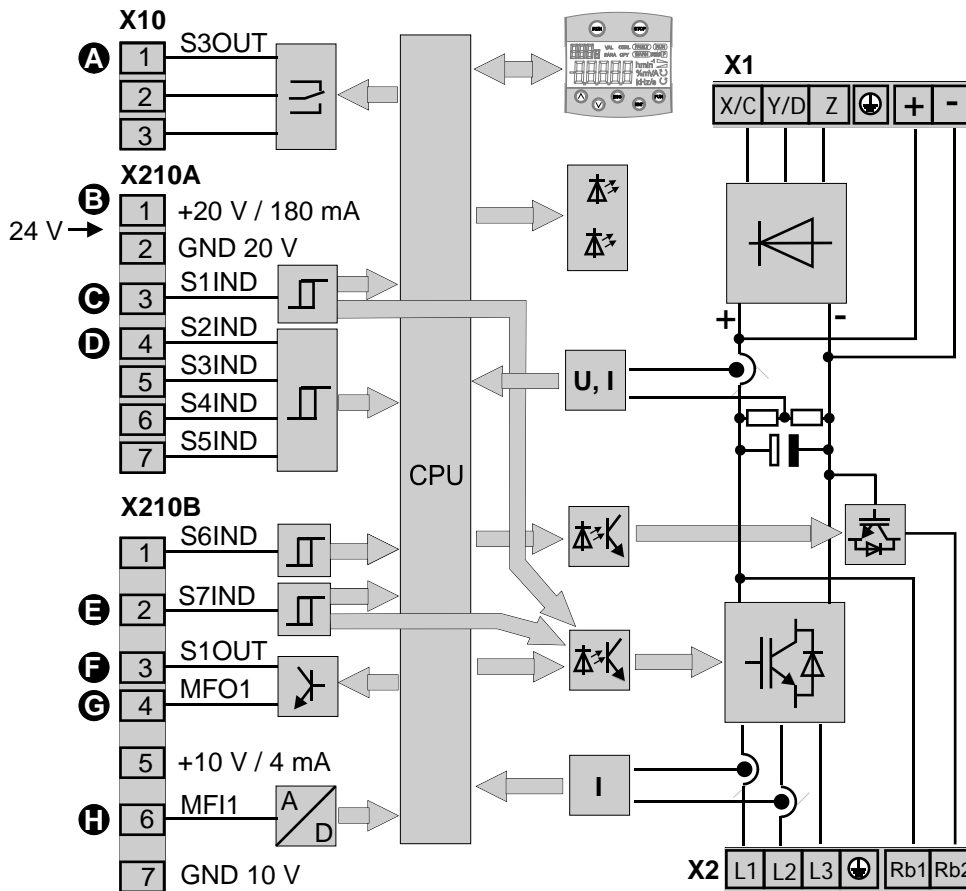
A Precharging circuit connection (X1: X/C, Y/D, Z)
To be installed separate from control cables.

B DC-link connection (X1: +, -)
Connect to common direct voltage source shielded Cable with a length >300 mm, the cable shield must be connected to the mounting plate on both sides. Use twisted cables where possible.

C Control connection (X210A, X210B)
control and signal cables must be kept physically separate from the power cables. Analog signal lines are to be connected to the shield potential on one side.

D Mains connection and connection of brake resistor (X2)
Mains cable to be installed separate from control and signal cables as well as DC link connection. Install radio interference filter at mains input of line chokes. As from a length of 300 mm the cables installed between radio interference filters, line choke, sine filter and the mains unit must be shielded. The shield is to be connected to a PE bar properly using a suitable cable clamp (large contact surface).
If a brake resistor is used, the connection cable must be shielded, and the cable shield is to be connected to earth potential on both sides.

8.3 Block diagram



A Relay connection S3OUT

Change-over contact, response time approx. 40 ms
 make-contact AC 5 A / 240 V, DC 5 A (ohmic) / 24 V
 break-contact AC 3 A / 240 V, DC 1 A (ohmic) / 24 V

For connection of a coupler relay for controlling power contactors. Note the technical data of the existing customer-provided components.

B Voltage output/input

Bidirectional, DC 20 V voltage output ($I_{\max}=180$ mA) or input for external power supply DC 24 V $\pm 10\%$

C Digital input S1IND

Digital signal, response time approx. 10 ms (on), 10 μ s (off), $U_{\max}=30$ V, 10 mA at 24 V, PLC compatible

D Digital inputs S2IND ... S6IND

Digital signal: response time approx. 2 ms, $U_{\max} =$ DC 30 V, 10 mA at 24 V, PLC compatible, frequency signal: DC 8 V ... 30 V, 10 mA at DC 24 V, $f_{\max} = 150$ kHz

E Digital input S7IND

Digital signal, response time approx. 10 ms (on), 10 μ s (off), $U_{\max} = 30$ V, 10 mA at DC 24 V, PLC compatible

F Digital output S1OUT

Digital signal, DC 24 V, $I_{\max} = 50$ mA, PLC compatible, overload and short-circuit proof

G Multi-Function Output MFO1

Analog signal: DC 24 V, $I_{\max} = 50$ mA, pulse-width modulated, $f_{\text{PWM}} = 116$ Hz,
 Digital signal: DC 24 V, $I_{\max} = 50$ mA, PLC compatible,
 Frequency signal: DC 0 V ... 24 V, $I_{\max} = 40$ mA, $f_{\max} = 150$ kHz,
 overload and short-circuit proof

H Multifunction input MFI1

Analog signal: Resolution 12 bit, DC 0 V ... 10 V ($R_i = 70$ k Ω), 0 mA ... 20 mA ($R_i = 500$ Ω),
 Digital signal: response time approx. 4 ms, $U_{\max} =$ DC 30 V, 4 mA at 24 V,
 PLC compatible

8.4 Optional components

Thanks to the modular hardware components, the mains unit can be integrated in the automation concept easily. The standard and optional modules are recognized during the initialization, and the controller functionality is adjusted automatically. For the information required for installation and handling of the optional modules, refer to the corresponding documentation.

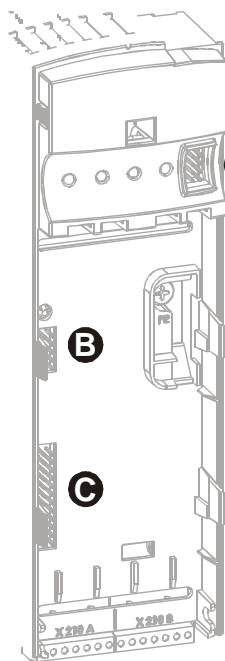


⚠ DANGER

The hardware modules at slots B and C may only be assembled and disassembled after the mains unit has been disconnected safely from power supply. Wait for some minutes until the DC link capacitors have discharged before starting the work.

- The unit may only be connected with the power supply switched off.
- Verify safe isolation from power supply.

Hardware modules



A Control unit KP500

Connection of the optional control unit KP500 or an interface adapter KP232.

B Communication module CM

Plug-in section for connection to various communication protocols:

- CM-232: RS232 interface
- CM-485: RS485 interface
- CM-PDP: Profibus-DP interface
- CM-CAN: CANopen interface

C Extension module EM

Slot for customer-specific adaptation of the control inputs and outputs to various applications:

- EM-ENC: extended encoder evaluation
- EM-RES: resolver evaluation
- EM-IO, analog and digital inputs and outputs
- EM-SYS: System Bus
(system bus in combination with CM-CAN communication module upon request)



⚠ CAUTION

If two optional components with CAN-Protocol controller are installed, the system bus interface in the EM extension module is deactivated!

8.5 Connection of Unit

8.5.1 Conductor cross-sections

- The cable dimensions must be selected according to the current load and voltage drop to be expected.
- Select the cable cross-section of the cables such that the voltage drop is as small as possible.
- Comply with any additional national and application-specific regulations and the separate UL instructions.
- The mains fuses and conductor cross-sections are to be selected according to EN 602041 and DIN VDE 0298 Part 4 for the nominal operating point of the mains unit.
- According to UL/CSA, approved Class 1 copper lines with a temperature range of 60/75 °C and matching mains fuses are to be used for the power cables.
- Select conductor cross-sections as per DIN VDE 0100 Part 430 and DIN VDE 0298 Part 4.
- Protective earth (PE) conductor cross-section is to be dimensioned as per (PE) EN61800-5-1.
- For typical mains feeder fuses, refer to chapter 8.5.2 "Fuses".

Precharging circuit: Three-phase connection (X/C, Y/D, Z)

AEC 401	Precharging cable
9.7 kVA	1.5 mm ²
12.5 kVA	1.5 mm ²
15.2 kVA	1.5 mm ²
17.3 kVA	1.5 mm ²
22.2 kVA	1.5 mm ²
27.7 kVA	1.5 mm ²
31.2 kVA	1.5 mm ²
41.6 kVA	1.5 mm ²
52.0 kVA	1.5 mm ²
62.3 kVA	1.5 mm ²
76.2 kVA	1.5 mm ²
86.6 kVA	1.5 mm ²
103.9 kVA	1.5 mm ²
124.7 kVA	1.5 mm ²
145.5 kVA	1.5 mm ²
173.2 kVA	1.5 mm ²



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

Mains cable	Protective conductor
Mains cable up to 10 mm ²	Install two protective conductors of the same size as the mains cable, or one protective conductor of a size of 10 mm ² .
Mains feeder 10...16 mm ²	Install one protective conductor of the same size as the mains feeder.
Mains feeder 16...35 mm ²	Install one protective conductor of a size of 16 mm ² .
Mains feeder > 35 mm ²	Install one protective conductor of half the size of the mains feeder.



CAUTION

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

The following table provides an overview of typical conductor cross-sections (copper cable with PVC insulation, 30 °C ambient temperature, continuous mains current max. 100% rated input current). Actual mains cable cross-section requirements may deviate from these values due to actual operating conditions.

400V: Three-phase connection (L1/L2/L3)

AEC 401		Mains cable	PE-conductor
-19	9.7 kVA	2.5 mm ²	2x2.5 mm ² or 1x10 mm ²
-21	12.5 kVA	2.5 mm ²	2x2.5 mm ² or 1x10 mm ²
-22	15.2 kVA	4 mm ²	2x4 mm ² or 1x10 mm ²
-23	17.3 kVA	4 mm ²	2x4 mm ² or 1x10 mm ²
-25	22.2 kVA	6 mm ²	2x6 mm ² or 1x10 mm ²
-27	27.7 kVA	10 mm ²	1x10 mm ²
-29	31.2 kVA	10 mm ²	1x10 mm ²
-31	41.6 kVA	16 mm ²	1x16 mm ²
-33	52.0 kVA	25 mm ²	1x16 mm ²
-35	62.3 kVA	35 mm ²	1x16 mm ²
-37	76.2 kVA	35 mm ²	1x16 mm ²
-39	86.6 kVA	50 mm ²	1x25 mm ²
-43	103.9 kVA	70 mm ²	1x35 mm ²
-45	124.7 kVA	95 mm ²	1x50 mm ²
-47	145.5 kVA	2x70 mm ²	1x70 mm ²
-49	173.2 kVA	2x95 mm ²	1x95 mm ²



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

Mains cable	Protective conductor
Mains cable up to 10 mm ²	Install two protective conductors of the same size as the mains cable, or one protective conductor of a size of 10 mm ² .
Mains feeder 10...16 mm ²	Install one protective conductor of the same size as the mains feeder.
Mains feeder 16...35 mm ²	Install one protective conductor of a size of 16 mm ² .
Mains feeder > 35 mm ²	Install one protective conductor of half the size of the mains feeder.

8.5.2 Fuses

- The plant components and cables installed must be protected by means of appropriate fuses.
- The mains power circuit (mains fuses, contactor K2) must be designed for the power of the mains unit.
- Install fuses, e.g. NH fuses¹ of operating class gL² as per VDE 636 Part 1 – low-voltage fuses (IEC 60269-1).
- Fuses UL-type 600 VAC RKS³.

	AEC 401	Mains ²	Mains ³	Precharging fuses ²
-19	9.7 kVA	16 A	20 A	10 A
-21	12.5 kVA	25 A	20 A	10 A
-22	15.2 kVA	25 A	20 A	10 A
-23	17.3 kVA	35 A	30 A	10 A
-25	22.2 kVA	35 A	40 A	10 A
-27	27.7 kVA	50 A	50 A	10 A
-29	31.2 kVA	50 A	50 A	10 A
-31	41.6 kVA	63 A	60 A	10 A
-33	52.0 kVA	100 A	100 A	10 A
-35	62.3 kVA	125 A	125 A	10 A
-37	76.2 kVA	125 A	125 A	10 A
-39	86.6 kVA	125 A	125 A	10 A
-43	103.9 kVA	160 A	FWH-250 A ⁴	10 A
-45	124.7 kVA	200 A	FWH-300 A ⁴	10 A
-47	145.5 kVA	250 A	FWH-350 A ⁴	10 A
-49	173.2 kVA	315 A	FWH-400 A ⁴	10 A



A central DC-link can be powered via the AEC mains unit. The cables in the DC-link of the connected frequency inverters are to be fused properly. When dimensioning the DC-fuses, the derating factors specified by the fuse manufacturer must be considered in addition to the specified DC-link voltage setpoint. If only one frequency inverter with a power corresponding to the mains unit is used, no DC-fuses are required.

¹ Low-voltage high-performance fuses.

² Full-range cable and line protection

³ UL conforming fusing with UL-type 600 VAC RKS.

⁴ For UL-conforming fusing of devices AEC 401-43 through AEC 401-49, the specified fuses from Cooper Bussmann must be used. Other fuses must not be used for UL-conforming fusing.

8.6 Connection of types



WARNING

The AEC mains unit may only be connected to mains via a precharging circuit.



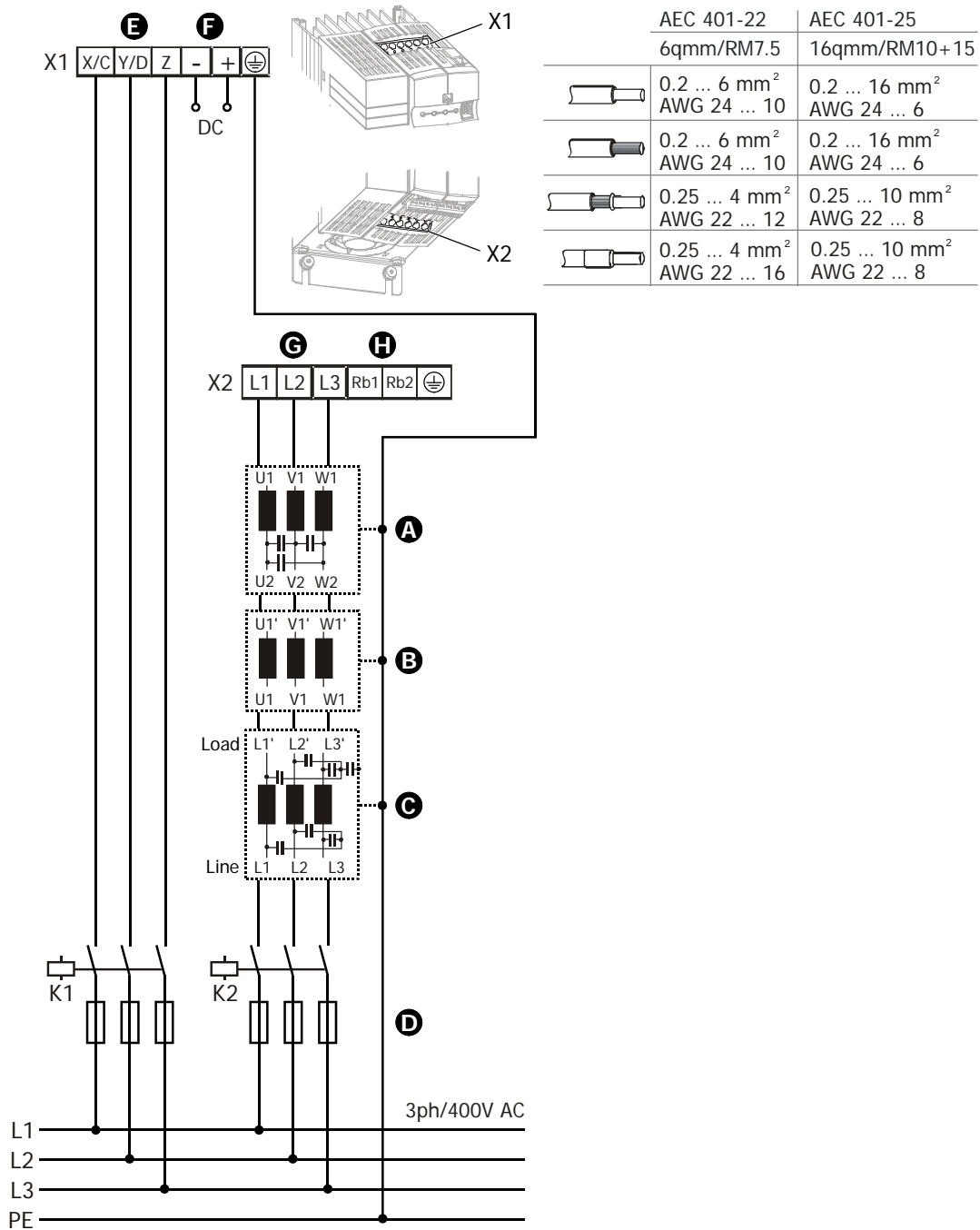
DANGER

Interrupt power supply before connection and disconnection. The terminals may be live even after disconnection of the mains unit from power supply. Wait for some minutes until the DC link capacitors have discharged before starting the work.

- The unit may only be connected with the power supply switched off.
- Verify safe isolation from power supply.

8.6.1 AEC 401-22 (size 3) and AEC 401-25 (size 4)

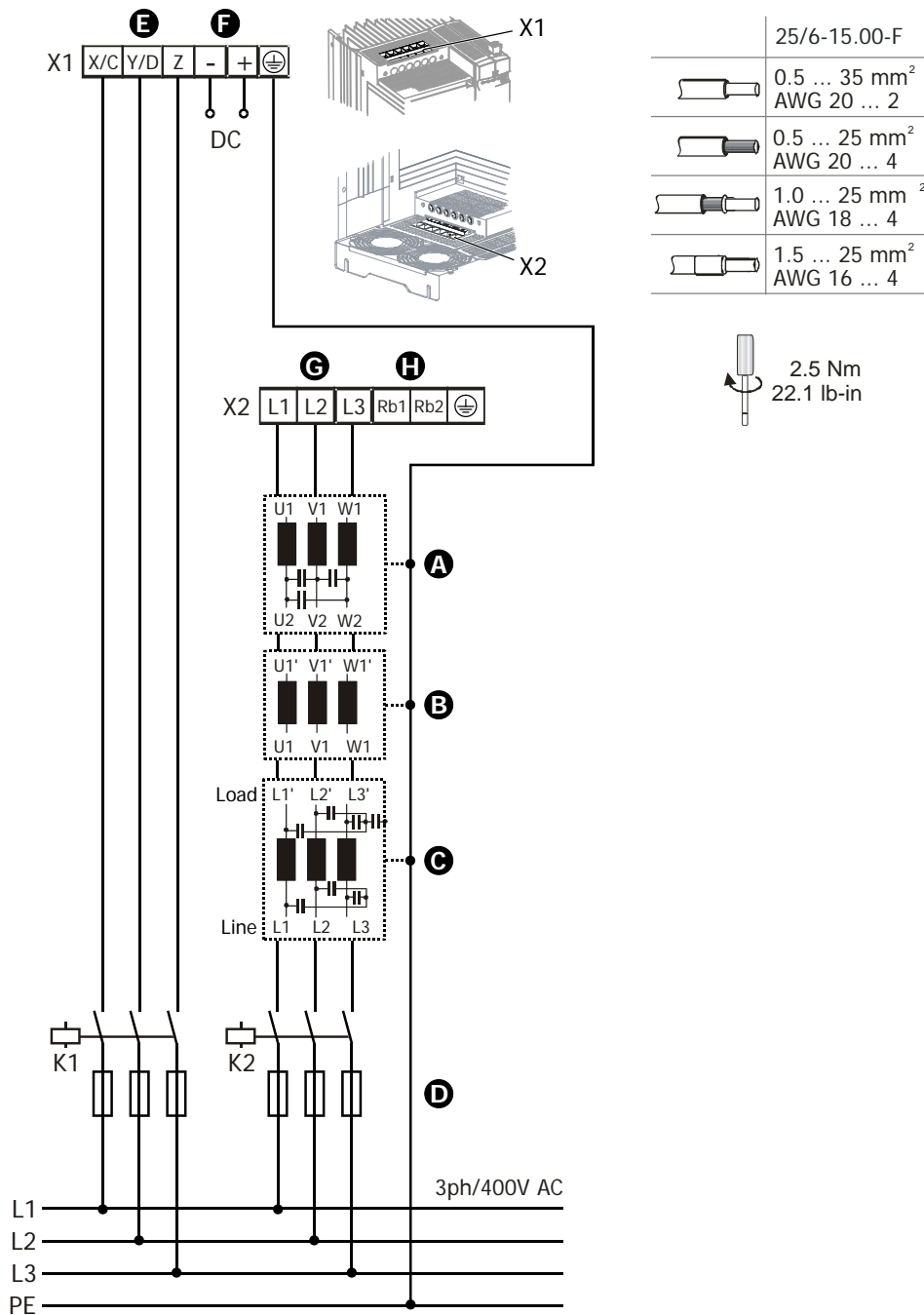
Mains and precharging circuit connection
AEC 401-22 (size 3) and AEC 401-25 (size 4)



- A** Sine filter
- B** Line choke
- C** Radio interference filter
- D** Mains fuses
- E** Precharging current connection
- F** DC-link connection
- G** Mains connection
- H** Brake resistor connection
- K1 Precharging circuit contactor
- K2 Mains contactor

8.6.2 AEC 401-31 (size 5)

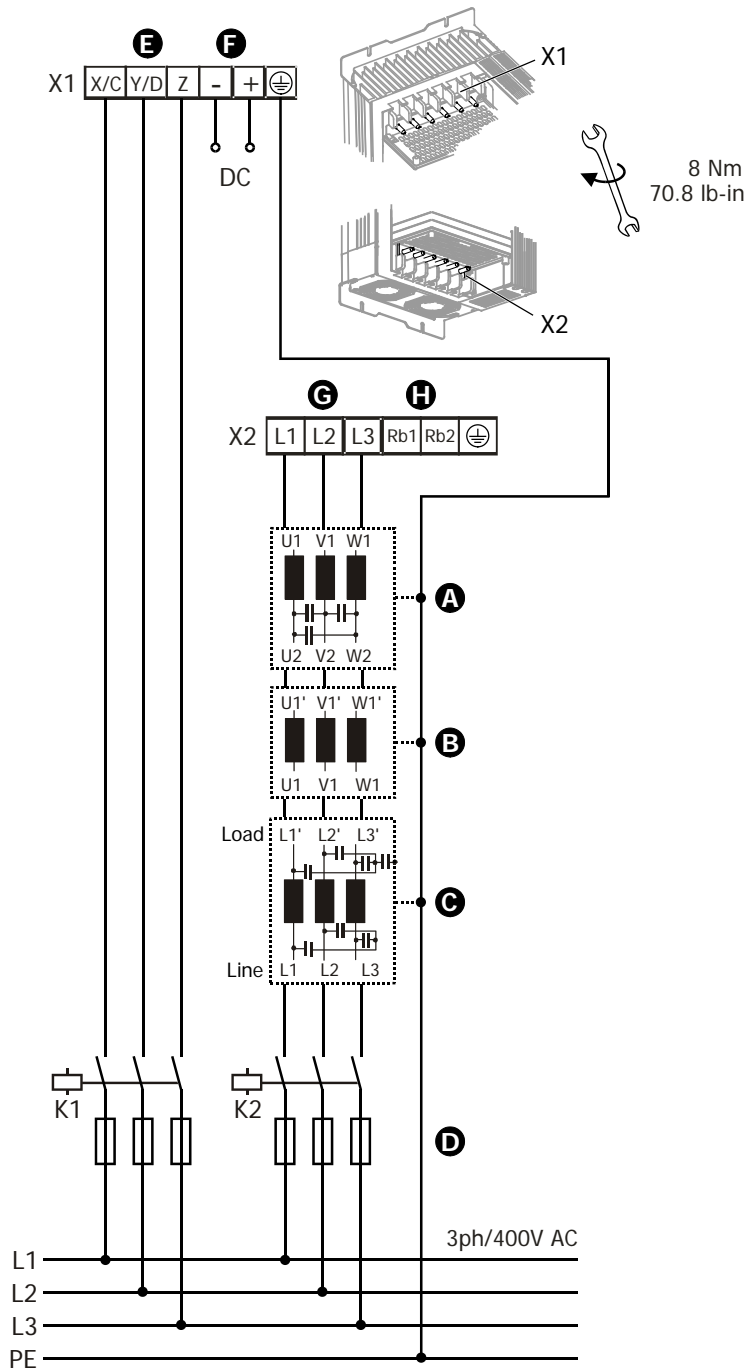
Mains and precharging circuit connection AEC 401-31 (size 5)



- A** Sine filter
- B** Line choke
- C** Radio interference filter
- D** Mains fuses
- E** Precharging current connection
- F** DC-link connection
- G** Mains connection
- H** Brake resistor connection
- K1 Precharging circuit contactor
- K2 Mains contactor

8.6.3 AEC 401-39 (size 6)

Mains and precharging circuit connection AEC 401-39 (size 6)

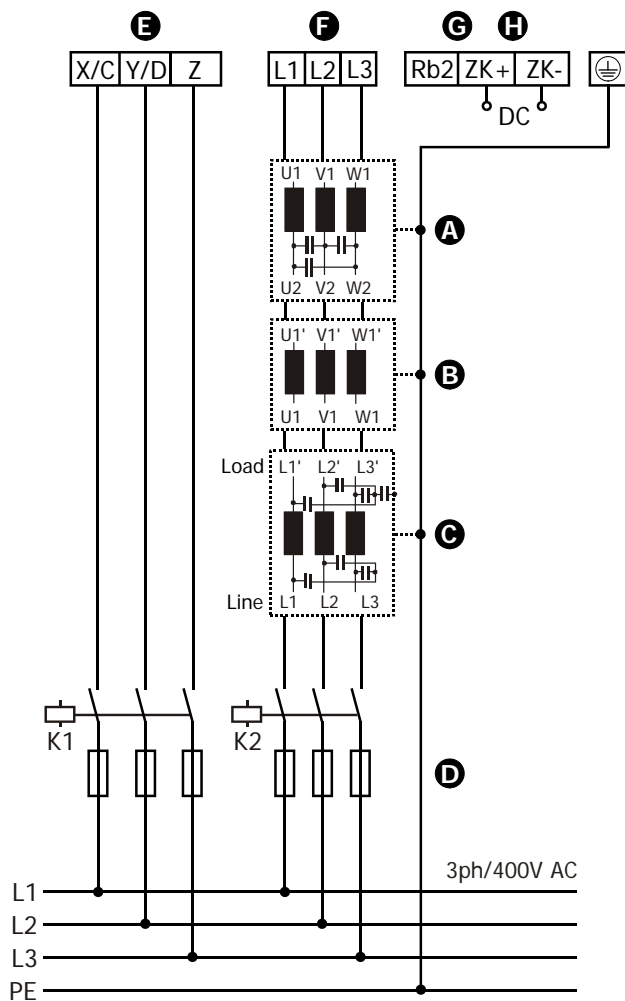
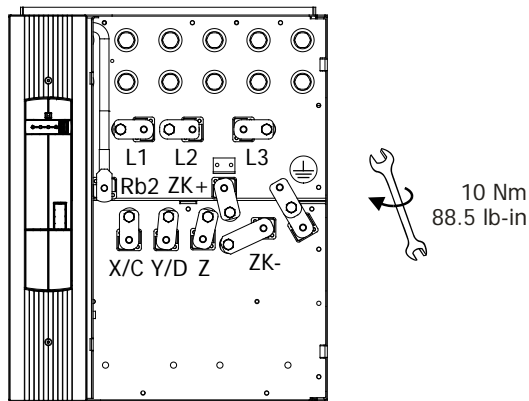


Threaded bolt M8x25
Conductor cross-section up to 70 mm²

- A** Sine filter
- B** Line choke
- C** Radio interference filter
- D** Mains fuses
- E** Precharging current connection
- F** DC-link connection
- G** Mains connection
- H** Brake resistor connection
- K1** Precharging circuit contactor
- K2** Mains contactor

8.6.4 AEC 401-49 (size 7)

Mains and precharging circuit connection AEC 401-49 (size 7)



Threaded bolt M8x20

- A** Sine filter
- B** Line choke
- C** Radio interference filter
- D** Mains fuses
- E** Precharging current connection
- F** Mains connection
- G** Brake resistor connection (Rb2/ZK+), terminal Rb2 optional
- H** DC-link connection
- K1 Precharging circuit contactor
- K2 Mains contactor

8.7 DC-link connection ACU frequency inverter with AEC mains unit



CAUTION

For connection of an ACU or ACT frequency inverter, comply with the Operating Instructions of this device.

The frequency inverters which are connected to the mains unit must be designed for higher voltage levels. An appropriate ACU or ACT frequency inverter design must be ordered.

8.8 Precharging circuit

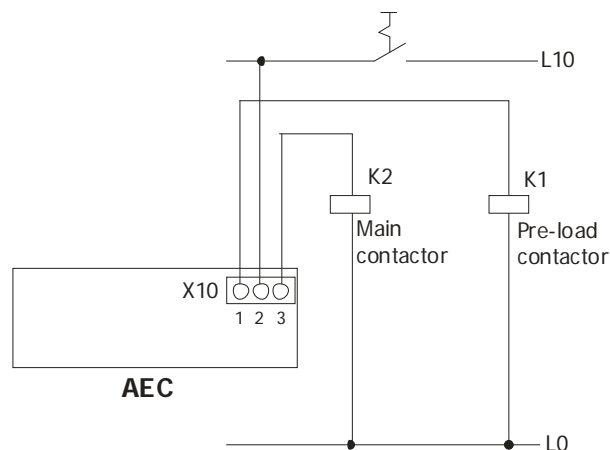
The AEC mains unit requires separate wiring of the main power circuit and the DC-link precharging circuit.

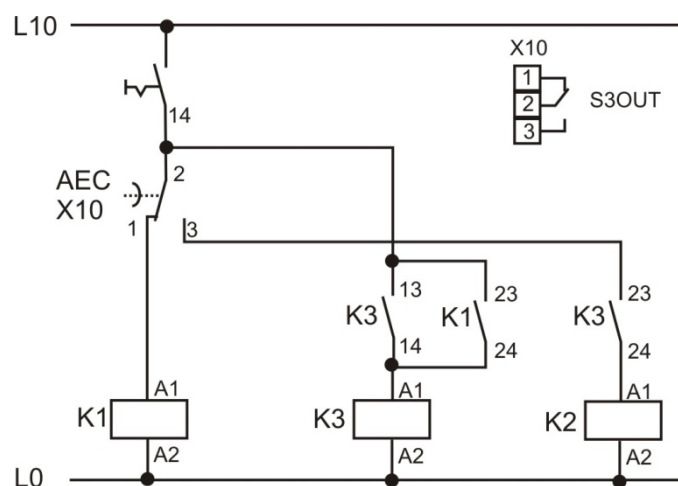
An external precharging circuit must be installed in order to protect the mains unit from the destructive charging currents of the DC link capacitors. A precharging circuit is installed in the mains unit between the rectifier and the DC link capacitors. This circuit closes the contact as soon as a certain DC link voltage is reached. However, this precharging circuit does not limit the current when the mains unit is connected to mains supply, as the AEC is connected to mains via the inverter.

Relay X10 is controlled by the mains unit through the DC-link voltage. The discharging operation of the DC link capacitors delays the switching operation of relay X10. The mains unit control ensures that the precharging circuit will be switched on first before connection to mains supply.

- The mains unit may only be connected to mains via the precharging circuit.
- Jog operation of the mains contactor is not permissible.
- When disconnected from mains supply, the mains unit may only be reconnected to mains supply after a waiting time of approx. 1 minute.
- The waiting time must be considered, e.g. by means of time function elements, when setting up a control system.
- The mains power circuit (mains fuses, contactor K2) must be designed for the power of the AEC mains unit.
- The precharging circuit (precharging fuse, contactor K1) up to a total power of 250 kW (total of equivalent motor shaft power values of AEC mains unit and ACU frequency inverters) must be designed for a power of 3 kW.
- Use fuses type gL 10 A for the precharging circuit. In case the total power is higher, the precharging circuit must be designed for higher power values accordingly.

The following circuit suggestions must be adjusted to the specific application and relevant regulations.





When the main switch is turned on directly after it was turned off before the waiting time has elapsed, the mains unit may be damaged.

To avoid this, a precharging circuit as shown in the second illustration can be set up.

When the main switch is opened, the DC-link voltage of the mains unit will only drop slowly due to the DC link capacitors. The contact at relay X10 is maintained between terminals two and three until the DC-link voltage has dropped below a certain value. When the main switch is closed again, the mains unit is connected to mains via the inverter and can be destroyed as a result. In the second circuit suggested, contactor K3 opens power supply of contactor K2 so that contactor K2 disconnects the connection between the AEC mains unit and mains.

8.9 Sine filter

Only use the AEC mains unit in combination with a sine filter. Sine filters with a relative short-circuit voltage of $u_k = 8\%$ are available as an accessory. Connect the sine filter such that the inductances of the sine filter are on the terminal side (L1, L2, L3) of the mains unit and the capacitances of the sine filter are on the mains side.

8.10 Line choke

Bonfiglioli Vectron recommends installation of a line choke at the mains connection of the mains unit. Line chokes with a relative short-circuit voltage of $u_k = 4\%$ are available as an accessory. Install the line choke between the radio interference filter and the sine filter.

8.11 Radio interference filter

To limit the radio interference voltage on the mains cable, a radio interference filter (available as an accessory) must be used and installed according to Chapter 8.2 "EMC information". Radio interference class according to EN 61800-3 is suitable for use in residential areas. This corresponds to limit value class B as per EN 55011.

The Load terminal of the radio interference filter is to be wired to the mains unit side, the Line terminal to the mains side.

When filter elements are used, the leakage current will generally increase. If a value of 3.5 mA is exceeded, one of the following requirements must be met:

- Protective earth conductor cross-section at least 10 mm^2
- Monitoring of protective earth conductor by a facility which will shut the system down automatically in case of an error.
- Installation of a second conductor, electrically parallel with the protective earth conductor, via separate terminals. This conductor must meet the requirements of VDE 0100 Part 540 (e.g. minimum cross-section).

8.12 Recommended accessories

Bonfiglioli Vectron recommends using the following accessories in combination with AEC mains units. These accessories are available at Bonfiglioli Vectron GmbH

		Accessories		
Mains unit	Current [A]	Sine filter		Article number
		Inductance [mH]	Capacitance (delta) [μF]	
AEC 401-19	14	4.2	1	181 421 014
AEC 401-21	18	3.6	1	181 421 018
AEC 401-22	25	2.4	1	181 421 025
AEC 401-23	25	2.4	1	181 421 025
AEC 401-25	34	1.9	2.2	181 421 034
AEC 401-27	45	1.5	2.2	181 421 045
AEC 401-29	45	1.5	2.2	181 421 045
AEC 401-31	60	1.1	3	181 421 060
AEC 401-33	75	0.9	4.7	181 421 075
AEC 401-35	90	0.8	6.8	181 421 090
AEC 401-37	115	0.65	6.8	181 421 115
AEC 401-39	150	0.5	16	181 421 150
AEC 401-43	150	0.5	16	181 421 150
AEC 401-45	180	0.44	22	181 421 180
AEC 401-47	210	0.4	13.6	181 421 210
AEC 401-49	250	0.33	16	181 421 250
Mains unit		Line choke		
	Current [A]	Inductance [mH]		Article number
AEC 401-19	15	1.95		184 420 015
AEC 401-21	18	1.63		184 420 018
AEC 401-22	25	1.17		184 420 025
AEC 401-23	25	1.17		184 420 025
AEC 401-25	34	0.86		184 420 034
AEC 401-27	50	0.59		184 420 050
AEC 401-29	50	0.59		184 420 050
AEC 401-31	60	0.49		184 420 060
AEC 401-33	75	0.39		184 420 070
AEC 401-35	90	0.33		184 420 090
AEC 401-37	115	0.25		184 420 115
AEC 401-39	135	0.22		184 420 135
AEC 401-43	160	0.18		184 420 160
AEC 401-45	180	0.16		184 420 180
AEC 401-47	210	0.14		184 420 210
AEC 401-49	250	0.12		184 420 250
Mains unit		Radio interference filter		
	Current [A]			Article number
AEC 401-19	35			189 430 035
AEC 401-21				
AEC 401-22				
AEC 401-25	80			189 430 080
AEC 401-27				
AEC 401-28				
AEC 401-31				
AEC 401-33	150			189 430 150
AEC 401-35				
AEC 401-37				
AEC 401-39				
AEC 401-43				

AEC 401-45	300		185 730 300
AEC 401-47			
AEC 401-49			

8.13 Connection of frequency inverter to AEC

Before connecting the DC-links of the ACU frequency inverter and the AEC mains unit, the PE jumper on the ACU unit must be disconnected. As from size 5, only custom devices modified in the factory may be connected to the AEC.



⚠ DANGER

- Before disconnecting the PE jumper, disconnect the frequency inverter from power supply.
- The terminals of the mains unit and frequency inverter may be live even after disconnection. Wait for some minutes until the DC link capacitors have discharged before starting the work.

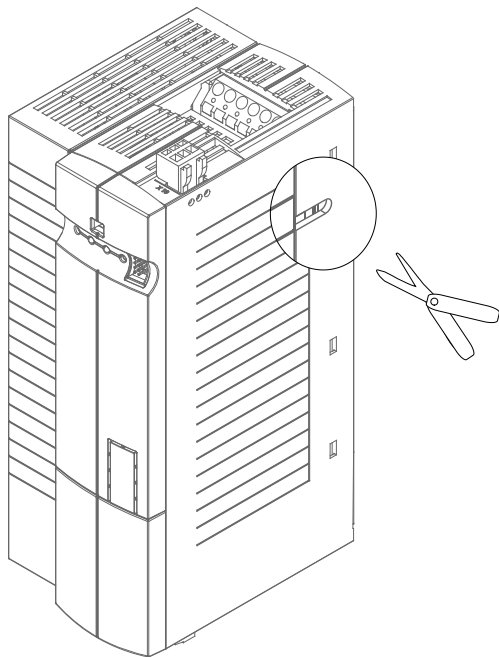


⚠ CAUTION

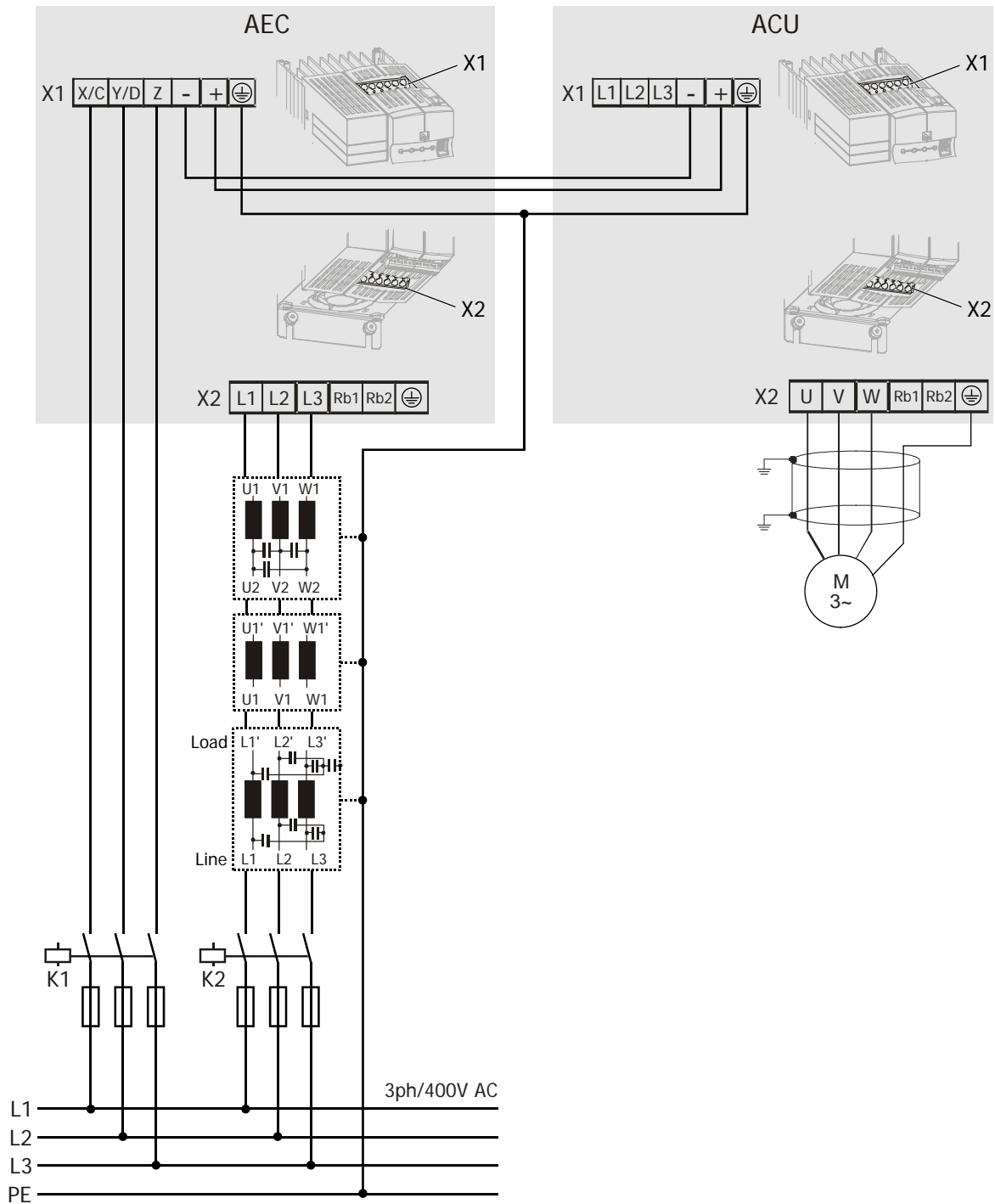
For connection of an ACU frequency inverter, comply with the Operating Instructions of this device.

Disconnection of PE jumper

ACU frequency inverter sizes 3 through 6

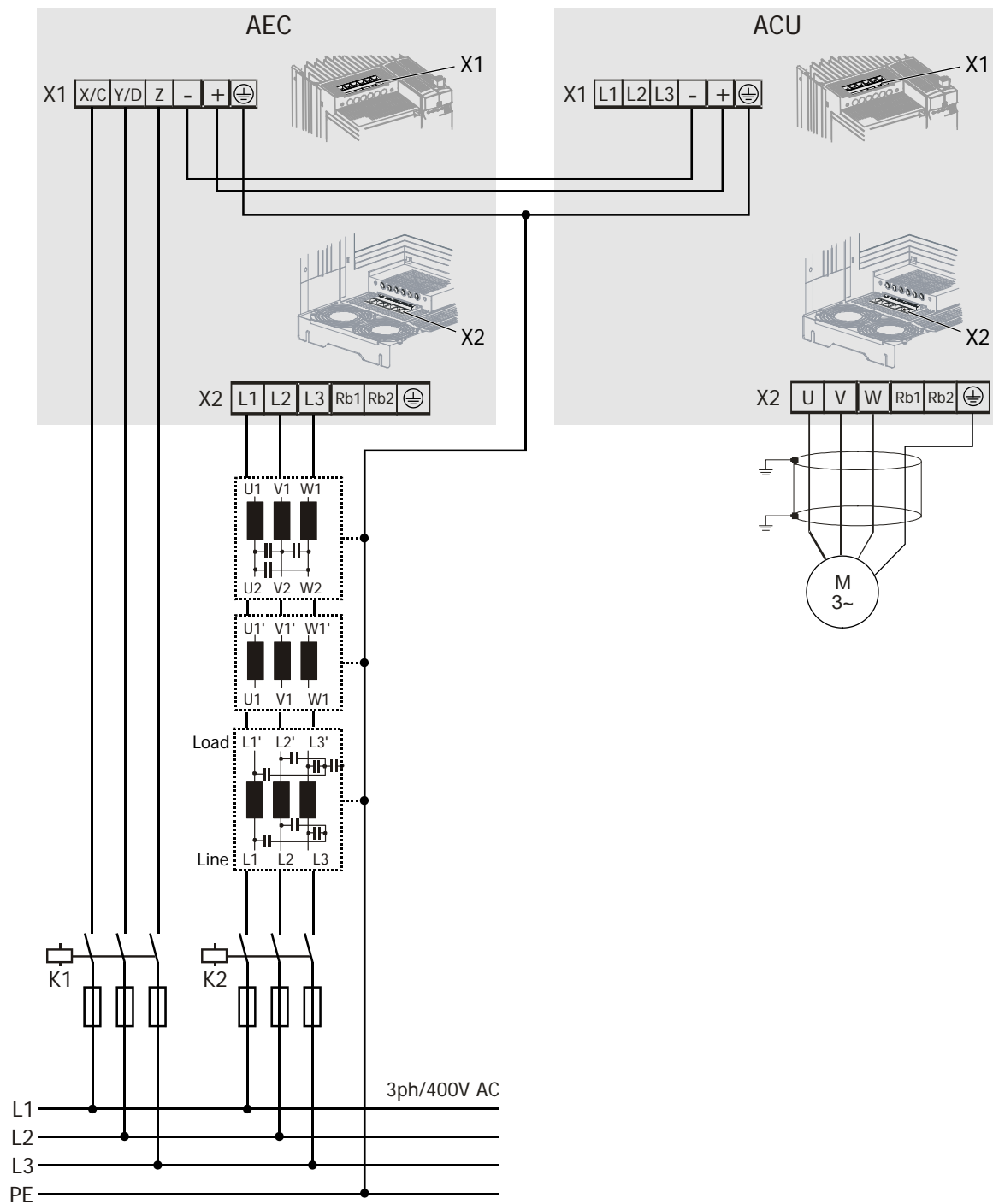


AEC 401-22 (size 3) and AEC 401-25 (size 4)
Mains connection, precharging circuit and DC-link



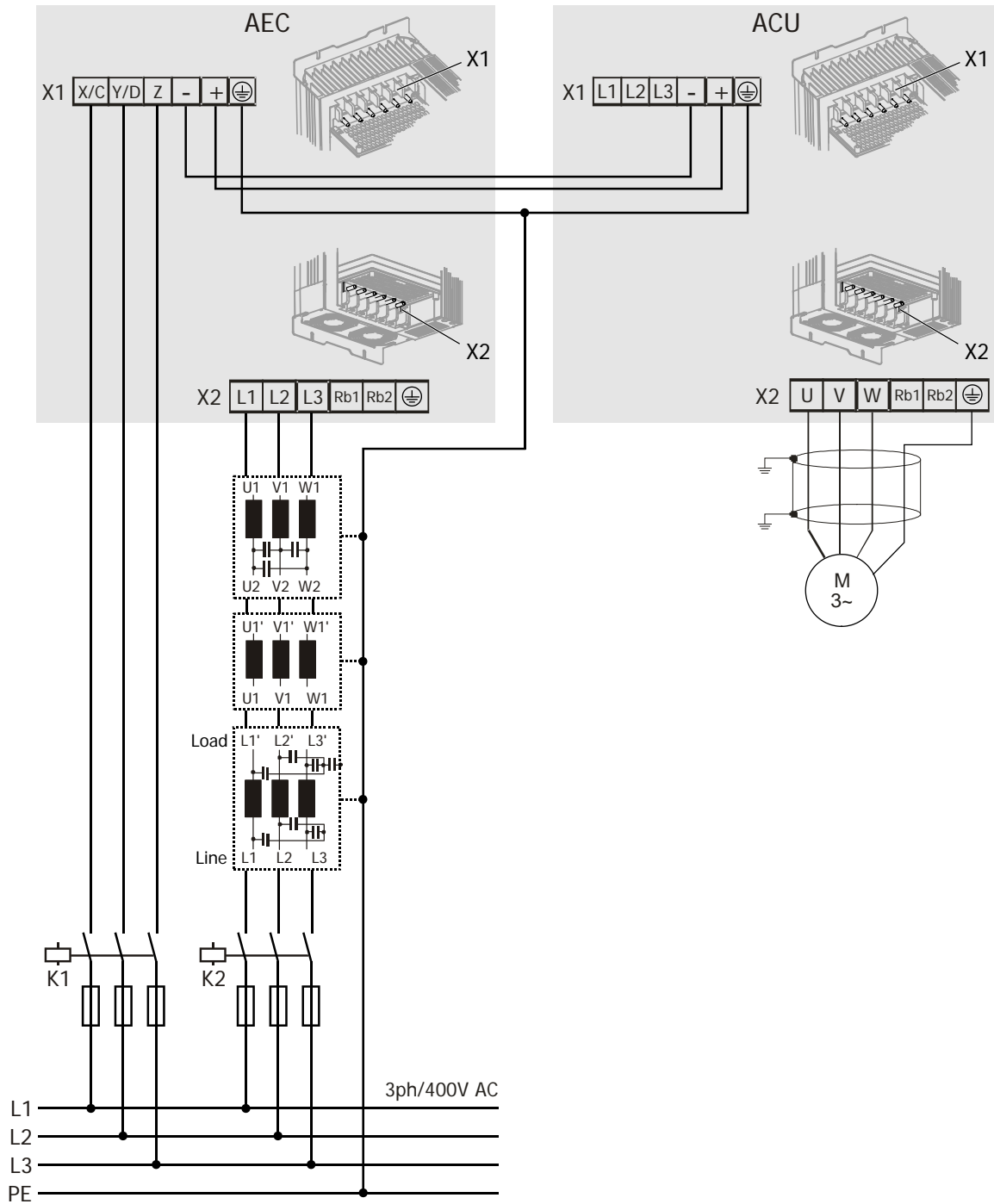
AEC 401-31 (size 5)
Mains connection, precharging circuit and DC-link

If an ACU frequency inverter of size 5 is to be connected to the AEC mains unit, a custom-made ACU frequency inverter (hardware modified in factory) must be ordered



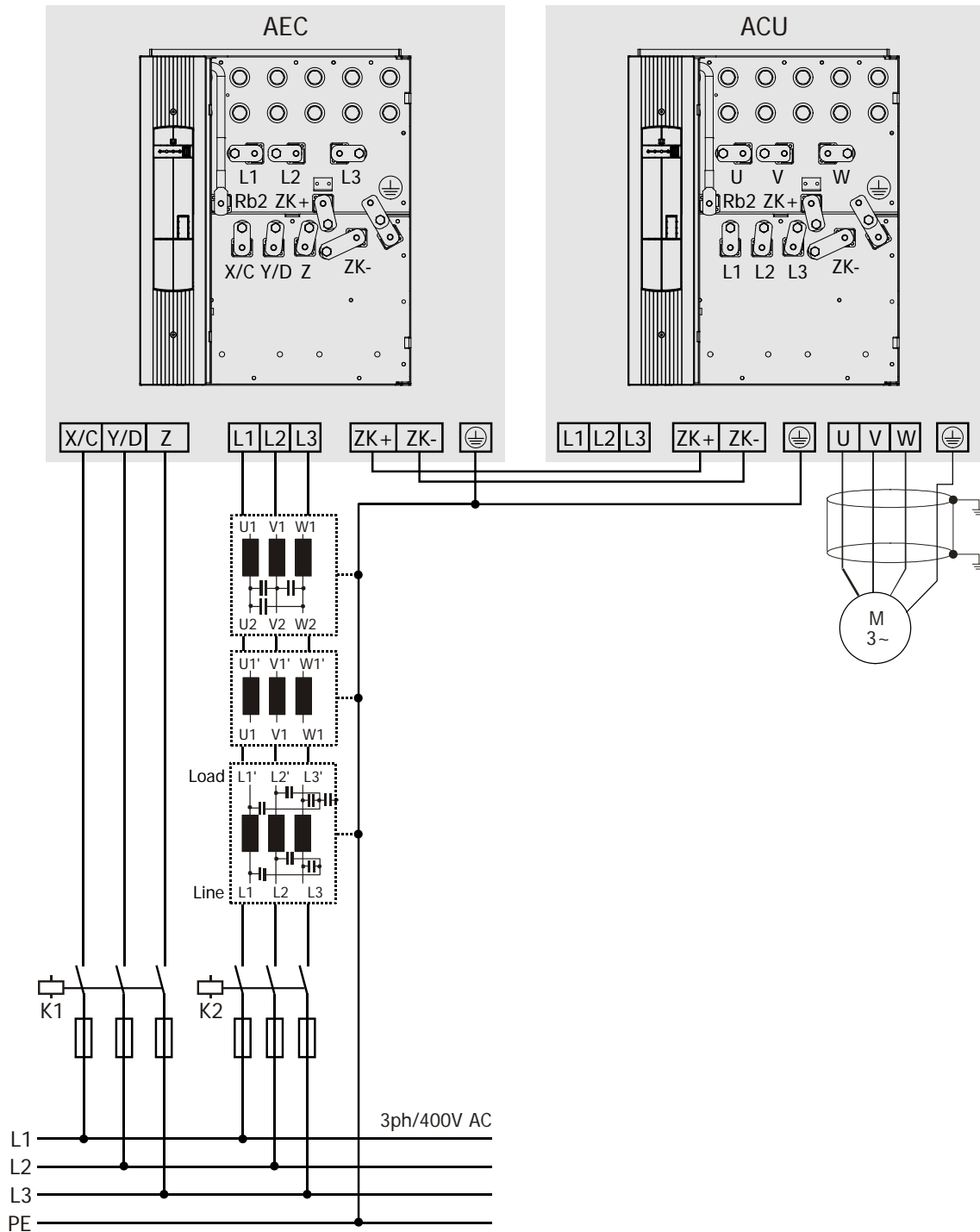
AEC 401-39 (size 6)
Mains connection, precharging circuit and DC-link

If an ACU frequency inverter of size 6 is to be connected to the AEC mains unit, a custom-made ACU frequency inverter (hardware modified in factory) must be ordered



AEC 401-49 (size 7)
Mains connection, precharging circuit and DC-link

If an ACU frequency inverter of size 7 is to be connected to the AEC mains unit, a custom-made ACU frequency inverter (hardware modified in factory) must be ordered



8.14 Control terminals

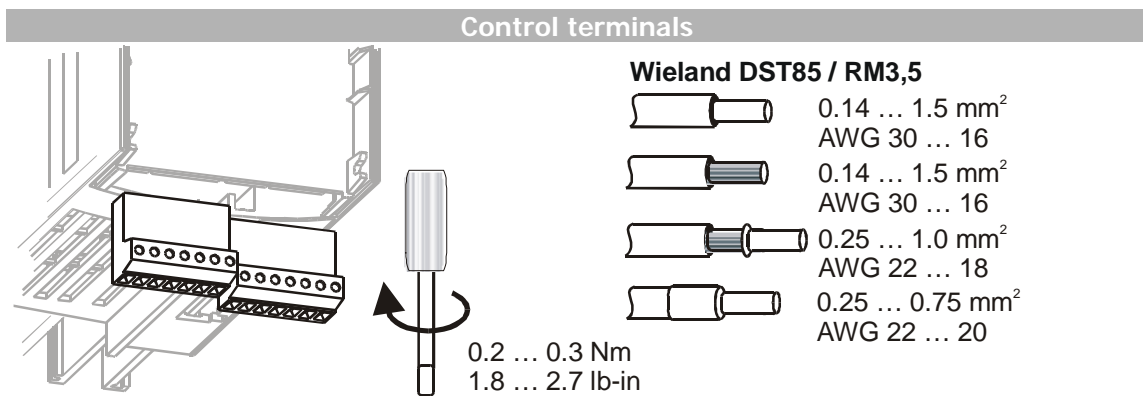
The control and software functionality is freely configurable to ensure a reliable and economical operation.



CAUTION

Switch off power supply before connecting or disconnecting the keyed control inputs and outputs. Verify that the keyed control inputs and outputs are deenergized before connecting or disconnecting them. Otherwise, components may be damaged.

- The unit may only be connected with the power supply switched off.
- Verify safe isolation from power supply.



Control terminal X210A	
Ter m.	Description
1	Voltage output 20 V, $I_{\max}=180$ mA 1) or input for external power supply DC 24 V $\pm 10\%$
2	GND 20 V and GND 24 V (ext.)
3	Digital input S1IND, $U_{\max}=\text{DC } 30$ V, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, response time approx. 10 ms
4	Digital input S2IND, $U_{\max}=\text{DC } 30$ V, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, response time approx. 2 ms
5	Digital input S3IND, $U_{\max}=\text{DC } 30$ V, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, response time approx. 2 ms
6	Digital input S4IND, $U_{\max}=\text{DC } 30$ V, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, Frequency signal: 0 V ... 30 V, 10 mA at 24 V, $f_{\max}=150$ kHz
7	Digital input S5IND, $U_{\max}=\text{DC } 30$ V, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, Frequency signal: 0 V ... 30 V, 10 mA at 24 V, $f_{\max}=150$ kHz

Control terminal X210B	
Ter m.	Description
1	Digital input S6IND, $U_{max}=DC\ 30\ V$, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC compatible, response time approx. 2 ms
2	Digital input S7IND, $U_{max}=DC\ 30\ V$, 10 mA at 24 V, input resistance: 2.3 k Ω , PLC-compatible, response time approx. 10 ms
3	Digital output S1OUT, $U=24\ V$, $I_{max}=50\ mA$, overload and short-circuit proof
4	Multi-function output MFO1, Analog signal: $U= 24\ V$, $I_{max} = 50\ mA$, pulse-width modulated, $f_{PWM} = 116\ Hz$, Digital signal: $U=24\ V$, $I_{max}=50\ mA$, overload and short-circuit proof, Frequency signal: 0 V ... 24 V, $I_{max}=50\ mA$, $f_{max}=150\ kHz$
5	Reference output 10 V, $I_{max}=4\ mA$
6	Multi-Function Input MF11, Analog signal: Resolution 12 bit, DC 0 V ... +10 V ($R_i=70\ k\Omega$), 0 mA ... 20 mA ($R_i=500\ \Omega$), Digital signal: response time approx. 4 ms, $U_{max}=30\ V$, 4 mA at 24 V, PLC compatible
7	Ground / GND 10 V

¹ The power output on terminal X210A.1 may be loaded with a maximum current of $I_{max}= 180\ mA$. The maximum current available is reduced by the digital output S1OUT and multifunction output MFO1.

	Level:
Digital inputs (X210A.3 ... X210B.2)	Low: 0 V ... 3 V, High: 12 V ... 30 V
Digital output (X210B.3)	

8.14.1 External DC 24 V power supply

The bidirectional control terminals X210A.1/ X210A.2 can be used as a voltage output or voltage input. By connecting an external power supply of DC 24 V $\pm 10\%$ to terminals X210A.1/X210A.2, the function of inputs and outputs as well as the communication can be parameterized and maintained, even when mains voltage is off.

Requirements to be met by external power supply	
Input voltage range	DC 24 V $\pm 10\%$
Rated input current	Max. 1.0 A (typically 0.45 A)
Peak inrush current	Typically: < 20 A
External fuse	Via standard fuse elements for rated current, characteristic:
Safety	Safety extra low voltage (SELV) according to EN 61800-5-1



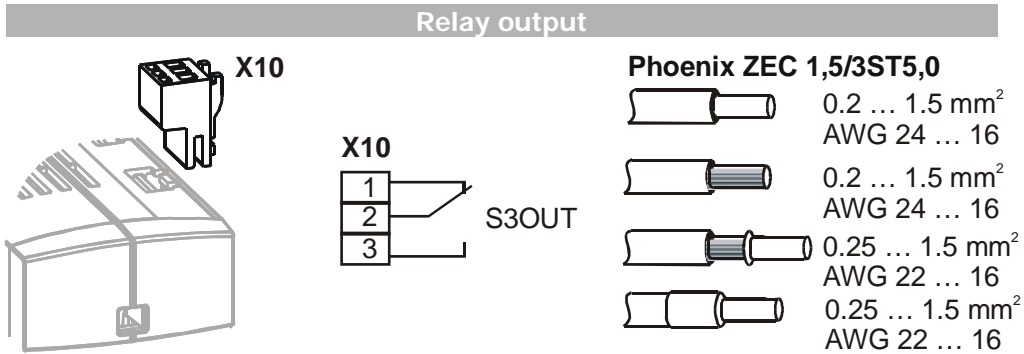
CAUTION

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

Use suitable external power supply units with a maximum output current of DC 30 V or use appropriate fuses to protect the unit.

8.14.2 Relay output

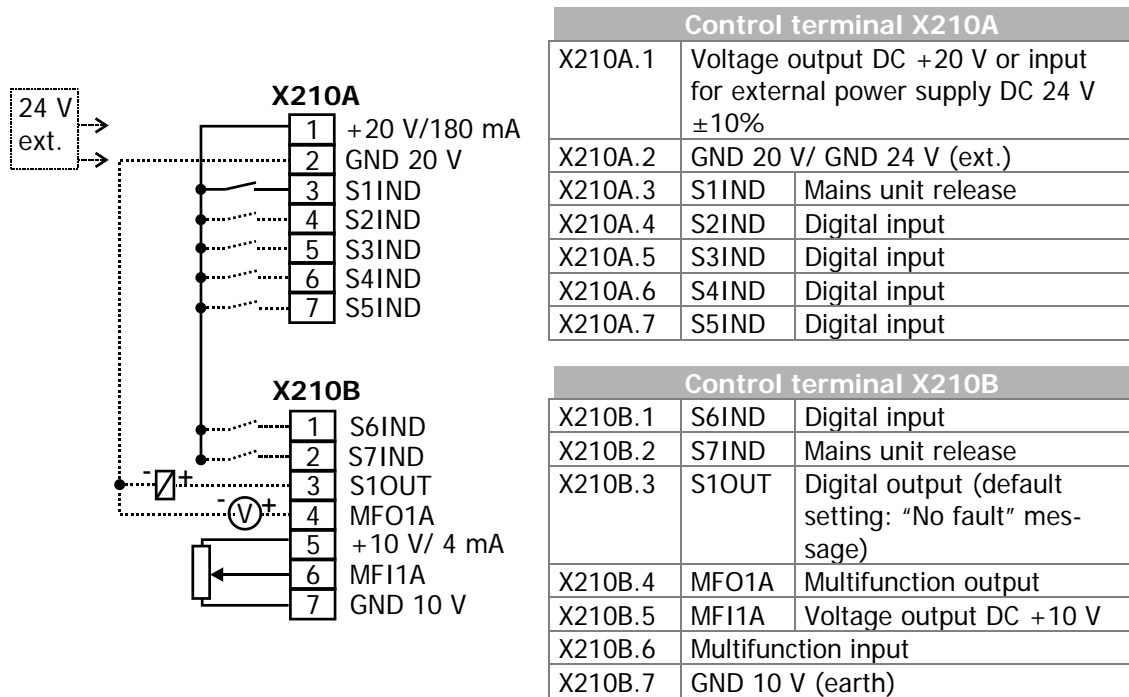
The relay output must be connected to a coupling relay for controlling the mains contactor. See Chapter 8.8 "Precharging circuit"



Control terminal X10	
Term.	Description
1 ... 3	Relay output, floating change-over contact, response time approx. 40 ms, maximum contact load:
make contact:	AC 5 A / 240 V, DC 5 A (ohmic) / 24 V
break contact:	AC 3 A / 240 V, DC 1 A (ohmic) / 24 V

8.14.3 Wiring diagram

The control hardware and the software of the mains unit are freely configurable to a great extent. Certain functions can be assigned to the control terminals, and the internal logic of the software modules can be freely selected.



9 Commissioning of mains unit

- Before turning mains voltage on, check all control and power connections.
- Before commissioning the mains unit, it must be ensured that Parameter **P30** is set to Configuration 710 "Mains Inverter".
- Ensure that the mains unit is turned off (control input S1IND/terminal X210A.3).
- Turn mains voltage on.

The mains unit will perform a self-test. After some seconds, the mains unit will be ready for operation.

- Turn mains unit release on (control input S1IND/terminal X210A.3) while closing digital input S7IND/ terminal X210B.2 at the same time.

The mains unit will synchronize with the mains. Feed-in / feed-back operation is enabled.




Digital output S1OUT signals "No fault" due to the default setting of Parameters *Op. Mode Digital Output 530* = "103 – Inv. Error Signal".

Alternatively, digital output S1OUT can output signal 30 – "Flux-Forming finished". As a result, "Synchronization done" is reported. This message can be used as the start signal for connected ACU frequency inverters, for example.

The AEC mains unit is supplied with default parameters. Generally, the parameters don't have to be changed. For an overview of the most important parameters, refer to Chapter 10.3 "AEC-relevant parameters".

10 List of parameters

The parameter list is structured according to the menu branches of the control unit. The parameters are listed in ascending numerical order. A headline (shaded) can appear several times, i.e. a subject area may be listed at different places in the table. For better clarity, the parameters have been marked with pictograms:

-  The parameter is available in the four data sets.
-  The parameter value is set by the SETUP routine.
-  This parameter cannot be written when the frequency inverter is in operation.

I_{RAT} , U_{RAT} , P_{RAT} : Nominal values of frequency inverter,
 \ddot{u} : Overload capacity of frequency inverter



In the KP500 control unit, parameter numbers > 999 are shown in hexadecimal form (999, A00 ... B5 ... C66).

10.1 Actual value menu (VAL)

Actual values of the system			
No.	Description	Unit	Display range
211	R.m.s Current	A	0.0 ... I_{max}
212	Output voltage	V	0.0 ... U_{rated}
Actual values of mains unit			
222	DC-Link Voltage	V	0.0 ... $U_{dmax}-25$
223	Modulation	%	0 ... 100
229	Reference Percentage Value	%	$\pm 300,00$
Actual value memory			
231	Peak Value Long Term Ixt	%	0.00 ... 100.00
232	Peak Value Short Term Ixt	%	0.00 ... 100.00
Actual values of mains unit			
243	Digital Inputs (Hardware)	-	00 ... 255
244	Working Hours Counter	h	99999
245	Operation Hours Counter	h	99999
249	Active Data Set	-	1 ... 4
250	Digital Inputs	-	00 ... 255
251	Analog Input MF11A	%	$\pm 100,00$
254	Digital Outputs	-	00 ... 255
255	Heat Sink Temperature	deg.C	0 ... T_{kmax}
256	Inside Temperature	deg.C	0 ... T_{imax}
257	Analog Output MFO1A	V	0.0 ... 24.0
258	PWM input	%	0.00 ... 100.00
259	Current Error	-	FXXXX
269	Warnings	-	AXXXX
273	Application Warnings	-	AXXXX
275	Controller Status	-	CXXXX
277	STO Status	-	XXXX
Actual value memory			
287	Peak Value Vdc	V	0.0 ... U_{dmax}
288	Average Value Vdc	V	0.0 ... U_{dmax}
289	Peak Value Heat Sink Temp.	deg.C	0 ... T_{kmax}
290	Average Value Heat Sink Temp.	deg.C	0 ... T_{kmax}
291	Peak Value Inside Temperature	deg.C	0 ... T_{imax}
292	Average Value Inside Temperature	deg.C	0 ... T_{imax}

293	Peak Value Irms	A	0.0 ... $\bar{u} \cdot I_{RAT}$
-----	-----------------	---	---------------------------------


























Actual value memory

No.	Description	Unit	Display range
294	Average Value Irms	A	0,0 ... $\bar{u} \cdot I_{RAT}$
295	Peak Value Active Power pos.	kW	0.0 ... $\bar{u} \cdot P_{RAT}$
296	Peak Value Active Power neg.	kW	0.0 ... $\bar{u} \cdot P_{RAT}$
297	Average Value Active Power	kW	0.0 ... $\bar{u} \cdot P_{RAT}$
301	Energy positive	kWh	0 ... 99999
302	Energy negative	kWh	0 ... 99999

List of errors

310	Last Error	h:m; F	00000:00; FXXXX
311	Last Error but one	h:m; F	00000:00; FXXXX
312	Error 3	h:m; F	00000:00; FXXXX
313	Error 4	h:m; F	00000:00; FXXXX
314	Error 5	h:m; F	00000:00; FXXXX
315	Error 6	h:m; F	00000:00; FXXXX
316	Error 7	h:m; F	00000:00; FXXXX
317	Error 8	h:m; F	00000:00; FXXXX
318	Error 9	h:m; F	00000:00; FXXXX
319	Error 10	h:m; F	00000:00; FXXXX
320	Error 11	h:m; F	00000:00; FXXXX
321	Error 12	h:m; F	00000:00; FXXXX
322	Error 13	h:m; F	00000:00; FXXXX
323	Error 14	h:m; F	00000:00; FXXXX
324	Error 15	h:m; F	00000:00; FXXXX
325	Error 16	h:m; F	00000:00; FXXXX

Error environment

	330	DC-Link Voltage	V	0.0 ... U_{dmax}
	331	Output Voltage	V	0.0 ... U_{rated}
	332	Stator Frequency	Hz	0.00 ... 999.99
	333	Encoder 1 Frequency	Hz	0.00 ... 999.99
	335	Phase Current Ia	A	0.0 ... I_{max}
	336	Phase Current Ib	A	0.0 ... I_{max}
	337	Phase Current Ic	A	0.0 ... I_{max}
	338	R.m.s Current	A	0.0 ... I_{max}
	339	Isd / Reactive Current	A	0.0 ... I_{max}
	340	Isq / Active Current	A	0.0 ... I_{max}
	341	Rotor Magnetizing Current	A	0.0 ... I_{max}
	342	Torque	Nm	\pm 9999.9
	343	Analog Input MF11A	%	\pm 100.00
	346	Analog Output MFO1A	V	0.0 ... 24.0
	349	Repetition Frequency Output	Hz	0.00 ... 999.99
	350	Status of Digital Inputs	-	00 ... 255
	351	Status of Digital Outputs	-	00 ... 255
	352	Time since Release	h:m:s.ms	00000:00:00.000
	353	Heat Sink Temperature	deg.C	0 ... T_{kmax}
	354	Inside Temperature	deg.C	0 ... T_{imax}
	355	Controller Status	-	C0000 ... CFFFF
	356	Warning Status	-	A0000 ... AFFFF
	357	Int. Value 1	-	\pm 32768
	358	Int. Value 2	-	\pm 32768
	359	Long Value 1	-	\pm 2147483647

360	Long Value 2	-	± 2147483647
361	Checksum	-	OK / NOK
List of errors			
No.	Description	Unit	Display range
362	No. of Errors	-	0 ... 32767
363	No. of self-acknowledged Errors	-	0 ... 32767
Error environment			
367	Application Warning Status	-	A0000 ... AFFFF
Digital Outputs			
537	Actual Warning Mask	-	AXXXXXXXXX
627	Actual Appl. Warning Mask	-	AXXXX
Mains actual values			
850	Frequency	Hz	0.0 ... 999.99
852	Power Supply Current	A	0.0 ... I _{max}
853	Power Supply Voltage	V	0.0 ... 999.99
Actual values of the system			
861	Active Current	A	0.0 ... I _{max}
862	Reactive Current	A	0.0...I _{max}

10.2 Parameter menu (PARA)

Inverter data			
No.	Description	Unit	Setting range
0	Serial Number	-	Characters
1	Optional Modules	-	Characters
12	Inverter Software Version	-	Characters
15	Copyright	-	Characters
27	Set Password	-	0 ... 999
28	Control Level	-	1 ... 3
29	User Name	-	32 characters
⊗ 30	Configuration	-	Selection
33	Language	-	Selection
⊗ 34	Program	-	0 ... 9999
Fan			
39	Switch-On Temperature	deg.C	0 ... 60
Digital Inputs			
70	Data Set Change-Over 1	-	Selection
71	Data Set Change-Over 2	-	Selection
72	Percent Motorpoti Up	-	Selection
73	Percent Motorpoti Down	-	Selection
75	Fixed Percent Change-Over 1	-	Selection
76	Fixed Percent Change-Over 2	-	Selection
83	Timer 1	-	Selection
84	Timer 2	-	Selection
87	Start 3-Wire Ctrl	-	Selection
103	Error Acknowledgment	-	Selection
183	External Error	-	Selection
204	Therm. Contact	-	Selection
Pulse width modulation			
400	Switching Frequency	-	Selection
Error/warning behavior			
405	Warning Limit Short Term Ixt	%	6 ... 100

406	Warning Limit Long Term Ixt	%	6 ... 100
407	Warning Limit Heat Sink Temp.	deg.C	-25 ... 0
408	Warning Limit Inside Temp.	deg.C	-25 ... 0

Error/warning behavior

No.	Description	Unit	Setting range
409	Controller-Status Message	-	Selection






Bus controller

	412	Local/Remote	-	Selection
---	-----	--------------	---	-----------

Error/warning behavior

415	IDC Compensation Limit	V	0.0 ... 1.5
417	Frequency Switch-off Limit	Hz	0.00 ... 999.99


Multifunction input 1

	450	Tolerance Band	%	0.00 ... 25.00
	451	Filter time constant	ms	Selection
	452	Operation Mode	-	Selection
	453	Error/Warning Behaviour	-	Selection
	454	Point X1	%	0.00 ... 100.00
	455	Point Y1	%	-100.00 ... 100.00
	456	Point X2	%	0.00 ... 100.00
	457	Point Y2	%	-100.00 ... 100.00

Motor potentiometer

473	Ramp Keypad Motorpoti	Hz/s	0.01 ... 999.99
474	Operation Mode	-	Selection


Reference percentage channel

	476	Reference Percentage Source	-	Selection
---	-----	-----------------------------	---	-----------

Percentage ramp

	477	Gradient Percentage Ramp	%/s	0 ... 60000
---	-----	--------------------------	-----	-------------



PWM-/repetition frequency input

	496	Operation Mode	-	Selection
---	-----	----------------	---	-----------



Brake Chopper

506	Trigger Threshold	V	425 ... 1000.0
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Digital Outputs

	510	Setting Frequency	Hz	0.00 ... 999.99
	517	Setting Frequency Off Delta	Hz	0.00 ... 999.99

Percentage Value Limits

	518	Minimum Reference Percentage	%	0.00 ... 300.00
	519	Maximum Reference Percentage	%	0.00 ... 300.00

Fixed percentages









	520	Fixed Percentage 1	%	-300.00 ... 300.00
	521	Fixed Percentage 2	%	-300.00 ... 300.00
	522	Fixed Percentage 3	%	-300.00 ... 300.00
	523	Fixed Percentage 4	%	-300.00 ... 300.00

Digital Outputs

530	Op. Mode Digital Output 1	-	Selection
535	Op. Mode ext. Error	-	Selection
540	Op. Mode Comparator 1	-	Selection
541	Comparator On above	%	-300.00 ... 300.00
542	Comparator Off below	%	-300.00 ... 300.00
543	Op. Mode Comparator 2	-	Selection
544	Comparator On above	%	-300.00 ... 300.00
545	Comparator Off below	%	-300.00 ... 300.00
549	Max. Control Deviation	%	0.01 ... 20.00

Multifunction output 1

550	Operation Mode	-	Selection
-----	----------------	---	-----------

551	Voltage 100%	V	0.0 ... 24.0
552	Voltage 0%	V	0.0 ... 24.0
553	Analog Operation	-	Selection
Multifunction output 1			
No.	Description	Unit	Setting range
554	Digital Operation	-	Selection
Error/warning behavior			
570	Motor Temp. Operation Mode	-	Selection
Motor circuit breaker			
 571	Operation Mode	-	Selection
 572	Frequency Limit	%	0 ... 300
Intelligent current limits			
 573	Operation Mode	-	Selection
 574	Power Limit	%	40.00 ... 95.00
 575	Limitation Time	min	5 ... 300
PWM-/repetition frequency input			
652	Offset	%	-100.00 ... 100.00
653	Amplification	%	5.0 ... 1000.0
Current controller			
 700	Amplification	-	0.00 ... 2.00
 701	Integral Time	ms	0.00 ... 10.00
Timer			
790	Operation Mode Timer 1	-	Selection
791	Time 1 Timer 1	s/m/h	0 ... 650.00
792	Time 2 Timer 1	s/m/h	0 ... 650.00
793	Operation Mode Timer 2	-	Selection
794	Time 1 Timer 2	s/m/h	0 ... 650.00
795	Time 2 Timer 2	s/m/h	0 ... 650.00
Voltage controller			
800	Operation Mode	-	Selection
DC-link			
801	Reference DC-Link Voltage	V	0.0 ... U_{dmax}
Voltage controller			
802	Max. DC-Link Voltage Deviation	V	0.0 ... U_{dmax}
804	Max. Feed Current	A	0.0 ... I_{max}
805	Max. Feedback Current	A	0.0 ... I_{max}
Filter compensation			
810	Operation Mode	-	Selection
 811	Relative Short-Circuit Voltage	%	0.0 ... 99.9
Mux/DeMux			
1250	Mux input index (write)	-	EEPROM: 0 ... 16 RAM: 17 ... 33
1251	Mux input index (read)	-	EEPROM: 0 ... 16 RAM: 17 ... 33
1252	Mux inputs	-	Selection
1253	DeMux Input	-	Selection

10.3 AEC-relevant parameters

10.3.1 Description of parameters

10.3.1.1 Adjustable parameters

AEC-relevant parameters				
	No.	Description	Unit	Explanation
1	30	Configuration		Selection of feedback method
2)	520	Fixed percentage 1	%	Setting of phase displacement between output current and mains voltage via input of I_{react}/I_{rated}
1)	530	Op. Mode Digital Output 1		Selection of operation mode of digital output 1. By default, it is set to "103 Inv. Error Signal". Alternatively, you can also choose "130 Inv. Flux-Forming finished". Then, output S1OUT will signal that synchronization was successful. This signal can be used, for example, as the start signal for connected ACU frequency inverters
2)	700	Amplification		Amplification of current controller
2)	701	Integral time	ms	Integral time of current controller
2)	800	Operation mode of voltage controller		Set the operation mode. In the standard software, "1 Voltage Control" is set (only in configuration 710)
2)	801	Reference DC-Link Voltage	V	Input of reference value of DC link voltage
2)	802	Max. DC-Link Voltage Deviation	V	
2)	803	Max. Output Current	A	Max. inverter output current; limits both the feed-in current and the feed-back current
2)	804	Max. Feed Current	A	Input of maximum feed-in current, the mains unit may receive from mains through the inverter
2)	805	Max. Feedback Current	A	Input of maximum feedback current, the mains unit may feed into the mains via the inverter.
2)	810	Filter compensation mode		
2)	890	Inductivity Sinus Filter	mH	Phase inductance of sine filter
2)	891	Filter Capacity Sinus Filter	μ F	Sine filter capacitance per phase
1)	1063	Inductivity line choke	mH	Phase inductance of line choke

NOTE

In the KP500 control unit, parameter numbers > 999 are shown in hexadecimal form (999, A00 ... B5 ... C66).

- 1) Parameter is active both in configuration 710 and 711
- 2) Parameter active in configuration 710 only

10.3.1.2 Actual value parameters

AEC-relevant parameters				
	No.	Description	Unit	Explanation
2)	213	Active power	kW	Current effective power, consumed or fed by the inverter from/into mains; actual value parameter
1)	811	Relative Short-Circuit Voltage	%	Describes the total longitudinal inductance of the inductive components across the voltage drop, referred to the phase voltage in a 400 V mains
2)	850	Frequency	Hz	Measured mains frequency
1)	852	Power Supply Current	A	Actual mains current value
2)	853	Power Supply Voltage	V	Calculated mains voltage
1)	854	Active power	kW	Current effective power, fed into the mains by the inverter in configuration 711.
2)	863	Current a	A	Actual current value in phase a
2)	864	Current b	A	Actual current value in phase b
2)	865	Current c	A	Actual current value in phase c

NOTE

In the KP500 control unit, parameter numbers > 999 are shown in hexadecimal form (999, A00 ... B5 ... C66).

- 1) Parameter is active both in configuration 710 and 711
- 2) Parameter active in configuration 710 only

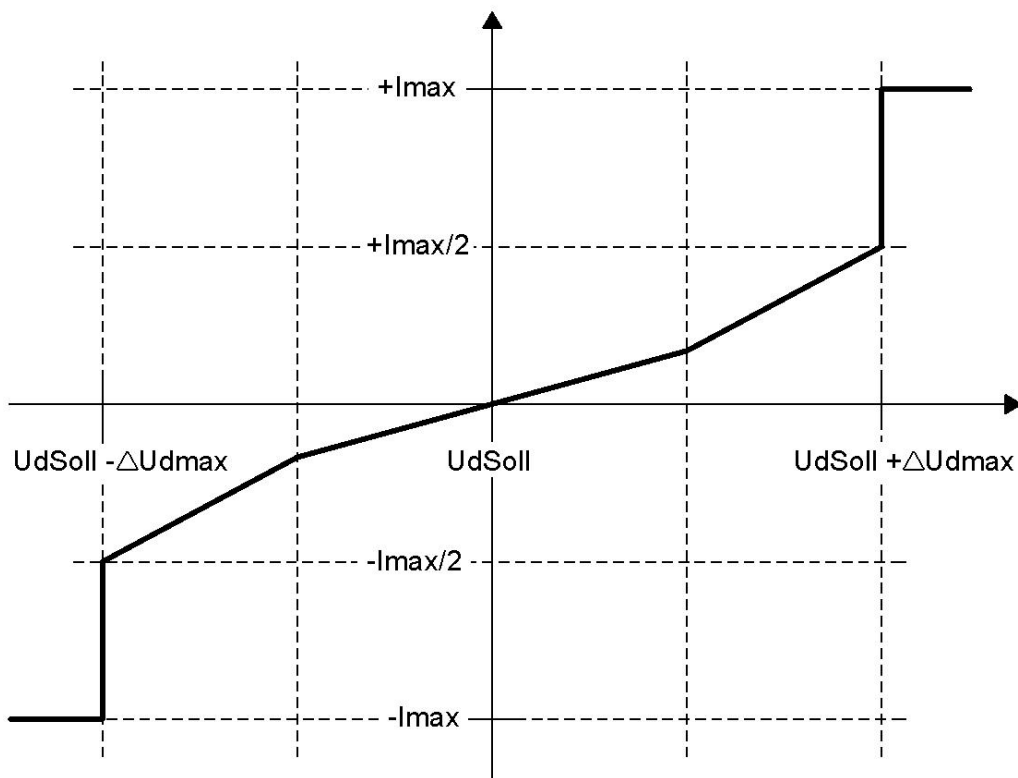
10.3.2 Parameter setting options

No.	Parameter Description	Setting		
		Min.	Max.	Factory setting
520	Fixed Percentage 1	-300.00 %	300.00 %	0.00 %
700	Amplification	0.00	80.00	0.40
701	Integral time	0.00 ms	10.00 ms	10.00 ms
801	Reference DC-Link Voltage	390,0 V	775.0 V	675.0 V
802	Max. DC-Link Voltage Deviation	10,0 V	200.0 V	75.0 V
803	Max. Output Current	1.6 A	2 * I _{rated}	I _{rated}
804	Max. Feed Current	0.0 A	2 * I _{rated}	2 * I _{rated}
805	Max. Feedback Current	0.0 A	2 * I _{rated}	2 * I _{rated}

Parameter		Setting	
No.	Description	Setting	Factory setting
30	Configuration	710 – Mains Inverter 711 – Feedback Unit	710
530	Op. Mode Digital Output 1	103 – Inverted Error Signal	103
800	Operation Mode Voltage Controller	1 – Voltage Control	1
810	Operation Mode Filter Compensation	1 – Without Overload 2 – With Overload 11 – Without Overload, Reactive Current Prior. 12 – With Overload, Reactive Current Prior.	11



For setting options of other parameters, refer to the ACU frequency inverter Operating Instructions.



I_{max} : Parameter 804, Max. Feed Current
 I_{max} : Parameter 805, Max. Feedback Current
 U_{dSet} : Parameter 801, DC-Link Voltage
 ΔU_{dmax} : Max. DC-Link Voltage Deviation

11 AEC as feed-back unit

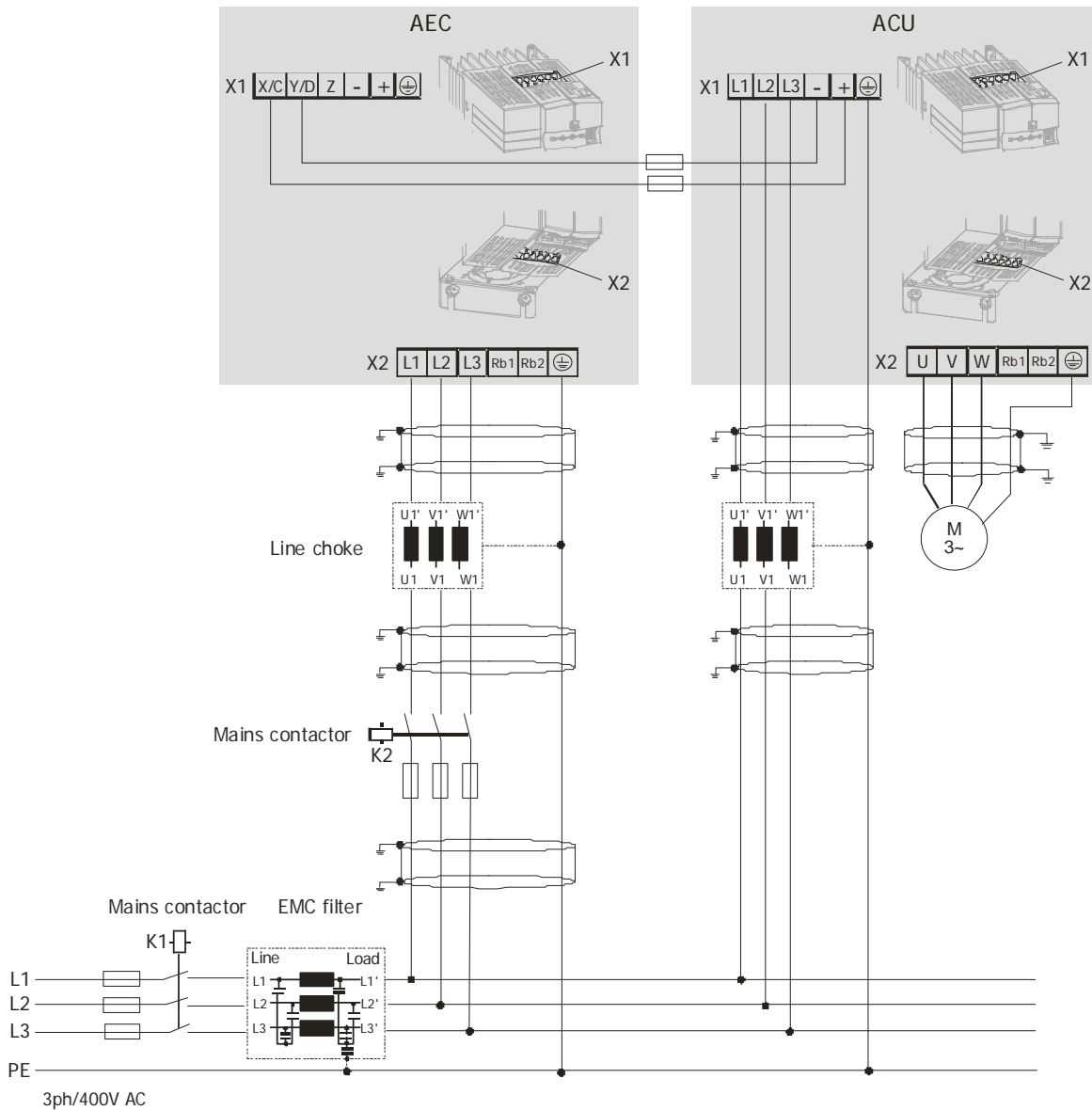
11.1 Installation instructions

NOTE

By setting Parameter 30 to 711, the AEC mains unit is set to "Feedback Unit" mode.

AEC 401-22 (size 3)
Mains connection

AEC block-type, precharging via drive inverter



NOTE

For information on how to connect the device, refer to Chapter 8.5.1 "Conductor cross-sections", 400 V three-phase connection and Chapter 8.5.2 "Fuses".

NOTE

The cables of the AEC feedback unit connected to the inverter DC-link must be fused using appropriate DC fuses.

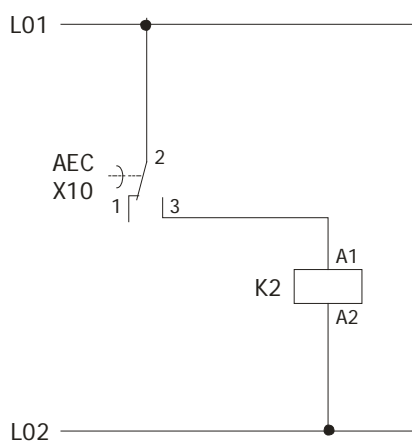
When dimensioning the DC-fuses, the derating factors specified by the fuse manufacturer must be considered in addition to the expected current and voltage values. If an AEC feed-back unit with a power corresponding to the drive inverter is used, no DC-fuses are required.

11.1.1 Precharging circuit

The AEC feed-back unit requires separate wiring for mains connection.

The mains contactor K2 must be controlled by relay output X10. When the mains contactor K1 is switched off, it must be ensured that the DC link is discharged before the mains contactor K1 can be switched on again.

Relay output X10 will be active once the precharging operation in the DC-link has been completed. If the DC-link voltage does not reach a certain level, relay output X10 will remain in idle state.



Mains contactor K1 must be designed for the power of the whole drive. Mains contactor K2 must be designed for the maximum expected braking power of the drive.

11.1.2 Start-up procedure

- For operation of the AEC as feedback unit, Parameter 30 "Configuration" must be set to 711. Other parameter settings are not required.
- To release the feed-back unit, digital inputs S1IND (terminal X210A.3) and S7IND (terminal X210B.2) must be activated.
- Before turning the start command on at the drive inverter, the release must be set at the AEC feed-back unit.
- Before setting the release at the AEC feed-back unit, mains contactor K2 must be closed.

Index

A		
Accessories	52	
Actual Value Menu (VAL).....	62	
Actual value parameter	68	
Adjustable parameters	67	
AEC 401-22 (size 3)	17, 32	
AEC 401-25 (size 4)	17, 32	
AEC 401-31 (size 5)	18, 33	
AEC 401-39 (size 6)	19, 34	
AEC 401-49 (size 7)	20, 35	
AEC as feed-back unit	70	
B		
Block diagram	40	
C		
Commissioning the mains unit	61	
Communication module.....	41	
Conductor cross-section	42	
Connection of frequency inverter to AEC .	53	
Control terminals	58	
Control unit	41	
Copyright	8	
D		
Decommissioning.....	16	
Designated use.....	10	
E		
Electrical connections.....	14	
Electrical installation	36	
Extension module EM.....	41	
External DC 24 V power supply.....	59	
F		
Fuses	44	
G		
General technical data.....	22	
I		
Installation	14	
L		
Line choke.....	51	
List of parameters.....	63	
M		
Mains unit – type	30	
Mechanical installation	31	
O		
Optional components	41	
P		
Parameter Menu (PARA).....	64	
R		
Radio interference filter.....	51	
Relay output.....	60	
S		
Safety		
General.....	9	
Scope of supply	17	
Service	16	
Sine filter	51	
Storage	14	
T		
Technical Data – AEC	24	
Transport	14	
W		
Warranty and liability	7	
X		
X10.....	60	
X210A	58	

Bonfiglioli worldwide network.

Bonfiglioli Australia

2, Cox Place Glendenning NSW 2761
Locked Bag 1000 Plumpton NSW 2761
Tel. (+ 61) 2 8811 8000 - Fax (+ 61) 2 9675 6605
www.bonfiglioli.com.au - sales@bonfiglioli.com.au

Bonfiglioli Brazil

Travessa Cláudio Armando 171 - Bloco 3
CEP 09861-730 - Bairro Assunção
São Bernardo do Campo - São Paulo
Tel. (+55) 11 4344 1900 - Fax (+55) 11 4344 1906
www.bonfigliolidobrasil.com.br
bonfigliolidobrasil@bonfiglioli.com

Bonfiglioli Canada

2-7941 Jane Street - Concord, Ontario L4K 4L6
Tel. (+1) 905 7384466 - Fax (+1) 905 7389833
www.bonfigliolicanada.com
sales@bonfigliolicanada.com

Bonfiglioli China

19D, No. 360 Pu Dong Nan Road
New Shanghai International Tower
200120 Shanghai
Tel. (+86) 21 5054 3357 - Fax (+86) 21 5970 2957
www.bonfiglioli.cn - bdssales@bonfiglioli.com.cn

Bonfiglioli Deutschland

Sperberweg 12 - 41468 Neuss
Tel. (+49) 02131 2988-0
Fax (+49) 02131 2988-100
www.bonfiglioli.de - info@bonfiglioli.de

Bonfiglioli España

TECNOTRANS BONFIGLIOLI S.A.
Pol. Ind. Zona Franca sector C, calle F, nº6
08040 Barcelona
Tel. (+34) 93 4478400 - Fax (+34) 93 3360402
www.tecnotrans.com - tecnotrans@tecnotrans.com

Bonfiglioli France

14 Rue Eugène Pottier BP 19
Zone Industrielle de Moimont II
95670 Marly la Ville
Tel. (+33) 1 34474510 - Fax (+33) 1 34688800
www.bonfiglioli.fr - btf@bonfiglioli.fr

Bonfiglioli India

PLOT AC7-AC11 Sidco Industrial Estate
Thirumudivakkam - Chennai 600 044
Tel. +91(0) 44 24781035 - 24781036 - 24781037
Fax +91(0) 44 24780091 - 24781904
www.bonfiglioliindia.com - bonfig@vsnl.com

Bonfiglioli Italia

Via Sandro Pertini lotto 7b
20080 Carpiano (Milano)
Tel. (+39) 02 985081 - Fax (+39) 02 985085817
www.bonfiglioli.it
customerservice.italia@bonfiglioli.it

Bonfiglioli New Zealand

88 Hastie Avenue, Mangere Bridge, Auckland
2022, New Zealand - PO Box 11795, Ellerslie
Tel. (+64) 09 634 6441 - Fax (+64) 09 634 6445
npollington@bonfiglioli.com.au

Bonfiglioli Österreich

Molkereistr 4 - A-2700 Wiener Neustadt
Tel. (+43) 02622 22400 - Fax (+43) 02622 22386
www.bonfiglioli.at
info@bonfiglioli.at

Bonfiglioli South East Asia

No 21 Woodlands industrial park E1
#02-03 Singapore 757720
Tel. (+65) 6893 6346/7 - Fax (+65) 6893 6342
www.bonfiglioli.com.au
sales@bonfiglioli.com.sg

Bonfiglioli South Africa

55 Galaxy Avenue,
Linbro Business Park - Sandton
Tel. (+27) 11 608 2030 OR - Fax (+27) 11 608 2631
www.bonfiglioli.co.za
bonfigsales@bonfiglioli.co.za

Bonfiglioli Türkiye

Atatürk Organize Sanayi Bölgesi,
10015 Sk. No: 17, Çigli - Izmir
Tel. +90 (0) 232 328 22 77 (pbx)
Fax +90 (0) 232 328 04 14
www.bonfiglioli.com.tr
info@bonfiglioli.com.tr

Bonfiglioli United Kingdom

Industrial Solutions
Unit 7, Colemeadow Road
North Moons Moat - Redditch,
Worcestershire B98 9PB
Tel. (+44) 1527 65022 - Fax (+44) 1527 61995
www.bonfiglioli.com
uksales@bonfiglioli.com

Mobile Solutions
3 - 7 Grosvenor Grange, Woolston
Warrington - Cheshire WA1 4SF
Tel. (+44) 1925 852667 - Fax (+44) 1925 852668
www.bonfiglioli.co.uk
mobilesales@bonfiglioli.co.uk

Bonfiglioli USA

3541 Hargrave Drive Hebron, Kentucky 41048
Tel. (+1) 859 334 3333 - Fax (+1) 859 334 8888
www.bonfiglioliusa.com

Bonfiglioli Vietnam

Lot C-9D-CN My Phuoc Industrial Park 3
Ben Cat - Binh Duong Province
Tel. (+84) 650 3577411 - Fax (+84) 650 3577422
www.bonfiglioli.vn
salesvn@bonfiglioli.com



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