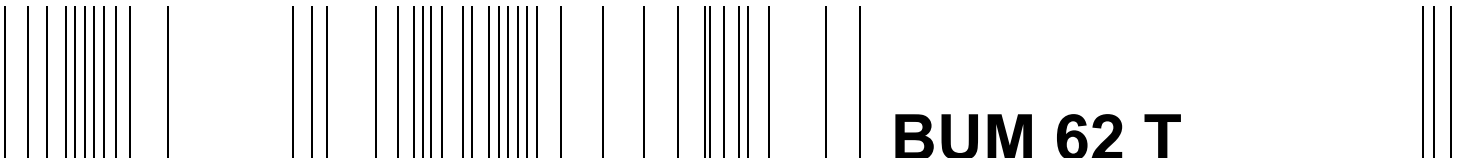


**be in motion be in motion**



**BUM 62 T**

**Mono Power Unit**

**Manual**

**E**

5.99009.03



Title	Manual
Product	Mono Power Unit BUM 62 T
Version	5.99009.03
Status	2005-02-03
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Obligatory	<p>These operating instructions are part of the equipment/machine. These operating instructions must be available to the operator at all times and must be in a legible condition. If the equipment/machine is sold or moved to a different location these operating instructions must be passed on by the owner together with the equipment/machine.</p> <p>After any sale of the equipment/machine this original and all copies must be handed over to the buyer. After disposal or any other end of use this original and all copies must be destroyed.</p> <p>When the present operating instructions are handed over, corresponding sets of operating instructions of a previous version are automatically invalidated. Please notice that specifications/data/information are <b>current values according to the printing date</b>. These statements are <b>not legally binding</b> according to the measurement, computation and calculations.</p> <p>Baumüller Nürnberg GmbH reserves the right, in developing its products further, to change the technical specifications and the handling of the products concerned without prior notice.</p> <p>No liability can be accepted concerning the correctness of the operating instructions unless otherwise specified in the General Conditions of Sale and Delivery.</p>
Manufacturer	<p>Baumüller Nürnberg GmbH Ostendstr. 80 - 90 D-90482 Nürnberg Germany Tel. +49 9 11 54 32 - 0 Fax: +49 9 11 54 32 - 1 30 <a href="http://www.baumueller.de">www.baumueller.de</a></p>

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## ABBREVIATIONS

AC	Alternating current
AM	Asynchronous motor
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
MC	Main contactor
IPM	Intelligent power module
a.m.s.l.	above mean sea level
PELV	Protective extra-low voltage
SELV	Safe extra-low voltage
PE	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 by use of the specified protective earth connections 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 could make triggering of the higher-level current-operated e.l.c.b. more difficult or even impossible.

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 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 of property.

### 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, 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 of property.

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

# Safety notes

---

## Danger information

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

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



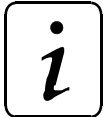
### DANGER

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



### WARNING

This means that **death, severe personal injury or considerable property damage 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

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, mounting, commissioning and operating the product and who have qualifications appropriate to their activities.

- Trained or instructed or authorised 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 authorised 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 EN 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 INTRODUCTION

The power units designated BUM 62 T are used for the upper power range.

### **Supply part (converter)**

The supply part (mains side) for the generation of the DC link voltage is an uncontrolled diode bridge. To reduce the peak making current (deburdening during switch-on), the DC link capacitors are charged via a charge resistor which is bridged by a thyristor after switching-on.

If the typical motor power of the converter on the motor side (see electrical data) is not fully used, e.g., because the power of the connected motor is smaller, the performance of the supply current controller can be used for the connection of other power modules of the BUS 6 series.

The total of all motor powers occurring at the same time must not be higher than the typical motor power.

### **Starting current load relief**

If precautions are not taken, the DC link capacitors produce inadmissibly-large charging current surges from the mains. In order to avoid these surges, the starting current is limited by a load relief device.

To this purpose, a resistance is integrated into the charging circuit. The resistance limits the charging current (with the exception of temporary mains failure) and is bypassed once the DC link is charged.

The cycle time for connect the unit in circuit again is  $\geq 3$  min.

If using an additional external capacitor at the DC (external capacity  $\geq 500 \mu\text{F}$ ) the cycle time is increased

## **Brake switch**

The energy which is generated in the generator mode, is dissipated by the brake switch (brake chopper) and an external regenerative resistor.

## **Inverter**

The inverter on the motor side consists of the IGBT power part and the corresponding sensors. The sensors supply measuring signals for the closed-loop control and also ensure the self-protection of the power electronics.

The inverter is triggered by the controller used.

Baumüller rack modules are provided for the control. The drives can therefore be adapted to different applications.

## **Controller**

The BUM 62 T only operates in conjunction with an additional controller. The controller types are equipped with modules. A separate description is available for the operation of the controllers.

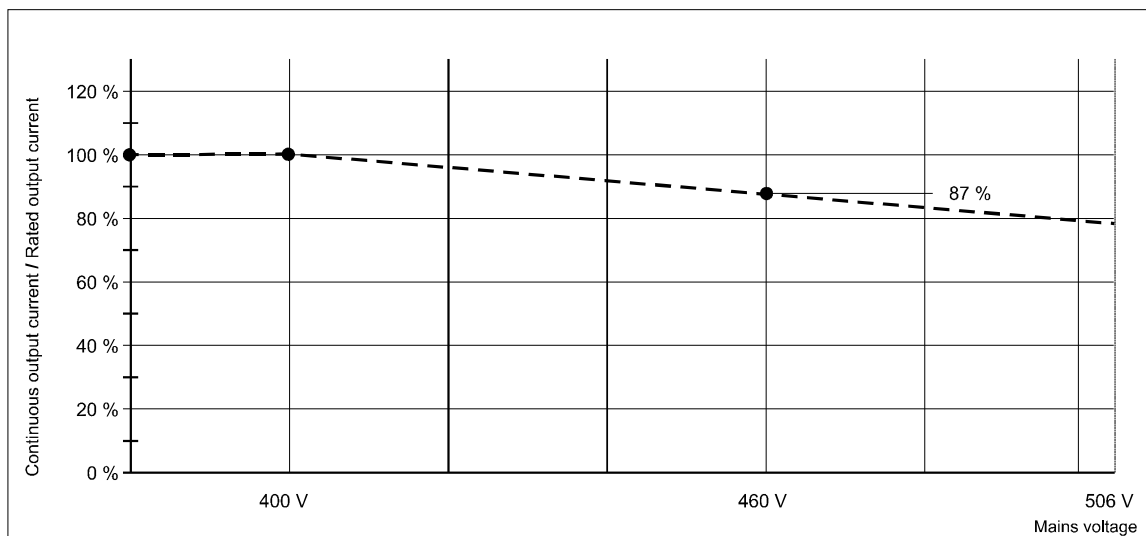
### 3 TECHNICAL DATA

#### 3.1 Table of technical data

		<b>BUM 62 T - 100 / 130 - ...</b>
Connection voltage (mains) <sup>1)</sup>		3 x 400 V <sub>AC</sub> ±15% 50 Hz 3 x 460 V <sub>AC</sub> +10% -25% 60 Hz
Supply voltage <sup>2)</sup>		+ 24 V <sub>DC</sub> -10% / +20 % (72W)
Continuous input power		max. 50 kVA
Rated DC link voltage <sup>3)</sup>		540 V <sub>DC</sub>
DC link capacity (internal)		1700 µF
DC link capacity (external)		max. 500 µF
Cycle time for connect the unit in circuit again (without additional DC link capacitors)		≥3 min
Output voltage <sup>4)</sup>		3 x 0 V <sub>AC</sub> ... 3 x (conn. volt. -30 V)
Output frequency <sup>5)</sup>		0 Hz. ...300 Hz
Continuous output power	at 4 kHz <sup>10)</sup>	max. 62 kVA
Continuous output power	at 8 kHz <sup>10)</sup>	max. 50 kVA
Continuous motor power	at 4 kHz <sup>10)</sup>	max. 43 kW
Continuous motor power	at 8 kHz <sup>10)</sup>	max. 35 kW
Rated output current <sup>6) 7) 8)</sup>	at 4 kHz <sup>10)</sup>	100 A
Rated output current <sup>6) 7) 8)</sup>	at 8 kHz <sup>10)</sup>	75 A
Peak output current <sup>6) 7) 9)</sup>	at 4 kHz <sup>10)</sup>	130 A
Peak output current <sup>6) 7) 9)</sup>	at 8 kHz <sup>10)</sup>	97 A
Connection power DC link connection		36 kW
External chopper current		max. 73 A
Internal chopper resistor		-
External chopper resistor		≥ 11 Ω
Application threshold of regenerative resistor		750 V
Ambient temperature range (operation) <sup>11)</sup>		min. 0 °C .... max. 55 °C 40 °C (nominal temperature)
Power loss <sup>3)</sup>	Connect. (mains) Supply	1400 W max. 72 W
Type of protection		IP 20
Installation height <sup>12)</sup>		max. 1000 m a.m.s.l.
relative humidity		15 % ... 85 % no condensation.
Temperature range for transport		- 30 °C ... + 70 °C
Temperature range for storage		- 30 °C ... + 70 °C
Dimensions (W x H x D)		264 x 560 x 280 mm
Weight without controller		30 kg

1. Voltage difference between phases must not exceed +/- 1.0 %.
2. According to EN 61131-2 (Table 5).  
With a supply voltage < 24 V the fan power is reduced. Therefore, it may be necessary to reduce the output current additionally.
3. All ratings refer to a connection voltage of 400 V and a supply voltage of 24 V.
4. The output voltage is a pulse-commutated DC. The setting range refers to the r.m.s. value of the fundamental wave.
5. The output frequency depends on the controller used.
6. R.m.s. value at an ambient temperature of 40 °C.
7. The unit provides the rated/maximum output current up to the connection voltage. When the input voltage exceeds the rated voltage, reduce the output currents at constant output power proportionally.

Characteristic 1: Output currents in relation to the connection voltage.



8. The rated output current must be reduced between 40 °C and 55 °C. The rated output current is calculated according to the following formula:

$$I_o = I_{o(40^\circ \text{C})} \cdot \left( 1 - \left( \frac{\text{ambient temperature} - 40^\circ \text{C}}{^\circ \text{C}} \cdot 0,03 \right) \right)$$

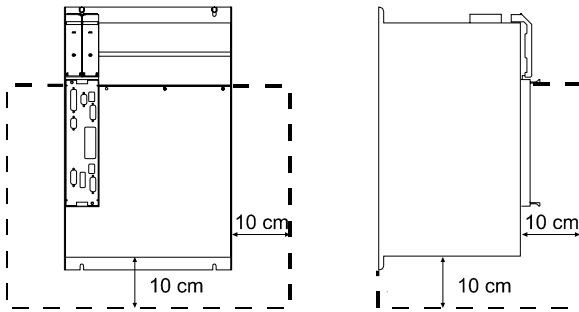
Example: Rated output current = 100 A, ambient temperature = 46 °C.

$$I_o = 100 \text{ A} \cdot \left( 1 - \left( \frac{46^\circ \text{C} - 40^\circ \text{C}}{^\circ \text{C}} \cdot 0,03 \right) \right) = 100 \text{ A} \cdot 0,82$$

The rated output current must therefore be reduced to: 82 A

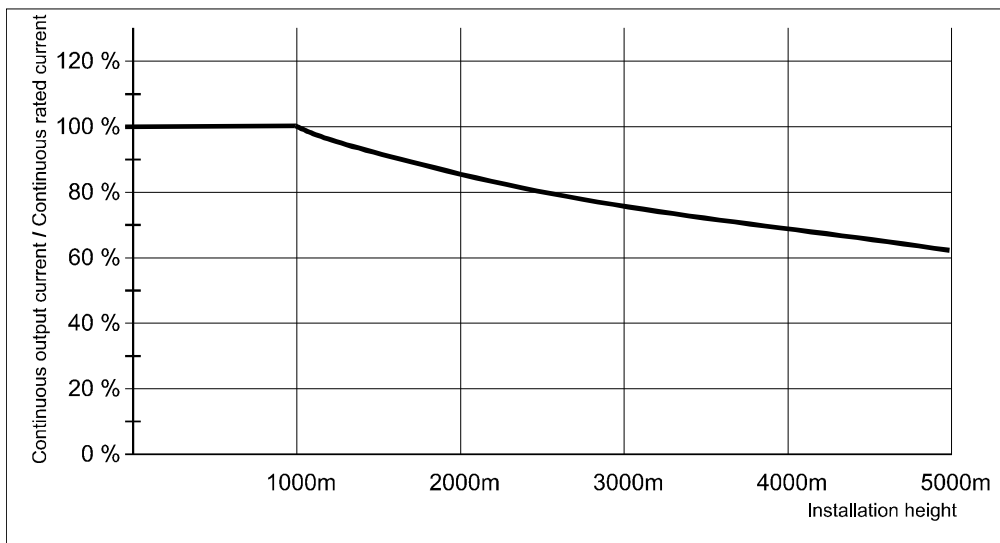
9. Maximum duration of the peak output current is 120 s. The duration depends on the motor current and the temperature of the heat sink. See Technical Description/Operating Instructions of the controller (V-controller: P139).
10. Chopping frequency of the inverter.  
(see description parameter P103 in the description of the V-controller)

11. The ambient temperature is determined as follows:

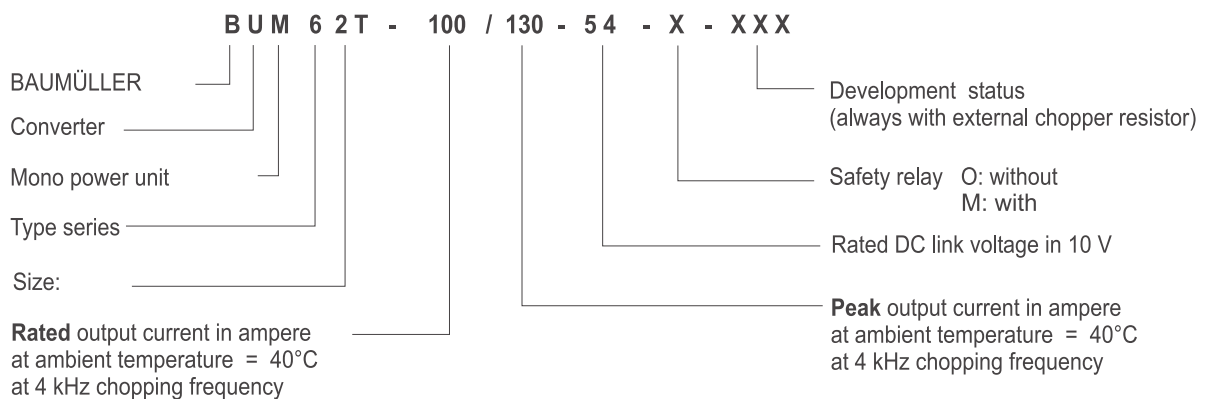


- Determine several measuring points covering the entire area as illustrated at a distance of 10 cm.
  - Measure the temperature at these measuring points.
- The highest value is the ambient temperature.

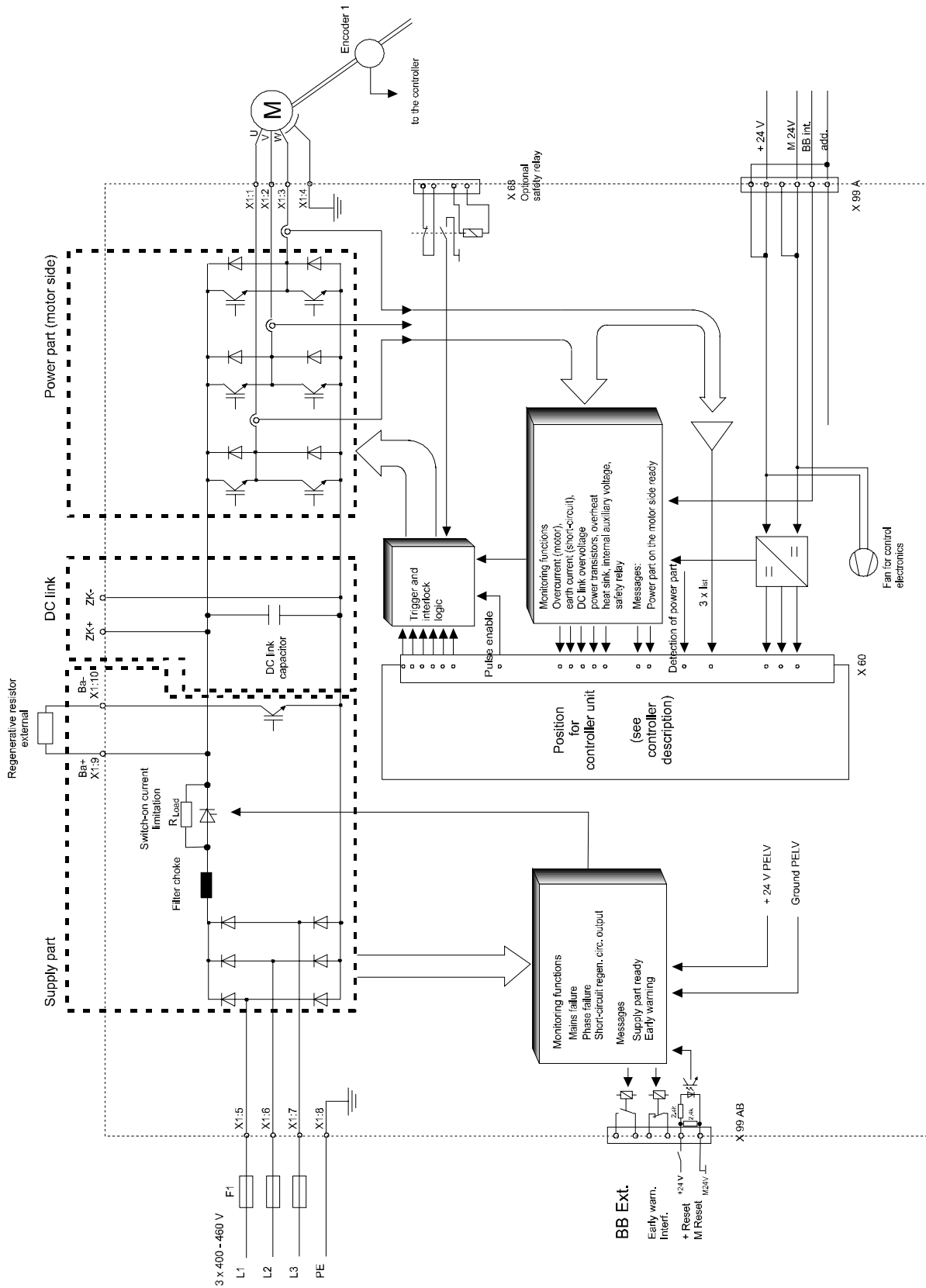
12. Characteristic 2: Values in relation to the installation height at normal air pressure.



## 3.2 Type key



### 3.3 Block diagram





### 4 TRANSPORTATION, UNPACKING

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

Avoid strong shaking during transportation and shocks, e.g. when setting the units down.

After unpacking the units and checking that the shipment is complete and undamaged, you can start assembly.

The packing consists of fibreboard, corrugated cardboard and/or wood. It can be disposed according to the local regulations.

Report any transport damage without delay.



**DANGER**

If you detect a transport damage on the unit, it must not be connected unless an appropriate voltage test has been carried out.

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



## 5 ASSEMBLY



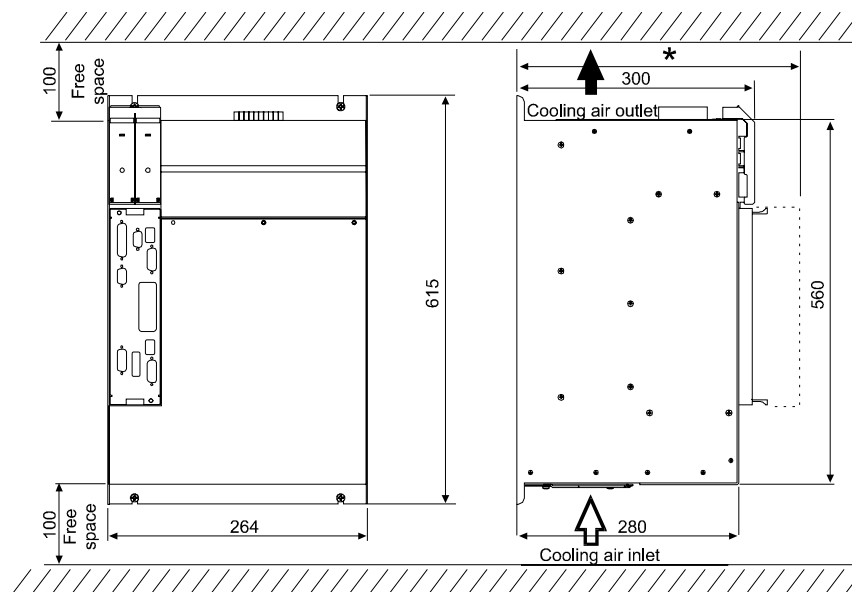
### WARNING

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 nations or local regulations concerning the conductor ratings and protection, grounding, disconnectors, overcurrent protection, etc.

The following measures for ventilation must be strictly observed. Otherwise, the unit may be overheated.

- Ensure sufficient cooling air and ventilation!
- Ventilation must be from the bottom to the top, ensure a free space above and below the unit (see "Free space" on page 19).
- The rated power of the unit is possible only up to a specific ambient temperature! The power must be reduced when higher temperatures occur (see "Table of technical data" on page 13).
- Do not locate any other sources of heat above the unit.
- Pollution degree 3 and 4 according to EN 50178:1994 Section 5.2.15.2 must be avoided. The units are suitable for the installation in closed operating rooms. (VDE 0558 Part 1a, Section 5.4.3.2.1 and 5.4.3.2.2)

### 5.1 Free space



\* The total depth depends on the controller dimensions!

## 5.2 Installation information



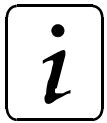
### WARNING

Inappropriate lifting can cause personal injury or damage to material assets.

Qualified personnel only may lift the unit using suitable equipment.

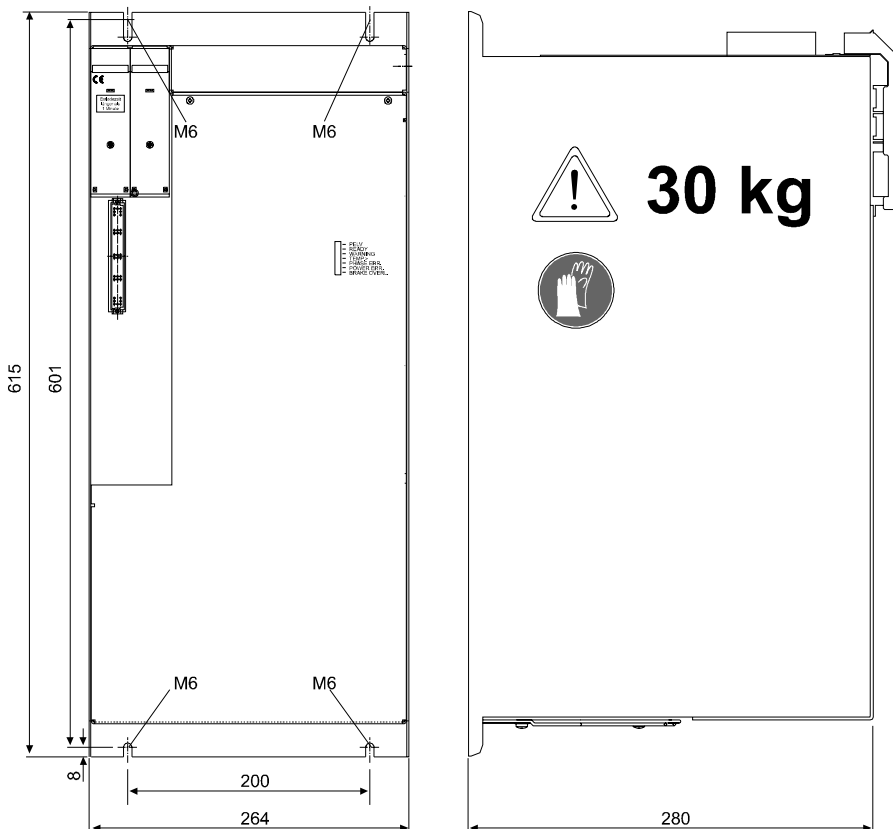
- Observe the weight of the unit!

- use protective gloves! 

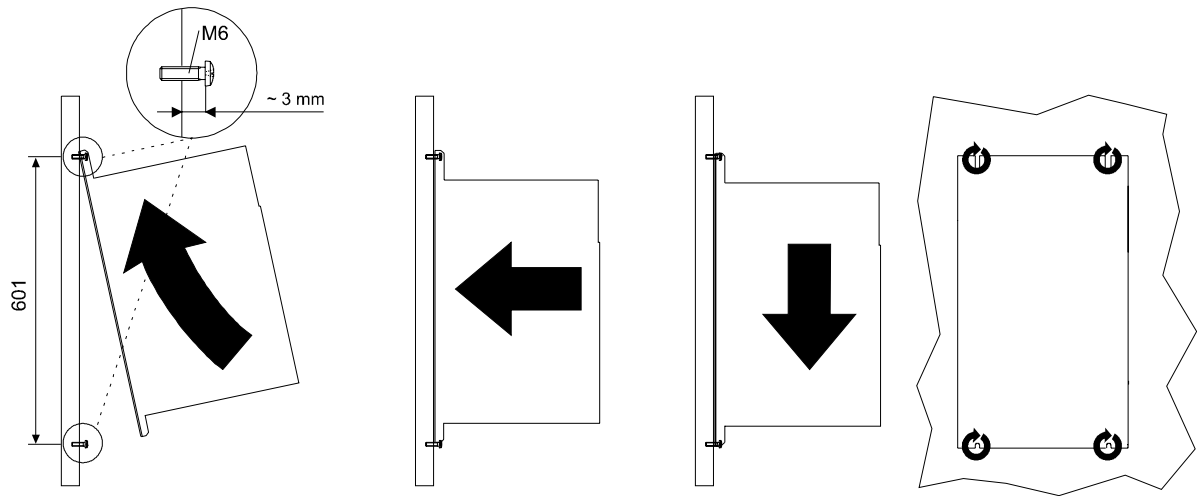


### NOTE

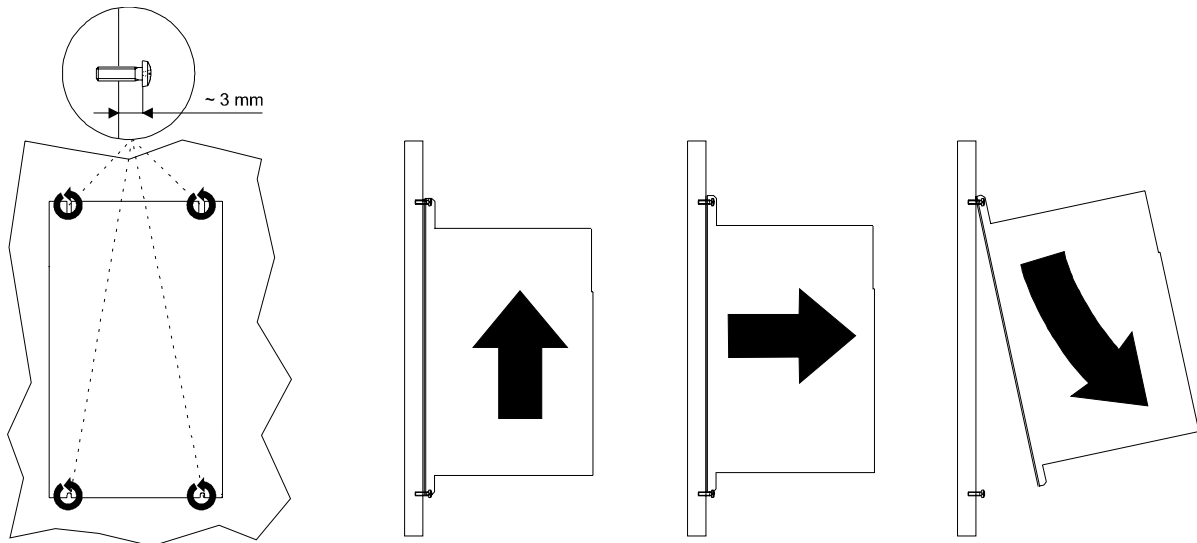
- Always mount the unit vertically at the back panel of the switch cabinet.
- Arrange several units side by side



## Installation



## Dismantling





## 6 INSTALLATION

### 6.1 Danger information



#### WARNING

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

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

The protective measures and safety regulations according to DIN/VDE are binding for personal security. If there are no PE connections on the unit, the commutation choke or the motor, personal injury may be caused since the surface may carry hazardous voltage.

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. Make the PE connection according to DIN EN 60204 / VDE 0113 Part 1 / 06.93, Section 8.2.2. considering EN 50178 / VDE 0160/11.94, Sections 5.3.2.1 and 8.3.4.4.

Before commissioning check whether the plastic covers over the live parts (power part connections) are in place.

#### Malfunction of the drive

During the initial commissioning, a faulty or uncontrolled movement of the driven machine elements cannot be excluded. Therefore, proceed with particular care.



## WARNING

Prior to connecting the drive, carefully check all higher-level safety equipment for perfect functioning, to avoid personal injury.

Special care must be taken when touching the drive shaft directly or indirectly (by hand). This is permissible only when the shaft is at standstill and the converter is de-energized. Machine parts which are freely accessible during operation (shafts, fans, etc.) must be covered.

Protection against contact according to Paragraph 4 Section 4 VBG 4

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

The active parts must therefore be protected from direct contact by insulation, design, position, arrangement or firmly installed facilities. Protection refers to common covers, barriers and procedures which ensure that persons are prevented from touching live, active parts.

Switch cabinet must have emergency stop facilities using which all voltages causing dangerous situations, can be switched off. This does not include equipment which, if switched off, would cause another dangerous situation. The releasing element for the emergency stop facility must be arranged such that it can easily be reached in case of danger. In the event of work which is considerably more dangerous than usual, another person must be present.

The operator must ensure that unauthorized persons do not work on the machine.

The operator must report immediately any changes that occur which adversely affect the safety of the unit/system.

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



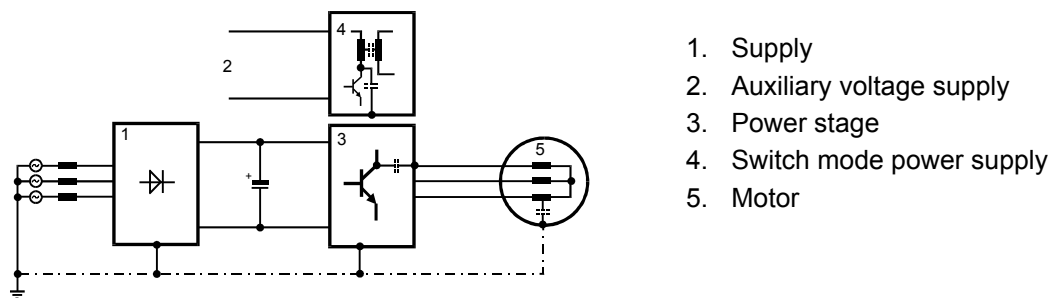
## 6.2 EMC information

### General information on converters

New semiconductor technologies (MCTs and IGBTs) minimize the power loss in the converter by faster switching operation. The size of the power modules is thus more and more decreased. This means that specific requirements must be met for the operation of converters to avoid electromagnetic influences caused by switching operations.

Interferences may be caused by:

- capacitive fault currents. This is caused by high voltage peaks and switching of bipolar transistors and IGBTs.



- high currents and current peaks in the motor cables The interfering energy bound in magnetic fields reaches frequencies of a few Hertz up to approx. 30 MHz. Due to the high voltage peaks, additional electromagnetic fields occur with frequencies of up to approx. 600 MHz.
- high chopping rates and fast logic circuits (electromagnetic field / 16 MHz .. 1 GHz).
- Mains feedbacks and harmonics. These are caused by commutations and non-sinusoidal mains loading, particularly for mains-commutated controllers (100 Hz ... 20kHz).

### German EMC Law (EMVG)

This converter corresponds to EMVG §5 Section 5, Sentence 3 of EMVG (German EMC Law) dated 09 Nov.92.

*"Devices, which 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 on their own."*

This takes into account that EMC is essentially dependent on the subassemblies of the individual modules and components in the switch cabinet. Regarding the total costs of the machine, it is preferable to suppress interference of an entire system rather than each of its individual components.

The information on the next pages is intended to allow the user to configure his plant according to the latest knowledge in the field of EMC and to comply with legal regulations.

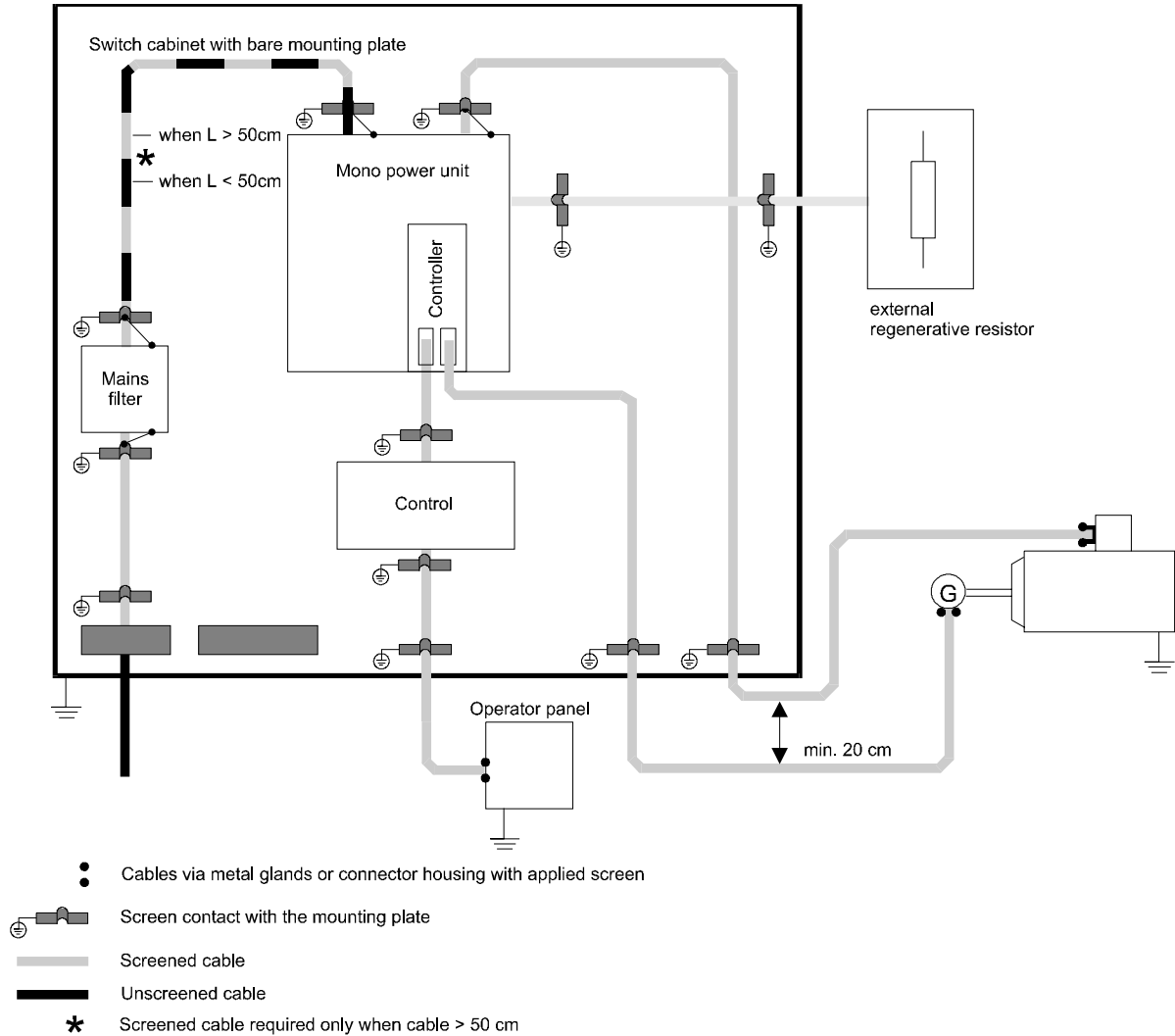
# Installation

## Measures for ensuring EMC

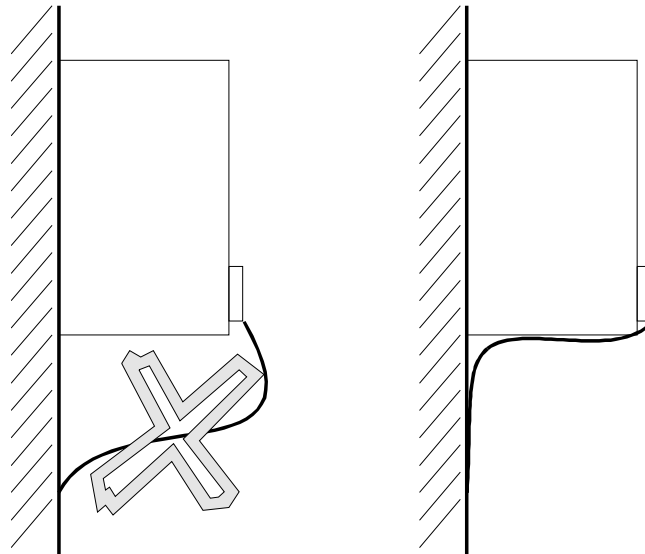
To ensure EMC you must observe the configuration information below.

## Cabling

- To suppress noise emission outside the converter always screen all connected cables. Also observe the items in Chapter "Screening".



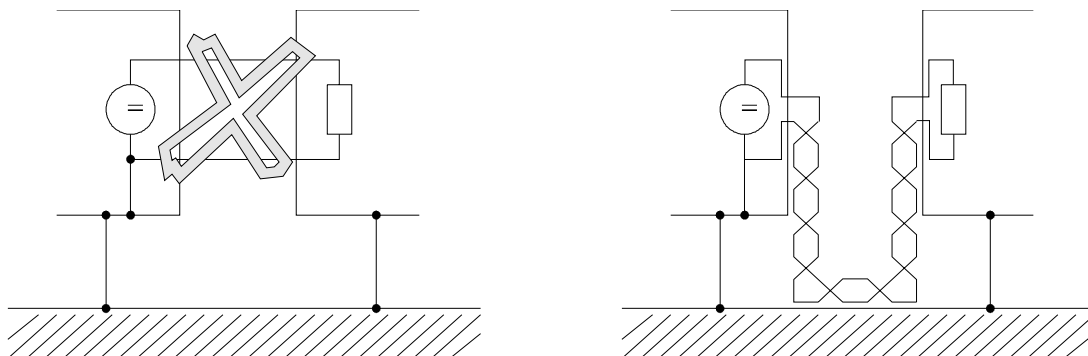
- You achieve the smallest possible effective antenna height by laying the cable directly on the ground of the metallic rack.



incorrect

correct

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



incorrect

correct

- When laying signal and control cables in parallel across power cables, maintain a minimum distance of 20 cm between the conductors.
- Cables of different EMC categories should only cross at an angle of 90°.
- For symmetrical signal transmission (e.g. differential amplifier inputs for the speed setpoint), twist the conductors of each pair together and twist the pairs of wires together.
- The connection between converter and ground plate should be as short as possible (<50 cm). Use large cross-sections (>10 mm<sup>2</sup>).
- Sources of noise such as fuses, transformers, chokes and noise-sensitive modules such as microprocessors, bus systems, etc. should be located at least 20 cm away from the converter and its cabling.
- Avoid reserve loops on long cables.
- The grounding of reserve wires in cables is mandatory (additional screening, avoidance of capacitively coupled, hazardous contact voltages).

## Grounding

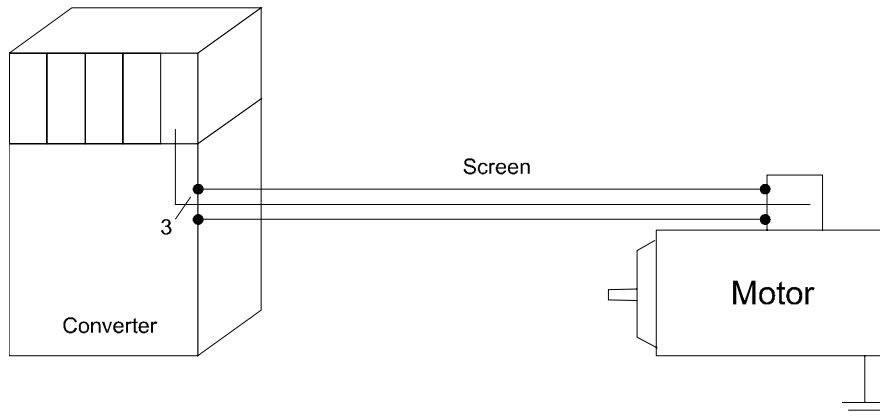
- To meet EMC requirements, the classical star grounding is no longer sufficient to reduce the noise of high frequencies caused by converter operation. Better results can be achieved by a reference surface which must be linked to the units' ground (e.g. bare metal mounting plate and housing parts).
- 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 < 50 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 (<50 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-frequent 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 when it is connected to ground at both ends.

With electrical fields, the screening is effective if the screen is connected to ground at one end.

For electrical or magnetic fields with high frequencies (depending on the cable length), always apply the screen at both ends because of the linkage (electromagnetic field).



If you apply the screen to ground at both ends, the cable does not leave the screening "system housing".

- If you connect cable screens to ground at both ends, the effect of earth loops (potential difference on the ground system) cannot be excluded totally. However, these are very rare if you observe the measures of the above chapters "Cabling" and "Grounding".

The HF connection of a screen to ground can also be capacitive. This prevents low-frequent noise caused by earth loops.

Screen cables passing through different EMC areas must not be separated at the terminals, otherwise the screening would be reduced considerably. They should be led to the next module without interruption.

The screen connection should be of low impedance and over a large surface. Cable tails with a length of only 3 cm (1 cm wire = 10 nH) reduce the screening of up to 30 dB when noise occur in the MHz range!



## NOTE

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

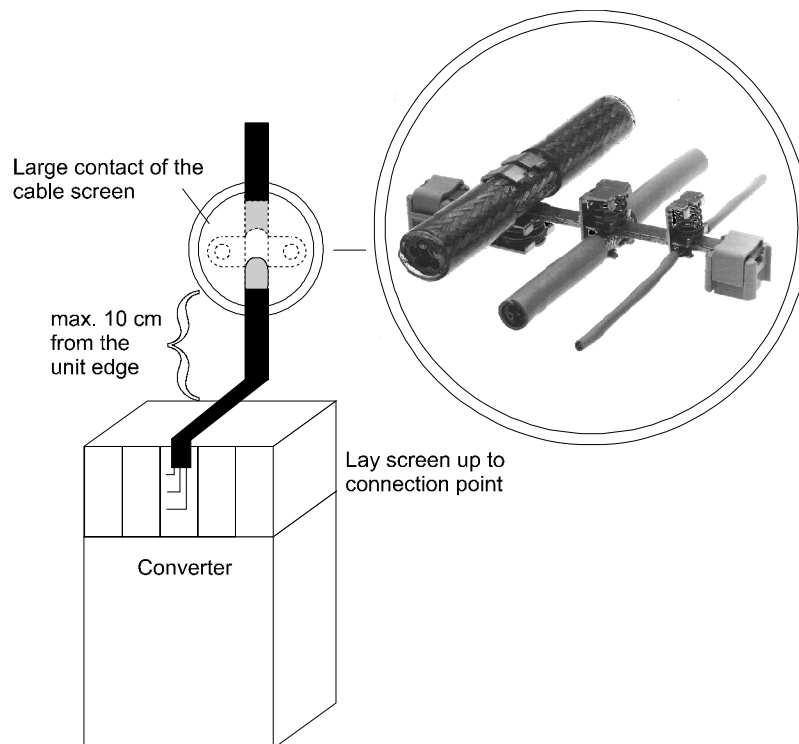
The following cables have a particularly high interference potential:

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

# Installation

---

- Proposal for the screen connection



## Filtering

No filters are necessary for the function of the converter. To maintain EMC regulations, filters at the input or output side may be required.

If you have any queries about the filter dimensioning, please ask for the description "Baumüller Filters for Mains Applications BFN".

## Filter assembly

- Mount the filter next to the converter. If the cables are longer than 50 cm, screen the mains cable between converter and filter (grounding at both ends).
- Input and output cables of the filter must be separated physically (distance > 50 cm).
- Connect the filter housing to ground over a large surface.

## Leakage currents

Due to the principle of operation, stray capacitances in the filter, power stage, motor cable and motor winding cause leakage currents of 100 mA and higher.

This means that converters with current-operated e.l.c.b. can be incompatible!

Observe the safety information in EN 50178:1994 Section 5.2.11.2.

## 6.3 Applicable standards

The power units of the series BUM 62 T are built-in devices according to EN 50178 / VDE 0160 / 11.94, Section 5.2.6 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.1.

Sheets of plastic covering the power connections, 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).

If the units are to be installed in closed electrical premises according to EN 50178/VDE 0160/11.94, Section 5.2.7 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.2, the user must ensure by additional measures that the requirements according to EN 50178/VDE 0160/11.94, Section 5.2.4 are met.

### Mains connection

The power unit is provided for the fixed mains connection to TN and TT mains according to DIN VDE 0100, Part 410/11.83 with a linked mains voltage of up to 3 x 460 V + 15%.

The power unit can be connected to IT mains using an isolating transformer with the neutral grounded at the secondary side.

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. Universal-current sensitive current-operated e.l.c.b. and current-operated e.l.c.b. for AC and pulsating AC fault currents with a rated fault current of 300 mA are suitable.

**The connection of the 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)**

### Climatic conditions / Temperature

Concerning climatic conditions, the units of the climatic category 3K3 for sheltered locations acc. to EN 50178/VDE 0160/11.94, Section 6.1, Table 7, Line 3 or acc. to Table 1 of

EN 60721-3-1,2,3,4 under consideration of Note 1 and 3 of EN 50178/ VDE 0160/11.94, Section 6.1. The actual operating temperature range is between 0 to +55 °C. For storage and transport, the specifications of Table 7 (lines 5 and 6) of EN 50178/VDE 0160/11.94, Section 6.1 apply.

Unlike these specifications, the storage and transport temperature of the units may adopt values between -30 and +70 °C (see technical data).

### Type of protection

The type of protection of the units is IP 20 acc. to EN 60529 (DIN VDE 0470-1).

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

Equipment of protection class I is equipment, in which the protection against shock currents does not only consist of the basic insulation and which includes an additional safety measure. This additional protection is ensured by the connection and other parts to the PE so that no voltage is applied if the basic insulation should fail. The entire insulation of these inverters acc. to EN 50178 / VDE 0160/11.94, Section 5.2.9.1 complies at least to a basic insulation. This also applies to the insulation between the individual circuits.

- The control connections of the power units are safely separated from the mains and are designed for the connection of PELV/SELV circuits.
- The following criteria were considered for the dimensioning of the air and creepage distances:  
Pollution degree 2 acc. to EN 50178/VDE0160/11.94, Section 5.2.15.2, Table 2, line 3
- Normally, only non-conductive pollution occurs. If the units are not in operation, a casual, short-term conductivity caused by condensation is possible.
- Overvoltage category III acc. to IEC 664-1, Table 1 for air distances of mains circuits to their environments acc. to EN 50178/VDE0160/11.94, Section 5.2.16.1.
- Voltage range of the mains circuit for TN and TT mains acc. to DIN VDE 0100 Part 410 / 1996 with a phase-to-earth voltage  $\leq 500$  V.
- Insulating material IIIa for creepage distances acc. to EN 50178/VDE0160,/11.94, Section 5.2.17.



## 6.4 Safety relay

In this chapter we describe the safety relay.

### 6.4.1 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  $180^\circ/\text{number of pole pairs}$ . 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.

### 6.4.2 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.

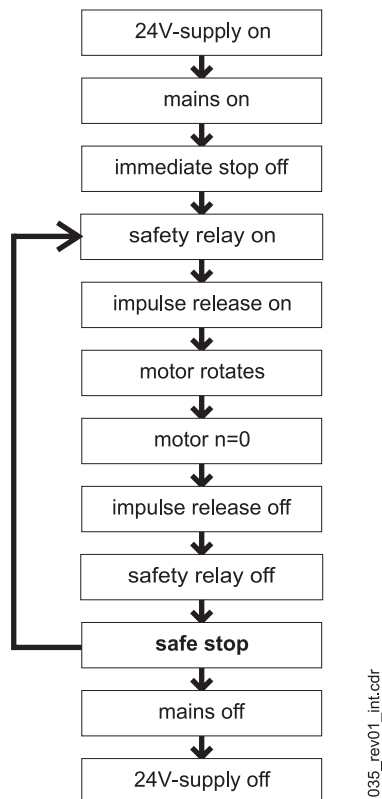
### 6.4.3 The safety relay

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

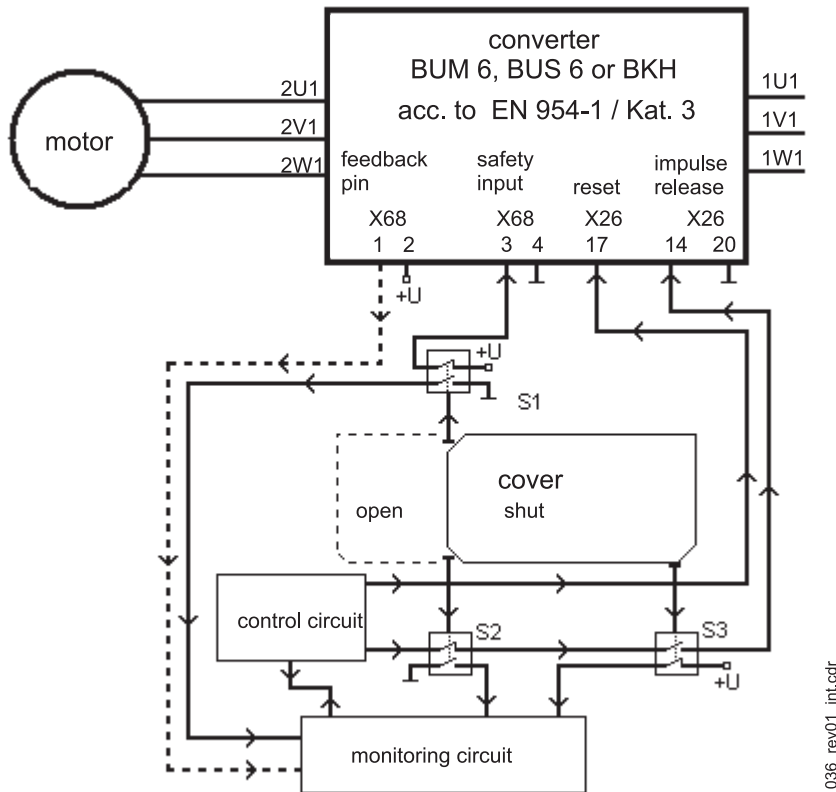
Baumüller-devices of the series BUM 6, BUS 6 and BKH, which are made with one safety relay (optional), comply with the requirements of the category 3 (EN 954-1) for the safety-relevant using “protection against unexpected starting”, if the configuring and installation instructions are complied with.

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 b maXX 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.

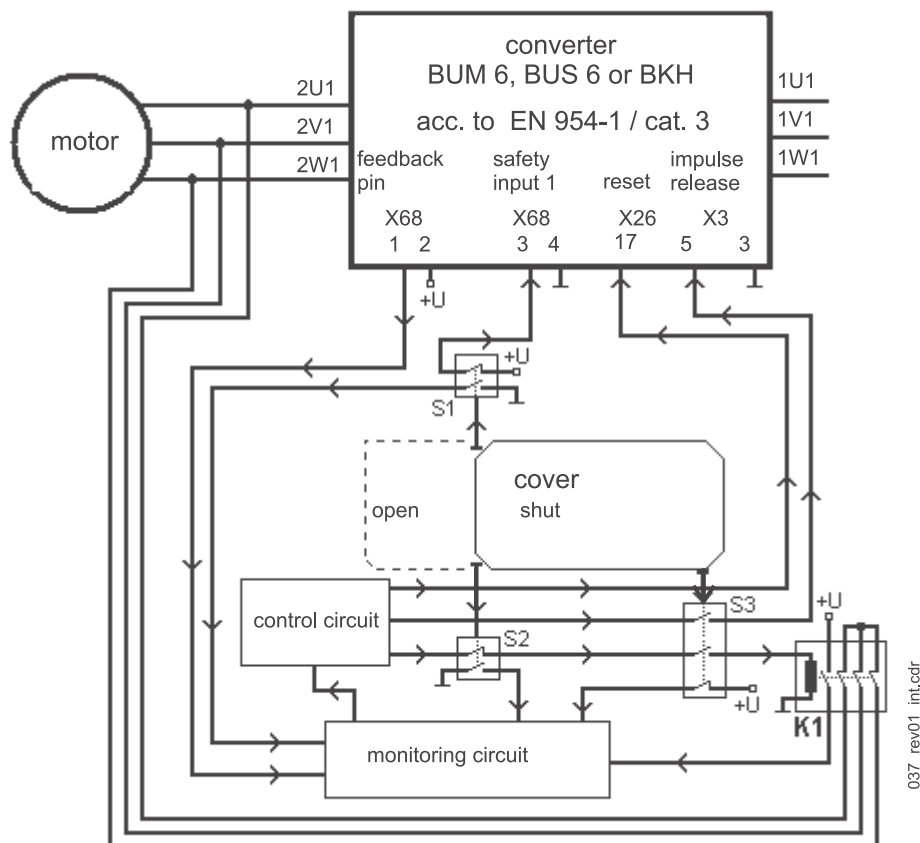
The connection cables between the safety relay input (X68: 3,4) and the control as well as between the impulse release input at the converter (X3:5) and the controller must not be installed outside the control cabinet in a common cable channel.

## 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

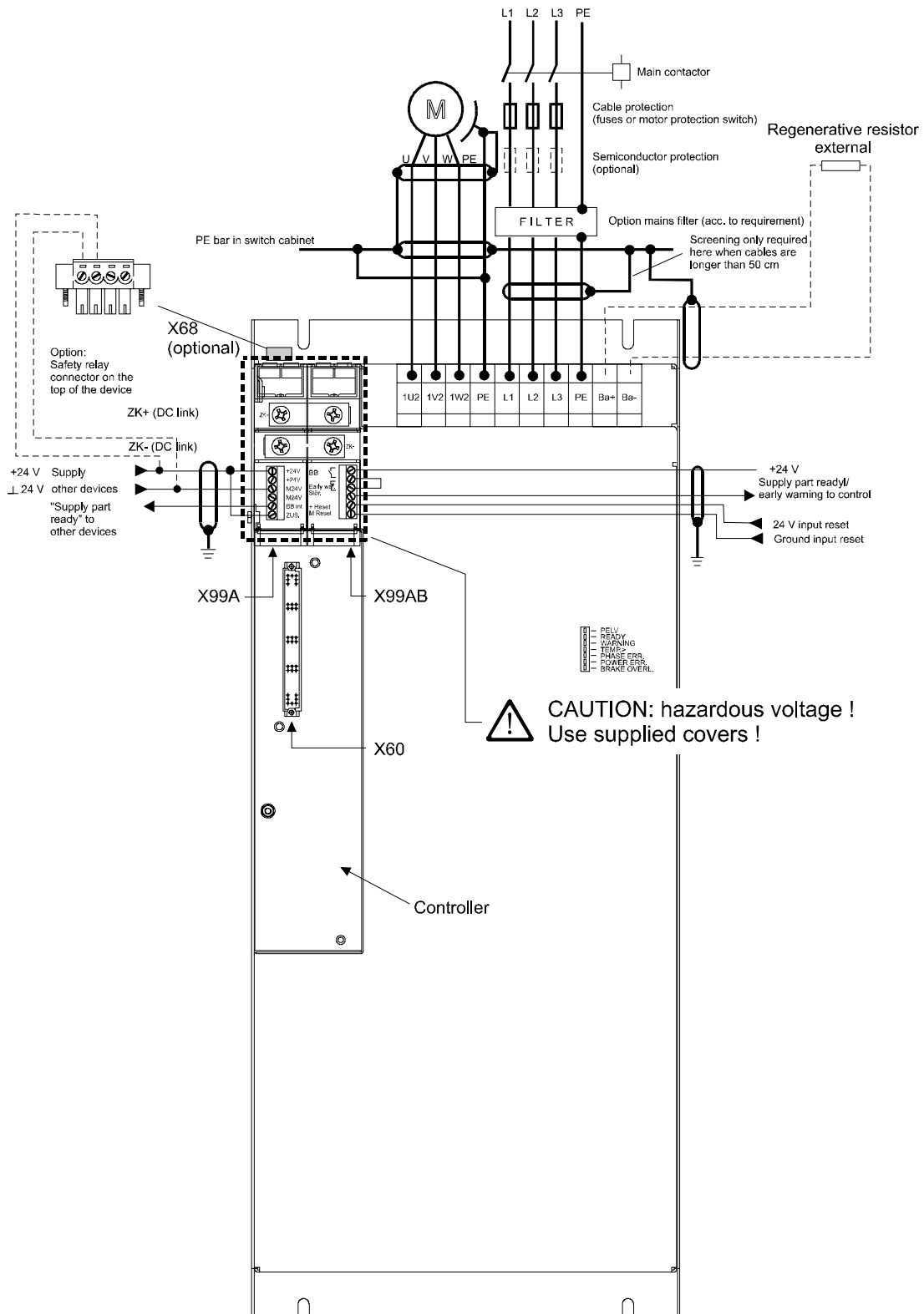
All information given in the Operation Manual of the converter, especially the chapters safety instruction, installation and commissioning, must absolutely be observed.

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.

### 6.4.4 Service time

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

6.5 Connection diagram



## 6.6 Terminal strips and plug-in terminals

### 6.6.1 Power connections

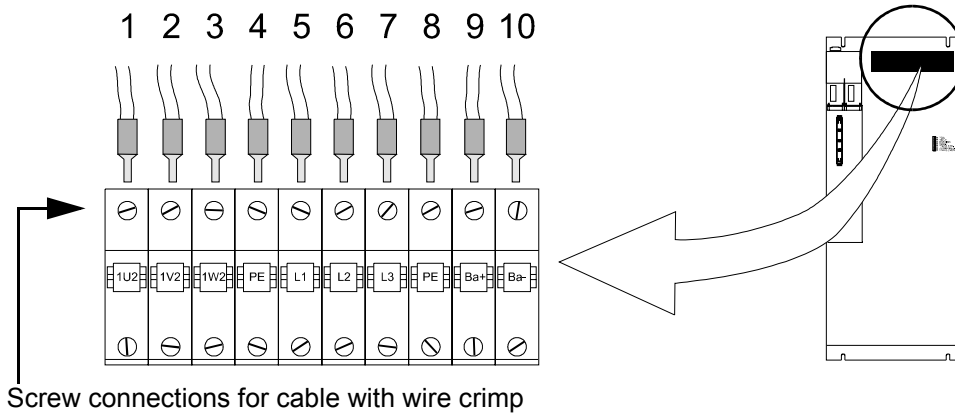


**DANGER**

Danger to life!

The permissible connection value (see "Technical data") must never be exceeded.

#### Terminal strip X1



Terminal	Pos. 1)	Description	U <sub>range</sub> 2)	I <sub>range</sub> 3)	A 4)
1U2	1	Motor connection phase U	max. 570 V	max. 130 A	10 - 25 mm <sup>2</sup> 8 - 4 AWG
1V2	2	Motor connection phase V			
1W2	3	Motor connection phase W			
PE	4	Earth connection			
L1	5	Mains connection phase L1	400 V -15 % up to 460V +10%	max. 105A	
L2	6	Mains connection phase L2			
L3	7	Mains connection phase L3			
PE	8	Earth connection			
Ba+	9	Connection regenerative resistor Ba+ is internally connected to ZK+, Ba- is connected to the collector of the brake switch.	between Ba+ and Ba- max. 800 V <sub>DC</sub>	max. 73 A	
Ba-	10				

1. Position
2. Voltage range (r.m.s. value)
3. Current range (r.m.s. value)
4. select the connection cross-section according to the applicable standards depending on the application. The specified values indicate which flexible conductors are safely connected.



## DC link terminals ZK+ and ZK- (adding units)

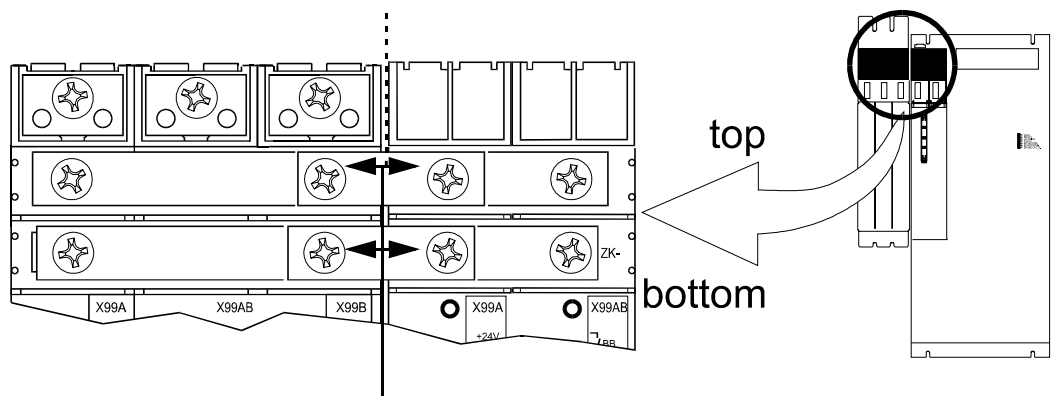
If a Baumüller unit is added to the BUM 62 T, connect the DC links of both units.

If you add power modules, the supply converter of the BUM 62 T supplies the connected power modules. The individual modules exchange energy (e.g. during braking).



**DANGER**

The total power of the motors supplied via the power modules which are connected to the BUM 62 T must not be higher than the power which can be supplied from the supply converter of the BUM 62 T.



Screw connections for bar connection M6

Terminal	Pos. <sup>1)</sup>	Description	U <sub>range</sub> <sup>2)</sup>	I <sub>range</sub> <sup>3)</sup>	A <sup>4)</sup>
ZK+	top	DC link connection Connection of two Baumüller units	between ZK+ and ZK- max. 800 V <sub>DC</sub>	max. 65 A	16 mm <sup>2</sup>
ZK-	bottom				

1. Position
2. Voltage range (r.m.s. value)
3. Current range (r.m.s. value)
4. Conducting cross-section of the bars



**DANGER**

Reassemble and tighten the supplied covers after having connected the DC links of the two units using a bar.

## 6.6.2 Control connections

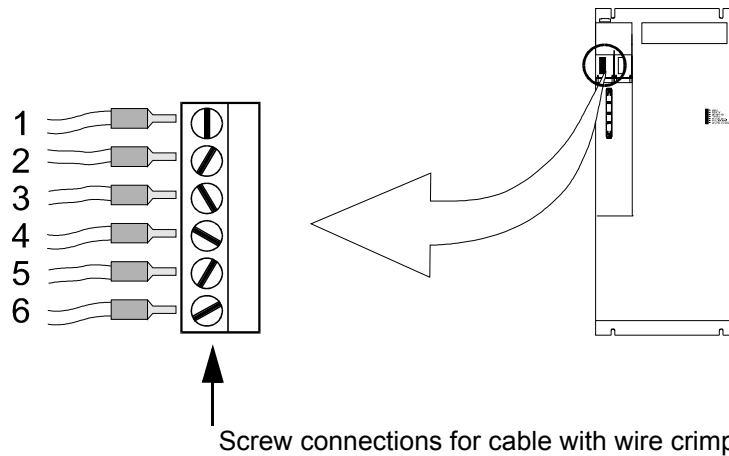


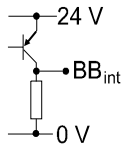
### WARNING

The permissible maximum current of 10 A per connection point must not be exceeded, otherwise the units may be damaged.

All control voltages applied externally must comply with the regulations for PELV or SELV

## Plug-in terminal X99A



Terminal	Pos. <sup>1)</sup>	Description	U <sub>range</sub> <sup>2)</sup>	I <sub>range</sub> <sup>3)</sup>	A <sup>4)</sup>
+24 V	1	<b>+ 24 V<sub>DC</sub> (PELV)</b> <sup>5)</sup> Terminals 1 and 2 are bridged internally	24 V +20 % 24 V -10 %	max. 10 A	0.2 -2.5 mm <sup>2</sup> 24 - 12 AWG
+24 V	2				
M 24 V	3	<b>Ground 24 V<sub>DC</sub> (PELV)</b> Terminals 1 and 2 are bridged internally	0 V	-	
M 24 V	4				
BB <sub>int.</sub>	5	Message "Internal ready for operation" <sup>6)</sup> 0 V Supply part is not ready 24 V Supply part is ready 	0 V or 24 V (PLC level)	-	
ZUS.	6	Reserve	-	-	

1. Position from the top
2. Voltage range (r.m.s. value)
3. Current range (r.m.s. value)
4. Cross-section of the conductor. Observe EMC requirements (see EMC information on page 25)
- 5.



### NOTE

The input of the power supply includes capacitors (250 µF) so that charge current occur when the 24V supply is switched!

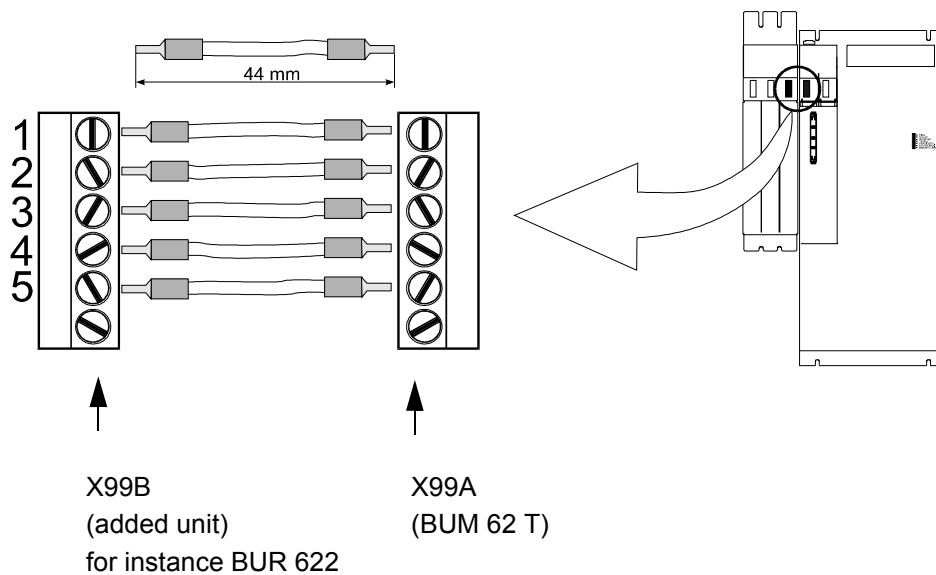
6. This message only refers to the BUM 62 T, and not to the controller!  
(see also "Ready for operation" on page 53 )

# Installation

## X99A (adding units)

If you add a Baumüller unit to the BUM 62 T, connect terminals 1 to 5 of relay X99B of the added unit to terminals 1 to 5 of relay X99A of the BUM 62 T.

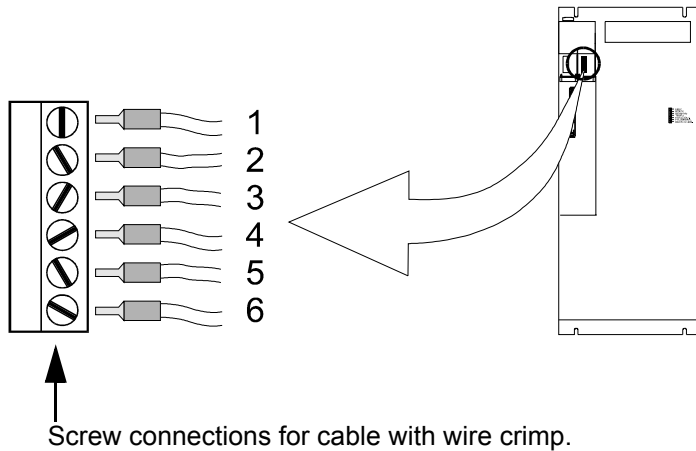
Connection

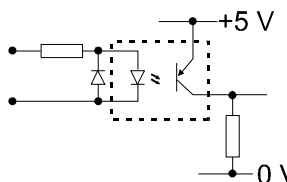


## NOTE

The combination of two plug-in terminals and connecting cables (see figure above) is available as an accessory from Baumüller Nürnberg.

## Plug-in terminal X99 AB



Terminal	Pos. <sup>1)</sup>	Description	U <sub>range</sub> <sup>2)</sup>	I <sub>range</sub> <sup>3)</sup>	A <sup>4)</sup>
} BB <sub>(ext)</sub>	1	Message " <b>External ready for operation</b> " <sup>5)</sup> Open contacts. Supply part not ready	24 V	0.5 A	max. 2.5 mm <sup>2</sup>
	2	Closed contacts. Supply part ready			
} Vorw. Stör.	3	Message " <b>Early warning</b> " <sup>5)</sup> Closed contacts. Supply part – no early warning			
	4	Open contacts. Supply part – early warning			
+Reset	5	isolated optocoupler input to reset error messages. PHASE ERR, POWER ERR, and BRAKE OVERL. 	24 V	-	
M Reset	6	Reference to input +Reset	0 V	-	

1. Position
2. Voltage range (r.m.s. value)
3. Current range (r.m.s. value)
4. Cross-section of the conductor
5. This message only refers to the BUM 62 T, and not to the controller!  
(see also "Messages via relay contacts" on page 61 )

# Installation

## 6.6.3 Controller connection

Plug-in terminal X60. Refer to the description of the controller.

## 6.6.4 Safety relay (as an option)

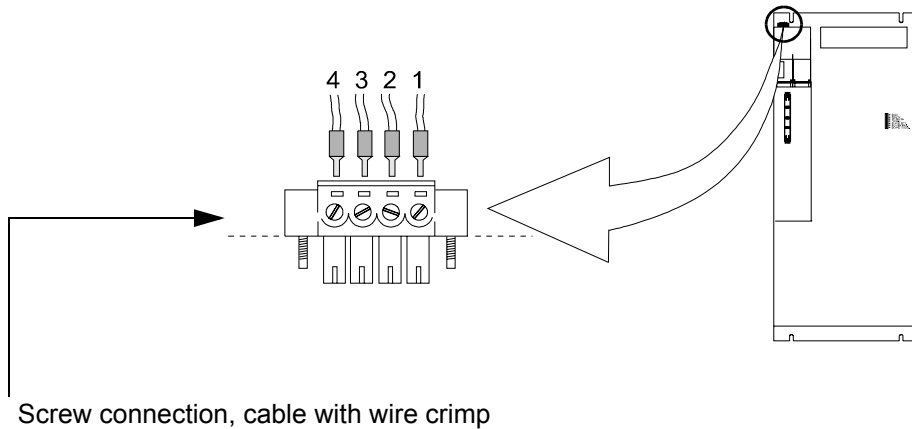
The safety relay is used to disconnect load from the drive by switching of the +24V via contacts 3 and 4.



### WARNING

The user must prevent overloading of the relay contacts, e.g. by suitable fuses.  
The load of 10 mA is a minimum load to ensure permanently a trouble-free function.

### Plug-in terminal X68



Terminal	Pos. 1)	Description	U <sub>range</sub> 2)	I <sub>range</sub> 3)	A 4)
	1 2	Feedback whether the safety relay is supplied with 24 V	+24 V	max. 8 A	1.5 mm <sup>2</sup>
+24 V	3	+ 24 V connection for the safety relay (PELV)	+24 V	max. 25 mA	
M 24 V	4	Ground connection for the safety relay (PELV)	0 V		

1. Position
2. Voltage range (r.m.s. value)
3. Current range (r.m.s. value)
4. Cross-section of the conductor



## NOTE

During motor operation, +24 V DC must be applied at the terminals 3 and 4.  
Safety relay OFF is saved as a message and must be reset via the controller.

## 6.7 Accessories

- **EMC package**
  - EMC filter
  - Screened cables
  - Connection parts





## 7 COMMISSIONING

### 7.1 Danger information



#### WARNING

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

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

The protective measures and safety regulations according to DIN/VDE are binding for personal security. If there are no PE connections on the unit, the commutation choke or the motor, personal injury may be caused since the surface may carry hazardous voltage.

The power connections of the converter carry potential!

The parts of the converter carry hazardous voltage even if the main contactor has released.

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. Make the PE connection according to DIN EN 60204 / VDE 0113 Part 1 / 06.93, Section 8.2.2. considering EN 50178 / VDE 0160/11.94, Sections 5.3.2.1 and 8.3.4.4.

Before commissioning check whether the plastic covers over the live parts (power part connections) are in place.



## WARNING

### Malfunction of the drive

During the initial commissioning, a faulty or uncontrolled movement of the driven machine elements cannot be excluded. Therefore, proceed with particular care.

Prior to connecting the drive, carefully check all higher-level safety equipment for perfect functioning, to avoid personal injury.

Special care must be taken when touching the drive shaft directly or indirectly (by hand). This is permissible only when the shaft is at standstill and the converter is de-energized. Machine parts which are freely accessible during operation (shafts, fans, etc.) must be covered.

### Protection against contact according to Paragraph 4 Section 4 VBG 4

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

The active parts must therefore be protected from direct contact by insulation, design, position, arrangement or firmly installed facilities. Protection refers to common covers, barriers and procedures which ensure that persons are prevented from touching live, active parts.

Switch cabinet must have emergency stop facilities using which all voltages causing dangerous situations, can be switched off. This does not include equipment which, if switched off, would cause another dangerous situation. The releasing element for the emergency stop facility must be arranged such that it can easily be reached in case of danger. In the event of work which is considerably more dangerous than usual, another person must be present.

The operator must ensure that unauthorized persons do not work on the machine.



### WARNING

Subsequent high-voltage tests must only be carried out by BAUMÜLLER NÜRNBERG GmbH. If you want to carry out high-voltage tests for complete switch cabinet installations, disconnect all cables from the devices prior to the test.

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

The operator must report immediately any changes that occur which adversely affect the safety of the unit/system.

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

This list does not claim to be complete for the safe operation of the unit. If you should need further information or if special problems arise please contact BAUMÜLLER NÜRNBERG or a sales agency. Please observe the warnings in Chapter 1 of these operating instructions.



### NOTE

Prior to touching the modules, the user must discharge electrostatically to protect electronic components from high voltages caused by electrostatic charge. This can simply be achieved by touching a conductive, grounded part immediately before touching the electronic component.



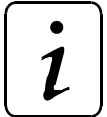
Devices with electrostatically endangered components or modules are marked using this label at a visible position.

## 7.2 Operation

The device is almost exclusively operated via the controller (see controller description).

Reset (acknowledgement) of errors via the optocoupler input "Reset" of the connector strip X99AB is the only exception from this.

## 7.3 Monitoring functions and their messages



### NOTE

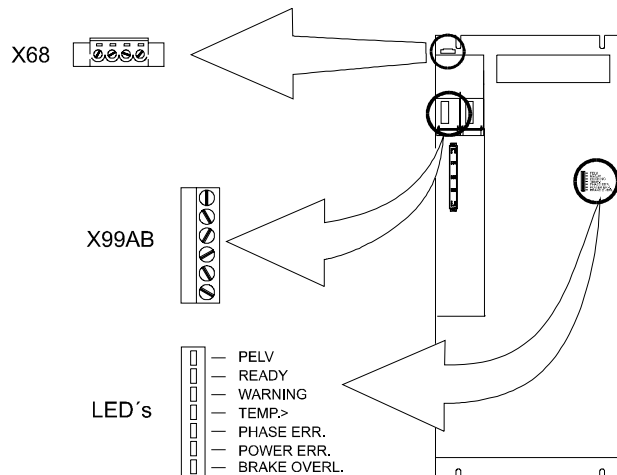
Monitoring functions are active only when the +24V supply voltage (X99A) is applied.

The monitoring functions of BUM 62 T is divided into two groups. The first group is "Monitoring functions of the supply part". The second group is "Monitoring functions of the power part on the motor side". This division corresponds to the internal design of the unit.

#### Monitoring functions of the supply part

The messages generated by the "Monitoring functions of the supply part" are indicated via relay contacts and/or displayed by LEDs. The messages are sent simultaneously to the controller which processes it.

The position of the relay contacts and the LEDs is illustrated on the following figure



For more detailed information on the messages and the LEDs/relay contacts refer to "Messages via LEDs" page 60 and to "Messages via relay contacts" page 61.

#### Monitoring functions of the power part on the motor side

The messages generated by the "Monitoring functions of the power part on the motor side" are exclusively sent to the controller which processes them.

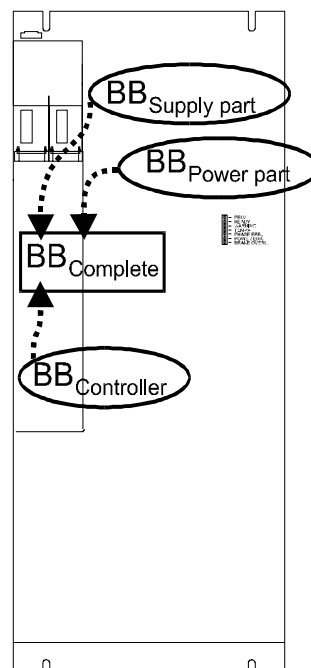
## 7.3.1 Ready for operation

The message "Ready for operation" is the most important message for you. If a monitoring function generates a message which clears the "Ready for operation" message, the production of your plant is stopped in the worst case.

There is more than one "Ready for operation" message. If, e.g. a V controller is included in the BUM 62 T, four different "Ready for operation" messages can be displayed in a drive.

- "Supply part ready" (available and visible in the BUM 62 T)  
= "Internal ready for operation" (digital output)  
= "External ready for operation"(relay contacts)
- "Supply part ready" (available in the BUM 62 T and **not** visible)
- "Controller ready" (available in the controller)
- "Completely ready" (available in the controller)

The message "Completely ready" depends on the three other "Ready" messages. The message "Completely ready" is output only when the messages "Supply part ready" and "Power stage ready" and "Controller ready" are output (see figure).



### NOTE

The drive is ready approx. 3.5 seconds after the +24V supply voltage and the mains voltage have been applied.

"Power part ready" after approx. 0.5 s.

"Controller ready" after approx. 3 s

The following sections provide further information on the different "Ready" messages.

## **"Supply part ready"**

When the "Monitoring function of the supply part" does not recognize any errors, the monitoring function generates the message "Supply part ready".

- **If the message "Supply part ready" is cleared by the monitoring function, the BUM 62 T disconnects the load from the drive, i.e. the units does no longer supply a torque.**

The BUM 62 T displays this message using an LED and supplies it to relay contacts at the same time. For more information refer to "Messages via LEDs" page 60 and "Messages via relay contacts" page 61.

The "Supply part ready" is also referred to as "Internal ready" (terminal designation BBint) or "External ready" (terminal designation BBext).

Both messages are identical. The difference lies in the internal structure of the unit.

At the output of the supply part, "Supply part ready" is also referred to as "Internal ready". After the message of the unit has been passed on to the power part, the message "Supply part ready" is referred to as "External ready".

## **"Power part on the motor side ready"**

When the "Monitoring function of the power part on the motor side" does not recognize and errors, the monitoring function generates the message "Power part on the motor side ready".

- **If the message "Power part on the motor side ready" is cleared by the monitoring function, the BUM 62 T disconnects the load from the drive, i.e. the units does no longer supply a torque.**

## **"Controller ready"**

The V controller was mentioned at the beginning of this section. It may be possible that you use another controller. Therefore, we will not provide any further information and refer to the corresponding documentation. The documentation of your controller provides information on whether the message "Controller ready" is available in the controller you are using and how you can process this message, if available.

## **"Completely ready"**

The above mentioned information applies here as well. The documentation of your controller provides information on whether the message "Completely ready" is available in the controller you are using and how you can process this message, if available.

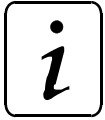
## 7.3.2 Monitoring functions

The following table lists all monitoring functions. An explanation of every individual monitoring function will be given on the following pages.

Monitoring function		LED	Relay	V-controller	Reset
Supply part	Phase failure	WARNING PHASE ERR.	- X99AB; 3,4	- F 0110 <sup>1)</sup>	- 24 V <sup>2)</sup>
	Mains failure	WARNING POWER ERR.	- X99AB; 3,4	- F 0110 <sup>1)</sup>	- 24 V <sup>2)</sup>
	Short circuit regenerative circuit output	BRAKE OVERL.	-	F 0110 <sup>1)</sup>	U <sub>ZK</sub> <sup>3)</sup>
power part on the motor side	Overcurrent (motor)	-	-	F 0202	cont. <sup>4)</sup>
	Earth current (short circuit)	-	-	F 0203	cont. <sup>4)</sup>
	Overvoltage DC link	-	-	F 0201	cont. <sup>4)</sup>
	Power transistors	-	-	F 0207	cont. <sup>4)</sup>
	Overheat heat sink	-	-	F 0205	cont. <sup>4)</sup>
	Internal auxiliary voltage	-	-	F 0204	cont. <sup>4)</sup>
	Safety relay	-	X 68; 1,2 <sup>5)</sup>	F 0206	cont. <sup>4)</sup>

1. The V controller always outputs this collective message in the event of an error in the supply part. The corresponding LED displays on the front of the unit which error has occurred.
2. Trigger reset input (apply +24V and M24V at X99AB, optocoupler input).  
**or**  
Switch off +24V supply voltage.  
  
This clears **all** messages of the supply part!  
If you observe the WARNING message, you can bring the drive to a defined operating state before the power unit clears the "Supply part ready" message and de-energizes.
3. Not possible via the reset input! For safety reasons you have to wait until the DC link has discharged (U<sub>ZK</sub> < 20 V), then switch off +24-V supply voltage.  
  
This clears **all** messages of the supply part!
4. You must clear this message by a controller reset.  
The controller documentation specifies how to display and clear the message.
5. A message occurs only if the safety relay is switched off. The safety relay is switched off only if the +24V supply voltage for the relay is not applied.  
Switch on again the +24 V supply voltage for the relay before you can clear the message by a controller reset.

## Reset



### NOTE

**Reset:** If the message cannot be reset, it is very likely that the cause of the error has not yet been removed.

## Monitoring functions of the supply part

### • Phase failure monitoring function

The voltage of all mains phases is monitored. If a mains phase fails, the BUM 62 T generates a WARNING message. If the voltage returns within 10 seconds, the WARNING message is cleared. If the mains phase fails for more than 10 seconds, the WARNING message is cleared and the message "Phase failure" is stored. The message "Supply part ready" is cleared.

### • Mains failure monitoring function

The voltage of all mains phases is monitored. Two different situations are possible:

#### 1. Two or three mains phases fail and the **DC link voltage slowly reduces**.

- The WARNING message is set.
- The message "Mains failure" is output, as soon as the DC link voltage is smaller than 300 V.
- The message "Supply part ready" and the WARNING message are cleared.

#### 2. Two or three mains phases fail and the **DC link voltage reduces very fast (within a few milliseconds)**.

- The message "Mains failure" is output, as soon as the DC link voltage is smaller than 300 V.
- The message "Supply part ready" is cleared.
- The WARNING message is set (for a few milliseconds).

Reason: If two or three mains phases fail, the procedure "Output WARNING message" is started. This procedure takes a few milliseconds. If the DC link voltage falls below 300 V within this time, the message "Supply part ready" is cleared immediately. The WARNING message is then set and cleared immediately since the message "Supply part ready" is no longer available.



### NOTE

After the +24V supply voltage has been switched on, the output of the "Mains failure" monitoring function is stored only if:

- the **mains** is recognized to be "**okay**" and the DC link **has fallen below 300 V**.

To achieve an automatic restart e.g. after mains interrupt, you can avoid the storing of the messages by a permanent triggering of the reset input (apply +24V and M24V at X99AB, optocoupler input),



provided that the mains failure time > 0 seconds has been set. Refer to "Mains failure time" in the controller description)



### WARNING

If you enable an automatic start of the drive, you cause a severe danger of the operating personnel. If a enable an automatic start of the drive, you must provide a protection on the machine side!

- **Monitoring function of short-circuit regenerative circuit output**

The connection for the external regenerative circuit is monitored.

If the monitoring function recognizes a short-circuit at the connection for the external regenerative circuit, the message "Short-circuit regenerative circuit" is generated. This message is stored and the message "Supply part ready" is cleared.



### WARNING

A short-circuit of the regenerative circuit may destroy the unit.

## Monitoring functions of the power part on the motor side

- **Overcurrent (motor) monitoring function**

Each of the three motor phase currents is monitored.

If the phase current exceeds 30% of the peak value of the permissible peak current, the BUM 62 T generates a message. This message is stored in the BUM 62 T and transmitted to the controller. The message "Power stage on the motor side ready" is cleared.



### NOTE

The overcurrent message and the subsequent stop of the drive protects the drive from damage/destruction. To avoid the message Overcurrent (motor), you must limit the permissible peak current of the motor phase currents by the control.

- **Earth current (short-circuit) monitoring function**

The earth fault current of the motor phases is monitored.

A message is generated when the fault current exceeds 20 % of the peak value of the permissible peak current of the power part. An earth fault at the motor connection is very probable. This message is transmitted to the controller. The message "Power part on the motor side ready" is cleared.

- **Overvoltage DC link monitoring function**

The voltage of the DC link is monitored.

If the DC link voltage exceeds 800 V, a message is generated. This message is transmitted to the controller. The message "Power stage on the motor side ready" is cleared.



### NOTE

The DC link voltage can rise until it is switched off if the drive brakes and no or an insufficient regenerative circuit is connected to the DC link.

- **Power transistors monitoring function**

The collector-emitter saturation voltage is monitored.

If the voltage is too high, an overcurrent is applied to the power transistor, caused e.g. by a short-circuit of the motor terminals and a controlled switch-off procedure switches off the transistor and generates a message. This message is transmitted to the controller. The message "Power stage on the motor side ready" is cleared.



### NOTE

To ensure a recovery of the transistor after a switch-off because of overcurrent, the message can only be reset after at least 5 seconds (typically 10 s).

- **Overheat heat sink monitoring function**

The temperature of the heat sink is monitored.

A linear thermal sensor is located on the heat sink the measured value of which is passed on to the controller. This means the controller is responsible for the temperature monitoring (refer to the controller description) which must be set according to the technical data in the controller description. The message "Power part on the motor side ready" is cleared.



### WARNING

The highest temperature allowed for the heat sink is 90 °C - higher temperatures may destroy the unit .

Adjust the controller in such a way, that "Power part on the motor side ready" will be cleared by the controller, when the heat sink reaches a temperature of 85 - 90 °C.

- **Internal auxiliary voltage monitoring function**

The voltage which is used to trigger the power transistors, is monitored.

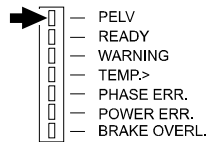
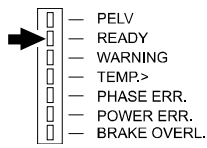
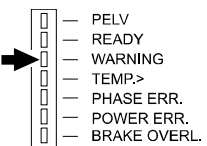
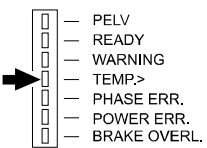
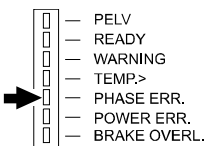
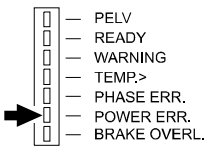
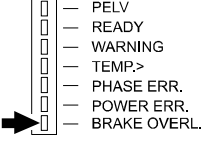
If there is no internal auxiliary voltage, a message is generated. This message is transmitted to the controller. The message "Power part on the motor side ready" is cleared.

- **Safety relay (option)**

The switching state of the safety relay is monitored.

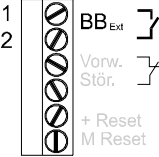
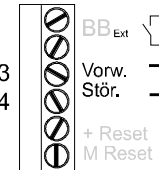
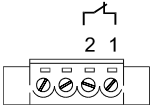
For further information on the safety relay please refer to "Messages via relay contacts" page 61.

## 7.3.3 Messages via LEDs

LED	Description
<p><b>PELV</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Protective extra low voltage +24 V</b></p> <p>green <b>LED off</b>: At the terminals of plug-in terminal X99A are applied: 1,2: no +24 V 3,4: no 24 V ground</p> <p>green <b>LED on</b>: At the terminals of plug-in terminal X99A are applied: 1,2: +24 V 3,4: 24 V ground</p>
<p><b>READY</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>"Supply part ready" <sup>1)</sup></b></p> <p>green <b>LED on</b>: The message "Supply part ready" is activated.</p> <p>Further information on this message can be obtained from "Supply part ready" page 54</p>
<p><b>WARNING</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Warning<sup>1)</sup></b></p> <p>yellow <b>LED on</b>: The WARNING message is activated.</p> <p>"Phase failure monitoring function" page 56 and "Mains failure monitoring function" page 56 will inform you in which cases the message is activated.</p>
<p><b>TEMP. &gt;</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Overheat</b></p> <p>The red LED is always off - it has no function in this unit.</p>
<p><b>PHASE ERR.</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Phase failure</b></p> <p>red <b>LED on</b>: The message "Phase failure" is activated.</p> <p>"Phase failure monitoring function" page 56 will inform you in which cases the message is activated.</p>
<p><b>POWER ERR.</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Mains failure</b></p> <p>red <b>LED on</b>: The message "Mains phase failure" is activated.</p> <p>"Mains failure monitoring function" page 56 will inform you in which cases the message is activated.</p>
<p><b>BRAKE OVERL.</b></p>  <p>— PELV — READY — WARNING — TEMP.&gt; — PHASE ERR. — POWER ERR. — BRAKE OVERL.</p>	<p><b>Short-circuit regenerative circuit output (Ba+ with Ba-)</b></p> <p>red <b>LED on</b>: The message "<b>Short-circuit regenerative circuit output</b>" is activated.</p> <p>"Monitoring function of short-circuit regenerative circuit output" page 57 will inform you in which cases the message is activated.</p>

1. see also "Messages via relay contacts" page 61.

### 7.3.4 Messages via relay contacts

Plug-in terminal	Description
 <p><b>X99AB</b></p>	<p><b>"Supply part ready"</b></p> <p>Contact <b>open</b>: The message "Supply part ready" is not activated.</p> <p>Contact <b>closed</b>: The message "Supply part ready" is activated.</p> <p>Further information on the message "Supply part ready" can be obtained from "Supply part ready" page 54</p>
 <p><b>X99AB</b></p>	<p><b>Early warning - interference</b></p> <p>Contact <b>closed</b>: The WARNING message is not activated.</p> <p>Contact <b>open</b>: The WARNING message is activated.</p> <p>"Phase failure monitoring function" page 56 and "Mains failure monitoring function" page 56 will inform you in which cases the message is activated.</p>
 <p><b>X68</b></p>	<p><b>For an immediate production restart, it is necessary to stop a drive electronically to achieve the following:</b></p> <ul style="list-style-type: none"> <li>no contactors in the motor cables are necessary</li> <li>DC link voltage does not have to be switched off.</li> </ul> <p><b>This requirement is met by using a safety relay.</b></p> <p><b>Feedback of safety relay (safety relay is available as an option)</b></p> <p>Contact <b>closed</b>: No +24 V supply for the safety relay. The power stage or the inverter is inhibited.</p> <p>Contact <b>open</b>: +24 V supply for the safety relay is applied. The power stage or the inverter can be triggered by the controller.</p> <p>If the +24V supply for the safety relay is no longer applied while the drive is running, the drive no longer supplies a torque (i.e. there is no supply from the BUM 62 T). To restart the drive, proceed as follows:</p> <ul style="list-style-type: none"> <li>Switch on +24 V supply for the safety relay</li> <li>Clear the existing message by a controller reset</li> </ul>



## 8 MAINTENANCE



### WARNING

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

All maintenance and service work must only be carried out when the unit is de-energized.

Do not begin work on the DC link of the power unit until you have made sure that neither potential nor voltage (residual charge) is applied.

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

After carrying out any work on the machine –regardless of whether this involves the motor, the actual value detection or the power unit – the owner must carry out acceptance testing of the entire drive and document this chronologically in the machine log.

Failure to do this may result in the owner being faced with consequences relating to liability.

### 8.1 Maintenance information

The supplied power unit is free of maintenance.

#### **Prohibition of unauthorized modifications**

For safety reasons, you must not modify or add components on/to the drive.

## 8.2 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.

## 8.3 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.



## 8.4 Disposal

The units consist essentially of the following components and materials:

Component	Material
diverse spacers, housing of the current transformer and the fan, etc.	Plastic
PCB on which the entire control electronic is located.	Basic material Epoxy resin glass fibrematerial, copper-plated on both sides and interconnected; diverse electronic components such as capacitors, resistors, relays, semiconductor elements, etc.

Electronic elements may contain dangerous material.

If the components are used as directed, there is no danger for human beings or to the environment.

Hazardous materials may be created or released in case of fire.

Electronic components must not be opened, since beryllium oxide is used as internal insulation e.g. in diverse semiconductors.

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 the units and modules according to the national regulations and the regional and local ordinances.



## 9 APPENDIX

### 9.1 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:**

Einzel-Leistungseinheit

BUM 62 T.. / .. - . - . - . - . - .

Nürnberg, den 03.02.2005

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

9.2 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:

Einzel-Leistungseinheit

BUM 62 T.. / .. - .. - - - - ..

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:

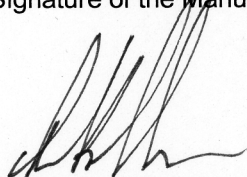
EN 50178: 1994 (VDE 0160/11.94)  
„Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln“

EN 50178: 1994 (VDE 0160/11.94)  
„Equipment of power installation concerned electronic operating materials“

Nürnberg, den 03.02.2005

Hersteller-Unterschrift:

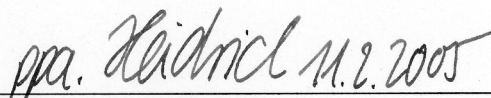
Signature of the Manufacturer:



16.02.2005

Andreas Baumüller

Geschäftsleitung  
Head Division



ppa. Dr. Peter Heidrich

Entwicklungsleiter  
Head of Development

## 9.3 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 transferral 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 transferral 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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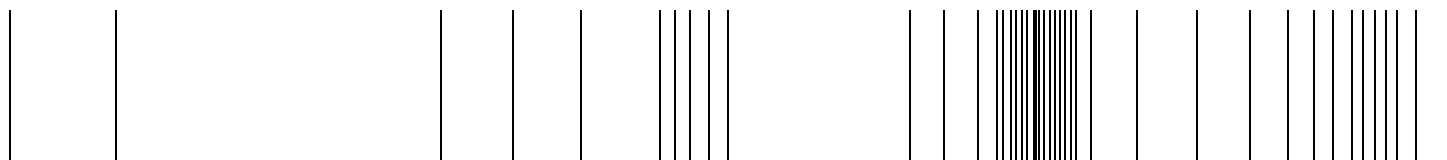
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**be in motion**



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