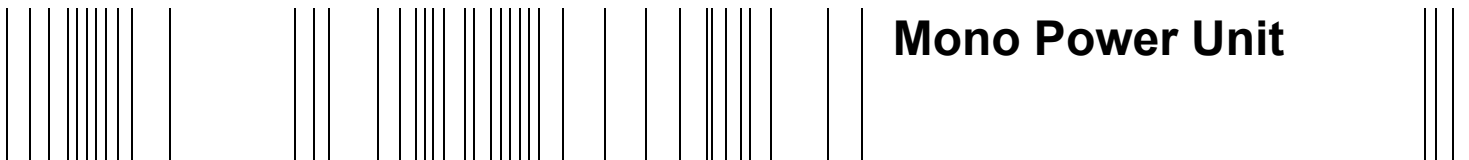


be in motion be in motion



Mono Power Unit

POWER CONVERSION EQUIPMENT



BUM 62, 63, 64

Manual

E

5.94005.12



BAUMÜLLER

Titel	Manual
Produkt	Mono Power Unit BUM 62, 63, 64
Version	5.94005.12
Stand	2001-01-04
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ABBREVIATIONS

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

1 SAFETY NOTES

Introductory remarks

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

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

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

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

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

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

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

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

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

The discharge time of live parts is > 1 min.

The units are partly short-circuit-proof.

General information

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

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



DANGER

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

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

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

Safety Notes

Danger information

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

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



DANGER

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



WARNING

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



NOTE

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

Qualified personnel

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

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

Application as directed



WARNING

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

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

Voltage test

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

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



WARNING

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

2 TECHNICAL DATA

2.1 General

The mono power units BUM 62, BUM 63 and BUM 64 complete the upper power range of the Baumüller Modular System.

They are produced as compact converter units and contain the mains supply as well as the motor-end power unit.

The rack-mounted modules of the Baumüller Modular System are designed for control tasks. As a result, the drives can be adapted to a wide variety of requirements.

There are two types of controller.

The BUS 6 E controller for almost all applications in constructional engineering.

The BUS 6 T controller for highly demanding control tasks.

As both controllers are equipped to be rack-mounted, separate descriptions are available with the respective characteristics and technical data.

Depending on the application, the unit can be delivered in variations from simple frequency converters to highly dynamic and precise vector controllers.

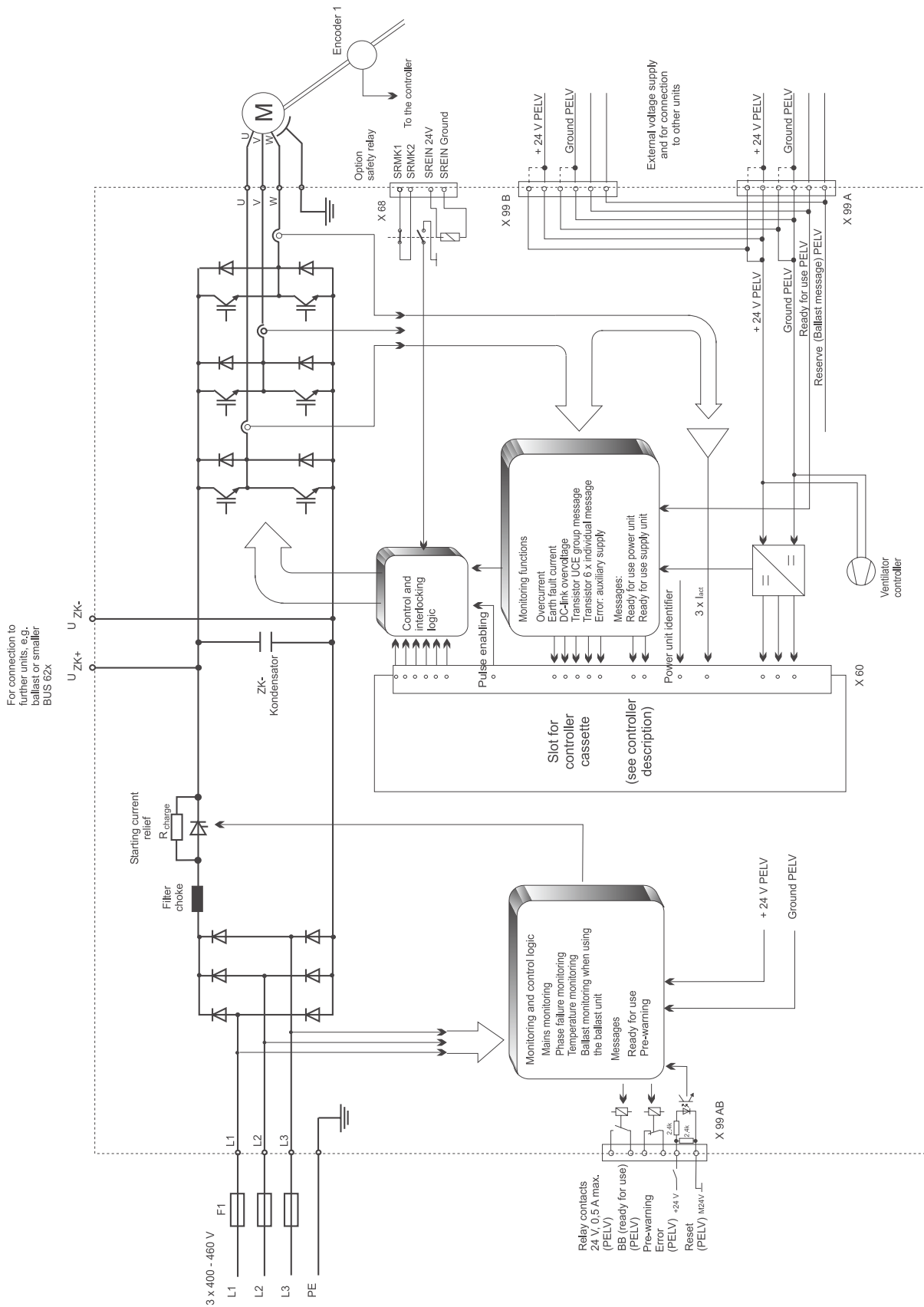
With the BUM 62, BUM 63 and BUM 64 mono power units, both asynchronous and synchronous motors with different encoder systems can be driven by the same unit.

2.1.1 Function description

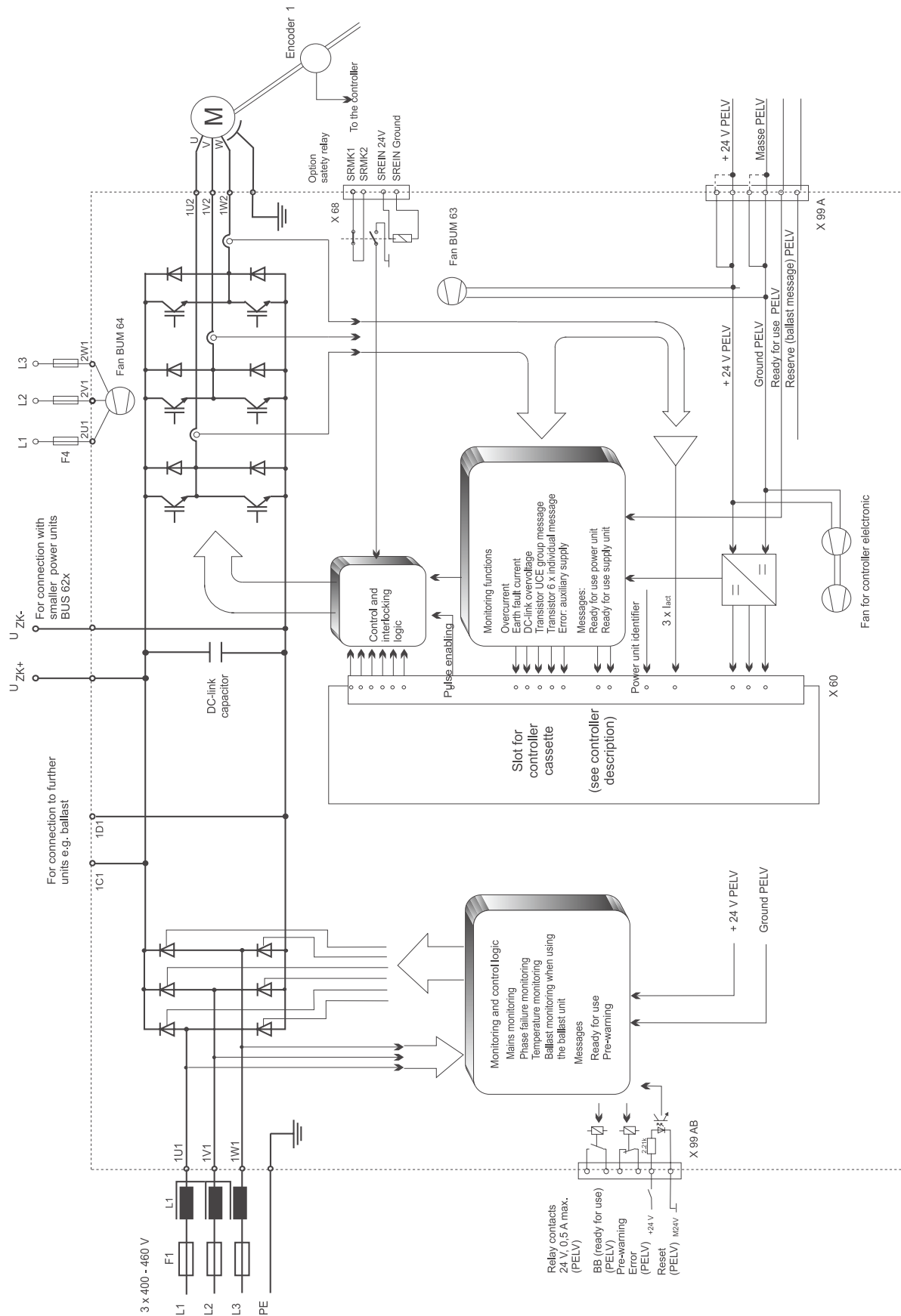
The BUM 62, 63 and 64 units consist of two parts, the supply converter and the motor-end inverter.

- **BUM 62:**
The supply converter for creation of the intermediate circuit voltage is an uncontrolled diode bridge. The intermediate circuit capacitors are charged via a charging resistance to reduce peak starting current, which is bridged by a thyristor after switching on.
- **BUM 63 and 64:**
The supply converter is a thyristor bridge. The starting current is limited, on switching on, by controlling the thyristor converter current .
- **BUM 62, 63 and 64:**
The IGBT motor-side inverter processes the transistor control signals sent by one of the controllers plugged into the slot, and makes the control measurement signals available. The mono unit has monitoring facilities of its own (self-protecting power unit).

2.1.2 Block diagram BUM 62



2.1.3 Block diagram BUM 63/64



2.2 Electrical data

	BUM 62	BUM 63	BUM 64
Control *	slot for BUS 6 controller cassette		
Connection voltage	3 x 400 V _{AC} ±10 %, 50 Hz 3 x 460 V _{AC} +10 % -25 %, 60 Hz		
Semi-conductor fuses (external)	100 A	250 A	350 A
Nominal DC-link voltage ¹⁾	540 V DC		
Total connectable capacitors in the DC-link (encl.. supply unit)	2200 µF	unlimited, pay attention to extended charge time	
Internal DC-link capacitors	1000 µF	2460 µF	4100 µF
Switch on: ready for use after	≤ 1,5 s	≤ 1,5 s without additional DC-link capacitors	
Choke external	no	4 % u _k	4 % u _k
Output voltage (AC)	0 ... supply voltage		
Output power ^{1) 2)}	52 kVA	104 kVA	208 kVA
Typical motor power ^{1) 2)}	35 kW	70 kW	140 kW
Nominal output current (I _{eff}) ^{1) 2)} at T _K = 45 °C and T _B = 45 °C	75 A	150 A	300 A
Peak output current (I _{eff}) ^{2) 3)} at T _K = 45 °C and T _B = 45 °C	97,5 A	195 A	390 A
Connecting voltage fan ⁵⁾	-	-	3x400 V _{AC} ±10 % 50/60 Hz
Control voltage ⁶⁾	+ 24 V _{DC} ± 20 %		
Power consumption control voltage without controller	65 W	80 W	50 W
Power loss in nominal use ^{1) 2)}	1410 W	2450 W	4900 W
Operation ambient temperature range T _B	0 ... 45 °C (with power reduction 55 °C)		
Coolant medium temperature range T _K	0 ... 45 °C (with power reduction 55 °C)		
Reduction output current T _K = 45 ... 55 °C	3 % / °C		
Installation height ⁴⁾	1000 m above sea level		
Relative air humidity	15 % ... 85 % no dew		
Storage temperature range	- 30 °C ... + 70 °C		
Dimensions (B x H x T)	328 x 460 x 280 mm	490 x 562 x 282 mm	490 x 990 x 282 mm
Weight without controller	35 kg	60 kg	95 kg

* not supplied, must be ordered extra

1) connection voltage equal 400 V_{AC}

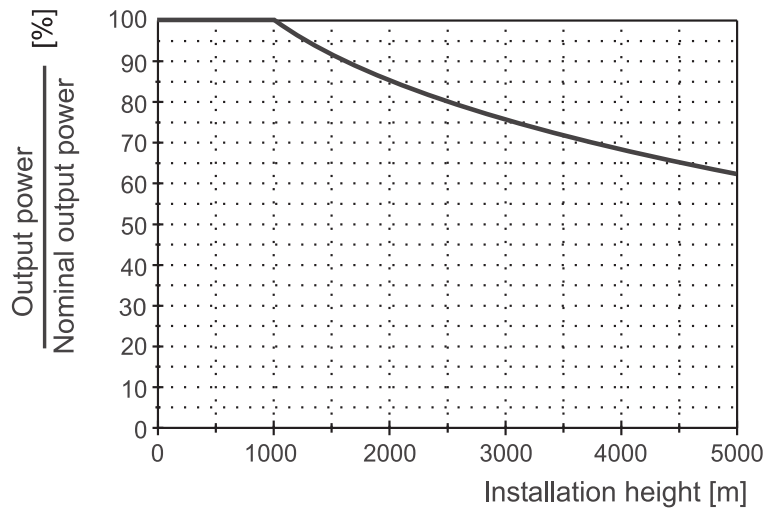
2) clock frequency equal 4 kHz

3) t < 2 min (when cooling element temperature = ambient temperature)

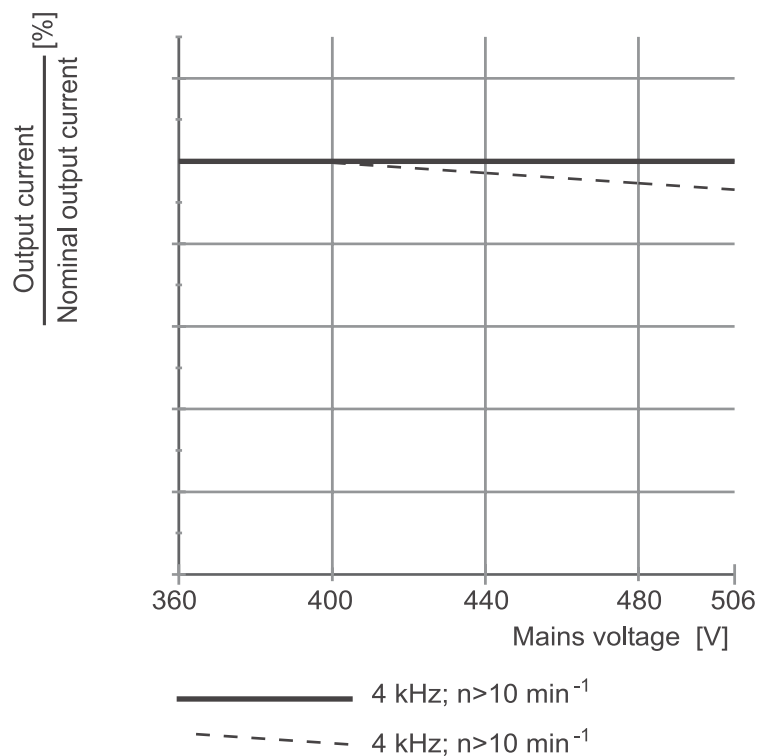
4) Installation height > 1000 m see characteristic curve 1

- 5) The output power must be reduced if the fan's connection voltage < 400 V. The fan cannot be supplied directly by mains voltage if the mains voltage > 440 V. Ensure the necessary supply voltage e.g. by an transformer (power: 110 VA/50Hz or 160 VA/60 Hz)
- 6) with reference to EN61131-2 (table 5)
 Only BUM 62 and BUM 63: The internal fan power is reduced if control voltage < 24 V. You must reduce the output currents when the control voltage < 24 V.

Characteristic curve 1: Load in dependence on installation height



Characteristic curve 2: Current reduction dependent on mains voltage

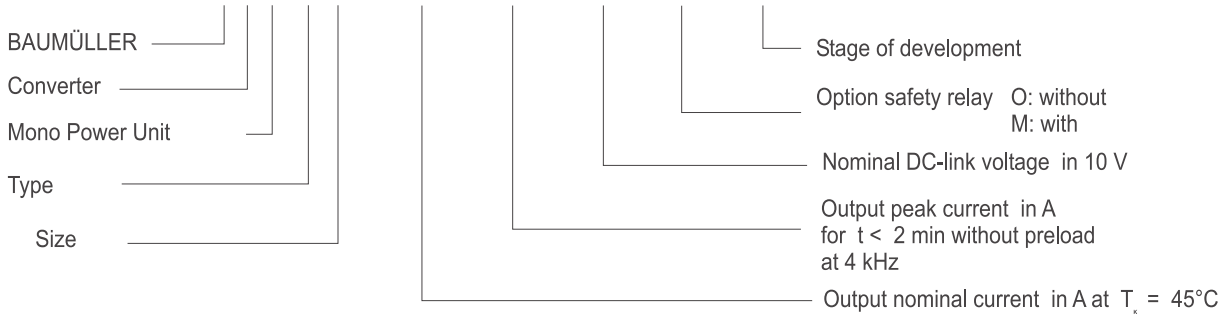


2.3 Type code

BUM 62 - 75 / 97.5 - 54 - X - 000

BUM 63 - 150 / 195 - 54 - X - 000

BUM 64 - 300 / 390 - 54 - X - 000



3 TRANSPORTATION, UNPACKING

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

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

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

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

Report any damage in transit without delay.



DANGER

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

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

4 ASSEMBLY



WARNING

The user is responsible for the assembly of the converter power unit, the motor and the other components according to applicable safety standards (e.g. DIN, VDE) and all other relevant national or local regulations regarding conductor dimensions and fusing, grounding, circuit breakers, overcurrent protection etc.

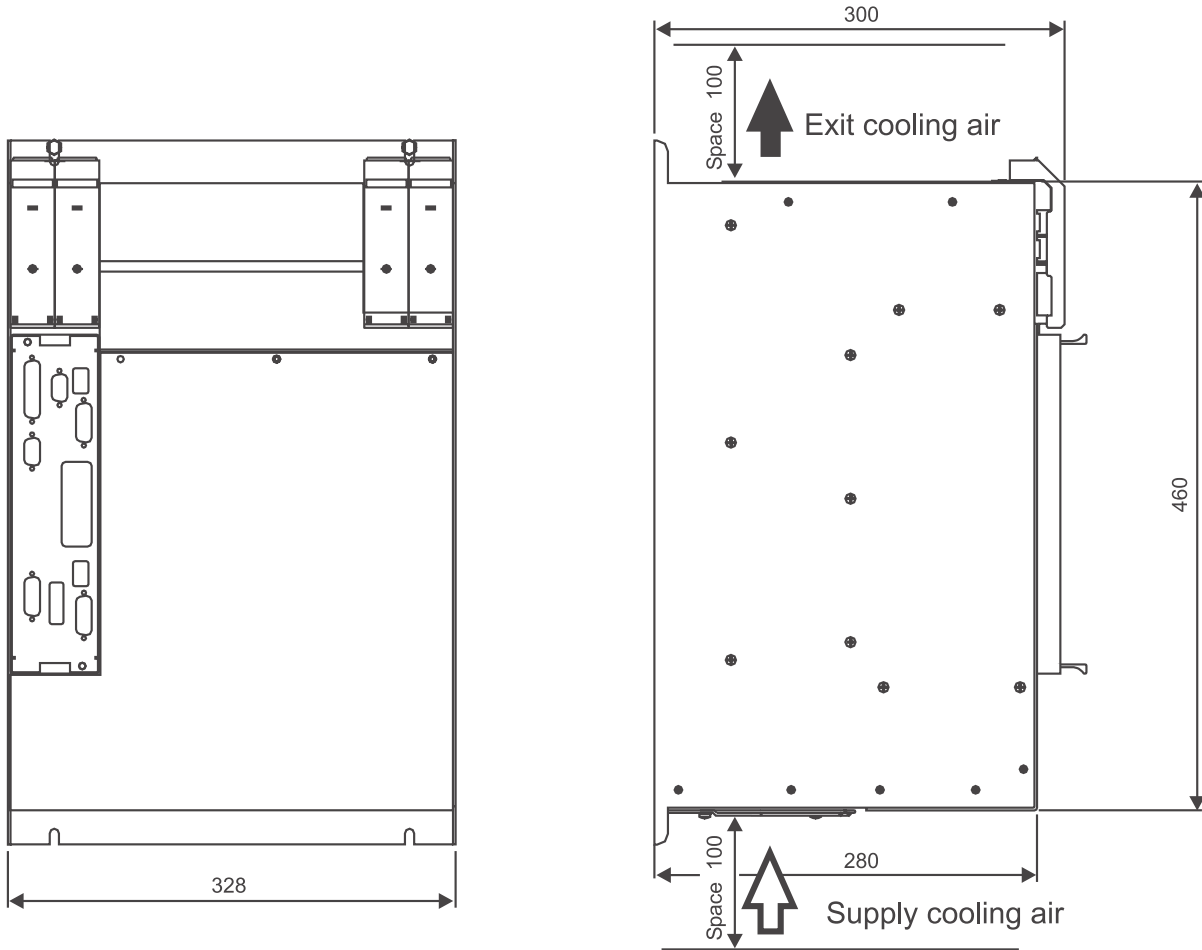
A space must be left above and below the units, and sufficient cool air and air circulation must be provided.

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

Pollution degree 3 and 4 according to EN 50178/VDE0160/4.98 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)

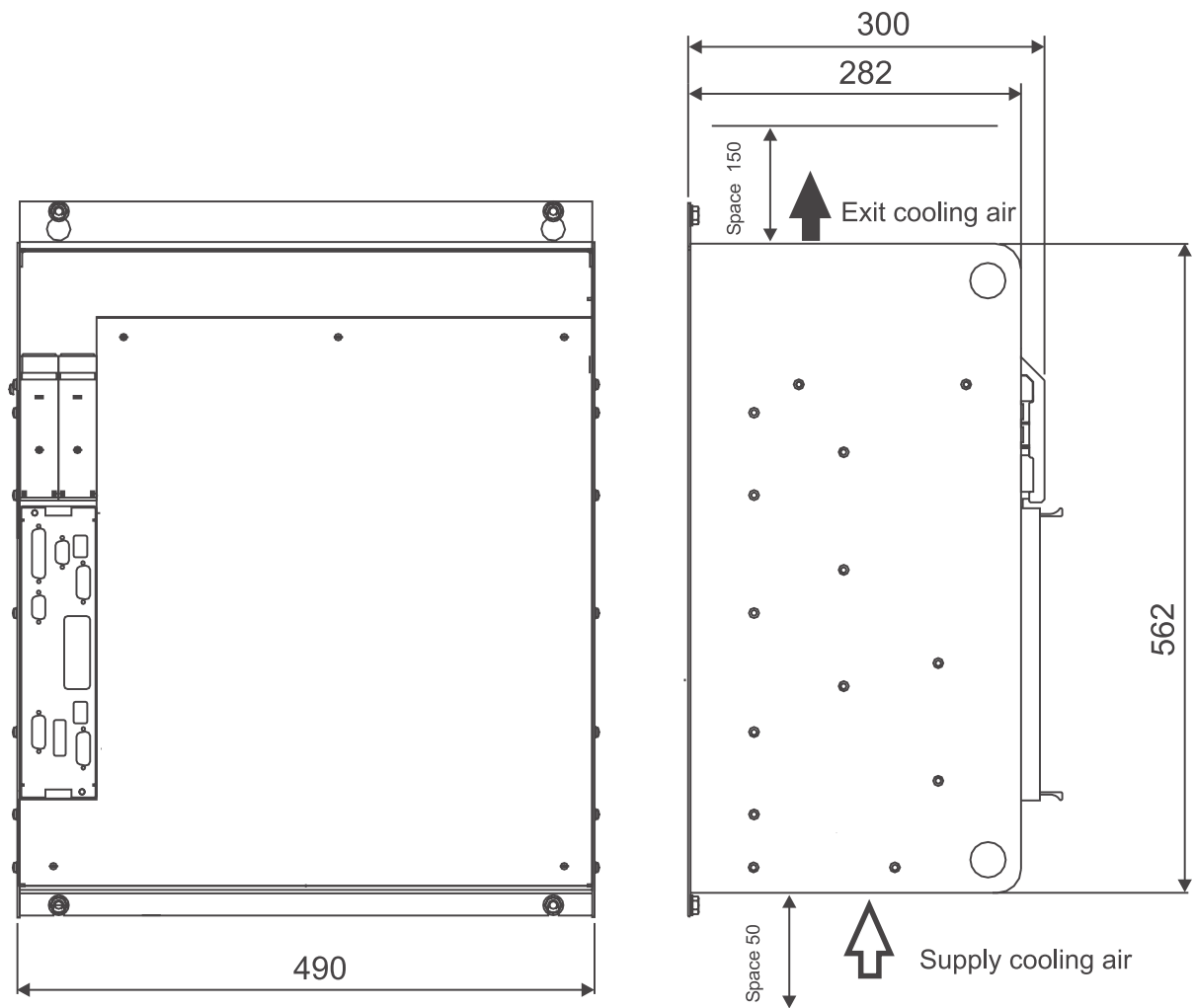
4.1 Dimensions

4.1.1 Dimensions BUM 62



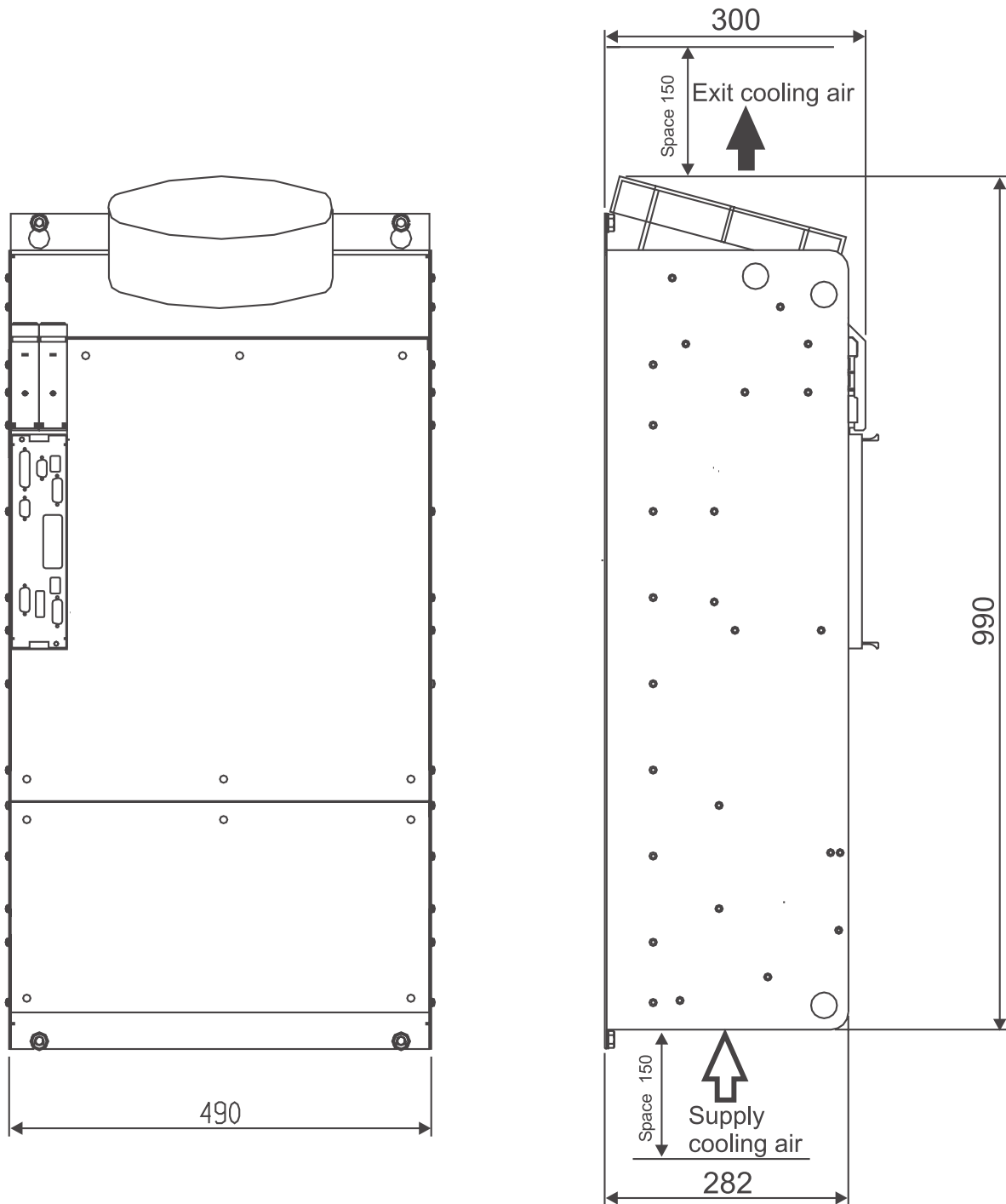
For the total depth pay attention to the controller's size!

4.1.2 Dimensions BUM 63



For the total depth pay attention to the controller's size!

4.1.3 Dimensions BUM 64



Für die Gesamttiefe ist die Reglergröße zu beachten!

4.2 Assembly information



WARNING

Not appropriate heave can lead to injury or damage. The unit must be heaved by appropriate device and with qualified personnel.

- The units must be installed in the switch cabinet vertically. Several units must be installed side by side.



WARNING

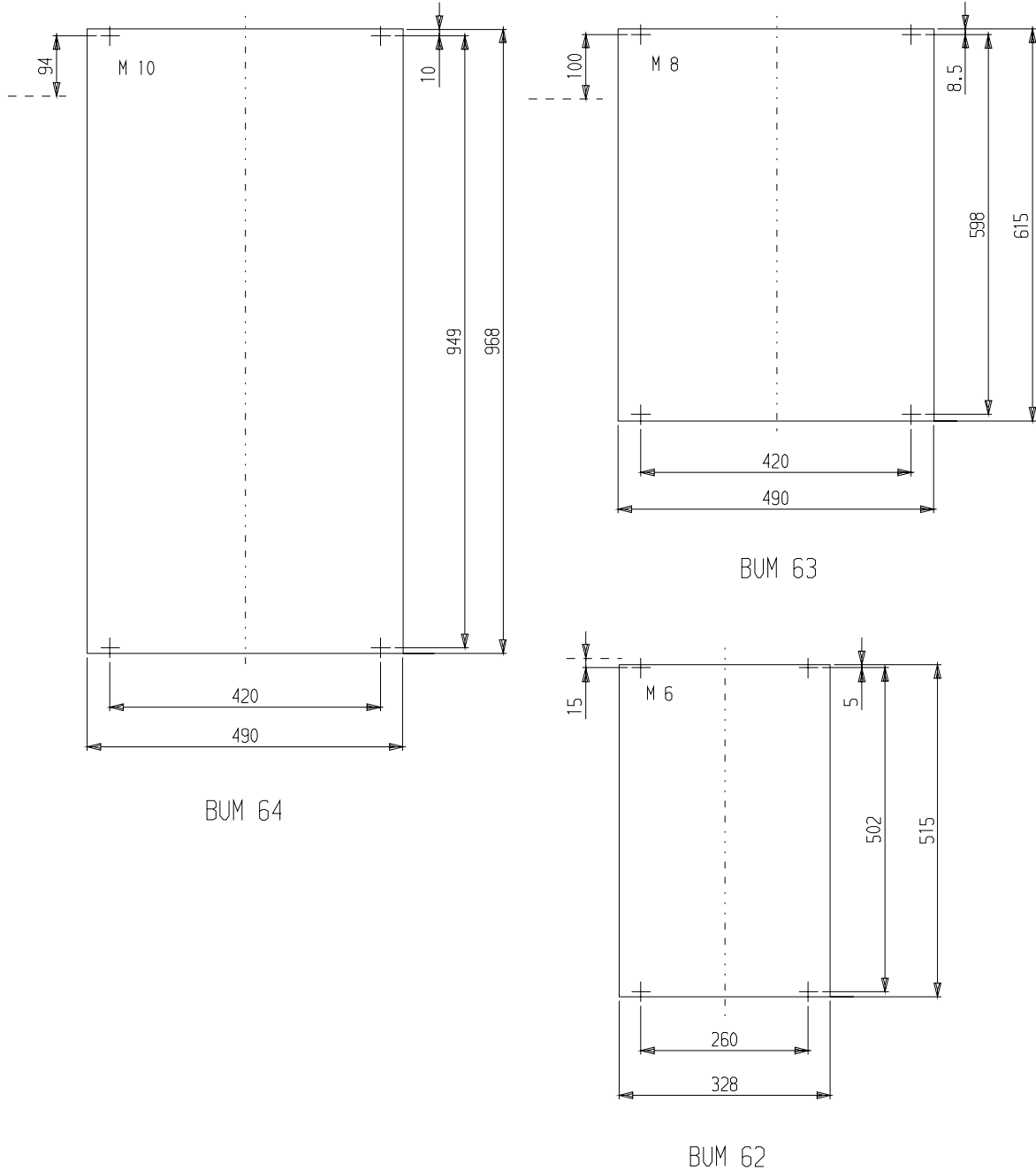
The following measures must be strictly observed to avoid the danger of device overheating.

- Ventilation must be from bottom to top.
- Unrestricted ventilation must be guaranteed.
- A space of at least
 - BUM 62 100 mm
 - BUM 63, 64 150 mmmust be left above and below the units, and sufficient cool air and air circulation is to be provided.
- Coolant temperature 50 mm under the units, up to 45 °C. With higher temperatures (up to max. 55 °C), power output of the units must be reduced by 3 % per K.
- Do not locate any additional sources of heat above or below the units.
- You must avoid degrees of contamination 3 and 4 according to provisional standard EN 50178:1994 Section 5.2.15.2. The devices are suitable for use in enclosed workshops (VDE 0558 Part 1a, Sections 5.4.3.2.1 and 5.4.3.2.2).

4.3 Fastening

Fasten the unit via the back panel in the switching cabinet (see dimensions).

With devices that are mounted next to one another, the back panels must be in contact with one another.



----- Befestigungslöcher für weitere Module

5 INSTALLATION

5.1 Danger information



WARNING

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

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

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

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



DANGER

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

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

Safety devices must never be deactivated.

5.2 Standardization information

Series BUM 62, 63, 64 are built-in units in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.6 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.1. They are intended for installation in commercially available control cabinets whose degrees of protection meet the minimum requirements of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.4 (IP 2x, possibly IP4x according to EN 60529/5.1).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- The rated insulation voltage of the mains circuits for TN and TT systems according to DIN VDE 0100 Part 410/11.83 with a diametric voltage of 3 x 500 V.

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

Series BUM 62, 63, 64 power converters are short-circuit-proof in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 6.3.4, assuming that you use protective semiconductor fuses to protect the transistors (see Accessories).

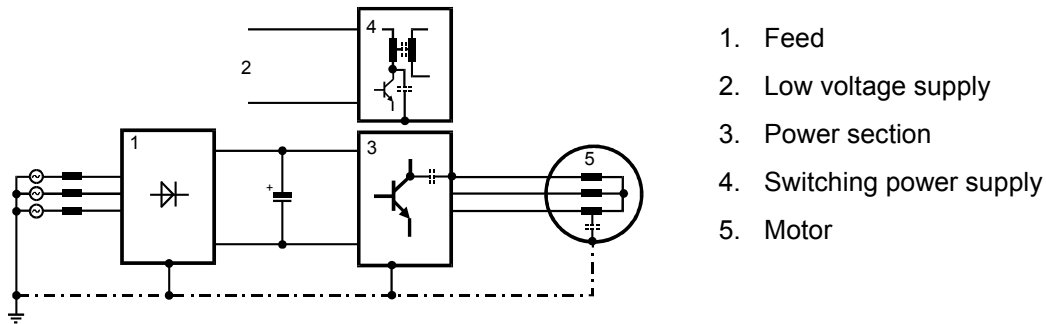
5.3 EMC information

General information about converters

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

Disturbances can occur due to:

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



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

German EMC Law (EMVG)

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

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

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

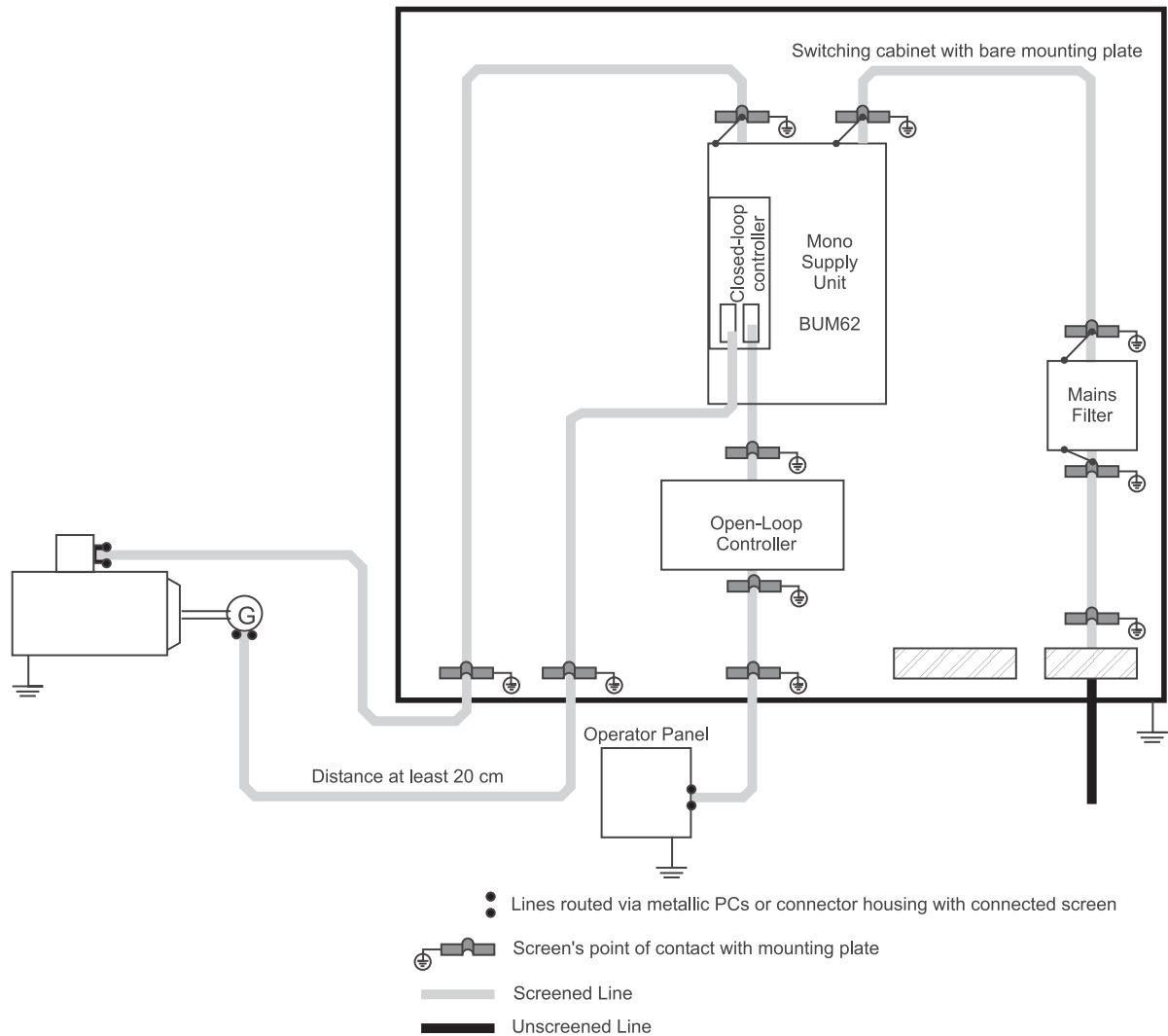
The information on the next few pages is intended to allow you to configure your system on the basis of the latest knowledge in the field of EMC and to comply with legal regulations.

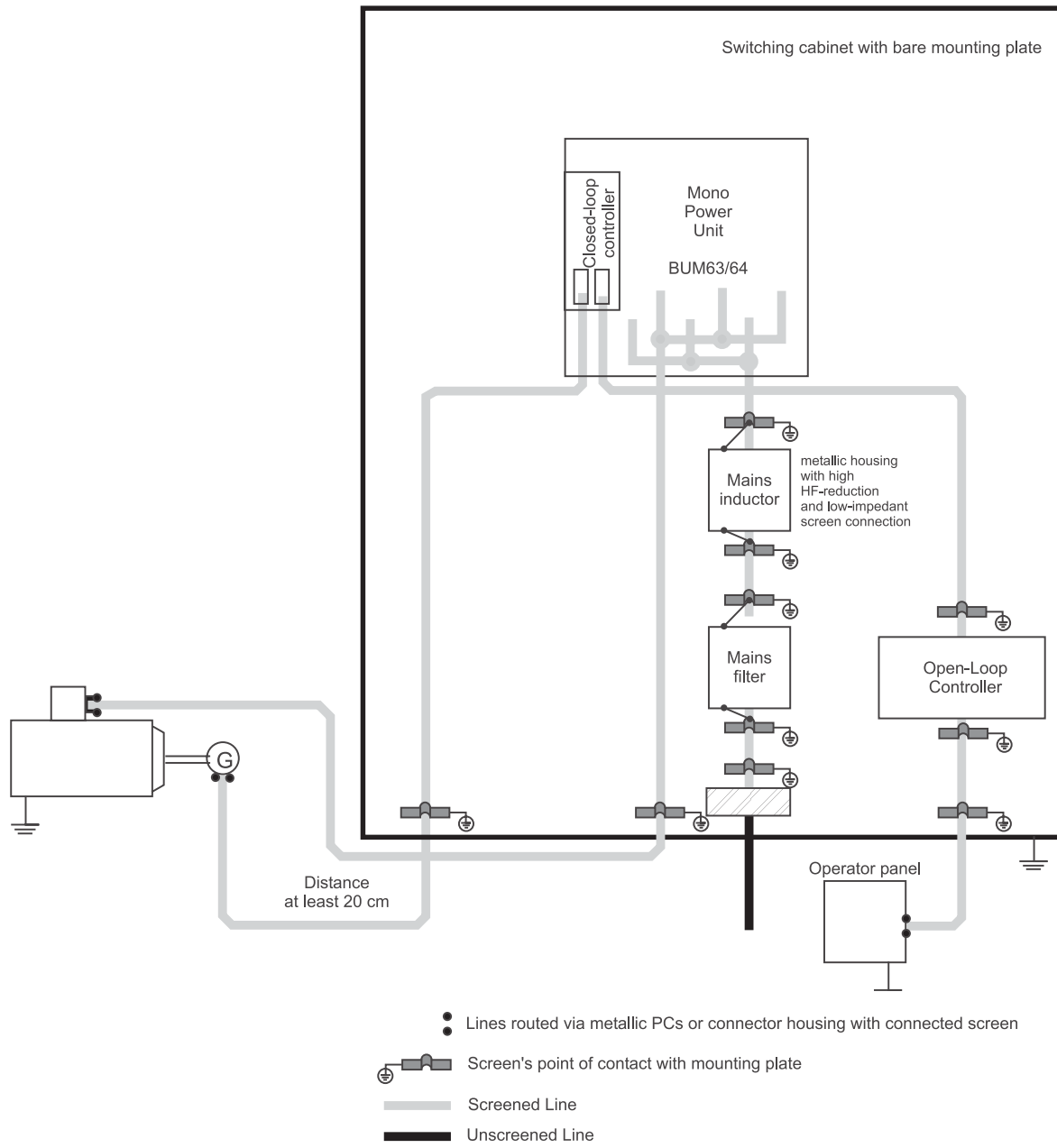
Measures for ensuring EMC

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

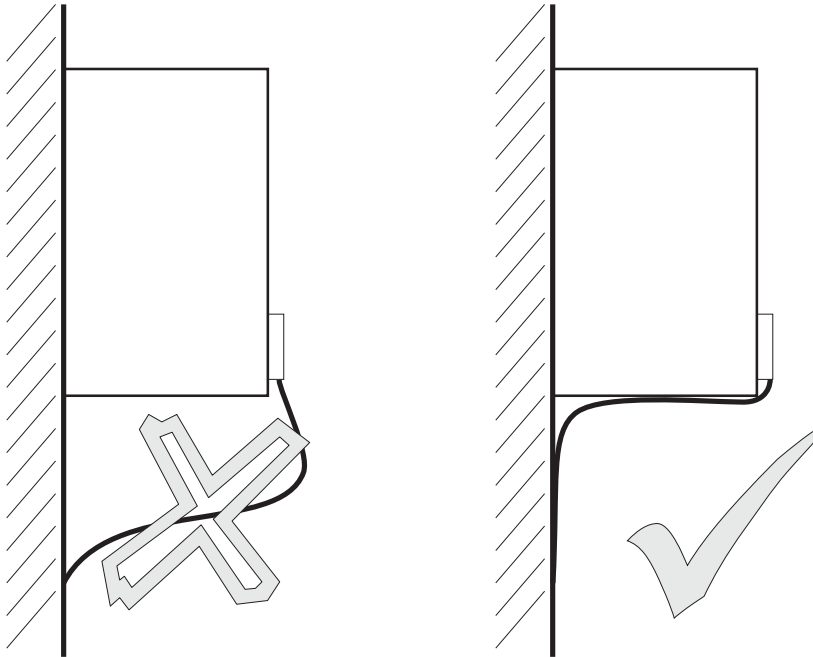
Cabling

- To suppress radiated noise outside the converter, you should screen all the connected cabling. Also observe the topics in the section entitled "Screening".

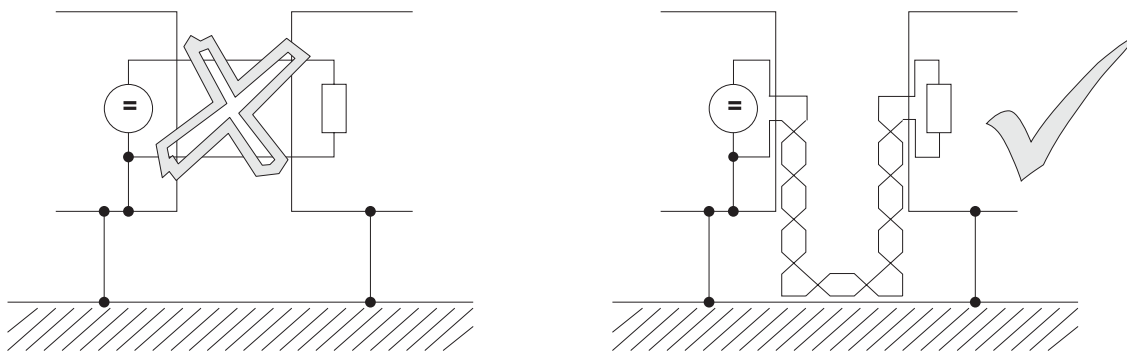




- You achieve the lowest possible effective antenna height by routing the cable directly on the ground of the metallic rack.



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



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

Installation

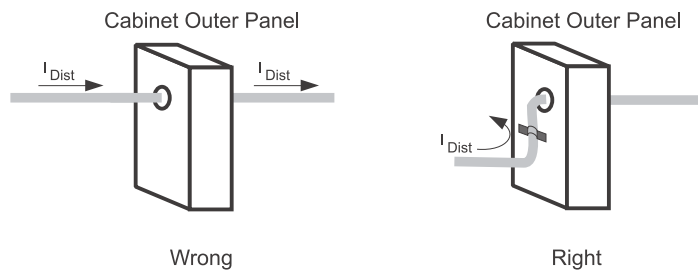
- The grounding of reserve wires in cables is mandatory (additional screening, avoidance of capacitively coupled, hazardous contact voltages).

Grounding

- To meet EMC requirements, the classical star grounding is no longer sufficient to reduce the noise of high frequencies caused by converter operation. Better results can be achieved by a reference surface which must be linked to the units' ground (e.g. bare metal mounting plate and housing parts)
- If a large reference surface is not possible the main equipotential bonding strip should be arranged directly at the power unit which generates the largest potential steps compared to the other components in the switch cabinet (ground connection < 30 cm if possible).
- To avoid earth loops, apply all ground connectors and screens as close as possible above the ground.
- If it is possible to ground the controller reference potential of the power unit, make the connection with as large a cross-section as possible and a short cable (< 30 cm).
- Remove insulating layers such as paint, adhesives, etc. from the ground connections. If necessary, use serrated lock washers (DIN 6798) or similar measures to ensure a permanent, conductive contact. To prevent corrosion on ground connections, use suitable metal combinations (electrochemical series of metals) and keep conductive electrolytes away from the connection by a protective coating (e.g. grease).
- Always connect screens at both ends over a large surface and conductive to ground. This is the only way to suppress the effects of magnetic or high-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

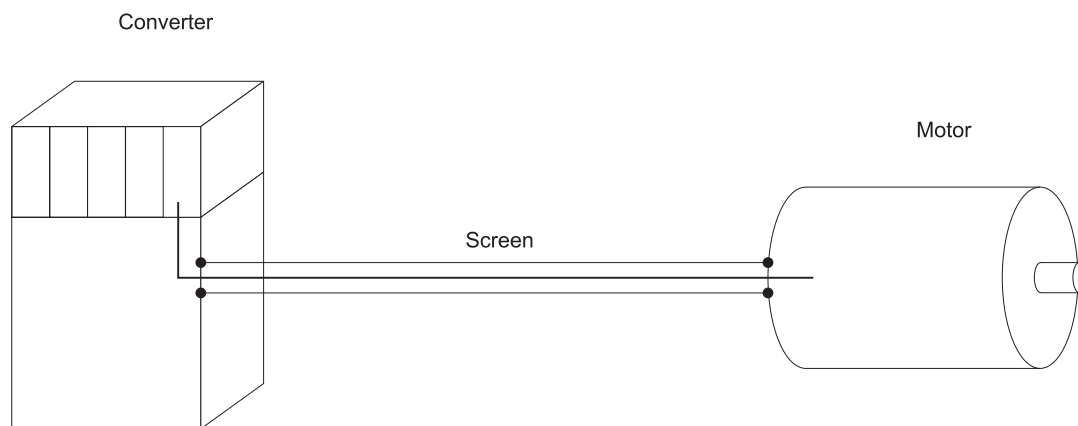


Screening

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

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

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



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

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

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

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

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



NOTE

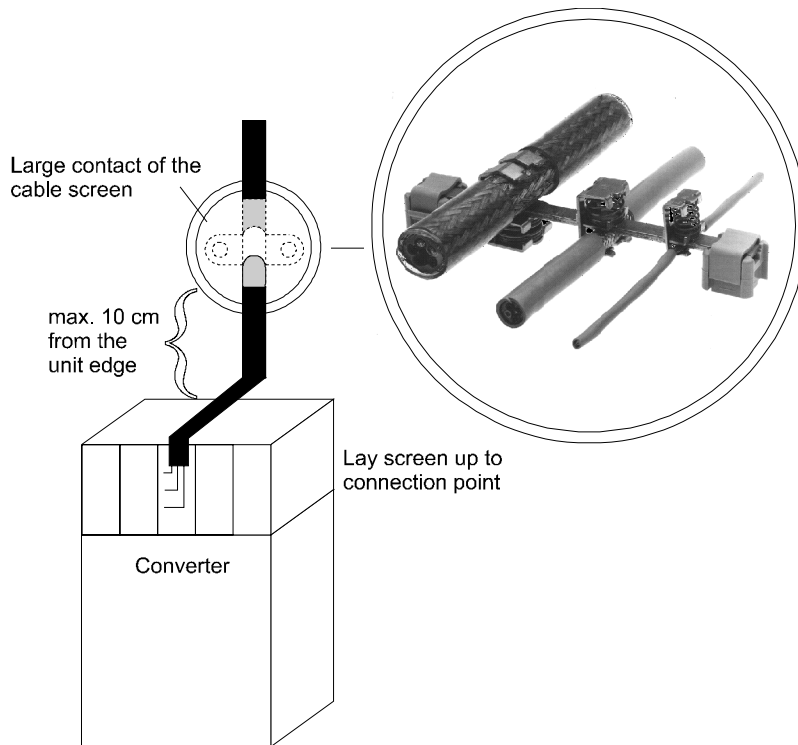
The screen braid must have a coverage of at least 85%.

The following cables have a particularly high interference potential:

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

Installation

- Proposal for the screen connection



Filtering

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

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

Filter assembly

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

Discharge currents

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

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

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

5.4 Safety relay

5.4.1 Methods to avoid an unexpected starting

In order to avoid hazards against persons, for example operators, service- and maintenance technics, the machine has to be kept in a secure condition (safe stop), while interfering in the hazardous area of the machine. That is why a reliable prevention of an unexpected starting is demanded (amongst other things Machine directive 89/392/EEC, 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.

5.4.2 Safety categories

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

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

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

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

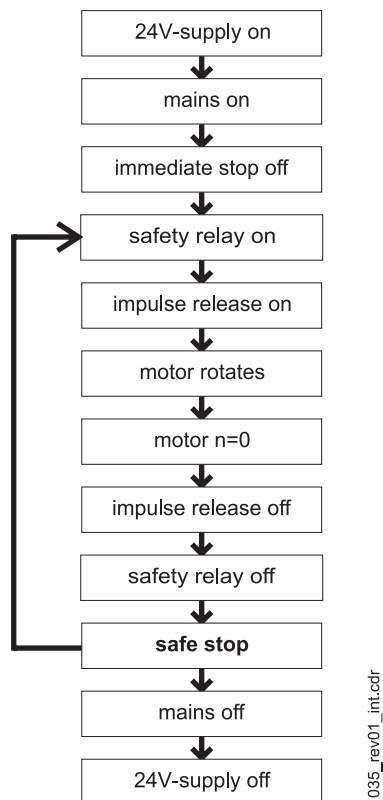
5.4.3 The safety relay

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

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

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

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



Sequence diagram of the safety relay

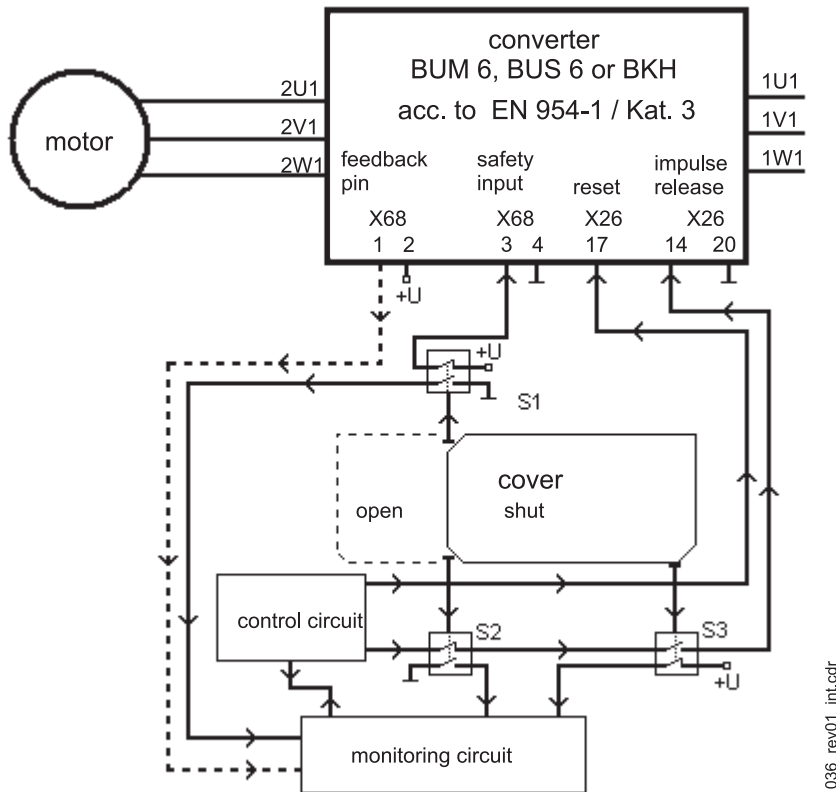
Baumüller-devices of the series BUM 6, BUS 6 and BKH, which are made with one safety relay (optional), comply with the requirements of the category 3 (EN 954-1) for the safety-relevant using “protection against unexpected starting”, if the configuring and installation instructions are complied with.

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

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

Application example for machine of category 3

Exemplary the following diagram shows the usage and cabling of a Baumüller converter of the series 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.

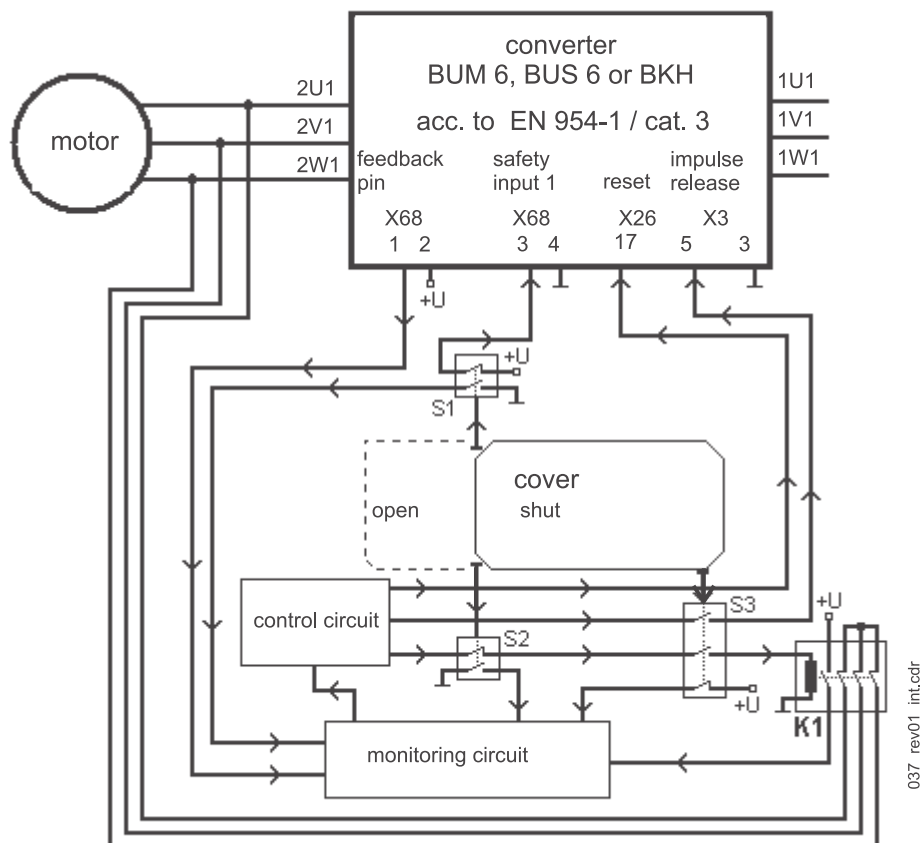
The connection cables between the safety relay input (X68: 3,4) and the control as well as between the impulse release input at the converter (X3:5) and the controller must not be installed outside the control cabinet in a common cable channel.

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)

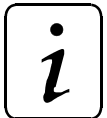
The switching-off of the electrical drive motor takes place three-ported.

- 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.

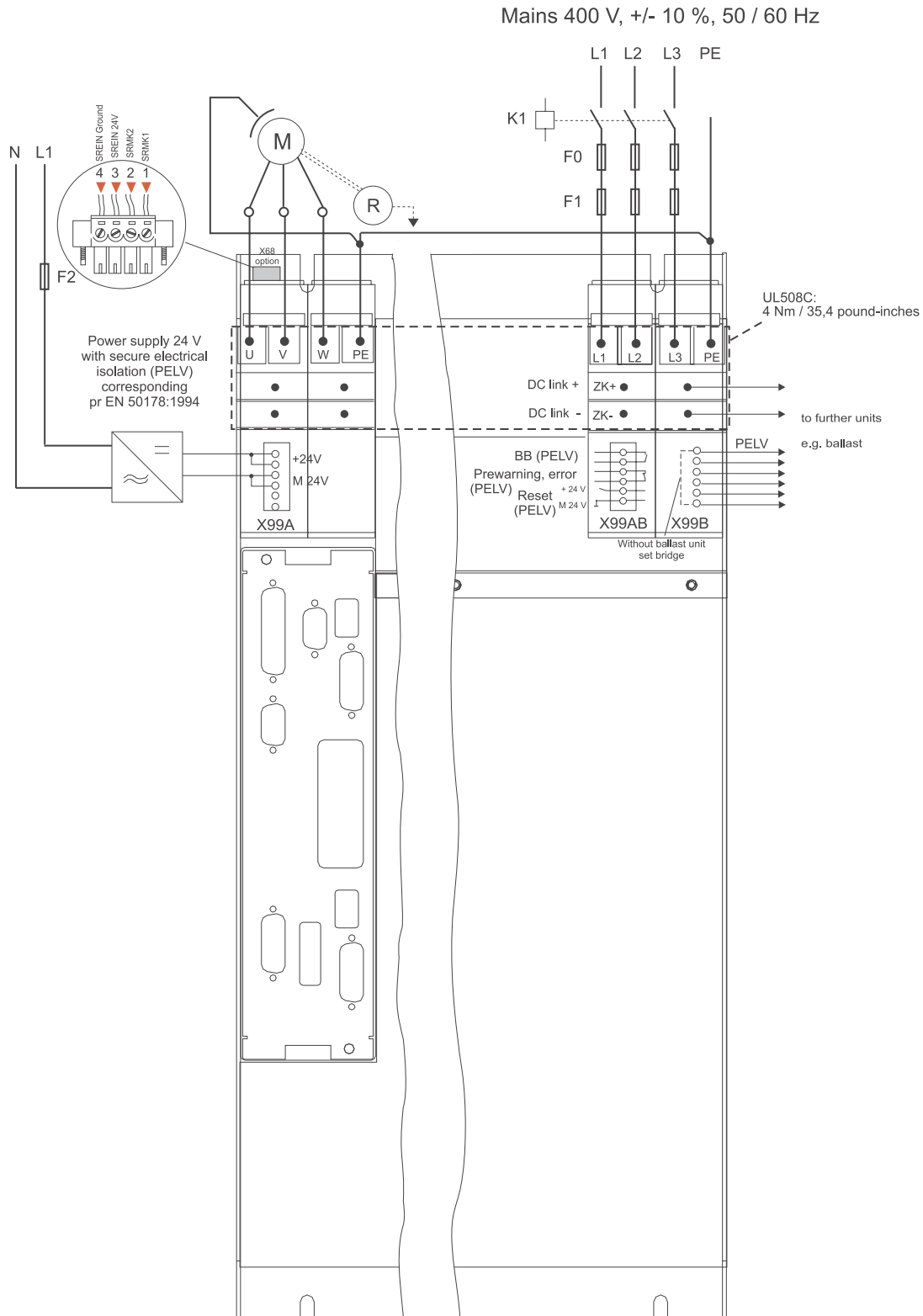
For the use and the installation of the safety devices the legal and official requirements of the government safety organizations and of the EU-Directives for safety requirements at installations and machines (for example EN 60204-1, security of machines, electric equipment and EN 292-2 security of machines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

5.4.4 Service time

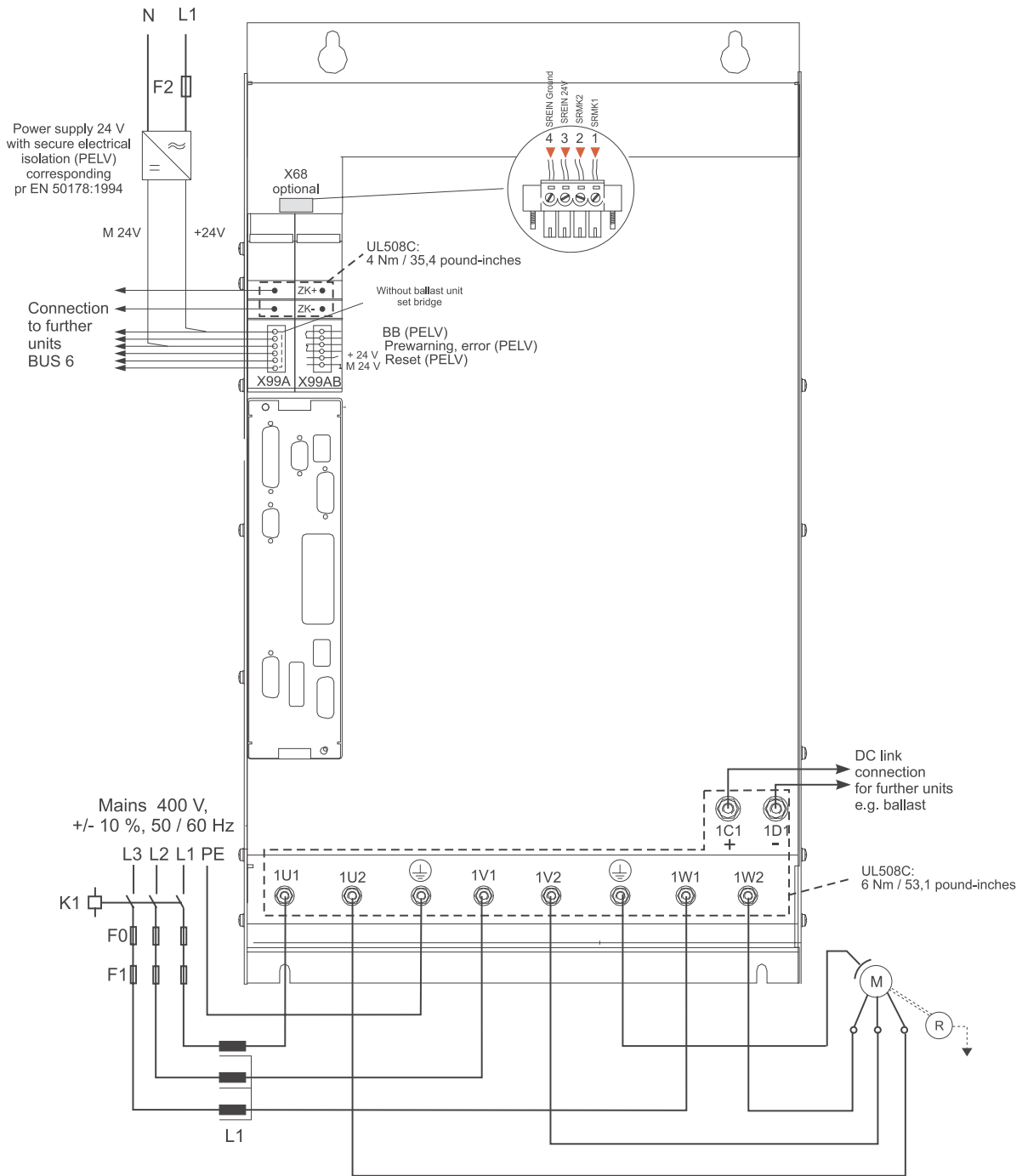
The mechanical service time of the safety relay is at least 1×10^7 cycles of operation.

5.5 Terminal diagrams

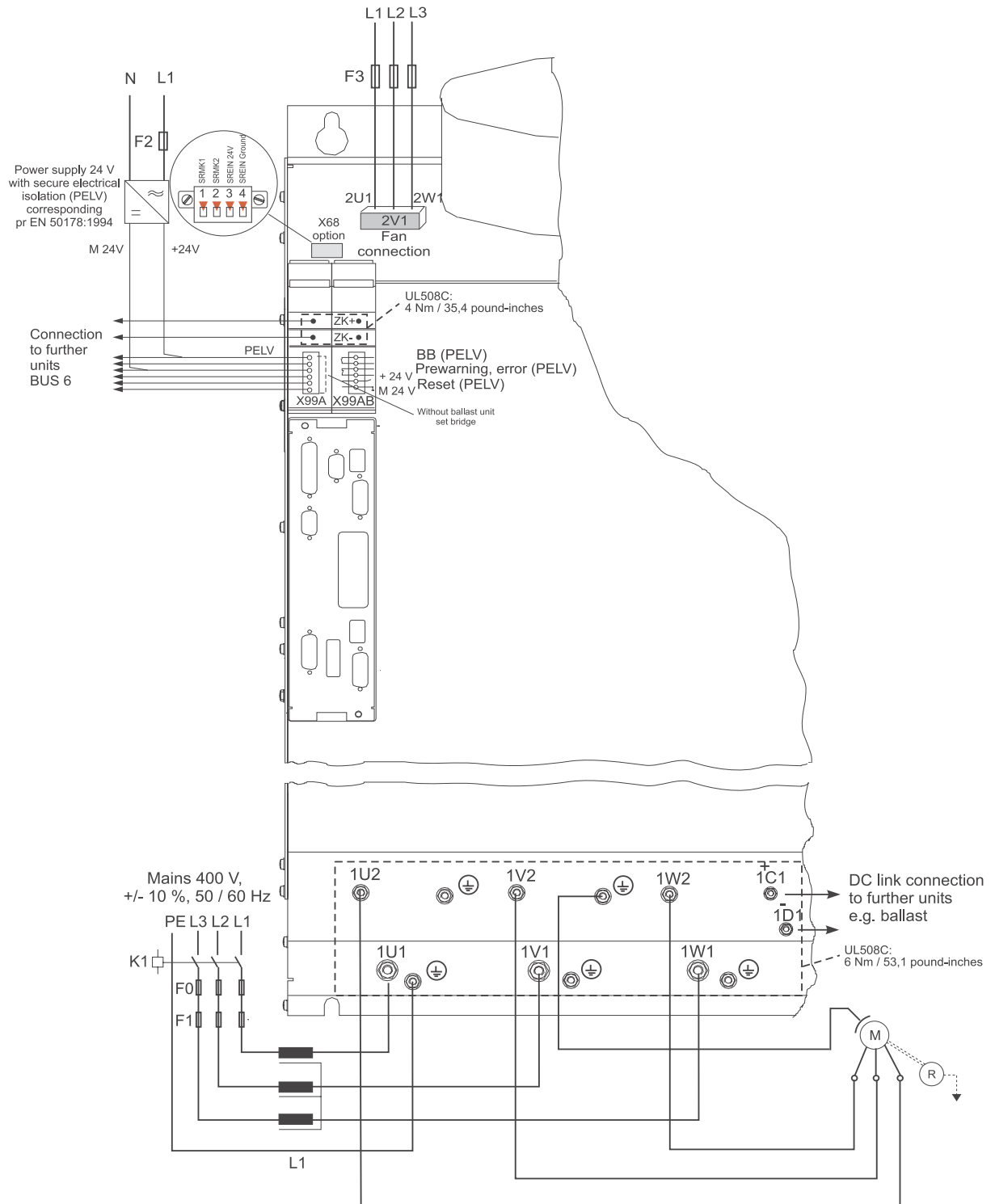
5.5.1 Terminal diagram BUM 62



5.5.2 Terminal diagram BUM 63



5.5.3 Terminal diagram BUM 64



Terminal notes

F0	Line protection fuse, dimension depends on feed line
F1	Semi-conductor fuse, possibly extra line protection with reduced cross-sections only (see Accessories, fuses)
F2	Fuse depends on power supply
BUM 64: F3	Circuit protection for power supply fan
Current-operated e.l.c.b.	The principles on which the power converter and the motor work lead to leakage currents to earth, i.e. the drive may be incompatible with current-operated e.l.c.b. systems. For configuration, take into account provisional standard EN 50178:1994 Para. 5.2.11.
K1	Mains contactor (auxiliary contact for controller enable optional, not absolutely necessary)
BUM 62: L1, L2, L3, PE	Cross-section of mains connection according EN 60204-1:1992 For cable-laying, refer to EMC information. If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.
BUM 63/64: 1U1, 1V1, 1W1, ⊕	Mains connection via commutating reactor Cross-section of mains connection according EN 60204-1:1992 For cable-laying, refer to EMC information. If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.
BUM 62: U, V, W, PE	Cross-section of motor connection according EN 60204-1:1992 For cable-laying, refer to EMC information.
BUM 63, 64: 1U2, 1V2, 1W2, ⊕	Screening only necessary, if a spacial separation of the signal cable is not possible or a noisy communication is expected. In this case the motor connection's screen has to be connected with low impedance on both sides. If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). BUM 62: Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches. BUM 63, 64: Nominal tightening torque of the terminal screws: 6 Nm resp. 53,1 pound-inches.
ZK+, ZK-	DC link of further units if the total power of the input rectifier is not exceeded. (max. 36 kW, see Technical Data, input rectifier). Moreover DC link of further units e.g. ballast. The intermediate circuit carries electrical potential: it is imperative that the provided cover is used. If UL508C has to be observed: Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.



DANGER

The intermediate circuit carries electrical potential: it is imperative that the provided cover is used.

BUM 63 / 64:
L1

Mains commutating reactor

BUM 63 / 64:
1C1, 1D1

DC link to further units e.g. ballast

If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2).

BUM 62: Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.

BUM 63, 64: Nominal tightening torque of the terminal screws: 6 Nm resp. 53,1 pound-inches.

BUM 64: Fan
2U1, 2V1, 2W1

Circuit protection according to VDE 0100;

BUM 62 / 63 fan power supply internal

BUM 64 3 x 400 V 50 Hz 0,23 A

3 x 400 V 60 Hz 0,27 A

Netzteil 24 V

24 V power supply with secure isolation (PELV) according DIN 19240 for supplying the electronic parts

Current consumption: BUM 62 3 A
 BUM 63 3,5 A
 BUM 64 2,5 A



NOTE

The power supply has capacitors at its input (250 µF); which means, on switching the 24 V supply, charging currents are present!

At continuous operation below 24 V -10 % (21.6 V) the cooling power of the internal ventilator is reduced. Power reduction of the mono power unit on requirement.

5.6 Connector pin assignment

5.6.1 Power terminals BUM 62

- **L1, L2, L3, PE**

L1, L2, L3:	Unit input voltage 400 V _{AC} - 460 V _{AC}
PE:	Control cabinet ground M 6 terminals

If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.

- **U, V, W, PE**

U, V, W:	Motor connections
PE:	Motor ground M 6 terminals


If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.


- **ZK+, ZK-**

Connections for further units e.g. ballast.
M6 terminals

If UL508C has to be observed: Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.

5.6.2 Power terminals BUM 63 / 64

- **1U1, 1U2, 1U3, **

1U1, 1U2, 1U3:	Unit input voltage 400 V _{AC} - 460 V _{AC}
 :	Control cabinet ground
BUM 63:	M 8 terminals
BUM 64:	M 10 terminals

If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 6 Nm resp. 53,1 pound-inches.

- **1U2, 1V2, 1W2, **

1U2, 1V2, 1W2:	Motor connections
 :	Motor ground
BUM 63:	M 8 terminals
BUM 64:	M 10 terminals

If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 6 Nm resp. 53,1 pound-inches.

- **ZK+, ZK-**

DC link of further units if the total power of the input rectifier is not exceeded.
(max. 36 kW, see Technical Data, input rectifier).

If UL508C has to be observed: Nominal tightening torque of the terminal screws: 4 Nm resp. 35,4 pound-inches.

- **1C1, 1D1**

DC link of further units e.g. ballast.

If UL508C has to be observed: Use 60°C / 75° C copper conductors only (UL508C, Nov 27, 1996, Tab. 39.2). Nominal tightening torque of the terminal screws: 6 Nm resp. 53,1 pound-inches.

BUM 63: M 8 terminals

BUM 64: M 10 terminals

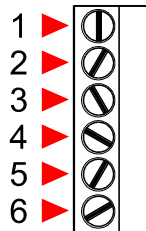
5.6.3 Control terminal



WARNING

All the control voltages connected from outside must be PELV or SELV.

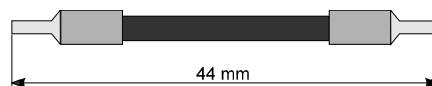
- **Sub-unit terminal X99A/X99B**



Terminal no.	Assignment
1, 2	+ 24 V (PELV) Terminal for power supply to the units, both terminals internally connected, 2nd terminal with power supply current > 10 A
3, 4	Ground 24 V (PELV) Terminal for power supply to the units, both terminals internally connected, 2nd terminal with power supply current > 10 A
5	BB int (PELV) Ready for use signal form the supply converter to all units connected to the DC link
6	Reserved (message ballast) (PELV) if no ballast unit is used the terminal 6 must be connected with terminal 1 or 2 (+24 V)

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

Recommended connection length 44 mm

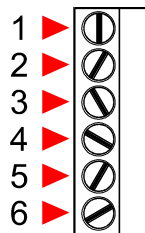




WARNING

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

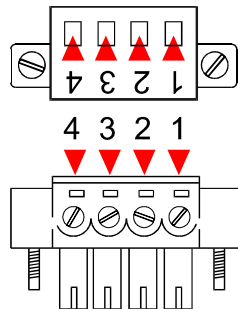
- **Sub-unit terminal X99AB**



Terminal-No.	Assignment
1, 2	BB ext (PELV) Relay output: Ready for use of supply converter 24 V, 0.5 A max.
3, 4	Alert (PELV) Relay output: Alert of supply converter 24 V, 0.5 A max.
5	+ Reset with 24-V signal (PELV) Input for resetting error messages of the supply converter (potential-free optocoupler input, 10 ... 25 mA)
6	Ground reset (PELV) Reference point for resetting error messages of the supply converter (potential-free optocoupler input)

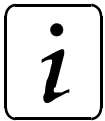
Installation

- **X68 safety relay, 4-pin block connector (option)**



Terminal-No.	Assignment
1, 2	Message contact 1 and 2, Relay output 24 V, 0,5 A
3	Relay ON + 24 V
4	Relay ON ground

It is possible to make the drive torque-free with the safety relay by switching off the +24 V on terminal no. 3 and 4 (refer to "Safety relay" on page 33).



NOTE

The terminals 3 and 4 must be connected with +24 V_{DC} while operation of the motor.
Safety relay OFF is stored as message and must be reset by a controller reset.

- **Terminal fan**

Only BUM 64:

3-pin plug (Part no. 19006141) supplied with the unit

Crimp contacts (Part no. 19006141) supplied with the unit

Connection:

3 x 400 V / 0.23 A/0.27 A / 50/60 Hz, a pre-transformer must be used for other voltages

- **X60 64-pin plug**

In order to connect the controller cassette to the motor-end converter, internal connection plug X 60 in the cassette recess must be used.

For information on the controller cassette external connections, see the controller description.

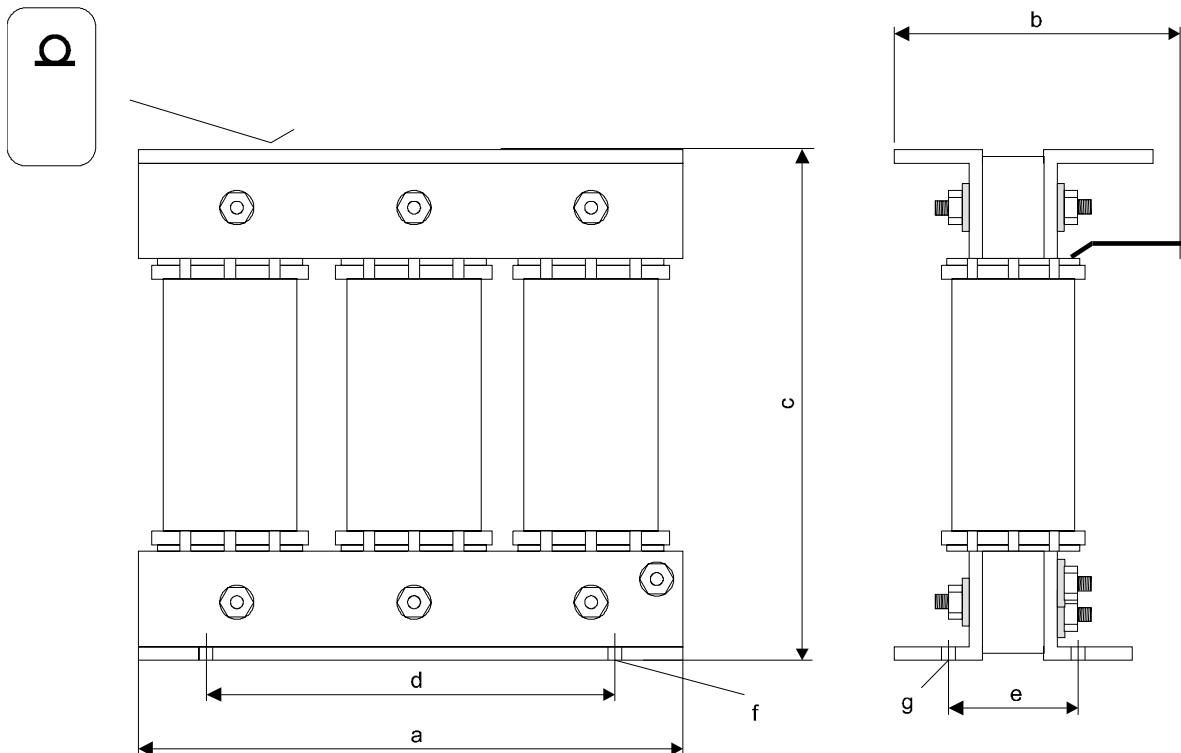
5.7 Accessories

- Fuses

	BUM 62	BUM 63	BUM 64
Semi-conductor fuses part no.	100 A / 1000 V 19008526	250 A / 1000 V 19008626	350 A / 1000 V 19008621
Needed amount per unit			
Size according DIN 43620	0	1	1
Line protection fuses	only with reduced cross-section		

- Line reactors

	BUM 62	BUM 63	BUM 64
Line reactor	no	DR3-50-4-0200 part no. 19007487 DR3-40-4-0200 part no. 19007474	DR3-50-4-0400 part no. 19007489 DR3-40-4-0400 part no. 19007476



Installation

- 3-phase line reactors for 400 V supply voltage, $T_A = 55^\circ\text{C}$ max., $U_k = 4\% / 4.8\%$, $U_N = 400\text{ V}$, 50/60 Hz, with flat termination IP 00

Line reactor DR3-40-4I	Type DC current A	a mm	b mm	c mm	d mm	e mm	f x g mm	Flat termination \varnothing mm x mm	Weight kg	Losses W	Part no. 1900 ..
- 0 200	200	310	170	255	280	106	11 x 18	40 x 4 \varnothing 14	28,0	160	-7474
- 0 400	400	310	220	260	280	131	11 x 18	40 x 4 \varnothing 14	45,0	180	-7476

- 3-phase line reactors for 500 V supply voltage, $T_A = 55^\circ\text{C}$ max., IP 00
 $U_k = 4\% / 4.8\%$, $U_N 420 \dots 500\text{ V}$, 50/60 Hz, with flat termination IP 00

Line reactor DR3-40-4I	Type DC current A	a mm	b mm	c mm	d mm	e mm	f x g mm	Flat termination \varnothing mm x mm	Weight kg	Losses W	Part no. 1900 ..
- 0 200	200	270	170	230	200	102	10 x 18	30 x 4 \varnothing 11	27,5	160	-7487
- 0 400	400	360	230	315	300	150	9 x 14	40 x 5 \varnothing 14	73,0	225	-7489

- EMC package**

on requirement available:

- EMC filter
- shielded cable
- connection parts

6 COMMISSIONING

6.1 Danger information



WARNING

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

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

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

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

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

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

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



WARNING

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

Faulty drive response

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

Contact Protection In Accordance with Paragraph 4 Section 4 VBG 4

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

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

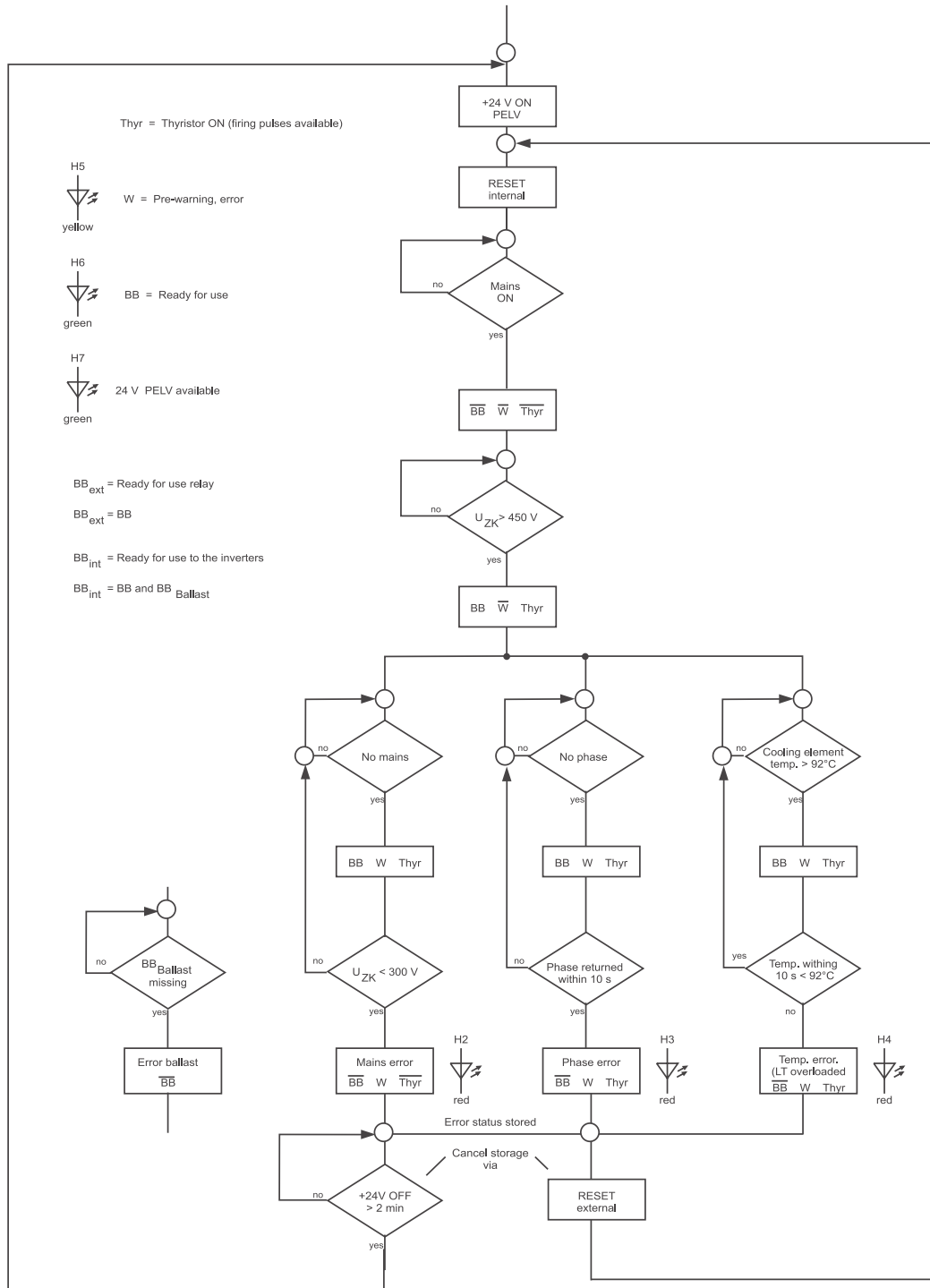
Switching cabinets must have an emergency off facility to switch off any voltages that could be dangerous. This does not include equipment which, if switched off, would cause an even more dangerous situation. The emergency off releasing element must be arranged in such a way that it can be reached quickly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

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

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

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

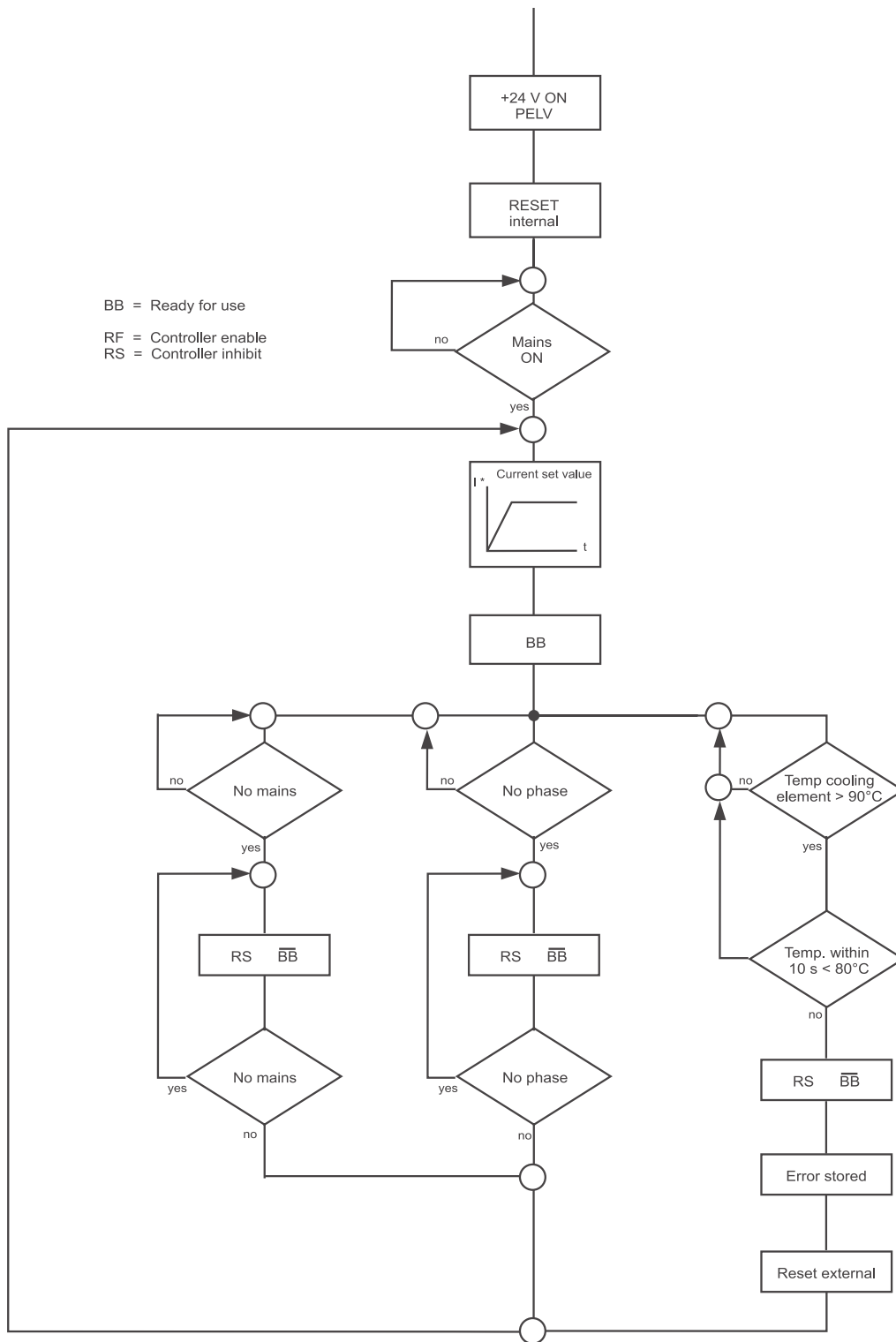
6.2 Function diagram BUM 62



NOTE

The LEDs cannot be seen from outside.

6.3 Function diagram BUM 63/64



6.4 Operation

The controller operates the unit (see controller's manual).

Errors of the motor-end power unit can be resetted by the controller.

Reset of operational faults reported by the supply unit

- Set the reset input at plug X99AB
- Switch off the +24 V power supply

The reset signal effects on the supply unit only, the stored faults in the motor-end power unit are not influenced.

Settings do not have to be made for the units BUM 62, 63, 64.

6.5 Messages and warnings

6.5.1 Monitoring of the input rectifier

To use the monitoring the +24 V power supply (X99A or X99B) must be available.

Following features are monitored:

- Voltage failure
- Phase failure
- High temperature (overload)

- Mains monitoring BUM 62

This prevents an internal and external "ready for use" message if a phase is missing in the mains.



NOTE

After switching on the +24V electronics supply, the operation of the mains monitoring is only saved when:

- the mains is reported OK for the first time
- the DC link voltage has dropped below 300 V.

- Mains monitoring BUM 63 / 64

This prevents an internal and external "ready for use" message if a phase is missing in the mains voltage.

- Phase monitoring BUM 62

The phase failure monitoring function recognizes that a phase is missing in the supply voltage and give a warning message.

After 10 seconds the error is stored and an internal and external "ready for use" message is prevented.

- Phase monitoring BUM 63 / 64

This prevents an internal and external "ready for use" message.

- Temperature monitoring

The temperature of the cooling element is monitored and a warning message is given in case of overload, i.e. excess temperature.

After 10 seconds the error is stored and an internal and external "ready for use" message is prevented.

Warning

The relay "warning" opens message contact X99AB if either of the phase failure, mains failure or temperature monitoring functions generates a warning.

Thus the machine can be set to a defined operating mode, in the event of error, before the drive prevents "ready for use" and shuts itself down.

Ready for use

The relay "ready for use" closes the message contact X99AB if none of the phase failure, mains failure or temperature monitoring functions generates a warning.

Reset

The error message memory of the supply unit is erased by operating the reset input (supply +24 V at X99AB, optocoupler input), without having to switch off the +24V auxiliary voltage supply (function erase error message memory).



NOTE

Errors that are present cannot be erased.

Only BUM 62:

Error saving can be cancelled by continual operation of the reset input if an automatic start, e.g. after mains failure, is to occur.



WARNUNG

Protection is to be provided at the machine-side.

6.6 Monitoring motor-end power unit

To use the monitoring the +24 V power supply (X99A or X99B) must be available.

Following features are monitored:

- Overcurrent in the motor cables
- Earth-fault current
- DC link voltage
- Power transistors switching status

- **Overcurrent message**

Motor current in the motor phases is monitored, and on exceeding phase current by 30 % of the permitted peak current, an overcurrent message is generated. This error message is saved and a pulse inhibit is made.

The overcurrent message can be reset by a controller reset.

For display and message resetting, see controller description



NOTE

The overcurrent message should be seen as protection, and limitation of the permitted peak of the motor phase currents is determined by the controller.

- **Earth-fault monitoring**

The earth fault current of the power unit, and thus the motor phase, is monitored for earth faults. An earth fault message is generated if the fault current exceeds 20 % (BUM 62) or 10 % (BUM 63/64) of the power unit's peak current.

Earth-fault monitoring can be reset by a controller reset.

For display and message resetting, see controller description.

- **DC link monitoring**

The amount of the DC link voltage is monitored in the power unit. If it reaches 800 V an error message is generated.

DC link monitoring can be reset by a controller reset. For display and message resetting, see controller description.



NOTE

The intermediate circuit voltage can rise until it is shut off if the drive brakes and no, or too little, ballast switching is available in the intermediate circuit.

- **Power transistors switching status monitoring**

During the power transistor switch-on command, the collector-emitter saturation voltage is monitored. If a too-high saturation voltage is detected in a conductive state, overcurrent of the power tran-

sistors is the reason, e.g. by a short-circuit of the motor terminals, and a controlled shut-down procedure follows, which shuts down the transistor and generates an error message.

This monitoring feature can be reset by a controller reset.

For display and message resetting, see controller description.



NOTE

To guarantee recovery of the transistor after switching off due to overcurrent, the error message can only be reset after 5 seconds (typically, 10 seconds).

- **Auxiliary voltage supply monitoring**

The power unit auxiliary voltage supply is monitored and generates an error message on appearance of a fault.

This monitoring feature can be reset by a controller reset.

For display and message resetting, see controller description.

- **Supply monitoring**

Mono unit monitoring has no direct influence on the power unit.

The ready for use message of the mono unit, terminal X99A and X99B connection 5 and the reserve circuit connection 6 is transferred, free of potential, to the controller cassette, where it is processed (see controller description).

- **Cooling element temperature monitoring**

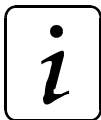
The power unit has no temperature monitoring feature of its own, as the cooling element temperature is not greatly time-critical.

The cooling element has a linear temperature sensor which passes measurements on to the controller. Temperature monitoring is thus taken over by the controller (see controller description).

Ready for use

All messages from monitoring motor-side power unit are stored there. The power unit is "Ready for use" if no message is generated or stored. The ready for use message is sent to the controller via the controller's connection plug.

The controller reacts with a pulse stop if a message is generated.



NOTE

After connecting the 24 V supply voltage and the main voltage the ready for use signal is generated within 5 sec. by the power unit.

Reset

The storage is erased by the controller's reset signal (see description controller).

- **Safety ready (option) (see Safety relay on page 33)**

For several applications it is necessary to shut down a drive on the electronic-side without switch contacts and without switch off the intermediate circuit voltage. Only in this case a continuation is possible immediately and without time loss.

Switching states of the safety relay:

	Relay	Feed back contact	Internal contact
normal run	activated (+24 V on)	opened	closed circuit is voltage supplied
secure state	deactivated (+24 V off)	closed active signal	opened circuit without voltage supply

The transition secure state \Rightarrow normal run only occurs via a RESET (caused by controlling).

It is recommended to avoid mistakes in recognizing the secure state:

- combine the output states
- test the output states once again after 10 ms.

6.7 Voltage failure

- BUM 62

It is possible to enable an automatic restart of the mono supply unit after a voltage failure.

For that purpose

Sub-unit terminal X99AB

Terminal no. 5: to +24 V

Terminal no. 6: to ground 24 V

corresponds to reset (error memory).

- "In the case of voltage failure (intermediate circuit voltage lower than 300 V) the mono unit generates the message voltage failure (power error H2).

"The unit's "ready for use" signal is taken away.

"The message voltage failure is deleted automatically if the mains voltage returns. The unit's status is now "ready for use".

- BUM 63 / 64

In the case of voltage failure the "ready for use" signal is taken away.

- If the mains voltage returns is the unit's status "ready for use" again.

7 MAINTENANCE



WARNING

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

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

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

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

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

7.1 Maintenance notes

The unit is free of maintenance.

Prohibition of unauthorised conversion

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

7.2 Environmental conditions

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



WARNING

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

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

7.3 Recommissioning

Carry out commissioning as with a new device.



WARNING

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

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

7.4 Disposal

The units consist essentially of the following components and materials.

Components	Material
Housing	Sheet-steel, aluminium
Various distance bolts, current converter housing and fan housing, etc.	Plastic
Conductor plates, accommodating the complete control and regulation electronic	Base material: EPOXY resin (filled with GRP). Copperplated on both sides and with interconnected channels. Various electronic components such as capacitors, resistors, relays and semi-conductor components, etc.

The electronic components can contain dangerous materials.

In normal use the various components do not represent a danger to humans or environment.

In event of fire dangerous materials may be released.

The electrical components should not be opened since, for the purpose of internal insulation, (e.g. on various power semi-conductor) beryllium oxide has been used. The beryllium dust caused by opening represents a health hazard.

The disposal of the units should conform to the recycling regulations of the country and region in which they are disposed.

8 APPENDIX

8.1 Manufacturer Declaration

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

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

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

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

Bezeichnung der Maschinenkomponente:
Specification of the machine component:

Typenbezeichnung:
Type:

Mono-Leistungs-Einheit

BUM 62 - 75 / 97.5 - 54 - . - . . .

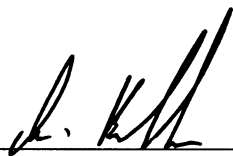
BUM 63 - 150 / 195 - 54 - . - . . .

BUM 64 - 300 / 390 - 54 - . - . . .

Nürnberg, den 04.01.2005

Hersteller-Unterschrift:

Signature of the Manufacturer:



Andreas Baumüller

Geschäftsleitung
Head Division

11/1/2005



ppa. Dr. Peter Heidrich

Entwicklungsleiter
Head of Development

8.2 Declaration of Conformity

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

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

Bezeichnung der Maschinenkomponente:

Typenbezeichnung:

Specification of the machine component:

Type:

Mono-Leistungs-Einheit

BUM 62 - 75 / 97.5 - 54 - . - . . .

BUM 63 - 150 / 195 - 54 - . - . . .

BUM 64 - 300 / 390 - 54 - . - . . .

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"

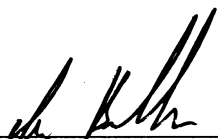
EN 50178: 1994 (VDE 0160/11.94)

"Equipment of power installation concerned electronic operating materials"

Nürnberg, den 04.01.2004

Hersteller-Unterschrift:

Signature of the Manufacturer:

 11/1/2005

Andreas Baumüller

Geschäftsleitung
Head Division

 10.1.2005

ppa. Dr. Peter Heidrich

Entwicklungsleiter
Head of Development

8.3 General Conditions of Sale and Delivery

1. Obligation and Conclusion of Contract

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

2. Price and Offers

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

3. Extent of Delivery and Delivery Time

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

4. Delivery Problems

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

5. Packaging

Items for sale and delivery items are packaged and transport insurance policies are taken out according to the

instructions of and at a cost to the purchaser. Upon demand, the packaging material has to be returned without delay, free of freight charges and expenses.

6. Dispatch and Passing of Risk

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

7. Warranty

- a) The period of warranty amounts to 12 months from the day of dispatch.
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 precondition for any warranty is the normal contractual use of the delivery items. In the event of the utilisation 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, over-voltages 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].
- d) The authorisation 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.

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.

- 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 13 c), 13 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 utilisation 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 dispu-

putes 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 17 and 18 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 re-

quired 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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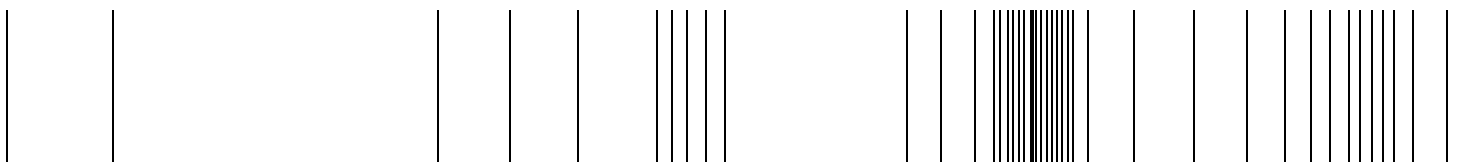
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be in motion



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