MOELLER

Hardware and Engineering

DE 4-BM 2-1,
DE 4-BM 4-1
Brake Chopper

06/97 AWB 823-1286-GB

1st published 1997, edition 04/97

Author: Rainer Günzel

Editor: Karola Großpietsch

Translators: David Long

Caution!

Dangerous Electrical Voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause uncontrolled operation or restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- According to their degree of protection frequency inverters may feature during operation live, bright metal, or possibly moving, rotating parts or hot surfaces.
- The impermissible removal of the necessary covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The relevant national regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).

- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- Installations fitted with frequency inverters must be provided with additional monitoring and protective devices in accordance with the relevant safety regulations etc. Modifications to the frequency inverters using the operating software are permitted.
- All shrouds and doors must be kept closed during operation.
- In order to reduce hazards to persons or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  - Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.)
  - Electrical or non-electrical system related measures (interlocks or mechanical interlocks).
  - Live parts or cable connections of the frequency inverter must not be touched after it has been disconnected from the power supply due to the charge in capacitors. Appropriate warning signs must be provided.

Contents

06/97 AWB 823-1286-GB

06/97 AWB 823-1286-GB

About This Manual

This manual contains the information you need to install, connect up and operate the brake chopper models DE 4-BM2-1 and DE 4-BM4-1.

The information in this manual only applies to the specified hardware versions.

The manual uses the following abbreviations and symbols:

Drive system:
Variable speed drive system which contains a brake chopper and other Klöckner-Moeller drive components.

This symbol refers to interesting tips and additional information.

▶ This symbol indicates steps of work that you need to carry out.

Attention!
This symbol warns you about instructions which should be observed to avoid possible damage to equipment, other items in the vicinity or data.

Warning!
This symbol warns you about instructions which should be observed to avoid possible severe damage to or destruction of equipment, other items in the vicinity or data. It also refers to information which should be observed to avoid possible serious injury or death to operating personnel.

06/97 AWB 823-1286-GB

06/97 AWB 823-1286-GB

1 About These Products

System overview

The brake chopper models DE 4-BM2-1 and DE 4-BM4-1 are optional accessories for the DF 4 series frequency inverters.

The generic type code for brake choppers shows its position among the Klöckner-Moeller family of products:

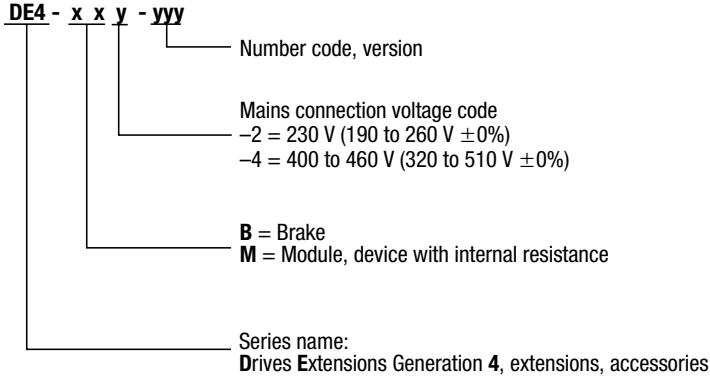

Figure 1: Type code for brake choppers

In generator mode, i.e. when braking, the frequency-controlled motor feeds energy back to the frequency inverter's internal DC bus. This increases the DC bus voltage U_{ZK}. If the maximum admissible DC bus voltage is exceeded, the frequency inverter triggers the controller inhibit and the motor can no longer be braked in a controlled way.

This can be avoided by connecting a brake chopper in parallel with the frequency inverter's internal DC bus. The internal high-power resistor in the brake chopper converts braking energy to heat. This prevents overvoltage in the DC bus and allows the motor to be braked in a controlled way..

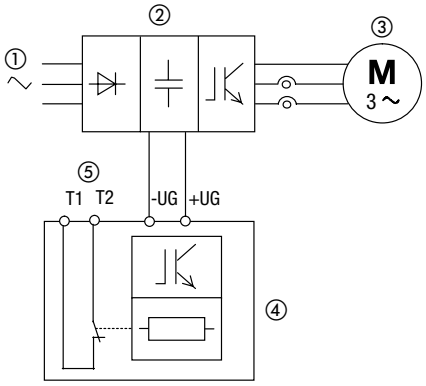

Figure 2: Block diagram of the brake chopper

① Mains input voltage (U_{LN})
② Frequency inverter DF 4
③ Variable speed motor
④ Brake chopper with internal high-power braking resistor
⑤ Temperature monitoring switch for the high-power braking resistor

Features of the brake chopper

The DE 4-BMx-1 brake chopper series has the following features:

DE 4-...	...-BM2-1	...-BM4-1
Compact construction	✓	✓
Simple assembly	yes	yes
Operating status LEDs	2	2
Temperature monitoring switch	✓	✓
High-power braking resistor	internal	internal
Very short braking times possible	✓	✓
Usable for	DF 4-120	DF 4-34x
regular braking with low power	✓	✓
occasional braking with medium power	✓	✓
Switching point preset for:		
mains input voltage 230 V AC	✓	–
mains input voltage 400 to 460 V AC	–	✓
Optional accessories		
Adapter DE 4-MNT-1 for top-hat rail	✓	✓

Admissible environmental conditions

Installation height:
Can be operated at full rated power up to 1000 m above sea level; from 1000 m to 4000 m the rated power drops by 5% per 1000 m additional height.

Moisture:
Moisture class F without condensation (average relative humidity 85%)

Protection class:

IP 10

NEMA 1: protection against electric shock

06/97 AWB 823-1286-GB

Degree of pollution:
EN 60 947 degree of pollution 2

Insulation class:
Overvoltage category III to EN 60 947

Temperature:

Operation	T = 0 °C to +40 °C at rated power; above +40 °C to T_{max} = +50 °C the rated power drops by 2% per °C temperature increase.
Storage	T = –25 °C to +70 °C
Transport	T = –25 °C to +70 °C

Intended Use

Brake choppers are electrical components for installation in closed equipment rooms or switchgear cabinets and meet the protection requirements of the EU Low Voltage Directive.

The brake chopper DE 4-BM2-1 may be used as an accessory for the DF 4-120 series frequency inverters; the brake chopper DE 4-BM4-1 may be used as an accessory for the DF 4-340 and DF 4-341 series frequency inverters.

Drive systems with the brake choppers DE 4-BM2-1 or DE 4-BM4-1 meet the requirements of the EU EMC Directive if they are installed as described under “EMC measures” in the manual for the DF-4 series frequency inverters.

06/97 AWB 823-1286-GB

Brake choppers are components

- to install in a machine
- to assemble with other components to form a machine.

The brake chopper models DE 4-BM2-1 and DE 4-BM4-1:

- are not household devices but are components which are solely for use in commercial applications;
- are not machines as covered by the EU Machinery Directive.

The brake chopper may only be used when it is in perfect working order.

Any changes or modifications to the brake chopper are forbidden.

You may only use the brake chopper under the specified conditions of use which are described in this manual.

The manual must be made available to operating personnel in its entirety and should be in good readable condition.

During operation of the equipment, the manual should always be available in the vicinity of the brake chopper for reference by operating personnel.

All personnel who work on or with the brake chopper must have ready access to the manual during their work.

Read the entire manual carefully before starting the work and observe the relevant information and warnings.

Suitable measures should be provided to ensure that there is no danger to operating personnel or risk of damage to equipment if a failure of the brake chopper should occur.

The user of the equipment is responsible for ensuring that the machine application complies with the relevant EU Directives.

All other usage is forbidden.

Persons responsible for safety

When delivered, the brake chopper complies with the current state of the art and is safe to use without exception.

The brake chopper can present a hazard if:

- unskilled persons work on or with the brake chopper;
- The brake chopper is improperly used.

Operator

The operator is any natural or legal person that uses the brake chopper or for whom the brake chopper is used on his/her order.

The operator and/or his/her safety officer must ensure that

- all regulations, warnings and national laws are observed;
- only qualified personnel are allowed to work on or with the brake chopper;
- this manual is available to operating personnel during all phases of work;
- unauthorised persons are prevented from accessing and working on or with the brake chopper.

06/97 AWB 823-1286-GB

Qualified personnel

Qualified personnel includes persons who, as a result of their training, experience and instruction and their knowledge of the relevant standards, regulations, safety standards and the operational environment have been authorised by the person responsible for the safety of the equipment to perform the required work and are able to recognise and avoid potential dangers (definition of qualified operators from VDE 105 or IEC 364).

Please contact the relevant Klöckner-Moeller Branch Office if you have any questions or problems.

Transport, recycling

The brake choppers DE 4-BM2-1 and DE 4-BM4-1 are carefully packed and prepared for shipment.

After receiving the delivery,

- check whether the packaging has been damaged externally;
- check whether the details on the delivery note match your original order

Open the packaging with suitable tools and check whether:

- parts have been damaged during transport;
- the equipment corresponds to the model which you ordered;
- the assembly instructions are also present.

In case of damage, incomplete or incorrect shipment, please make your claim directly to the sales office which is responsible.

The brake chopper is manufactured from a variety of materials.

The following materials can be recycled:

metal;

plastic;

assembly Instructions.

The assembled printed circuit board is manufactured from materials which need to be recycled separately.

06/97 AWB 823-1286-GB

2 Engineering

The process engineering information and example circuit diagrams described in this manual are suggestions whose suitability for the respective application must be checked by the user.

Engineering considerations for the brake chopper should ensure that it meets its intended function when the equipment operates correctly and that it does not present any danger to operating personnel when:

- it is correctly installed,
- it is used as intended,
- it functions correctly together with the rest of the equipment.

You should limit the consequences of malfunction to minimise the danger to operating personnel and the risk of damage to equipment by:

- providing additional, independent devices which carry out the same function as the brake chopper in case of malfunction,
- installing electrical and mechanical protective devices (interlocks, mechanical locks,...) for the drive system,
- implementing safety measures for the overall system.

Screening

The cables must be screened:

- in order to satisfy the relevant standards,
- if radio interference suppression is required to EN 55011 (limit class A or B).

The effectiveness of cable screening is dependent on

- a good earth connection to the screening and
- a low screen impedance.

Connect the screening of the cable between the frequency inverter and the brake chopper to the mounting plate at both ends of the cable using a large-area contact surface.

Only use screens with tinned or nickel plated copper braiding; screens from steel braiding are unsuitable. The degree of cover of the screen braiding must be at least 70% to 80% and the braiding angle should be 90°.

Cable cross-sections and cable lengths

The cable types used must comply with the appropriate regulations at the installation site.

Always observe the regulations on the minimum cross-section of the PE cables to use. The cross-section of the PE conductor must be at least as large as that of the power cables ($\geq$ 10 mm^2).

The information on cable cross-sections applies to:

- installation in switchgear cabinets and machines,
- cable installation in cable ducts,
- maximum ambient temperature +40 °C

06/97 AWB 823-1286-GB

Choose the cable cross-sections in order to satisfy the relevant regulations.

The recommended cable cross-section for the feed cables +UG and –UG and the temperature switch cables T1 and T2 for brake chopper models DE 4-BM2-1 and DE 4-BM4-1 is 1.5 mm^2 (see table on page 27).

The user is responsible for satisfying further standards (e.g. EN 60 204, IEC 50-461).

The maximum admissible length of the cables between the frequency inverter and the brake chopper is 2 m.

If the brake chopper is connected directly to the frequency inverter and the cable lengths are < 0.5 m, the connections can be made using unscreened single-core cable.

Temperature monitoring

The brake chopper models DE 4-BMx contain a temperature switch in addition to the high-power resistor. The temperature switch operates as soon as the maximum admissible temperature of the high-power resistor has been exceeded. The temperature switch should be used e.g. to disconnect the frequency inverter from the power supply if the maximum admissible temperature has been exceeded or to trigger controller inhibit for all connected frequency inverters.

Attention!
The temperature monitoring is necessary to ensure that the frequency inverter is shut down correctly in case of a fault. Otherwise, the frequency inverter will trigger the controller inhibit due to overvoltage and the motor will coast to a halt without being braked in a controlled way.

Standard installation

The frequency inverter is normally operated with an internal power supply and using the factory settings for the configuration. The screening and the installation must be EMC compliant as described under “EMC measures” in the manual for the DF-4 series frequency inverters.

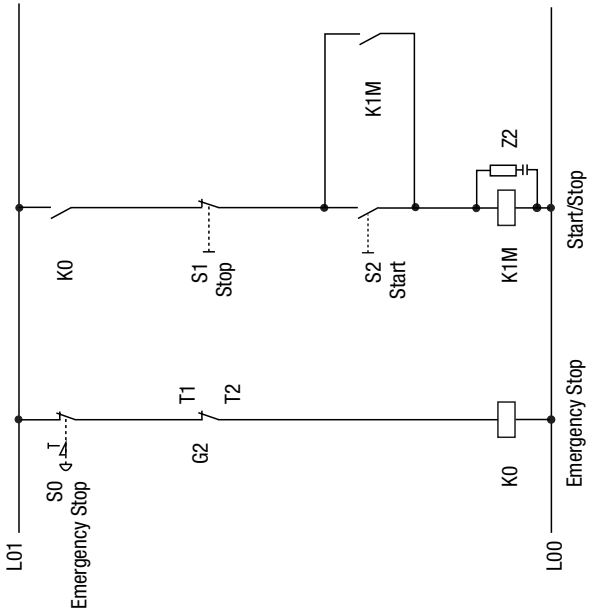

Figure 3: Control wiring of the DF 4-120 frequency inverter and the DE 4-BM2-1 brake chopper

06/97 AWB 823-1286-GB

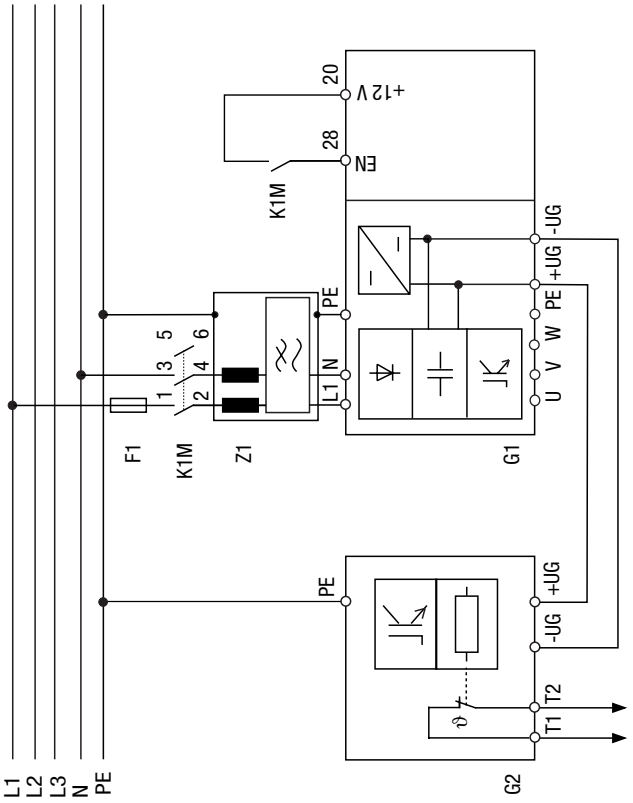

Figure 4: Power wiring of the DF 4-120 frequency inverter and the DE 4-BM2-1 brake chopper

The frequency inverter is normally operated with an internal power supply and using the factory settings for the configuration. The screening and the installation must be EMC compliant as described under “EMC measures” in the manual for the DF-4 series frequency inverters.

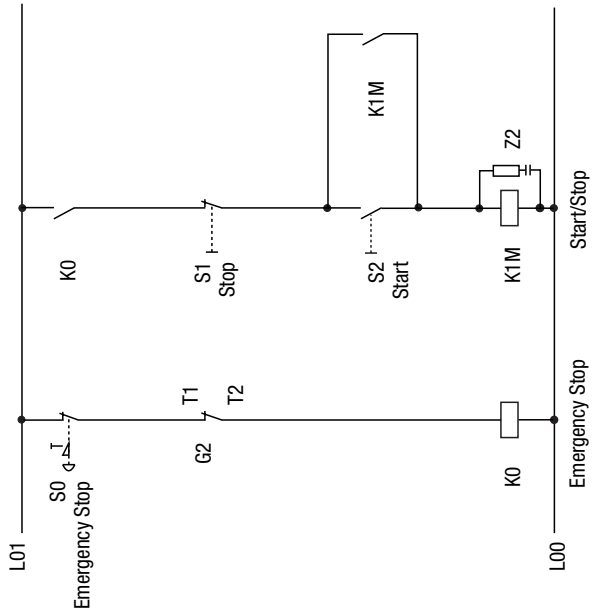

Figure 5: Control wiring for the DF 4-340 frequency inverter and the DE 4-BM4-1 brake chopper

06/97 AWB 823-1286-GB

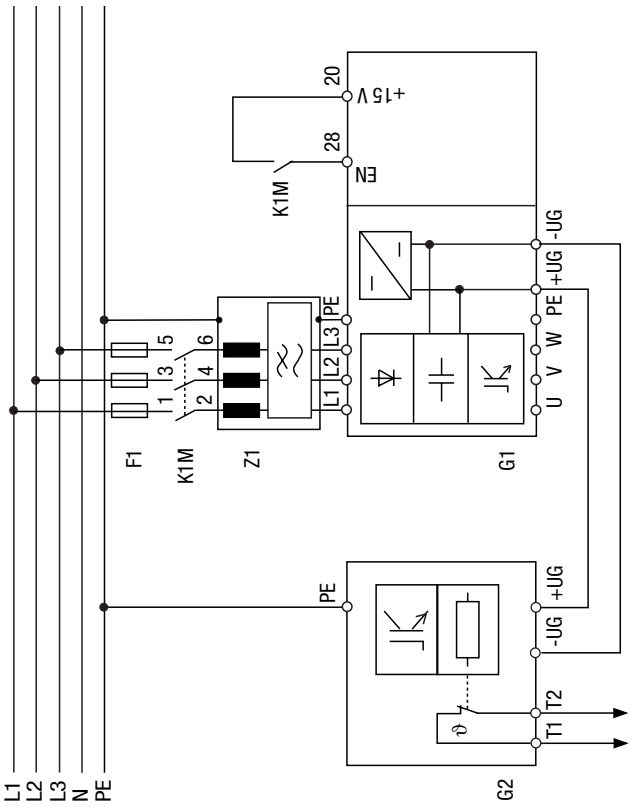

Figure 6: Power wiring for the DF 4-340 frequency inverter and the DE 4-BM4-1 brake chopper

3 Assembly/Installation

Scope of delivery

After receiving the equipment, check immediately whether the delivered items match the delivery documents. Klöckner-Moeller cannot be responsible for guarantee claims made at a later date.

The following components are supplied with the brake chopper:

- the brake chopper DE 4-BM2-1 or DE 4-BM2-1
- a plug-in screw terminal
- a mounting strip (two part)
- Assembly instructions with the reference number AWA 823-1568

Making claims:

- If there is any visible transport damage, please contact the supplier immediately.
- If there are any visible faults or if some of the items are missing, please contact your local Klöckner-Moeller agent immediately.

Installation in a switchgear cabinet

If the brake chopper is installed at locations which are subject to continuous vibration or mechanical shock, you should consider the use of vibration damping devices

In order to avoid overheating:

- ensure that the cooling air supply and the cooling air exhaust can flow freely without obstruction;
- do not install other equipment which generates large amounts of heat close to the brake chopper;
- ensure that there is a clearance of 100 mm above and below the brake chopper since otherwise the temperature of the cooling air can increase to over 40 °C.

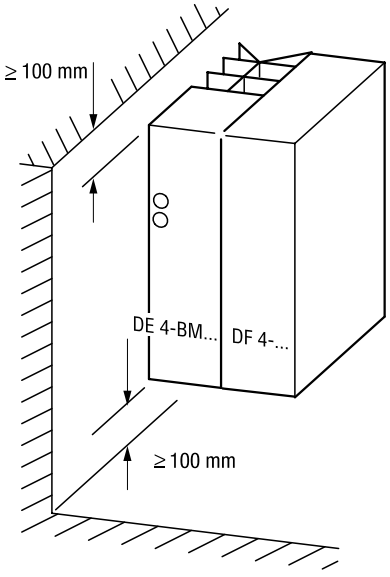

Figure 7: Necessary clearances for the brake chopper

06/97 AWB 823-1286-GB

Attention:
Only install the brake chopper as a complete unit; do not dismantle.

Provide appropriate countermeasures in the case of:

- cooling air which is polluted with dust, fluff or fat. This can cause short-circuits on the printed circuit board (install filters, use a separate ventilation air supply),
- aggressive gases. They can etch the tracks on printed circuit boards (install filters, use a separate ventilation air supply), and
- dirty filters. This can lead to overheating (clean the filters regularly)

Mounting angle

The maximum admissible angle of tilt for the brake chopper is 30°.

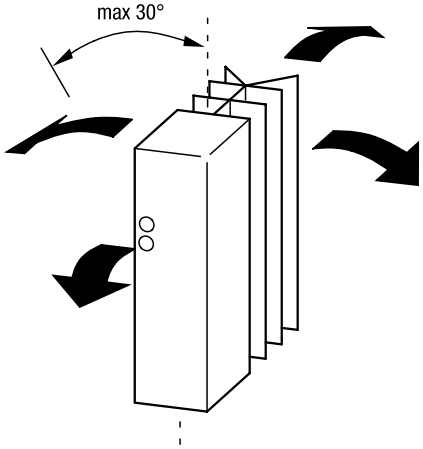

Figure 8: Mounting angle of the brake chopper

Mounting the brake chopper

The brake chopper can be attached to a mounting plate or to a top-hat rail in the switchgear cabinet.

In order to attach the brake chopper to a mounting plate, use the supplied pair of mounting strips.

▶ Slide each mounting strip into the guide at the rear of the brake chopper until it engages with an audible click.

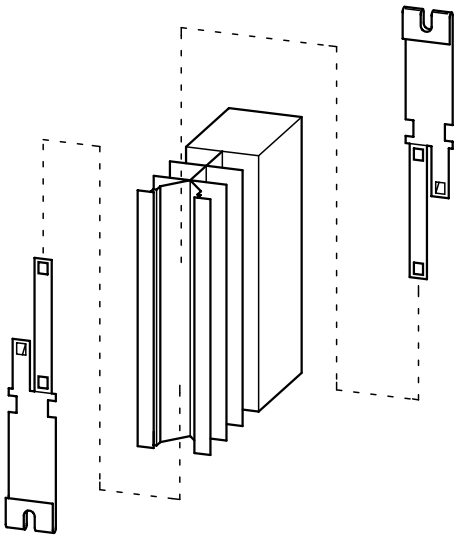

Figure 9: Inserting the mounting strips

06/97 AWB 823-1286-GB

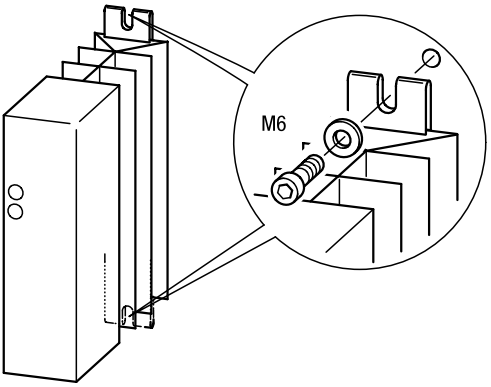

Figure 10: Attaching to the mounting plate

Use M 6 screws and washers to attach the brake chopper to the mounting plate.

You can also attach the brake chopper to a top-hat rail. This requires the optional adapter DE 4-MNT-C1 which must be ordered separately from Klöckner-Moeller. Refer to the mounting instructions provided with the adapter for information on attaching the adapter to the brake chopper and the top-hat rail.

Connections

Only insert or remove the plug-in screw terminals when the power is off.

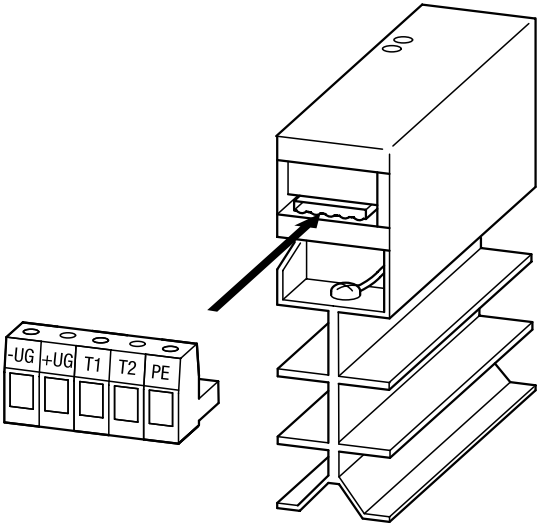

Figure 11: Inserting the plug-in screw terminals

Warning!
All terminals of the brake chopper can carry dangerous voltages for up to three minutes after switching off the power; do not work on the terminals or within the unit under any circumstances before this period has elapsed. There is a risk of serious injury or death if this precaution is not observed.

06/97 AWB 823-1286-GB

Attention!
This device contains components which can be damaged by electrostatic charges (ESD). Discharge any electrostatic charges from the body before undertaking installation or service work in the vicinity of the terminals by touching a PE mounting screw or another earthed metal surface within the switchgear cabinet.

Attention!.
The electrical installation and commissioning work may only be carried out by suitably qualified personnel. They are responsible for ensuring that appropriate earthing and conductor protection is provided for the incomers in accordance with currently valid local and national regulations.

Attach the cable between the brake chopper and the frequency inverter to the terminals +UG and –UG.

The values for tightening torque and cable cross-section in the table below apply to the +UG, –UG, T1 and T2 terminals of the brake chopper models DE 4-BM2-1 and DE 4-BM4-1.

Type	**DE 4-BM2-1/DE 4-BM4-1**
Nm	0.5 to 0.6
Cable cross-section	1,5 mm^2 (AWG 14)

4 Operation/diagnostics

Commissioning

The green LED lights up when the brake chopper is supplied with power is and ready for use.

Warning!
Before applying power to the equipment, check whether the brake chopper cables +UG and –UG are connected to the right terminals. If the cables are switched over, the brake chopper and all connected components can be destroyed.

Attention!
Before power is applied to the equipment, make sure that the admissible ambient conditions are not exceeded and that no moisture is present within the brake chopper. Moisture can be present if the brake chopper has been stored in a cold place. If moisture has entered the device, it must be dried completely before use.

Attention!.
The electrical installation and commissioning work may only be carried out by suitably qualified personnel. They are responsible for ensuring that appropriate earthing and conductor protection is provided for the incomers in accordance with currently valid local and national regulations.

Operation

The brake chopper has two LEDs to indicate the operating status:

the green LED lights up when the brake chopper is supplied with power and is ready for use.

the yellow LED lights up when the brake chopper is operating in braking mode

Warning!
During use, outside surfaces of brake chopper can reach a temperature of 130 °C. Take care – there is a risk of severe burns.

Attention!
During braking, (e.g. with large rotating masses, test rig operation) all terminals can carry dangerous voltages even after switching off the power. Accordingly, you should set controller inhibit for all connected frequency inverters and wait for at least 3 minutes for the internal DC bus voltage to discharge before working on the equipment.

Diagnostics

When switching off the equipment in order to work on it, please note that:

when operating frequency inverters in parallel, you should set controller inhibit for all frequency inverters and then disconnect them from the power supply;

when operating individual frequency inverters, dangerous voltages can be present on all terminals for up to 3 minutes after switching off the power.

06/97 AWB 823-1286-GB

Attention!
This device contains components which can be damaged by electrostatic charges (ESD). Discharge any electrostatic charges from the body before undertaking installation or service work in the vicinity of the terminals by touching a PE mounting screw or another earthed metal surface within the switchgear cabinet.

Error messages and remedies

Error	Cause	Remedy
Green LED does not light up	No voltage on +UG, –UG	– Switch on power – Connect brake chopper to frequency inverter +UG, –UG
Yellow LED does not light up with controller inhibited, overvoltage warning during braking	Brake chopper not connected to frequency inverter +UG, –UG	Connect brake chopper to frequency inverter +UG, –UG
Braking time of frequency inverter is too long; frequency inverter sets controller inhibit and outputs overvoltage warning	Power fed back from motor to brake chopper during braking is higher than the maximum admissible power rating of the internal braking resistor	– Increase –a (deceleration time) – Increase $-a_{Quick}$ (quickstop time) – Use a brake chopper with a higher power rating

Appendix

Technical data

Type	DE 4-BM2-1	DE 4-BM4-1
Supported frequency inverter models	DF 4-120	DF 4-34x
U_{ZK} for the frequency inverter	270 to 400 V DC	270 to 750 V DC
Switching level U_{ZK}	375 V DC	725 V DC
Peak current	5.4 A DC	2.7 A DC
Max. continuous current	0.18 A DC	0.096 A DC
Peak braking power at U_{ZK}	2 kW[1)]	2 kW[1)]
Continuous braking power at U_{ZK}	70 W	70 W
Braking resistor	internal	internal
Peak energy (min. 5 min. pause)	20 kWs	20 kWs
Weight	1.3 kg	1.3 kg

1) max. 10 s at a switching cycle of 3%

Dimensions

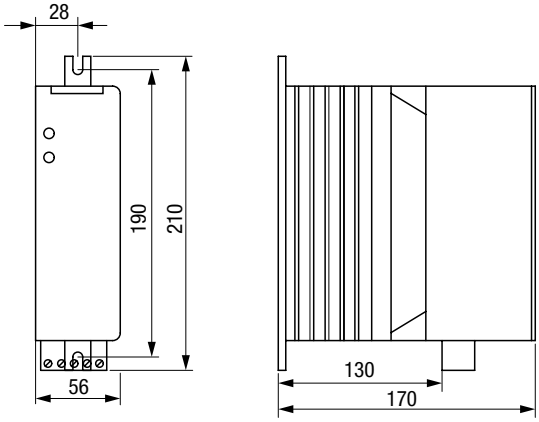

Figure 12: Dimensions of DE 4-BM2-1 and DE 4-BM4-1

06/97 AWB 823-1286-GB

Index

06/97 AWB 823-1286-GB

06/97 AWB 823-1286-GB

06/97 AWB 823-1286-GB

06/97 AWB 823-1286-GB