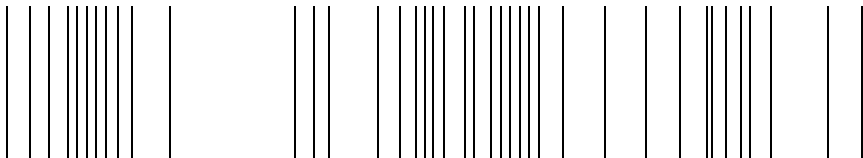


be in motion be in motion



POWER CONVERSION EQUIPMENT



BKH 62, 63

**Compact Power Unit with
Feed/Feedback**

Manual

E	5.95244.08
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BAUMÜLLER

Title	Manual
Product	Compact Power Unit with Feed/Feedback BKH 62, 63
Version	5.95244.08
Status	2005-01-13
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ABBREVIATIONS

AC	Alternating current
AM	Asynchronous motor
a.m.s.l.	above mean sea level
BUC	Baumüller Feed/Feed back Unit
BUG	Baumüller Basic Feed Unit
BUM	Baumüller Mono Power Unit
BUS	Baumüller Power Module
DC	Direct current
DIN	Deutsches Institut für Normung e.V. (German Standardization Authority)
EMC	Electromagnetic compatibility
EN	European standard
HS	Main contactor
PELV	Protective extra-low voltage
SELV	Safe extra-low voltage
MSL	Main Sea Level
SL	Protective earth
SM	Synchronous motor
ZK	DC link

1 SAFETY NOTES

Introductory remarks

During operation, the principles on which the converter and motor work, lead to leakage currents to earth which are dissipated via specified protective earth connections and which may result in a current-operated e.l.c.b. on the input side blowing prematurely.

A DC component in the fault current may occur in the event of a short-circuit to frame or earth fault which makes a triggering of the higher-level current-operated e.l.c.b. more difficult or even impossible.

The connection of the current controller to the mains using only the current-operated e.l.c.b. is prohibited (preliminary standard EN 50178 / VDE 0160 / 11.94, sections 5.2.11 and 5.3.2.1)

The units are protected against direct contact by being installed into common switching cabinets which meet the minimum protection requirements according to pr EN 50178 / VDE 0160 / 11.94, section 5.2.4.

Sheets of plastic covering the control electronics, the power stage and the device connection, additionally prevent accidental contact during commissioning and casual use of control elements located close to the equipment.

(DIN VDE 0106 Part 100, Accident Prevention Regulation VBG4 "Electrical Systems and Equipment).

The protective measures and safety regulations according to DIN/VDE are binding for personal security.

Neglecting to fit PE connections on the equipment or the motor will result in serious personal injury and/or considerable damage to material assets.

It is only permitted to use the units on earth-protected supply mains.

The discharge time of live parts is > 1 min.

The units are partly short-circuit-proof.

General information

These operating instructions contain the information required for the application as directed of the products described herein. The document is intended for specially trained, skilled personnel who are well-versed in all warnings and maintenance activities.

The units are manufactured using the state-of-the-art technology and are safe in operation. They can be installed safely and commissioned and function without problems if the safety information below is observed.



DANGER

When operating this electrical unit, some parts of the equipment always carry dangerous voltage.

Ignoring these safety instructions and warnings may result in death, serious personal injury and/or damage to material assets.

Only qualified personnel who are familiar with the safety information, assembly, operation and maintenance instructions may carry out work on this unit.

Safety Notes

Danger information

One the one hand, the information below is for you own personal safety and on the other to prevent damage to the described products or to other connected units.

In the context of the operating instructions and the information on the products themselves, the terms used have the following meanings:



DANGER

This means that **death, severe personal injury or considerable damage to material assets will occur**, unless appropriate safety measures are taken.



WARNING

This means that **death, severe personal injury or considerable damage to material assets may occur**, unless appropriate safety measures are taken.



NOTE

This draws your attention to **important information** about the product, handling of the product or to a particular section of the documentation.

Qualified personnel

In the sense of the safety-relevant information in this document or on the products themselves, qualified personnel are considered to be persons who are familiar with setting up, assembling, commissioning and operating the product and who have qualifications appropriate to their activities.

- Trained or instructed or authorized to commission, ground and mark circuits and equipment in accordance with recognized safety standards.
- Trained or instructed in accordance with recognized safety standards in the care and use of appropriate safety equipment.

Application as directed



WARNING

You may only use the unit/system for the purposes specified in the operating instructions and in conjunction with the third-party equipment and components recommended or authorized by BAUMÜLLER NÜRNBERG GmbH.

For safety reasons, you must not change or add components on/to the unit. The operator must report immediately any changes that occur which adversely affect the safety of the unit/system.

Voltage test

BAUMÜLLER carries out a voltage test according to prEN 50178 / VDE 0160 /11.94, Section 9.4.5 for each unit.

Subsequent high-voltage tests must only be carried out by BAUMÜLLER NÜRNBERG GmbH.



WARNING

If you want to carry out high-voltage tests for complete switch cabinet installations, disconnect all cables from BAUMÜLLER units prior to the test.

2 TECHNICAL DATA

2.1 General

The compact power units BKH62 and BKH 63 are available to extend the Baumüller Modular System for use in the higher performance range.

They are configured as compact mono-units (without controllers) and contain both the power side feed/feedback unit and the motor side power unit.

Control is performed by the Modular System plug-in modules and the DSP System. This enables the drives to be adapted to all varying needs.

There are three types of controllers available.

- The BUS 6 E controller for almost all applications in constructional engineering.
- The BUS 6 T or BUS 6 V controller and the DSP System for highly demanding control tasks.



NOTE

Both types of controller are fitted as plug-in cards and each have descriptions, which are available separately, containing their respective properties and technical data.

Depending on the application, the units can be configured for use from simple frequency converters to highly dynamic, highly accurate vector controllers.

Using the compact power units BKH 62, 63, it is possible to operate both asynchronous and synchronous motors with different transmission systems from the same unit according to the controller used.

The units BKH 63/63 consist of two parts, the power side feed/feed back converter and the motor side converter.

- "The motor side converter, with integrated IGBT technology, processes transistor control signals supplied from a controller located in a slot and provides the measuring signal for the regulation. The compact power unit has its own monitoring equipment (self-protecting power section).
- "The power side feed/feedback converter, with integrated IGBT technology, regulates the DC link voltage. When the motor is braking, the energy released is fed back to the mains.

2.1.1 Description of function

The units consist of two parts, the power side feed/feed back converter and the motor side converter.

Power side feed/feedback converter

The power side feed/feedback converter is an IGBT-B6 circuit which regulates the DC link voltage to a specific value when the motor is being driven. When the motor is braking, the energy re-leased is fed back to the mains.

The mains currents are regulated sinusoidal, applying $\cos = 1$, so that the equipment does not require reactive power and negative power effect is minimized.

When the standard motor power provided by the motor side converter (refer to Electrical Data) is not fully used, e.g. because the connected motor requires lower power, the remaining power capacity of the power supply converter can be used to power other units connected to the BUS 6 series.

The DC link from BKH 62, 63 are connected to the DC link of the BUS 6 servo power units by means of DC link connections ZK+ and ZK-. Also, the connections X99A or X99B can be connected through (refer to the technical description of the servo power unit BUS 6).

The sum of the motor output provided simultaneously must not continuously exceed the typical motor output.

Furthermore, the total DC link power of the connected units powered via BUS 6 is limited to 36 kW.

States and Messages of the power side feed/feedback converter are displayed via LED's (front plate).



WARNING

The equipment may be damaged if one of these values is exceeded!

Power-on current relief

The DC link capacitors would be exposed to impermissibly high current charging peaks from the mains after switching on the mains switch if no measures to prevent this were taken. To prevent the current charging peaks, the power-on current is limited by means of a power-on current relief.

For this purpose, a low setting regulator is integrated which limits the charging current. When an in DC link voltage of $500 V_{DC}$ is achieved, the buck converter is deactivated and the main contactor release is generated. The auxiliary contact X98:1,2 (power side feed/feedback converter ready to operate) is closed.

Reset

Using Reset X98AB:5,6, signals which generated by the compact power unit are reset. A continuous reset (+24 V) must not be applied. The reset signal must be received for a minimum of 50 ms.



NOTE

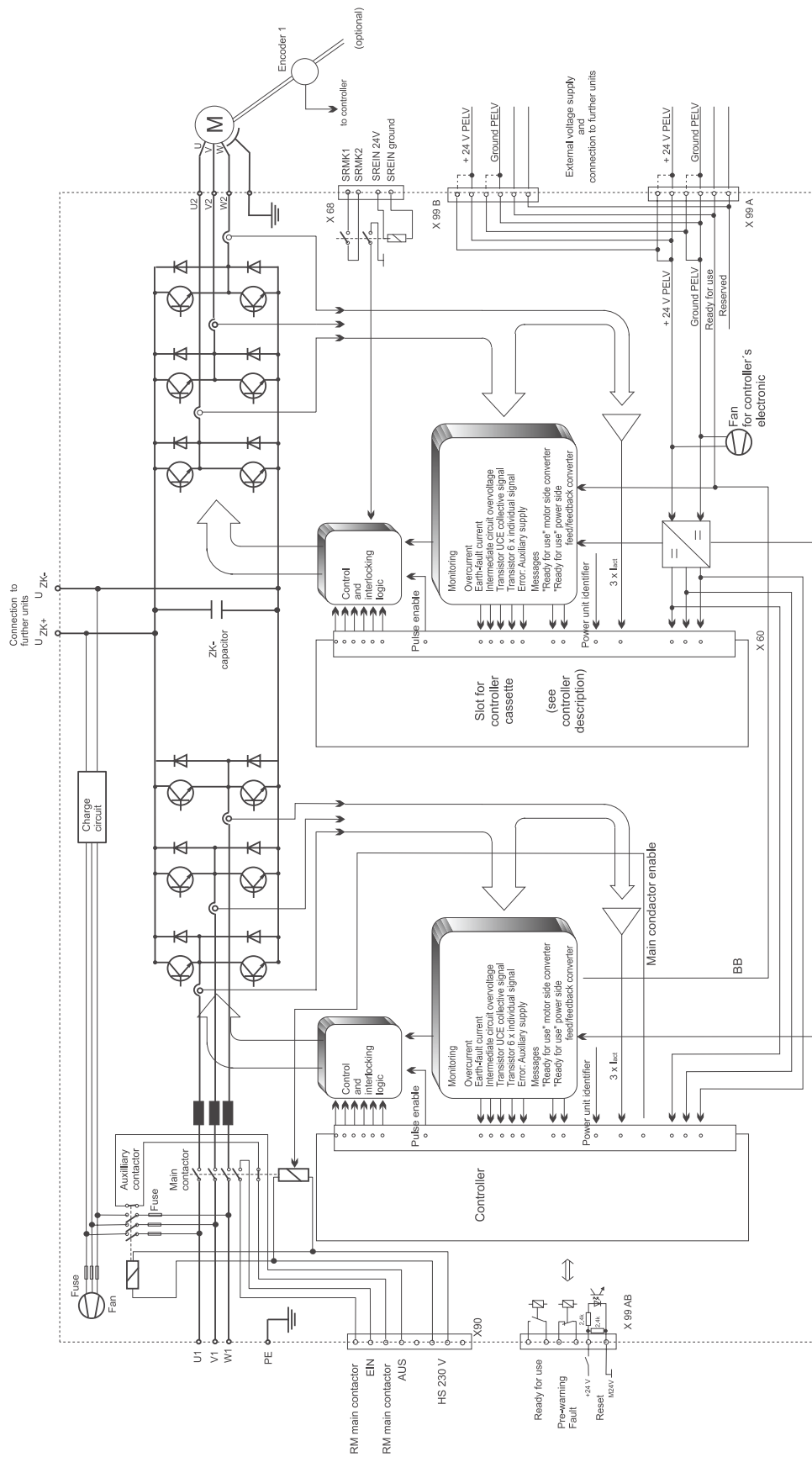
With BKH 62, 63, the capacitor charging time when using external DC link capacities is increased, e.g. through additional units connected to the DC link.

Motor side converter

The motor side converter consists of the IGBT power unit and the self-protection equipment. The control of the motor side converter is not a part of the unit but is an independent unit in the controller plug-in unit.

States and messages of the motor side converter are sent to the controller. The controller evaluates the data (see description controller).

2.1.2 Block diagram



2.2 Electrical data

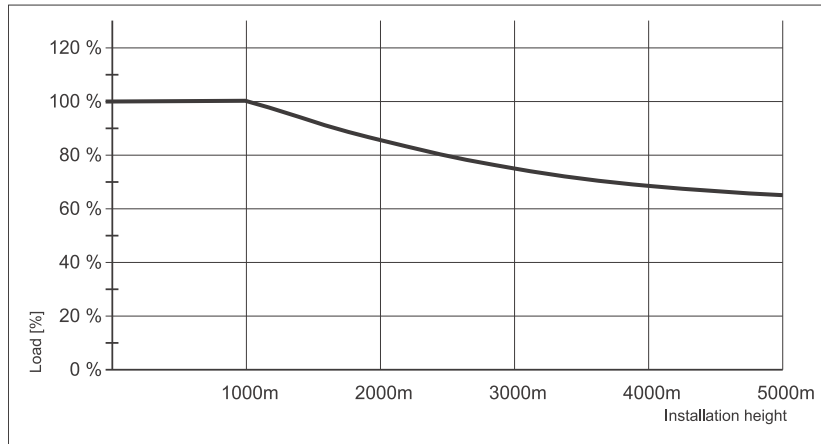
	BKH 62	BKH 63
Control *	Slot for BUS 6 control cassette	
Connection voltage	400 V \pm 10 % 47 - 63 Hz	
Nominal input current ¹⁾	75 A	150 A
Semi-conductor fuse (external)	100 A	250 A
Nominal DC link voltage ¹⁾	640 V DC	
Max. sum connectable capacitors in DC link (encl. feed unit)	Note longer charging time	
	10 mF	13 mF
DC link capacitor	4700 μ F	7050 μ F
Power on: Ready for use after	2 s	
External reactor	no (internal)	
Output voltage	0 ... 430 V	
Output power ^{1) 2)}	52 kVA	104 kVA
Typical motor power ^{1) 2)}	35 kW	70 kW
Nominal output current (I_{eff}) ¹⁾ at $T_K = 45$ °C and $T_B = 45$ °C	75 A ²⁾	150 A ²⁾
	90 A ³⁾	180 A ²⁾
Peak output current (I_{eff}) ¹⁾ up to $T = 1$ s	97,5 A ^{2) 3)}	195 A ^{2) 3)}
Permitted transistor clock frequency	3 ... 8 kHz	
Low voltage supply complying with DIN 19240	+ 24 V _{DC} \pm 20 %	
Power consumption without controller	65 W	80 W
Power loss at nominal operation without low voltage power supply ^{1) 2)}	2,5 kW	5 kW
Operational environmental temperature range T_B ⁵⁾	0 ... 45 °C (with power reduction 55 °C)	
Coolant temperature range T_K ⁵⁾	0 ... 45 °C (with power reduction 55 °C)	
Reduction for nominal output current ($T_K = 45$... 55 °C)	3 % / °C	
Max. installation height ⁴⁾	1000 m above sea level	
Relative humidity	15 % ... 85 % no condensation	
Storage temperature range	- 30 °C ... + 70 °C	
Dimensions (B x H x T)	450 x 773 x 280 mm	450 x 1436 x 280 mm
Weight without controller unit	86 kg	140 kg

* Not contained in BKH 62 - 63, must be ordered additionally.

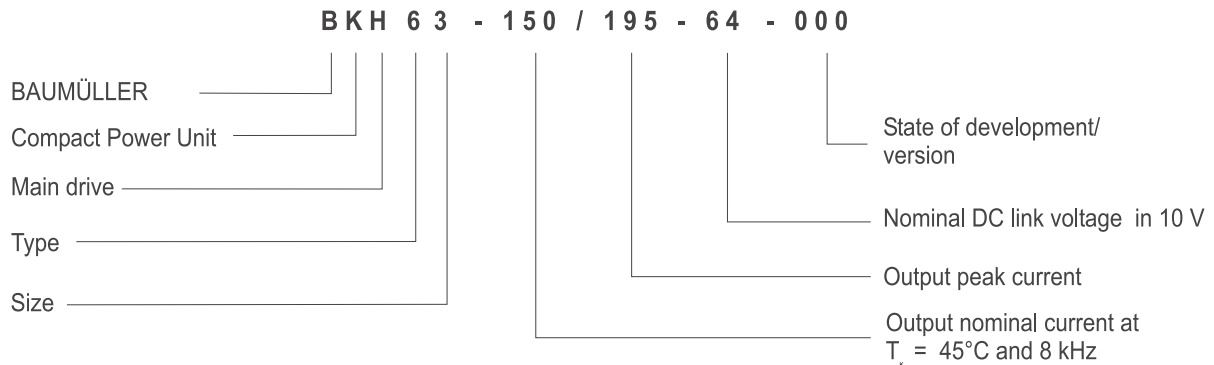
1. with connection voltage 400 V_{AC}
2. with clock frequency 8 kHz
3. with clock frequency 4 kHz

- 4. Installation height > 1000 m see characteristic curve 1
- 5. see ["Assembly information" auf Seite 22](#)

Characteristic curve 1: Load in dependence on installation height



2.3 Type code



3 TRANSPORTATION, UNPACKING

The units are packed at the factory in accordance with the order.

You should avoid jarring packages in transit or jolting them, e.g. when setting them down on the ground.

After unpacking the package(s) and checking that the shipment is complete, you can start assembly.

Fibreboard, cartridge paper and/or wood are used as packaging materials and they can be disposed of in accordance with local regulations.

Report any damage in transit without delay.



DANGER

If the unit has been damaged in transit, do not connect it to the mains until appropriate high-voltage testing has been carried out.

Ignoring this information can result in death, severe personal injury, or considerable damage to property.

4 ASSEMBLY



WARNING

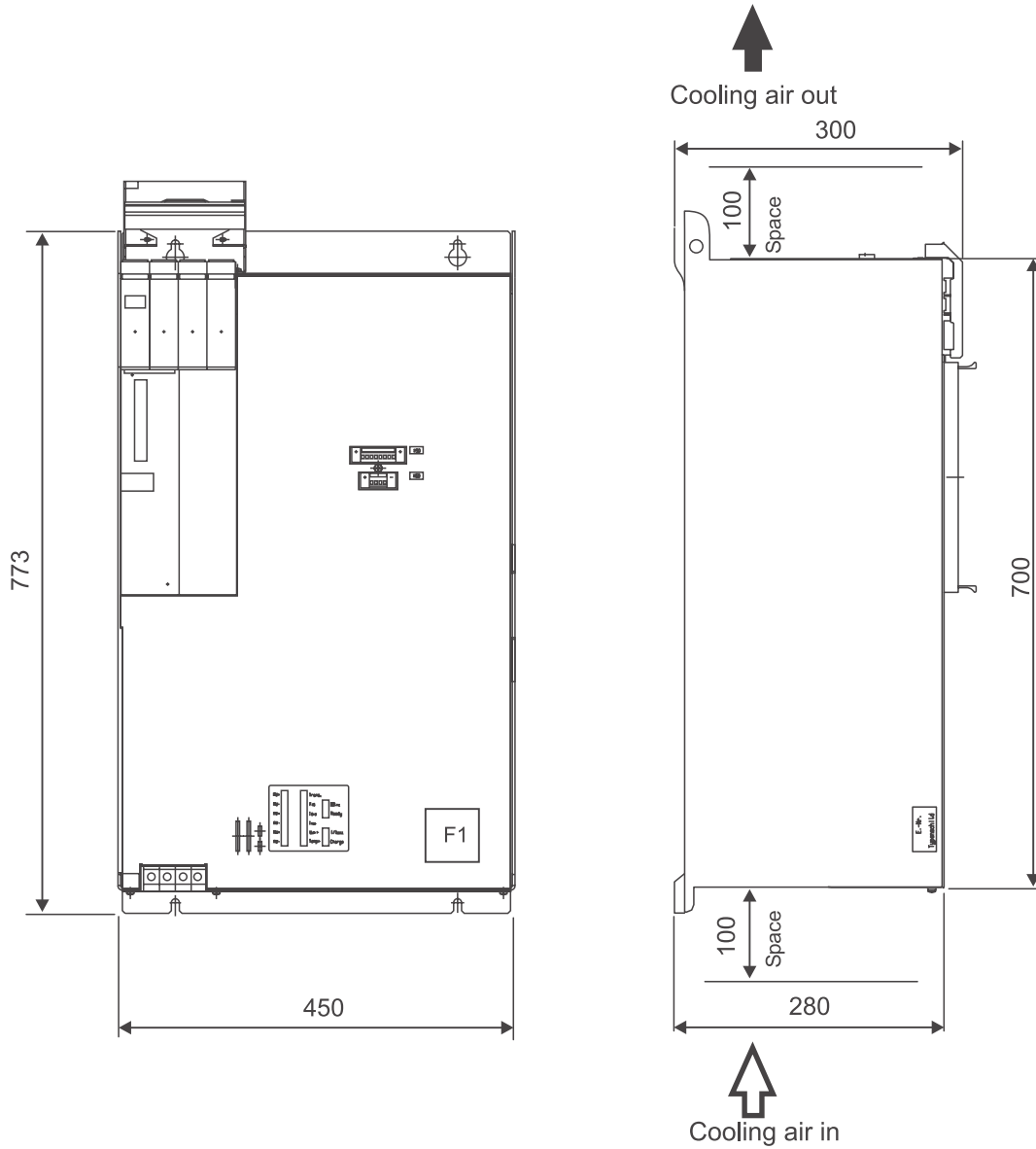
The user is responsible for the assembly of the unit described, the motor, and the other devices according to the safety regulations (e.g. EN, DIN, VDE) and all other relevant national or local regulations concerning the conductor ratings and protection, grounding, disconnectors, overcurrent protection, etc.

Ensure that there is no blockage of cooling air flowing into and out of the equipment and that there is enough space above and below the equipment to prevent overheating.

Sheets of plastic on the devices that cover the equipment connection act as additional guards preventing accidental contact at commissioning and in the case of casual use of control elements located close to the equipment (DIN VDE 0106 Part 100, Accident Prevention Regulation VBG4 "Electrical Systems and Equipment").

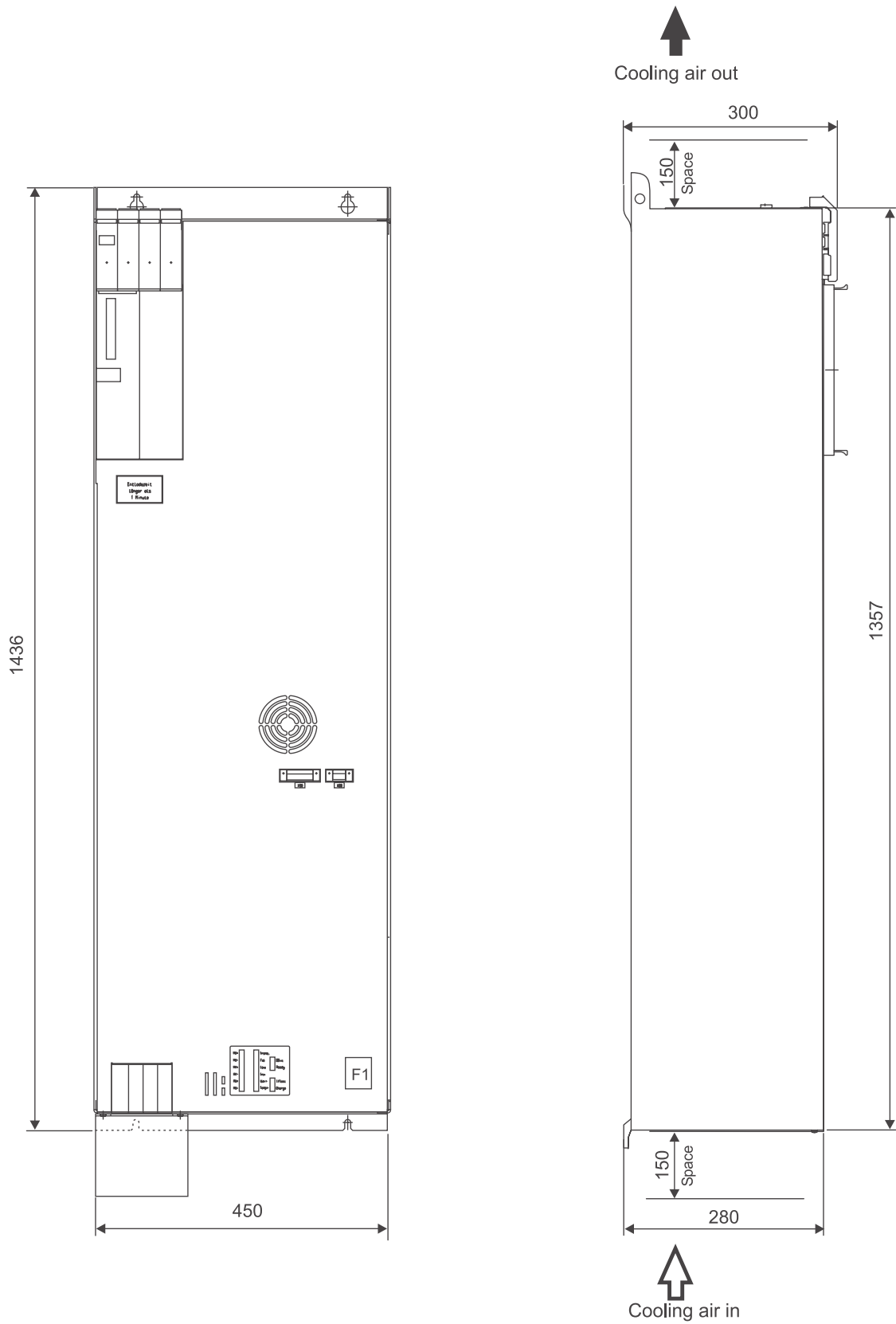
4.1 Dimensions

4.1.1 Dimensions BKH 62



Note the controller dimensions in respect of the total depth!

4.1.2 Dimensions BKH 63



Note the controller dimensions in respect of the total depth!

4.2 Assembly information



WARNING

Lifting incorrectly can result in personal injury or damage to property. The device should only be lifted by appropriately qualified personnel using the proper equipment.

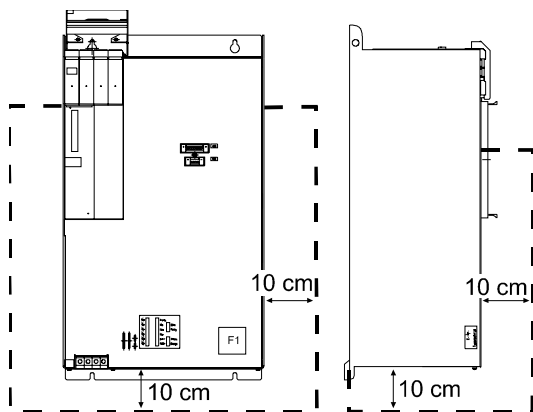
- Install the units vertically in a switching cabinet. If there are several units, mount them next to one another.



WARNING

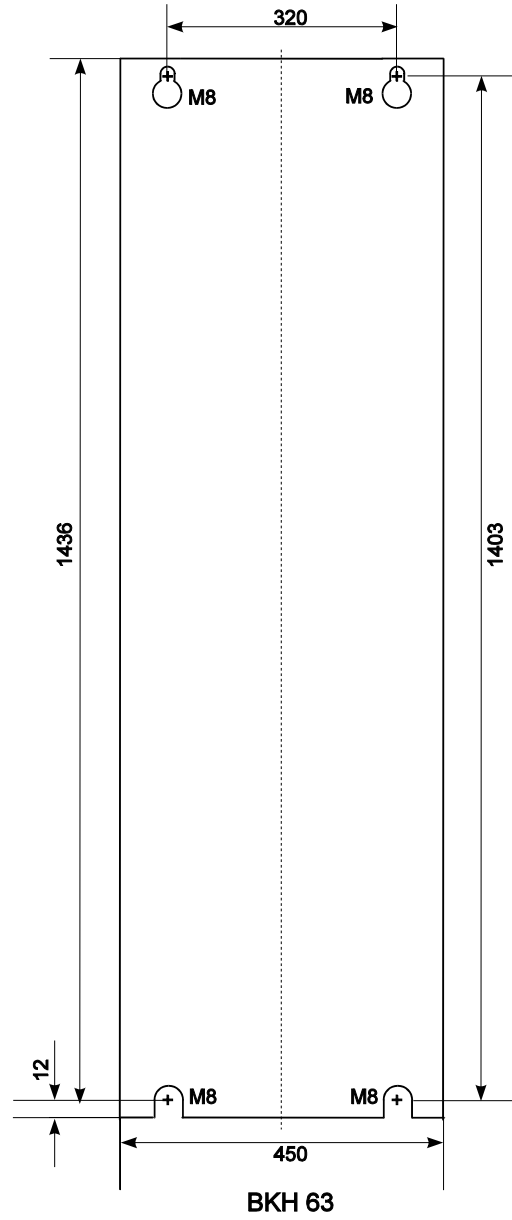
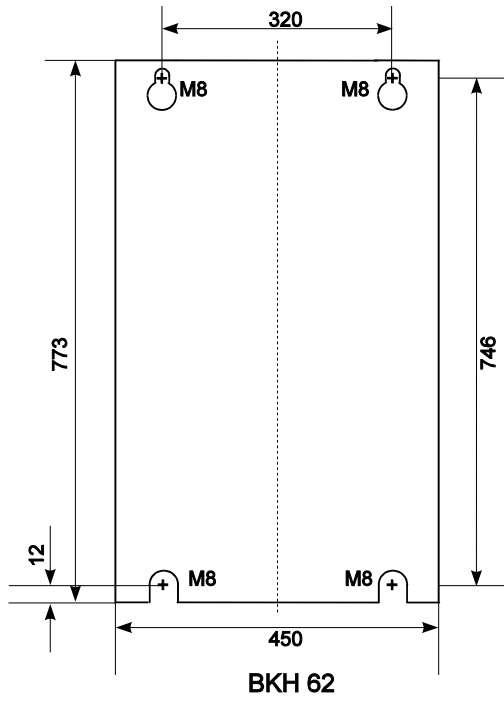
It is crucial to comply with the ventilation measures listed below. Ignoring these measures can lead to the device overheating.

- Ventilation must be in the specified direction from the bottom to the top.
- Ensure that the flow of air is not obstructed.
- There must be a minimum clearance above and below the devices of
BKH 62 100 mm with conventional cooling
BKH 63 150 mm with conventional cooling
- The temperature of the coolant may be up to 45° C. At higher temperatures (up to a maximum of 55 °C), you must reduce the power of the devices by 3% per degree Kelvin. The cooling of the unit is ensured if in no point of the hatched range (see figure below) the cooling air temperature is lower than 45 °C.



- Do not locate any additional sources of heat above or below the devices.
- You must avoid degrees of contamination 3 and 4 according to provisional standard EN 50178:1994 Section 5.2.15.2. The devices are suitable for use in enclosed workshops (VDE 0558 Part 1a, Sections 5.4.3.2.1 and 5.4.3.2.2).

4.3 Mounting



5 INSTALLATION

5.1 Danger information



WARNING

This equipment carries a dangerously high voltage and has dangerous rotating parts (fans). Ignoring the safety and warning information may result in death, severe personal injury or damage to property.

The machine operator is responsible for mounting the power unit, the motor, the transformer and any other equipment in accordance with appropriate safety regulations (e.g. DIN, VDE); equally, you must ensure that all other relevant national and local regulations are met with regard to cable ratings and protection, grounding, disconnectors, overcurrent protection, etc.

Relatively high leakage to ground occurs in the converter and the motor, i.e. the drive may be incompatible with current-operated e.l.c.b.s (corresponding to provisional standard EN 50178:1994 Section 5.2.11.2).

You may only use variable-speed drives in applications that correspond to valid EN specifications.



DANGER

The DC link carries a voltage! It is imperative that the provided cover is used

Be particularly careful before touching the drive shaft directly or indirectly with your hands. This is only allowed when the system is deenergized and the drive is stationary.

Safety devices must never be deactivated.

5.2 Standardization information

Series BKH 62, 63 are built-in units in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.6 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.1. They are intended for installation in commercially available control cabinets whose degrees of protection meet the minimum requirements of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.4 (IP 2x, possibly IP4x according to EN 60529/5.1).

Plastic covers on the equipment provide additional protection against accidental contact in the case of casual use of control elements located close to the equipment (DIN VDE 0106 Part 100, Accident Prevention Regulation VBG4 "Electrical Systems and Equipment").

If you intend to set up the equipment in closed electrical workshops according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.7 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.2, you must implement additional measures to ensure compliance with the requirements of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.4.

These power converters are intended for permanent mains connection to conventional TN and TT systems according to DIN VDE 0100 Part 410/11.83 with a diametric voltage of up to $3 \times 500 V_{\text{eff}}$ ("and not more than 5000 rms symmetrical amperes", if UL508C has to be observed (Nov 27, 1996, Tab. 44.1)

Connecting to a system with an insulated neutral point (IT system) is only possible under special circumstances. If necessary, enquire at the factory.

During operation, the principles on which the power converter and the motor work lead to leakage currents to earth occurring that may be dissipated via the specified protective earths and may result in a current-operated e.l.c.b. on the input side blowing prematurely. In the case of a short-circuit to frame or to ground, a direct proportion may arise in the leakage current that makes triggering a higher-level current-operated e.l.c.b. either more difficult or totally impossible. This means that connecting the power converter to the mains using only the current-operated e.l.c.b. is prohibited (preliminary standard EN 50178/VDE 0160/11.94, Sections 5.2.11 and 5.3.2.1).

With regard to climatic conditions, the equipment conforms to category 3K3 for sheltered locations according to provisional standard EN 50178/VDE 0160/11.94, Section 6.1, Table 7, Line 3 or Table 1 of EN 60721-3-1,2,3,4 respectively, taking into account Remarks 1 and 3 of provisional standard EN 50178/VDE 0160/11.94, Section 6.1. The actual operating temperature range is higher and is in the range 0 .. +55°C. The information in Table 7 (lines 5 and 6) of provisional standard EN 50178/VDE 0160/11.94, Section 6.1 also applies to storage and transportation.

The storage and transportation temperature of the equipment varies from this information in as much as it may be between -30 ... +70°C (refer to Technical Data).

The units are in protection class IP 20 according to EN 60529 (DIN VDE 0470-1)

The units are equipment in protection class I corresponding to IEC 536/3 and DIN VDE 0106 Part 1 (provisional standard EN 50178/VDE 0160/11.94, Section 5.2.9).

Equipment of protection class I is equipment whose protection against dangerous shock currents is not limited to basic insulation but which also has additional safety devices. This additional protection is provided by connecting the housing and other parts to the protective earth such that if the basic insulation fails no voltage can remain. With these power converters, the entire insulation is carried out according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.9.1, at least to basic insulation standard. This also applies to the insulation between the individual circuits.

The power converters' control terminals are safely isolated from the mains and are designed for connection of SELV and PELV circuits.

At measurement of the creepage distances and clearances, the following criteria were taken into account:

- Soiling grade 2 according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.15.2, Table 2, Line 3:

Normally, only non-conducting pollutants are produced. When the equipment is out of service, brief conductivity can occur due to condensation.

- Overvoltage category III according to IEC 664-1, Table 1 for the air clearances of mains circuits to their environment according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.16.1.

- The rated insulation voltage of the mains circuits for TN and TT systems according to DIN VDE 0100 Part 410/11.83 with a dielectric voltage of $3 \times 500 \text{ V}$.

- Insulation material IIIa for creepage distances according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.17.

Series BKH 62, 63 power converters are short-circuit-proof in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 6.3.4, assuming that you use protective semiconductor fuses to protect the transistors (see Accessories).

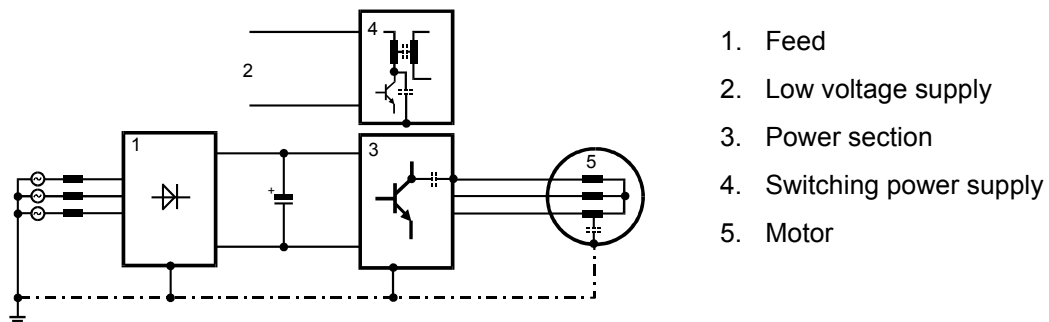
5.3 EMC information

General information about converters

Modern semiconductor technologies such as MCTs and IGBTs are intended to minimize the power loss in the converter by switching more quickly and, with this, to continually reduce the size of the power section. As a result, when running converters you must meet specific conditions to avoid electromagnetic influences caused by switching operations.

Disturbances can occur due to:

- capacitive fault currents caused by high rates of voltage rise when bipolar transistors and IGBTs switch.



- high currents and high rates of current rise in the motor lines. The disturbance energy bound in magnetic fields reaches frequencies of between a few Hertz and about 30 MHz. Due to the high rates of current rise, additional electromagnetic fields occur with frequencies of up to approximately 600 MHz.
- high clock rates and fast logic circuits (electromagnetic field/16 MHz...1 GHz).
- system perturbation and harmonics caused by commutations and non-sinusoidal network loading, in particular with line-commutated converters (100 Hz ... 20 kHz).

German EMC Law (EMVG)

This converter complies with Paragraph 5, Section 5, Sentence 3 of the German EMC Law (EMVG) dated 09.11.92.

"Devices that are exclusively manufactured or stocked as vendor parts or spare parts for further processing by industrial companies or craftsmen or by other specialists in the field of electromagnetic compatibility do not need to comply with the protective requirements of Paragraph 4, Section 1, nor do they need EU conformity certification and marking, assuming that the devices in question cannot be run automatically."

This does justice to the fact that EMC is heavily dependent on the individual subassemblies and components in the switching cabinet. With regard to the total costs of the machine, it is preferable to troubleshoot an entire system rather than each of its individual components.

The information on the next few pages is intended to allow you to configure your system on the basis of the latest knowledge in the field of EMC and to comply with legal regulations.

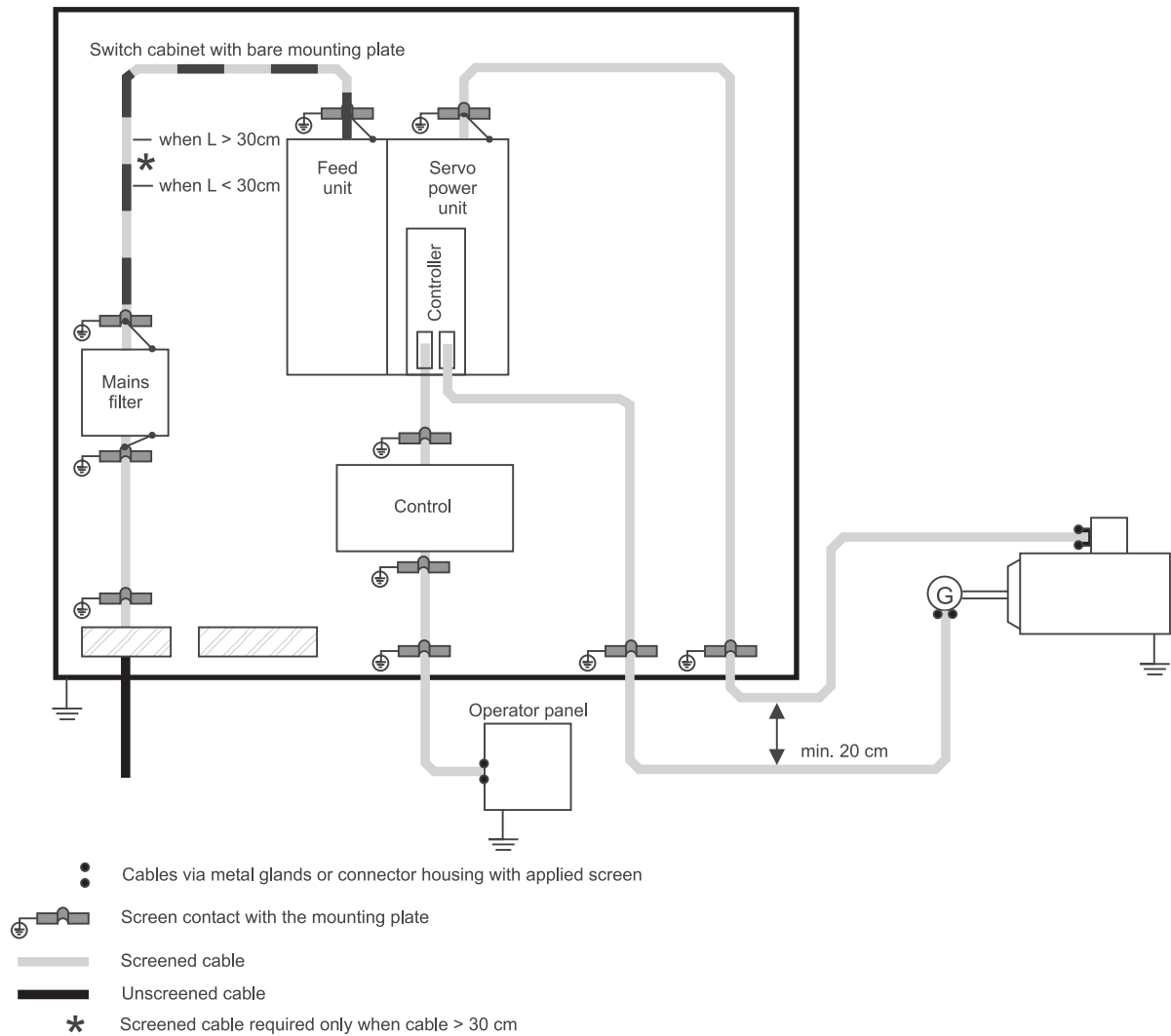
Measures for ensuring EMC

To ensure EMC, you must observe the configuration information below.

Cabling

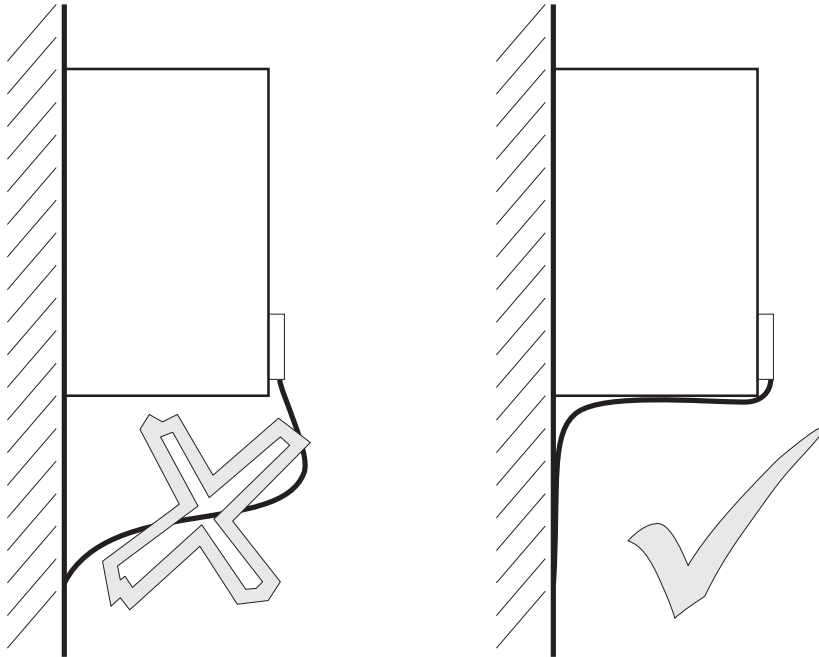
- To suppress radiated noise outside the converter, you should screen all the connected cabling.

Also observe the topics in the section entitled "Screening".

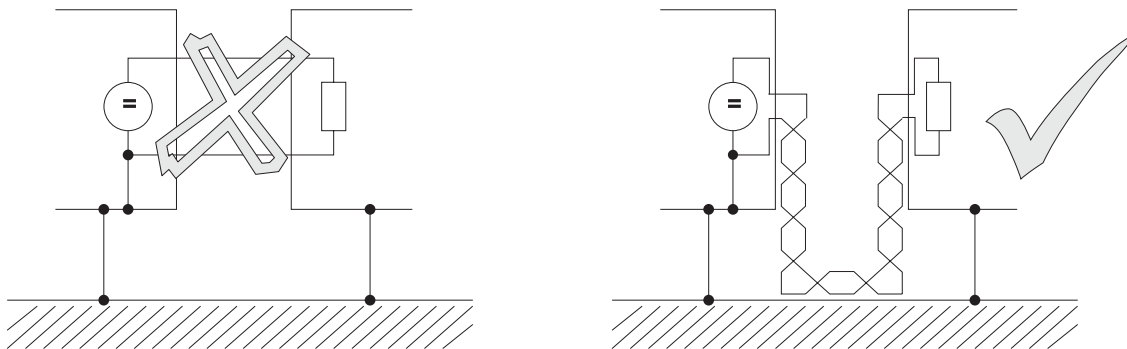


Installation

- You achieve the lowest possible effective antenna height by routing the cable directly on the ground of the metallic rack.



- You should route all lines as close as possible to the conductors of the ground system to reduce the effective loop area for magnetic coupling.

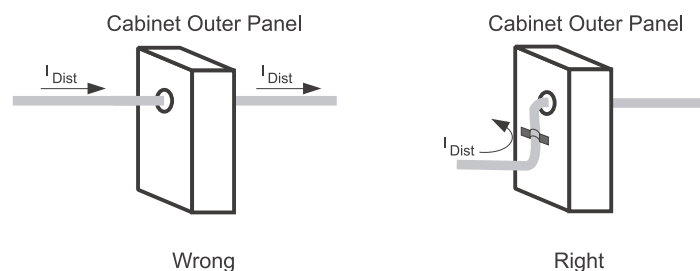


- When parallel-routing signal and control lines across power cables, the conductors must be at least 20 cm apart.
- Lines of different EMC categories should only cross at an angle of 90°.
- In the case of symmetrical signal transfer (e.g. differential amplifier inputs for the speed specified value), twist the conductors of each pair of wires together and twist the pairs of wires together.
- The converter to ground plate earth connection should be as short as possible (less than 30 cm). Use large cross-sections (more than 10 mm²).
- Sources of interference such as fuses, transformers and chokes and modules that are sensitive to interference like μ Ps, bus systems, etc. should be located at least 20 cm away from the converter and its cabling.
- Avoid reserve loops on overlong cables.

- The grounding of reserve wires in cables is mandatory (additional screening, avoidance of capacitively coupled, hazardous contact voltages).

Grounding

- To meet EMC requirements, the classical star grounding is no longer sufficient to reduce the noise of high frequencies caused by converter operation. Better results can be achieved by a reference surface which must be linked to the units' ground (e.g. bare metal mounting plate and housing parts)
- If a large reference surface is not possible the main equipotential bonding strip should be arranged directly at the power unit which generates the largest potential steps compared to the other components in the switch cabinet (ground connection < 30 cm if possible).
- To avoid earth loops, apply all ground connectors and screens as close as possible above the ground.
- If it is possible to ground the controller reference potential of the power unit, make the connection with as large a cross-section as possible and a short cable (< 30 cm).
- Remove insulating layers such as paint, adhesives, etc. from the ground connections. If necessary, use serrated lock washers (DIN 6798) or similar measures to ensure a permanent, conductive contact. To prevent corrosion on ground connections, use suitable metal combinations (electrochemical series of metals) and keep conductive electrolytes away from the connection by a protective coating (e.g. grease).
- Always connect screens at both ends over a large surface and conductive to ground. This is the only way to suppress the effects of magnetic or high-frequency noise. If earth loops occur (e.g. double insulation of the setpoint conductor screen), apply the receiver side galvanically and the transmitter side capacitively.
- When laying external cable screens through panels separating different EMC areas, make contact to the cable screens.
Cables which are passed through the panels of screening housings without special measures (e.g. filtering), may impair the screening effect of these housings. For this reason, you must make a conductive connection of the cable screens at the point at which the cable enters the housing.
The distance of the last screen contact point to the exit of the cabinet must be as short as possible

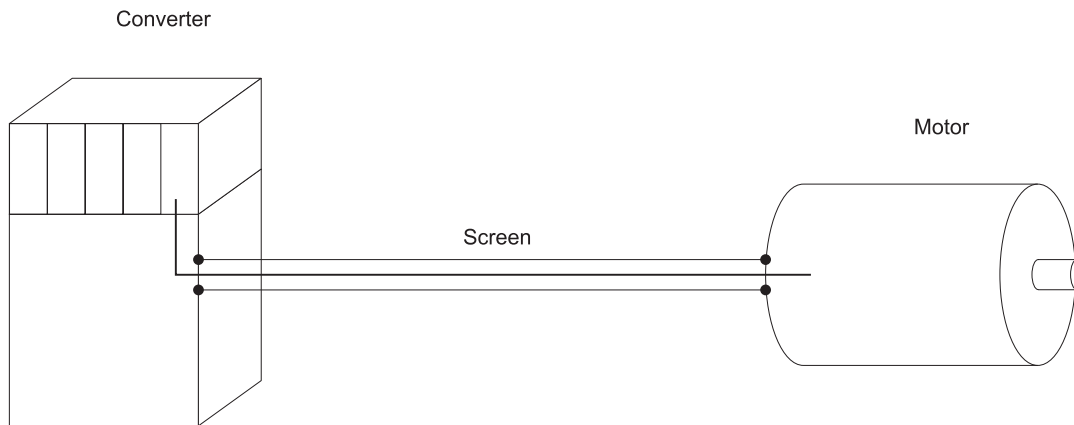


Screening

- The screen is effective against magnetic fields if it is connected to frame ground at both ends.

With electrical fields, the screen is effective when it is connected to frame ground at one end.

However, in the case of (electrical or magnetic) fields with high frequencies (depending on the length of the line), you must always connect the screen at both ends due to the linkage (electro-magnetic field).



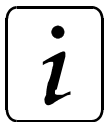
Connecting the screen to frame ground at both ends ensures that the conductor does not leave the screening "system housing".

- Frame-grounding of conductor screens on both sides does not entirely rule out the influence of earth circuits (potential differences on the frame ground system). However, this is very rare if you carry out the measures described in the previous sections entitled "Cabling" and "Grounding".

You can also make a capacitive RF connection of a screen to frame ground. This prevents low-frequency interference due to earth circuits.

Screened cables that pass through different EMC areas must not be separated at terminals, since screen damping would otherwise be considerably reduced. The cables should be routed to the next module without interruption.

Make the screen connection low-impedance and over a wide surface area. Cable tails that are only three centimeters long (1 cm of wire = 10 nH) reduce the screening effect in the megahertz range by up to 30 dB!



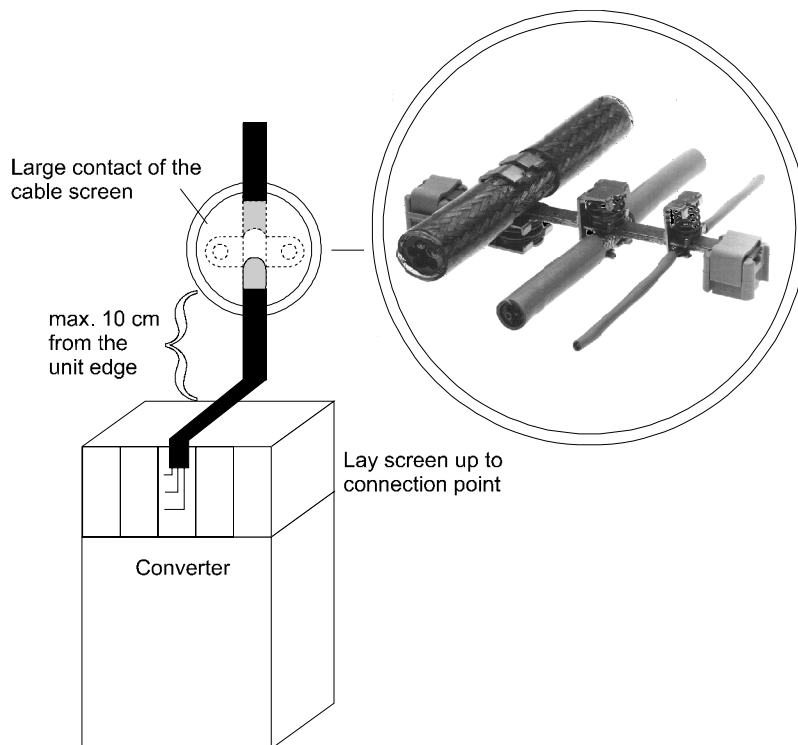
NOTE

The screen braid must have a coverage of at least 85%.

The following cables have a particularly high interference potential:

- Motor cable
- Cable to external regenerative resistors
- Cable between mains filter and converter

- Proposal for the screen connection



Filtering

No filters are needed for the converter to function. However, under some circumstances, filters may be needed on the input or the output side to comply with EMC regulations.

If you have any queries about filter design, please ask for the description entitled Baumüller Filters for Network Applications, BFN.

Filter assembly

- Mount the filter directly next to the converter. With lines that are more than 30 cm long, you must screen the mains line between the converter and the filter (frame-ground on both sides).
- Physically separate the filter's input and output lines by more than 30 cm.
- Make a broad connection between the filter housing and frame ground.

Discharge currents

Due to the principle of operation, parasitic capacities in the filter, the mains unit, the motor cable and the motor winding cause discharge currents of around 100 mA and higher.

This means that converters with earth leakage circuit-breakers may be incompatible!

In this context, you should observe the safety information in provisional standard EN 50178:1994 Section 5.2.11.2.

5.4 Safety relay

In this chapter we describe the safety relay.

5.4.1 Methods to avoid an unexpected starting

In order to avoid hazards against persons, for example operators, service- and maintenance technics, the machine has to be kept in a secure condition (safe stop), while interfering in the hazardous area of the machine. That is why a reliable prevention of an unexpected starting is demanded (amongst other things Machine directive 89/392/EEG, appendix I, 1.6.3, last passage; EN 292-2, 4.1.4; EN 60204-1, 5.4). Under unexpected starting is to be understood every starting that can cause a risk when appearing unexpected for persons (EN 292-1). Moreover, besides the transition of the release- to the operating condition of the machine also the unexpected ramp-up of the machine, this means the transition from the safe stop into an unsafe moving has to be considered. This is necessary, because the unexpected ramp-up usually is to be led back to an interruption of the control loop of the machine. In this case the drive is, because of its control system, anxious to achieve highest speed at maximal acceleration. If an unexpected starting occurs, the operator therefore doesn't have the possibility anymore to remove himself or his hand from the hazard area. This is why the drive has to be stopped and has to be kept safe in its 'off-position', when having opened, electrical interlocked safety devices. The motor may not have torque and thus cannot generate a dangerous movement.

The prevention of an unexpected starting of the machine can be reached by electrical separated safety devices, e.g. contactors. By some machine types it has to be done without the isolation of the electrical connection of the drive to the mains, if e. g. a drive supplied by a power converter is often stopped and started again. The constant dis- and re-charging of the DC-link represents a big stress for the concerned parts and often leads to disturbing delays and failures of these parts.

The requirement for the starting of a three-phase a. c. motor is the generation of a rotating field, which drives the inductor of the motor. When having variable-speed three-phase current drives, usually in the micro-processors a complex pulse pattern is generated, then the pulses are amplified and are used for the switching of the power semiconductors. If either no defined pulse pattern is available or the amplifying connection is interrupted, e. g. by switching off of the power supply with a relay (safety relay), no rotary field can be generated. An error by the pulse pattern generation therefore cannot lead to a starting of the motor, as long as the second condition, namely the interruption of the amplifying power supply is available and contrary. The protection against unexpected starting is reached by an electromechanical method which is superior to the electronics. It is reached by a safe isolation - elsewhere than in the load circuit.

The power supply to the windings of the motor is reached at a stoppage by inhibiting the power semiconductor. As semiconductors possibly can fail or be started, because of electromagnetic disturbances, the behavior of the shut down drive has to be considered if such a fault scenario arises. The fail or "accidental" turning on of a single or of more power semiconductors at the same DC-link pole does not lead to an uncontrolled starting, as no current flow is accomplished. Not until additionally a further power semiconductor is enabled at another DC-link pole, current is able to flow through the motor. If, thereby the DC-link is directly short-circuited, the fuses which are upstreamed to the converter are tripped, the motor doesn't start. If the DC-link is "short-circuited" over a winding of the motor, a magnetic field can be set up in the motor. If it is an asynchronous motor, then the generated d. c. magnetic properties cannot cause a lurch of the inductor. By the permanent-magnetic synchronous motor the inductor will rotate into a notch position. The therewith angular movement which is covered is dependable of the inductor's position and the number of pole pairs of the motor. It amounts to maximal 180° /number of pole pairs. Subsequently the enabled DC-link operates like a brake, this means after the ending of the lurching movement the drive is in a blocked condition. A starting of the drive is impossible. If a machine with a synchronous motor is planned, the possible sudden movement must be considered, because it can lead to a dangerous movement. Therefore the machinist must carry out a safety evaluation for the residual movement.

The function of the safety relay is limited to the prevention of an unexpected starting. The switching of the safety relay, while the inductor of the motor is rotating, causes an uncontrolled "coasting" of the machine, a braking with help of the converter is not possible anymore.



WARNING

Both on the motor and at the unit there can be mains voltage although safety relay is switched off.

If required, switch the appliance off-circuit like an appliance without a safety relay - the safety relay does not switch the appliance and the motor off- circuit!

Turning off the safety relay has no isolation from the supply system as a consequence. Therefore, mains potential can be both at the converter and at the motor. The protection against electric hazards has to be therefore saved with other means (for example master switches) when maintaining, servicing or repairing electrical components of the drive system.

5.4.2 Safety categories

Dependant of the possible hazards (these are rated due to the consideration of the severity of the injuries, the frequency of the length of stay within the hazard area and possibilities in order to prevent hazards) security relevant components of machines have to meet certain safety criteria. The requirements to safety-based parts are divided into five categories in the standard EN 954-1.

In category B basic demands, in 1 additionally safety-technical proved components and principles are claimed. In category 2 an error between inspection intervals can lead to a loss of the safety function.

Category 3 accords to the level "the single-error-certainty to recognize errors partially". The safety-relevant components must be in such a way, that a single error doesn't lead to a loss of the safety function, whereat not the complete possible errors can be self-contained recognized by the system. Therefore an accumulation of unrecognized errors can lead to a loss of the safety function.

Category 4 accords to the level "Self-monitoring". This component recognizes self-contained possible errors and signals these in time of the loss of the safety function. Also if up to three from one another independent errors arise the safety function is always maintained.

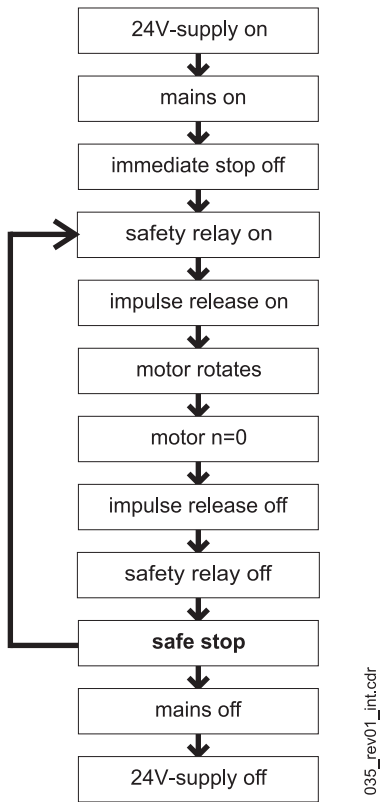
5.4.3 The safety relay

The function of the safety relay is executed in fail-safe-technic, also named closed-circuit principle. The safety function "safe stop" is active, as long as no voltage is applied to the input terminals (X68: 3,4). Consequently the functioning of the safety function is guaranteed if power failure takes place. In order to deactivate "safe stop" a voltage of 24 V has to be applied to the terminals, which are intended for this use (X68: 3,4).

For the external error monitoring of the safety relay', the instantaneous control state can be interrogated at its positively driven status signal contact (X68: 1,2). In case there is no voltage applied to the safety relay (X68: 3,4), that means during the "safe stop", then the status signal contact is closed (NC contact). Also a parting of a cable can thusly be recognized as an error.

If the voltage at the input terminals of the relay (X68: 3,4) is switched off, then the converter generates one or two error messages (F0204 and/or F0206), which it displays on the V-controller. The drive can only be taken in operation again, if these messages are deleted after a reset of the safety relay with a reset signal from the controller (for example by X26, pin programmable or over the interface to a bus system).

The closing- and opening sequence of the release signals as well as of the safety relay must be considered in order to assure a faultless operation of the drive.



Sequence diagram of the safety relay

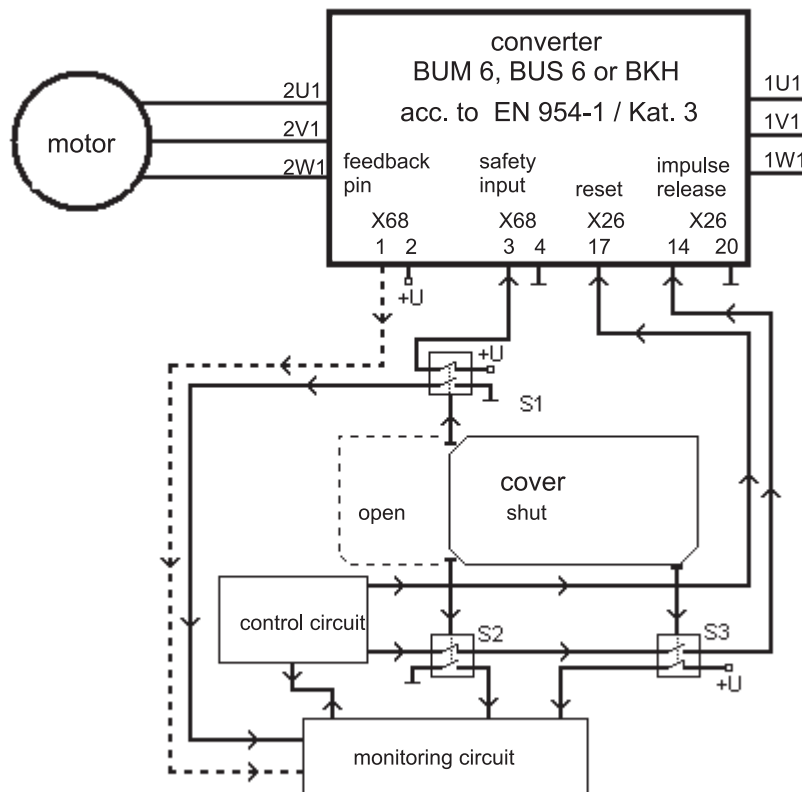
Baumüller-devices of the series BUM 6, BUS 6 and BKH, which are made with one safety relay (optional), comply with the requirements of the category 3 (EN 954-1) for the safety-relevant using “protection against unexpected starting”, if the configuring and installation instructions are complied with.

Before the commissioning of the machine, in which the converter with the safety relay is built in, the safety function “protection against unexpected starting” must be checked. For that purpose a safety device must be executed (for example door contact). The motor must now be zero-torque.

If the reliability performance of the “protection of unexpected starting” once has been determined, then this safety function of the converter doesn’t have to be checked by an external monitoring, as the device checks itself on possible errors and if necessary displays a message as well as turns off the drive.

Application example for machine of category 3

Exemplary the following diagram shows the usage and cabling of a Baumüller converter of the series bmaXX in a machine tool, at which the safe taking of work pieces at opened barrier is possible according to category 3 (EN 954-1).



Example for an application for safe stop according to category 3 (EN 954-1)

The switching-off of the electrical drive motor takes place dual-ported.

- S2 (NC contact) and S3 (NO contact) have hardware effects on the pulse release input of the converter (X26: 14). Only if S2 and S3 display a closed cover (and therewith a safe condition) voltage is being applied to the impulse release input of the converter.
- S1 (NC contact) has hardware effects on the safety relay of the converter. Only if S1 displays a closed cover (and therewith a safe condition) voltage is applied to the safety relay input (X68: 3) and therewith allows a torque generation at the shaft of the motor. The NO contact of S1 is connected with the monitoring circuit.
- The monitoring circuit, a fail-safe monitoring control of the category 3 (EN 954-1), checks on its own the directly connected switching contacts of the position switch S1 (NO contact), S2 (NO contact) and S3 (NC contact). If the barrier is not completely closed or a theoretical impossible condition of the position switch contacts is present (for example S1 and S2 show a different switching condition or S2 and S3 show the same switching condition), then the control circuit will not get a release signal from the monitoring circuit. A missing release signal of the monitoring device leads to a direct switching off of the converter by means of the control circuit. If the monitoring circuit has recognized an error (for example different switch condition of S1 and S2), this is displayed to the operator and a commissioning of the drive is not possible until the error has been repaired.
- The status signal contact of the safety relay (X68: 1,2; NC contact) can additionally be evaluated by the monitoring circuit (not obligatory).

- The position switches, which are used, must unavoidable have actuated and mechanical connected contacts as well as a dual-port connection (NC contact/ NO contact). The mechanical operating at the safety device must take place unavoidable, that means tamper-resistant.

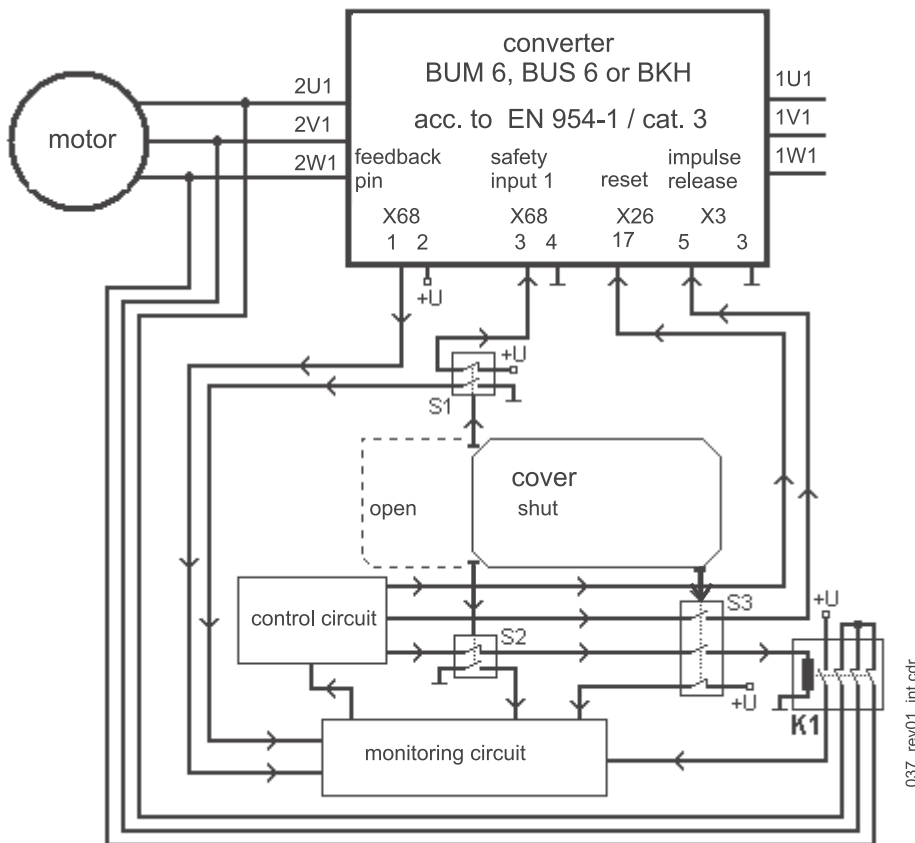
The connection cables between the safety relay input (X68: 3,4) and the control as well as between the impulse release input at the converter (X3:5) and the controller must not be installed outside the control cabinet in a common cable channel.

Application example for machine of category 4

Additional procedures when configuring a machine make it possible with a converter of the category 3 (EN 954-1) at safety-relevant operations for the “protection against unexpected starting” also category 4 for the complete drive.

A possibility is the usage of a contactor, with which the external conductors of the motor cable is short-circuited.

The diagram shows exemplary the usage and cabling of a Baumüller converter of the series BUM 6, BUS 6 or BKH of a machine tool, at which the safe taking of work pieces at opened barrier according to category 4 (EN 954-1) is possible.



Example for an application for safe stop according to category 4 (EN 954-1)

The switching-off of the electrical drive motor takes place three-ported.

- The contactor K1 with three NC contacts short-circuits the current to the motor in the release state in all poles (closed-circuit current principle), so that no electrical energy of the converter arrives at the motor. S2 (NC contact) and S3 (NO contact) effectuate K1. Only if S2 and S3 display a closed barrier (and therewith a safe condition) K1 starts up and the short-circuit in the motor line is reset.

The status signal contact of K1 (NO contact) to the monitoring circuit is constructed with mechanical with the NC contacts connected contacts. The selection of the contactor takes place after its limiting short-time current load capability (10 ms). This must be bigger than the nominal current of the used semiconductor fuses at the mains input of the converter.

- S1 (NC contact) has hardware effects on the safety relay of the converter. Only then if S1 displays a closed barrier (and therewith a safe condition) voltage is applied to the safety relay input (X68: 3) and therewith makes a torque generation at the shaft of the motor. The NO contact of S1 is connected with the monitoring circuit.
- S3 (NO contact) has hardware effects on the impulse release input of the converter (X26: 14). Only if S3 displays a closed barrier (and therewith a safe condition) voltage is applied to the impulse release input of the converter.
- The monitoring circuit, a fail-safe monitoring control of the category 4 (EN 954-1), checks on its own the directly connected switch contacts of the position switches S1 (NO contact), S2 (NO contact), S3 (NC contact) and the status signal contact of the safety relay (X68: 1,2; NC contact) as well as the contactor K1 (NO contact). If the barrier is not completely closed or a theoretic impossible condition of the position switch contacts is present (for example S1 and S2 show a different switch condition or S2 and S3 show the same switch condition or the status signal contact of the safety relay is opened/closed, although the status signal contact of S1 is closed/opened), the control circuit receives no release signal of the monitoring signal. A missing release signal of the monitoring device leads to a direct switching off of the converter by means of the control circuit. If the monitoring circuit has recognized an error (for example different switch condition of S1 and S2), this is displayed to the operator and the commissioning of the drive is not possible until the error has been repaired.
- The position switches, which are used, must unavoidable have actuated and mechanical connected contacts as well as a dual-port connection (NC contact/ NO contact). The mechanical operating at the safety device must take place unavoidable, that means tamper-resistant.

The connection cables between the contactor K1 and the control circuit as well as between the safety relay input at the converter (X68: 3,4) and the control circuit must not be installed outside the switching cabinet in a common cable channel.



NOTE

All information given in the Operation Manual of the converter, especially the chapters safety instruction, installation and commissioning, must absolutely be observed.

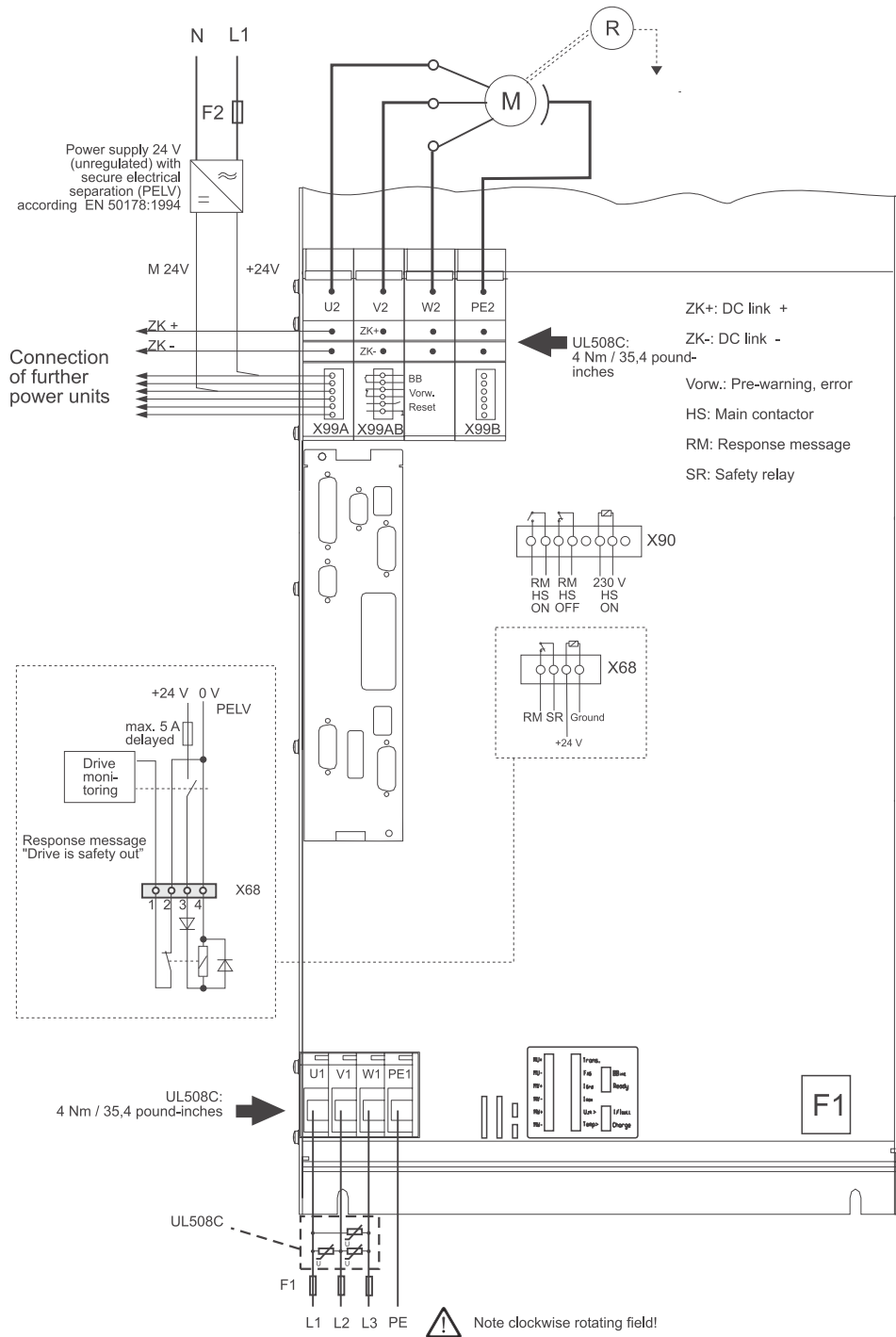
For the use and the installation of the safety devices the legal and official requirements of the government safety organizations and of the EU-Directives for safety requirements at installations and machines (for example EN 60204-1, security of machines, electric equipment and EN 292-2 security of machines general configuration directives) are valid.

5.4.4 Service time

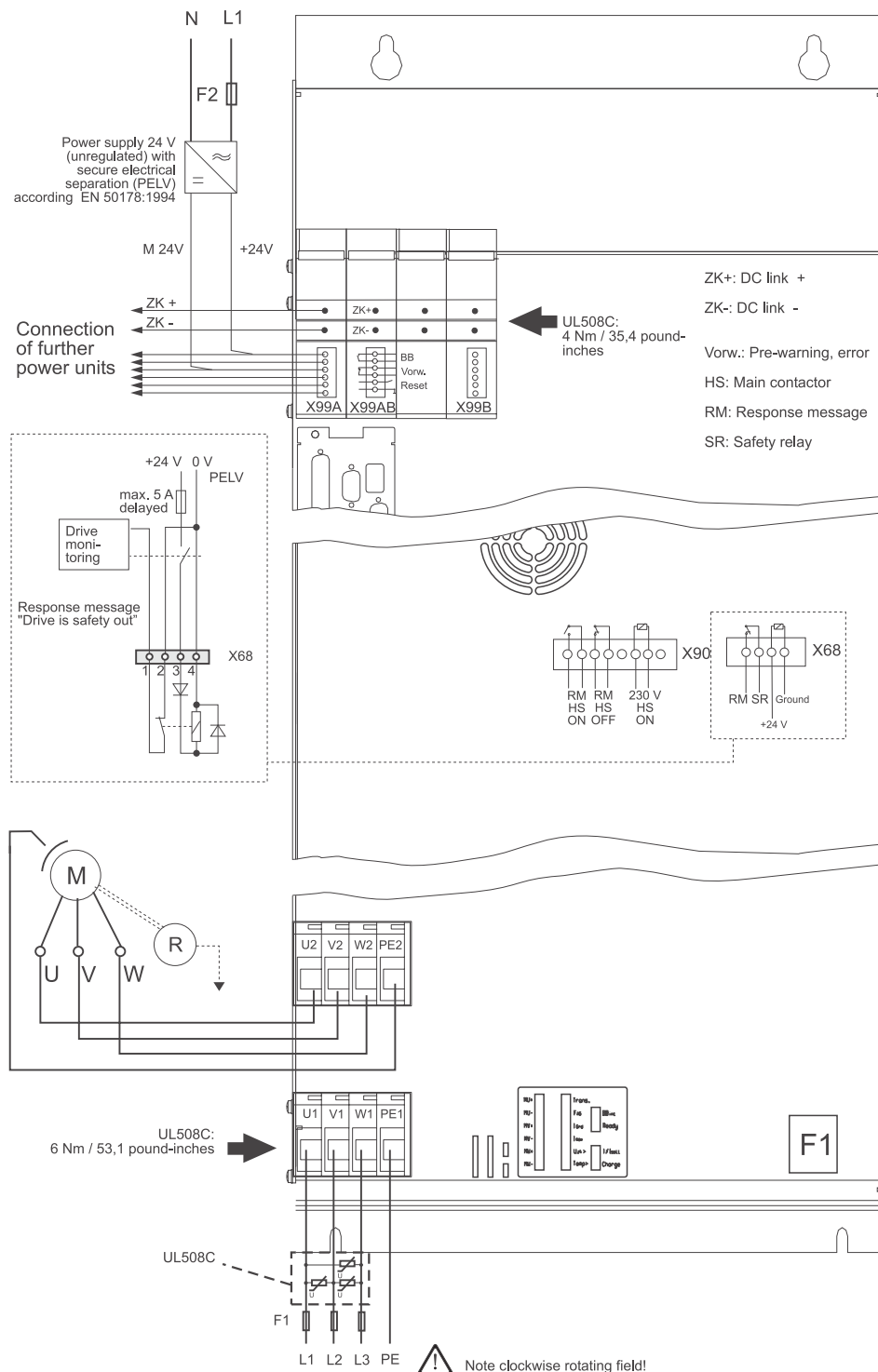
The mechanical service time of the safety relay is at least 1×10^7 cycles of operation.

5.5 Connection diagram

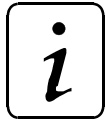
5.5.1 Connection diagram BKH 62



5.5.2 Connection diagram BKH 63



Connection notes



NOTE

Supplementary notes to comply with the US standard UL508C (UL Standard for Safety for Power Conversion Equipment):

The units are adapted for the connection to mains with maximum 10000 A short circuit current. (UL508C, Nov 27, 1996, Tab. 44.1)

F1	Semi-conductor fuse, line protection fuse with reduced cross-sections only (refer to Accessories, Fuses)
F2	Fuse dependent on the used power supply
FI-contactor switch	Due to methods used, relatively high leakage currents occur in the converter and motor, i.e. the drive may be incompatible with FI equipment. For projecting, observe EN 50178:1994, Para. 5.2.11.2.
U1, V1, W1, PE1	<p>Cross-section of mains connection according to standard EN 60204-1:1992.</p> <p>For cable-laying, refer to EMC information.</p> <p>If UL508C has to be observed:</p> <p>Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: BKH 62: 4 Nm resp. 35,4 pound-inches, BKH 63: 6 Nm bzw. 53,1 pound-inches.)</p>
U2, V2, W2, PE2	<p>Cross-section of motor connection according to standard EN 60204-1:1992.</p> <p>For cable-laying, refer to EMC information.</p> <p>If UL508C has to be observed:</p> <p>Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: BKH 62: 4 Nm resp. 35,4 pound-inches, BKH 63: 6 Nm bzw. 53,1 pound-inches</p> <p>Screening only necessary if a spacial separation of the signal cables is not possible or if a noisy communication is expected. In this case the screening of the motor cables must be connected on both sides with low impedance.</p>
ZK+, ZK-	<p>DC link connection to further units if the total power of the power-side converter is not exceeded (max. 36 kW, see Description of function on page 12).</p> <p>If UL508C has to be observed:</p> <p>Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches</p>



DANGER

The DC link is potentially charged! Use the cover supplied!

Power supply 24 V

24 V voltage supply with secure separation (PELV) according DIN 19240 to supply the electronic part.

Current:	BKH 62	3 A
	BKH 63	3,5 A



NOTE

The power supply unit is equipped with capacitors (250 μ F) in the input, so that when the 24 V is applied, charging currents are generated!

5.6 Pin assignment

All control voltages supplied externally must be PELV or SELV.

5.6.1 Power terminals BKH 62

- **U1, V1, W1, PE1**

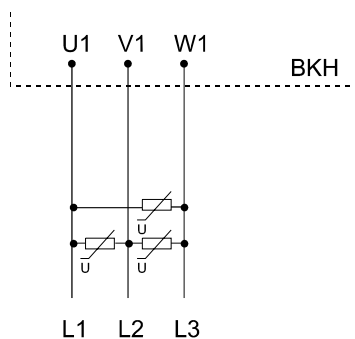
1U1, 1V1, 1W1:

PE1:

Unit input voltage $400 V_{AC} \pm 10 \%$

Switching cabinet grounding

Row of terminals 35 mm^2



If UL508C has to be observed:

To comply with UL 508C, Nov 27, 1996, para. 35.9 a power-side overvoltage protection. Therefore UL listed varistors with $550V_{eff}$ operation voltage and minimum 1 W continuous load, e.g. SIOV-S20K550, SIEMENS (Baumüller no. 3.19005301).

- **U2, V2, W2, PE2**

1U1, 1V1, 1W1:

PE2:

Motor connections

Motor ground

Terminals M6

- **ZK+, ZK-**

Connections to further units

Terminals M6

5.6.2 Power terminals BKH 63

- **U1, V1, W1, PE**

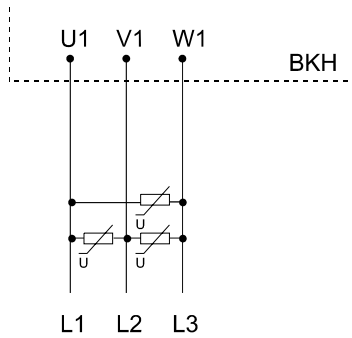
1U1, 1V1, 1W1:

PE1:

Unit input voltage $400 V_{AC} \pm 10 \%$

Switching cabinet grounding

Row of terminals 70 mm^2



If UL508C has to be observed:

To observe UL 508C, Nov 27, 1996, section. 35.9 it is imperative to connect a overvoltage protector on the mains side.

Use UL-listed varistors with an operating voltage of $550V_{eff}$ and a continuous power of at least 1W for example SIOV-S20K550, SIEMENS (Baumüller no. 3.19005301).

- **U2, V2, W2, PE2**

1U1, 1V1, 1W1:

PE2:

Motor connections

Motor ground

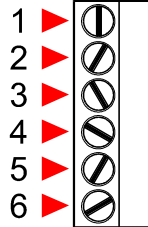
Row of terminals 70 mm^2

- **ZK+, ZK-**

DC link connection to further units if the total power of the power-side converter is not exceeded (max. 36 kW).

5.7 Control terminal

- All control voltages supplied externally must be PELV or SELV.
- **Sub-unit terminal X99A/X99B**

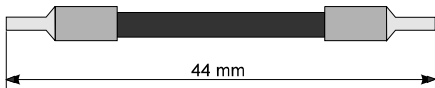


Terminal no.	Assignment
1, 2	+ 24 V (PELV) Connection for mains unit supply of the devices, both connections are jumpered internally; use second connection with mains unit currents above 10 A
3, 4	24-V Frame ground (PELV) Connection for mains unit supply of the devices, both connections are jumpered internally; use second connection with mains unit currents above 10 A
5	BB int (PELV) Ready for use signal of the power-side converter to all the devices connected to the DC link
6	Reserve (PELV)

All terminals are connected to each other (i.e. terminal 1 of X99A is connected to terminal 1 of X99B ...). Because of this they can be used as BUS-connection from one Baumüller unit to the other.

Due to the connection of X99A (BUC) to the X99B of the next BUS-device in the chain, the system can execute the signals as a bus connection.

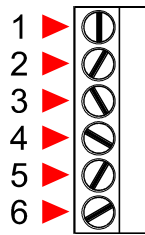
Line length of the connection: 44 mm.



WARNING

The allowed maximum current of 10 A per terminal connection must not be exceeded, otherwise there is a risk of damaging the devices. With higher current requirements, there must be several, separate current feeds.

- **Sub-unit terminal X99AB**



Terminal-No.	Assignment
1, 2	BB ext (PELV) Relay output: Ready for use of power-side converter 24 V, 0.5 A max.
3, 4	Alert (PELV) Relay output: Alert of power-side converter 24 V, 0.5 A max.
5	+ Reset with 24-V signal (PELV) Input for resetting error messages of the power-side converter (potential-free optocoupler input, 10 ... 15 mA)
6	Ground reset (PELV) Reference point for resetting error messages of the power-side converter (potential-free optocoupler input)

If a fault occurs during operation of the power side feed/feed back converter (refer to 'Signals and warnings'), the signals are stored until deleted after +24 V is applied at the terminals X99AB:5 and 6 or after switching the +24 V voltage supply.



NOTE

Using X99AB, only the status of the power side feed/feed back converter are issued externally; the reset only resets the power side feed/feedback converter messages.

Resetting the motor side converter signals is performed by the controller (refer to the description of the controller) and does not influence the main side converter messages.

- **X60 96-pin connector**

In order to connect the controller cassette with the motor side converter, the X60 connector is provided in the cassette plug-in unit for internal connections.

The external connections of the controller cassette are described in the description of the controller.

- **X90 (main contactor control) 8-pin lead-through terminal**

Terminal no.	Assignment
1, 2	Response: main contactor ON, Relay output 24 V, 0.5 A
3, 4	Response: main contactor OFF and auxiliary contactor OFF, Relay output 24 V, 0.5 A
5, 8	reserved for further functions
6, 7	Main contactor ON, 230 V

Use contact plug X90 to control the internal contactors (main and auxiliary).

- By switching off the 230 VAC voltage from terminals 6 and 7, the feed/feed back converter, charging connection and fan are disconnected from the power supply.
- Contacts 1 and 2 (response: main contactor ON) are closed as long as the main contactor is closed.
- Contacts 3 and 4 is closed when either the main or auxiliary contactor is closed.



DANGER

Even with the main contactor OFF, voltage is applied to the intermediate circuit for several minutes.

- **X68 safety relay, 4-pin lead-through terminal**

Terminal no.	Assignment
1, 2	Indicator contacts 1 and 2, Relay outputs 24 V, 0.5 A
3	Relay ON + 24 V
4	Relay ON ground

Using the safety relay, it is possible to switch the drive moment-free by disconnecting the +24 V from contacts and 4.



NOTE

When the motor is in operation, terminals 3 and 4 connected with +24 VDC.

The status of safety relay OFF is stored as a signal and must be reset either with a reset signal or via the controller.

5.8 LED's on front panel

The LED's display the states and messages of the power-side converter. The messages of the motor-side converter are displayed via the controller.

5.9 Automatic circuit breaker F1

The automatic circuit breaker protects the charge circuit and the internal fan against short circuit or earth connection.



NOTE

If the automatic circuit breaker is off the power-side converter cannot be switched on (charge circuit is not active)



WARNING

With discharged DC link the automatic circuit breaker is off without enabled pulses on the motor-side converter if

- Main and auxiliary contactor are enabled (via 230 V_{eff} on terminal X90; 6,7)
- and
- on DC link or motor connection a earth connection is detected.

5.10 Accessories

• Fuses

	BKH 62	BKH 63
Semi-conductor fuse	100 A / 1000 V	250 A / 1000 V
Article no.	19008526	19008626
Size according DIN 43620	0	1
Line protection fuse	only with reduced cross-section	

• EMC pack

Can be supplied on request:

- EMC filter
- Screened cables
- Connection parts

6 COMMISSIONING

6.1 Danger information



WARNING

This unit carries a dangerous voltage and contains dangerous rotating parts (fans). Ignoring the safety and warning information may result in death, severe personal injury or damage to property.

You are responsible for mounting the power unit, the motor, the line reactor and any other equipment in accordance with appropriate safety regulations (e.g. DIN, VDE); equally, you must ensure that all other relevant national and local regulations are met with regard to cable ratings and protection, grounding, disconnectors, overcurrent protection, etc.

The most important factors for protecting people are the DIN/VDE protective measures and safety regulations. If there are no protective earth connections on the equipment, commutating reactor or the motor, personal injuries are inevitable, since the surfaces may carry dangerously high voltages.

During operation, the principles on which the power converter and the motor work lead to leakage currents to earth that are dissipated via the specified protective earths and may result in a current-operated e.l.c.b on the input side blowing prematurely.

In the case of a short-circuit to frame or to ground, a direct proportion may arise in the leakage current that makes triggering a higher level current-operated e.l.c.b either more difficult or totally impossible. Make the PE connection in accordance with DIN EN 60204/VDE 0113 Part 1/06.93; Section 8.2.2 taking into account provisional standard EN 50178/ VDE 0160/11.94, Sections 5.3.2.1 and 8.3.4.4.

Before carrying out commissioning, check whether the plastic covers over the power stage connections are in place.

When an error occurs, the drive is de-energised and the motor coasts to stop. This fact must be taken into account particularly for hoist and lifting drives.



WARNING

Before switching on the drive, you must carefully check the functions of all the higher level safety equipment to prevent injury to people.

Faulty drive response

During initial commissioning, faulty or uncontrolled motion of the driven machine elements is always possible. At this stage, you should therefore proceed with particular care.

Contact Protection In Accordance with Paragraph 4 Section 4 VBG 4

Protection against direct contact comprises all the measures against danger that can result from touching the active parts of electrical equipment.

Sheets of plastic covering the control electronics, the power stage and the device connection, additionally prevent accidental contact during commissioning and casual use of control elements located close to the equipment. (DIN VDE 0106 Part 100, Unfallverhütungsvorschrift „Elektrische Anlagen und Betriebsmittel“ VBG4).

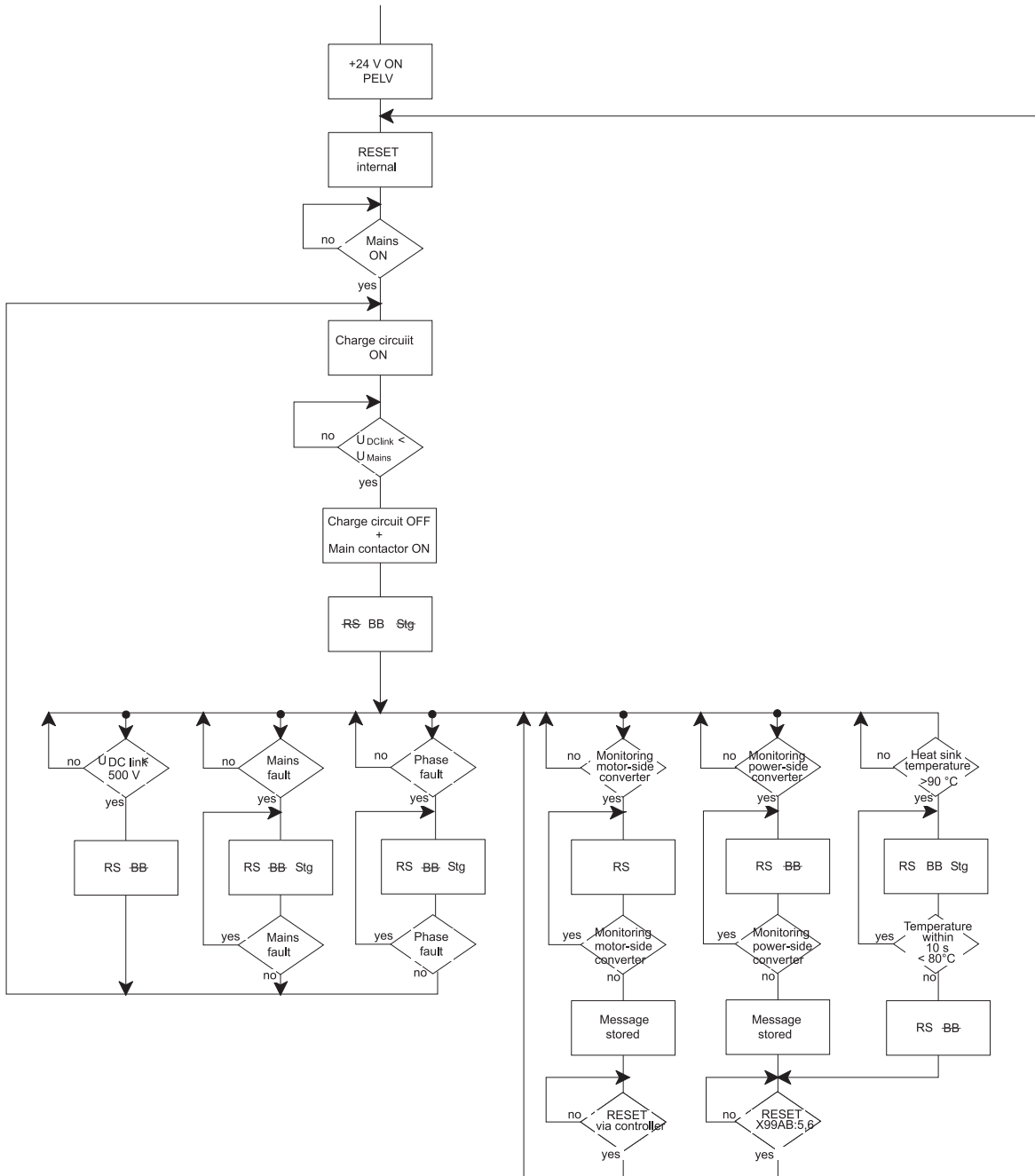
Switching cabinets must have an emergency off facility to switch off any voltages that could be dangerous. This does not include equipment which, if switched off, would cause an even more dangerous situation. The emergency off releasing element must be arranged in such a way that it can be reached quickly in case of danger. In the case of work that is considerably more dangerous than usual, another person must be present.

The machine minder must ensure that unauthorized people do not work at the machine.

The machine minder must report immediately any changes that occur at the machine which adversely affect safety.

When dismantling safety equipment during commissioning, repair and maintenance work, you must ensure that the machine is taken out of commission in accordance with applicable regulations. You must remount and check safety equipment immediately after completing commissioning, repair and maintenance work.

6.2 Function diagram BKH 62, 63



Abbreviations:

- BB: Ready for use
- BB̄: Not ready for use
- RS: Pulses or controller inhibit for motor-side or power-side converter
- U_{DC link}: Voltage between the DC link condensers.
- U_{Mains}: Mains voltage
- Stg: Relay output pre-warning (X99AB; 3,4)

6.3 Operation

The unit is operated via the controller plug-in unit (refer to the description of the controller). Settings on the BKH 62 and 63 are not necessary.

6.3.1 Switch-on sequence

Power-side converter

- Switch-on mains and +24 V (**LED "Mains off"** is on)
- If the mains reached 400 V (transients are decayed) the main contactor can be enabled with 230 V_{AC} on terminal X90; 6,7 (main contactor ON 230 V). Then the feed/feedback unit contacts the auxiliary contactor firstly and the DC link is charged via the electronic charge circuit. As long as the charge circuit is active the yellow **LED "Charge"** is on.
- If the DC link is charged above 500 V_{DC} the feed/feedback unit contacts the main contactor and the yellow **LED "Charge"** is off. The feedback contact of the main contactor (X90; 1,2) is closed.
- After the main contactor is active the mains synchronization is done. If the synchronization is finished and no mains error is detected the red **LED "Mains off"** is off.
- Then the monitoring of the feed/feedback unit are activated (green **LED "Ready"** is on, the DC link is adjusted to 640 V_{DC} and the external and internal ready for use is generated (BB_{int}: X99A; 5 and BB_{ext}: X99AB; 1,2 - see connection terminal). The green **LED BB_{int}** and the green **LED "Ready"** are on - the power-side converter is active.
Now the motor-side converter can be started.



NOTE

It is recommended after enabling the main contactor ("main contactor ON 230 V" X90; 6,7) to read the signal ready for use external (X99AB; 1,2)

If the feed/feedback unit is not ready for use after 10 seconds (X99AB; 1,2 open) following is recommended: switch-off main contactor (X90; 6,7).

Therefore in case of a mains fault (e.g. fuse fault in one phase) a damage of the internal three-phase current fan is avoided definitely (by e.g. long-lasting 2 phase operation).

Motor-side converter

- Before the motor-side converter can be started the safety relay must be activated.



NOTE

The safety relay has no influence on the power-side feed/feedback converter and can be switched on and off independently of the main contactor. The messages are stored in the motor-side converter.

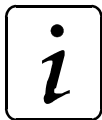
- After the safety relay is switched on and the ready for use signal of the feed/feedback unit is available (BB_{int}) the messages of the motor-side converter ("safety relay off") must be acknowledged by the controller (refer to "safety relay"). The acknowledgement can be done at least after 100 ms after connecting the safety relay.
Perhaps recognized messages of the controller (e.g. "feed/feedback unit not ready for use") must be acknowledged, too (see controller manual).
- After the messages are acknowledged the drive can be operated after pulse enable of the controller (see controller manual).

6.3.2 Reset failures

Failures of power-side converter

Reset of failures recognizes, stored and displayed via LED's by the power-side converter

- Set reset input at terminal X99AB (+24 V on X99AB; 5, ground on X99AB; 6).



NOTE

The reset signal effects only the power-side converter and doesn't effect the storage of the motor-side converter.

A continual reset is not allowed!

- Switch-off the +24 V power supply

Failures of the motor-side converter

Reset of failures of the motor-side converter:

- via the controller (see controller manual).



NOTE

The reset doesn't effects the messages of the power-side converter.

6.4 Messages and warnings

The signals and warnings from the power side converter and motor side converter are stored and evaluated separately.

6.4.1 Monitoring of the power-side converter

In order to use the monitoring function the +24 V auxiliary voltage (X99A or X99B) must be available.

Monitoring:

- Overcurrent of the mains connections
- DC link voltage
- Switching state of power transistors
- Auxiliary power supply



NOTE

The monitoring mentioned above is only active if the power-side converter is in operation (LED ready is on).

If a monitoring is active the corresponding red LED is on and the green LED "ready" is off.

- Low voltage
- Mains failure and phase failure
- Temperature



NOTE

Pending messages cannot be cleared!

- **Overcurrent message**

The input current in the power feed lines are monitored, and when a line current is exceeded by 30% of the permissible peak current, an overcurrent signal is generated. This signal is stored and a pulse block follows. The internal and external ready for use signal is withdrawn.

The overcurrent message is displayed by the red LED I_{\max} and the reset can be done by an external reset (X99AB; 5,6) (see [Connection diagram on page 40](#)).



NOTE

The overcurrent signal should be regarded as a protective function. Limitation of the permissible peak current of the motor phase current is ensured by the motor controller.

- **DC link monitoring**

The DC link voltage is monitored by the power-side converter. If the DC link voltage reaches 800 V a message is generated. The internal and external ready for use signal is withdrawn.

The active DC link monitoring is displayed by the red LED "U_{ZK}>" and can be reset by the external reset (X99AB; 5,6).

- **Monitoring of the power transistor's switching state**

The collector-emitter saturation voltage is monitored during the period of the power transistors power-on command . If an excessive saturation voltage is detected when in a conductive state, an over-current is present in the power transistor resulting in a controlled shutdown procedure, the transistor is deactivated and generation of a corresponding message. The internal and external ready for use signal is withdrawn. In addition with the LED's "MU+", "MU-", "MV+", "MV-", "MW+" and "MW-" can be evaluated which transistor the message generated.

The signal can be reset by means of an external reset.

- **Monitoring of the auxiliary voltage supply**

The auxiliary voltage of the power-side converter and controller is monitored and a message is generated when undervoltage is detected. The internal and external ready for use signal is withdrawn. The message is displayed with the LED "FAG" and can be reset by means of an external reset.



NOTE

If the above mentioned monitoring is active the green LED "ready" is on. If a monitoring responses the corresponding red LED is on and the green LED "ready" is off.

- **Undervoltage**

If the DC link voltage falls below 500 V the power-side converter deactivates the main contactor. Therefore the main contactor is not closed, if the mains voltage is lower than 300 V when switching on the unit. This monitoring is not stored. The LED "Mains off" is on.

- **Mains failure monitoring, phase failure monitoring and rotating field monitoring**

This monitoring function prevents internal and external ready for use signal if at least a single-phase is missing in the mains voltage; in addition, a pulse block is generated in the power side converter. This signal is **not** stored, it is only active as long as the cause is present.

As long as no mains is available the yellow LED "mains failure" is on.

As long as a phase failure or a counterclockwise rotating field is detected the yellow LED "mains failure" is flashing.



NOTE

If the main contactor and the auxiliary contactor is switched off via terminal X90; 6,7 ("main contactor on 230 V") the LED "mains off" is on, also.

- **Temperature monitoring**

If a overload or overtemperature is detected (heatsink temperature > 90 °C) the message pre-warning (X99 AB; 3,4 relay contact open) is set by the controller.

After 10 seconds the message is stored and the internal and external ready for use is withdrawn.

In this time the machine can be set into a defined operation state before the ready for use signal is withdrawn and the machine is stopped.

This message can be reset via a external reset if the heatsink temperature is below 85 °C.

Ready for use of the power-side converter

If the ready for use of the power-side converter is available and **no** monitoring is active the relay ready for use external connects the message contact X99AB; 1,2.

At the same time the ready for use internal is generated. This signal is evaluated by connected units on X99A/X99B (X99A; 5 / X99B; 5). The ready for use is displayed by the green LED BBint. The feed/feedback unit is ready for use if **no** above mentioned message is active.



NOTE

A missing ready for use internal can be followed by a stored message at the connected units. This message must be reset on the unit relating to.

Reset

With the reset input (connect +24 V on X99AB; 5 and M24V on X99AB; 6 optocoupler input) the message storage of the feed unit is deleted without disconnecting the +24 V power supply. The internal and external ready for use signal is withdrawn during the reset time. The reset signal must be available at least 50 ms.



NOTE

The messages of the motor-side converter are reset via the controller.

6.4.2 Monitoring of the motor-side converter

In order to use the monitoring function the +24 V auxiliary voltage (X99A or X99B) must be available.

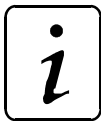
Monitoring available:

- Overcurrent within motor cables
- Earth fault current (BKH63)
- DC link voltage
- Switching state of power transistors
- Safety relay

- **Overcurrent message**

The motor current in the motor phases is monitored, and if a phase current exceeds 30% of the permissible rated current, an overcurrent signal is generated. This signal is stored and causes a pulse block.

The overcurrent signal can be reset by means of a reset from the controller. Refer to the description of the controller for information on signal indication and reset.



NOTE

The overcurrent signal should be regarded as a protective function. Limitation of the permissible peak current of the motor phase current is ensured by the motor controller.

- **Earth fault monitoring**

With the BKH 62 the earth fault protection is done via the overcurrent switch-off.

Using the BKH 63, the fault current of the motor side converter and, thus, the motor phases, are monitored to detect short to ground faults. A fault current error signal is generated if the fault current exceeds 10 % of the permissible rated current of the power unit.

Fault current monitoring can be reset by means of a reset from the controller. Refer to the description of the controller for information on signal indication and reset.

- **DC link voltage monitoring**

The DC link voltage is monitored. When the DC link voltage reaches 800 V, a signal is generated. DC link voltage monitoring can be reset by means of a reset from the controller. Refer to the description of the controller for information on signal indication and reset.

- **Monitoring the switching state of the power transistors**

During the period of the power transistors power-on command, the collector-emitter saturation voltage is monitored. If the saturation voltage in conductive state is too high, there is an overcurrent of the power transistors, e.g. through a short circuit of the motor terminals, a controlled shut-down procedure is initiated which deactivates the transistors and a signal is generated.

This can be reset by means of a reset from the controller. Refer to the description of the controller for information on signal indication and reset.

- **Monitoring the auxiliary voltage supply**

The auxiliary voltage supply of the power unit is monitored and issues a signal if undervoltage occurs.

The overcurrent signal can be reset by means of a reset from the controller. Refer to the description of the controller for information on signal indication and reset.

This message is generated if the safety relay is dropped-out.

- **Monitoring the feed/feedback converter (see chapter 6.3.1)**

Monitoring of the feed/feedback converter have no direct influence on the power unit.

The standby status of the feed/feed back unit, terminals X99A and X99B connection 5 and the reserve line connection 6 is processed and transferred on, potential-free, from the controller cassette (refer to the description of the controller).

- **Monitoring the heat sink temperature**

The power unit hasn't its own temperature monitoring because the heat sink temperature does not represent a time-critical value.

A linear temperature sensor is located on the heat sink which transfers its measurements to the controller. Temperature monitoring is therefore performed by the controller (refer to the description of the controller) and must be adjusted according to the technical data.

Ready for use of motor-side power unit

All signals issued from a monitoring feature of the power unit are stored there. As soon as no more signals are at hand or stored, the power unit is ready to operate and signals this via the connector on the controller.

If a signal is present, a pulse block is set.



NOTE

After connecting the 24 V power supply and the mains voltage the ready for use of the power unit is generated after 1 second.

Reset

Signals stored are reset via a reset signal from the controller (refer to the description of the controller).

- **Safety relay (see chapter safety relay)**

Various applications require that one drive on the electronics side is defined idle without switching contactors in the motor lines or switching off the intermediate circuit to enable restarting operation directly and without loss of time.

	Relay	Feedback contact	Internal contact
in operation	closed (+24 V on)	opened	closed voltage supplied to control
secure state	open (+24 V off)	closed active signal	open no voltage supplied to control

After switching-on the safety relay (+24 V on) the "secure state" is left, the messages of the safety relay are still stored until a RESET (initialized via the higher level control).

The RESET is sent from the controller to the power unit (RESET / reset the messages refer to controller manual).

To recognize the "secure state" exactly it is recommended to link the output states applicable and check them after ca. 10 ms again.



NOTE

In order to correctly detect "safe state", it is recommended to couple suitable initial state and to make a new request after approximately 10 seconds.

Commissioning

Power unit messages in connection with the safety relay

Power unit message	BBLT Ready for use power unit	GA_G * Collective transistor message	SRAUS_G * Safety relay OFF	FAC_G * Failure auxiliary voltage supply	RMA+ RMA- RMB+ RMB- RMC+ RMC- Transistor messages
in operation	High	Low	Low	Low	High
secure state	Low	Low	High	High	Low

*_G stored
High: logic level +5 V
Low: logic level 0 V

This messages are evaluated and displayed by the controller (see controller manual).

Sequence of drive control

Pulse enable OFF ⇒ safety relay OFF ⇒ stored messages (see above) ⇒ safety relay On ⇒ RESET by controller ⇒ pulse enable ON

7 MAINTENANCE



WARNING

This unit carries dangerous voltage and contains dangerous rotating machine parts (ventilators). This means that death, serious injury or considerable material damage can occur if the safety and warning notes are not heeded.

Maintenance work on the equipment may only be carried out in a voltage-free state.

Work on the DC link may only be started when it is ascertained that there is neither potential nor voltage (remanent voltage) present.

On dismantling safety equipment during commissioning, repair and maintenance, the machine is to be shut down exactly according to instructions. After completion of commissioning, repair and maintenance work the safety equipment is to be reinstalled immediately.

After all work on the drive, the machine operator must inspect the machine and document all work in the machine log chronologically, irrespective of whether it was on the motor, speed value recording or converter. In cases of non-compliance the operator carries full legal responsibility for the consequences.

7.1 Maintenance notes

The unit is free of maintenance.

Prohibition of unauthorised conversion

Unauthorised conversion and alteration of the drive are prohibited for safety reasons. In cases of doubt, contact the manufacturer.

7.2 Environmental conditions

If you keep to the environmental conditions during the entire period of storage, you can assume, that the device will not be damaged.



WARNING

From six months storage period on, the capacitors are destroyed during commissioning, if they are not reformed beforehand.

Reform the capacitors by supplying the device ready-for use for at least 48 hours with supply voltage, but no impulse enable.

7.3 Recommissioning

Carry out commissioning as with a new device.



WARNING

From six months storage period on, the capacitors are destroyed during commissioning, if they are not reformed beforehand.

Reform the capacitors by supplying the device ready-for use for at least 48 hours with supply voltage, but no impulse enable.

7.4 Disposal

The units consist essentially of the following components and materials.

Component	Material
Housing, various intermediate plates, fan, plates	steel plate
Heat sink in power unit	aluminium
Various distant bolts	steel
Various distant bolts, housings of current transformers and of the fan and so on	plastic
Connections in power unit	copper/aluminium
Cables	PVC isolated copper cable
Power electronic: module diodes on heat sink	basic plate metal, semi-conductor chip, plastic housing, various insulation parts
Conductor plates, accommodating the complete control and regulation electronic	base material: EPOXY resin (filled with GRP). Copperplated on both sides and with interconnected channels. Various electronic components such as capacitors, resistors, relays and semi-conductor components, etc.
Electrolyte condensers	aluminium housing, electrolyte must be disposed separately
Chokes	copper cables and pulverized iron
Main contactor	copper, iron, plastic
Terminals	copper, iron, plastic
DC link connection	nickel-plated brass

Electronic components may contain dangerous substances.

If used as intended, the various components pose no danger to human beings or the environment.

Hazardous substances may be created or released through fire.

Electronic components must not be opened, since beryllium oxide is used as internal insulation in various power semiconductors, for example.

The beryllium dust set free when the components are opened, is dangerous to your health.

The units and modules must be recycled at the end of their service life.

If recycling is not possible, dispose of the units and modules according to the respective country's national, regional and local regulations.

8 APPENDIX

8.1 Manufacturer Declaration

HERSTELLERERKLÄRUNG IN SINNE DER EG-MASCHINENRICHTLINIE 89/392/EWG, ANHANG IIB

Manufacturer Declaration in Accordance with the EC-Machine Guidelines 89/392/EEC, Appendix II B

Hiermit erklären wir, dass es sich bei dieser Lieferung um die nachfolgend bezeichnete Maschinenkomponente handelt und dass ihre Inbetriebnahme solange untersagt ist, bis festgestellt wurde, dass die Maschine, in die diese Komponente eingebaut ist, den Bestimmungen der EG-Maschinenrichtlinie 89/392/EWG, Anhang II B entspricht.

We herewith declare that this delivery includes the following specified machine component and that its putting into operation is prohibited until the declaration is made that the machine, in which this component is built in, complies with the regulations of the EC-machine guideline 89/392/EWG, appendix II B.

Bezeichnung der Maschinenkomponente:
Specification of the machine component:

Typenbezeichnung:
Type:

Kompakt-Leistungs-Einheit BKH 62, 63

BKH 62, 63 .. / .. - .. -

Nürnberg, 13.01.2005

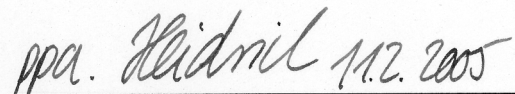
Hersteller-Unterschrift:

Signature of the Manufacturer:

 16.02.2005

Andreas Baumüller

Geschäftsleitung
Head Division

 11.2.2005

ppa. Dr. Peter Heidrich

Entwicklungsleiter
Head of Development

8.2 Declaration of Conformity

**KONFORMITÄTSERKLÄRUNG IM SINNE DER
EG-NIEDERSPANNUNGSRICHTLINIE 73/23/EWG**

EG Declaration of conformity of equipment regarding low voltage directive 73/23/EWG

Bezeichnung der Maschinenkomponente:
Specification of the machine component:

Typenbezeichnung:
Type:

Kompakt-Leistungs-Einheit BKH 62, 63

BKH 62, 63 .. / .. - .. - - - - - ..

Die Übereinstimmung des bezeichneten Produkts mit den Vorschriften der Richtlinie wird nachgewiesen durch die Einhaltung folgender Normen:

Conformity of the signficated product with the guidelines will be proved by following rules:

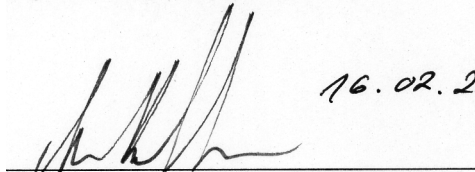
pr EN 50178: 1994 (VDE 0160/11.94)

"Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln"
"Equipment of power installation concerned electronic operating materials"

Nürnberg, 13.01.2005

Hersteller-Unterschrift:

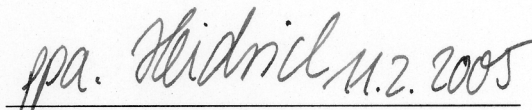
Signature of the Manufacturer:



Andreas Baumüller

Geschäftsleitung
Head Division

16.02.2005



ppa. Dr. Peter Heidrich

Entwicklungsleiter
Head of Development

8.3 General Conditions of Sale and Delivery

1. Obligation and Conclusion of Contract

- a) Deliveries of goods and provision of services shall be effected exclusively based on these trading conditions. They are an essential component of the contracts for delivery and shall be considered as having been accepted by the placing of an order. In the case of constant business relations, they also apply for the future contracts.
- b) Agreements diverging from the contract and verbal collateral agreements shall only be binding if they have been confirmed in writing by Baumüller Nürnberg GmbH (hereinafter referred to as Baumüller). Diverging trading conditions on the behalf of the purchaser shall be without obligation, even where these have not been expressly objected to. These General Conditions of Sale and Delivery shall be considered as having been accepted by the purchaser at the latest when the delivery is accepted.
- c) In as far as deliveries of goods are subject to separate external obligations in accordance with the Law Concerning Foreign Trade and Payments with respect to the Federal Office for Economics, the purchaser has to observe the relevant conditions at his/her own responsibility.

2. Price and Offers

Offers are subject to confirmation, not binding and apply subject to material supply possibilities. Supplements and amendments require written confirmation. Prices are ex works and are subject to confirmation. Invoicing takes place in accordance with the prices valid on the date of delivery.

3. Extent of Delivery and Delivery Time

- a) Specified delivery periods/dates are without obligation, in as far as nothing else to the contrary has been expressly agreed upon in writing. Delivery periods do not commence until the purchaser has fulfilled all duties of co-operation, in particular regarding details of performance. In the event that the agreed deposits for orders are delayed, then the delivery time shall be extended accordingly.
- b) The purchaser is entitled, in particular in the event of a delay in delivery of longer than 3 months, to set an appropriate period of grace and after its expiry, to withdraw from the order. Claims to compensation due to non-fulfilment or delay shall be excluded, in as far as Baumüller is not responsible for intent or gross negligence.
- c) Baumüller is entitled at any time to effect partial deliveries and partial services, as well as to invoice these accordingly

4. Delivery Problems

- a) Delays/preventions in the delivery of goods or the provision of services due to force majeure entitle Baumüller to delay the production and delivery by the duration of the obstruction plus an appropriate period of time or to withdraw in part or in whole from the order.
- b) Industrial disputes or other circumstances which substantially impede or render impossible the delivery, such as, in particular, disturbances in the operating processes, problems in procuring materials, official directives also apply as force majeure, irrespective of whether they arise with regard to Baumüller or suppliers.
- c) In these cases, Items 4 a), b), the purchaser shall have no claim to compensation due to non-fulfilment or delay of the delivery.

5. Packaging

Items for sale and delivery items are packaged and transport insurance policies are taken out according to the instructions of and at a cost to the purchaser. Upon demand, the packaging material has to be returned without delay, free of freight charges and expenses.

6. Dispatch and Passing of Risk

Deliveries shall be made ex works. The dispatch shall be effected at a cost to and at the risk of the recipient of the service/the purchaser. The risk passes to the recipient of the delivery/purchaser as soon as the delivery items leave the works. This shall apply at the latest, from the transferal of the delivery items to the person carrying out the transport, forwarding agent or carrier.

7. Warranty

In the event that a delivery item is defective, Baumüller shall deliver an additional replacement or make a subsequent improvement at its own choice. Multiple subsequent improvements are permissible. Other warranty claims on the behalf of the purchaser, in particular also due to direct or indirect consequential damage are excluded. The pre-condition for any warranty is the normal contractual use of the delivery items. In the event of the utilization of warranty services, the motor, the replacement part or the device has to be sent in free of freight charges, packaging costs or customs duties after prior co-ordination with Baumüller. Baumüller is exempted from any warranty if the party ordering returns the goods complained about without prior co-ordination or contrary to agreement. Warranty claims expire one month after rejection of a defect on which notice is given, in as far as the purchaser remains silent in this respect.

8. Notification of Defects

- a) The purchaser shall examine the subject matter of the contract and delivery items immediately and give notice of any defects without delay, however, no later than 7 days after receipt of the delivery. In case of non-obvious defects notice has to be given in writing without delay after their discovery, however, no later than 6 months from the point of delivery. In the event that the purchaser does not give notice of any defects in writing within this period of time, then the subject matter of the contract shall be considered as having been approved.
- b) The purchaser shall allow Baumüller a suitable inspection of defects of which notice is given and shall place all necessary/requested technical information, in particular, inspection records and test reports at Baumüller's disposal. In the event that the purchaser fails to do so, then the delivery items shall be considered as not having been complained about and as being approved. In the event that the purchaser alters the delivery items, then he/she shall lose his/her warranty claims.
- c) In the event of an established material defect or performance defect, Baumüller can eliminate the defect or supply a replacement. The purchaser can demand rescission or a reduction after the expiry of an appropriately set period of grace. Further claims on the behalf of the purchaser, in particular to the reimbursement of dismantling costs or installation costs are excluded. The same applies to damages which do not affect the delivery item itself.
- d) Natural wear and tear and damage which arises after the transferal of risk, in particular also due to incorrect or

negligent handling, excessive demands or other unsuitable use not in conformity with the contract are excluded from the warranty. The same applies in particular for defects which are attributable to atmospheric discharges, overvoltages and chemical influences.

- e) If no case of warranty is in existence or in the event that this subsequently turns out to be the case, the purchaser shall remunerate the utilization or the use of an item or of a right, as well as services provided and expenses to an appropriate amount. Baumüller is entitled to a right of control as referred to in §§ 315 ff. BGB [German Civil Code].

9. Liability

Contractual or legal claims on the behalf of the purchaser against Baumüller are limited to intent and gross negligence. This does not apply in as far as claims from the ProdHaftG [Product Liability Act] have been enforced. Baumüller shall only be held liable to the amount of the damage foreseeable in accordance with the purpose of the contract. Material damage which exceeds the value of a delivery/service is not foreseeable in this sense. The liability is limited in terms of amount to the remuneration contractually owed.

10. Payments

- a) Invoices are payable at the time agreed in the contract, at the latest within 30 days after the invoice date, in cash and without deductions. The purchaser can only offset with claims which are final and absolute or undisputed. The same applies to the exercising of rights of retention.
- b) In the event of a delay in payment on the behalf of the purchaser, interest to the rate of 4 % above the respective minimum lending rate of the German Federal Bank, however at least 10 % has to be paid without separate proof being required.
- c) Failure to comply with the terms of payment or circumstances which endanger the credit worthiness of the purchaser result in all claims immediately becoming due. In these cases, deliveries shall only be made against payment in advance.
- d) Cash payments, bank transfers or cheque and bill payments shall not be considered as payment/fulfilment of the obligation before the amount due for payment has been irrevocably received by Baumüller or credited to Baumüller's account.
- e) Payments have to be made directly to Baumüller. The field staff are not entitled to accept payments or to issue extensions or waivers without separate written authority.

11. Reservation of Ownership

- a) The ownership of delivery items remains reserved up to the fulfilment of all existing claims against the purchaser from the business relation. Any bundling with other items shall be effected by the purchaser for Baumüller. Then, the entire product shall be considered as reserved goods.
- b) The purchaser is entitled to sell the reserved goods in orderly business transactions. All claims to which the purchaser is entitled from this sale or other legal grounds shall be assigned by him/her in advance to Baumüller. Baumüller shall accept the assignment. In the event that the reserved goods are bundled or sold with other items standing in the possession of third parties, then the assignment shall only apply to the amount of the invoice value of the reserved goods. The purchaser is authorised to collect these assigned claims. Upon request, he/she has to make notice of the assignment to the debtor.
- c) The purchaser shall inform Baumüller without delay of impending and enforced access on the behalf of third parties to the reserved goods or to the assigned claims.

The purchaser shall bear the costs incurred by this.

- d) The authorization on the behalf of the purchaser to dispose of the reserved goods and to collect assigned claims expires in the event that the terms of payment are not complied with, in particular, also in the case of bill and cheque protests. In this case, Baumüller is entitled to take possession of the reserved goods. The purchaser bears the costs incurred by this. The taking back of goods shall only represent a withdrawal from the contract when this is expressly stated.
- e) In the event that the value of the securities granted exceeds the secured claims in terms of amount by more than 20 %, then Baumüller shall renounce the securities exceeding this value.

12. Drawings and Documentation

Baumüller is entitled to the exclusive property right and copyright to cost estimates, drawings and all other documentation. These documents may not be made accessible to third parties without prior written consent. In the event that a contract is not concluded, not implemented or otherwise ended, then all documents have to be returned immediately and unsolicited. There shall be no right to retention to these documents.

13. Copyright (in particular Software / Licence)

- a) Baumüller is exclusively entitled to all rights to the software/edited versions, in particular property rights and copyrights to the relinquished software, in particular for the controlling of machines, systems and installations.
- b) Baumüller grants the purchaser/buyer the non-exclusive, non-transferable right to use the relinquished software in the framework of the contractual purpose at the contractually intended location/on the places in existence at the time of purchase (single licence). The software shall only be used on the associated purchased contractual item. Any use extending beyond this is prohibited. In the event of a use extending beyond this, Baumüller shall have the rights referred to in Items 14 c), 14 d).
- c) It is prohibited to make copies of the relinquished software, whether in whole or in part, in as far as the making of copies of the machine-readable material in the framework of the required data backup or as copies for internal company use has not separately been agreed upon with prior written consent from Baumüller. Processing of the relinquished software, in particular by means of alteration, translation or by bundling with other programs shall only be permitted after prior written consent from Baumüller. Protection notices from Baumüller on/in the software may not be removed and also have to be adopted onto copies and edited versions. Copies produced contrary to this condition shall come under the possession and copyright of Baumüller. Baumüller can prohibit the use of such copies and elect to demand the immediate surrender or complete destruction with proof of this destruction.
- d) The buyer is not permitted to extend the licence in terms of location/work places/machines/machine types or to grant rights of utilization or grant sub-licences. The extension of the licence shall be permitted by Baumüller exclusively against a separate remuneration which has to be agreed upon in writing.

14. Applicable Law

The law of the Federal Republic of Germany is authoritative for all rights and obligations from and in connection with this contract. The regulations of the UN Sales Convention (CISG) are excluded.

15. Place of Performance and Place of Jurisdiction

The place of performance for delivery and payment is the seat of Baumüller. The place of jurisdiction for all disputes from and in connection with this contract, in particular also for cheque and bill liabilities is the seat of Baumüller.

16. Miscellaneous

In the event that individual or several conditions of these Conditions of Sale and Delivery should be or become ineffective in part or in whole, then the validity of the remaining conditions shall remain unaffected by this. The parties shall complement/replace the ineffective or incomplete condition with an appropriate regulation which most extensively corresponds to the economic purpose of the contractually desired regulation. The same applies for the case of the presence of a gap in the regulations.

For the case that acceptance and installation are also agreed upon, then the following conditions, Items 18 and 19 shall also apply:

17. Acceptance

- a) The inspection of the delivery items ready for acceptance shall take place in the Baumüller works. The purchaser shall bear the costs of this inspection. In the event that the purchaser fails to perform the inspection, then the delivery items shall be considered as having been delivered in conformity with the contract when they leave the works.
- b) The purchaser is obliged to take delivery of goods and services from Baumüller without delay. Immaterial defects do not entitle the purchaser to refuse the acceptance.
- c) In the event that the purchaser does not declare within 7 days after notification of the readiness for acceptance on the behalf of Baumüller or after receipt of the contractual service in writing and with exact, examinable specification of reasons that he/she refuses the acceptance, then the acceptance shall be considered as having been declared and the orderly performance of the contract as having been ascertained.
- d) The agreed service shall be considered as having been accepted when the item delivered has been put into operation by the purchaser himself/herself or upon his/her

instructions by third parties beyond the functional test required to carry out the acceptance. This also applies in the event that the purchaser refuses the functional test/the acceptance without sufficient cause.

- e) Experts to be designated by both parties shall take part in the acceptance inspection. The result of the functional test shall be entered in a record to be signed by the purchaser in consideration of the technical specifications.

18. Erection and Installation

Erection and installation shall only be effected in the case of express agreement at the following further conditions:

- a) The purchaser makes required workers and material available at his/her own expense.
- b) Before the commencement of installation works the purchaser shall make available unsolicited all required specifications, in particular concerning the location of power lines which have been laid such that they are hidden and similar installations, as well as the required static specifications.
- c) Before the commencement of the erection/installation, the delivery items required for the commencement of works have to be on site and all preliminary works progressed to the extent that the erection/installation can immediately begin and be completely carried out without interruption.
- d) In the event that the erection, installation or putting into operation is delayed due to circumstances for which Baumüller is not responsible, then the purchaser shall bear the costs for idle time and journeys required on the behalf of the installation personnel.
- e) The installation personnel working time has to be certified weekly by the purchaser. The purchaser shall present to the installation personnel a written certification regarding the ending of the erection/installation without delay.
- f) Baumüller shall not be held liable for the installation personnel works, in as far as the works are not connected to the delivery and the erection or installation.
- g) Trial runs on systems not supplied by Baumüller shall not be carried out by the installation personnel.

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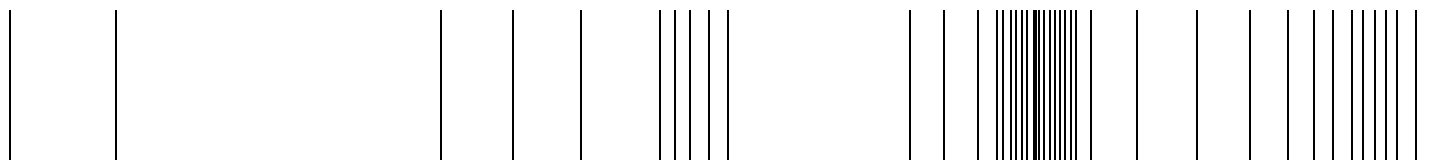
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be in motion



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