



BAUMÜLLER

**BASIC
FEED UNIT**

BUG 3 / 2 / 20

Technical description and
operation manual

ion 15. February 2002

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5.96064.02

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| <p>PLEASE READ AND PAY ATTENTION TO SAFETY INSTRUCTIONS AND OPERATING GUIDE PRIOR TO COMMISSIONING</p> |
|---|

This manual contains the necessary information for normal operation of the products described therein. The drives may only be used, maintained and repaired by personnel familiar with the operation manual and the applicable regulations on working safety and accident prevention. The devices are manufactured to a high technical specification and are operationally safe. Provided that all safety instructions have been adhered to, there will be no personal danger during the installation and commissioning stages.

The commissioning is prohibited until it has been positively determined that the machine, into which these components are to be incorporated, complies with EC machine regulations.

This technical description replaces and nullifies all previous description. In order to provide the best possible service, we reserve the right to alter information without notice.

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Country of origin: Made in Germany

Date of manufacture: Determined from the serial number on the machine/motor.

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ABBREVIATIONS

| | |
|-------|---|
| AC | Alternating current |
| AM | Asynchronous motor |
| BEDAS | German abbreviation of Operating data store |
| BUC | Baumotronic Converter Feed/Feed back Unit |
| BUG | Baumotronic Converter Basic Feed Unit |
| BUM | Baumotronic Converter Mono Power Unit |
| BUS | Baumotronic Converter Servo Power Unit |
| DC | Direct current |
| DIN | German Standardization Institute (Deutsches Institut für Normung e.V.) |
| EMC | Electromagnetic compatibility |
| EN | European standard |
| HS | Main contactor |
| IPM | Intelligent Power Module |
| MSL | Mean sea level |
| PE | Protective earth |
| SM | Synchronous motor |
| ZK | Intermediate circuit |

Abbreviations

1 SAFETY INFORMATION

Preliminary Remarks

During operation, the principles on which the power converter and the motor work lead to leakage currents to earth 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).

The units are protected from direct contact by being installed in commercially available switching cabinets that meet the minimum protection requirements of preliminary standard EN 50178/VDE 0160/11.94, Section 5.2.4.

Sheets of plastic covering 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").

At routine testing of this equipment, a high-voltage test is carried out that conforms with preliminary standard EN 50178/VDE 0160/11.94, Section. 9.4.5.

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 property.

The equipment may only be run on grounded supply networks.

Sections carrying current take more than one minute to discharge.

The equipment is conditionally shortcircuit-proof.

General Information

These operating instructions contain all the information necessary for correct operation of the products described. The document is intended for specially trained, technically qualified personnel who are well-versed in all warnings and commissioning activities.

The equipment/system is manufactured using state-of-the-art technology and is safe in operation. It can safely be installed and commissioned and functions without problems if the safety information below is followed.

Safety Information



WARNING

When operating electrical equipment, some parts of the equipment always carry dangerous voltages.

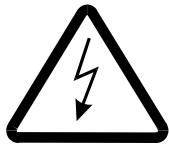
Ignoring these safety instructions and warnings may result in serious personal injury and/or damage to property.

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

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 equipment.

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 damage to property **will** occur unless appropriate safety measures are taken.



WARNING

This means that death, severe personal injury, or considerable damage to property **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 context of the safety-specific 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.

Appropriate Use



WARNING

You may only use the equipment/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 equipment/system.

The machine minder must report immediately any changes that occur which adversely affect the safety of the equipment/system.

Appropriate use also includes observing the operating instructions and complying with the conditions of inspection and maintenance.

2 TECHNICAL DATA

2.1 General

The motor and the converter must be matched to one another to be able to fulfil the requirements made of the drive system three-phase current servo motor and the converter. Our BAUMOTRONIC converters, which have been specially developed for servo drives, are transistor converters for four-quadrant operation.

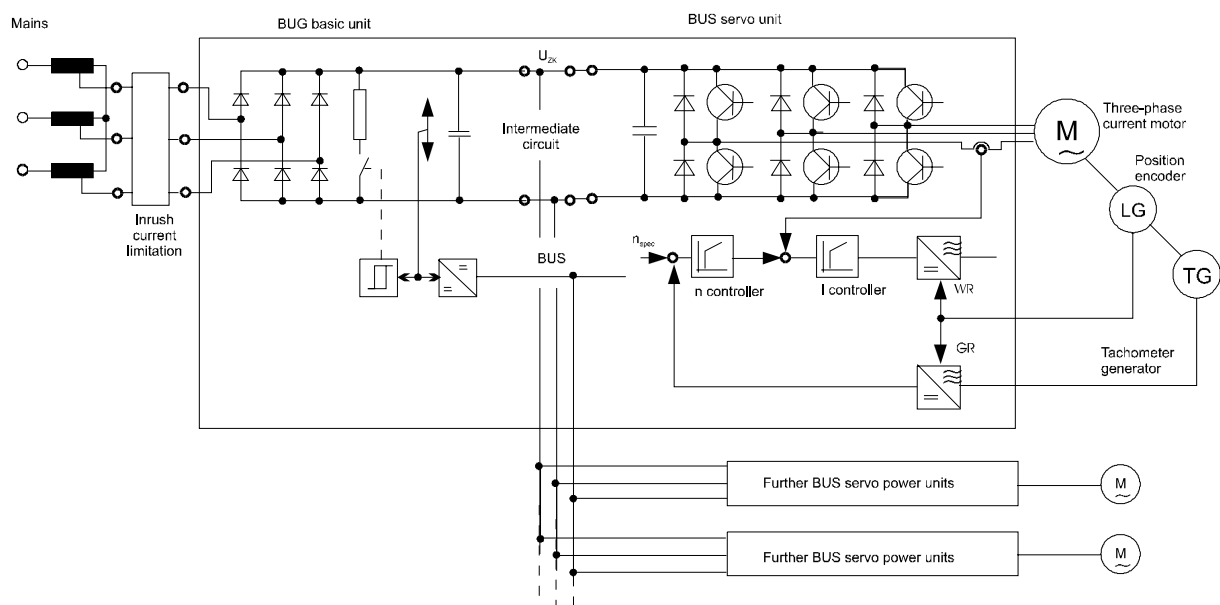
The BAUMOTRONIC converter system is of modular structure and comprises the following units:

- the BUG basic feed unit
- the BUS servo power unit

The BUG 2/3/20 named basis feed units are mains-side power converters for feeding the BUS 3/21/20 drive amplifiers. They have a ballast circuit to dissipate the drive's braking energy. They are available with internal ballast resistor or, as E version with a connector for external resistors.

Features:

- BUG 3 basic unit for up to 10.5 kW
- BUG 2 basic unit for up to 18 kW
- BUG 20 basic unit for up to 36 kW
- Connection using a pre-transformer of 400 V/230 V 3 ~
- Servo power units' current supplied from the intermediate circuit
- Switching power supply with wide voltage range continues to be ready-for-use while the intermediate circuit is charged
- Ballast circuit with high peak power integrated in the basic feed unit



2.1.1 Description of Function

Intermediate Circuit

The intermediate circuit, which supplies the connected servo units, is fed from the mains via an external matching transformer and the uncontrolled bridge rectifier.

Starting Current Limitation Device

If no measures were taken, the intermediate circuit capacitors would lead to inadmissibly high charging current surges when you switch on the mains current. Mains transformers of up to 5 kVA automatically reduce the charging current surge to a non-dangerous level. In the case of large transformers, you must install a starting current limitation device on the input side.

This device is shunted out after the start-up stage.

Power Supply

The internal switching power supply generates the supply voltages for the connected servo units from the intermediate circuit or from an external auxiliary voltage.

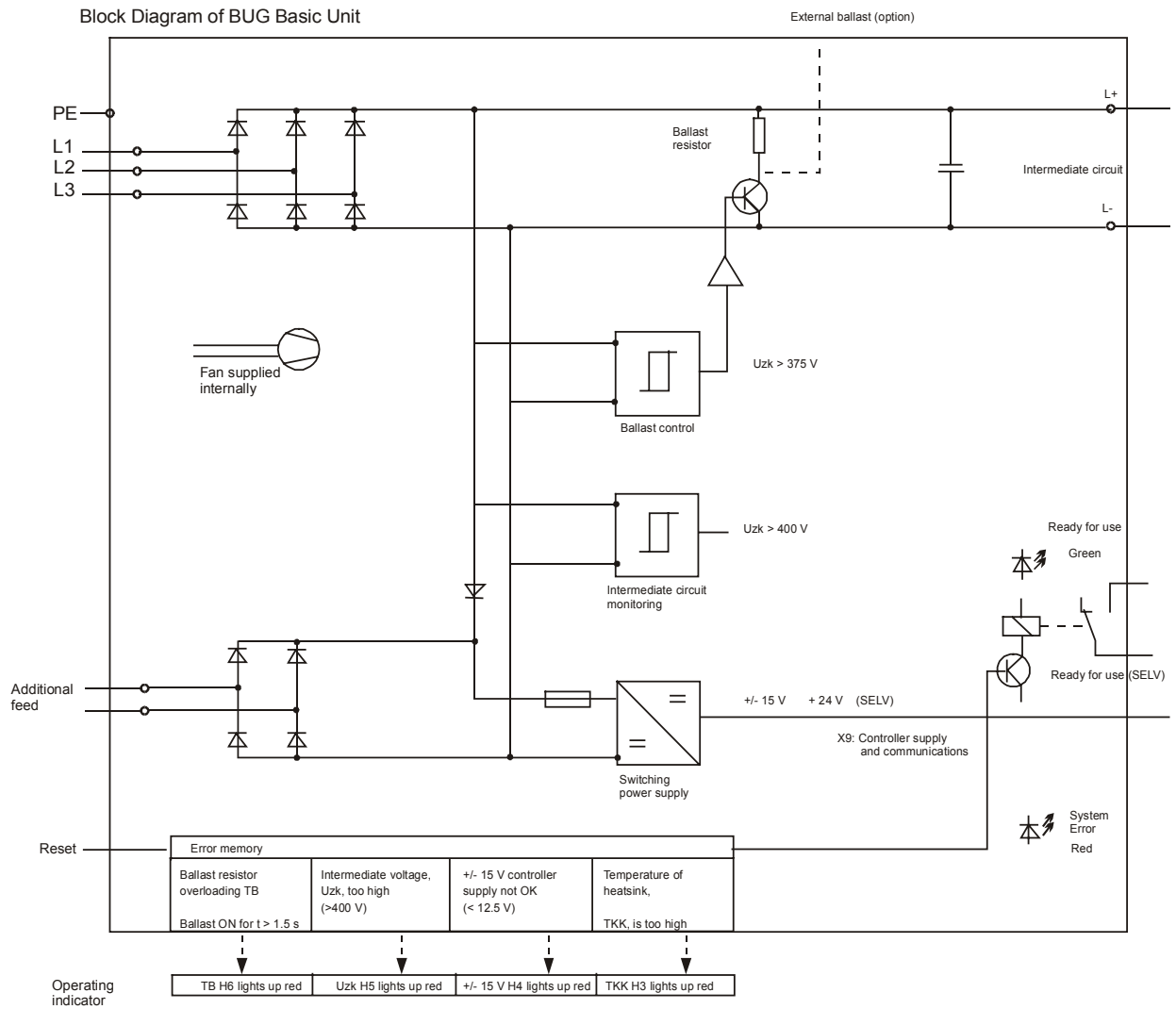
In addition, permanent monitoring is carried out of the temperature, the intermediate circuit voltage, the supply voltages and the ballast function. In the case of inadmissible values, the system issues a message that is further-processed appropriately.

The system indicates these messages to you directly by means of LEDs.

Ballast

When the drive is operating in regenerative mode, it feeds back to the intermediate circuit and raises its voltage. If this voltage exceeds an impermissibly high value, the integrated ballast transistor switches the ballast resistor (which can be external if desired) to the intermediate circuit and removes the excess energy.

2.1.2 Block Diagram



2.2 Electrical Data

| Basic Feed Unit | BUG 3 - 35 - 30 | BUG 2 - 60 - 30 | BUG 20 - 120 - 30 |
|--|---|--|--|
| Connection voltage ¹⁾ | 3 x 230 V _{AC} +10 %/-15 % | | 50/60 Hz |
| Intermediate circuit power | 10.5 kW | 18 kW | 36 kW |
| Intermediate circuit rated voltage | 310 V | | |
| Rated current at T _K = 45° C and T _B = 45° C | 35 A | 60 A | 120 A |
| Peak current for t ≤ 1 s | 105 A | 180 A | 360 A |
| Peak starting current I _{ON} , ²⁾ Max. allowed for t ≤ 10 ms | 300 A | 700 A | 1400 A |
| Controller supply ⁴⁾ | ±15 V/100 W +24 V/10 mA | | ±15 V/200 W +24 V/10 mA |
| Additional feed via transformer | 230 V/160 VA potential-free | | 230 V/250 VA potential-free |
| Isolation transformer T2 | 1900 7153 | | 1900 7176 |
| Ballast resistor R _B peak power for t < 1.5 s peak power for t < 1.8 s internal (version B) external (version E) rated power | 9 kW 16 Ω/190 W ≥ 16 Ω As required | 15 kW 9.4 Ω/400 W ≥ 8 Ω As required | 37 kW 4 Ω/900 W ≥ 4 Ω As required |
| Power loss in rated operation without ballast ⁵⁾ | 110 W | 200 W | 280 W |
| Fan | No | Supplied internally | Supplied internally |
| Environmental operating temp. range T _B ⁶⁾⁷⁾ | 0 ... 45 °C (with power reduction, 55 °C) | | |
| Coolant temperature range T _K ^{6) 7)} | 0 ... 45 °C (with power reduction, 55 °C) | | |
| Power reduction | 3 %/°C | | |
| Max. site altitude at rated loading (see also char. curve 1 on page 9) | 1000 m above sea level | | |
| Relative humidity | 15 % - 85 % no condensation | | |
| Storage temperature range | -30 °C ... +70 °C | | |
| Dimensions | 100 x 250 x 230 mm | 105 x 400 x 330 mm | 157.5 x 400 x 330 mm |
| Weight | 3 kg | 9 kg | 12 kg |

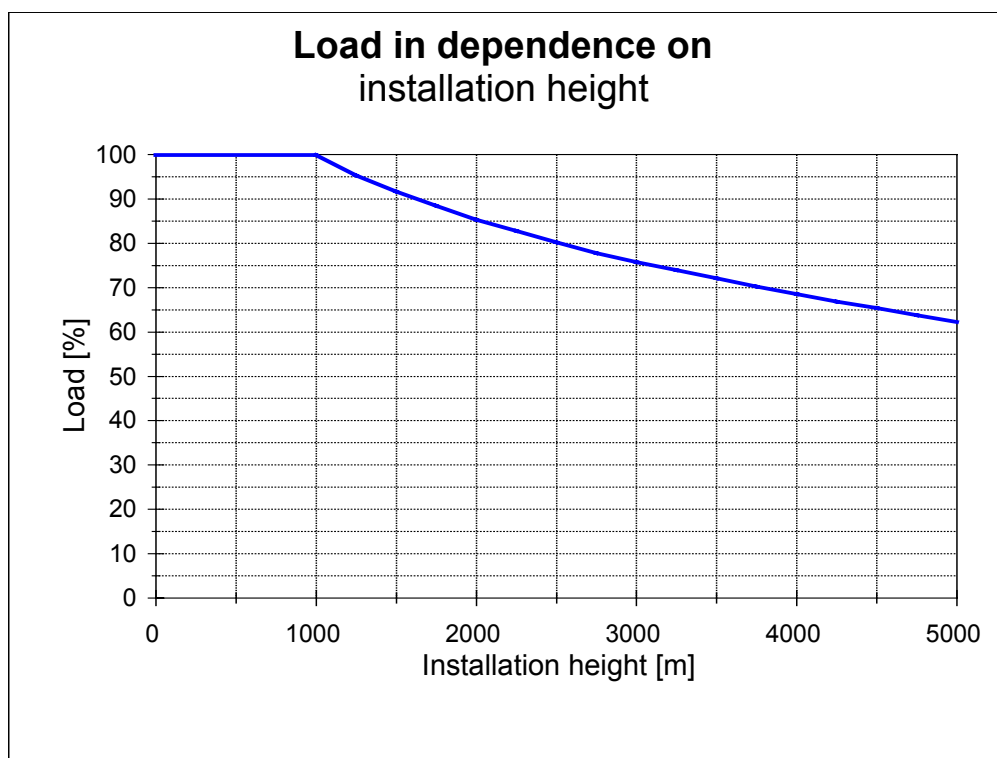
Remarks on the Technical Data

- 1) Connection voltage of the basic unit = secondary voltage U_2 of transformer T_1 .
Rated value: 230 V; never directly connect devices to the mains.
- 2) Max. permissible non-repetitive peak current ($t < 10$ ms) at switch-on; this is limited by the inductivity of transformer T_1 on the input side and possible additional current limiting resistors, R_2 (refer to the transformer layout); switch-on frequency: once per half hour.
- 3) Controller supply (switching power supply); the total of all the triggering power of all the BUS devices may not exceed the power of the selected BUG unit's switching power supply!
- 4) Additional feed for the mains unit; useful when carrying out trouble-shooting with a test adapter BU; the isolating transformer (T_2) is specially matched to the mains unit; transformer T_2 is not needed for operating the basic units.
- 5) Power losses of the devices; on one hand, this is important for rating the switching cabinet, and on the other for rating the BUG basic unit:

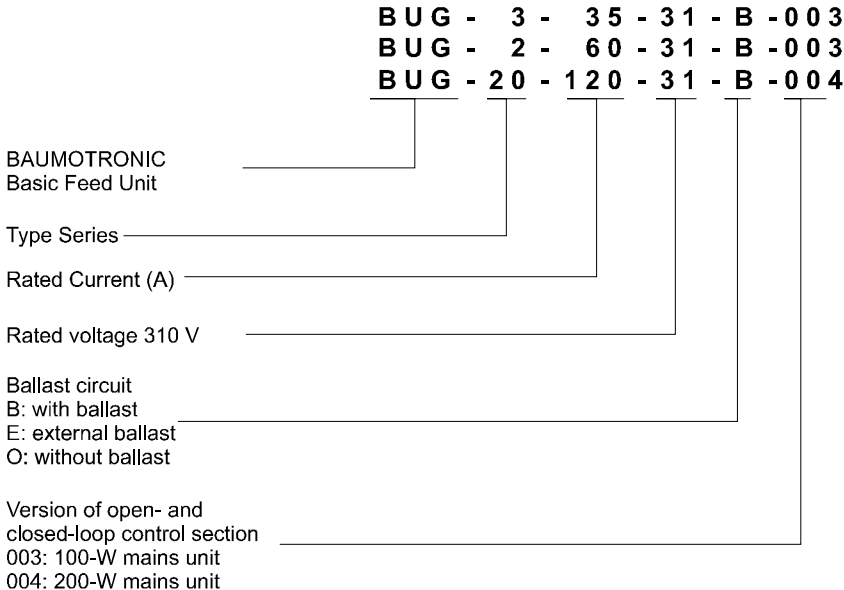
$$\Sigma P_V + \Sigma P_{\text{tomotor}} \leq P_N \text{ (BUG) (see also Transformer Rating)}$$

- 6) Coolant temperature measured 50 mm below the device according to DIN VDE 0160/DIN VDE 0558 Part 1; in rated operation, T_K as well as T_B must be below the specified limit temperatures. Otherwise, you must reduce the device's rated current.
- 7) Operating environment temperatures measured 300 mm away from the unit at the most, halfway up the device according to DIN VDE 0160/DIN VDE 0558 Part 1; T_B and T_K must not exceed the specified limit temperature. The same conditions apply as before.

Characteristic curve 1: Load in dependence on the site elevation



2.3 Type Code



3 TRANSPORTATION, UNPACKING

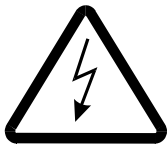
The units are packed at the factory in accordance with the order.

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

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

Cardboard, cartridge paper and/or wood are used as packaging materials that can be disposed of according to 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.

Environmental conditions must be regulated according to pr EN 50178.

4 ASSEMBLY



WARNING

The owner is responsible for assembly of the described unit, motor, transformer as well as any other equipment in accordance with safety regulations, such as DIN or 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.

Protect drive converters from impermissible loading. In particular, components may not be warped and/or insulation gaps changed during transportation and handling. Avoid touching electronic components and contacts.

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

The units are protected from direct contact by being installed in commercially available switching cabinets that meet the minimum protection requirements of preliminary standard EN 50178/VDE 0160/11.94, Section 5.2.4.

Plastic protectors on the devices that cover up the connections 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").

Drive converters contain components at risk from electrostatic energy which can be damaged by incorrect handling.

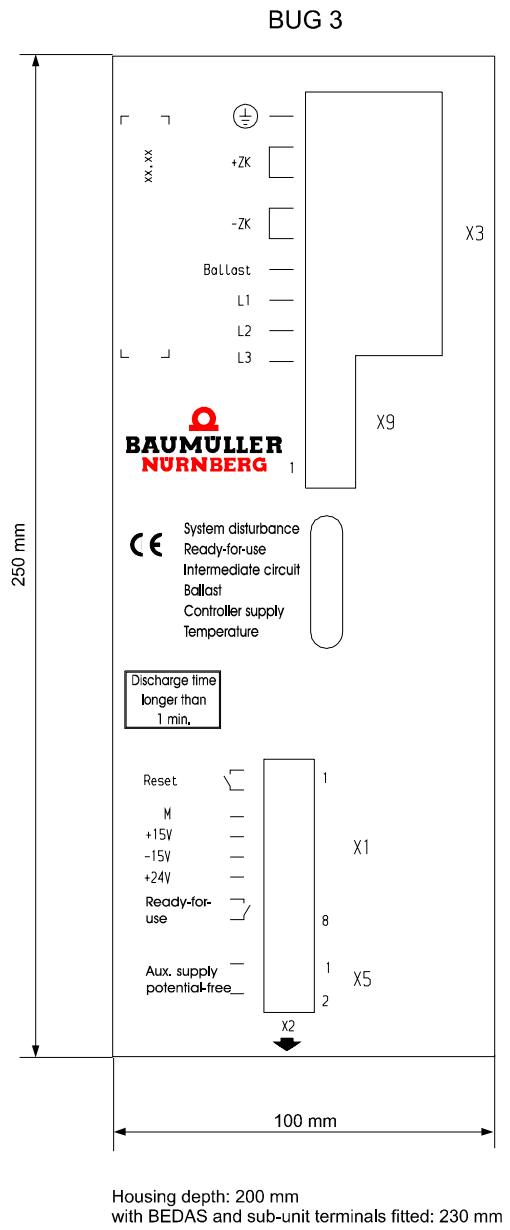
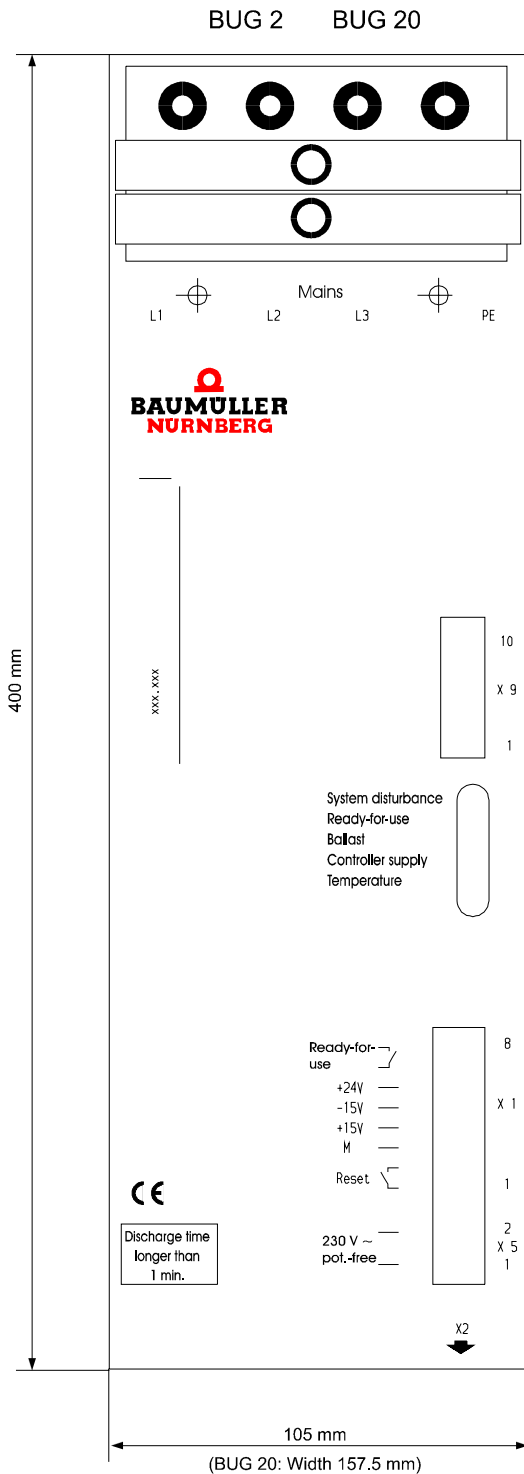
Electrical components must not be mechanically damaged or destroyed as this could lead to health risks!



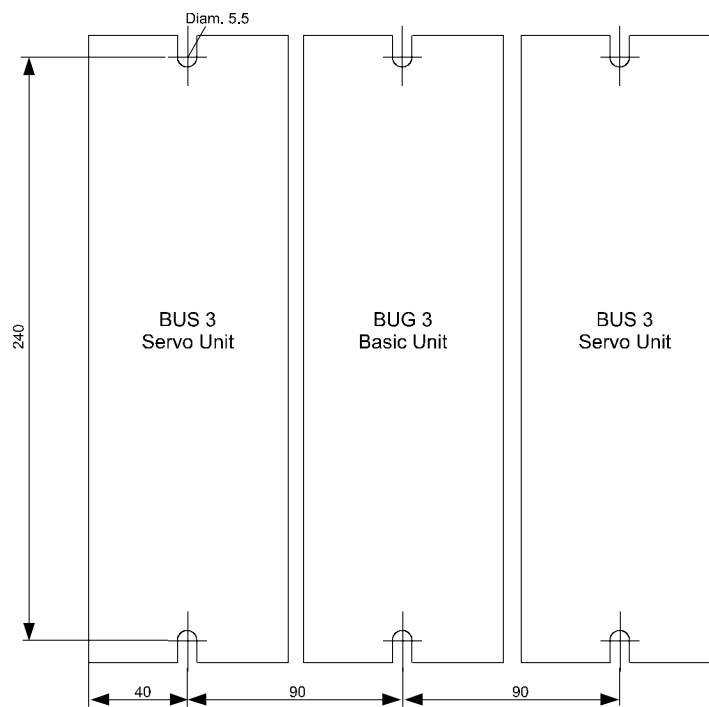
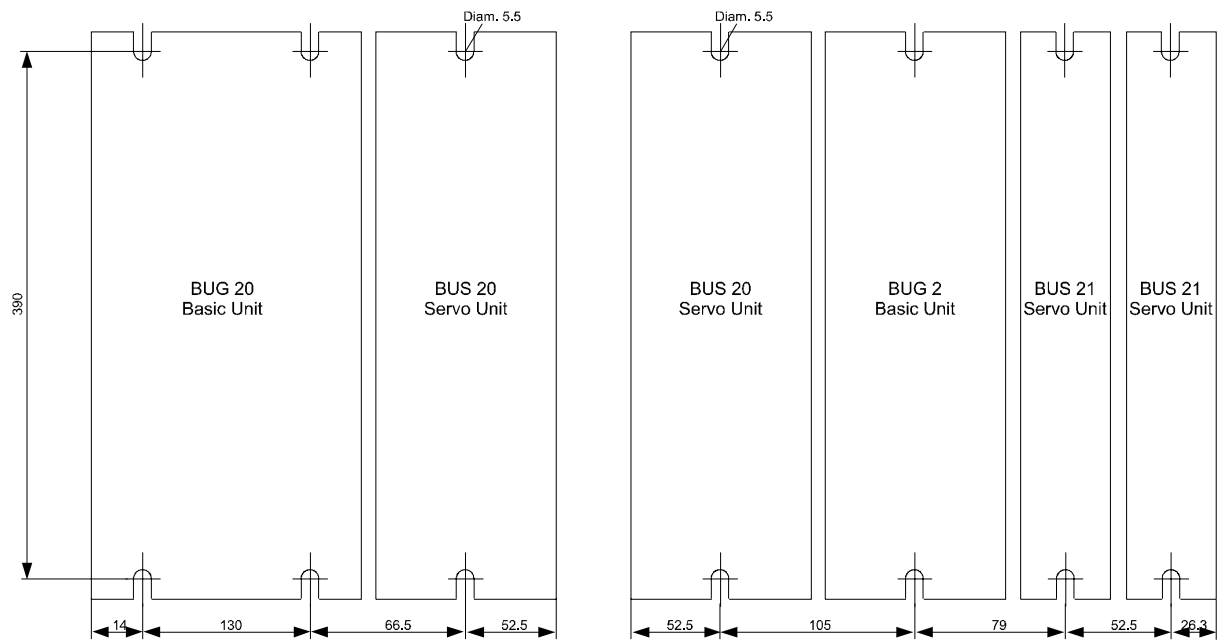
WARNING

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

4.1 Dimensions



Fastening Holes



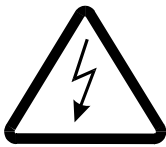
4.2 Assembly Information



WARNING

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

- Install the units vertically in a switching cabinet. Mount the BUS 3/21/20 servo power units next to the BUG 3/2/20 basic feed unit and connect the intermediate circuit using the supplied rails.



DANGER

Relatively long connections are not allowed, since there is a risk of destroying the device!



WARNING

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

- Ventilation must be in the specified direction from the bottom to the top.
- Ensure that the flow of air is unobstructed.
- There must be a minimum clearance above and below the device of

100 mm

and you must ensure that there is enough cooling air that can circulate freely!

- The temperature of the coolant 50 mm below the devices may be up to 45 °C.
- Do not locate any additional sources of heat above or below the devices.
- You must avoid degrees of contamination 3 and 4 according to provisional standard EN 50178:1994 Section 5.2.15.2. The devices are suitable for use in enclosed workshops. (VDE 0558 Part 1a, Sections 5.4.3.2.1 and 5.4.3.2.2).
- The live parts take more than one minute to discharge.

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 mono 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.

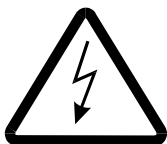
If you carry out works at power-on drive converters you must obey the national safety rules to avoid accidents. The electrical installation must be carried out according to the respective guidelines (e.g. cross-sections, fuses, protective earth attachment).

The protective earth connection has to be carried out according to DIN EN 60204/VDE 0113 Part1/06.93; section 8.2.2, also pr EN 50178/VDE 0160/11.94, sections 5.3.2 and 8.3.4, or the respective local guidelines. Information about EMC-correct installation – as screening, earthing, positioning of filters and running cables, you will find in this document. This information must be respected also when using CE-marked drive converters.

The responsibility for keeping the limits requested by the EMC laws has the manufacturer of the plant or machine.

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



DANGER

The intermediate circuit carries a voltage!

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.

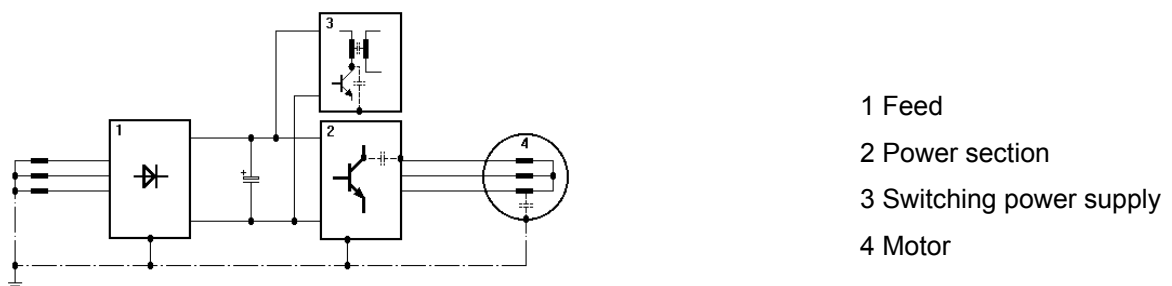
5.2 EMC Information

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.

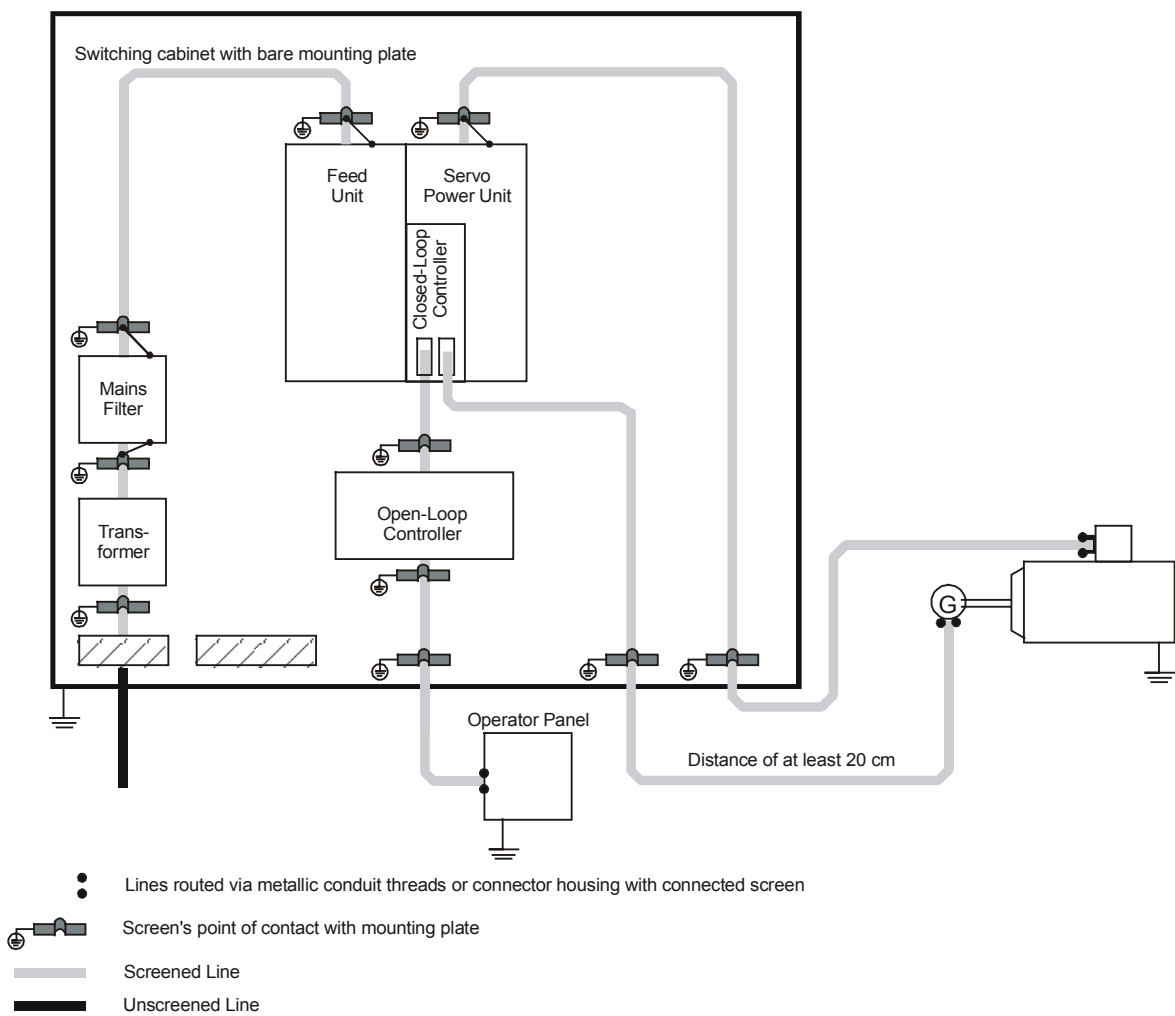
The information on the next pages is intended to allow you to configure your system on the basis of the latest knowledge in the field of EMC and to comply with legal regulations.

Measures for Ensuring EMC

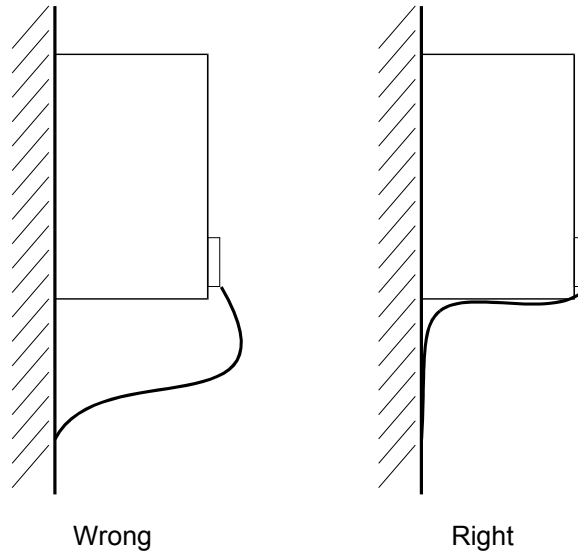
To ensure EMC, you must observe the configuration information below.

Cabling

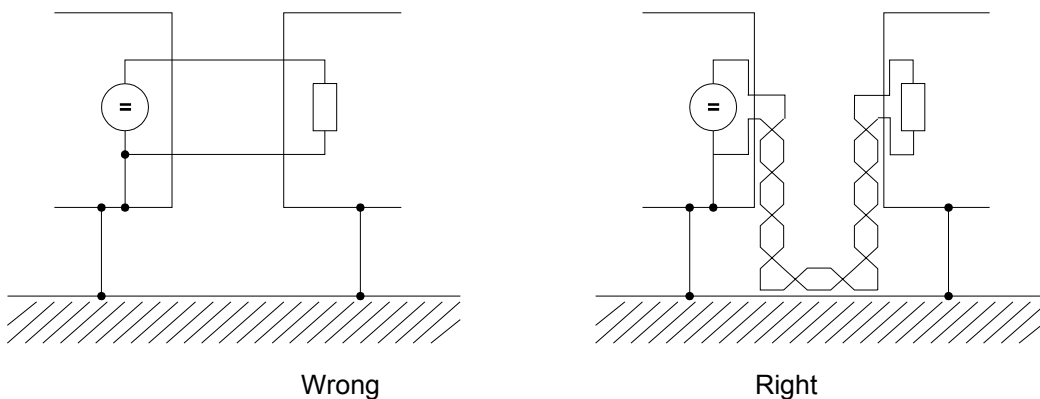
- To suppress radiated noise outside the converter, you should screen **all** the connected cabling. Also observe the topics in the section entitled "Screening".



- 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.

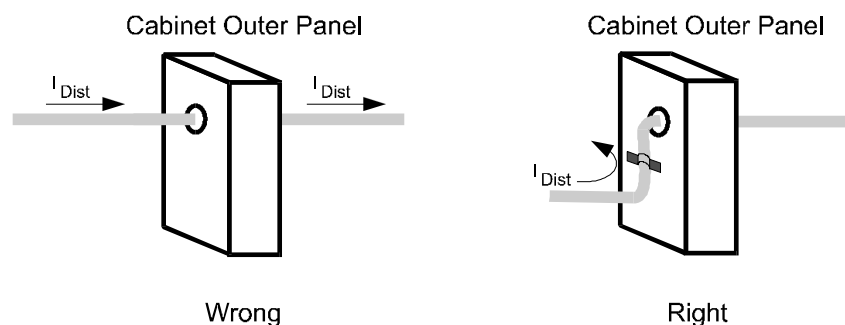


- When parallel-routing signal and control lines across power cables, the conductors must be at least 20 cm apart.
- Lines of different EMC categories should only cross at an angle of 90°.
- In the case of symmetrical signal transfer (e.g. differential amplifier inputs for the speed specified value), 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.
- You **must** ground reserve lines at both ends (this has an additional screening effect, avoids capacitively coupled, dangerous touch voltages).

Grounding

- From an EMC point of view, classical star grounding is no longer adequate for reducing the influence of disturbances at relatively high frequencies that occur as a result of converter operation. Better results can be achieved by a reference surface that must be linked to the devices' frame grounds over a wide area (e.g. a bare, metallic mounting plate and parts of the housing).
If it is not possible to use a broad reference place, it is sensible to mount the main equipotential busbar directly next to the converter, since this device generates the greatest potential jumps, compared with the other components in the switching cabinet, due to the steep switching edges (the ground connection should be less than 30 cm long if possible).
- Route all earth conductors and screens as closely as possible above the frame ground to prevent earth circuits.
- If it is possible to earth the controller reference voltage, make this connection with cabling that has as large a cross-section as possible and is less than 30 cm long.
- Remove insulating layers, such as varnish, adhesives, etc., from the frame ground connections. If necessary, use DIN 6798 serrated lock washers or similar to ensure a permanent, conductive contact. To prevent corrosion of frame ground connections, use suitable pairs of metals (electrochemical displacement series), and keep conductive electrolytes away from the connection by means of a protective coating (e.g. grease).
- Always connect screens at both ends to the frame ground; the connection should be over a wide area and conductive. This is the only way to suppress the effects of magnetic or high-frequency noise interference fields. If there are problems with earth circuits (e.g. double earth fault of the specified value conductor screen), the receive side should be galvanically connected and the transmit side capacitively connected.
- When routing cable screens through panels that separate different EMC areas, the cables must be in contact with the panel.
Cables that are routed through the outer panels of screening housings without special measures (e.g. filtering), can have an adverse effect on the screening capability of the housing. For this reason, you must make a conductive connection of the cable screens to the screening outer panel at the point at which the cable enters the housing.
The distance of the last screen contact point to the exit from the cabinet must be as short as possible.

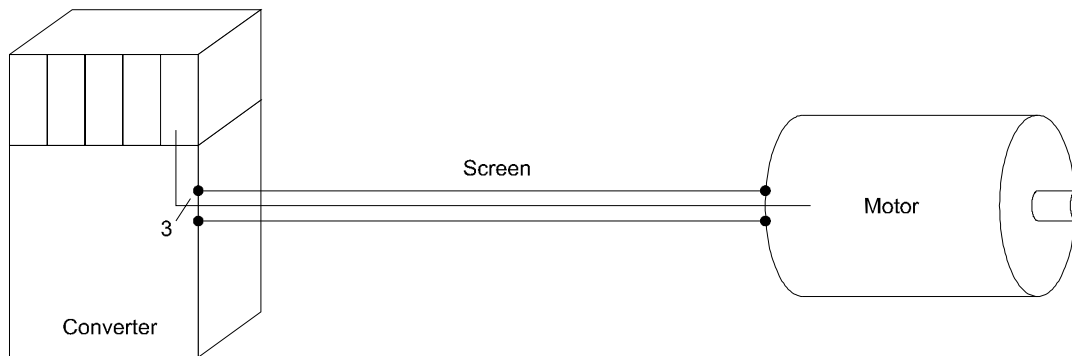


Screening

- 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 (electromagnetic 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!

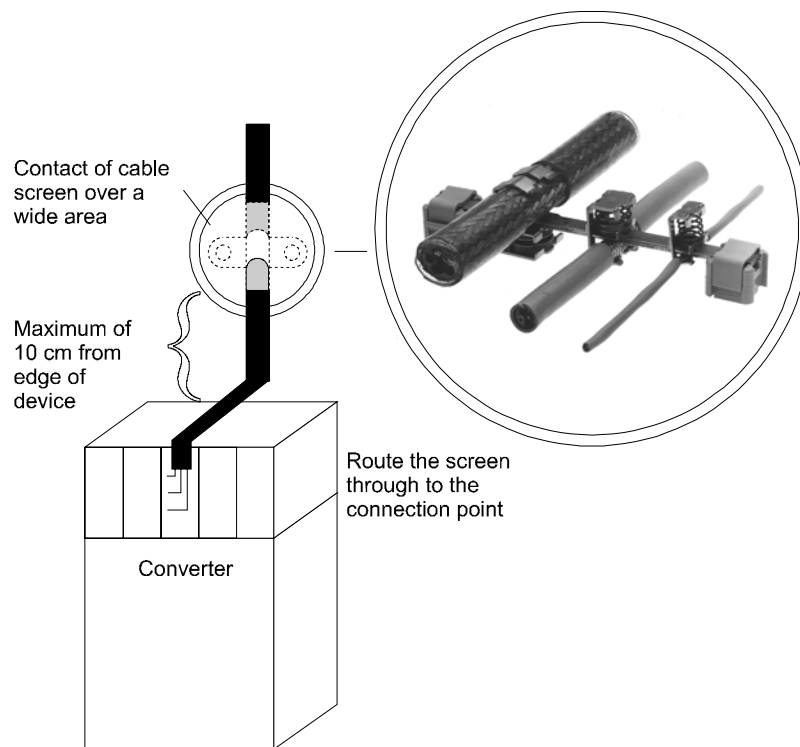
NOTE

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

The following lines have particularly high levels of interference potential:

- the motor line
- the line to the external ballast resistors
- the line between the mains filter and the converter

- Suggestion for 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

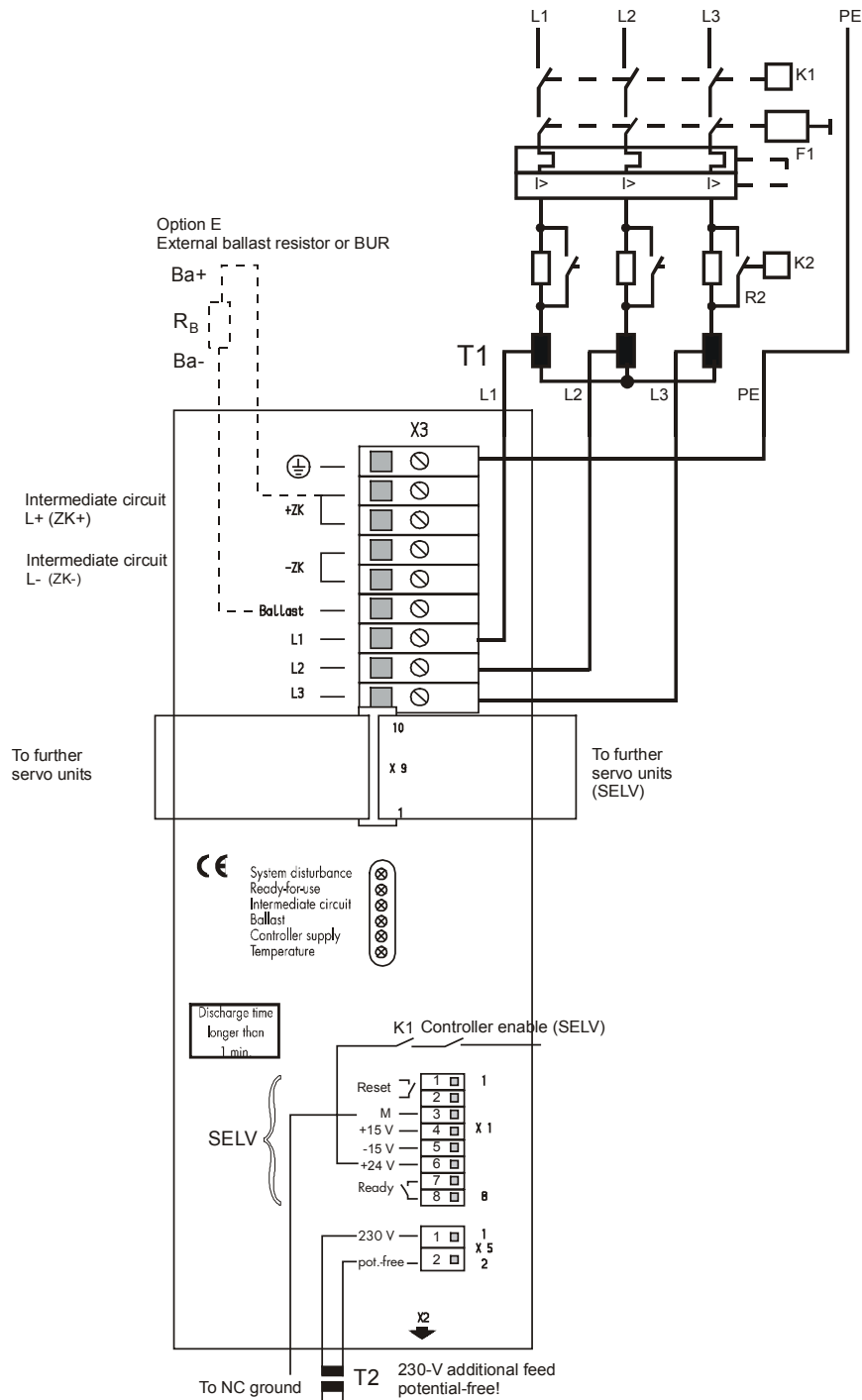
Due to the principle of operation, parasitic capacities in the filter, the mains unit, the motor cable and the motor winding cause discharge currents of around 100 mA and higher.

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.

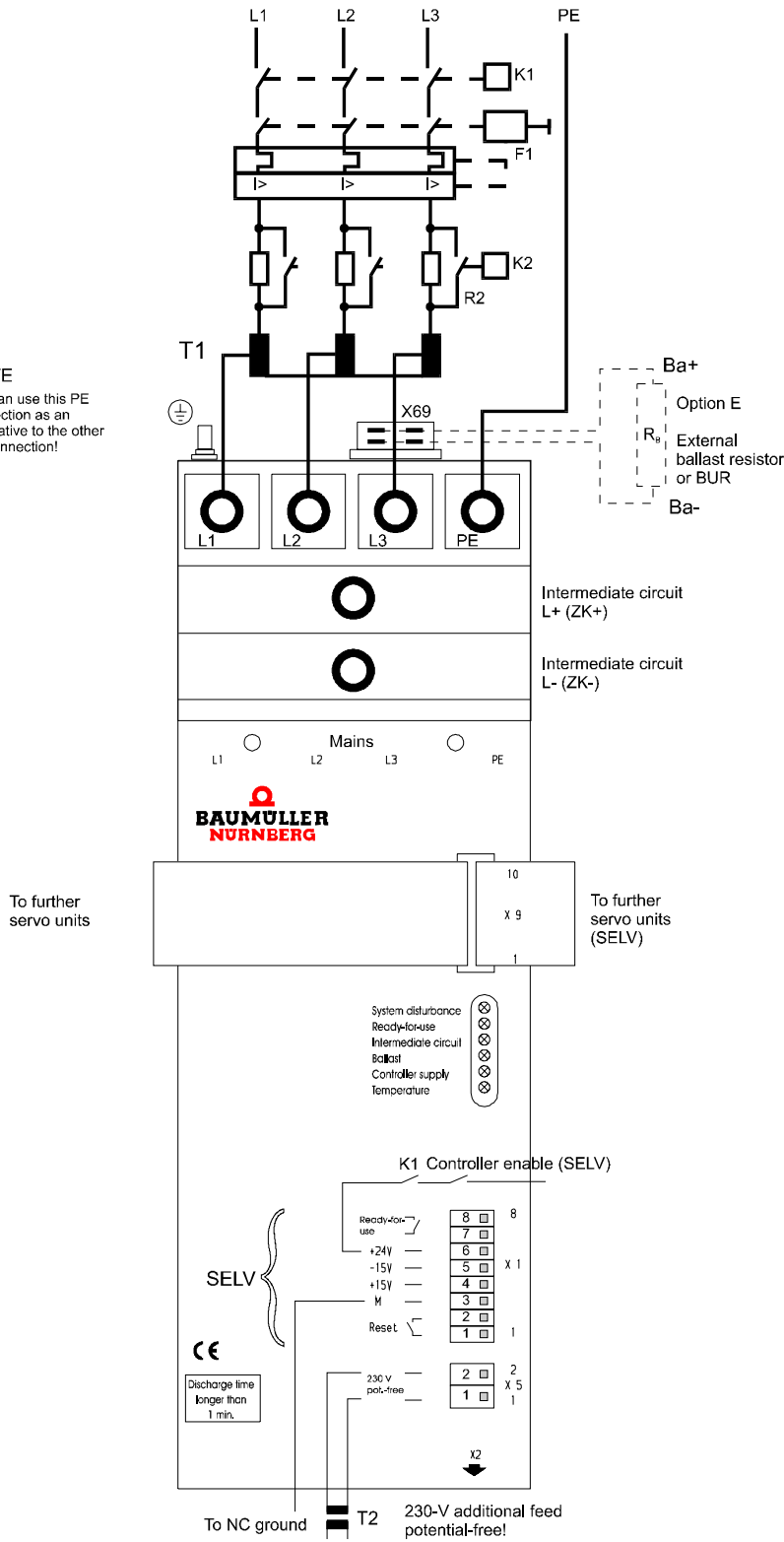
5.3 Connection Diagram

5.3.1 BUG 3



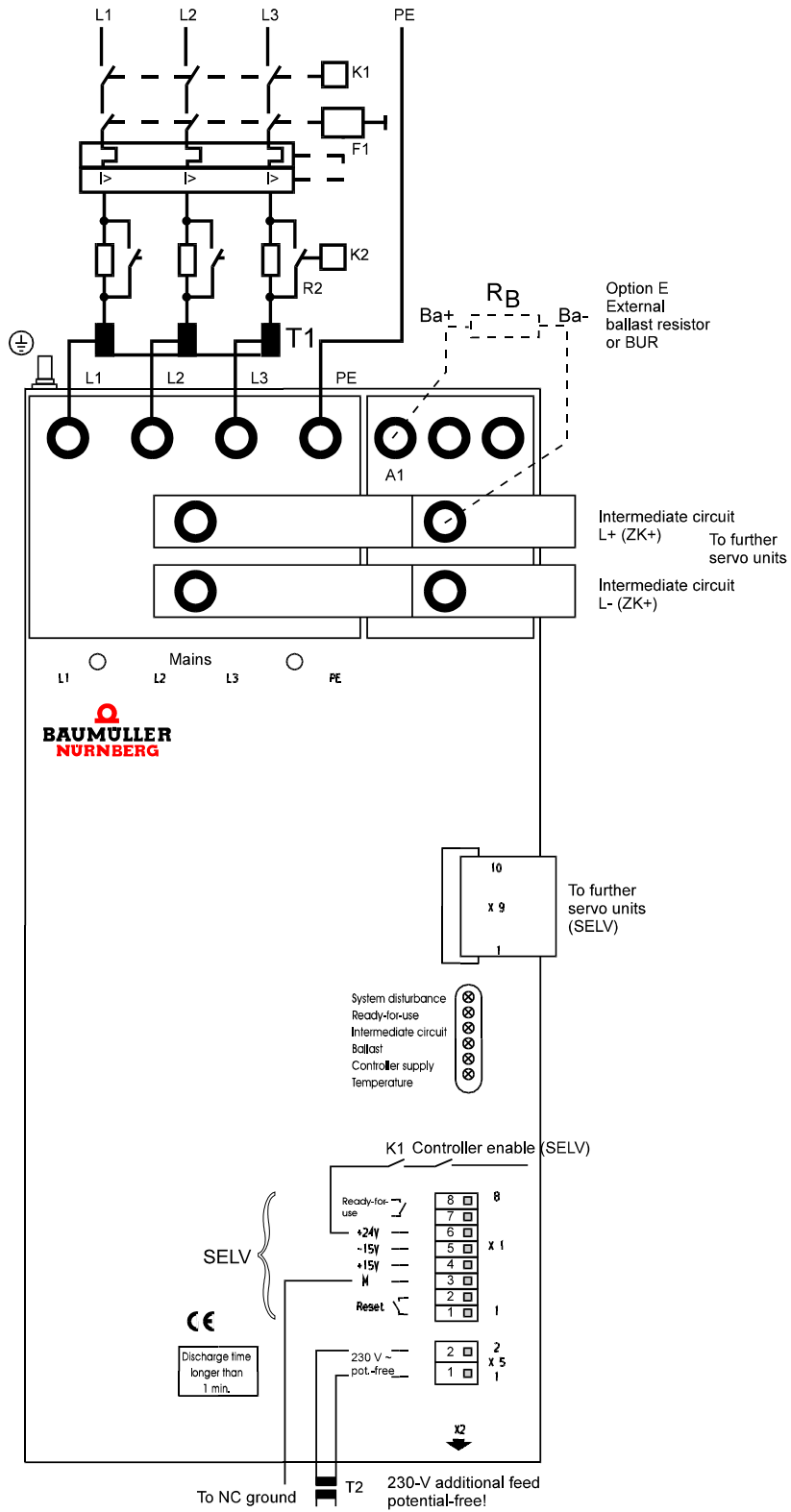
5.3.2 BUG 2

NOTE
You can use this PE connection as an alternative to the other PE connection!

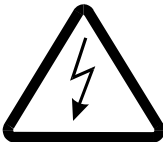


5.3.3 BUG 20

NOTE
You can use this PE connection as an alternative to the other PE connection!



5.3.4 Connection Information

| | |
|---|---|
| F1 | Line protection in accordance with VDE 0100, slow-blowing fuse of 2-3 times the transformer's rated current or motor protection switch in systems with only one axis. |
| Current-operated e.l.c.b. | The principles on which the power converter and the motor work lead to relatively high 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 Section 5.2.11. |
| T1 | Autotransformer YNO or isolating transformer Yny0; inrush current limitation device depending on the type and power of the transformer. For further details, refer to Transformer Accessories |
| T2 | <p>Isolating transformer for additional feed of the auxiliary controller supply</p> <p>BUG 2 and 3: isolating transformer 230/230, 160 VA, No. 1900 7153 BUG 20: isolating transformer 230/230, 250 VA, No. 1900 7176</p> <p>With this option, error messages are retained even if K1 has dropped. The option is not necessary for operation. Use one transformer per basic unit.</p> |
| K1 | Mains contactor with auxiliary contact for controller enable |
| K2, R2 | Starting current limitation prevents the B6 rectifier's permissible non-repetitive peak current, I_{ON} , from being exceeded; the contactor shunts out resistors $R = 10 \Omega/50 W$ after one second; this is always necessary when using capacitor unit BUK, otherwise only with transformers T_1 rated at 5 kVA and above; available as a complete module designated WSV (chapter 5.4.2) |
| L+, L- ZK+, ZK- | <p>Intermediate circuit connection to the BUS units via the supplied busbars. With several servo units, arrange the BUG in the middle.</p> <p>Wire the BUG 3 with 4 mm² wires.</p> <p>DANGER</p> <p>When using autotransformers, the intermediate circuit carries mains potential; When using isolating transformers, ground L- (ZK-).</p> |
|  | |
| L1, L2, L3, PE | Cross-section according to EN 60204-1:1992 For line-laying, refer to EMC Information |
| R _B | <p>Drives that have a very high centrifugal mass or acceleration/braking drives are run with external ballast. For more information, refer to the section entitled BUR Resistor Unit.</p> <p>BUG 3: Connection of an external ballast resistor rated at 10 Ω or above between ballast and L+.</p> <p>BUG 2: Connection of an external ballast resistor rated at 8 Ω or above on connector X69 on the top of the device.</p> <p>BUG 20: Connection of an external ballast resistor rated at 4 Ω or above between A1 and ZK+.</p> |

5.4 Pin Assignments

5.4.1 Power Terminals

| | |
|--|--|
| L1, L2, L3, PE | Mains connection (via mains transformer), ground connection |
| L+ (ZK+) | Intermediate circuit connection to the servo power units via the supplied bus-bars. Arrange the BUG in the middle of the servo power units. Wire the intermediate circuit from the BUG 3 and the servo power units with 4 mm ² wires. |
| L- (ZK-) | |
| DANGER | |
| When using autotransformers, the intermediate circuit carries mains potential; when using isolating transformers, ground L-. | |
| X69 | Connection of external ballast (BUG 2 only) |
| A1, L+ (ZK+) | Connection of external ballast (BUG 20 only) |
| L+ (ZK+), Ballast | Connection of external ballast (BUG 3 only) |

5.4.2 Control Terminals

Plug-in connection X9 Bus connection to the servo power units.
Supply voltages and operating messages are routed via this connection.

Terminal strip X5

| Pin No. | Assignment |
|---------|--|
| 1 | Additional feed via isolating transformer T2 230 V _{AC} |
| 2 | Additional feed via isolating transformer T2 230 V _{AC} |

Terminal strip X1

| Pin No. | Assignment |
|---------|--|
| 1 | When both contacts close, the system resets stored messages whose causes are no longer pending |
| 2 | |
| 3 | Device ground |
| 4 | +15 V output |
| 5 | -15 V output |
| 6 | +24 V output for controller enables, direction reversal and NP switch only |
| 7 | Relay contact (max. of 24 V/1 A) closed on ready-for-use is pending for 1-2 seconds after mains contactor closes K1 (SELV) |
| 8 | |

Terminal strip X2 Connection for test adapter BU (option)

5.5 Accessories

5.5.1 Transformers

You connect servo drives to the mains by using a three-phase current transformer. Calculate the power from the absorbed power, P_M , of the individual motors added to the power losses of the servo units. When rating the transformer, you must take into account a form factor of 1.2 due to the harmonics.

$$P = \frac{P_{M1} + P_{M2} + P_{M3} + P_{M4}}{G}$$

$$P_M = 0.5 * \frac{M_N * n_N}{9550 * \eta} + P_{Bus}$$

M_N : Rated torque in Nm
 n_N : Rated speed in RPM
 P : Power in kW
 η : Efficiency of motor
 P_{Bus} : Losses of the servo power unit

$G = 1$ (for 1 axis)
 $G = 1.15$ (for 2 axes)
 $G = 1.32$ (for 3 axes)
 $G = 1.75$ (for 4 axes)

P_M represents an average mean value ($\frac{n}{n_{max}} = 0.5$) matched to a typical CNC feed drive.

When operating at rated speed ($\frac{n}{n_{max}} = 1$), you must take into account the complete motor power.

Isolating transformer or autotransformer

Autotransformers are preferable at power ratings above 5 kVA. Note that the intermediate circuit may not be grounded and that potential is connected to the intermediate circuit as well as the motor. If necessary, you may need to limit the peak starting current. These recommendations apply to Baumüller transformers only!

Technical Data of Transformers

| | Isolating transformer ^{*)} | Autotransformer |
|----------------------|-------------------------------------|---------------------------|
| Rated Input Voltage | 400 V/3 ~ 50/60 Hz | 400 V/3 ~ 50/60 Hz |
| Rated Output Voltage | 230 V/3 ~ | 230 V/3 ~ |
| Switching Group | YNy0 | Yn0 |
| Mode | S1 at 40° C | S1 at 40° C |
| Type of Protection | IP 00, Insulation class E | IP 00, Insulation class E |
| Ambient Temperature | +40° C max. | +40° C max. |

^{*)} Do not connect the star point to the mains

| Isolating transformers | | | | | | | Autotransformers | | | | | | |
|-------------------------|--------------------------|-----------------------|----------------|--|----|---|-------------------------|--------------------------|-----------------------|----------------|--|---|---|
| P _M (kVA) | Works No. 1900 ... | U _K (%) | Weight (kg) | Starting current limitation de- vice ¹⁾ | | | P _M (kVA) | Works No. 1900 ... | U _K (%) | Weight (kg) | Starting current limitation de- vice ¹⁾ | | |
| | | | | B | B | B | | | | | B | B | B |
| | | | | U | U | U | | | | | U | U | U |
| | | | | G | G | G | | | | G | G | G | |
| | | | | 2 | 20 | 3 | | | | 2 | 20 | 3 | |
| 0.4 | ... 7154 | 4 | 7.5 | 0 | 0 | 0 | 0.4 | ... 7159 | 2 | 4.2 | 0 | 0 | 0 |
| 1.0 | ... 7155 | 4 | 15.0 | 0 | 0 | 0 | 1.0 | ... 7160 | 2 | 7.5 | 0 | 0 | 0 |
| 2.5 | ... 7156 | 4 | 22.5 | 0 | 0 | 0 | 2.5 | ... 7161 | 2 | 15.0 | 0 | 0 | 0 |
| 5.0 | ... 7157 | 4 | 68.0 | 0 | 0 | 1 | 5.0 | ... 7162 | 2 | 22.5 | 0 | 0 | 1 |
| 8.0 | ... 7158 | 4 | 77.0 | 0 | 0 | 1 | 8.0 | ... 7163 | 2 | 27.0 | 1 | 0 | 1 |
| | | | | | | | 10.0 | ... 7164 | 2 | 29.0 | 1 | 0 | 1 |
| | | | | | | | 15.0 ²⁾ | ... 7165 | 2 | 29.0 | 1 | 0 | 1 |
| | | | | | | | 25.0 ²⁾ | ... 7167 | 2 | 78.0 | 1 | 1 | 1 |

¹⁾ Starting current limitation device

0: Not necessary

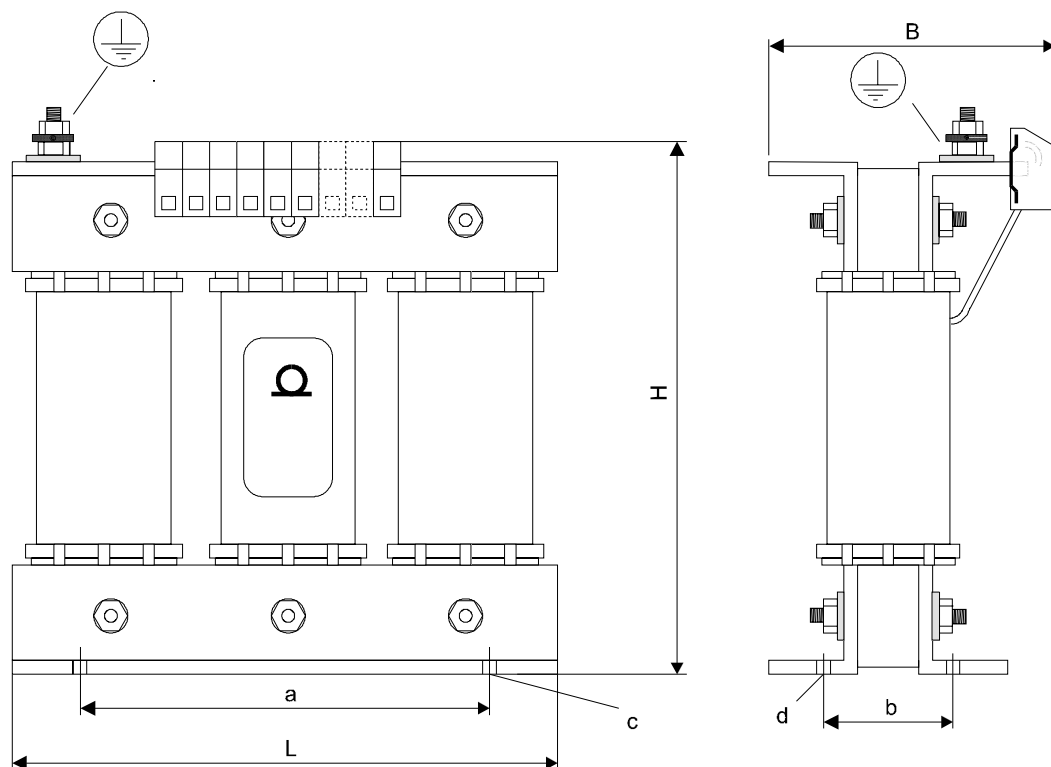
1: Operation **with** starting current limitation device only

²⁾ These transformers have an additional tap for 190 V; 40-kVA transformers on request

Dimensions

| Isolating transformer | Power (kVA) | Length L (mm) | Breadth W (mm) | Height H (mm) | Weight W (kg) | Fastening/Hole axb / cxd (mm) |
|-----------------------|-------------|---------------|----------------|---------------|---------------|-------------------------------|
| 19007154 | 0.4 | 180 | 110 | 155 | 7.5 | 136x55 / 7.0x14 |
| 19007155 | 1.0 | 204 | 140 | 175 | 15.0 | 175x85 / diam. 8.5 |
| 19007156 | 2.5 | 240 | 160 | 205 | 22.5 | 200x100 / diam. 8.5 |
| 19007157 | 5.0 | 360 | 195 | 305 | 68.0 | 300x130 / 9x14 |
| 19007158 | 8.0 | 360 | 210 | 305 | 77.0 | 300x150 / 9x14 |

| Autotransformer | Power (kVA) | Length L (mm) | Breadth W (mm) | Height H (mm) | Weight W (kg) | Fastening/Hole axb / cxd (mm) |
|-----------------|-------------|---------------|----------------|---------------|---------------|-------------------------------|
| 19007159 | 0.4 | 150 | 75 | 130 | 4.2 | 113x48 / 5.8x11 |
| 19007160 | 1.0 | 180 | 110 | 175 | 7.5 | 136x56 / 7.0x14 |
| 19007161 | 2.5 | 204 | 140 | 200 | 15.0 | 175x85 / 7.0x14 |
| 19007162 | 5.0 | 240 | 160 | 225 | 22.5 | 200x100 / 9.0x14 |
| 19007163 | 8.0 | 270 | 170 | 255 | 27.0 | 220x105 / 8.5x12 |
| 19007165 | 10.0 | 270 | 170 | 250 | 29.0 | 220x105 / 9.0x14 |
| 19007166 | 15.0 | 340 | 210 | 305 | 51.0 | 280x110 / 12.0x8.5 |
| 19007167 | 25.0 | 400 | 210 | 385 | 78.0 | 340x130 / 9.0x14 |

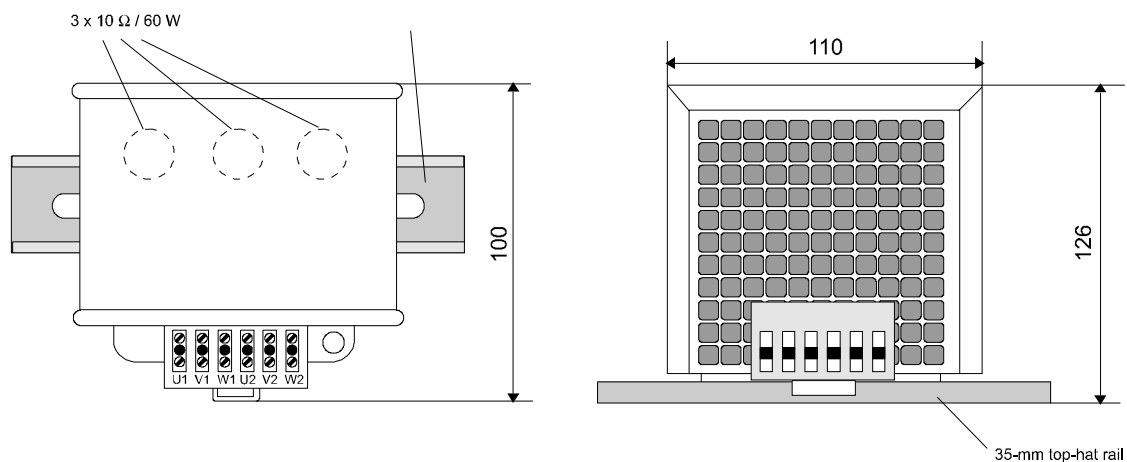


5.5.2 Starting Current Limitation Device

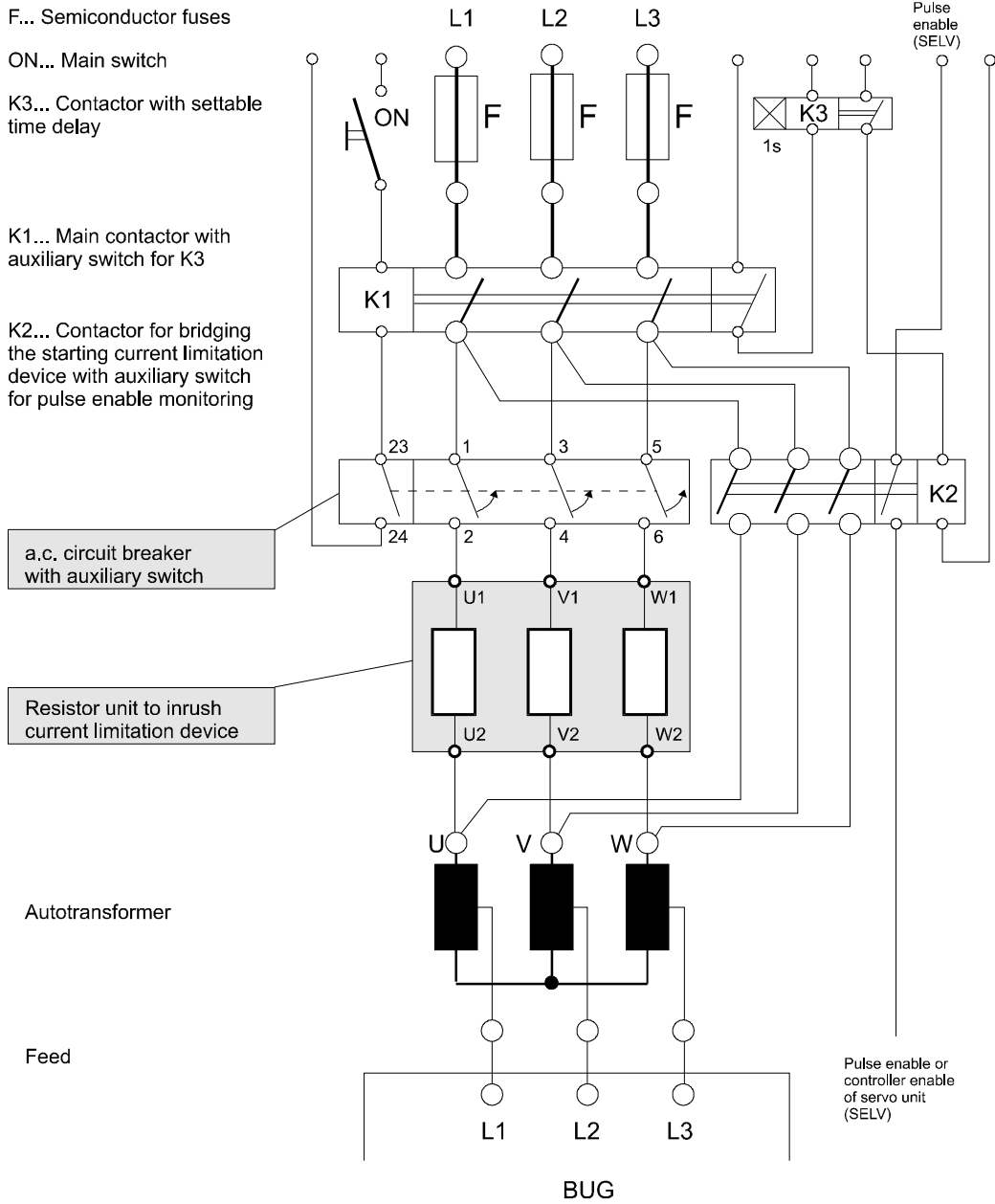
Technical Data

| | |
|---|-----------------------------------|
| Type Designation | WSV 3 - 10/60 - 001 |
| Resistor | 3 x 10 Ω |
| Rated Power | 3 x 60 W |
| Reclose after | 2 s |
| Max. closing energy | 350 Ws |
| Max. capacitance at $U_{ZKmax}=340$ V | 6 mF |
| Overload protection by safety circuit breaker with auxiliary switches | Rated current 2 A Trip curve C |

Dimensions



Connection Suggestion



5.5.3 BUR Resistor Unit

Device Description

During the braking stage of converter-fed three-phase current drives, the system initially loads the device-internal intermediate circuit capacitors with the fed-back electrical energy.

If there is still electrical energy available after loading, it can be additionally stored in an external capacitor unit or converted to heat via device-internal or device-external resistors. Specifically for the latter purpose, a Type Series 6 device is provided that combines the resistors in a force-ventilated way in a safe housing.

Electrical specifications

| | | |
|--|--|--------------------------------|
| Resistor ¹⁾ | BUG20 BUG2 BUG3 | R = 4 Ω R = 8 Ω R = 16 Ω |
| Rated Power | P _V ≤ 2 kW, force ventilated, T _A = 45 °C, mounted vertically | |
| Peak Power | P _V ≤ 18 kW for t ≤ 15 s P _V ≤ 36 kW for t ≤ 7 s | |
| Max. permissible ballast energy | 270 kW | |
| Operating environm. temperature T _B | 0 ... 45 °C | |
| Coolant temperature range T _K | 0 ... 45 °C | |
| Storage temperature range | -30 ... +70 °C | |

¹⁾ When UL508C is considered: The resistor-units are only to be used in connection with Baumüller-appliances of BUG and BUM61, 62 and 62T types.

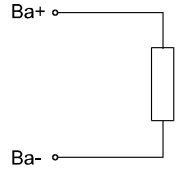
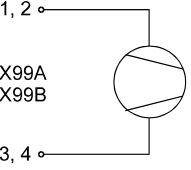
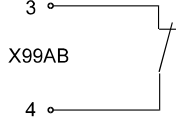
Calculation

| | | |
|---|---|---|
| Kinetic energy | $W_m = \frac{1}{2} * J * \left(\frac{2\pi * n}{60}\right)^2$ | |
| Stored energy | $W_m = \frac{1}{2} * C * (U_2^2 - U_1^2)$ | |
| Ballast energy | W _V = P _V * t | |
| The following are stored in the capacitor with BUG 3 and BUG 21 with BUG 20 and BUG 2 BUK capacitor unit | W _{el} = 3.8 Ws/unit W _{el} = 17.25 Ws/unit W _{el} = 345 Ws/unit | |
| The following are burnt out in the ballast resistor | | |
| Ballast | BUG 3 | W _{el} = 13.5 kW P _{eff} = 200 W |
| | BUG 2 | W _{el} = 24 kW P _{eff} = 400 W |
| | BUG 20 | W _{el} = 55 kW P _{eff} = 900 W |
| Ext. ballast | BUR | W _{el} = 270 kW P _{eff} = 2 kW |

In cyclic operation, the power P of the ballast resistors is not to be exceeded.

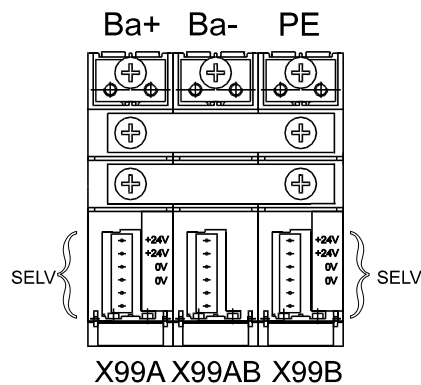
$$P = \frac{P_1 \cdot t_1 + P_2 \cdot t_2 + \dots}{t_{ges}}$$

Connection

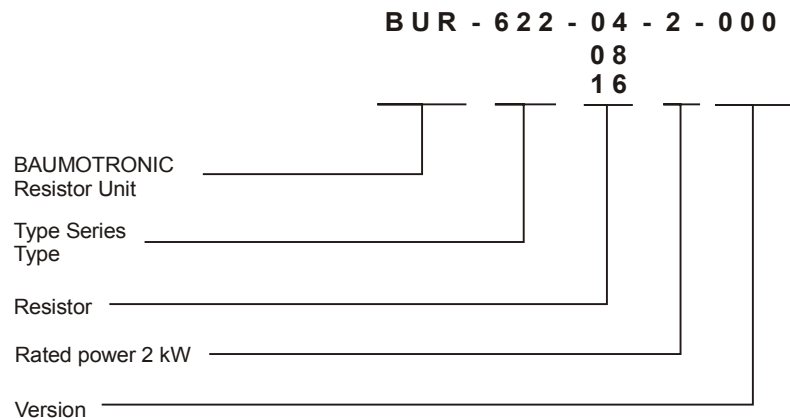
| | |
|---|--|
| <p>Connect ballast resistor connector to basic unit (refer to connection¹⁾ plan of basic unit)</p> |  |
| <p>Fan (24 V_{DC}, 0.25 A, SELV)</p> |  |
| <p>Pre-warning Error (Overtemperature BUR) (SELV)</p> |  |

¹⁾ When UL508C is considered: The resistor-units are only to be used in connection with Baumüller-appliances of BUG and BUM61, 62 and 62T types.

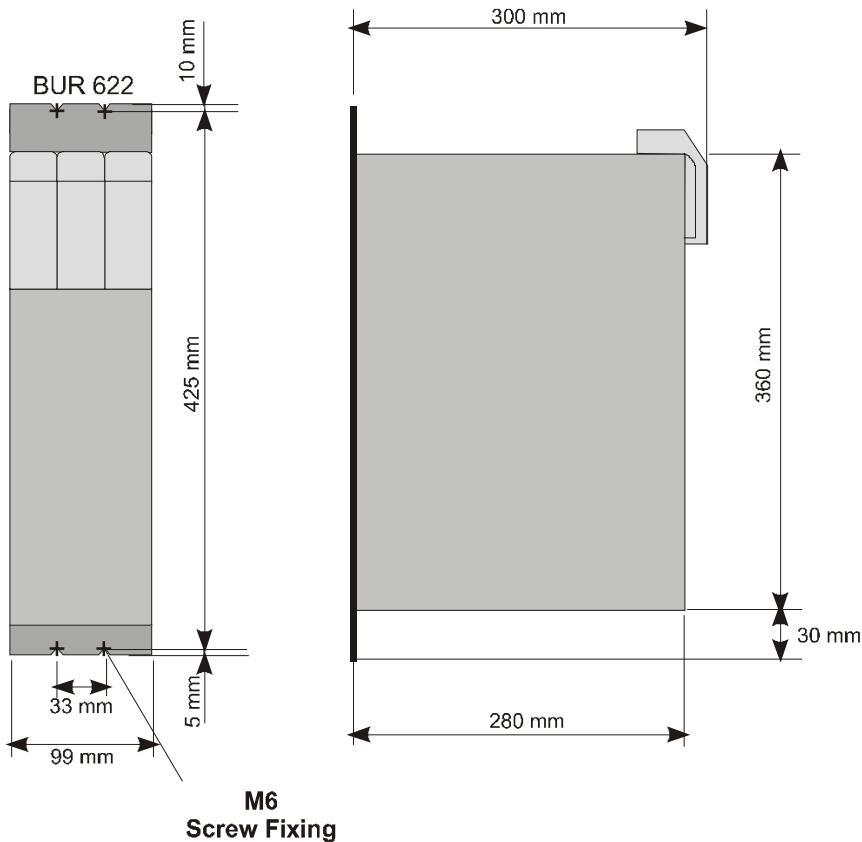
Connections



Type Code



Dimensions



5.5.4 BUK Capacitor Unit

Device Description

In the case of converter-fed three-phase current drives that are primarily used as acceleration drives, e.g. as transverse cutting drives, it is frequently practical to supplement the internal intermediate circuit capacitor by adding an external capacitor unit. This makes it possible to store the energy that is fed back at braking of the drive.

Due to the use of a capacitor unit, it may be possible to replace a ballast unit that normally converts the fed-back energy to heat. In addition, a capacitor unit is always used in cases where the intermediate circuit voltage must be maintained during brief mains failures.

BUK external capacitor units are integrated in Type Series 6 housings and are available for intermediate circuit voltages of 310 V and 540 V.

Electrical Data

| Type | BUK 622 - 31 - 20 | BUK 622 - 54 - 05 |
|--|---|---------------------|
| Capacitance | 20 mF | 5 mF |
| Rated voltage | 310 V _{DC} | 540 V _{DC} |
| Max. intermediate circuit voltage | 400 V _{DC} | 800 V _{DC} |
| Charging current limitation | by use of basic unit varies depending on type series (for this, refer to description of basic unit) | |
| Permissible charging time per capacitor unit | t > 1 s | |
| Discharge time | t > 10 min | |
| Ambient temperature range T _K | 0 ... 45 °C | |
| Storage temperature range | -30 ... +70 °C | |

Calculation

Energy storage capacity during braking

$$W_{el} = \frac{1}{2} * C * (U_2^2 - U_1^2)$$

U₁ = intermediate circuit voltage before braking

U₂ = intermediate circuit voltage after braking

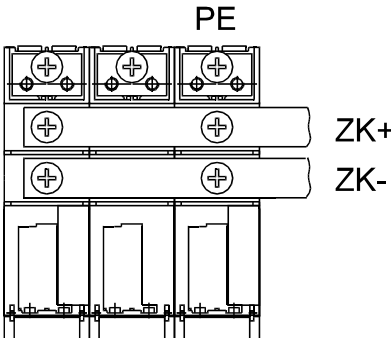
This gives a storage capacity at braking of:

BUK 622 - 31- 20: approx. 640 Ws (U₁ = 310 V, U₂ = 400 V)

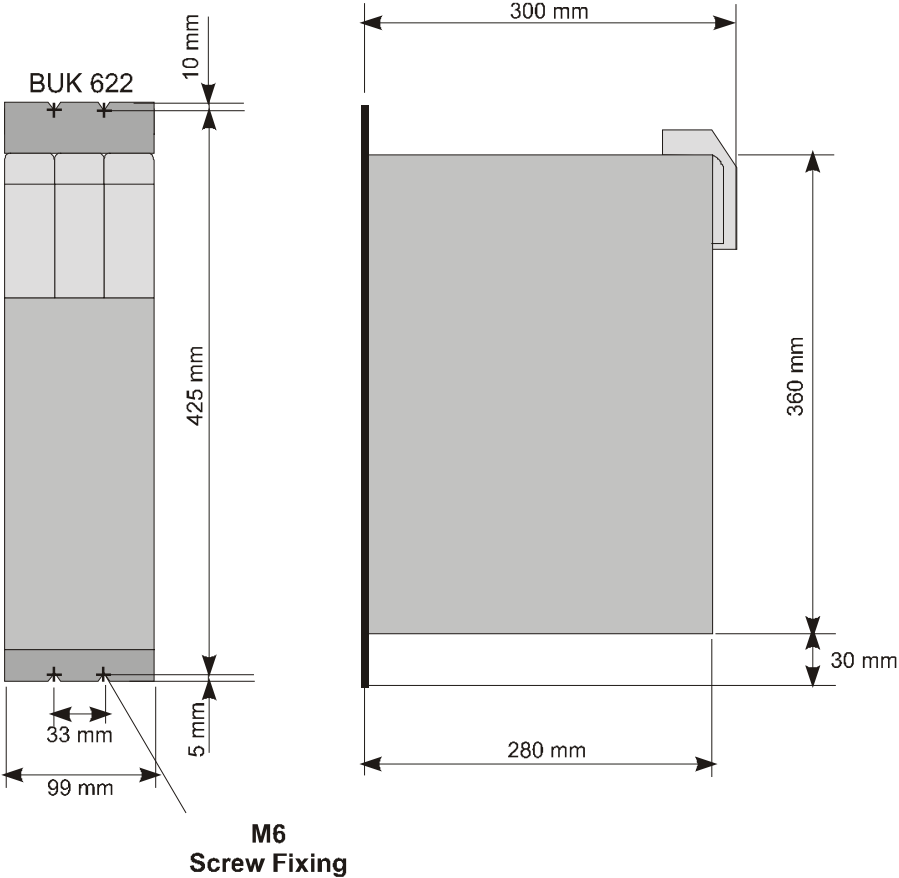
BUK 622 - 54- 5: approx. 870 Ws (U₁ = 540 V, U₂ = 800 V)

Connection

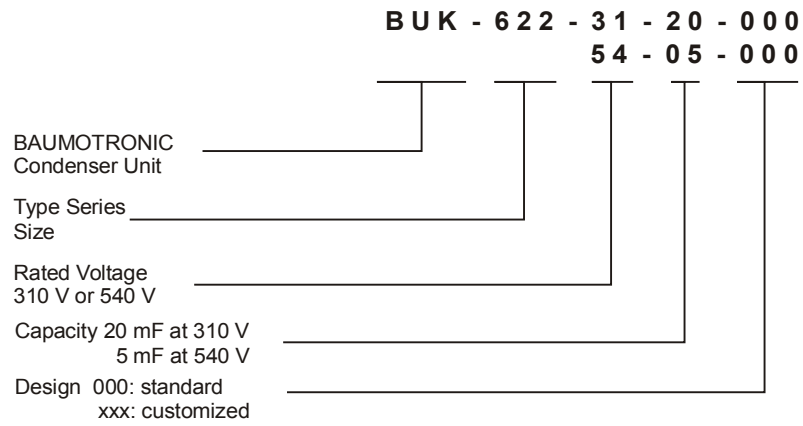
- To intermediate circuits ZK+ and ZK-
- with short 10-mm² wires for Series 2/20 type
 - with short 4-mm² wires for Series 3 type
- deenergized.



Dimensions



Type Code



6 COMMISSIONING



WARNING

Plants that have drive converters installed, must have additional monitoring and protection devices according to the respective regulations, e.g. technical equipment regulations, safety precautions etc. Alterations of the drive converters or the operation software are prohibited.

This equipment 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.

Only qualified personnel which has been instructed with all safety-related information as well as the mounting-, service- and maintenance instructions given in this document is allowed to operate this device.

You are responsible for mounting the Mono power unit, the motor 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.

The mains unit and the field connector of the power converter carry a dangerous voltage even when the main contactor has dropped. Do not touch these modules when under power. Connect test equipment only in powerless state!

After the drive converter is separated from the power supply you must not touch any connectors as they still might carry dangerous loads. Observe the waiting time given on the danger sign information on the drive converter.

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. The connection of the converter to mains using only an e.l.c.b. is prohibited (refer to pr EN 50178:1994 section 5.2.11.2 and appendix A 5.2.11.2 diagram 7).

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

The appliances are only to be operated on earthed mains systems.

The discharge time of the power conducting parts is more than 1 minute.



WARNING

Irregular drive behavior

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.

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

Take particular care when directly or indirectly touching the drive shaft with your hand. This is only allowed when the shaft is stationary and the power converter is deenergized. Any exposed parts of the machine, such as the shafts, fans, etc., must be covered during operation.

Contact Protection In Accordance with Paragraph 4 Section 4 VBG 4 (German safety regulation)

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

You must therefore protect the active parts from being touched by means of insulation, the construction and arrangement of the equipment or directly mounted guards. The guards in question are standard covers, barriers and procedures that guarantee that people cannot touch active parts that are carrying power.

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

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

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



WARNING

Follow the safety information on the motor, tachometer and further electrical appliances in the respective operating and maintenance instructions.

Avoid any working practices that jeopardize safety at the machine.

After carrying out any work involving intervention in the drive – regardless of whether this involves the motor, actual value acquisition or the power converter – the owner must carry out acceptance testing of the machine and document it chronologically in the machine log (maintenance manual or similar). Failure to do this may result in the owner being faced with consequences relating to liability legislation.

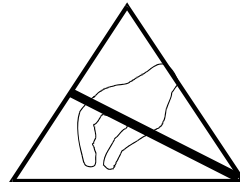
This is not a complete list of all the procedures necessary for safe operation of the unit. If you need further information or have particular problems, contact BAUMÜLLER NÜRNBERG or one of our distributors.

Observe the warning information in chapter 1 of these operating instructions.

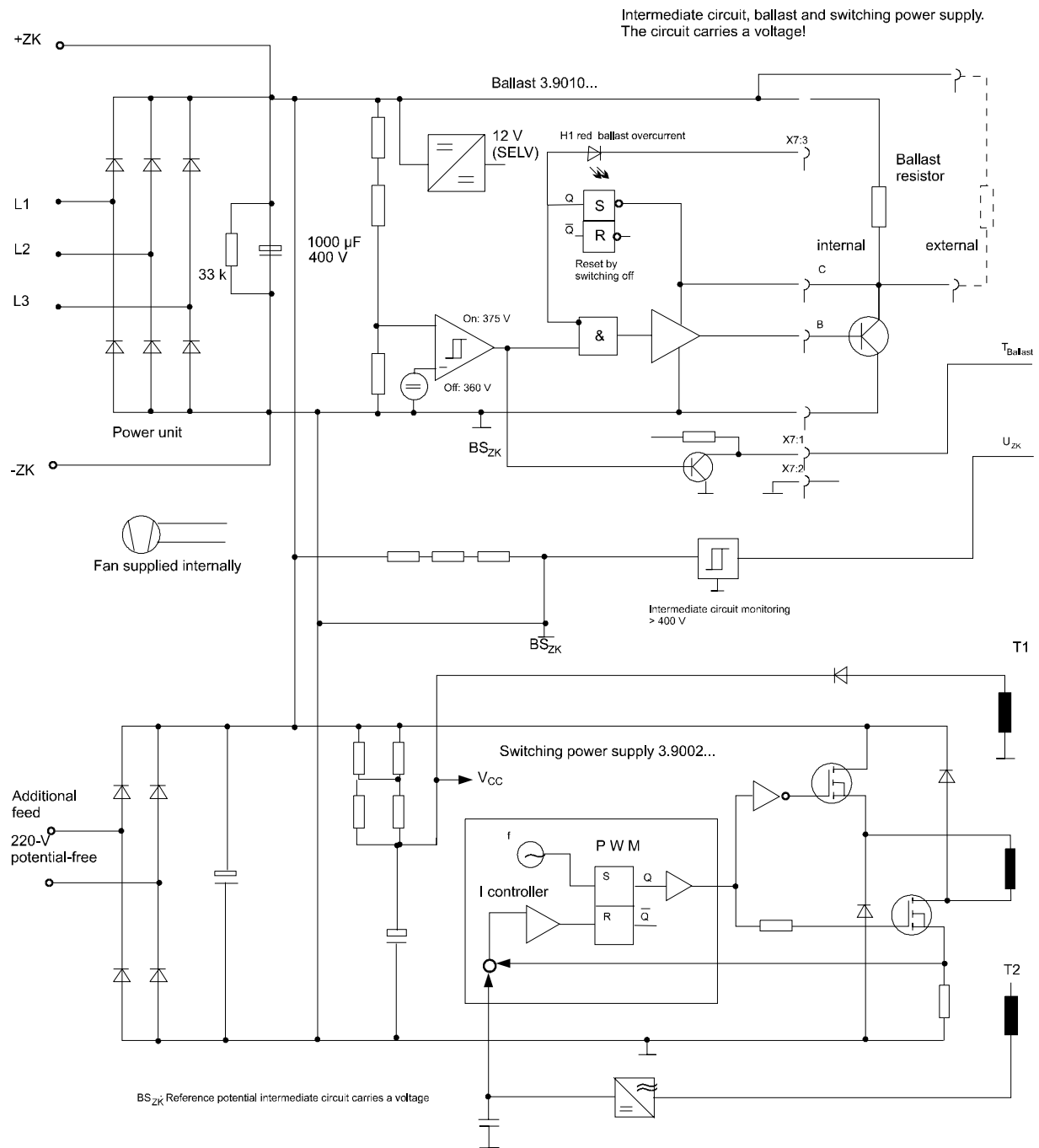
NOTE

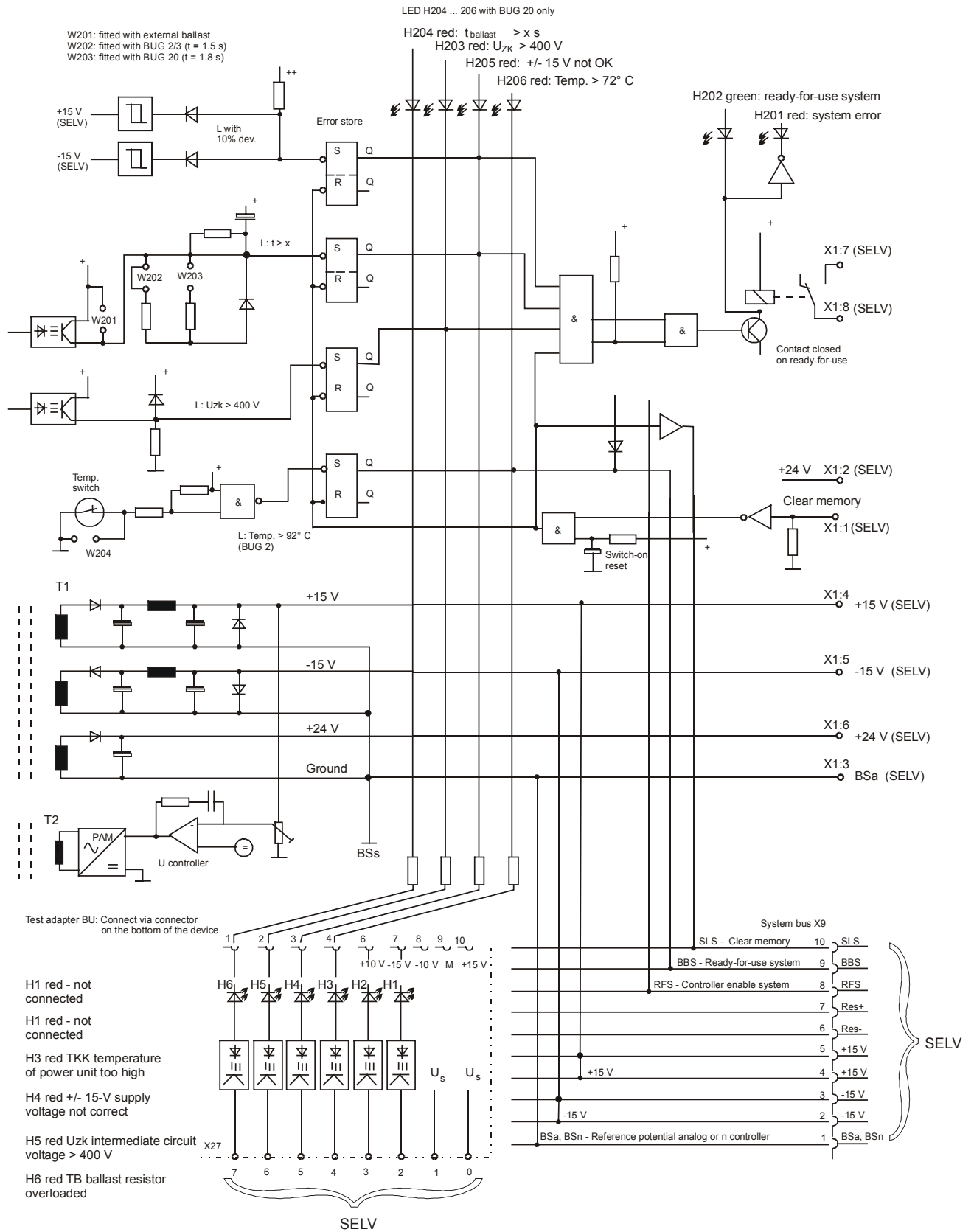
- Before touching the modules, you must discharge electrostatic energy from your body to protect electronic components from high voltages resulting from electrostatic charging. The easiest way to do this is to touch a grounded conductive object before handling components.

Units containing components or modules at risk from electrostatic energy are clearly marked as such by the sticker below.



6.1 Function diagram





6.2 Messages and Warnings

On the front panel of the Basic Feed Unit, there are six LEDs that indicate the messages listed below.

These messages are stored and you can reset them by either switching on again or by a Reset on terminal strip X1 (contacts 1,2).

Possible messages:

| |
|----------------------|
| System error |
| Ready-for-Use |
| Intermediate Circuit |
| Ballast |
| Controller Supply |
| Temperature |

- **Ready-for-Use**

If no message is pending, the green ready-for-use LED is lit and the system reports this condition to the servo units. If only one message of the BUS servo units is pending and the group message on the servo units is activated in the BEDAS, the system cancels ready-for-use and does not indicate any further messages.

- **Intermediate Circuit**

If the intermediate circuit voltage exceeds the set limit value, the system issues a message and displays it. Ready-for-use is cancelled.

This message is issued in the following cases:

- braking energy is greater than $P_{\max\text{Ballast}}$
- ballast circuit is missing
- wrong or defective external ballast resistor

- **Ballast**

Ballast monitoring supervises the switching frequency of the ballast transistor. If the maximum time exceeds the internally set time, the system issues a message and cancels ready-for-use.

This message is issued in the following cases:

- if the braking power is too high
- if the continuous power of the ballast resistor is too high
- if the short-time loading is longer than two seconds
- if the intermediate circuit voltage due to the mains overvoltage is greater than 375 V

- **Controller Supply**

Controller supply monitoring supervises the internal switching power supply for overloading and brief short-circuits. If one of these errors occurs, the system generates a message and cancels ready-for-use.

- **Temperature**

Overtemperature monitoring supervises the temperature of the heatsink. If this temperature exceeds an internally set limit value, the system issues a message and cancels ready-for-use.

This message is issued in the following cases:

- if the input rectifier is overloaded
- if the fan is blocked
- if the ambient temperature is too high

- **System error**

If the system issues one of the messages listed above, it is stored and displayed as the System error group message.

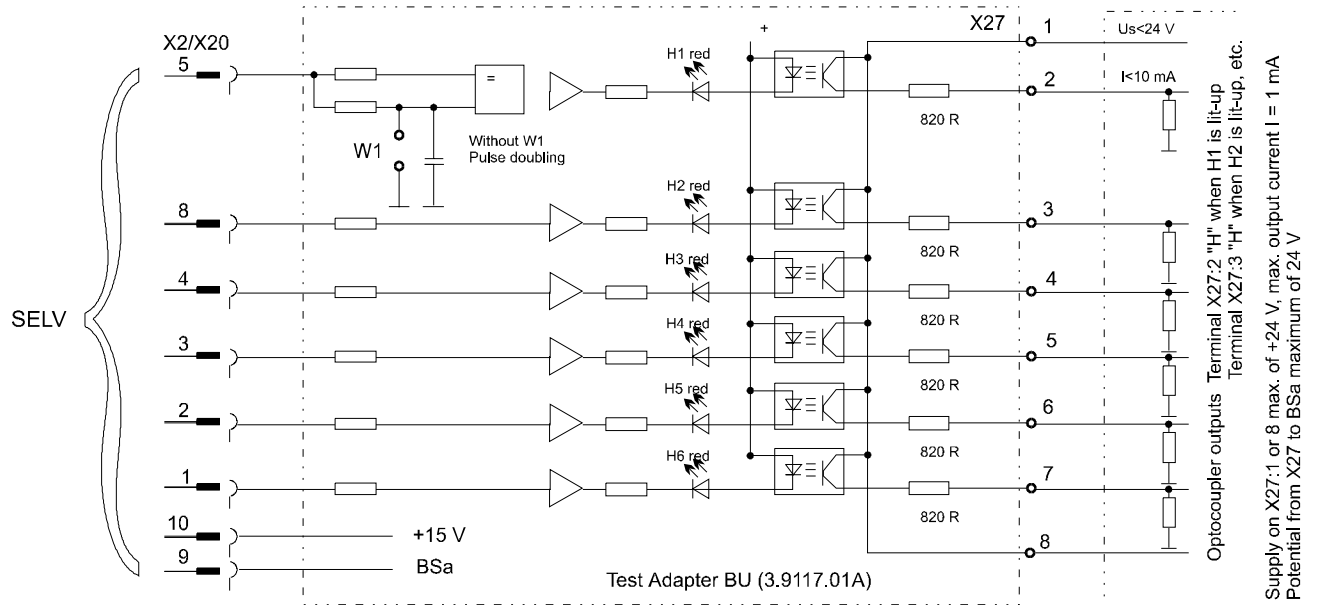
The system cancels ready-for-use and reports it to the connected servo units.

NOTE

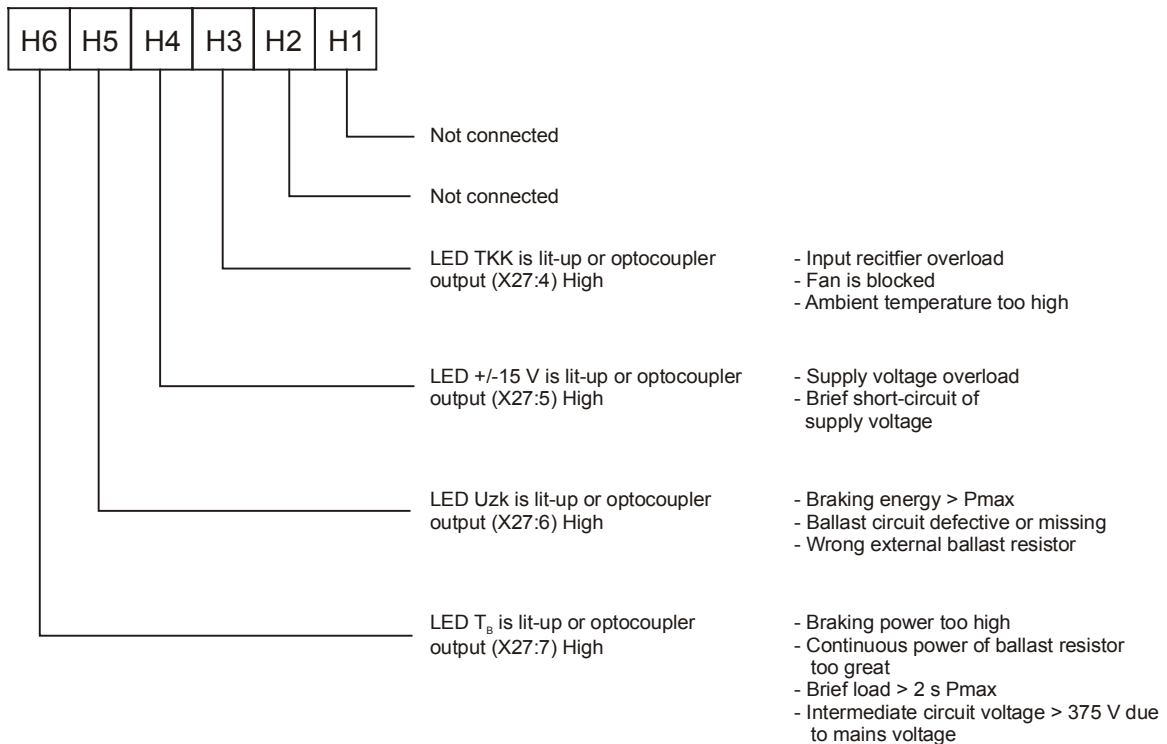
You cannot clear messages whose disturbances are still pending.

6.3 Test Connector

The test connector is situated at the bottom of the unit behind a cover-plate. By use of this it is possible to poll individual messages by means of the optional BU test adapter and to display or transfer them to higher-level controllers using an optocoupler.



Error Evaluation



7 MAINTENANCE



WARNING

This appliance 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.

You may only carry out maintenance and corrective maintenance work when the equipment is deenergized.

Do not begin work on the power stage and the connections until you have made sure that the system has been deenergized.

After switch-off wait until the intermediate circuit is fully deenergized.

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.

After carrying out any work involving intervention in the machine – regardless of whether this involves the motor, the actual value acquisition or the power converter – the operator must carry out acceptance testing of the machine and document it chronologically in the machine log. Failure to do this may result in the owner being faced with consequences relating to liability legislation.

Due to technical requirements, devices or motors may include individual components that contain dangerous substances.

You may only use manufacturer-approved spares.

We cannot guarantee that the product documentation is completely error-free unless this is expressly indicated in our General Conditions of Business and Supply.

7.1 Maintenance Information

The supplied units are maintenance-free.

Prohibition of Unauthorized Modifications

For safety reasons, unauthorized additions or modifications to the drive are not allowed.

7.2 Disposal

The equipment consists mainly of the following components and materials:

| Component | Material |
|---|--|
| Housing, various intermediate panels, fan impeller, mounting panels | Sheet steel or aluminium |
| Heat sink of the power section | Aluminium |
| Various spacer bolts | Steel |
| Various spacers, housing of current converter and unit fan, etc. | Plastic |
| Bus bars in the power stage | Copper/aluminium |
| Cable harnesses | PVC- or Teflon-insulated copper wire |
| Power electronics: Module diodes mounted on a heat sink | Metal base plate, semiconductor chip, plastic housing, various insulation materials |
| PCBs on which all the open- and closed-loop electronics are mounted | Base material: Epoxy-resin fibreglass woven material, copper-coated on both sides and plated-through, various electronic components such as condensers, resistors, relays, semi-conductors, etc. |

For technical reasons, electronic components might need to contain dangerous materials, so you should not open them.

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

In case of fire, dangerous compounds can be generated or released.

You must dispose of or recycle equipment or components according to national regulations as well as any applicable local or regional ordinances.

8 APPENDIX

8.1 Manufacturer Declaration

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

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/EEG, appendix II B.

Specification of the machine component:

Type:

Basic Feed Unit

BUG - 3 - 35 - 31 - . - ...
BUG - 2 - 60 - 31 - . - ... - ..
BUG - 20 - 120 - 31 - . - ...

Date/Signature of the Manufacturer:

Nürnberg, 4. März 1997



Information regarding the Undersigned:

Head Division Electronics

8.2 Declaration of Conformity

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

Specification of the machine component:

Type:

Basic Feed Unit

BUG - 3 - 35 - 31 - . -
BUG - 2 - 60 - 31 - . - . - . -
BUG - 20 - 120 - 31 - . -

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

pr EN 50178: 1994 (VDE 0160/11.94)

"Equipment of power installation concerned electronic operating materials"

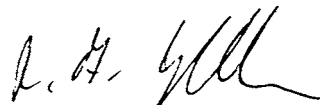
Nürnberg, 8. January 1997

Signature of the Manufacturer



Dr.-Ing. P. Kreisfeld

Head Division Electronics



Dipl.-Ing. (FH) R.-A. Geller

CE-Agent Electronic

8.3 Conditions of Business and Delivery

1. Scope
- 1.1 Deliveries and performance provided by Baumüller and offers made by Baumüller are exclusively and completely subject to these general terms and conditions (from now on referred to as "these terms"). Unless a mutual agreement has been made which differs from this statement, these terms also apply to future business relationships.
- 1.2 If a customer places an order with Baumüller, this implies that these terms are accepted. Any counterconfirmations made by persons or legal persons placing an order with Baumüller with reference to their own general terms and conditions or their terms and conditions of purchase are thereby objected to.
- 1.3 Supplements or modifications to these terms require written consent from Baumüller in order to take effect.
2. Offer and Copyright
- 2.1 Offers made by Baumüller are subject to confirmation and not binding. Supplements, modifications or ancillary agreements require written consent from Baumüller in order to take effect.
- 2.2 Any pictures, drawings, measures, weights or other performance specifications are only binding if this is explicitly stipulated in writing. Drawings, dimensional drawings and descriptions of projects are subject to the copyright of Baumüller and must neither be copied nor revealed to third parties without prior written consent from Baumüller. Baumüller reserves the right to demand that these objects are immediately returned to Baumüller if they are not used for orders to Baumüller.
- 2.3 The purchaser must not use any process engineering knowledge revealed to him in his business relationship with Baumüller for his own purposes and must not reveal that knowledge to third parties. Any violation of this condition makes the purchaser (violator) liable for damages of an amount of DM 70,000.
3. Scope and Term of Delivery
- 3.1 The deadlines and terms specified by Baumüller are not binding unless explicitly specified otherwise in a written agreement.
- 3.2 The delivery term begins at one of the points in time listed below:
 - Date of confirmation of order
 - Date on which the purchaser meets all of the technical, commercial or other prerequisites he is obliged to meet
 - Date on which a downpayment or security required prior to delivery of the merchandise is furnished by the purchaser
 - If the stipulated downpayments to Baumüller are made delayed, the delivery term is extended proportionally.
- 3.3 Baumüller has the right to make partial deliveries and provide partial performance and to issue partial invoices for these deliveries or performance at any time of their choice. Excess volume or short deliveries up to 5% of the delivery quantity are permitted. The amount charged is calculated according to the delivery quantity.
- 3.4 Baumüller is not responsible for delayed delivery or performance or the inability to deliver or perform due to acts of god or force majeure or other events which make it impossible or more difficult for Baumüller to deliver - e.g. war, problems in the provision of materials which arise after the time the offer has been made, malfunctions, strike, lockout, personnel shortage, shortages of means of transportation, instructions issued by the authorities etc. which occur at suppliers of Baumüller or their sub-suppliers. Therefore, Baumüller has the right to postpone deliveries or performance by the duration of the problem plus an appropriate startup time and Baumüller also has the right to withdraw from the contract partially or completely. If the problems persist for more than 3 months the purchaser has the right to withdraw from that part of the contract which has not yet been fulfilled after having fixed an appropriate extension of the time limit.
- 3.5 The deadline is considered to have been met if the object to be delivered leaves the storage facility on the fixed date or if the purchaser is informed of its availability for shipment on the fixed date.
- 3.6 Baumüller or subcontractors of Baumüller will install and assemble the delivered objects exclusively subject to conditions and terms separately agreed upon not later than 4 weeks before delivery.
4. Passage of risk, acceptance, packing
- 4.1 Delivery is made free carrier (FRC, INCOTERM 1980). The goods are packed at the discretion of Baumüller at the costs of the customer. The risk is passed to the customer as soon as the consignment has been handed over to the person carrying out the transport or has left the store.
- 4.2 If the shipment is delayed or becomes impossible due to reasons for which Baumüller is not responsible, the risk is passed to the customer with the notification of readiness for shipment if the delivery is stipulated to be carried out upon call-forward notice, the goods are regarded as called off at the latest one year after the date of order.
- 4.3 Special acceptance conditions must be defined at conclusion of the contract at the latest. The acceptance test has to take place in the works of Baumüller. The costs for the acceptance test will be charged to the customer. If the customer omits the acceptance test, the goods are regarded as delivered as stipulated when they leave our works.
5. Prices and terms of payment
- 5.1 The prices stipulated by Baumüller in the order confirmation plus the respective legal value added tax apply. Additional deliveries and services will be separately invoiced. The prices are valid ex works or store excluding packing.
- 5.2 If not otherwise agreed upon, the prices stipulated in the order confirmation are binding for 30 days only.
- 5.3 Payments shall be made in cash without any deductions free paying office of the vendor in the currency agreed upon. Bills of exchange and checks are only accepted on account of payment. The customer has to bear any costs and bank charges arising thereof. A payment is regarded as made only, if the amount is available to Baumüller. In case of payment by check, the payment is regarded as made when the check has been irrevocably cashed.
- 5.4 Invoices are to be paid without deductions within 30 days from the date of issue. Baumüller is entitled to enter payments of the customer on older open invoices in spite of deviating instructions by the customer. If costs and interests have ahead arisen, Baumüller is entitled to enter the payment first on the costs, then on the interests and last on the main service.
- 5.5 The customer is entitled to offset, to retain or reduce the payment - independent of notices of complaint or possible counterclaims - only, if Baumüller has explicitly agreed or if the counterclaims have been legally verified.
- 5.6 If payments are delayed, Baumüller is entitled to charge interest on arrears at a rate corresponding to the interest rate for open credits in current account, however, at least corresponding to the current discount rate of the Deutsche Bundesbank. This does not affect the assertion of another damage caused by delayed payment.
- 5.7 If the customer fails to meet his payment obligations, especially if he does not cash a check or stops his payment or if Baumüller is informed of other circumstances making the credit worthiness of the customer uncertain, Baumüller is entitled to demand advance payments or securities before delivery or to invoice the total remaining amount in the case that instalments had been previously agreed upon.
6. Retention of ownership
- 6.1 Until all claims for present or future relations have been satisfied, Baumüller can at any time demand securities from the customer. Baumüller will arbitrarily release provided securities if the value of the securities continuously exceeds the claims by more than 20%.
- 6.2 Any goods delivered remain property of Baumüller until payment has been made in full (= delivery under proviso). Goods delivered under proviso are processed or reconfigured at the purchaser's for Baumüller as the manufacturer but without additional obligations. If Baumüller ownership rights are nullified because the goods are integrated into or assembled to other objects, a portion of the ownership rights of the purchaser to that object covering the amount in question is transferred to Baumüller. The purchaser keeps the property of Baumüller in custody for no charges.
- 6.3 The purchaser has - unless he is in delay of payment - the right to process and sell the goods delivered under proviso in normal business. However, he must not distress or transfer ownership of the goods delivered under proviso by way of security. The purchaser transfers any receivables arising from the selling of the goods or from another legal reason completely to Baumüller when the goods are received. Baumüller revocably entitles the purchaser to collect the receivables transferred to Baumüller on the account of Baumüller under his own name. Upon request by Baumüller, the purchaser will reveal the transfer.
- 6.4 If third parties access the goods delivered under proviso, the purchaser will inform them about the ownership rights of Baumüller and will immediately inform Baumüller. Any expenses and damages are paid for by the purchaser.
- 6.5 If the purchaser violates any of the terms of the contract - in particular if he is in delay of payment - Baumüller has the right to reposes the goods delivered under proviso at the cost of the purchaser or Baumüller has the right to require transfer of the restitution title the purchaser has against third parties. If Baumüller repossesses or distresses the goods delivered under proviso, this does not mean that Baumüller withdraws from the contract. The right to receive payment for damages remains unaffected by this.
7. Warranty
- 7.1 If the delivered products are faulty or fail to have properties guaranteed by Baumüller or if the products become defective during the warranty period because of faults which occurred or were caused during the process of manufacturing or in case of material defects Baumüller supplies - excluding any other warranty claims by the purchaser, in particular excluding any direct or indirect secondary claims for damages from the purchaser - replacement parts of their own choice or rectifies defects. Multiple rectification is permitted. For essential products and parts not manufactured by Baumüller - in particular if the purchaser has made specifications - the liability of Baumüller is limited to the transfer of the claims for damages Baumüller has against the supplier of these products or parts.
- 7.2 The warranty period is 12 months and starts on the day the goods are shipped to the purchaser or - if the delivery scope is installed and assembled by Baumüller - the warranty period starts on the day the installation is complete.
- 7.3 The purchaser is obliged to inspect the delivered goods for damages or defects immediately or at least within two weeks after receiving the goods or - if the product is installed - within two weeks after completion of the installation process. In addition, he is obliged to inform Baumüller of any damages, defects or losses immediately by sending a report created by the carrier or a corresponding report in the form of a statement in lieu of an oath which must have been signed by two witnesses and by the purchaser. In addition, Baumüller must be informed in writing of obvious defects or shortcomings immediately or at least within two weeks after delivery. If shortcomings and defects cannot be detected in thorough tests within two weeks and are found at a later time, Baumüller must be informed of these problems immediately after they are detected. Defective products must be submitted to Baumüller for testing on request in the condition in which the defect was detected. Defective products must not be returned to Baumüller unless Baumüller requests in writing that the products are returned. Failure to observe any of the regulations specified above nullifies all warranty claims against Baumüller.
- 7.4 If rectification or replacements are not successful within an appropriate period of time, the purchaser may either request reduction of the purchase price or cancellation of the delivery contract.
- 7.5 If Baumüller manufactures a product based on design specifications, drawings, models or other specifications provided by the purchaser, Baumüller is responsible only for the fact that the manufactured product meets the specifications. Baumüller is not responsible for the usability of the product for the purposes the purchaser intends to use it for.
- 7.6 Excluded from warranty are shortcomings or defects caused by instructions/and or assembly not effected by Baumüller, insufficient equipment of the customer, overload of the components exceeding the capacity specified by Baumüller, negligent and improper treatment and utilization of unsuitable operating materials at the customer. This also applies to shortcomings or defects arising due to material provided by the customer. The warranty does not apply to damages caused by third parties, atmospheric discharges, overvoltages and chemical influences or to the replacement of parts which are exposed to natural wear. The warranty is void if the customer or a third party changes or repairs the units delivered without written permit by Baumüller.
- 7.7 In case of guarantee and/or warranty claims, the motor, the spare part or the unit shall be shipped free of duty and with free packing after prior agreement with Baumüller. Baumüller is freed of any warranty, if the customer returns the defective products without prior agreement or without observing the arrangements.
- 7.8 Baumüller is entitled to install spare parts and units into the plants of the customer for warranties to be fulfilled within the warranty period, in order to replace the defective products so that the efficiency of the customer's parts is affected as little as possible. The warranty period for installed spare parts and units is 6 months from the date of replacement at the customer. Taking into account the service time for the delivered products, the warranty period of 12 months from date of delivery acc. to item 7.2 remains unchanged.
8. Liability
- 8.1 Baumüller is liable for information and consulting activities on the utilization of the ordered and delivered products only with written confirmation in accordance with the below regulations. Verbal statements and information are not binding.
- 8.2 Claims for damages due to impossibility of performance, nondelivery, positive breach of obligations, culpa in contrahendo and unlawful act to Baumüller as well as to the persons employed in performing an obligation are excluded, if the damage has not been caused deliberately or grossly negligent or Baumüller is liable according to the product liability law.
9. Lump-sum damages in case of withdrawal
- 9.1 If the customer withdraws from the written order due to reasons for which Baumüller is not responsible, Baumüller is entitled to charge lump-sum damages of 50% of the net order amount. This applies also, if Baumüller withdraws from the contract due to reasons for which the customer is responsible.
10. Miscellaneous
- 10.1 Place of fulfilment and jurisdiction is Nuremberg. However, Baumüller is entitled to advance claims at the legal place of jurisdiction of the customer.
- 10.2 The legal regulations applicable in the Federal Republic of Germany are applicable to these conditions and terms of sales and delivery. The regulations or the UN law of sales are excluded.
- 10.3 If one or several regulations of these conditions and terms of sales and delivery are or become ineffective or if any arising situation and circumstances are not covered by this contract text, jurisdiction will replace or supplement the ineffective or incomplete stipulations by appropriate regulations corresponding to the economic purpose of the intended regulation to the largest possible extent. The validity of the other regulations remains unchanged.

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