BAUMÜLLER

be in motion be in motion

Single Power Unit BUM64S/A/F

POWER CONVERSION EQUIPMENT

c UL us
LISTED
38WA

CE

Manual

E	5.01056.05

Title	Manual
Product	Single Power Unit, BUM64S/A/F
Version	5.01056.05
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Obligatory

These operating instructions are part of the equipment/machine. These operating instructions must be available to the operator at all times and must be in a legible condition. If the equipment/machine is sold or moved to a different location these operating instructions must be passed on by the owner together with the equipment/machine.
After any sale of the equipment/machine this original and all copies must be handed over to the buyer. After disposal or any other end of use this original and all copies must be destroyed.

When the present operating instructions are handed over, corresponding sets of operating instructions of a previous version are automatically invalidated. Please notice that specifications/data/information are **current values according to the printing date**. These statements are **not legally binding** according to the measurement, computation and calculations.
Baumüller Nürnberg GmbH reserves the right, in developing its products further, to change the technical specifications and the handling of the products concerned without prior notice.

No liability can be accepted concerning the correctness of the operating instructions unless otherwise specified in the General Conditions of Sale and Delivery.

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1

INTRODUCTION

In this chapter we describe the first steps you should carry out after you have received your appliance. We will give you a definition of terms used throughout this documentation and we will give you information about what must be observed when using this appliance.

1.1 First steps

1. check the scope of delivery, see ▹Packing and Transport◃ from page 23.
2. pass on the supplied documentation to the respective departments.
3. take care of suitable personnel for mounting, installation and commissioning.
4. hand over this manual to the personnel for mounting, installation and commissioning. Make sure, that particularly the safety information is understood and will be observed.

1.2 Terms used

In this documentation for the Baumüller product “Single Power Unit“ we will also use the term "appliance". In the appendix you will find a list of all terms used, see ▹Appendix A - Abbreviations◃ from page 87.

1.3 Obligation and liability

In order to enable you to run this appliance with maximum safety it is essential that you know and obey the danger- and safety information given in this documentation.

1.3.1 Observing danger- and safety information

To keep you from damage of personnel and property we will use unified danger information signs in this documentation.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

All persons, who work at or with this appliance, must have knowledge of and observe all hazard and security information given in this manual.

Furthermore all persons who work with this appliance must in addition know and observe all local instructions and regulations.

1.3.2 Dangers when handling this appliance

This “Single Power Unit“ appliance has been developed and produced according to the state-of-the-art technics also keeping the respective guidelines and standards. Still the handling of the appliance can hold dangers. An overview of possible dangers you will find in chapter ▷Fundamental security information◁ from page 11.
When there is a hazard you will always find a detailed security information at the respective location.

1.3.3 Guarantee and liability

The “Terms of sale and delivery“ of Baumüller Nürnberg GmbH are applied generally. These are available to you at the latest since the contract was assured. Claims of guarantee or liability towards Baumüller Nürnberg GmbH are rejected if one or more of the reasons listed below has/have been the cause of the damage/s:

- you have disregarded the information given in this manual
- you have used this appliance within a non-appropriate application
- this appliance you have
  - unskillfully mounted
  - unskillfully connected
  - unskillfully commissioned
  - unskillfully operated
  - unskillfully or not maintained
  - let be mounted, connected, commissioned, operated and/or maintained by not or not adequate qualified personnel
  - overloaded
  - operated it with
    - defective security devices
    - not properly mounted or without security devices
    - not efficient safety- and protection devices
    - environmental conditions being not within the specified values
- you have reconstructed this appliance without written permission of Baumüller Nürnberg GmbH.
- you have disregarded instructions concerning maintenance in the component manuals
- you have failed to monitor parts of wear and tear properly
- you have carried out a repair job unskillfully

- you have unskillfully combined the appliance with products of other manufacturers
- you have combined the drive system with defective and/or incorrectly documented products of other manufacturers

The “General terms of sale and delivery“ of Baumüller Nürnberg GmbH apply generally. Those you have available at least since the contract has been confirmed.

2

FUNDAMENTAL SECURITY INFORMATION

Every Baumüller appliance was constructed and produced under strict safety guidelines. Nevertheless working with the appliance can still be dangerous for you.

In this chapter we describe the possible dangers which may occur when you work with this Baumüller appliance. Dangers are indicated within this documentation by symbols (icons). All the symbols used in this documentation you will find listed and explained below.

How you can protect yourself against every single danger in detail, we however cannot state in this chapter. Here only information about general safety measures will be given to you. The respective safety measures against an occurring hazardous situation you will find in the following chapters always directly where the hazard arises.

The operation of the described devices is permissible, if the mentioned methods/procedures/measures are obeyed to. Everything else, that means also the operation of devices in installations, which are not shown here, is not permitted and must be checked with the company in each particular case. Any kind of claim to warranty will expire, if the devices are operated other than here described.

2.1 Hazard information and commands

Hazard information shows you the dangers, which can cause injuries or even your death.

Please always consider the hazard information which is given to you in this documentation.

Each hazard is classified in one of three different hazard classes. Every hazard class has one of the following characteristic signal words:

DANGER

- serious property damage
- serious personal injury
- death - **will** occur

WARNING

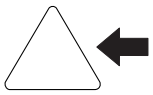
- serious property damage
- serious personal injury
- death - **may** occur

CAUTION

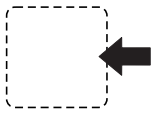
- minor to medium personal injury or
- environmental pollution or
- property damage - **may** occur

2.1.1 Hazard information structure

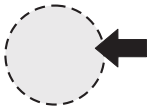
The following two examples show you how the hazard informations are constructed. The triangle is used when indicating a hazard for human beings. When there is a circle instead of the triangle, the hazard information is only for possible property damage.



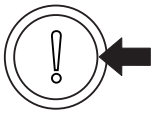
A triangle indicates hazard for human beings.
The shade of grey of the outline reflects the severity of the hazard - darker grey means rising hazard.



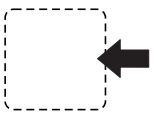
The icon within the square illustrates the hazard.
The outline´s shade of grey reflects the severity of the hazard - darker grey means rising hazard. (Not every hazard information has a square representing the hazard, so we have shown it as draft here)



The icon in the circle represents a command.
(Not every hazard information has a circle representing the hazard, so we have shown it as draft here)



The circle indicates hazard for property.



The icon within the square illustrates the hazard.
The outline´s shade of grey reflects the severity of the hazard - darker grey means rising hazard. (Not every hazard information has a square representing the hazard, so we have shown it as draft here)

The text beneath the icons is constructed as follows:

HERE STANDS THE SIGNAL WORD WHICH INDICATES THE DEGREE OF THE HAZARD

Here we tell if one or more of the consequences described lower will occur if this hazard information is not observed.

- here we describe the possible consequences. The worst consequence stands on the right side.

Here we describe the hazard.

Here we describe what you can do to avoid this hazard.

2.1.2 Form of the hazard sign (triangular or round)

If there is a triangle like ⚠ or ⚠ or ⚠ in front of the signal word, the hazard information is referring to personal damage.

If there is a round hazard signal like ⓘ in front of the signal word, the hazard information is referring to property damage.

2.1.2.1 Hazard information on personal injury

To distinguish each class of hazard information, we use a characteristic outline for both the triangular hazard signs and the square-form icons

For the hazard class **DANGER** we use the ⚠ danger sign. The hazard information of this hazard class we use in this documentation is listed below:

DANGER

The following **will occur**, if you do not observe this danger information:

- serious personal injury
- death

*The hazard is: **electricity.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

DANGER

The following **will occur**, if you do not observe this danger information:

- serious personal injury
- death

*The hazard is: **mechanical influence.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

For the hazard class **WARNING** we use the warning sign ⚠. The following hazard information of this hazard class we will use in this documentation.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **electricity.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **mechanical influence.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **electro-conductive liquid together with electricity.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **electro-magnetic radiation.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **liquid coolant.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

For the hazard class **CAUTION** we use the caution sign ⚠ when there is hazard for persons or of environmental pollution. The following hazard information of this hazard class we will use in this documentation.

CAUTION

The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **hot surface.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION

The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **sharp edges.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION

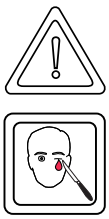
The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **rotating parts.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION



The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **injury of the eye caused by ricochetting particles.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION

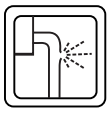
The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **noise.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION



The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The hazard is: **hazard of sliding caused by liquid.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

CAUTION

The following **may occur**, if you do not observe this danger information:

- environmental pollution.

*The hazard is: **unadequate disposal.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

2.1.2.2 Hazard information on property damage

If there is a round caution sign ⓘ in front of the signal word, the safety information refers to property damage.

CAUTION

The following **may occur**, if you do not observe this caution information:

- property damage.

*The hazard is: **electro-static discharge.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.

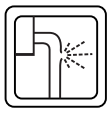
CAUTION

The following **may occur**, if you do not observe this caution information:

- property damage.

*The hazard is: **damage of the coolant hose.** Here the hazard may be described in detail.*

Here we describe what you can do to avoid the hazard.



2.1.2.3 Command signs used

carry safety gloves

carry safety shoes

carry eye protection

carry ear protection

Use this fire extinguishing agent:

ABC powder.

2.2 Information sign

NOTE

This note is a very important information.

2.3 Application according to the terms

You must always use this appliance properly. Listed below you will find some important information. The information given is intended to give you some impression on how to operate this appliance according to the terms. The information below is not a complete list; you must always observe the information given throughout this documentation.

- project this application in a way, that the appliance is run within its specifications.
- take care that only qualified personnel is working with or at this appliance.
- mount this appliance only at a reasonable steady wall.
- install this appliance according to the way shown in this documentation.
- take care that the power supply always meets the requested specifications.
- operate this appliance only if it is in a correct technical state.
- operate this appliance always in an environment according to the information given in the “Technical specifications“.
- operate this appliance always in the regular condition.
  For safety reasons you are not allowed to reconstruct this appliance.
- observe all respective information given if you want to store this appliance.

You are using this appliance according to the terms, if you observe all notes and information given in this operating manual.

2.4 Non-appropriate application

Listed below you will find some examples of non-appropriate application. The information below is intended to give you some impression of what non-appropriate application is. However we cannot state all possible non-appropriate applications here. All applications, where the notes and information given in this documentation is disregarded, are non-appropriate and therefore forbidden.

Examples:

- you have disregarded the information given in this manual
- you have used this appliance within a non-appropriate application
- this appliance you have
  - unskillfully mounted
  - unskillfully connected
  - unskillfully commissioned
  - unskillfully operated

  - unskillfully or not maintained
  - let be mounted, connected, commissioned, operated and/or maintained by not or not adequate qualified personnel
  - overloaded
  - operated it with
    - defective security devices
    - not properly mounted or without security devices
    - not efficient safety- and protection devices
    - environmental conditions being not within the specified values
- you have reconstructed this appliance without written permission of Baumüller Nürnberg GmbH.
- you have disregarded instructions concerning maintenance in the component manuals
- you have failed to monitor parts of wear and tear properly
- you have carried out a repair job unskillfully
- you have unskillfully combined the appliance with products of other manufacturers
- you have combined the drive system with defective and/or incorrectly documented products of other manufacturers
-

2.5 Education of the personnel

The appliances of Baumüller Nürnberg GmbH are only to be mounted, installed, operated and maintained by qualified personnel.

Qualified personnel

Qualified personnel are persons who have been authorized by the plant manager to carry out the activities required, who are able to recognize possible dangers and to avoid them. They must have the skills, experience, instruction and knowledge of the operational conditions and the respective standards, regulations and rules to detect and avoid accidents.

2.6 Reconstructing the appliance

Unauthorized reconstructions without written permission of Baumüller Nürnberg GmbH are not allowed.

2.7 Disposal of the appliance

The correct disposal of the appliance is described in ▹Disposal◃ from page 83.

2.8 Fire fighting

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The hazard is: ***electricity when using a conductive fire extinguishing medium.***

Use this fire extinguishing agent:

ABC powder

2.8 Fire fighting

3

PACKING AND TRANSPORT

Every Baumüller appliance we have packaged before shipping in a way, that makes becoming damaged while on transport very unlikely.

3.1 Transport

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

- avoid heavy shaking while on transport and severe bumping, e.g. when lowering, of the unit.

3.2 Unpacking

After delivery of the (still packaged) item:

- check if there are visible transportation damages!

if yes:

- report this to your deliverer. Request a written confirmation of your reclamation and make immediate contact with your local Baumüller Nürnberg GmbH representative.

if there is no transportation damage visible:

- open the packaging of the appliance.
- check the scope of delivery according to the delivery note.

The scope of delivery is:

- Produkt
- these operating instructions including declaration of conformity/Declaration by manufacturer
- supplement and fixing material

- report a reclamation at your local Baumüller representative if the scope of delivery is incomplete or if there is a transportation damage.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The hazard is: ***electricity.***

Do not operate the appliance if you have detected or suppose a transportation damage.

In this case please contact Baumüller Nürnberg GmbH immediately.

3.3 Disposal of the packaging

The packaging consists of cardboard, plastics, metal pieces, corrugated cardboard and/ or wood.

➲ observe the local regulations of disposal if you dispose the packaging.

3.4 Transportation precautions

For the first transport the appliance has been packaged by the manufacturer. If you intend to transport the appliance yourself, make sure that the following conditions are kept throughout the whole transport:

- 2 K 3 (environmental class)
- - 30 °C to + 70 °C (temperature interval)
- max. 1 *g* (vibration, shock, continuous shock)

4

DESCRIPTION OF THE UNIT

This appliance is a power converter for the range of power up to 150 kW. This unit converts power taken from the mains network (mains-side supply unit) and supplies the electrical motor connected to it with the converted power (motor-side power unit). For control only Baumüller Nürnberg GmbH rack type controllers can be used.

- BUS 6 V-controller
- BUS 6 M-controller

For the controller there is a separate description with the respective features and technical specifications available.

Depending on the controller used, you can drive either asynchronous or even synchronous motors equipped with different encoder systems at the BUM64S/A/F single power units.

NOTE

Do not use this appliance in populated areas (see EN 61800-3, 6.4.2.1), because this unit may cause high frequency interference.

4.1 Variants

The BUM64S/A/F single power units are available in 3 variants, which differ in power (T) or in the cooling version (S/A/F):

- **S** stands for **S**witching cabinet variant (air ventilation inside the switching cabinet)
- **A** stands for window mounting variant (**A**ir ventilation outside the switching cabinet)
- **F** stands for window mounting variant (water cooler outside the switching cabinet)

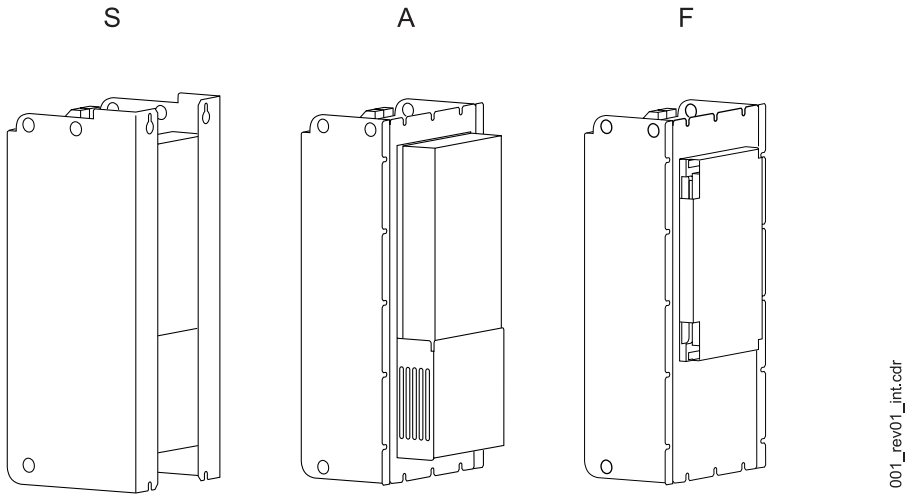


Figure 1: Cooling variants

4.2 Overview of hazardous areas

The following figure shows the hazardous areas at each respective appliance. Use this overview to get informed about the existing hazardous areas when you learn to get familiar with this appliance.

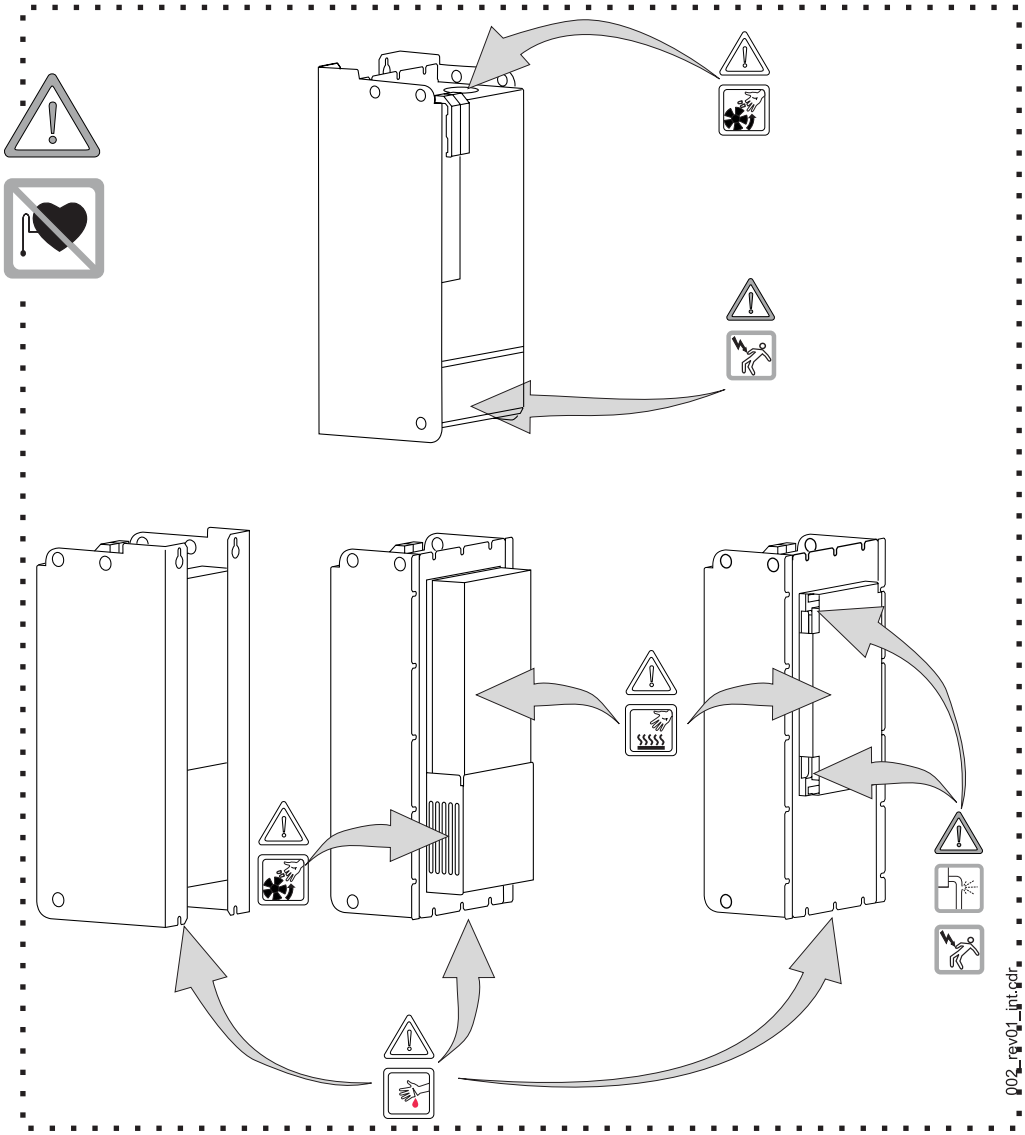


Figure 2: Hazardous areas

4.3 Characteristics of the unit - type key

On the type shield (positioned on the inner side, see figure below) you will find the type key and the serial number of the appliance.

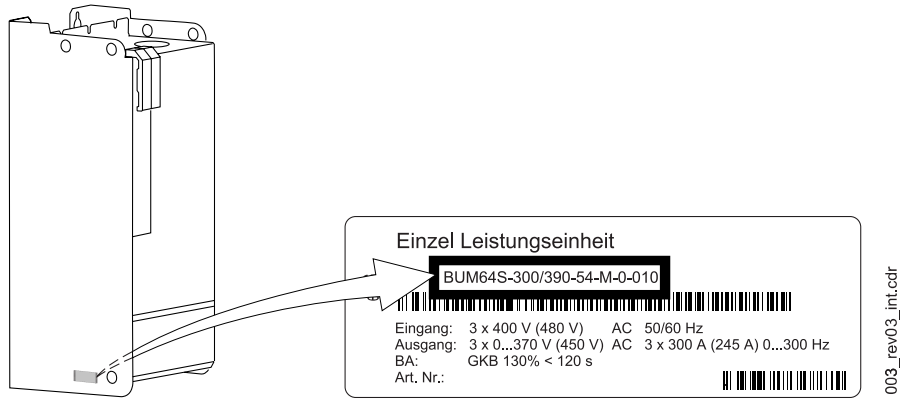


Figure 3: type shield with type key

BUM64X - XXX/X XX - XX - X - X - XXX Baumüller converter single power unit

BUM6 4X - XXX/X XX - XX - X - X - XXX Type

BUM64X - XXX/X XX - XX - X - X - XXX Size

BUM64 X - XXX/X XX - XX - X - X - XXX Cooling variant

S: air ventilation with intake and outlet inside the switching cabinet
A: air ventilation with intake and outlet outside the switching cabinet
F: water-cooled with water cooler outside the switching cabinet

BUM64X - XXX /X XX - XX - X - X - XXX Output rated current in ampere at 40° C environmental- and coolant temperature and 4 kHz cycle frequency

BUM64X - XXX/X XX - XX - X - X - XXX Output peak current in ampere at 40° C environmental- and coolant temperature and 4 kHz cycle frequency, t ≤ 120 s.

BUM64X - XXX/X XX - XX - X - X - XXX Rated DC link voltage x 10 [V]

BUM64X - XXX/X XX - XX - X - X - XXX Chopper resistor

O: without chopper resistor circuit
E: with chopper resistor circuit, external resistor

BUM64X - XXX/X XX - XX - X - X - XXX Safety relay

O: without safety relay
M: with safety relay

BUM64X - XXX/X XX - XX - X - X - XXX Stage of development / model

On the type key you will find only a part of the technical specifications. An overview of all technical specifications you will find in ▹Appendix D - Technical data◃ from page 101.

4.4 Block switching diagram

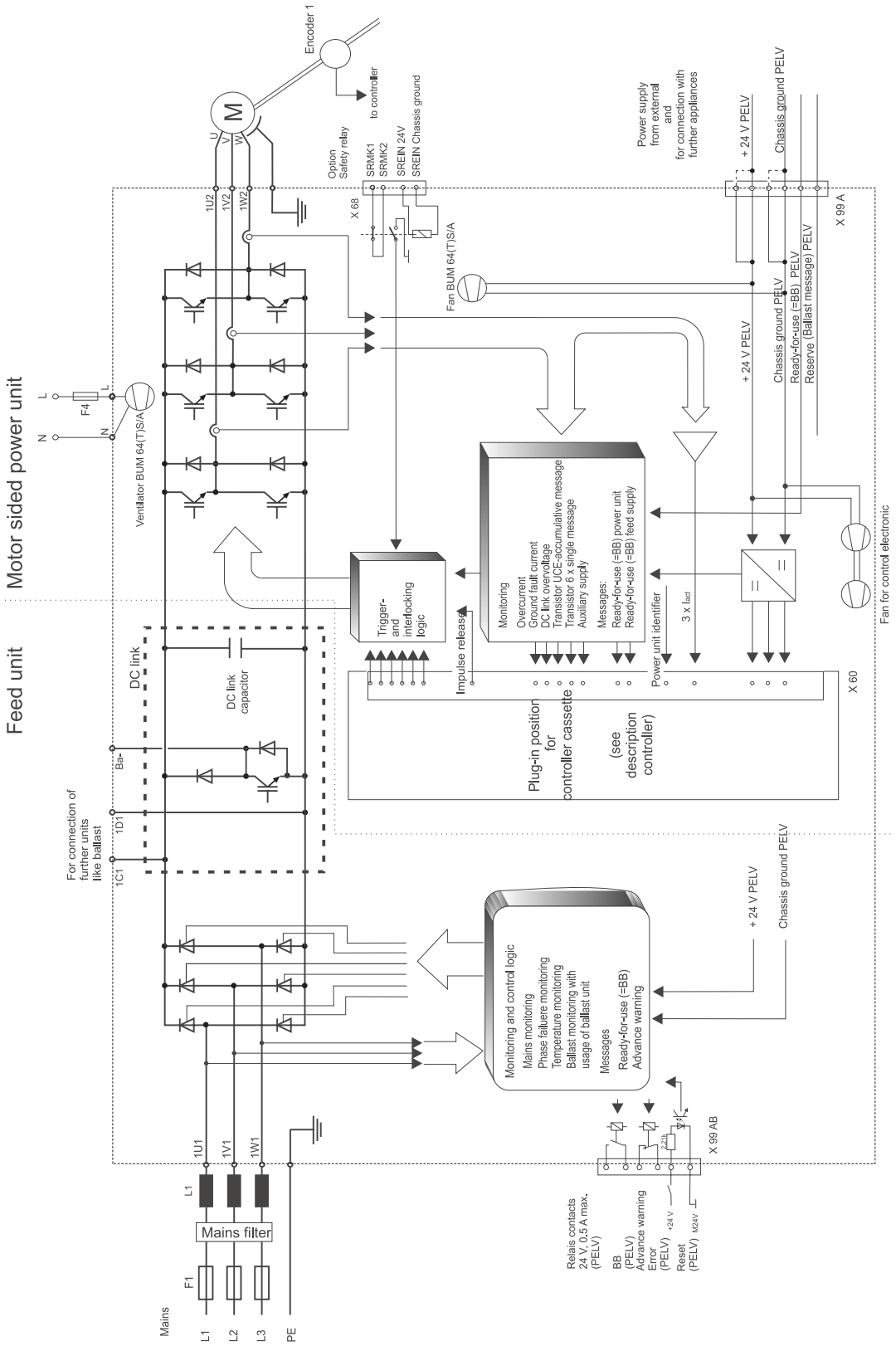


Figure 4: Block switching diagram BUM 64S/A/F

4.4 Block switching diagram

5

MOUNTING

In case the units shall be mounted in an isolated electrical work shop according to EN 50178/VDE 0160, section 5.2.7, you will in addition have to take additional measures, that the requirements according to EN 50178/VDE 0160, section 5.2.4 and EN 60204-1/VDE 0113 part 1, section 6.2.2 are fulfilled.

5.1 Danger areas during mounting

The following overview shows the existing danger areas at the device, which are important for the mechanical mounting.

Use this survey only for the mechanical mounting. Dangers, which, for example, result from electricity are not shown here. Dangers, which, for example, result from electricity are shown in ▹Danger areas at installation◃ on page 43.

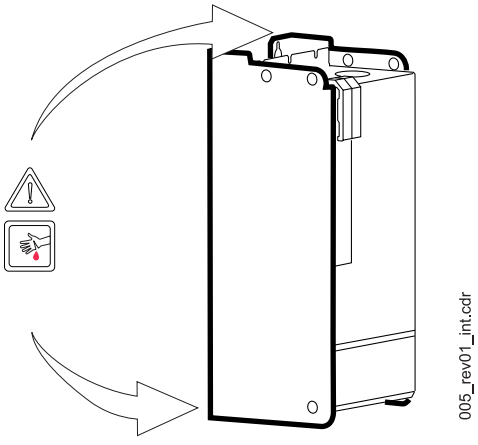


Figure 5: Danger areas during mounting

5.2 Mounting steps

The mechanical consists of the following steps:

- select the control cabinet.
- produce the drill holes/threaded holes and the cut-outs (only variant A/F).
- mount the unit.
- connect the cooling circulation (only variant F), check on tightness and perform a pressure test.

Further information concerning the single steps are given in the following sections.

5.2.1 Select control cabinet

BUM64S/A/F units are build-in devices in terms of EN 50178/VDE 0160 section 5.2.6. They are intended for mounting into ordinary control cabinets, which meet the minimum requirements acc. to EN 50178/VDE 0160, section (IP 2X, eventually also IP4X acc. to EN 60529/5.1).

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **mechanical effects.** The units weigh between 65 and 88 kg, depending on the model.*

select a control cabinet, which can carry this weight permanently.

NOTE

- In case you mount a through-hole variant (F/A), the thickness of rear panel must maximum be 6 mm.

5.2.1.1 Mounting space - dimensional drawings

Use the following dimensional drawings, in order to specify mounting space in the control cabinet.

CAUTION

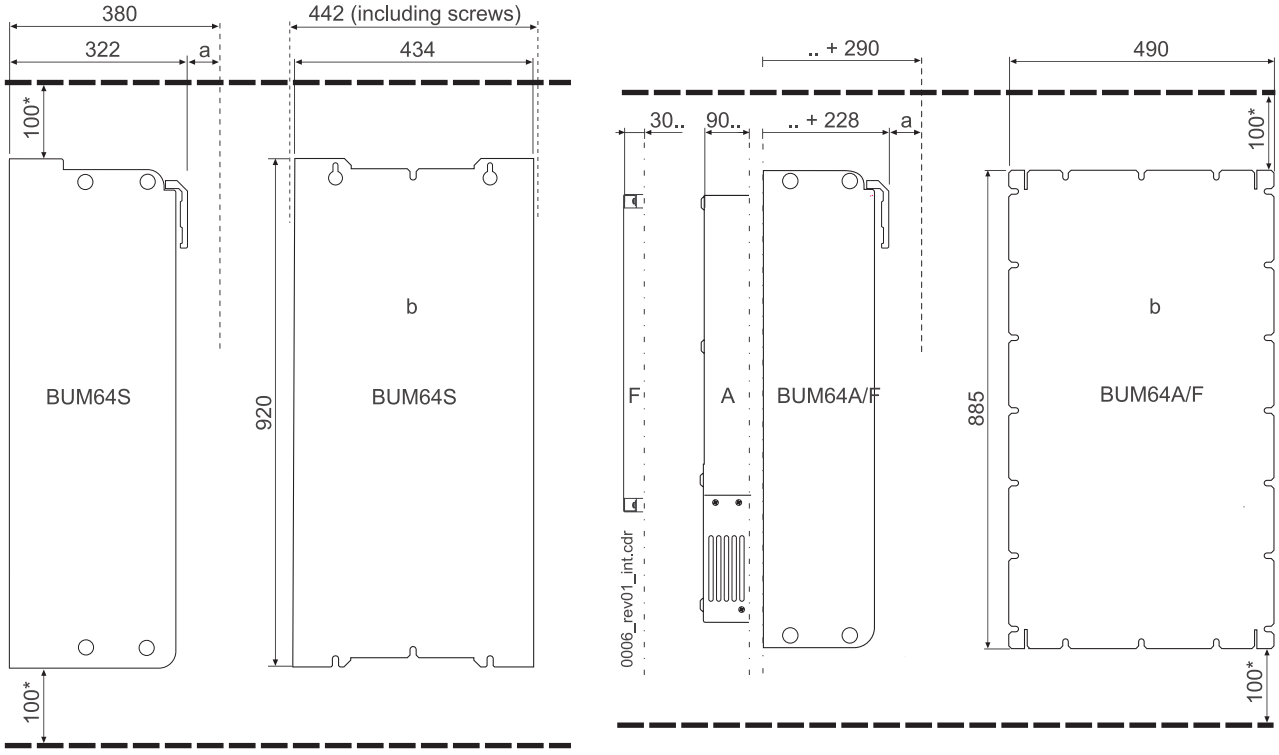
The following **may occur**, if you do not observe this caution information:

- property damage.

The danger is: overheating of device.

Provide output of device waste heat. Assure, that unrestricted coolant input and -output is possible.

Provide the required coolant temperature and coolant amount (see ▹D.2 Required environmental conditions◃ on page 103). If necessary apply an additional fan at the control cabinet.

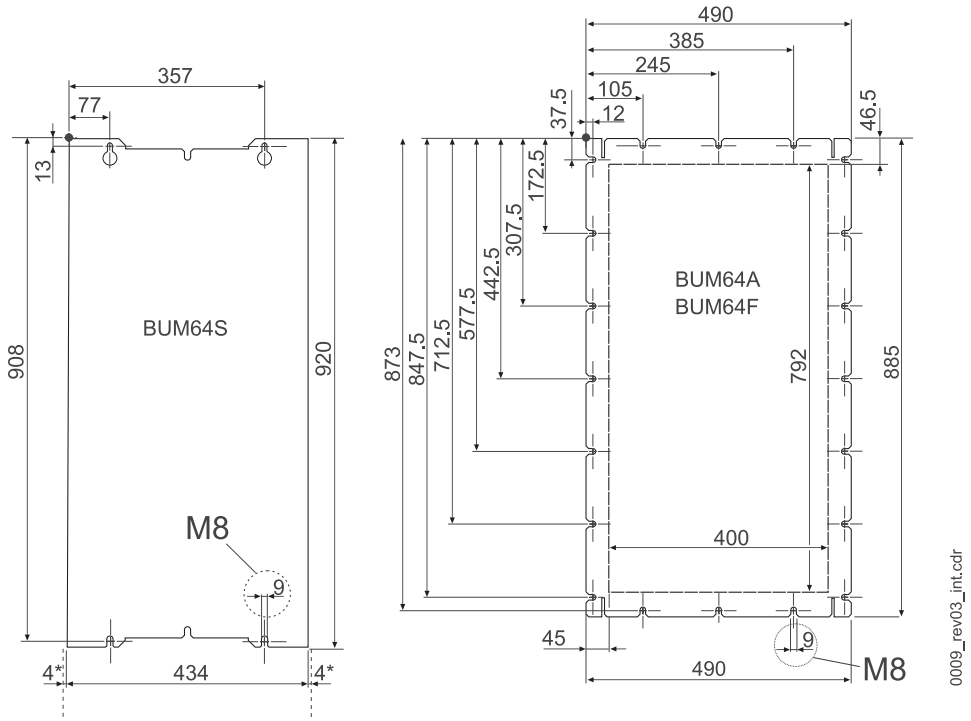


a: Expansion space for controller, connector and cable approx. 60 mm
b: rear view
*: expansion space

Figure 6: Dimensional drawing BUM64S/A/F

5.3 Creating of drillings/threads and cut-outs

- Create drillings/thread and cut-outs (only variant A/F) as specified in the following drilling drawings.



* screw head

Figure 7: Drill drawing BUM64(T)S/A/F/I

5.4 Mounting the unit

1 Screw the rear panel of unit with the rear panel of the control cabinet together.
2 Mount all screws in order to assure the EMC of the unit.

5.4.1 Mount BUM64S

CAUTION

The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

The danger is: ***sharp edges.***

Consider the weight of unit - the unit weighs at least 65 kg.

Lift the unit only with suitable equipment and/or with the help of qualified personnel.

wear safety gloves

screws (A)	4 x M8			
washers (B)	4 x (8.4 x 17)			
mount spacing (c)	c = 7 mm			

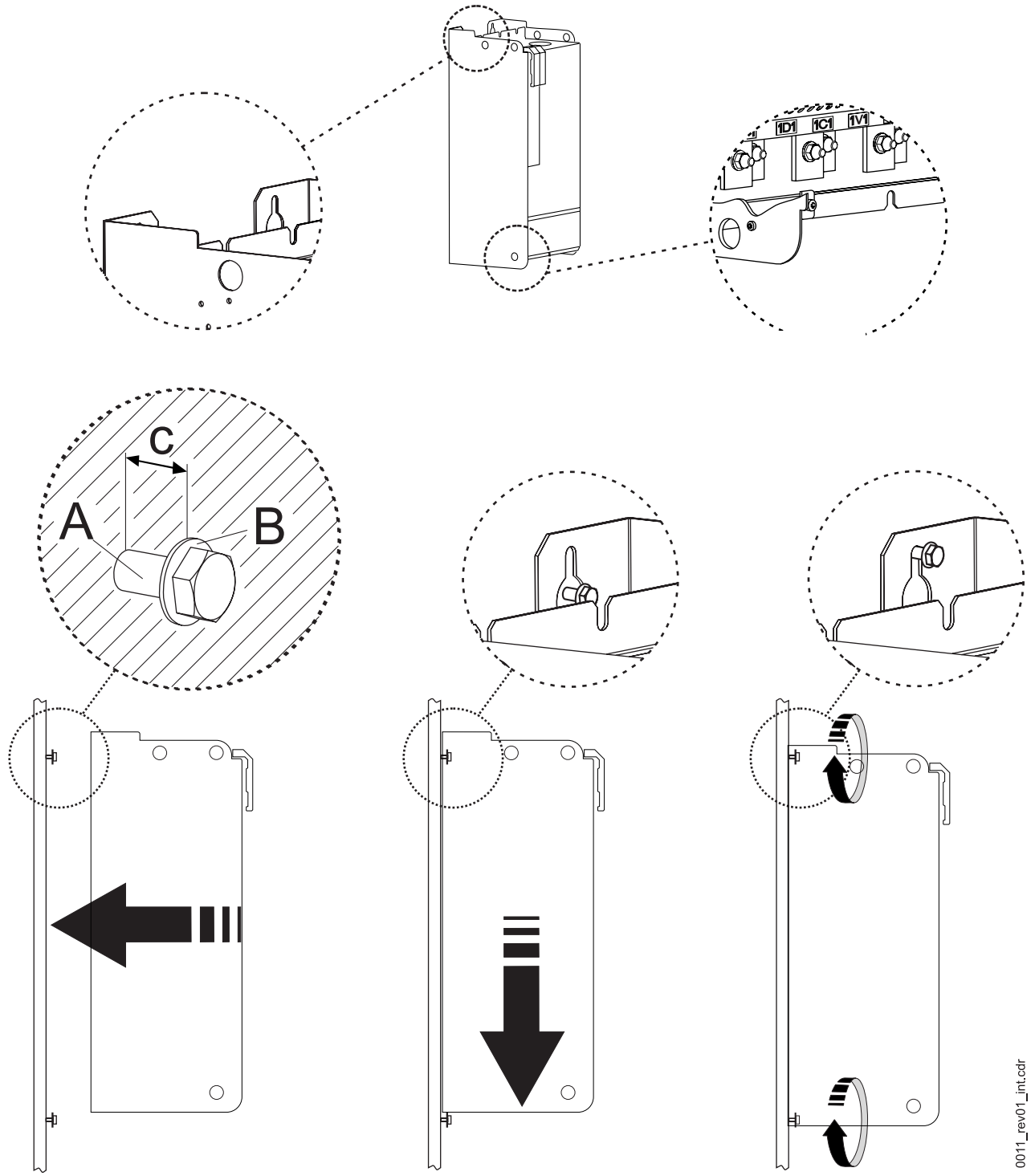


Figure 8: Mounting instruction BUM64S

5.4.2 BUM64 mount through-hole variant A/F

CAUTION

The following **may occur**, if you do not observe this caution information:

- minor to medium personal injury.

*The danger is: **sharp edges.***

Consider the weight of unit - the unit weighs 42 kg.

Lift the unit only with suitable equipment and/or with the help of qualified personnel.

wear safety gloves

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **conductive fluid in connection with electricity.** If cooling water escapes from a water-cooled unit, it may happen, if there are faulty seals that water enters the control cabinet and may contact parts, which carry hazardous voltage levels.*

Assure, that seals at the rear side of the unit are not damaged. You may only mount the unit, if the seal is not damaged.

screws (A)	16 x M8				
washers	16 x (8.4 x 17)				
seal	see accesso-ries				

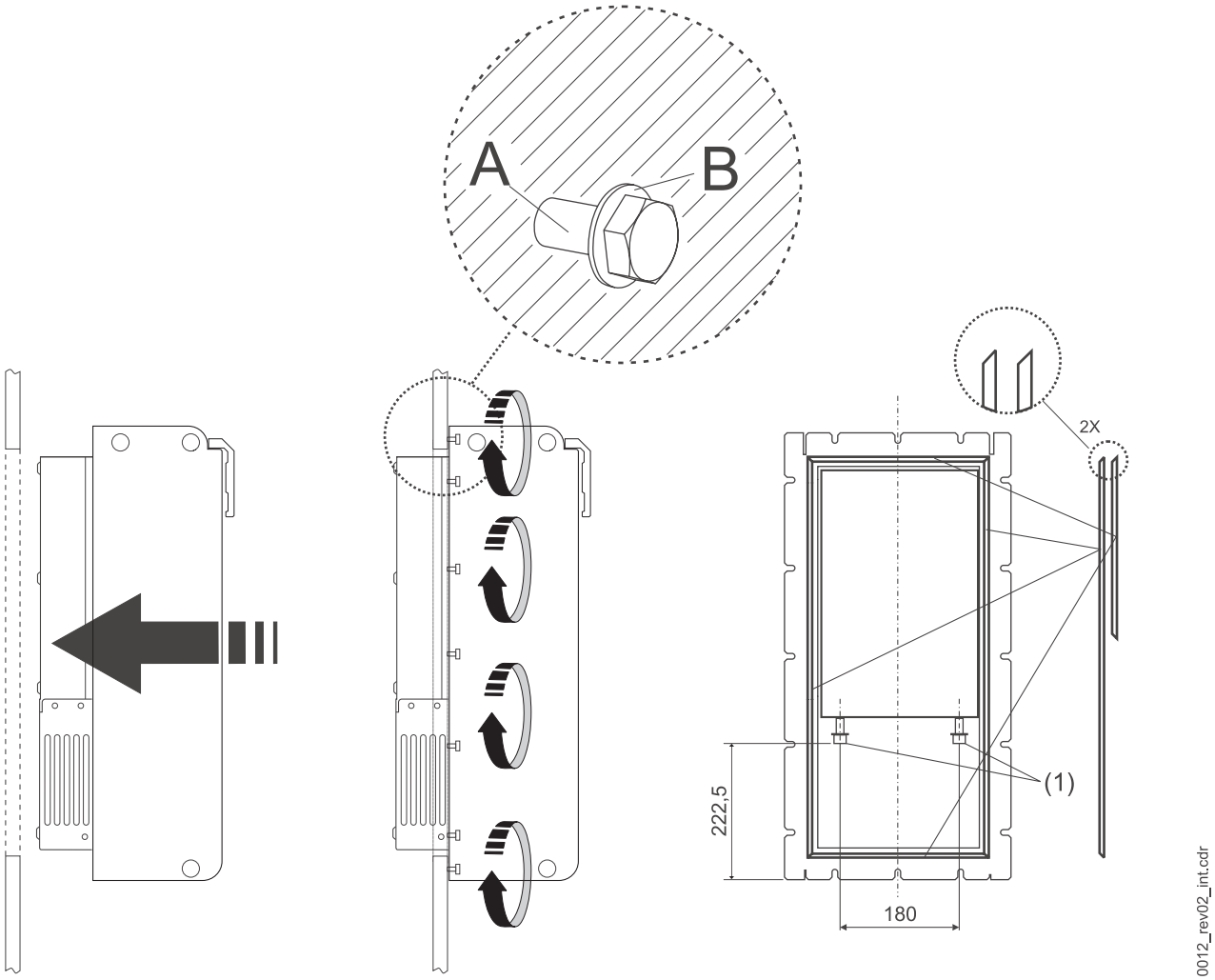


Figure 9: Mounting instruction BUM64 through-hole variant A/F

(1): Screwing 1/2“ AG for flat sealing

5.4.2.1 Coolant

The coolant must meet certain requirements. The requirements the coolant must have is to be found in ▹D.2 Required environmental conditions◃ on page 103.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The danger is: ***conductive fluid in connection with electricity.*** *The heatsink can corrode and become leaky if the wrong coolant is used. If, e. g. the heatsink is leaky, the cooling water can escape from the cooling circulation, into the control cabinet and can contact parts, which carry hazardous voltage levels.*

Do not mix anticorrosives!

Under all circumstances keep the mixture ratio and test the mixture ratio within the stated maintenance intervals (see ▷Inspection interval◁ from page 77).

Refer to the safety instructions of the anticorrosive manufacturer and the safety data sheets acc. to EU directive or the common national guidelines of the country, where the device is in operation.

For disposal of the coolant observe the water endangerment classes (WGK) supplied by the manufacturer. Since May 17, 1999 there is no more class 0 within the VwVwS (German regulation about water endangering substances). Beginning from class 1 (weak endangering water, Germany) the water endangering rises with the number. In any case the disposal has to be carried out according to the regulations. The local waste water administration must be consulted. A disposal into the sewer - even thinned - is not allowed.

CAUTION

The following **may occur**, if you do not observe this caution information:

- property damage.

The danger is: ***Damage of the cooling circulation.***

Do not use coolant lubricants from manufacturing processes as coolant!

Coolant circulations must be kept in a filled state using coolant-water mixtures in order to avoid corrosion at the transition between liquid and air.

Make sure, that there are no air reservoirs within the coolant circulation.

Remainders of coolant can act corrosive, lead to a lowering of the pH-value and act corrosive within the acid pH-value sector.

When exchanging or switching over from one coolant to another observe that the coolant circulation must be thoroughly rinsed with water several times.

If coolant circulations that have been filled with a coolant-water mixture must be emptied and cannot be refilled within a few days, it is essential, that they are rinsed repeatedly with water and after that be emptied completely.

5.4.2.2 Connecting BUM64F to coolant circulation

The BUM64F device has a pre-mounted heatsink at its back.
Two connections (G1/2") at the heatsink are destined for the intake and outlet of a coolant circulation system. For the connection to the customer side of the coolant circulation use connectors with an inside thread G1/2", which are screwed with the existing heatsink connections at the device together.

The heatsink connections are at the bottom side of the device.

Connection to cooling circulation:

1 provide suitable connections
(material: brass/stainless steel/plastics, thread: G1/2“).

2 clear internal thread of connections.

3 assure, that the seals are undamaged.

4 Manually screw on supply cable to the existent connections and tighten with the maximum permissible torque.

CAUTION

The following **may occur**, if you do not observe this caution information:

- property damage.

The danger is: Damage of connecting thread.

Never tighten stronger than with the maximum permissible torque 12 Nm).

5 connect outlet with another connection.

NOTE

The flow direction is as desired.

6 check tightness of cooling circulation.

7 perform cooling circulation with the specified pressure test (12 bar).

6

INSTALLATION

In this chapter we describe the electric installation of the device. Mechanic mounting is described in chapter ▹Mounting◃ from page 31.

Installation exists of the following steps:

1. Check the requirements to the electrical mains and check if the existing mains is suitable.
2. Check the requirements to the electrical cables and provide the according cables.
3. Check the characteristics of connections and configurate the connections accordingly.
4. Lay all cables EMC-compatible.
5. Is the fastening to be carried out according to UL 508C? If so, use a suitable torque spanner (see ▹Screwing in accordance with UL◃ on page 61).

6.1 General danger notes

Units BUM64SA/F are devices of protection class I accordant to HD366 S1 chapter 3.2, also see EN 50178/VDE 0160 paragraph 5.2.9.

Devices of protection class I are devices, where the protection against dangerous residual currents dependent on the base insulation and therewith contains additional safety measures. This additional protection is provided by connecting housing and other parts with the PE conductor, so that in case of failure of the base insulation no voltage remains. The insulation of the appliances is carried out across the total component at least in the basic insulation class according to EN 50178/VDE 0160, para. 5.2.9.1. This applies to the insulation between current circuits and the environment.

The control connections of devices have got a protective separation from the mains and are executed for the connection of PELV-/SELV circuits.

When measuring clearance and creepage distances following criteria are considered:

- Degree of pollution 2 acc. to EN 50178/VDE 0160, para. 5.2.15.2, table 2, line 3: normally only a non-conductive pollution occurs. Ana conductive pollution (for a short period or continuous) is not permitted and can lead to the destruction of the device. The customer is responsible for destructions based on pollution with conductive substance or materials.
- Overvoltage category III acc. to IEC 664-1, table 1 for clearance distances of mains circuits against its environment acc. to EN 50178/VDE 0160, paragraph 5.2.16.1.

- Rating of insulation voltage of mains circuits for TN- and TT mains 849 V acc. to EN 50178/VDE 0160, paragraph 3.64.

The devices BUM64S/A/F are only limited to a certain level short-circuit proof in the sense of EN 50178/VDE 0160, paragraph 6.3.4.

During operation in the converter and in the motor discharging currents always occur against earth and can result in a premature response to a connected ELCB.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **electricity.** At residual currents or at earth fault a direct component in the fault current can occur, which complicates or avoids the release of a higher-level ELCB.*

The connection of power unit to the mains only with the use of the ELCB is forbidden (EN 50178/VDE 0160, paragraph 5.2.1.1 and 5.3.2.1).

The protection against touching of the units is achieved by the mounting of the converters into conventional control cabinets, which, regarding the protection type comply with the minimum requirements acc. to EN 50178/VDE 0160, paragraph 5.2.4 and EN 60204-1, chapter 12.4.

Plastic covers on the devices, which cover the control connections, provide additional protection against accidental contact when commissioning or in case of „occasional handling“ of operator control elements, which are nearby. For the power connection additional measures are to be token.
(IEC 60536-2, chap. 5.1.1, German Accident Prevention Directive „Electrical Installation and Equipment“ BGV A2).

Essential for personal protection are the safety precautions and safety instructions acc. to DIN/VDE.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **electricity.***

In case there are missing protective earth connections at the unit or at the motor it must be reckoned on personal injury.

Connect protective conductor.

Discharging time of components under voltage is > 1 min.

Before working check with suited measuring devices at components under voltage, that the parts are not voltage-carrying. Touch the parts not until you have verified yourself from the safe isolation, and if the unit and the motor are secured against switching on.

6.1.1 Voltage check

At routine test of these units a voltage check is executed acc. to EN 50178/VDE 0160, paragraph 9.4.5 by Baumüller Nürnberg GmbH.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

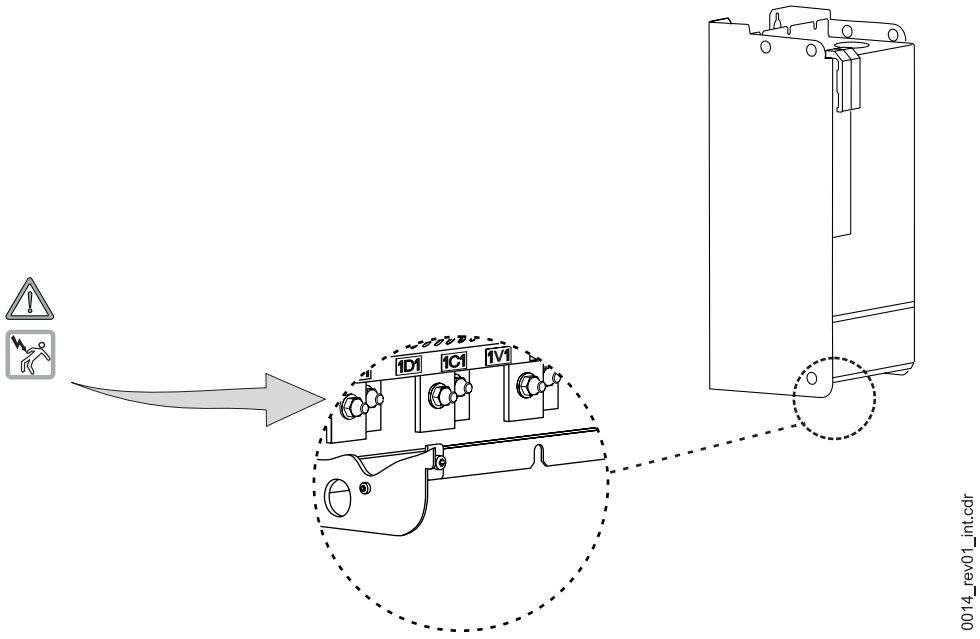
The danger is: ***electricity.***

Subsequent checks of unit with high voltages must be executed only by Baumüller Nürnberg GmbH.

If you want to check complete control cabinet installation with high voltage, you must separate all cable connection from the Baumüller units before checking.

6.2 Danger areas at installation

The following overview shows all areas at the unit, which can be dangerous at the electrical installation.



6.3 Requirements to the electrical mains

The units are provided for the firm mains connection at the TN- and TT- industrial networks in wye connection with direct or low impedance earthed wye point acc. to IEC 364-4-41, chap. 413.1.3, chap. 413.1.4, at the industrial mains with non- or high impedance at the earthed wye point (IT mains) and industrial mains with hard or low impedance at the earthed corner point (earthed star delta supply) with a line-to-line voltage from up to 3 x 480 V_{eff}.

in case you consider UL 508 C: the maximum short-circuit current of the supply may be 10000A.

A listing of the requirements to the electrical supply is to be found in ▹Requirements on the power supply◃ on page 102.

- Assure, that the existing supply fulfills all requirements.

6.4 Cable requirements

In the technical data (▹Appendix D - Technical data◃ from page 101) you will find data as e. g. environmental conditions, electrical connection data amongst other things, which have to be considered at selection of the cables. The unit BUM64S/A/F accords to the requirements of UL508C, if you use accordant cables and if the screwing of the cables are accordantly executed.

NOTE

In case you consider UL 508 C: connect only 60°C/75° C copper cables. Execute screwing of power connection with the torque, as we have specified in ▹Connection diagram◃ on page 58.

Further information is to be found in appendix ▹Circuit mains - device◃ on page 108, ▹Cable control voltage supply/signals◃ on page 108 and ▹Cables device-motor◃ on page 109.

- Assure, that all cables, which are used accord to the requirements.

6.5 Connection

Here you find detailed information regarding all connections. An overview is to be found in ▹Connection diagram◃ on page 58.

6.5.1 Power connections

Power connection are on the bottom side of the device (see ▹Figure 10◃ on page 45).

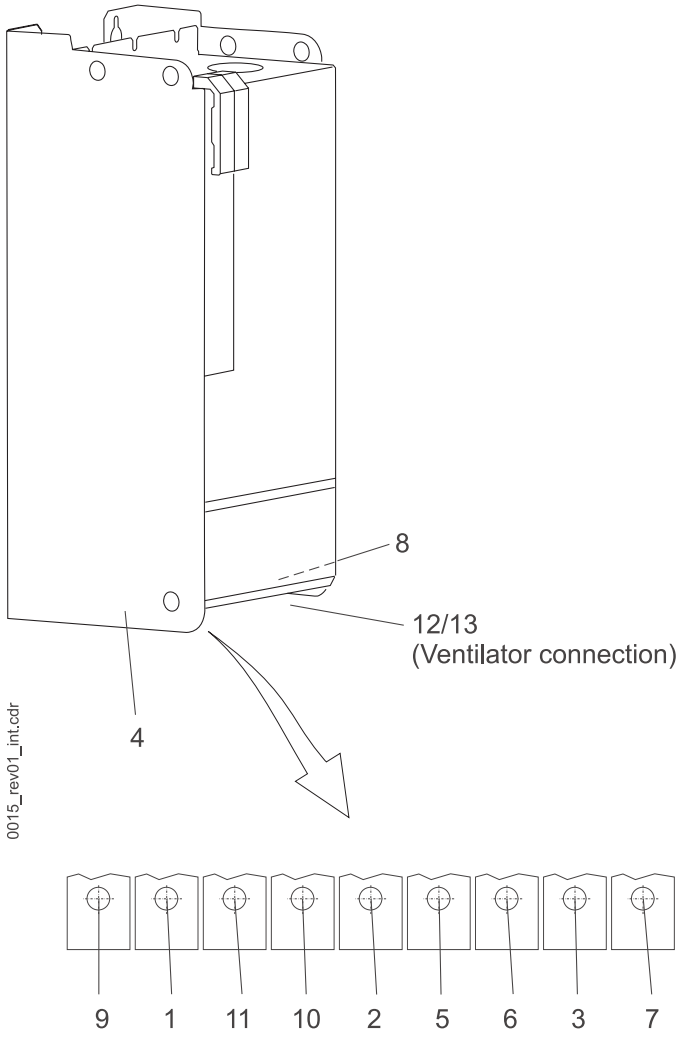


Figure 10: Power connections

Terminal	Pos.[1)]	Description	U_{Range}*	I_{Range}**	A[2)]
1U2	1	Motor connection phase U	0 V (Û) to 830 V (Û)	0 A (I_{AC}) to 390 A (I_{AC})	dependent on cable lug
1V2	2	motor connection phase V			
1W2	3	motor connection phase W			
⏚	4	Earth connection			
1U1	5	Mains connection phase L1	360 V (U_{AC}) to 528 V (U_{AC})	0 A (I_{AC}) to 380 A (I_{AC})	
1V1	6	Mains connection phase L2			
1W1	7	Mains connection phase L3			
⏚	8	Earth connection			
Ba-	9	Connection chopper resistor Ba- is connected with the collector of the braking switch Ba+ is 1C1 [4)]	between Ba+ and Ba- 0 to 830 V (U_{DC})	0 A (Î) to 130 A (Î)	
1C1	10	+ Connection DC-link	between 1C1 and 1D1 0 to 830 V (U_{DC})	0 A (I_{AC}) to 410 A (I_{AC})	
1D1	11	- connection DC-link			
L	12	Fan connection [3)]	207 V (U_{DC}) to 243 V (U_{DC})	0 A (I_{AC}) to 1 A (I_{AC})	
N	13				

1) Position, see ▹Figure 10◃ on page 45.

*: Voltages, which can occur at the terminals
**: Currents, which can flow via the terminals

2) the connected cross-section is selected in accordance with the valid standards (e. g. DIN VDE 0100-430) dependent on application case.

3) Is only valid for cooling variants S and A. The 2-pole terminals 12/13, N and L for the connection of the fan at 230 V AC are on the right bottom side at the device in the area of the power connections (see ▹Figure 22◃ on page 60).

4)

NOTE

Die terminals for the chopper resistor are not protected against overload, short-circuit and earth faults. The connection of a low resistance results in a destruction of the device. The value for the chopper resistor is to be found in ▹D.3 Electrical data◃ from page 105.

6.5.2 Control connections

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The danger is: ***electricity.***

Avoid an overload of the relay contacts e. g. with suitable fuses. The permissible maximum current of 10 A per clamping may not be exceeded.

Assure that all control voltages meet the PELV or SELV.

6.5.2.1 Control connection X99A

Use the plug-in terminals, which are attached in order to connect X99A. In case you require further plug-in terminals, contact Baumüller Nürnberg GmbH or directly at the manufacturers' (see ▹B.1 Connector◃ on page 91).

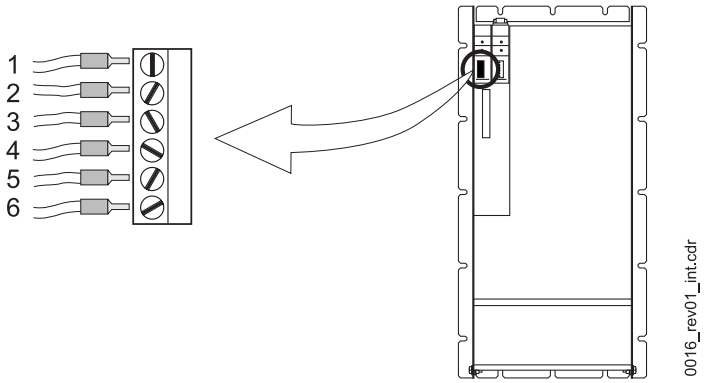
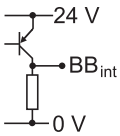


Figure 11: Control connection X99A

Terminal	Pos.[1)]	Description	U_{Range}*	I_{Range}**	A[2)]
+24 V	1	+ 24 V (PELV) [3)] Terminals 1 and 2 internally bridged.	21.6 V (U_{DC}) to 28.8 V (U_{DC})	0 A (I_{eff}) to 10 A (I_{eff})	0.2 to 2.5 mm^2 AWG 24 to 12
+24 V	2				
M 24 V	3	Earth 24 V (PELV) Terminals 3 and 4 internally bridged.	0 V (U_{DC})		
M 24 V	4				
$BB_{int.}$	5	Message ready-for-use internal [4)] (PELV) 0 V: supply unit not ready-for-use 24 V: supply unit is ready-for-use  Figure 12: Ready-for-use internal	0 V (U_{DC}) or 24 V (U_{DC}) (PLC level)	0 A (I_{eff}) to 0.2 A (I_{eff})	
ZUS.	6	Reserved (PELV)	-	-	

1) Position, see ▹Figure 11◃ on page 48.

*: Voltages, which can occur at the terminals
**: Currents, which can flow via the terminals

2) Connection cross-section of conductor. Consider EMC instructions when connecting (see ▹Requirements on the laying (EMC instructions)◃ from page 52).

3)

NOTE
The power supply has capacitors at the input (250µF), so that when switching the 24 V supply charging currents can occur.

4) This message is only related to BUM64S/A/F! (also see ▹"Ready-for-use supply unit"◃ on page 69).

6.5.2.2 Control connection X99AB

Use the plug-in terminals, which are attached in order to connect X99AB. In case you require further plug-in terminals, contact Baumüller Nürnberg GmbH or directly at the manufacturers' (see ▷B.1 Connector◁ on page 91).

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The danger is: ***electricity.***

Assure that at higher current requirements, that it is supplied separate.

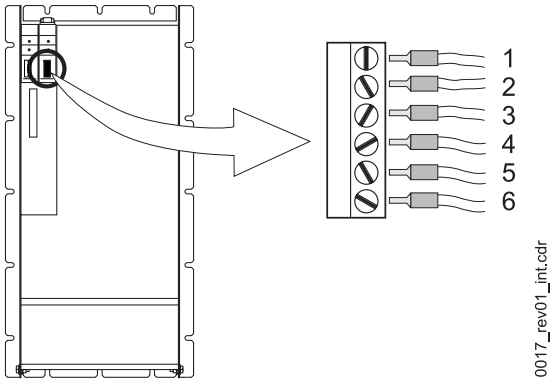
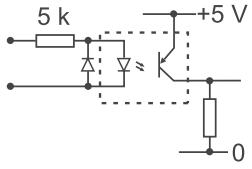


Figure 13: Control connection X99AB

Termi-nal	Pos.[1)]	Description	U_{Range}*	I_{Range}**	A[2)]
BB (ext)	1 2	Message **"ready-for-use external"** (PELV) Open contacts: Supply unit not ready for use Closed contacts: Supply unit ready-for-use	0 V (U_{DC}) to 24 V (U_{DC})	0 A (I_{DC}) to 0.5 A (I_{DC})	max. 2.5 mm^2
Vorw. Stör.	3 4	Message **"warning"** (PELV) Closed contacts: Supply unit - no warning Open contacts: Supply unit - warning			
+Reset	5	isolated optocoupler input in order to reset error messages (PELV): PHASE ERR, POWER ERR, and BRAKE OVERL.  Figure 14: isolated optocoupler input	0 V (U_{DC}) to 24 V (U_{DC})	10 mA (I_{DC}) to 25 mA (I_{DC})	
M Reset	6	Specified point for input +Reset (PELV)	0 V	-	

1) Position, see ▹Figure 13◃ on page 49.

*: Voltages, which can occur at the terminals
**: Currents, which can flow via the terminals

2) Connection cross-section of conductor.

6.5.2.3 Safety relay X68

With the safety relay the drive can be switched to a torque-free state.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **mechanical influence** by failure of safety relay.*

Assure that the minimum current of the contacts 1 and 2 are not less than 10 mA during operation. Operate the safety relay within its specifications.

Coil side	
Rated voltage	24 V (PELV)
Operating voltage	19 V 37 to 1080 V at T_U = 20 °C (PELV)
Coil resistance	660 Ω to 905 Ω
Contact side	
Switching voltage U_{AC}	max. 25 V_{AC} (PELV)
Switching voltage U_{DC}	max. 60 V (PELV)
Switching current	max. 5 A
Continuous current	min. 10 mA - max. 6 A
Switching capacity P_{AC}	max. 150 VA
Switching capacity P_{DC}	max. 30 W

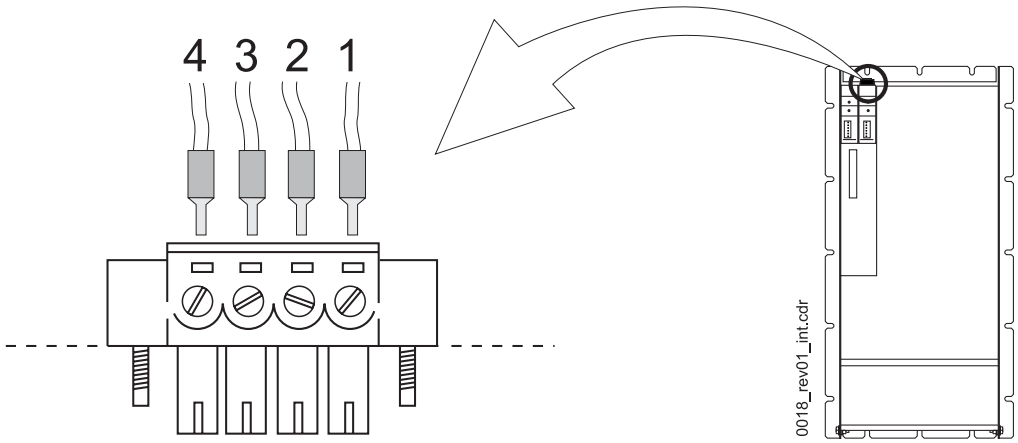


Figure 15: Safety relay X68

Termi-nal	Pos.[1)]	Description	U_{Range}*	I_{Range}**	A[2)]
	1 2	Feedback (NC contact), if safety relay is active (PELV)	0 V (U_{DC}) or 24 V (U_{DC})	0.01 A (I_{DC}) to 5 A (I_{DC})	1.5 mm^2
+24 V	3	+ 24 V connection to deacti-vate safety relay (PELV)	0 V (U_{DC}) to 24 V (U_{DC})	0 mA (I_{DC}) to 35 mA (I_{DC})	1.5 mm^2
M 24 V	4	Specified point to input +24 V (PELV)	0 V (U_{DC})		

.

1) Position see ▹Figure 15◃ on page 51
*: Voltages, which can occur at the terminals
**: Currents, which can flow via the terminals

2) Connection cross-section of conductor.

NOTE

When operating the motor, terminal 3 must be connected to +24 V (U_{DC}) and 4 with 0 V (U_{DC}).

„Safety relay off“ is stored as a message and must be reset by the use of the controller.

A detailed description of the safety relay is to be found in ▹Appendix E - Safety relay◃ from page 111.

6.6 Fuses of the device

To protect the device or the cable connections at an earth fault, fuses must be installed accordingly. Use the fuse, which are listed in ▹D.4 Fuse protection◃ on page 107!

6.7 Requirements on the laying (EMC instructions)

In these units semiconductors are used, which are able to minimize power loss by quick switching, and therewith make a small size of the device possible. These semiconductors generate by its quick switching electromagnetic waves. Therewith, when operating converters certain preconditions must be considered, in order to avoid electromagnetic influences due to switching procedures.

Interferences can arise throughout all areas of the drive system and originate in the following:

- capacitive discharge currents. Causes are the high voltage gradients at the switching of semiconductors.
- high currents and current gradients in the motor cables. The disturbance energy bound in magnetic field reaches frequencies of between a few Hertz to about 30 MHz. Due to the high rates of current rise, additional electromagnetic fields occur with frequencies of up to approximately 600 MHz.

- high cycle rates and quick logic circuits
  (electromagnetic field/16 MHz to 1GHz).
- Reaction on system and harmonics. The cause are commutation procedures and not sinusoidal mains loadings especially at line-commutated converters. (100 Hz to 20 kHz).

NOTE

In this Manual you will find the most important information according an EMC-compatible installation. Further notes, which necessarily have to be considered in order to erect a CE-conform installation are to be found in the manual „filters for mains applications“.

6.7.1 EMC regulation (EMVG)

This device is accordant to § 6 para. 9 of the EMVG from September 18, 1998:

"Devices, systems and parts in terms of section 3, which exclusively are manufactured and are determined as subcontracting parts or spare parts for the subsequent processing by competent companies or persons in the field of electromagnetic compatibility, must not comply with the protection requirements as well as the requirements of § 4 paragraph 1, no. 1 to 3 and 5.

The EMC decisively depends on the assembling of the single modules and components in the control cabinet. The notes on the following pages enable to configure the installation according to the latest EMC knowledges, and therewith consider the legal requirements referring to this.

6.7.2 Measures for EMC-assurance

In order to assure the EMC the following configuration notes must be regarded.

6.7.2.1 Cabling

- Screen **all** connected cables, so the cables are kept free from interfering radiation (see ▹Screening◃ from page 57). You can install unscreened control cables, if the control cabinet has a sufficiently high screen attenuation (see limit values for noise emission according to EMVG for your installation) and also if the EMC compatibility inside the control cabinet is guaranteed (this can be assumed if you have observed all configuration instructions given in this manual).

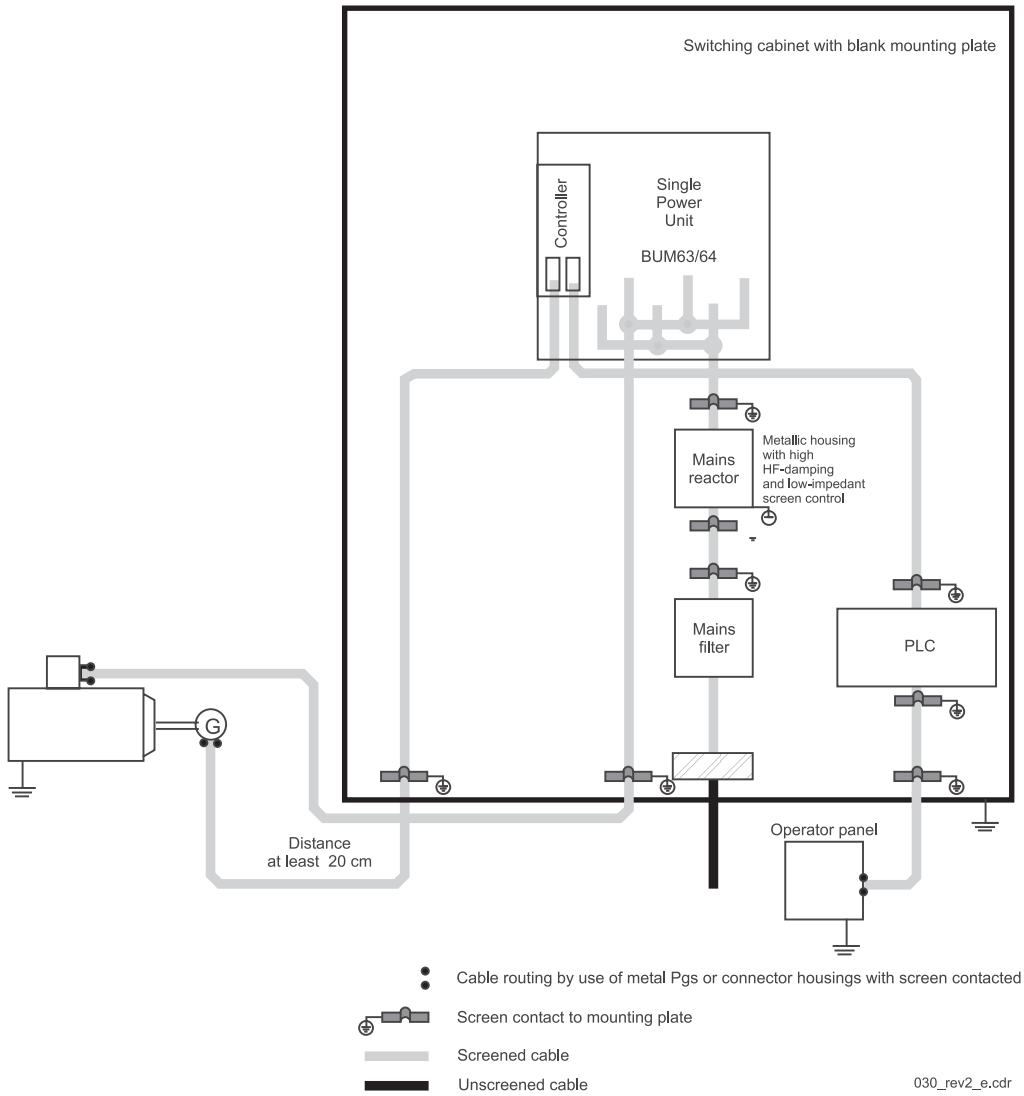


Figure 16: Cabling proposal BUM64S/A/F

- It can be assumed, that the permissible limit values are observed, if Baumüller-motor cables are used.
- The maximum length of motor cable is limited. The maximum length of the motor cable is dependent on the cross section of cable (see ▹D.10 Cables device-motor◃ on page 109).
- The screened motor cable between converter and motor must be made of one piece. Do not interrupt the cable by e. g. terminals, contactors, fuses a. s. o.

- You achieve the lowest possible effective aerial height by routing the cable directly alongside the earth of a metallic surface.

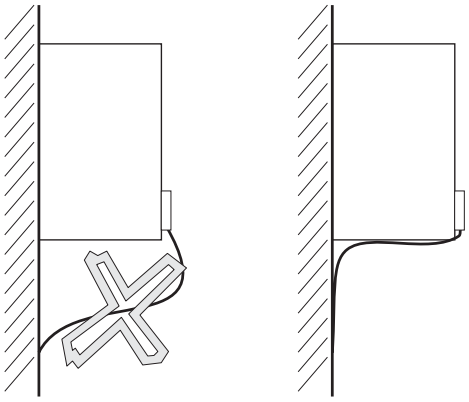


Figure 17: Reducing effective aerial height

- All cables should basically be laid as near as possible to the conductors of the earth system, in order to reduce the loop area which is effective for magnetic coupling.

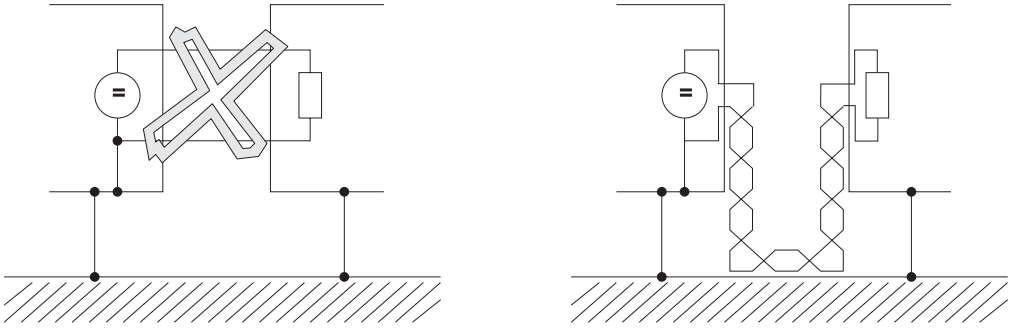


Figure 18: Reducing loop areas

- Keep a minimum clearance of 20 cm between the lines, when parallel-routing signal-/ control lines across power cables.
- Cross cables of different EMC categories only in a 90 °angle.
- For symmetrical signal transmission form twisted pair cables and twist those against all other twisted pairs (e. g. for differential amplifier inputs used for speed set value).
- Establish a connection between earth connection-converter/ground plane (< 30 cm). Use large cross-sections (>10 mm^2).
- The PE-connection on the load side of the filter to the mounting plate should be carried out with low impedance. Ideal is a galvanized metal angle piece or a high frequency earth band.
- Keep a distance of at least 20 cm between converter and its cabling and
  - disturbance sources as contactors, transformers, chokes and
  - noise-sensitive components as µPs, bus systems a. s. o.
- Avoid reserve loops on overlong cables.
- The earthing of reserve cables is mandatory on both ends (additional screening is achieved, you avoid capacitive coupled hazardous contact voltages).
- Don’t switch mains filters parallel.

- Don’t connect mains filters of the same type of construction in series - the attenuation characteristics are not improved.
- Use a separate line filter for each device. Use a separate mains filter for each device. If you must suppress all drives together - do not interrupt the screening between the converter and the mains filter, except by the mains choke, which has to be mounted into a earthed metal housing, which is of low impedance.

6.7.2.2 Earthing

From the view of EMC the classical star-connected earthing is inadequate, in order to minimize the influence of interferences with higher frequencies. Better results are achieved by a reference surface which must be linked to the device’s earth (e. g. plane metal mounting plate and housing parts).

- To avoid earth loops, position all earth conductors and screens as close as possible to earth.
- Execute the connection of controller reference potential - earth with a cross section, which is as large as possible and with a short cable (< 30 cm), as long as there is the possibility to earth the controller reference potential of the device.
- Remove insulation layers such as paint, adhesives a. s. o. from the earth connections.
- If necessary use lock washers (DIN 6798) or similar measures to ensure a permanent, conductive contact.
- Select suitable metal combinations (electro-chemical voltage series), in order to avoid corrosion on earth connections.
- Keep conductive electrolytes by using a protection film (e. g. grease) away from the connection.
- Connect screens on both ends plane and highly conductive with earth.
  Only like this magnetic and accordingly high-frequency interference fields are able to be attenuated in its actions.
- If there are problems with earth loops (e. g. double earthing of set value conductor), apply the receiver side galvanically and the sender side capacitively.
- Contact the outer cable screens with the housing, if the cable is passed through the housings, which separate different EMC areas from each other.

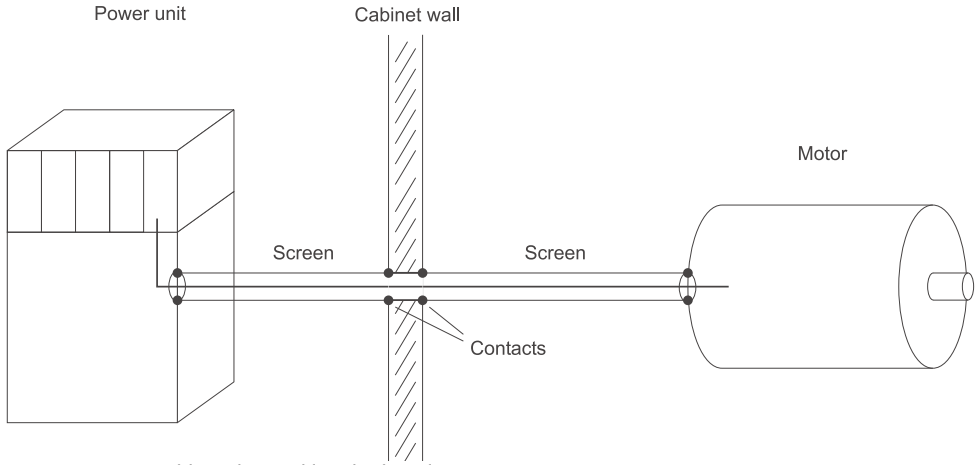


Figure 19: Contact cables when exiting the housing

Cables which are passed through the panels of screening housings without special measures (e. g. filtering), may impair the screening effect of these housings.

- Therewith connect the cable screens also at the exiting point with a well conductive screening.
- Assure that the distance of the last screen contact point to the housing exit is as short as possible.

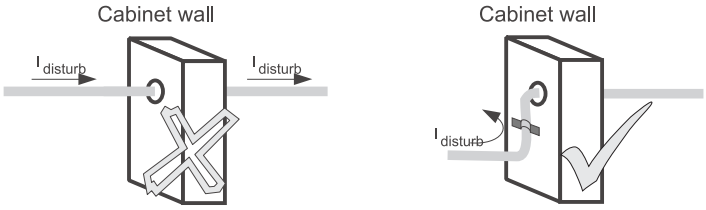


Figure 20: Cable screening at exiting housing

6.7.2.3 Screening

Screening is effective against magnetic fields if the screen is connected to earth on both ends.

With electrical fields a screening effect is already existent, if the screen is connected to earth on one side.

- Always apply the screen on both sides to the fields with high frequencies (dependent on the cable length), regardless of being an electric or a magnetic field.

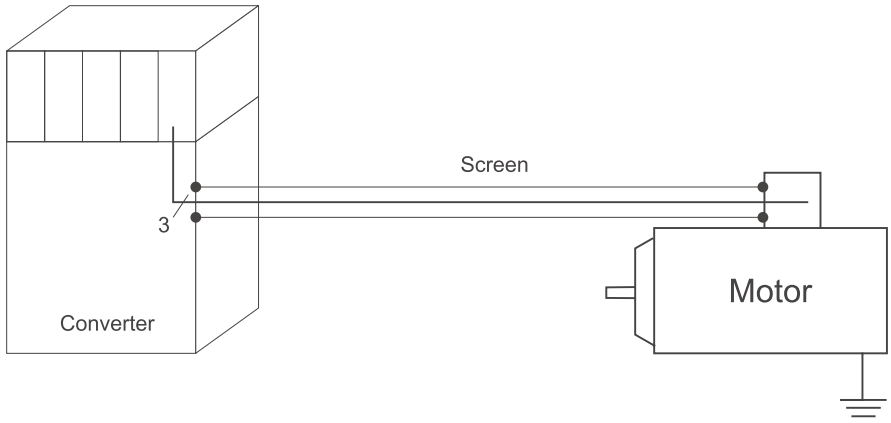


Figure 21: Screen on both sides

With both-sided applying of the screen on earth you reach that the cable doesn't leave the screening "system housing".

The both-sided earthing of cable screenings nearly excludes an influence due to earth loops (potential differences on the earth system). These are very rare, if the notes from the sections (▹Cabling◃ from page 53) and (▹Earthing◃ from page 56) are regarded.

The HF-connection of a screen with earth can also follow capacitive. This avoids low-frequent errors due to earth loops.

- Screened cables that are routed through different EMC areas must not be interrupted at terminals, since screen attenuation would otherwise be reduced considerably.
- Run the cables without interruption to the next component, if this is possible.

- Carry out all screen connections by using a wide surface and with a low impedance.

Cable tails with a length of only 3 cm (1cm wire = 10 nH) reduce the screening effect with errors in the MHz range up to 30dB!

NOTE

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

The following cables possess an especially high noise potential:

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

6.7.2.4 Filtering

The functioning of the device requires not filters. But to comply with the limit values of EN 61800-3 input-sided mains filters are necessary.

If you have questions on how to perform filtering you can order manual „Filters for mains application BFN“.

6.7.2.5 Filter mounting

- Arrange the filter close to the unit.
- Use a screened mains cable between unit and filter at a cable length greater than 30 cm (earthing on both sides).
- Separate in- and output cables of the filter (distance > 30cm).
- Connect the filter housing plane with earth.

6.7.2.6 Leakage currents

Parasitic capacities in filter, power unit, motor cable and motor winding on principle cause leakage currents in the range of 100mA and larger.

Hence it follows that the converters can be incompatible with ELCBs!

- Pertinent to this refer to the safety instructions in EN50178/VDE 0160 para. 5.2.11.2.

6.8 Connection diagram

- Install the mains cables EMC compatible and then connect the cables as specified in the connection plan.

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The danger is: ***electricity.***

Assure, that the permissible connection value (see ▹Electrical data◃ from page 105) never is exceeded!

Again mount the covers, which have been provided and screw on the covers, after the cables have been connected to the power connections.

Assure, that the total power of BUM64S/A/F is not higher than the power of the motors which are supplied by the lined up power modules, which the power supply converter can provide to the BUM64S/A/F.

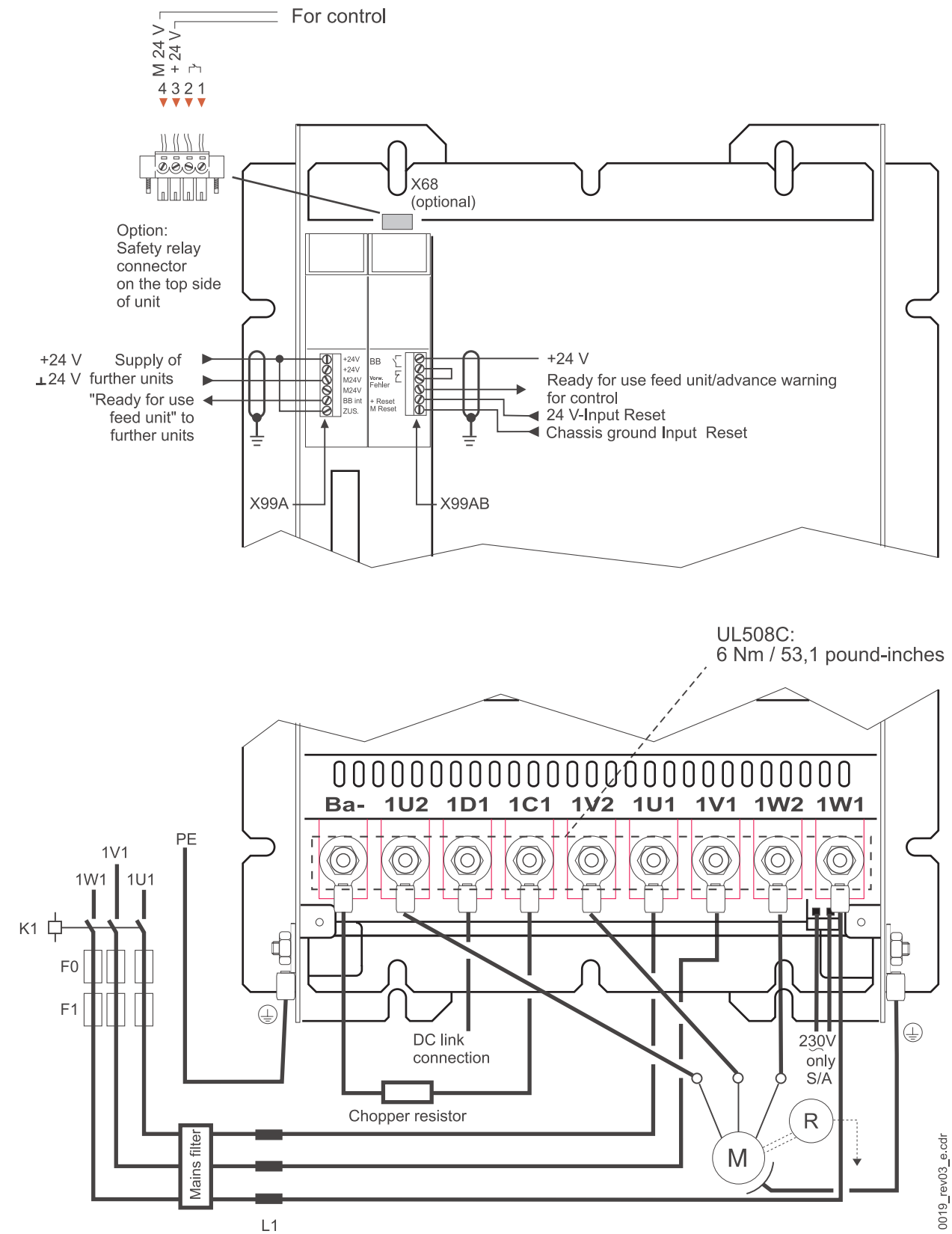


Figure 22: Connection plan BUM64S/A/F

Information concerning the individual connections are to be found from section ▹Power connections◃ from page 45.

Further connection notes are to be found in the following table.

F0	Cable protection fuses, use fuses dependant on supply cables (DIN VDE0100-430)
F1	Fuse for protection of semiconductors or full-range protection (see ▹D.4 Fuse protection◃ from page 107)
K1	Line contactor (auxiliary contact for controller enable optional, not mandatory)
Mains filter	Mains filter see ▹B.5 EMC accessories◃ on page 94.
L1	Mains choke (see ▹B.4 Mains chokes◃ on page 93)
+ 24 V ⊥ 24V	24 V power supply with safe isolation (PELV) acc. to IEC 61131-2; table 7 for supply of electronic part.

6.9 Screwing in accordance with UL

Use a torque code, in case a screwing acc. to UL508C is executed.

6.9 Screwing in accordance with UL

7

COMMISSIONING

The commissioning is divided into the following steps:

1 check mounting

2 check installation

3 check safety devices

4 check operating and display elements

Further information about these steps will be given in the following sections.

7.1 Requirements the executing personnel must meet

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **Electricity.** When this electrical appliance is in operation, certain parts of it conduct dangerous voltages.*

Make sure, that only qualified personal which is familiar with safety information, mounting-, operation- and maintenance procedures is working at this appliance.

Qualified personnel are persons who have been authorized by the plant manager to carry out the activities required, who are able to recognize possible dangers and to avoid them. They must have the skills, experience, instruction and knowledge of the operational conditions and the respective standards, regulations and rules to detect and avoid accidents.

Examples of the qualifications to work with this appliance are:

- education, training or authorization to commission, ground and mark appliances according to safety technology standards.
- education or training in maintenance and use according of adequate safety equipment to safety technology standards.

7.2 Checking the mounting

- make sure, that the appliance is properly screwed to the switching cabinet.
- make sure, that the sealing has not been damaged (for window variants only).
- make sure, that the coolant circulation is tight (for variants F only).

7.3 Checking the installation

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The hazard is: **Electricity.** Voltage conducting parts must be protected against direct touch.*

This you can achieve by insulation, model, position, arrangement or firmly applied devices.

The power terminals of the power module hold potential!

Essential for personal security are the safety measures and safety regulations of the DIN/VDE standards. If protective conductor connections are missing at the appliance or at the motor you will have to face personal damage, because the surfaces may carry dangerous voltages.

The protective conductor connection is to be carried out according to DIN EN 60204/VDE 0113 part 1; section 8.2.2 regarding also EN 50178/VDE 0160, sections 5.3.2.1 and 8.3.4.4.

Under operation there always appear discharge currents in the power module and the motor. They are conducted by using the orderly protective conductor and can lead to premature response of a series fault current circuit breaker.

In case of a body contact or a earth fault a direct current component can appear within the fault current, which can complicate or keep a supervising fault current circuit breaker from responding.

Even after the action of the supply units main contactor the parts of the power module are carrying dangerous voltages.

- check, if the cables leading to the power terminals are routed and connected properly.
- check, if the cables leading to the signal (control-) terminals are routed and connected properly.

7.4 Checking the safety devices

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

This appliance is conducting dangerous voltages and holds dangerous rotating machines (ventilators).

Switching cabinets must be equipped with emergency stop devices who are able to cut off all voltages which can lead to hazards. Not included are appliances that would generate new hazards after being cut off. The release for the emergency stop device must be placed in a way that it is fast to reach in case of an emergency. If you carry out operations that hold higher hazard levels the presence of an additional person is required.

- before activating the drive check thoroughly the function of all supervisory safety devices in order to avoid personal hazard.
- before commissioning make sure, that all covers for the voltage conducting parts (power terminals) are in place and the ventilators have been covered with gratings.
- make sure, that the touch protection has been carried out according BGV A2 (German regulation).

7.5 Commissioning sequence

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

During the first commissioning there is no guarantee that the driven machine elements are not activated by fault or mistake. Therefore be extra careful during the first commissioning.

Extra care is to be taken when directly or indirectly touching the shaft. This is allowed only when the shaft is in stand still position and the power module is cut off from voltage. During operation free accessible machine parts such as shafts or ventilators must be covered.

When an error occurs the drive will be switched off current; the motor will run down without breaking. This circumstance must be regarded especially in transmission or hauling applications.

- make sure there are no persons present in the dangerous area of the machine driven.
- make sure the plant can be switched off immediately by emergency stop devices.
- switch on the appliance and be aware of faulty or uncontrolled conditions of the plant.

8

OPERATION

The device is operated via the controller (see description of controller). The only exception from this is the resetting (acknowledge) of errors via the optocoupler input "reset" of plug-in terminal X99AB.

In this chapter we do not describe the operation but the monitoring and display elements on the device, which are important for the operation.

8.1 Safety instructions

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

Immediately report changes, which could affect the security.

In order to demount safety devices, to commission or to repair, set the machine/installation in exact accordance with the instructions out of operation.

Mount the safety devices again and assure their function directly after completion of commissioning or repairing it.

8.2 Monitoring functions and its messages

NOTE

The monitoring functions are only active, if the +24V-supply voltage (X99A) is present.

The monitoring functions of the unit are divided into two groups. The first group is "monitoring functions supply unit" see ▹Figure 4◃ on page 29. The second group is "monitoring functions motor-sided power unit". This division corresponds with the internal installation of the unit.

8.2.1 Monitoring functions supply unit

The messages, which were generated by "monitoring functions supply unit" are given out externally via the relay contacts. Simultaneously the messages are transmitted to the controller and are processed by this one.

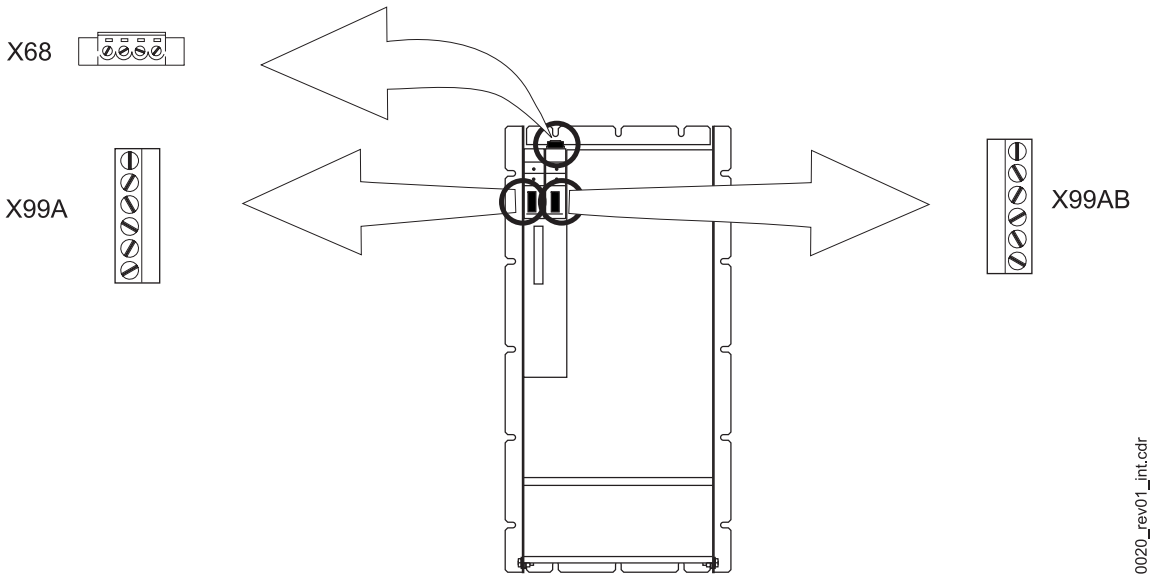


Figure 23: Position of relay contacts

Further information according messages and the involved relay contacts are to be found in ▷Messages via relay contacts◁ on page 75.

8.2.2 Monitoring functions motor-sided power unit

The messages, which were generated by "monitoring functions motor-sided power unit" are exclusively forwarded and processed to the controller. Further information is to be found in ▷Monitoring functions◁ from page 71.

8.3 Ready-for-use

The message "ready-for-use" is the most important message to you. If a monitoring function generates a message, which resets the message "ready-for-use" the drive is stopped.

There is only one message "ready-for-use". If, for example, a V-controller is in BUM 64S/A/F, there are four different messages "ready-for-use" in one drive.

- "Ready-for-use supply unit" (in BUM 64S/A/F existent and visible)
  ="Ready-for-use internal"(digital output X99A - 5)
  ="Ready-for-use external"(relay contacts X99AB - 1.2)
- "Ready-for-use power unit" (in BUM 64S/A/F existent and **not** visible)
- "Ready-for-use controller" (existent in the controller)
- "Ready-for-use total(in the controller)

The message "ready-for-use total" is dependent on the two other ready-for use messages. Not until the messages "ready-for-use supply unit" and "ready -for-use power unit"

and "ready-for-use controller" are available, the message "ready-for-use total" is displayed (see ▹Figure 24◃ on page 69).

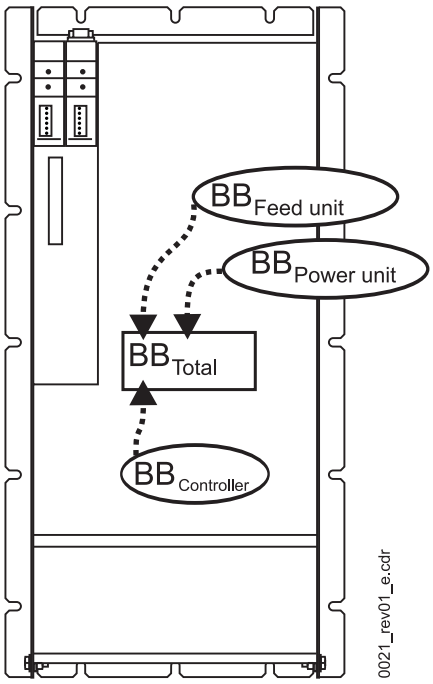


Figure 24: „Ready-for-use“

NOTE

After applying the +24V-supply voltage and the mains voltage, the device is ready-for-use in approximately five seconds.

"Ready-for-use power unit" after approx. 0.5 s, “ready-for-use supply unit“ after approx. 2 s, "ready-for-use controller" after approx 4.5 s

In the following section your will receive further information according the different "ready-for-use" messages.

"Ready-for-use supply unit"

If the "monitoring function supply unit" does not locate errors, the monitoring function generates the message "ready-for-use supply unit".

- If the message "**ready-for-use supply unit**" of monitoring function is reset, BUM 64S/A/F changes the drive torque-free, e. g. the unit doesn’t supply power anymore.

The BUM 64S/A/F shows this message using a LED and at the same time this message is transmitted to the relay contacts. Further information is to be found in▹Monitoring functions◃ on page 71 and ▹Messages via relay contacts◃ on page 75.

The "ready-for-use supply unit" also is classified as "ready-for-use internal" (terminal marking BB int) or "ready-for-use external" (terminal marking BB ext).

The differentiation is due to the internal structure of the unit.
At the output of supply unit "ready-for-use supply unit" is also indicated as "ready-for-use internal". After the message has been transmitted within the unit to the power unit, the message "ready-for-use supply unit" is indicated as "ready-for-use external".

"Ready-for-use motor-sided power unit"

If the "monitoring function motor-sided power unit" doesn't locate an error, the monitoring function generates the message "ready-for use motor-sided power unit".

If the message "ready-for-use motor-sided power unit" is reset by the monitoring function, the BUM64S/A/F changes the drive torque-free, e. g. the unit doesn't supply power anymore.

"Ready-for-use controller"

At the beginning of this section we have mentioned the V-controller. In the documentation for the controller, which is used, you will find information, if the message "ready-for-use controller" is there and if so, how you can process the message "ready-for-use controller".

"Ready-for-use total"

Here also the above mentioned is valid. In the documentation for the controller, which is used, you will find information, if the message "ready-for-use total" is there and if so, how to process message "ready-for-use total".

8.4 Monitoring functions

The following table is listing all of the monitoring functions of the power unit. A declaration of every single monitoring function is to be found on the following pages.

Monitoring function		Relay	V-Controller	Reset
Supply unit	Phase failure	- X99AB; 3.4	- F 0110[1)]	- 24 V_{DC} [2)]
	Power failure	- X99AB; 3.4	- F 0110[1)]	- 24 V_{DC} [2)]
motor-sided power unit	Overcurrent (motor) e. g. Short-circuit	-	F 0202	Reg.[3)]
	Earth current (motor), e. g. Earth fault	-	F 0203	Reg.[3)]
	Overcurrent DC-link	-	F 0201	Reg.[3)]
	Overtemperature heatsink	-	F 0205	Reg. [3)]
	Internal auxiliary supply	-	F 0204	Reg. [3)]
	Safety relay	X 68; 1.2 [4)]	F 0206	Reg.[3) 4)]

1) The V-controller always displays this group error signal if an error appears in the supply unit. Which kind of error has occurred, is shown on the according LED on the front side of the supply unit.

2) Activate reset input (apply +24V and M24V to X99AB), optocoupler input).
or
+24 supply voltage switch off.

Thus **every** message of the supply unit is reset!
With consideration to message WARNING you have the possibility, to bring the drive into a defined operational status, before the power unit resets the message "ready-for-use supply unit" and is current-free.

3) The message must be deleted by a reset of the controller.
Display and reset of the message is described in the manual of the controller.

4) A message only then appears, if the safety relay is switched off. The safety relay is switched off then, if the +24V-supply voltage for the relay is inexistent.
Before you are able to delete the message by a reset of the controller, you must switch on the +24V supply voltage again.

NOTE
Reset: In case the message is not reset, it is in all probability, that the cause of the error still is existent.

8.4.1 Monitoring functions of the supply unit

- **Monitoring function phase failure**

The voltage of all phase conductors is monitored. If the voltage at an phase conductor is missing, the BUM64S/A/F generates the message „warning“. If the voltage comes back within 10 seconds, the message „warning“ is reset. If the voltage of the phase conductor is more than 10 seconds, the message „warning“ remains and the message "ready-for-use supply unit" is reset.

NOTE

If the BUM 64S/A/F is operated during phase failure with high motor powers, the input rectifier may be destroyed. In order to avoid this, you must use semiconductor fuses.

- **Monitoring function mains failure**

The voltage of all phase conductors is monitored. If the voltage is missing at 2 or 3 phase conductors, immediately the message „warning“ is set. If voltage returns again, as long as the DC link voltage is over 300 V, the DC link voltage is charged anew and the message „warning“ is reset.

If the DC-link voltage falls under 300 V after mains failure or supply-system voltage dip, the message „ready-for-use supply unit“ is reset. If the supply voltage returns again, the circuitry of the input X99AB-5/6 determines the further performance:

- Shortly connect (> 1 ms) 24 V, the DC-link is charged again, the message "warning" is reset and the message ready-for-use is set again.
- If you have permanently connected input with 24 V, the DC-link is charged again after return of supply, the message "warning" is reset and the message "ready-for-use" is set again.
  (precondition is, that mains failure time > 0 seconds is set. See "mains failure time" in the controller description).

WARNING

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

The danger is: ***mechanical effects.***

execute protection on the motor side, if an automatic restarting of the drive is possible - because of the automatic restart the operating personal is subject to potential injury!

8.4.2 Monitoring functions motor-sided power unit

- **Monitoring function overcurrent (motor)**

Every of the three phase currents of the motor are monitored.
In case of an exceeding of the phase current of 30 % of the peak value of the permissible peak current the BUM64S/A/F generates this message. This message is stored in the BUM64S/A/F and is routed onto the controller. The message "ready-for-use motor-sided power unit" is reset.

NOTE

The overcurrent message and the consequential stopping of the drive protects this of damage/destruction. In order to avoid the message „overcurrent (motor)“, you must limit the permissible peak current of the motor phase currents by the control system.

- **Monitoring function earth current (short-circuit)**

The earth fault current of the motor phase current monitored.
A message is generated, if the error current exceeds 20% of the amplitude of the permissible peak current of the power unit. As a cause of error an earth fault at the motor connection is likely. This message is routed onto the controller. The message "ready-for-use motor-sided power unit" is reset.

- **Monitoring function overcurrent DC-link**

The level of the DC-link voltage is monitored.
If the DC-link voltage reaches 830 V, a message is generated. This message is routed onto the controller. The message "ready-for-use motor-sided power unit" is reset.

NOTE

The DC-link voltage can increase until switch-off takes place, if the drive brakes and if there is no or a too high chopper circuit at the DC-link.

- **Monitoring function overtemperature heatsink**

The temperature of the heatsink is monitored.
On the heatsink there is a linear temperature sensor, whose measured value is routed onto the controller. So the controller takes over temperature monitoring (see description of controller) and this must be according to technical data be set in the controller description. If the heat sink exceeds the permissible temperature the message "ready-for-use motor-sided power unit" is reset.

CAUTION

The following **may occur**, if you do not observe this caution information:

- property damage.

The danger is: ***temperature of unit too high.*** *The maximum permissible temperature of the heatsink is 90 °C - if there is a higher temperature the device can be destructed.*

Set the controller in such a way, that the "ready-for-use motor-sided power unit" is reset by the controller at a temperature of heatsink of 85 - 90 °C.

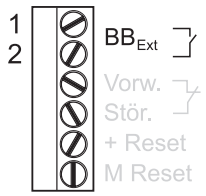
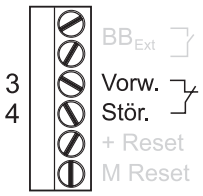
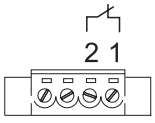
- **Monitoring function internal auxiliary supply**

The voltage, which is necessary for the controlling of the power transistors is monitored. If the internal auxiliary supply is missing, a message is generated. This message is routed onto the controller. The message "ready-for-use motor-sided power unit" is reset.

- **Safety relay** (option)

The output status of the safety relay is monitored.
Further information referring to the safety relay you find in ▹Messages via relay contacts◃ on page 75 and in ▹Appendix E - Safety relay◃ from page 111.

8.4.3 Messages via relay contacts

Plug-in terminal	Description
 Figure 25: BB_Ext, X99AB	"Ready-for-use supply unit" Contact **open**: The message "ready-for-use supply unit" isn't present. Contact **closed**: The message "ready-for-use supply unit" is present. Further information acc. message "ready--for-use power unit" you will find in ▹"Ready-for-use supply unit"◃ on page 69.
.  Figure 26: Pre-warning/error, X99AB	Pre-warning -error (pre-warning is actually the wrong expression, warning would be correct) Contact **closed**: The message WARNING isn't present. Contact **open**: The message WARNING is present. In which case this message is issued, please read in ▹Monitoring functions of the supply unit◃ on page 72.
 Figure 27: X68	With the safety relay you are able to switch off the supply voltage of the transistor control. After the switching-off the motor is zero-torque, but is isn't isolated from the power module. The motor is not off-circuit! A typical application for the safety relay is: ▸ very quick reuptake of the operation after switching off This is possible, because the DC link voltage is not switched off. Resetting safety relay (safety relay is optional available) Contact **closed**: +24V-supply for the safety relay is missing. The output stage and accordingly the inverter is inhibited. Contact **open**: +24V supply for the safety relay is existing. The output stage and accordingly the inverter can be controlled by the controller. If the +24V-supply for the safety relay is taken away, while the drive is running, then the drive is immediately switched zero-torque (this means the device doesn't supply any power anymore), the motor rotates freely back to zero. In order to start the drive again you must follow the following procedure: Switch on +24V supply for safety relay Reset existing message by a reset of the controller See also ▹Appendix E - Safety relay◃ from page 111.

9

MAINTENANCE

Control is the basis of maintenance. If you carry out the inspection carefully, arising problems can be avoided.

9.1 Inspection interval

When the surrounding air is polluted, the required coolant air quantity cannot be achieved, because the dirt will clog up the ventilation grids.

Even before clusters of dirt inside the appliance can block the required heat dissipation. Layers of dirt on the ventilation grids are a warning signal which you should keep an eye on.

- check the devices (e.g. air filters) within the switching cabinet which ensure the required environmental conditions and be sure to keep the maintenance intervals given by the manufacturers.
- weekly check the specified environmental conditions.

The specified environmental conditions you will find in chapter ▹Appendix D - Technical data◃ from page 101.

- monthly check the mixture ratio of the anticorrosive (applies to window variant F only).

9.1 Inspection interval

10

REPAIR

DANGER

The following **will occur**, if you do not observe this danger information:

- serious personal injury
- death

Only Baumüller-personnel, that is familiar with safety notes and mounting-, operation- and maintenance instructions is allowed to repair this appliance.

This appliance conducts dangerous voltages - all repair jobs are to be done only when the appliance is in powerless state.

Begin to work at the DC link of the appliance only after it has been secured, that neither potential nor voltage (residual charge) is present.

Before demounting safety devices for commissioning or repair jobs, the machine/plant is to be put out of operation according exactly to the regulations. Right after the commissioning or repair job is done, all safety devices must be remounted and it must be made sure that they function correctly.

NOTE

The operator of the machine must carry out a complete drive acceptance procedure after every intervention in the drive, no matter if it´s the motor, the actual value encoder or the power module. Also this has to be written down in a chronological protocol (service note-book etc.) If this is disregarded, the operator runs the risk of liability consequences.

11

SETTING OUT OF OPERATION, STORAGE

In this chapter, we describe how the BUM64S/A/F is set out of operation and the storage after.

11.1 Demands on the personnel

The personnel that you order to set the appliance out of operation, must have the required knowledge and instructions to carry out these jobs properly. The personnel is to be chosen in a way that the safety information found on the appliance, its parts and its connections are understood and observed.

11.2 Safety regulations

The sense of the safety regulations during commissioning must be applied to the set-out-of-operation procedure as well.

DANGER

The following **will occur**, if you do not observe this danger information:

- serious personal injury
- death

The hazard is: ***Electricity.***

Make sure that all electrical connections are switched powerless and are secured against unauthorized reactivation.

The modules inside the appliance (e.g. capacitors) can hold dangerous charges! The capacitors used inside the appliance will take at least ***10 min*** *to become discharged by themselves.*

Before working at electrical connections check with suitable test instruments that there is no more voltage at the terminals. Only demount the connecting cable after you are sure that they are completely powerless.

11.3 Setting out of operation

The setting out of operation has the following steps:

1 switch to powerless state and secure against unauthorized reactivation.

2 (approx. 10 min after switching off) test that the connections are voltage free.

3 demount the connections and secure them according to the safety regulations.

4 (if required: demount coolant circulation connections and seal them).

5 make a set-out-of-operation document.

11.4 Demounting

Prerequisite for demounting is a completely documented set-out-of-operation procedure.

For the demounting, observe the same regulations and safety information as for „mounting“. Observe in particular that a BUM64A/S/F weighs between 36 kg and 49 kg.

Supply suitable transport devices (hoisting gear, cranes, transportation personnel etc.) for transport after demounting.

Disengage all mechanical connections to the switching cabinet only after the appliance has been secured against falling off/falling down.

Keep ready suitable packing material if you intend to store the appliances. If in doubt contact Baumüller Nürnberg GmbH. During transport observe, that the appliance is not damaged by false supports or severe shocks, see also ▷Packing and Transport◁ from page 23.

11.5 Storage conditions

The duration of the storage is unlimited if you keep the storage conditions given below:

- 1 K 4 (climatic class)
- - 30 °C to + 70 °C (temperature range)

11.6 Maintenance during the storage

During storage there is no maintenance necessary.

11.7 Re-commissioning

1 change the seal.

2 carry out commissioning like for a new appliance.

In case you have stored the unit longer than six months, the DC-link capacitors must be reformed before recommissioning. Therefore you must supply the device for at least 48 hours ready-for-use with supply voltage without giving impulse release.

12

DISPOSAL

In this chapter we describe the correct and secure disposal of BUM64S/A/F-appliances. During the disposal you will get mainly metal parts (iron- and non-iron metal), electronics scrap and plastics.

12.1 Safety regulations

The disposal is to be carried out only according to the safety regulations. Observe also particular local regulations. If you are unable to carry out a proper disposal yourself, contact a certified disposal business.

CAUTION

The following **may occur**, if you do not observe this danger information:

- environmental pollution.

The hazard is: ***non-appropriate disposal.***

During a fire dangerous materials may be generated or set free.

Do not expose electronic modules to high temperature.

The inner insulation of e.g. various power semiconductors holds beryllium oxide. When opened, the beryllium dust is dangerous to your health.

Do not open modules.

12.2 Demands on the personnel

The personnel which you instruct to dispose/demount the appliance must have the knowledge and training to carry out these jobs properly. Choose the personnel in a way that it is secured that safety information on the appliance and its parts are understood and observed.

12.3 Disposal instructions

Prerequisites

- the appliance has been properly demounted.
- all technical devices and tools required for demounting are ready-to-use and are in a good technical condition.

12.3.1 Modules

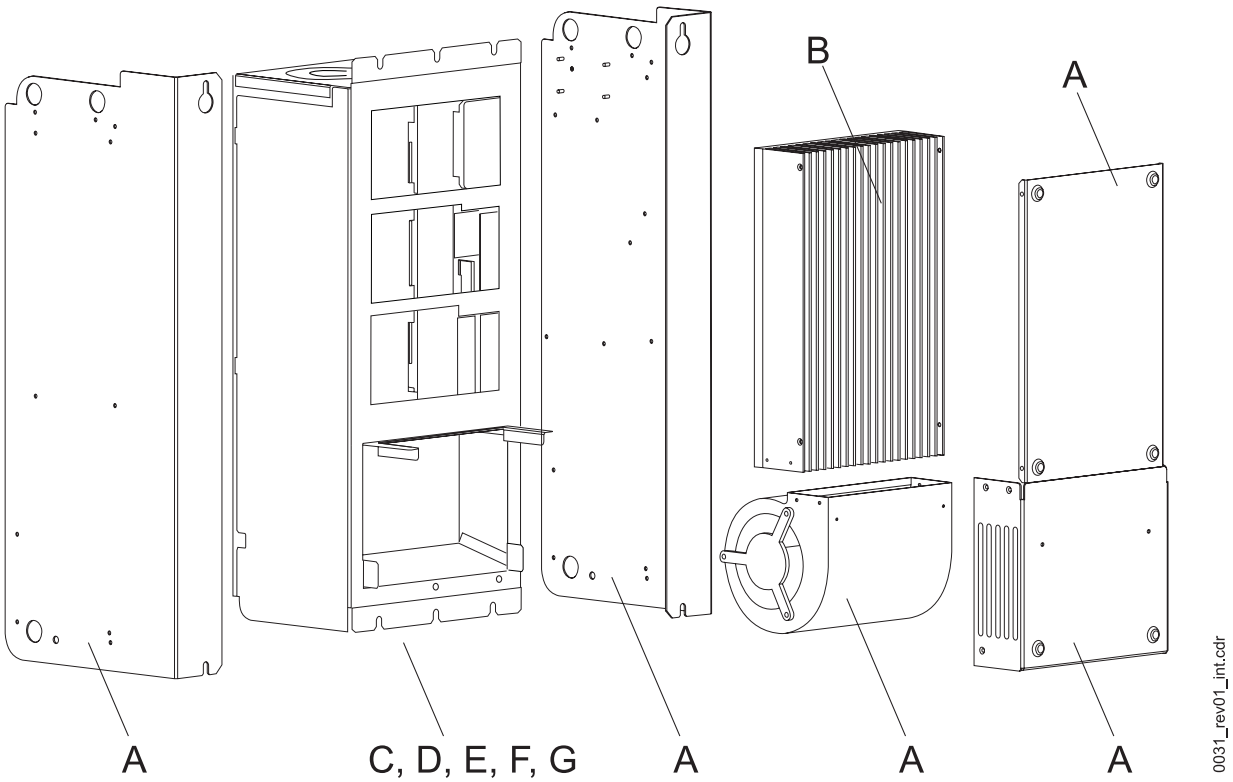


Figure 28: Demounting scheme

The modules/units below given in brackets you will find in the figure above.

sheet steel **(A)** sheet steel must be given to the iron metal recycling.

aluminium **(B)** aluminium must be given to the non-iron metal recycling.

aluminium/copper-compound **(C)** aluminium/copper-compound must be given to the non-iron metal recycling.

plastics **(D)** the plastic parts of the housing, the plastic covers and other small parts made from plastic must be given to the plastics recycling.

CAUTION

The following **may occur**, if you do not observe this danger information:

- environmental pollution.

The hazard is: ***non-appropriate disposal.***

The following elements/modules must be handled as special waste.

condensers	**(E)** condensers must be disposed off as special waste. Observe the respective regulations.
semiconductor modules	**(F)** semiconductor modules must be disposed off as special waste. Observe the respective regulations.
electronic scrap	**(G)** the electronic scrap from PCBs, which cannot be demounted further, must be recycled as special waste. Observe the respective regulations.

12.4 Recycling plants / offices

Make sure, that the disposal is carried out according to your company's regulations and the regulations of the disposal companies and official administration. If in doubt, contact the local business administration, environmental office or other.

APPENDIX A - ABBREVIATIONS

+|IAist|	Absolute value of armature current actual value (pos. signal)
AO	Function module Analog Outputs
AC	Alternating current
ADR	Adress byte
AI	Function module Analog Inputs
AK	Request-/answer code
AM	▸ Asynchronous motor ▸ Function module Drive-Manager
ASF	Armature contactor enable
BAPS	Baumüller drives parallel interface
BASS	Baumüller drives serial interface
BB	Ready for operation
BBext	Readiness for operation (external)
BBint	Readiness for operation (internal)
BCC	Block check character
BE	▸ Component (corresp. to “UU“) ▸ Operator’s station
BEDAS	Operating data memory
BOF	Begin of file
BS	Function module operating system
BSA	Analog reference potential
BSD	Digital reference potential
BSE	External reference for 24 V controller inputs
BUB	Ballast unit
BUC	Baumüller incoming-/feedback unit
BUG	Baumüller converter basic incoming unit
BUM	Baumüller single power unit
BUS	Baumüller power module
CPU	Central processing unit
DA	Digital/analog
DAC	Digital/analog converter
DB	Data byte (8 bit)
DC	▸ Direct current ▸ Drive-Control
DE	Function module Digital Inputs
DES	Digital input actuator
DIN	’Deutsches Institut für Normung e.V.’, German institution for standardization
DOPPELW	Double word (32 bit)
DSV	Function module Data Set Management
DW	Data word (16 bit)
DWort	Double word (32 bit)
EMK	Electromagnetic constant
EMC	Electromagnetic compatibility
EN	European standard
EOF	End of file
ES	Function module Incoming Feeder
Ext	Function module Current Monitoring
EXT, ext	External
FBS	BEDAS missing
FI	Fault current
FLG	Error position encoder signal
FPH	Missing phase
FTO	Error tacho signal
GL	Technology module Synchronous Operation
GRE	Rectifier end position
HE	Mains contactor ON

HLG	Function module Ramp-function Generator
HM	Main menu
HS	Mains contactor
HSE	Mains contactor ON
HSF	Mains contactor enable
HW	▸ High word ▸ Hardware
I	Function module Current Control
I2t	Function module Overload Monitoring
I_{Aist}	Armature current actual value
IKG	Function module Incremental encoder
ID-Nr.	Identification number
I_F	field current
I_{Fmax}	Maximum field current (rated current)
I_{Fmin}	Minimum field current
I_{Fsoll}	Filed current setpoint value
Inc	Counting unit of position encoder
IND	Index
Ink	Stroke character number of incremental encoder
INK.	Incremental
KT	Function module Coordinate transformation
IPM	Intelligent power module
I_{soll}	Armature current setpoint value
IW	Actual value
IWK	Actual value channel
$IxR_{service}$	IxR-compensation with “service“
$IxR_{creep\ speed}$	IxR-compensation with “creep speed“
IZK	Overcurrent in DC link
KT	Function module Coordinate Transformation
L	Function module Position Control
LED	Light-emitting diode
LGE	Telegram length
LT	Function module Power Module
LW	Low word
M	Function module Drive-Manager
M24	Reference potential 24 V
MM	▸ Function module Motor Model ▸ Torque detector
$	Prefix for hexadecimal number
Mot	Function module Field Angle Computing
MR1	Torque direction 1
MR2	Torque direction 2
MT	Function module Motor Temperature
mtr.	Medium time-lag fuse
n = 0	Speed = 0
N	Function module Speed Controller
n_{ist}	Speed actual value
n_{max}	Maximum speed
n_{min}	Minimum speed
NMX	Maximum speed exceeded
NN	Altitude above sea level
n_{SG}	Creep feed speed
n_{soll}	Speed setpoint value
P	Identification number
PBE	Parameter description
PELV	Protective exta-low voltage
PKE	Parameter identifier
PKW	Parameter identifier value
PNU	Parameter number
POS	Technology module Positioning
PWE	Parameter value
PWM	Function module Pulse-width Modulation
PZD	Process data
R	Reserved
R_A	Armature resistance
RA	Function module Relais Output
Res	Function module Resolver Evaluation
RF	Controller enable
RS	Controller blocking
SE	Screen earthing
SELV	separated extra low voltage system
SF	Following error
SGR	Current limit reached
SH	Quick stop
SL	Protective earth conductor
SM	Synchronous motor
STX	Start of text
SV	Function module Service Interface

SW	▸ Setpoint value ▸ Software
SWG	Function module Setpoint Value Generator
SWK	Setpoint value channel
TBA	Overtemperature ballast resistor
TKK	Overtemperature heat sink
TM	Temperature of motor
TMO	Overtemperature of motor
U_A	Armature voltage
UM	Submenu
USS	Function module USS-protocol
UVS	Supply voltage too low
USS®	Siemens trademark universal seriel interface
U_{ZK}	DC link voltage
VBG	“Verwaltungs-Berufsgenossen-schaft“, German management occupation-cooperative
VDE	“Verband deutscher Elektrotechni-ker“ German electrical engineer con-nected
VE	Logic element
WRE	Inverter limit position
X	Terminal strip
ZK	DC link

APPENDIX B - ACCESSORIES

B.1 Connector

Article	Article no.	Manufacturer - order no. Type
Connector for X99 A	00309454	Phoenix Contact - MVSTBW 2.5/6-ST
Connector for X99 AB	00309455	Phoenix Contact - MVSTBR 2,5/6-ST
Connector for X68	00309482	Phoenix Contact - MC 1,5/4-STF-3,81-BD:1-4

B.2 Water cooling

Article	Article no.
Sealing tape	00350790
Adaptor set 1/2 ‘‘ flat-sealing to 3/8 ‘‘ tube connection	00381044

B.3 Fuses

General information according fuses is to be found in ▹D.4 Fuse protection◃ on page 107.

B.3.1 Whole range fuses gR (device and cable)

Baumüller	3	350A/660V: 00101951	500A/660V: 00308396
Bussmann	1	350A/690V: 170M4185	400A/690V: 170M4186
	2	350A/690V: 170M5884	400A/690V: 170M5885
		450A/690V: 170M5886	
	3	350A/690V: 170M6080	400A/690V: 170M6081
		450A/690V: 170M6082	
Gould	1	350A/1250V: A1-125E350 D1	400A/1250V: A1-125E400 D1
		450A/1250V: A1-125E450 D1	500A/1250V: A1-125E500 D1
		550A/1250V: A1-125E550 D1	630A/1250V: A1-125E630 D1
	2	350A/1250V: A2-125E350 D1	400A/1250V: A2-125E400 D1
		450A/1250V: A2-125E450 D1	500A/1250V: A2-125E500 D1
		550A/1250V: A2-125E550 D1	630A/1250V: A2-125E630 D1
		700A/1250V: A2-125E700 D1	800A/1250V: A2-125E800 D1
	3	350A/1250V: A3-125E350 D1	400A/1250V: A3-125E400 D1
		450A/1250V: A3-125E450 D1	500A/1250V: A3-125E500 D1
		550A/1250V: A3-125E550 D1	630A/1250V: A3-125E630 D1
		700A/1250V: A3-125E700 D1	
SIBA	2	350A/690V: 2021234-350	400A/690V: 2021234-400
Siemens	1	350A/690V: 3NE1 331-0	
	2	**350A/660V: 3NC8 431-3**	**350A/500V: 3NC2 431-3**
		500A/660V: 3NC8 434-3	

Size ↑ ↑ **bold: no UL**

B.3.2 Semiconductors aR (device)

Baumüller	1	350A/1000V: 00204479	
Siemens	1	**350A/1000V: 3NE3 231**	
	2	**350A/690V: 3NE1 331-0**	

Size ↑ ↑ **bold: no UL**

B.4 Mains chokes

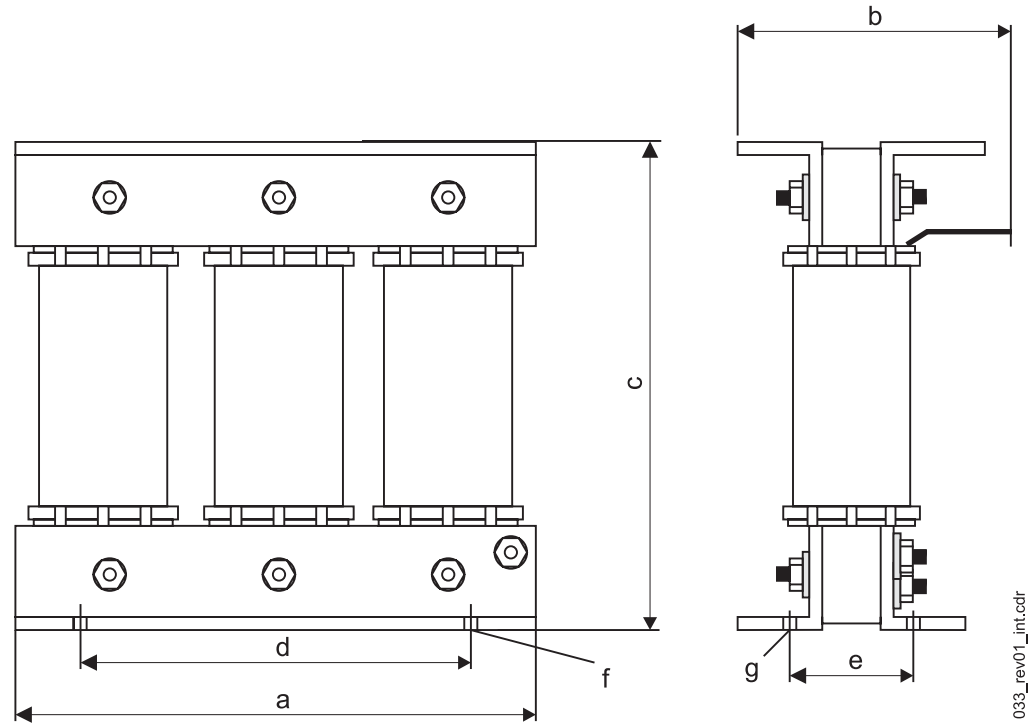


Figure 29: Mains choke

- Three-phase mains chokes

BUM	Choke BK3-	Direct current type A	Type alternating current A	a mm	b mm	c mm	d mm	e mm	f x g mm	Flat connection for M10 mm x mm	Weight kg	Loss W	Article number
64	- 0365/0450	450	365	360	220	320	310	125	11 x 15	40 x 5	47.0	370	368385

B.5 EMC accessories

Mains filters for TN-mains

$I_{Bem\ AC}$ 1)	Type	Article no.
320 A	BFN 3-1 - 320 - 001	373896
400 A	BFN 3-1 - 400 - 001	373900

Mains filters for IT mains

$I_{Bem\ AC}$ 1)	Type	Article no.
320 A	BFN 3-1 - 320 - 001	373894
400 A	BFN 3-1 - 400 - 001	373898

1) Rated temperature = 40° C

C

APPENDIX C - DECLARATION OF CONFORMITY/ BY MANUFACTURER/ UL-CERT.

In this section we provide general information about EU directives, the CE symbol and the Declaration of Conformity/by Manufacturer.

C.1 What is an EU directive?

EU directives specify requirements. The directives are written by the relevant bodies within the EU and are implemented by all the member countries of the EU in national law. In this way the EU directives guarantee free trade within the EU.

An EU directive only contains essential minimum requirements. You will find detailed requirements in standards, to which references are made in the directive.

C.2 What the CE symbol indicates

a) The CE marking symbolizes conformity to all the obligations incumbent on manufacturers for the product by virtue of the Community directives providing for its affixing.
...

b) The CE marking affixed to industrial products symbolizes the fact that the natural or legal person having affixed or been responsible for the affixing of the said marking has verified that the product conforms to all the Community total harmonization provisions which apply to it and has been the subject of the appropriate conformity evaluation procedures.
...

Council Decision 93/465/EEC, Annex I B. a) + c)

We affix the CE mark to the equipment and to the documentation as soon as we have established that we have satisfied the requirements of the relevant directives.

All converters and control systems supplied by the Baumüller Nürnberg GmbH satisfy the requirements of 73/23/EEC (Low Voltage Directive).
As all converters and control systems comply with the requirements of the harmonized standards EN50178, EN 60204-1, EN 60529 and HD625.1 S1, the protection targets of 73/23/EWG are reached.

With specified application of this Baumüller equipment in your machinery, you can act on the assumption that the equipment satisfies the requirements of 98/37/EG (machinery directive). Therefore the equipment is developed and constructed in such a way, that the requirements of the harmonized standard EN 60204-1 can be met by the electrical installation.

Compliance with 89/336/EEC (EMC Directive) depends on how the equipment is installed. Since you are performing installation yourself, it is you who are responsible for complying with 89/336/EEC.
A declaration of conformity on the EMC directive therefore cannot be issued.

We will provide you with support in the form of EMC information. You will find this information in the operating manual and in “filters for main applications”. When you have complied with all the requirements we impose in this documentation, you can assume that the drive satisfies the requirements of the EMC Directive.
The limit values and requirements for variable-speed electrical drives are determined in the harmonized product standard EN61800-3. If you are erecting an installation, for which a declaration of conformity on the EMC directive must be generated, it may be necessary to specify several harmonized standards, which you have used for the compliance of the protection targets of the directive. The harmonized product standard EN 61800-3 has to be used with electrical drives.

To enable you to market your machine within the EU, you must be in possession of the following:

- Conformity mark (CE mark)
- Declaration(s) of Conformity regarding the directive(s) relevant to the machine

C.3 Definition of the term Declaration of Conformity

A Declaration of Conformity as defined by this documentation is a declaration that the electrical equipment brought into circulation conforms to all the relevant fundamental safety and health requirements.

By issuing the Declaration of Conformity in this section the Baumüller Nürnberg GmbH declares that the equipment conforms to the relevant fundamental safety and health requirements resulting from the directives and standards which are listed in the Declaration of Conformity.

C.4 Definition of the term Declaration by Manufacturer

A Declaration by Manufacturer as defined by this documentation is a declaration that the machine/safety component brought into circulation conforms to all the relevant fundamental safety and health requirements.

By issuing the Declaration of Conformity in this section the Baumüller Nürnberg GmbH declares that the equipment conforms to the relevant fundamental safety and health requirements resulting from the directives and standards which are listed in the Declaration of Conformity .

The Baumüller equipment is integrated into a machine. For health and safety, of the users for example, it is important for the entire machine to conform to all the relevant fundamental safety and health requirements. For this reason the Baumüller Nürnberg GmbH draws attention in the Declaration by Manufacturer to the fact that it is prohibited to put the machine as a whole into operation before it has been declared that the machine conforms to the provisions of the Machinery Directive.

C.5 Declaration of Conformity

EU-Konformitätserklärung

Declaration of Conformity

gemäß EU-Richtlinie 73/23/EG (Niederspannung) vom 19.02.1973
geändert durch: 93/68/EWG vom 22.07.1993

in accordance with EC directive 73/23/EG (low voltage) dated 19.02.1973
changed by: 93/68/EWG dated 22.07.1993

BUM64A - XXX/XXX - XX - X - X - XXX

BUM64F - XXX/XXX - XX - X - X - XXX

BUM64S - XXX/XXX - XX - X - X - XXX

Das obige Gerät wurde entwickelt und konstruiert sowie anschließend gefertigt in Übereinstimmung mit o.g. EG-Richtlinie und u.g. Normen in alleiniger Verantwortung von:

the unit specified above was developed and constructed as well as manufactured in accordance with the above mentioned directive and the standards mentioned below under liability of:

Baumüller Nürnberg GmbH, Ostendstr. 80 - 90, D-90482 Nürnberg

Berücksichtigte Normen - standards complied with:

Norm / standard	
EN 50178	Ausrüstung von Starkstromanlagen mit elektrischen Betriebsmitteln Electronic equipment for use in power installations
EN 60204-1	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen Safety of machinery - Electrical equipment of machines
EN 60529	Schutzarten durch Gehäuse (IP Code) Degrees of protection provided by enclosures (IP Code)
HD 625.1 51	Isolationskoordination für elektrische Betriebsmittel in Niederspannungsanlagen Insulation coordination for equipment within low-voltage systems

Nürnberg, 09.12.2004

11/1/2005

Andreas Baumüller
Geschäftsführer
Head Division

ppa. Heidrich 16.12.2004

i.A. Dr. Heidrich
Entwicklungsleiter
Head of development

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C.6 Declaration by Manufacturer

EU-Herstellererklärung

Declaration by Manufacturer

gemäß EU-Richtlinie 98/37/EG (Maschinen) vom 22.06.1998
geändert durch: 98/79/EG vom 27.10.1998

in accordance with EC directive 98/37/EG (machinery) dated 22.06.1998
changed by: 98/79/EC dated 27.10.1998

BUM64A - XXX/XXX - XX - X - X - XXX

BUM64F - XXX/XXX - XX - X - X - XXX

BUM64S - XXX/XXX - XX - X - X - XXX

Die Inbetriebnahme der Maschine, in die dieses Gerät eingebaut wird, ist untersagt bis die Konformität der Maschine mit der obengenannten Richtlinie erklärt ist.

The machinery into which this unit is to be incorporated must not be put into service until the machinery has been declared in conformity with the provisions of the directive mentioned above.

Bei der Entwicklung und Konstruktion des Geräts wurden folgende Normen beachtet:

The development and construction of the unit is complied with following standards:

Norm / standard

EN 60204-1	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen Safety of machinery - Electrical equipment of machines

Baumüller Nürnberg GmbH, Ostendstr. 80 - 90, D- 90482 Nürnberg

Nürnberg, 09.12.2004

11/1/2005

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Entwicklungsleiter
Head of development

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C.7 UL-certification

UL is a mark of conformity, which is assigned from **U**nderwriters **L**aboratories Inc. (www.ul.com), an American company. The UL-certification is not statutory regulated, but takes place voluntarily.
In order to be allowed to mark equipments and components with the UL-mark of confomity, tests must have to be done, which are attended and documentated by an UL-inspector. Only if all necessary tests have been passed and regular product monitoring at the production process of the equipment or the components has been passed without objections, the UL-mark of conformity may be attached to the equipment under test.
Line filters of the company Baumüller Nürnberg GmbH are checked in accordance of the UL-standard UL 508C (UL-Standard for Safety for Power Conversion Equipment) and are recorded under the category control number NMMS. The product- and test description is recorded under
file-no. E179860.

Only if all necessary tests have been completely carried out the Ⓤ-mark may be attached to the equipments or components. If single tests have not already taken place at the manufacturer´s, but are carried out not until at the user´s, then only the -mark may be attached.
With products of the Baumüller Nürnberg GmbH all tests are already completed at the UL-certification process, so that they may be marked with the Ⓤ-mark.

In case with the UL-certification process also standards of the CSA (**C**anadian **S**tandard **A**ssociation) are considered, then instead of the Ⓤ- or -mark the cⓊ or c us -mark may be attached to the product.
With products of the company Baumüller Nürnberg GmbH the CSA-standard Norm C 22.2 was considered, that´s why they are marked with the cⓊ-mark.

If products of Baumüller Nürnberg GmbH are mounted into an UL-certified installation, then certain application-, mounting- and installation notices must be considered, which are upon the functioning of the device. We have marked these notes in the manual with „UL 508C ...“. Only if you follow these notes and apply to them you may go by it, that the installation has been mounted UL-conform.

D

APPENDIX D - TECHNICAL DATA

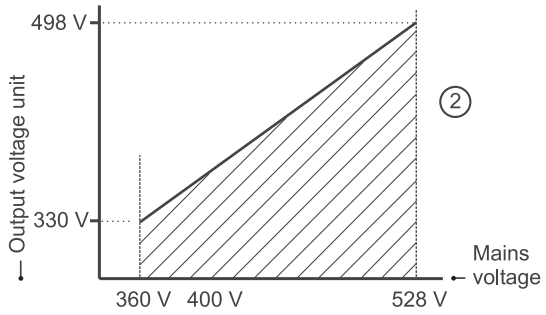
In this appendix you will find a survey of technical data. Some of this data we used in aforementioned chapters at the according positions.

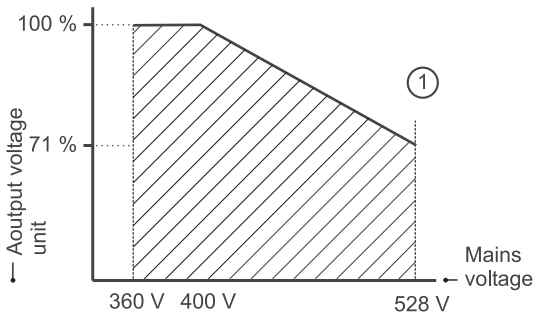
D.1 Requirements on the power supply

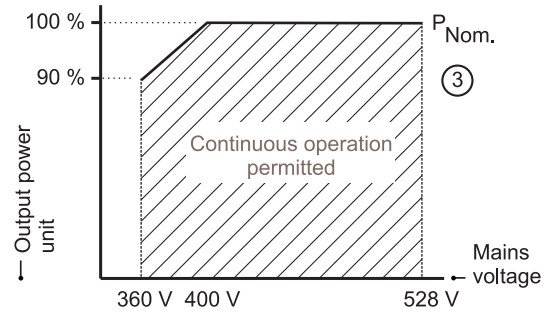
Mains	Industrial system with direct or low impendance earthed star point (TN-mains or TT-mains) Industrial network with no or high impedance earthed star point (IT mains) Industrial system with direct or low impendance earthed junction of phases (earthed delta wye)
Total inductance at the device connection (sum of mains inductance and mains choke inductance)	min. U_k = 4% max. U_k = 6%
Mains voltage/-frequency [1] [2] Device (U_{AC}) Fan [8] (U_{AC})	min. 3 x 360V / 48 to 62 Hz max. 3 x 528 V / 48 to 62 Hz min. 207 V / 48 to 62 Hz max. 243 V / 48 to 62 Hz
Harmonics (mains voltage)	THD < 10% [3]
Unbalanced mains voltage	max. 3% [4]
Voltage dip	Depth of dip < 40%, area < 250% x degree [5]
Control voltage [6] (U_{DC})	+ 24 V -10% / +20% [7]

[1] At voltage interrupts ($0{,}7U_B > U > 0.1U_B$ for t > 0.1 sec.) (U = mains voltage) the error „Phase failure“ or „Mains failure“ is generated (also see ▹Monitoring functions◃ from page 71).

[2] The rated voltage is 400 V. At mains voltages that are smaller 400 V the output power of the device reduces (see curves).







① Curve „Output current“

② “Kurve „Ausgangsspannung“

③ If the output current is multiplied with output voltage the output power is obtained.
In order to obtain the specified curve/surface, it is necessary, that the output current is reduced between 400 and 528 volt.

[3] EN 61800-3, chapter 5.2.1

[4] IEC 1000-2-4, chapter 1, class 3

[5] EN 61800-3, chapter 5.2.2

6) The supply voltage must accord to PELV (EN 50178, chapter 3 and accordingly SELV (EN 50178, chapter 3.70).
At control voltage of < 24 V the ventilation power output reduces.
It, therefore, may be necessary, to reduce the output currents as well.

7) EN61131-2:1994, table 7

8) is only valid for cooling variants S and A

D.2 Required environmental conditions

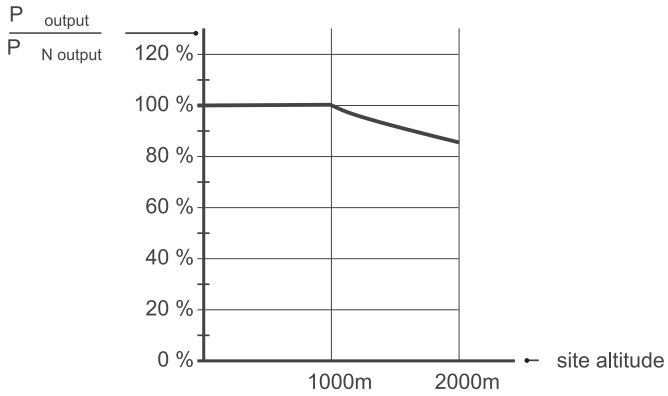
Transportation temperature range	- 30 °C to + 70 °C
Transportation climatic category	2 K 3 [1)]
Storage temperature range	- 30 °C to + 70 °C
Storage climatic class	1 K 4 [1)]
Operational environment	outside of residential areas [2)]
Operation temperature range	min. 0 °C up to max. 55 °C [3)]
Operation climatic class	3 K 3 [1)]
Mounting height [4)]	absolute altitude up to 2000 m (rated duty at 1000 mm over sea level)
Relative humidity (operation)	5% to 85% no condensation [1)]
Vibration, shock and repetitive shock	max. 1 *g* [5)]
Degree of pollution	2 [6)]
Air ventilation temperature [8)]	min. 0 °C to max. 55 °C [3)]
Cooling water temperature [7)]	min. "cooling air temperature [9)]“ to max. 60 °C
Cooling air requirement (power heat sink) [10)]	400 m^3 / h
Cooling air requirement (interior space of device) [10)]	200 m^3 / h
Cooling water flow rate [7)]	min. 4 l/min. to max. 10 l/min.
Cooling water pressure [7)]	max. 6 bar
Temperature difference (cooling water inlet to-outlet)	< 11,5 K at 4 l/min at rated operation
Pressure loss at water cooler [7)]	1.15 bar at 4 l/min

1) EN 50178, table 7

2) at use in residential areas you must reckon that there are high frequency disturbances (EN 61800-3, 6.3.2.3)

3) 40° is the rated temperature

4) Characteristic curve: Power output of the device in dependence with the mounting height at normal pressure



5) EN 50178, chapter 9.4.3.2

6) EN 50178, table 2

7) The cooling water must meet the following requirements:

pH-value	6.5 to 9.5
Conductivity	< 1.8 ppm
Total water hardness (incl. $CaCO_3$)	< 100 ppm
Suspended matters	< 10 ppm
Particle size	< 5 µm
Ryznar Stability Index (RSI)	5.0 to 6.0

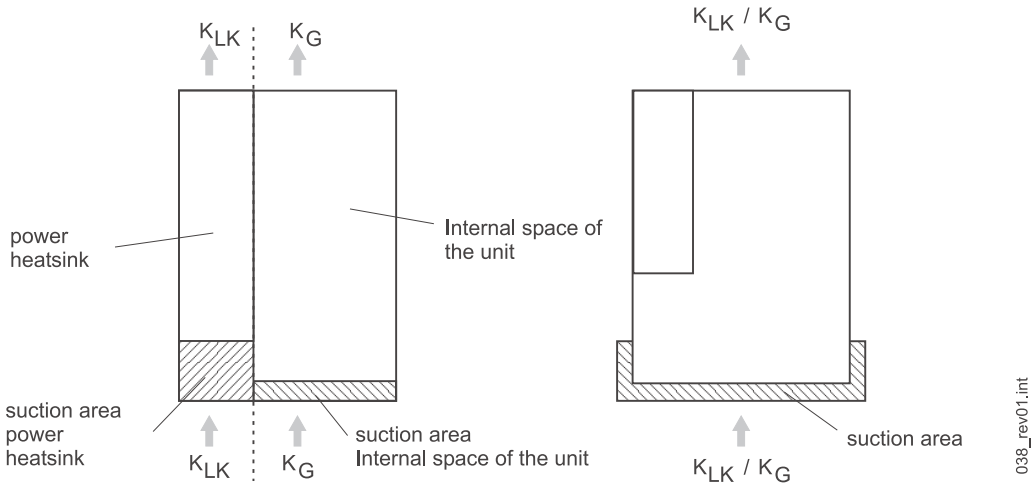
Manganese (Mn)	< 0.05 ppm
Copper (Cu)	< 0.1 ppm
Chlorine (Cl_2)	< 1 ppm
Chloride (Cl^-)	< 500 ppm
Sulfates (SO^{2-}_4)	< 500 ppm

The corrosion-resistant compared with further materials you can take from the DECHEMA-material tables.
Use a corrosion-resistant and a closed cooling circuit.

8) Air inside and outside the control cabinet.

9) Air inside the control cabinet.

10) The cooling air requirement corresponds at least to that of a free-blowing device. Under free blowing an unlimited air inlet and air outlet is to be understood.
With the mounting of the device into a control cabinet it therefore can be necessary to use additional fans, so that the necessary cooling air requirement is covered (see ▹Figure 30◃ on page 104). If the necessary cooling air requirement of the power heat sink is not provided, then the output power of the device has to be reduced.



K_{LK} : cooling air requirement power heatsink

K_G : cooling air requirement of the internal space of the unit

Figure 30: Cooling air requirement

D.3 Electrical data

		BUM64S/A/F
Input power 24V [1]		72 W
DC link rated voltage [1] (U_{DC})		540 V
DC link capacity (internal)		6000 µF
DC link capacity (external)		max. 20 mF
Input current, typical at 4kHz (I_{eff})[1]		290 A
Input power, maximum at 4 kHz [8] (I_{eff})[1]		380 A
Output voltage [2] (U_{AC})		3 x 0 V to 3 x (supply voltage -30 V)
Output frequency [3]		0 Hz to 300 Hz
Output frequency [1]	at 4 kHz [4]	192 kVA
Output frequency [1]	at 8 kHz [4]	148 kVA
Output peak power [8]	at 4 kHz [4]	250 kVA
Output peak power [8]	at 8 kHz [4]	192 kVA
Motor power, typical [1]	at 4 kHz [4]	160 kW
Motor power, typical [1]	at 8 kHz [4]	132 kW
Output rated current [1][5][6][7] (I_{AC})	at 4 kHz [4]	300 A
Output rated current [1][5][6][7] (I_{AC})	at 8 kHz [4]	231 A
Output peak current [1][5][6][8] (I_{AC})	at 4 kHz [4]	390 A
Output peak current [1][5][6][8] (I_{AC})	at 8 kHz [4]	300 A
Power supply DC-link (1C1/1D1)		175 kW
Chopper current, permissible (Î)		max. 130 A
Fan power [9]		max. 200 W
Chopper resistor internal		-
Chopper resistor external		≥ 6 Ω
Brake switch on threshold (Â)		780 V
Power loss „heatsink“ [1] Power loss „interior space of device“ (with controller, without fan)		3200 W 250 W

[1] All rated values refer to a mains input voltage of 400 V and a rated output current (I_{AC}) a control voltage of 24 V and a switching frequency of 4 kHz.

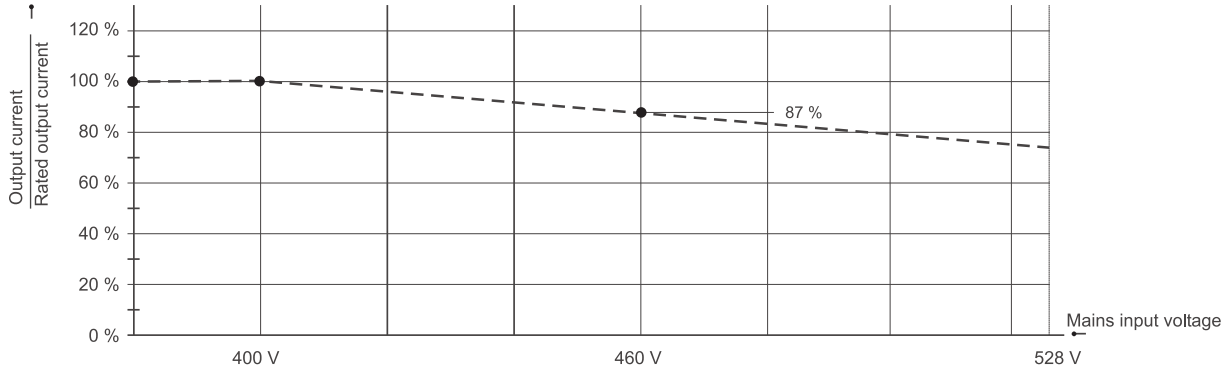
[2] The output voltage is a pulsed d.c. voltage. The operating range refers to the effective value of the fundamental wave.

[3] The frequency is dependent on the controller, which is used.

[4] Switching frequency of the inverter. For this see manual of controller.

[5] Effective value by an environmental temperature of 40 °C.

6) At rated mains input voltage the device enables the rated-/maximum output currents. At input voltages above the rated input voltage the output currents at constantly output power have to be accordingly reduced.
Characteristic curve: output current dependent on supply voltage.



7) Between 40° C and 55° C the output current must be reduced.
The allowable output current (I_0) is calculated with the following formula:

$$I_o = I_{o\,(40\,°C)} \cdot \left(1 - \left(\frac{\text{cooling air temp.}^* - 40\,°C}{°C} \cdot 0{,}03\right)\right)$$

* Possibly there are two temperature values (cooling air, which flows through the inner space of the device/cooling air which flows through the heat sink).
Here use the higher value.

Example: output rated current = 300 A, environmental temperature = 46° C

$$I_o = 300\,A \cdot \left(1 - \left(\frac{46\,°C - 40\,°C}{°C} \cdot 0.03\right)\right) = 300\,A \cdot 0.82$$

Therewith the output current must be reduced: 246 A.

8) The input peak power, the output peak power and the output peak current are made available maximum 120 seconds. The period is dependent on the previous motor current and on the heat sink temperature. For this see manual of controller.

9) is only valid for cooling variants S and A

D.4 Fuse protection

NOTE

In case you consider UL 508C, use semiconductor- or full-range fuses.

Also if you do not consider UL 508C, it is recommended to use semiconductor- or full-range fuses.

Overcurrent protection devices mains cable [1)]	in accordance to EN 60204-1
Overcurrent protection devices for device [1)]	I2t value ≤ 320,000 A^2s

1) Use fuses, which **fall in the operating point below** the stated total operating I2t value (i^2t).
Consider that there are different types of fuses and that accordant fuse holders must have to be used.
A list of the fuses are to be found in ▹B.3.1 Whole range fuses gR (device and cable)◃ on page 92 and ▹B.3.2 Semiconductors aR (device)◃ on page 92.

D.5 BUM64S - non-electrical data

Dimensions (W x H x D)	442 x 920 x 322 mm
Weight without controller	49kg
Type of protection	IP 00
Fight fire with	ABC powder

D.6 BUM64A - non-electrical data

Dimensions (W x H x D)	490 x 885 x (228+90)[1)] mm
Weight without controller	42kg
Type of protection	IP 00/outside IP 44
Fight fire with	ABC powder

1) The first value is the depth inside the control cabinet. The second value is the depth outside the control cabinet.

D.7 BUM64F - non-electrical data

Dimensions (W x H x D)	490 x 885 x (228+30)[1)] mm
Weight without controller	36kg
Type of protection	IP 00/outside IP 54
Fight fire with	ABC powder

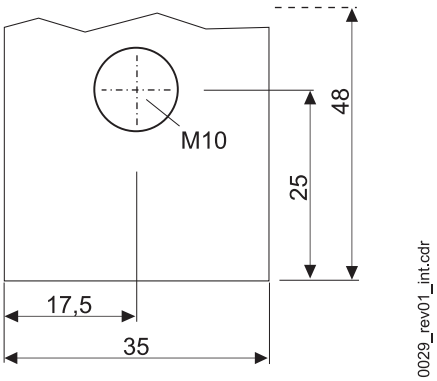
1) The first value is the depth inside the control cabinet. The second value is the depth outside the control cabinet.

D.8 Circuit mains - device

Cross section [1]	dependent on line current
maximum length mains to mains filter	user-defined
maximum length mains filter to choke	max. 0.3m (unscreened) max. 5 m (unscreened)
maximum length mains choke to device	max. 0.3m (unscreened) max. 5 m (unscreened)
Connection to device [2]	Cable lug

1) EN 60204, table 5, type of installation C
For UL conform machines/installations you must use UL certified circuit cables.

2)



Install two cable lugs at the maximum to the lug. Don't install cable lugs above one another, per side only one cable lug. mount. Use cable lugs, which are 35 mm wide at the maximum. Consider that the M10 screw only is intended for fastening. serves.

D.9 Cable control voltage supply/signals

Cross section	2 x 0.2 to 2.5 mm^2 (without ferrules) 2 x 0.25 to 2.5 mm^2 (with ferrule)
Maximum length	user-defined
Ferrule, connection to device	flexible, with or without ferrules

D.10 Cables device-motor

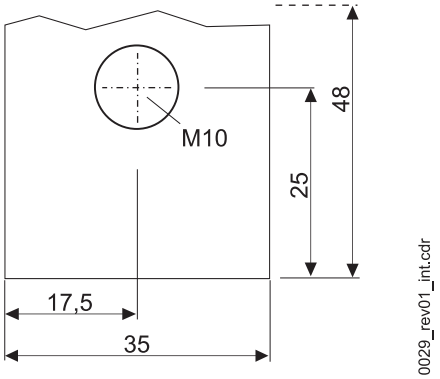
Cross section [1]	dependent on connection
Type of cable	screened, shield overlapping > 85%
maximum length [2] [3]	dependent on the used cross section: up to 4x 25mm^2 (AWG 10 to 3): 60m 4 x 35 mm^2 (AWG 1): 50m > 4x 50mm^2 (AWG 1/0): 15m
Connection to device [4]	Cable lug

[1] EN 60204, table 5, type of installation C
For UL conform machines/installations you must use UL certified circuit cables.

[2] Only for Baumüller cables with this maximum length you can act on the assumption, that it is complied with the EMC-regulations.

[3] In case you use parallel-installed motor cables, the maximum length is to be reduced by the factor 1/n.

[4]



Install two cable lugs at the maximum to the lug. Don't install cable lugs above one another, per side only one cable lug. mount. Use cable lugs, which are 35 mm wide at the maximum. Consider that the M10 screw only is intended for fastening. serves.

D.11 Electric motor, which has to be connected

Motor type [1]	AC motor (synchronous, asynchronous)

[1] dependent on controller

APPENDIX E - SAFETY RELAY

In this chapter we describe the safety relay.

E.1 Methods to avoid an unexpected starting

In order to avoid danger for persons, for example operators, service- and maintenance technics, the machine has to be kept in a secure status (safe stop), while interfering in the dangerous area of the machine. Therefore a reliable avoidance of an unexpected starting is requested (amongst other things Machine directive 89/392/EWG, appendix I, 1.6.3, last paragraph; EN 292-2, 4.1.4; EN 60204-1, 5.4). Under unexpected run every starting, which can cause risks for persons by its unexpected appearing, is to be understood (EN 292-1). Moreover, besides the transition of the enable- to the operating status of the machine also the unexpected running up of the machine, this means the transition from the safe stop into an unsafe moving is to be considered. This is necessary, because the unexpected running 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 maximum acceleration. If an unexpected starting occurs, the operator therefore doesn't have the possibility anymore to remove himself or his hand from the danger 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. At 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 recharging of the DC-link represents a big stress for the concerned parts and often leads to disturbing delays and failures of these parts.

The precondition of the starting of an AC 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 at the pulse pattern generating therefore cannot lead to a starting of the motor, as long as the second precondition, 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 interferences, the behaviour of the shut down drive has to be considered if such an error 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 maximum 180°/number of pole pairs. Subsequently the enabled DC-link operates like a brake, this means after the ending of the lurching movement the drive is in a blocked status. 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

The following **may occur**, if you do not observe this warning information:

- serious personal injury
- death

*The danger is: **electricity.** 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. At maintenance-, service- and repair workings at electrical components of the drive system therefore the protection against electrical dangers has to be assured with other means (e. g. main switch).

E.2 Safety categories

Dependent on the possible dangers (these are rated due to the consideration of the severity of the injuries, the frequency of the length of stay within the danger area and possibilities in order to prevent dangers) 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 checked 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.

E.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 mains failure occurs. 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 external monitoring of safety relais the instantaneous switch status can be sensed for 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 reset after a reset of the safety relay with a reset signal from the controller (for example by X26, pin programmable or via the interface to a bus system).

The switch-on and switch-off sequence of the enable signals as well as of the safety relay must be considered in order to assure a faultless operation of the drive.

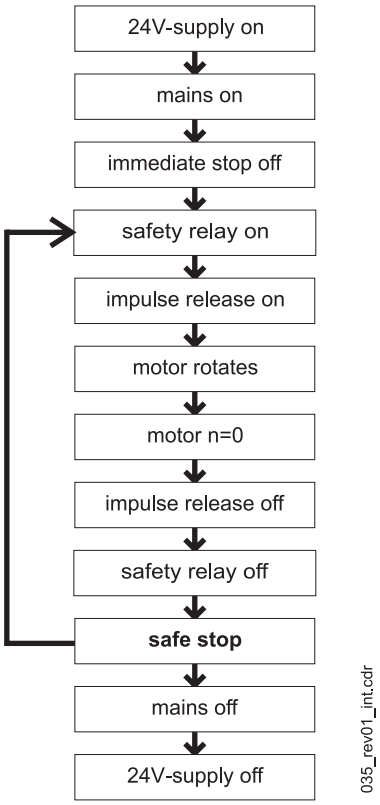


Figure 31: Sequence diagram of safety relay

Baumüller-device of series BUM 6, BUS 6 and BKH, which are executed with a safety relay (optional), comply with the requirements of category 3 (EN 954-1) for die safety-relevant application “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. Therewith a protection device (e. g. door contact) must be enabled. 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.

E.4 Application example for machine of category 3

Exemplary the following diagram shows the usage and cabling of a Baumüller converter of the series BUM 6, BUS 6 or BKH in a machine tool, at which the safe removing of work pieces at opened cover is possible according to category 3 (EN 954-1).

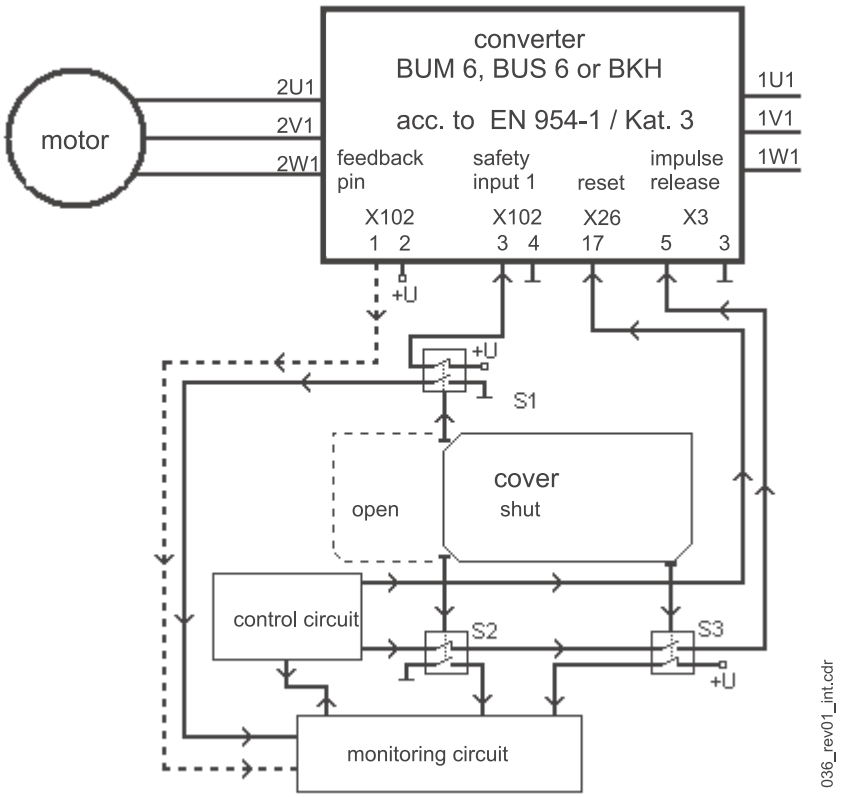


Figure 32: Application example for safe stop according to category 3 (EN 954-1)

The switching-off of the electrical drive motor operates on two channels.

- S2 (NC contact) and S3 (NO contact) have hardware effects on the pulse enable input of the converter (X26:14). Only if S2 and S3 display a closed cover (and therewith a safe status) voltage is being applied to the pulse enable 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 status) voltage is applied to the pulse enable input of the converter (X68:3) an and allows a generation of torque 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 cover is not completely closed or if there is a theoretically impossible status of position switch contacts (e. g. S1 and S2 show a different switch status or S2 and S3 show the same switch status), thus the control circle receives no enable signal of the monitoring circuit. A missing enable signal of the monitoring equipment leads to a direct switching off of the converter by means of the control circuit. If the monitoring circuit has recognized an error (for ex-

ample different switch status 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 connection on two channels (NC contact/ NO contact combination). The mechanical operating at the safety device must take place unavoidable, that means tamper-proof.

The connection cables between safety relay input (X68:3.4) and the control between the pulse enable input at the converter (X26:14) and of the control must not be installed outside the control cabinet in a common cable channel.

E.5 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 phases 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 removal of work pieces at opened cover according to category 4 (EN 954-1) is possible.

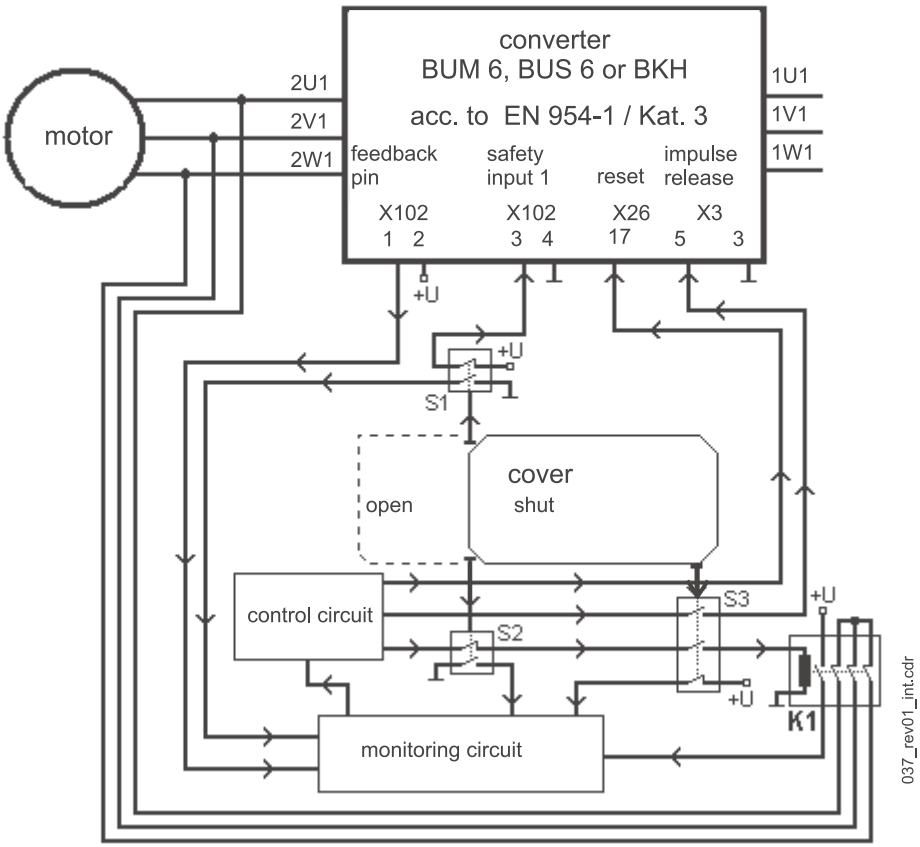


Figure 33: Application example for safe stop according to category 4 (EN 954-1)

The switching-off of the electrical drive motor operates on three channels.

- The contactor K1 with three NC contacts short-circuits the current to the motor in the enable 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 cover (and therewith a safe status) K1 starts up and the short-circuit in the motor cable 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 operates 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 if S1 displays a closed cover (and therewith a safe status) voltage is applied to the safety relay input and therewith enables a torque generation at the wave of the motor. The NO contact of S1 is connected with the monitoring circuit.
- S3 (NO contact) has hardware effects on the pulse enable input of the converter (X26: 14). Only if S3 displays a closed cover (and therewith a safe status) voltage is applied to the pulse enable input of the converter.
- The monitoring circuit, a fail-safe monitoring control of category 4 (EN 954-1), checks 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 (NC contact). If the cover is not completely

closed or a theoretically impossible status of the limit switch contacts is present (for example S1 and S2 show a different switch status or S2 and S3 show the same switch status 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 enable signal of the monitoring signal. A missing enable 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 (e. g. different switch status of S1 and S2), this is displayed to the operator and the commissiong 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 connection on two channels (NC contact/ NO contact combination). The mechanical operating at the safety device must take place unavoidable, that means tamper-proof.

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 may be outside the control cabinet, but not commonly routed in one cable channel.

NOTE

All information given in the manual for 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 relevant legal and official requirements of the Safety Authorities and of the EU-Directives for safety regulations at installations and machines (for example EN 60204-1, security of machines, electrical equipment and EN 292-2, security of machinery - general configuration guidelines).

E.6 Operating lifetime

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

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