



BAUMÜLLER

**POWER CONVERTER**

**BKD 6 / ... 6000**

**BKF12 / ... 6000**

Technical description and  
operation manual

Edition 11. January 1996

|   |            |
|---|------------|
| E | 5.95001.02 |
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**PLEASE READ AND PAY ATTENTION TO SAFETY INSTRUCTIONS  
AND OPERATING GUIDE PRIOR TO COMMISSIONING**

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

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

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

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**Country of origin:** Made in Germany

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

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# Abbreviations

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## ABBREVIATIONS

|                     |   |                  |                               |
|---------------------|---|------------------|-------------------------------|
| BSA                 | Reference voltage, analog                             | M24              | 24-V reference potential      |
| BSE                 | External reference for 24-V control inputs            | MM               | Torque signalling             |
| DAC                 | Digital/analog converter                              | MTL              | Medium time-lag (fuse)        |
| EXT, ext            | External  | n = 0            | RPM = 0                       |
| HE                  | Main contactor ON                                     | n <sub>act</sub> | Speed actual value            |
| I <sub>Aact</sub>   | Armature voltage actual value                         | n <sub>nom</sub> | Speed nominal value           |
| + I <sub>Aact</sub> | Amount of armature voltage actual value (pos. signal) | R <sub>A</sub>   | Armature resistance           |
| IF                  | Pulse enable  | RF               | Controller enable             |
| I <sub>Fmax</sub>   | Maximum field current (nominal current)               | SH               | Fast brake                    |
| I <sub>Fmin</sub>   | Minimum field current                                 | TD1              | Torque direction 1            |
| I <sub>Fnom</sub>   | Field current nominal value                           | TD2              | Torque direction 2            |
| INC.                | Incremental   | X                | Terminal strip                |
| I <sub>nom</sub>    | Armature voltage nominal value                        | \$               | Prefix for hexadecimal number |
| LED                 | Light-emitting diode                                  |                  |                               |

# 1 SAFETY INFORMATION

## Preliminary Remarks

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

In the case of a short-circuit to frame or to ground, a direct proportion may arise in the leakage current that makes triggering a higher-level current-operated e.l.c.b. either more difficult or totally impossible.

This means that connecting the power converter to the mains using only the current-operated e.l.c.b. is prohibited (preliminary standard EN 50178/VDE 0160/11.94, Sections 5.2.11 and 5.3.2.1)

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

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

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

The protective measures and safety regulations according to DIN/VDE are binding for personal security. Neglecting to fit PE connections on the equipment or the motor will result in serious personal injury and/or considerable damage to property.

## General Information

These operating instructions contain all the information necessary for correct operation of the products described. The document is intended for specially trained, technically qualified personnel who are well-versed in all warnings and commissioning activities. The equipment is manufactured using state-of-the-art technology and is safe in operation. It can safely be installed and commissioned and functions without problems if the safety information in these operating instructions is followed.



## WARNING

When operating electrical equipment, some parts of the equipment always carry dangerous voltages. Ignoring these safety instructions and warnings may result in serious personal injury and/or damage to property.

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

# Safety Information

---

## Danger Information

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

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



## DANGER

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



## WARNING

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

## NOTE

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

## Qualified Personnel

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

Trained or instructed or authorized to commission, ground and mark circuits and equipment in accordance with recognized safety standards.

Trained or instructed in accordance with recognized safety standards in the care and use of appropriate safety equipment.



### Appropriate Use



### WARNING

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

For safety reasons, you must not change or add components on/to the equipment/system.

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



## 2 TECHNICAL DATA

### 2.1 General

BAUMOTRONIC Series 6000 power converters are line-commutated units for speed-controlled DC drives with microprocessor closed-loop control.

Single- and four-quadrant versions are available, which differ only in the version of the power unit used for armature control:

In the case of the BKD 6/.../...-6000 single-quadrant version, the power stage is a fully controlled three-phase current bridge circuit (B6C); with the BKF12/.../...-6000 four-quadrant version by contrast, the power stage is a circular current-free counter-parallel circuit (B6C)2I.

In general, a B2HKF semi-controlled two-phase bridge, which is controlled by the microprocessor, is used as the field supply.

Single-quadrant power converters have rated currents of between 30 A and 2050 A; rated currents of between 30 A and 1650 A are available for four-quadrant versions.

This means that it is possible to run on a 500-V 3~ industrial supply DC drives with power ranges of approximately 5 kW to 800 kW in the case of four-quadrant power converters (armature voltage 520 V) and up to approximately 1100 kW with single-quadrant versions (armature voltage 600 V).

The equipment series is divided into four performance levels that are designated in general as unit size I to IV. They differ from one another by virtue of the construction and size of the power stages and the arrangement of the open-loop and closed-loop control module.

Size I and size II units have the tried and tested compact structure. The power stage is in the lower part of the device and comprises electrically insulated thyristor modules on a potential-free heat sink. The control electronics, including the microprocessor PCB, are mounted above the power stage and separated from it by a metal panel to ensure interference immunity.

Size III and size IV units consist of two modules, i.e. the control unit and the power stage; these components must be mounted separately next to one another in the control cabinet. Amongst other things, the closed-loop control module contains the microprocessor PCB, the mains unit and the field controller and it is contained in its own housing. The two units are electrically connected via a plug-in bus cable. The thyristor block is fitted with disk-type thyristors.

In the case of size I and size II units, the necessary phase and armature fuses must be arranged externally, whereas with size III and size IV units, the units already contain semiconductor fuses.

With this series, a powerful 16-bit microprocessor system, which is located on the microprocessor PCB, carries out open- and closed loop control, communications and general signal processing. The PCB and the rest of the electronic components, such as the mains unit and the field unit are the same with all unit sizes. The microprocessor PCB is a lid board: this means that you can easily reach all the relevant components and they are accessible from the front. The power converter's operating software is stored in two plug-in EPROMs that you can easily replace if necessary.

Parameters and data sets are stored on the lid board in a plug-in EEPROM. If required, you can pre-program it. You can also carry out parameterization via an external controller.

This versatile series of equipment can be used in a wide variety of applications:

First of all, this series is intended to replace existing analog equipment such as BKF 12/./2000, BKF 12/./3000 or BKD 6/./2000. The appropriate analog nominal value and additional inputs and digital control inputs are already available.

The equipment achieves optimum efficiency when linked with PCs, PLCs, NCs or CNCs. Adaptation to various bus systems is possible, for example, by means of supplementary modules (interface boards) that you can optionally fit on the lid board. It is possible to fit a maximum of two supplementary modules.

## Features

- Signal processing
  - By means of a 16-bit 68000 microprocessor
- Operation
  - By means of an integrated keyboard, display via LEDs and seven-segment displays
  - Optionally menu-driven via PC (standard RS232, 9600 bps) for rapid commissioning and documentation
- Controller structures
  - Speed control via tachometer generator with/without field weakening
  - Speed control via incremental encoder (option) with/without field weakening
  - Armature voltage control with constant field
  - Torque control with constant field
- Four data sets
  - Freely programmable for adaptation to different applications
  - If technically sensible, switchable online via the serial interface or terminals even during operation:

from tachometer control to e.m.f. control  
(in the case of a tachometer breakdown)

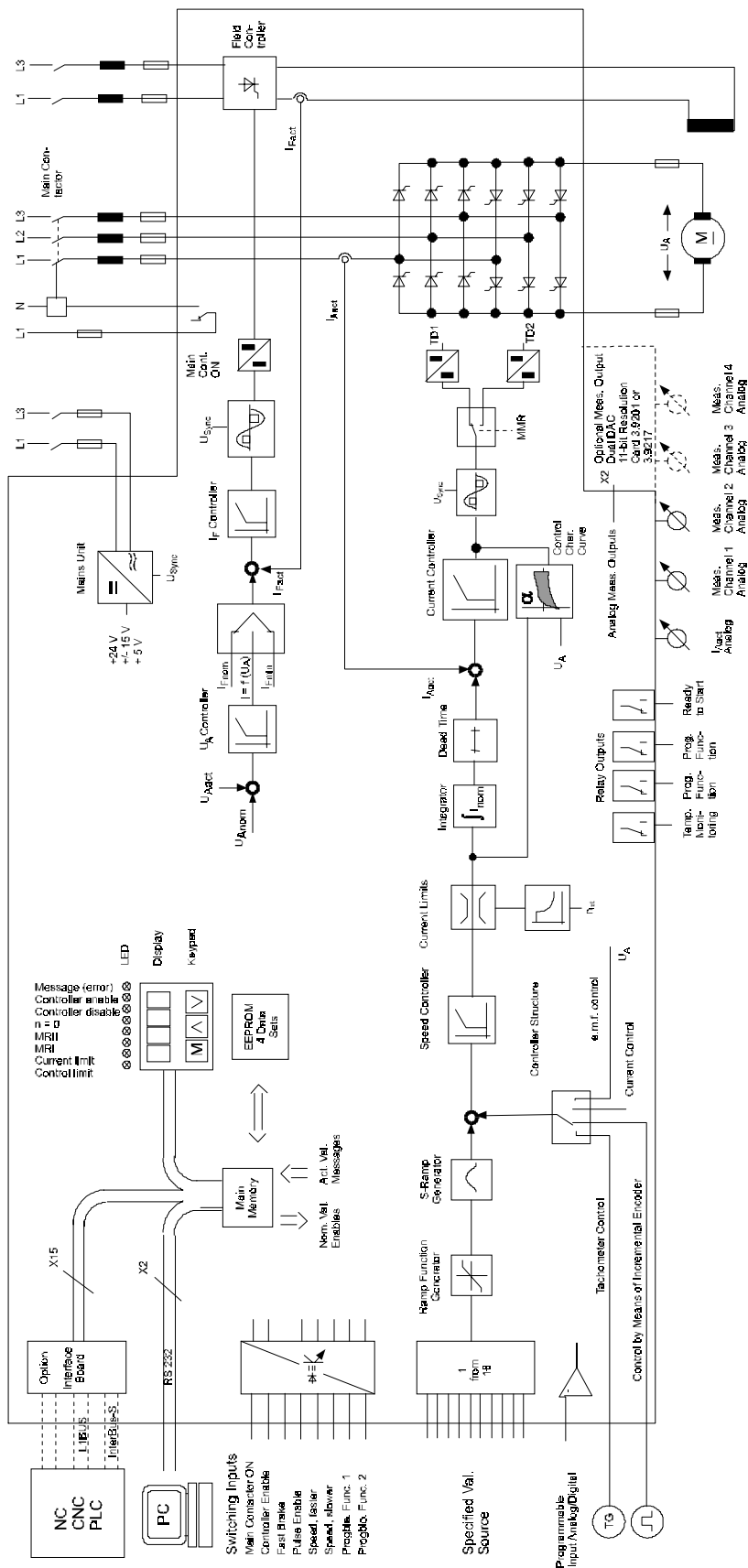
from constant field to field weakening  
(to extend the speed range)

from one drive stage to another

different nominal value sources (inching, ext. nominal value,  
motor potentiometer)

- 16 nominal value sources including, amongst others, analog or digital nominal value source, nominal value generator, inching function and motor potentiometer function
- Ramp function generator and S-ramp generator
- Microprocessor-controlled field supply, with or without field weakening as well as zero-speed field
- Mains monitoring and connection monitoring on the AC and DC sides (also applies to tachometer connection)
- Control via decoupled partially programmable switching inputs
- Analog input, e.g. for external current limits or reversing direction of rotation
- Up to four 0 –  $\pm 10$  V analog outputs for continuous checking of 47 test points within the unit
- One non-digitized 0 –  $\pm 10$  V analog output for display of armature voltage
- Indication of the operating status by means of four partially programmable relay outputs
- Power converters BKD and BKF completely identical except for the power stages

Block Diagram



## 2.2 Type Code



1) 460 V at the original mains voltage of 380 V ±10% or at a mains voltage of 400 V +6%, -15%.  
470 V according to DIN 40030/09.93 since the raising of the mains voltage in accordance with DIN IEC 38/05.87 to 400 V +6%, -10%.  
The 460-V voltage specification in the type code is retained, even after the raising of the mains voltage, in the interests of uniform type designations.

2) 400 V at the original mains voltage of 380 V ±10% or at a mains voltage of 400 V +6%, -15%.

420 V according to DIN 40030/09.93 since the raising of the mains voltage in accordance with DIN IEC 38/05.87 to 400 V +6%, -10%.  
The 400-V voltage specification in the type code is retained, even after the raising of the mains voltage, in the interests of uniform type designations.

2.3 Technical Data of Power Converter Units

|  | BKD 6/.../460-6000<br>BKF12/.../400-6000                            | BKD 6/.../600-6000<br>BKF12/.../520-6000   |                          |
|--|---|--|--------------------------|
| Connection Voltage <sup>2)</sup>   | 3 x 400 V   | 3 x 460 V  | 3 x 500 V                |
| Permiss. mains voltage tolerance <sup>2)</sup>   | ±10%  |  |                          |
| Mains Frequency  | 47 ... 63 Hz  |  |                          |
| Nominal DC current acc. to<br>DIN 40030/09.93<br>BKF <sup>3)</sup><br>BKD  | 420 V<br>470 V  | 480 V<br>550 V   | 520 V<br>600 V           |
| In unit sizes I and II, the graduation<br>of the nominal DC current of BKD6<br>and BKF12 is the same <sup>1)</sup> |   |  |                          |
| Size I   | 30 A<br>50 A<br>70 A<br>100 A<br>120 A<br>150 A<br>200 A            | Correcting range<br>(P025)<br>15 A ... 30 A<br>25 A ... 50 A<br>35 A ... 70 A<br>50 A ... 100 A<br>60 A ... 120 A<br>75 A ... 150 A<br>100 A ... 200 A |                          |
| Size II  | 300 A<br>400 A<br>500 A<br>600 A                                    | 150 A ... 300 A<br>200 A ... 400 A<br>250 A ... 500 A<br>300 A ... 600 A   |                          |
| In unit sizes III and IV, the nominal<br>DC currents of BKD6 and BKF12 are<br>different <sup>1)</sup>              |   |  |                          |
| Size III<br>(BKD6/.../...-6000)  | 750 A<br>920 A<br>1100 A  | 375 A ... 750 A<br>460 A ... 920 A<br>550 A ... 1100 A   |                          |
| Size III<br>(BKF12/.../...-6000)   | 850 A   | 425 A ... 850 A  |                          |
| Size IV<br>(BKD6/.../...-6000)   | 1550 A<br>1750 A<br>2050 A  | 775 A ... 1550 A<br>875 A ... 1750 A<br>1025 A ... 2050 A  |                          |
| Size IV<br>(BKF12/.../...-6000)  | 1250 A<br>1400 A<br>1650 A  | 625 A ... 1250 A<br>700 A ... 1400 A<br>825 A ... 1650 A   |                          |
| Operating temperature range  | Self-ventilated: 30-A unit<br>Force-ventilated: 50-A and above unit |  | 0 ... 45°C<br>0 ... 35°C |
| At temperatures up to 55°C   | Reduction of the nominal DC current by                              |  | 1% per °C                |
| At H > 1000 m above sea level  | Reduction of the nominal DC current by                              |  | 10% per 1000 m           |
| Storage & transportation temperature   | -30 ... +70 °C  |  |                          |
| (Humidity rating acc. to DIN 40440)  | (F; power stages of unit sizes III and IV: E)                       |  |                          |
| Climatic category acc. to EN 60721   | 3K3   |  |                          |
| Type of protection acc. to EN 60529<br>or DIN VDE 0470-1   | IP 00   |  |                          |
| Dimensions   | Refer to 4.1, Assembly  |  |                          |
| Weight   | Refer to 4.1, Assembly  |  |                          |
| Speed range  | > 1:100   |  |                          |



- 1) The nominal DC voltage applies to the stated temperature range up to an altitude of 1000 m above sea level (the permanently permissible nominal DC voltage)
- 2) Refer to 2.11 for the adaptation of power converters to different connection voltages
- 3) Output voltage of the power converters in dependence on delay angle  $\alpha$ :

$$U_{di\alpha} = \frac{3 \cdot \sqrt{2}}{\pi} \cdot U_{mains} \cdot \cos \alpha$$

The correcting range of the delay angle  $\alpha$  depends on the unit type (BKD or BKF) and on parameters P105: "Nominal mains voltage" and P110: "Armature/Mains voltage".

You can request the limits set in the power converter at any one time using display parameters P111: "Final rectifier position  $\alpha_G$ " and P112: "Final inverter position  $\alpha_W$ ". You can only change the limits indirectly using parameters P105 and P110 mentioned above.

Example of P105 = 400 V

| Unit     | BKF + BKD |      |      |      |      |      | BKD  |      |      |
|----------|-----------|------|------|------|------|------|------|------|------|
| P105 [V] | 400 V     |      |      |      |      |      |      |      |      |
| P110     | 0.8       | 0.85 | 0.90 | 0.95 | 1.00 | 1.05 | 1.10 | 1.15 | 1.21 |
| P111 [°] | 49        | 46   | 42   | 39   | 35   | 30   | 25   | 19   | 10   |
| P112 [°] | 150       |      |      |      |      |      |      |      |      |

2.4 Technical Data of Field Power Converter

|   | BKD 6/.../460-6000<br>BKF12/.../400-6000  | BKD 6/.../600-6000<br>BKF12/.../520-6000 |  |
|---|---|--|--|
| Connection voltage  | 400 V   | 460 V                                    | 500 V  |
| Perm. mains voltage tolerance                                 | ±10%  |  |  |
| Mains frequency   | 47 ... 63 Hz  |  |  |
| Nominal DC voltage, field <sup>1)</sup>                       | 310 V   | 360 V                                    | 390 V  |
| Nominal DC voltages, field                                    | 0.5 A<br>1 A<br>3 A<br>4 A<br>6 A<br>8 A<br>10 A<br>15 A<br>25 A  | Setting range<br>(P049)                  | 0.1 A ... 0.5 A<br>0.2 A ... 1.0 A<br>0.6 A ... 2.0 A<br>0.8 A ... 4.0 A<br>1.2 A ... 6.0 A<br>1.6 A ... 8.0 A<br>2.0 A ... 10.0 A<br>3.0 A ... 15.0 A<br>5.0 A ... 25.0 A |
| With sizes II, III and IV only                                |   |  |  |
| Operating temperature range                                   | 0 ... 45 °C   |  |  |
| At temperatures up to 55°C                                    | Reduction of the nominal DC voltage by  | 1% per °C                                |  |
| At H > 1000 m above sea level                                 | Reduction of the nominal DC voltage by  | 10% per 1000 m                           |  |
| Connection  | Up to 15 A nominal DC current inclusive<br>Terminals X2:6-9 on PCB 3.8942<br>Input voltage at X2:6, 7 in-phase with mains unit X2:1,2 and power stage AK1, AK5<br><br>25 A nominal DC current<br>Terminals X3:1-4 (separate terminal strip)<br>Input voltage at X3: 1, 2 in-phase with mains unit X2:1,2 and power stage AK1, AK5 |  |  |
| "Main contactor ON" relay<br>Relay contact can be loaded with | Changeover contact<br>250 V/1 A or 24 V/1 A,<br>Min. switching capacity: 12 V, 400 mA, 4.8 W<br>Terminals X2:3, 4, 5<br>(on field and mains unit supply 3.8942)   |  |  |
| Field weakness control  | With controller structure P083=1, 3   |  |  |
| Release point   | 50% to 100% of the nominal armature voltage   |  |  |
| Zero speed field  | 20% to 100% above parameters P075 and P077  |  |  |
| Timeout for zero speed field                                  | 0 to 180 s above parameter P076   |  |  |
| Field failure protection                                      | 50% of field current nominal value value  |  |  |
| Field connection monitoring                                   | At switch-on, see parameter P122  |  |  |
| Line reactors   | 2 x DR1-23-3-003 3 A<br>or 2 x DR1-23-3-008 8 A<br>or 2 x DR1-23-3-015 15 A<br>or 2 x DR1-23-3-025 25 A   |  |  |
| Semiconductor fuses   | 2 x 5 SD 420, Silized 16 A/500 V, size E27<br>or 2 x 5 SD 430, Silized 20 A/500 V, size E27<br>or 2 x 5 SD 440, Silized 25 A/500 V, size E27<br>or 2 x 5 SD 480, Silized 30 A/500 V, size E27<br>Mount externally   |  |  |

<sup>1)</sup> Output voltage of the field power converter in dependence on delay angle α:

$$U_{d\alpha} = \frac{2 \cdot \sqrt{2}}{\pi} \cdot U_{mains} \cdot \frac{1 + \cos \alpha}{2}; \quad \alpha = 20 \dots 165^\circ$$

## 2.5 Technical Data of Mains Unit

### 2.5.1 Standard Version with Conventional Mains Unit

Type designation of units: BKF 12/ ... - 60400...

BKD 06/ ... - 60400...

|   | <b>BKD 6/.../460-6000<br/>BKF12/.../400-6000</b>   | <b>BKD 6/.../600-6000<br/>BKF12/.../520-6000</b> |
|---|--|--|
| Connection voltage <sup>1)</sup>  | 400 V/460 V/500 V, settable using wire bridges (W3, W4 on PCB 3.8942)                              |  |
| Connection  | Terminals X2:1, 2<br>In-phase with power stage and field (L1/L3)                                   |  |
| Permiss. mains voltage tolerance <sup>1)</sup>                          | -15%/+10%  |  |
| Mains frequency   | 47 ... 63 Hz   |  |
| Power demand  | 50 W   |  |
| Fuse  | 0.4 A medium time lag 500 V external   |  |
| Direct voltages<br>For switching inputs<br>Range<br>Reference potential | Terminal X1:20, +24 V/100 mA, non-stabilized<br>20 V ... 28 V<br>BSE, terminal X1:21 on PCB 3.8934 |  |
| Direct voltages<br>Internal for controller<br>Internal for fan          | ±15 V<br>+5 V<br>24 V (unit size I 50 A nominal current and above)                                 |  |

<sup>1)</sup> Refer to 2.11 Adapting Power Converters to Different Connection Voltages

**2.5.2 Special Version with Switching Mains Unit and External 24-V Supply**

Type Designation of the Units: BKF 12/ ... - 60401 ...  
 BKD 06/ ... - 60401 ...

|   | <b>BKD 6/.../460-6000<br/>BKF12/.../400-6000</b>  | <b>BKD 6/.../600-6000<br/>BKF12/.../520-6000</b> |                 |
|---|---|--|-----------------|
| Mains connection voltage <sup>1)</sup>                                  | 400 V/460 V/500 V, settable using wire bridges (W3, W4 on PCB 3.8942)   |  |                 |
| Connection  | Terminals X2:1, 2<br>In-phase with power stage and field (L1/L3)  |  |                 |
| Permiss. mains voltage tolerance <sup>1)</sup>                          | 200 V ... 440 V   | 230 V ... 510 V                                  | 250 V ... 550 V |
| Mains frequency   | 47 ... 63 Hz  |  |                 |
| Power demand  | 10 W ... 50 W, depending on the mains connection voltage level  |  |                 |
| Fuse  | 0.4 A medium time lag 500 V external on X2:1,2  |  |                 |
| Direct voltage Range  | +24 V<br>21 V ... 30 V  |  |                 |
| Connection  | Terminals X34: 1, 2; 1: GND; 2: +24 V isolated,<br>max. potential to electronic ground: 50 V  |  |                 |
| Nominal current   | With unit fully equipped: maximum of 1.7 A  |  |                 |
| Permiss. starting current inrush  | 50 A  |  |                 |
| Limiting  | External action necessary, e.g.<br>– Using an external power supply with current limiting<br>– Current limiting by means of a series resistor                         |  |                 |
| Fuse  | Depending on the limiting of the starting current inrush;<br>at $\hat{I} = 50 \text{ A}$ : at least 5 A slow-blow acc. to DIN 41571                                   |  |                 |
| Uses  | – With automatic restarting after brief mains disturbances<br>– Applications in which the tolerance of the connection voltage exceeds the permissible values of 2.4.1 |  |                 |
| Direct voltages<br>For switching inputs<br>Range<br>Reference potential | Terminal X1:20, +24 V/100 mA, non-stabilized<br>20 V ... 28 V<br>BSE, terminal X1:21 on PCB 3.8934  |  |                 |
| Direct voltages<br>Internal for controller                              | ±15 V<br>+5 V   |  |                 |
| Internal for fan  | 24 V (unit size I 50 A nominal current and above)   |  |                 |

<sup>1)</sup> Refer to 2.11 Adapting Power Converters to Different Connection Voltages

## 2.6 Technical Data of Power stage

|   | BKD 6/.../460-6000<br>BKF12/.../400-6000   | BKD 6/.../600-6000<br>BKF12/.../520-6000 |                           |
|---|--|--|---------------------------|
| Connection voltage <sup>1)</sup>  | 3 x 400 V  | 3 x 460 V                                | 3 x 500 V                 |
| Connection  | Phases L1 and L3 identical with mains unit and field<br>AK1, AK3 and AK5, clockwise-rotating field   |  |                           |
| Power stage<br>Sizes I, II: Modular thyristor<br>Sizes III, IV: Disk-type thyristor   | SKKT .. /12<br>SKT .. /12  | SKKT .. /16<br>SKT .. /16                | SKKT .. /16<br>SKT .. /16 |
| Permiss. mains voltage tolerance <sup>1)</sup>  | ±10%   |  |                           |
| Mains frequency   | 47 ... 63 Hz   |  |                           |
| Fan<br>Size I<br>From 50 A ... 200 A<br><br>Size II<br>300 A ... 600 A<br><br>Size III<br>BKD 6/.../...-6000, 750 A .. 1100 A<br>BKF 12/ / -6000, 850 A<br><br>Size IV<br>BKD 6/.../...-6000, 1550 A .. 2050 A<br>BKF 12/ / -6000, 1250 A .. 1650 A | 24 V/4.5 W/3000 RPM<br>Range: 12 V <sub>-</sub> ... 28 V <sub>-</sub> ,<br>Internal connection<br>Order No. 19007542<br><br>400 V/3 ~/50 Hz/0.23 A/120 W/2680 RPM<br>400 V/3 ~/60 Hz/0.3 A/180 W/2680 RPM<br>Connection via plug-in contact X100 on fan<br>Order No. 19007543<br><br>230 V/1 ~/0.94 A at 50 Hz<br><br>400 V/3 ~/1.2 A at 50 Hz |  |                           |
| Current transformer<br>Size I<br><br>Size II<br><br>Size III<br><br>Size IV   | 50 A/70 mA Order No. 19007313<br>120 A/70 mA Order No. 19007314<br><br>250 A/70 mA Order No. 19007304<br>400 A/70 mA Order No. 19007300<br><br>720 A/70 mA Order No. 19007338<br><br>1200 A/70 mA Order No. 19007339<br>1500 A/70 mA Order No. 19007340  |  |                           |
| With unit sizes III and IV only:<br>Fuse monitoring   | Terminals X100:1, 2<br>Contact loading: max. of 250 V~/2 A<br>or 30 V~/2 A, min. of 24 V~/100 mA   |  |                           |

<sup>1)</sup> Refer to 2.11 Adapting Power Converters to Different Connection Voltages

2.7 Technical Data of Processor Board 3.8934

|  |   |
|--|---|
| Processor  | MC 68000  |
| Display  | 4-digit 7-segment display including sign  |
| Input  | Keyboard (PC, controller)   |
| Operating status   | 10 LEDs   |
| CPU board connections<br>controller<br>PC (RS232)  | Terminal block X1, 42-pin<br>Sub-D socket X2, 25-pin  |
| Relay<br>K1<br>K2 optionally programmable<br><br>K3 optionally programmable<br><br>K4 optionally programmable<br><br>Relay contact can be loaded with<br>max. potential  | <ul style="list-style-type: none"> <li>– Ready for operation</li> <li>– Speed <math>n &gt; n_x</math></li> <li>– Current monitoring</li> <li>– Operating speed reached (<math>n_{nom}</math> at ramp function generator input)</li> <li>– Current monitoring</li> <li>– Speed monitoring</li> <li>– Drive ready to start</li> <li>– Field current monitoring</li> <li>– Operating speed reached (<math>n_{nom}</math> at speed controller input)</li> <li>– Temperature monitoring of power stage and motor or</li> <li>– Drive ON message and temperature monitoring of power stage and motor</li> </ul> <p>Max. of 24 V/1 A; min. of 1 V/1 mA<br/>50 V to electronic ground</p> |
| Switching inputs<br>Low level<br>High level<br>Max. potential<br>Voltage supply<br><br>Reference potential BSE<br>Main contactor on<br>Controller enable<br>Emergency stop<br>Pulse enable<br>Motor potentiometer RPM ↑<br>Motor potentiometer RPM ↓<br>Programmable switching input<br>Programmable switching input | <p>Input open or 0 V, range 0 V ... +5 V<br/>+24 V, range +15 V ... +30 V, <math>R_i = 3 \text{ k}\Omega</math><br/>50 V to electronic ground<br/>+24 V/100 mA, terminal X1:20</p> <p>X1:21<br/>X1:22<br/>X1:23<br/>X1:24<br/>X1:25<br/>X1:26<br/>X1:27<br/>X1:28<br/>X1:29</p>   |

|   |  |
|---|--|
| <p>Programmable input<br/>Input resistance</p> <p>As an analog input</p> <ul style="list-style-type: none"> <li>- various current limits for both torque directions</li> <li>- Analog specification of the field current nominal value value</li> </ul> <p>As a switching input</p> <ul style="list-style-type: none"> <li>- Low level</li> <li>- High level</li> <li>- Hysteresis</li> <li>- Polarity reversal of nominal value value</li> <li>- Nominal value multiplication</li> <li>- Nominal value zeroing before/after nominal value integrator</li> <li>- Ramp function generator stop</li> <li>- On/stop simulation</li> <li>- Quick starting</li> </ul>                      | <p>X1:9 to X1:10 (BSA); Parameter P084= 0 ... 13<br/>55 kΩ</p> <p>-10 V ... 0 V ... +10 V</p> <p>P084=1, 2, 3, 10, 11</p> <p>P084=8</p> <p>Input open or 0 V, range 0 V ... +5 V<br/>+24 V, range +7.5 V ... +30 V<br/>Approximately 5 V</p> <p>P084=5<br/>P084=4</p> <p>P084=6, 7<br/>P084=9<br/>P084=12<br/>P084=13</p>  |
| <p>Speed nominal value source</p> <p>Analog nominal value 1 (P080=1)<br/>Adaptation<br/>Limiting<br/>Input</p> <p>Analog nominal value 2 (P080=2)<br/>Adaptation<br/>Limiting<br/>Input</p> <p>Nominal value 3 (P080=3)<br/>Limiting</p> <p>Nominal value 4 (P080=4)<br/>Connection<br/>Specification</p> <p>Nominal value 5 (P080=5)<br/>Value<br/>Time</p> <p>Nominal value 6 (P080=6)<br/>Inching function</p> <p>Nominal value 7 (P080=7)<br/>Inching function</p> <p>Nominal value 8 (P080=8)</p> <p>Nominal value 9 (P080=9)</p> <p>Nominal value 10 (P080=10)<br/>Lower value<br/>Upper value<br/>Ramp-up time<br/>Ramp-down time<br/>Memory value<br/>Display of function</p> | <p>Parameter P080 = 1 ... 16</p> <p>0 ... ±10 V, + for clockwise rotation<br/>Potentiometer R100<br/>±100%<br/>Difference amplifier, terminals X1:7 and 8, R<sub>i</sub>=55kΩ</p> <p>0 ... ±10 V, + for clockwise rotation<br/>Parameter P113, P114<br/>±100%<br/>Summing amplifier, terminals X1:3 and 5, R<sub>i</sub>=55kΩ<br/>Reference potential BSA X1:4 and X1:6</p> <p>Σ from nominal value 1 and nominal value 2<br/>±100%</p> <p>0 ... ±100%, serial, parameter P050<br/>Sub-D socket X2 or daughterboard<br/>PC or controller</p> <p>Square-wave generator, internal<br/>-100.0 ... +100.0; parameters P090 and P091<br/>0.1 ... 100 s, parameters P092 and P093</p> <p>-100.0% ... +100.0%, parameter P051<br/>X1:28, parameter P099=1</p> <p>-100.0% ... +100.0%, parameter P052<br/>X1:29, parameter P099=1</p> <p>-100.0% ... +100.0%, parameter P053</p> <p>-100.0% ... +100.0%, parameter P054</p> <p>Motor potentiometer function, internal<br/>-100.0% ... +99.9%, parameter P056<br/>-99.9% ... +100.0%, parameter P055<br/>0.1 s ... 100.0 s, parameter P057 (850 s from S04.27 onwards)<br/>0.1 s ... 100.0 s, parameter P058 (850 s from S04.27 onwards)<br/>Any<br/>Via parameter P108</p> |

| <p>Nominal value 11 (P080=11)</p> <p>Nominal value 12 (P080=12)</p> <p>Nominal value 13 (P080=13)</p> <p>Nominal value 14 (P080=14)</p> <p>Nominal value 15 (P080=15)</p> <p>Nominal value 16 (P080=16)</p> <p>Nominal value voltage stable</p> <p>Internal resistance</p>       | <p>Nominal value setting via dual-port RAM without protocol (with InterBus-S daughterboard 3.9208 only)</p> <p>15-bit twos complement parallel nominal value setting (with daughterboard 3.9217 only)</p> <p>14-bit and sign parallel nominal value setting (with daughterboard 3.9217 only)</p> <p>14-bit with sign parallel nominal value setting, decimal nominal value setting (with daughterboard 3.9217 only)</p> <p>Additive linking of nominal value sources 2 and 4</p> <p>As with nominal value 3; nominal value 1 is routed directly to the speed governor; nominal value 2 is routed via the ramp function generator</p> <p>-10 V/10 mA, terminal X1:19<br/>+10 V/10 mA, terminal X1:17<br/>BSA, terminal X1:18</p> <p>100 Ω</p>  |         |         |         |         |         |     |     |                 |        |        |        |        |         |         |                    |         |         |         |         |         |         |
|--|---|---------|---------|---------|---------|---------|-----|-----|-----------------|--------|--------|--------|--------|---------|---------|--------------------|---------|---------|---------|---------|---------|---------|
| <p>Speed actual value</p> <p>With tachometer control</p> <p>Input</p> <p>Adaptation</p> <p>Value</p> <p>Component fitted ex-works</p> <p>With e.m.f. control</p> <p>Adaptation</p> <p>With speed control with incremental encoder input</p>                                      | <p>Terminals X1:1 and X1:2</p> <p>Potentiometer R103 and tachometer series resistor R102, 2 W, 2%, TK25</p> <table border="1"> <thead> <tr> <th>R102</th> <th>6.8k</th> <th>10k</th> <th>15k</th> <th>22k</th> <th>27k</th> <th>33k</th> </tr> </thead> <tbody> <tr> <td>Tachom. voltage</td> <td>25 V..</td> <td>40 V..</td> <td>60 V..</td> <td>80 V..</td> <td>100 V..</td> <td>120 V..</td> </tr> <tr> <td><math>U_T</math> at <math>n_{max}</math></td> <td>.. 50 V</td> <td>.. 80 V</td> <td>..110 V</td> <td>..150 V</td> <td>..200 V</td> <td>..230 V</td> </tr> </tbody> </table> <p>10 kΩ if the power converter cannot be preset due to missing motor and tachometer data.</p> <p>P082, P110</p> <p>Alternatively, daughterboard from</p> <ul style="list-style-type: none"> <li>- InterBus-S 3.9208</li> <li>- Input/output expansion card 3.9217</li> <li>- CS31/USS 3.9493</li> </ul> <p>Adaptation via P142, P143, P144</p> | R102    | 6.8k    | 10k     | 15k     | 22k     | 27k | 33k | Tachom. voltage | 25 V.. | 40 V.. | 60 V.. | 80 V.. | 100 V.. | 120 V.. | $U_T$ at $n_{max}$ | .. 50 V | .. 80 V | ..110 V | ..150 V | ..200 V | ..230 V |
| R102   | 6.8k  | 10k     | 15k     | 22k     | 27k     | 33k     |     |     |                 |        |        |        |        |         |         |                    |         |         |         |         |         |         |
| Tachom. voltage  | 25 V..  | 40 V..  | 60 V..  | 80 V..  | 100 V.. | 120 V.. |     |     |                 |        |        |        |        |         |         |                    |         |         |         |         |         |         |
| $U_T$ at $n_{max}$   | .. 50 V   | .. 80 V | ..110 V | ..150 V | ..200 V | ..230 V |     |     |                 |        |        |        |        |         |         |                    |         |         |         |         |         |         |
| <p>Analog outputs</p> <p>Armature current actual value</p> <p>Standardization</p> <p>Output</p> <p>Measuring channel 1</p> <p>Test point</p> <p>Resolution</p> <p>Connection</p> <p>Measuring channel 2</p> <p>Test point</p> <p>Resolution</p> <p>Scaling</p> <p>Connection</p> | <p>0 ... +10 V/4 mA, <math>R_i = 100 \Omega</math>; decoupled compliance voltage 10 V corresponds to unit's rated current (at P025 = 1.00)</p> <p>Terminals X1:15 and X1:16 (BSA)</p> <p>0 ... ±10 V/4 mA, <math>R_i = 100 \Omega</math></p> <p>Refer to parameter P088</p> <p>7-bit (approx. 150 mV)</p> <p>Terminals X1:11 and X1:12 (BSA)</p> <p>0 ... ±10 V/4 mA, <math>R_i = 100 \Omega</math></p> <p>Refer to parameter P089</p> <p>7-bit (approx. 150 mV)</p> <p>0.20 ... 1.00 (P125), 0.20 ... 2.00 from S04.30 onwards</p> <p>Terminals X1:13 and X1:14 (BSA)</p>  |         |         |         |         |         |     |     |                 |        |        |        |        |         |         |                    |         |         |         |         |         |         |



|  |  |
|--|--|
| <p>Analog outputs</p> <p>Measuring channel 3<br/>         Test point<br/>         Resolution<br/>         Connection</p> <p>Measuring channel 4<br/>         Test point<br/>         Resolution<br/>         Scaling<br/>         Connection</p> | <p>Measuring channels 3 and 4 with daughterboard only, choice from<br/>         – Dual DAC 12, 3.9201<br/>         – Input/output expansion card 3.9217</p> <p>0 ... ±10 V/4 mA, R<sub>i</sub> = 100 Ω<br/>         Refer to parameter P130<br/>         11-bit (approx. 10 mV)<br/>         Depending on the daughterboard used</p> <p>0 ... ±10 V/4 mA, R<sub>i</sub> = 100 Ω<br/>         Refer to parameter P131<br/>         11-bit (approx. 10 mV)<br/>         0.20 ... 1.00 (P132), 0.20 ... 2.00 from S04.30 onwards<br/>         Depending on the daughterboard used</p> |
| <p>Display of operating status conditions/error messages</p>   | <p>LED displays</p>  <p>Control Limit<br/>         Current Limit<br/>         Torque Direction 2<br/>         Torque Direction 1<br/>         Speed n = 0 (P078)<br/>         Controller Enable<br/>         Contr. Inhibit<br/>         Message</p> <p>H15 H16 H17 H18 H19 H20 H21 H22</p> <p>Display and Keypad</p>  <p>H1 H2<br/>         Red STOP Yellow Watchdog</p>                                   |

## 2.8 Technical Data of Supplementary Modules

As an option, you can fit several different daughterboards on the CPU board, which have the following functions:

### 2.8.1 "Dual DAC 12", Daughterboard 3.9201

Additional measuring channels 3 and 4

|  |   |
|--|---|
| Measuring channel 3<br>Test point<br>Resolution<br>Connection            | 0 ... ±10 V/4 mA, $R_i = 100 \Omega$<br>Refer to parameter P130<br>11-bit (approx. 10 mV)<br>Terminals X4:1 and X4:2 (BSA)  |
| Measuring channel 4<br>Test point<br>Resolution<br>Scaling<br>Connection | 0 ... ±10 V/4 mA, $R_i = 100 \Omega$<br>Refer to parameter P131<br>11-bit (approx. 10 mV)<br>0.20 ... 1.00 (P132), 0.20 ... 2.00 from S04.30<br>Terminals X4:3 and X4:4 (BSA) |
| Assembly   | By means of a 22-mm spacer bolt on CPU card 3.8934 and 64-pin ribbon cable X15  |

### 2.8.2 "Input/Output Expansion", Daughterboard 3.9217

|  |   |
|--|---|
| Incremental encoder input for speed measurement<br>Alternatively<br>Incremental encoder with +5-V supply for two 90° phase-shifted differential impulses<br>Signal level<br>Connection | <ul style="list-style-type: none"> <li>– Differential input</li> <li>– Power supply of encoder possible from daughterboard</li> </ul> <p>LOW signal: 0 ... +0.45 V    HIGH signal: +2.4 V ... +5.25 V<br/>Sub-D socket<br/>15-pin X7A</p>                               |
| Incremental encoder with +24-V supply for two 90° phase-shifted differential impulses<br>Signal level<br>Connection  | <ul style="list-style-type: none"> <li>– Isolated via optocoupler</li> <li>– Power must be supplied to encoder externally</li> </ul> <p>LOW signal: 0 ... +4 V    HIGH signal: +15 V ... +30 V    <math>R_i = 3 \text{ k}\Omega</math><br/>Terminal block X7B:15-17</p> |
| Encoder selection via jumpers<br>Speed range<br>No. of incr. encoder graduations<br>Maximum frequency<br>Polarity reversal<br><br>Achievable maximum speed                             | <p>W1 and W2</p> <p>P142: 100 ... 6000 <math>\text{min}^{-1}</math><br/>P143: 250 ... 4096<br/>300 kHz<br/>P144: on, off</p> $n_{\text{nom}}[\text{RPM}] = \frac{60 \cdot 300}{\text{Pulse number}} \cdot 1000$   |

|  |  |
|--|--|
| Two additional measuring channels  |  |
| Measuring channel 3<br>Test point<br>Resolution<br>Connection                                    | 0 ... ±10 V/4 mA, $R_i = 100 \Omega$<br>Refer to parameter P130<br>11-bit (approx. 10 mV)<br>Terminals X7B:2 and X7B:1 (BSA)   |
| Measuring channel 4<br>Test point<br>Resolution<br>Scaling<br>Connection                         | 0 ... ±10 V/4 mA, $R_i = 100 \Omega$<br>Refer to parameter P131<br>11-bit (approx. 10 mV)<br>0.20 ... 1.00 (P132), 0.20 ... 2.00 from S04.30<br>Terminals X7B:4 and X7B:3 (BSA)  |
| Digital parallel nominal value setting<br><br>Signal level<br>Connection<br>Nominal value source | – Isolated via optocoupler<br>– Max. potential to electronic ground: 50 V<br><br>LOW signal: 0 ... +4 V      HIGH signal: +15 V ... +30 V $R_i = 3 \text{ k}\Omega$<br>Terminal block X7B:21-38<br>Parallel nominal value setting<br>P080=12: 15-bit twos complement<br>P080=13: 14-bit and sign<br>P080=14: 12-bit and sign, decimal nominal value settings |
| Digital outputs<br><br>Connection<br>Signals   | – Isolated via optocoupler<br>– Loadable with 35 V/100 mA<br>– Max. potential to electronic ground: 50 V<br><br>Terminal block X7B:5-14<br>DA0: Loaded data set<br>DA1: Loaded data set<br>DA2: Loaded data set<br>DA3: Not assigned<br>DA4: Not assigned<br>DA5: Not assigned<br>DA6: Not assigned<br>DA7: Frequency message                                |
| Assembly   | By means of a 22-mm spacer bolt on CPU card 3.8934 and 64-pin ribbon cable X15   |

**2.8.3 InterBus-S Interface Board, 3.9208**

With incremental encoder acquisition for speed actual value formation

InterBus-S interface

|  |   |
|--|---|
| Processor  | 80C32   |
| ASIC   | SμPI  |
| Isolation<br>INTERBUS-S/controller<br>Within the local bus | 500 V AC/VDE 0160<br>None   |
| Power supply<br>External<br>Internal                       | Bus terminal<br>Power converter unit  |
| Transfer rate  | 300 kbps  |
| Length of remote bus<br>from node to node<br>maximum       | 100 m/400 m*<br>12.8 km   |
| Length of local bus<br>from drive to drive<br>maximum      | 1.5 m<br>6 m/10 m*  |
| Number of drives or I/O modules                            | 4/8 on one bus terminal (node)  |
| Operation indicators                                       | 5 LEDs: H1 Yellow Message<br>H2 Red PCP error<br>H3 Green Online<br>H4 Red Reset<br>H5 Green 5-V supply |
| Connection   | Local bus input: Sub-D plug X8B, 15-pin<br>Local bus output: Sub-D socket X8C, 15-pin                   |

You can obtain detailed documentation about the InterBus-S bus system\*\* from the Phoenix Contact company in D-32819 Blomberg, Germany.

\* The data applies to bus terminals IBS 220 BK or IBS 24 BK.

\*\* InterBus-S is a registered trademark of Phoenix Contact.

Incremental encoder input for speed measurement

|  |  |
|--|--|
| Incremental encoder with +5-V supply for two 90° phase-shifted differential impulses | – Differential input<br>– Power supply of encoder possible from daughterboard  |
| Signal level   | LOW signal: 0 ... +0.45 V<br>HIGH signal +2.4 V ... +5.25 V                    |
| Connection   | Sub-D socket, 15-pin. X8D  |
| Speed range  | P142: 100 ... 6000 RPM   |
| No. of incr. encoder graduations   | P143: 250 ... 4096   |
| Maximum frequency  | 300 kHz  |
| Polarity reversal  | P144: on, off  |
| Achievable maximum speed   | $n_{nom}[RPM] = \frac{60 \cdot 300}{\text{Pulse number}} \cdot 1000$           |
| Assembly   | By means of a 22-mm spacer bolt on CPU card 3.8934 and 64-pin ribbon cable X15 |

For further details, refer to the additional description.

**2.8.4 RS232, RS485 Interface Card, 3.8947**

|  |  |       |     |
|--|--|-------|-----|
| Task   | RS232, RS485 interface card $\Leftrightarrow$ power converter BKF/BKD  |       |     |
| CPU  | $\mu$ P 68008  |       |     |
| Clock frequency  | 8 MHz  |       |     |
| Memory   | 64 kB ROM<br>32 kB RAM   |       |     |
| Software version<br>interface card   | 01.12  |       |     |
| Transfer rate  | 1200 ... 38400 bps   |       |     |
| Bus system   | RS485  | RS232 | TTY |
| Line length  | 400 m  | 20 m  | 5 m |
| Potential, between bus and card  | 150 V <sub>eff</sub> (max.)  |       |     |
| Voltage supply on bus side<br>at X1:1, 2<br>voltage  | Typically 300 mA<br>24 V <sub>-</sub>  |       |     |
| Voltage supply of interface card   | Via X15 from power converter   |       |     |
| Maximum current loading of connections X3 and X4   | Total of 50 mA   |       |     |
| Connections<br>X1: 24-V supply<br>X2: RS232<br>X3: RS485<br>X4: RS485<br>X5: Test plug<br>X15: Ribbon cable to the power converter | Via terminals<br>Via 15-pin Sub-D socket<br>Via 9-pin Sub-D socket<br>Via 9-pin Sub-D plug<br>For functional testing in the factory only |       |     |
| Assembly   | By means of a 22-mm spacer bolt on CPU card 3.8934 and 64-pin ribbon cable X15   |       |     |

For further details, refer to the additional description.

**2.8.5 RS485 with USS Protocol or as a CS31 System Bus Interface, 3.9493**

With incremental encoder acquisition for speed actual value formation

Bus interface

|  | USS   | CS31  |
|--|---|---|
| Processor                                  | 80C32   |   |
| Isolation                                  | Via optocoupler,<br>50 V to electronic ground   |   |
| Power supply<br>Processor side<br>Bus side | Power converter<br>Power converter via DC/DC converter  |   |
| Interface standard                         | RS485   |   |
| Transfer rate                              | 9600, 19200 bps   |   |
| Line length                                | Maximum of 400 m  |   |
| Operation indicators                       | H101 Yellow: No message frame received for more than 1 s<br><br>H102 Red: Bus interrupted<br><br>H103 Green: Communication with power converter ongoing | H101 Yellow: Monitoring time-out for bus communication has expired<br><br>H102 Red: Disturbance<br><br>H103 Green: Communication with power converter ongoing<br><br>H401 Red: Remote Unit Error<br><br>H402 Green: CS31 system running |
| Connections                                | RS485: X601, X602<br>X601: 9-pin SUB-D plug<br>X602: 9-pin SUB-D socket   |   |

Incremental encoder input for speed measurement

|  |  |
|--|--|
| Incremental encoder with +5-V supply for two 90° phase-shifted differential impulses | – Differential input<br>– Power supply of encoder possible from daughterboard  |
| Signal level   | LOW signal: 0 ... +0.45 V<br>HIGH signal +2.4 V ... +5.25 V                    |
| Connections  | X8: 15-pin SUB-D socket<br>X9: 15-pin SUB-D plug                               |
| Speed range  | P142: 100 ... 6000 RPM   |
| No. of incr. encoder graduations   | P143: 250 ... 4096   |
| Maximum frequency  | 300 kHz  |
| Polarity reversal  | P144: on, off  |
| Achievable maximum speed   | $n_{nom}[\text{RPM}] = \frac{60 \cdot 300}{\text{Pulse number}} \cdot 1000$    |
| Assembly   | By means of a 22-mm spacer bolt on CPU card 3.8934 and 64-pin ribbon cable X15 |

For further details, refer to the additional description.

## 2.9 Power Loss of Power Converter, Line Converter and Fuses

When using the additional components (line converter, semiconductor fuses) listed in chapter 4, the power losses shown below result at the equipment's nominal working point:

| Power Converter<br>BKD or BKF | Nominal<br>Current | Power Losses |                   |          |       |        |        |
|-------------------------------|--------------------|--------------|-------------------|----------|-------|--------|--------|
|                               |                    | Unit *       | Line<br>Converter | Fuses ** |       | Total  |        |
|                               |                    |              |                   | BKD      | BKF   | BKD    | BKF    |
| Size I:                       |                    |              |                   |          |       |        |        |
| BK ../30                      | 30 A               | 120 W        | 40 W              | 15 W     | 35 W  | 175 W  | 195W   |
| BK ../50                      | 50 A               | 195 W        | 55 W              | 30 W     | 50 W  | 280 W  | 300 W  |
| BK ../70                      | 70 A               | 290 W        | 60 W              | 50 W     | 85 W  | 400 W  | 435 W  |
| BK ../100                     | 100 A              | 340 W        | 90 W              | 45 W     | 80 W  | 475 W  | 510 W  |
| BK ../120                     | 120 A              | 380 W        | 100 W             | 50 W     | 85 W  | 530 W  | 565 W  |
| BK ../150                     | 150 A              | 420 W        | 105 W             | 55 W     | 125 W | 580 W  | 650 W  |
| BK ../200                     | 200 A              | 590 W        | 120 W             | 90 W     | 190 W | 800 W  | 900 W  |
| Size II                       |                    |              |                   |          |       |        |        |
| BK ../300                     | 300 A              | 850 W        | 170 W             | 85 W     | 185 W | 1100 W | 1200 W |
| BK ../400                     | 400 A              | 1170 W       | 180 W             | 185 W    | 310 W | 1530 W | 1660 W |
| BK ../500                     | 500 A              | 1250 W       | 200 W             | 145 W    | 280 W | 1590 W | 1730 W |
| BK ../600                     | 600 A              | 1550 W       | 300 W             | 195 W    | 350 W | 2050 W | 2200 W |
| Size III                      |                    |              |                   |          |       |        |        |
| BKD 6/750                     | 750 A              | 2700 W       | 350 W             | 380 W    |       | 3430 W |        |
| BKD 6/920                     | 920 A              | 2900 W       | 370 W             | 410 W    |       | 3680 W |        |
| BKD 6/1100                    | 1100 A             | 3600 W       | 400 W             | 550 W    |       | 4550 W |        |
| BKF 12/850                    | 850 A              | 2550 W       | 360 W             |          | 310 W |        | 3220 W |
| Size IV                       |                    |              |                   |          |       |        |        |
| BKD 6/1550                    | 1550 A             | 4450 W       | ***               | 730 W    |       |        |        |
| BKD 6/1750                    | 1750 A             | 5700 W       | ***               | 750 W    |       |        |        |
| BKD 6/2050                    | 2050 A             | 5750 W       | ***               | 920 W    |       |        |        |
| BKF 12/1250                   | 1250 A             | 3550 W       | ***               |          | 510 W |        |        |
| BKF 12/1400                   | 1400 A             | 4500 W       | ***               |          | 640 W |        |        |
| BKF 12/1250                   | 1650 A             | 4400 W       | ***               |          | 710 W |        |        |

\* The power loss of the power converter includes the losses of the power stage for armature and field supply as well as electronics supply.

\*\* In the case of unit sizes I and II, you must arrange the mains semiconductor protective fuses (phase fuses) outside the power converter in the control cabinet. In addition, with the BKF you must also take into account the armature circuit fuses. Unit sizes III and IV have arm-circuit fuses that are already integrated in the equipment.

The chapter entitled Installation contains, to some extent, a choice of two types of fuses. The stated power loss refers to the type with the higher losses, i.e. if you use the other fuse, the power loss is more favourable.

\*\*\* On request





**Internal Functions:**

Plug-in jumpers: W2: A-B  
 W3: A-B  
 W4: B-C  
 W5: B-C  
 W6: A-B  
 W7: A-B  
 W9: A-B  
 W10: A-B  
 W20: B-C (baud rate 9600 bps)  
 W22: Fitted

Resistors on solder tags: R73:  $R_V$  for power stage identification  
 R110:  $R_V$  for power stage temperature

Soldering jumper W11: Reference point for control inputs X1:22 ... 29  
 –fitted if the unit's +24 V is used for controlling the power converter  
 – not fitted if the external controller carries out direct control.  
 In this case, terminal X1:21 (BSE) is the reference potential.  
 – The jumper is fitted in the factory

Condenser C17: 0.47  $\mu$ F  
 Low pass filter in  $n_{act}$  measurement with speed control via tachometer generator.

Resistor R102: Series resistor for adapting the tachometer voltage of the electronics (controller structure P083 = 0 or 1).

| R102                               | 6.8k              | 10k               | 15k                | 22k                | 27k                 | 33k                 |
|------------------------------------|-------------------|-------------------|--------------------|--------------------|---------------------|---------------------|
| Tachom. voltage $U_T$ at $n_{max}$ | 25 V..<br>.. 50 V | 40 V..<br>.. 80 V | 60 V..<br>.. 110 V | 80 V..<br>.. 150 V | 100 V..<br>.. 200 V | 120 V..<br>.. 230 V |

Potentiometer R103: Fine-tuning the maximum speed

Potentiometer R100: Nominal value adaptation with nominal value source P080 = 1, 3, 16. Only affects the differential gain input (gain: 0.9 ... 2.0)

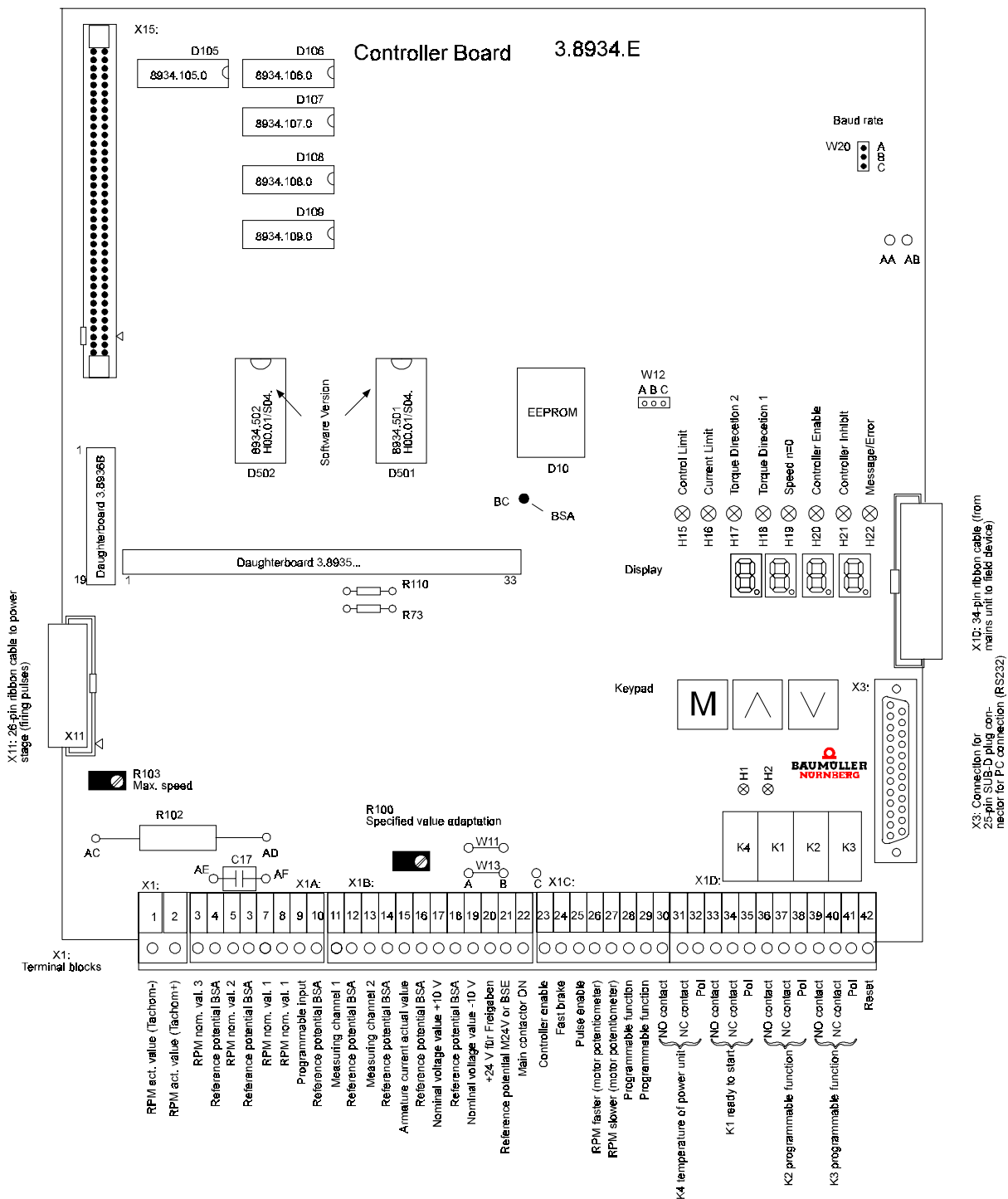
Solder tags AA-AB: Jumpering results in a hardware reset.

**NOTE**

You must only specify a reset for the power converter when the controller is disabled **and** the motor is idle.

Solder tag BC Device-internal reference point BSA, e.g. for measurements.

• PCB Version 3.8934 E



Resistors on solder tags: R73: R<sub>v</sub> for power stage identification  
 R110: R<sub>v</sub> for temperature determination

Solder tags AA-AB: Open, do not connect!

**NOTE**

With PCB 3.8934.C you could trigger a hardware reset via solder tags AA-AB without switching off the unit. This is not allowed with PCB version 3.8934.E. In this case, a hardware reset is activated by applying +24 V at terminal X1:42 (this terminal was not assigned in PCB version 3.8934.C). You must only specify a reset for the power converter when the controller is disabled **and** the motor is idle.

Soldering jumper W11: Reference point for control inputs X1:22 ... 29  
 – fitted if the unit's +24 V is used for controlling the power converter  
 – not fitted if the external controller carries out direct control.  
 In this case, terminal X1:21 (BSE) is the reference potential  
 – The jumper is fitted in the factory

Soldering jumper W13: Specification of the reference point for control input X1:25 (pulse enable)

- Tag A-B selects the reference point that is to be specified with W11 for the other control inputs (fitted in the factory)
- Tag B-C connects the reference point permanently to the device-internal reference ground (M24V). If there is a break in the signal/a voltage failure, this prevents the deletion of the firing pulses in the higher-level controller

Resistor R102: Series resistor for adapting the tachometer voltage of the electronics (controller structure P083 = 0 or 1).

| R102   | 6.8k              | 10k               | 15k                | 22k                | 27k                 | 33k                 |
|--|-------------------|-------------------|--------------------|--------------------|---------------------|---------------------|
| Tachom. voltage U <sub>T</sub> at n <sub>max</sub> | 25 V..<br>.. 50 V | 40 V..<br>.. 80 V | 60 V..<br>.. 110 V | 80 V..<br>.. 150 V | 100 V..<br>.. 200 V | 120 V..<br>.. 230 V |

Condenser C17: 0.47 µF  
 Low pass filter in n<sub>act</sub> measurement with speed control via tachometer generator.

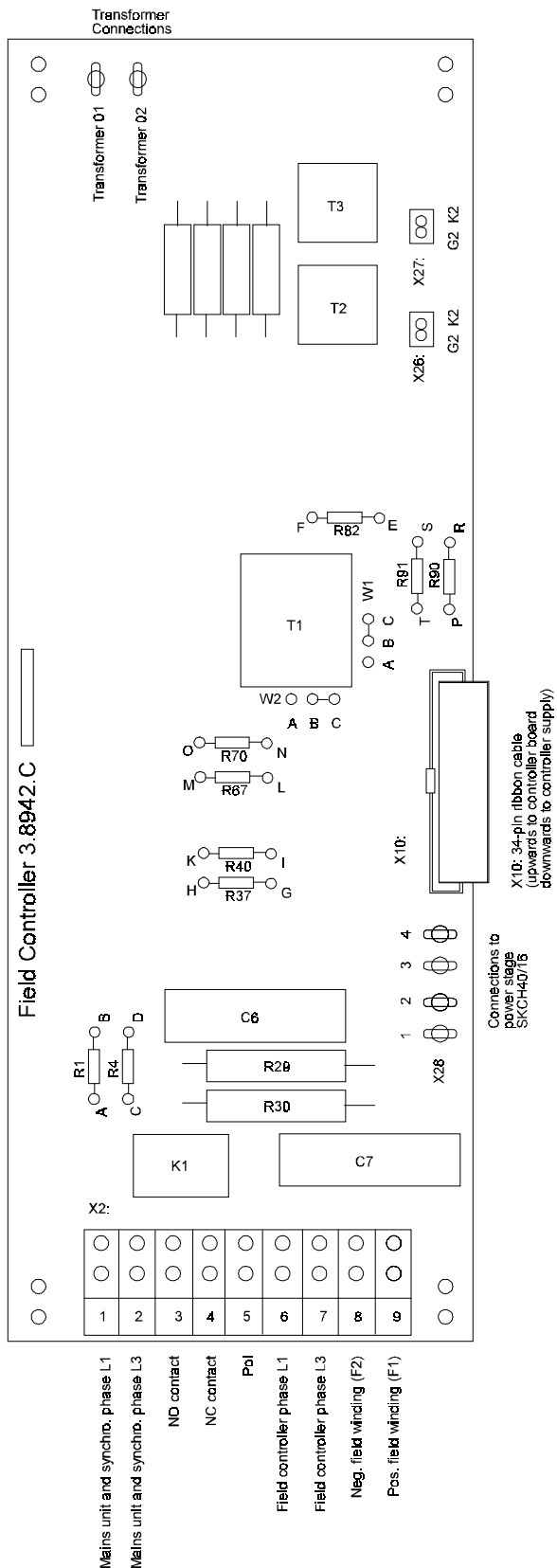
Potentiometer R103: Fine-tuning the maximum speed

Potentiometer R100: Nominal value adaptation with nominal value source P080 = 1, 3, 16. Only affects the differential gain input (gain: 0.9 ... 2.0)

Solder tag BC Device-internal reference point BSA, e.g. for measurements.

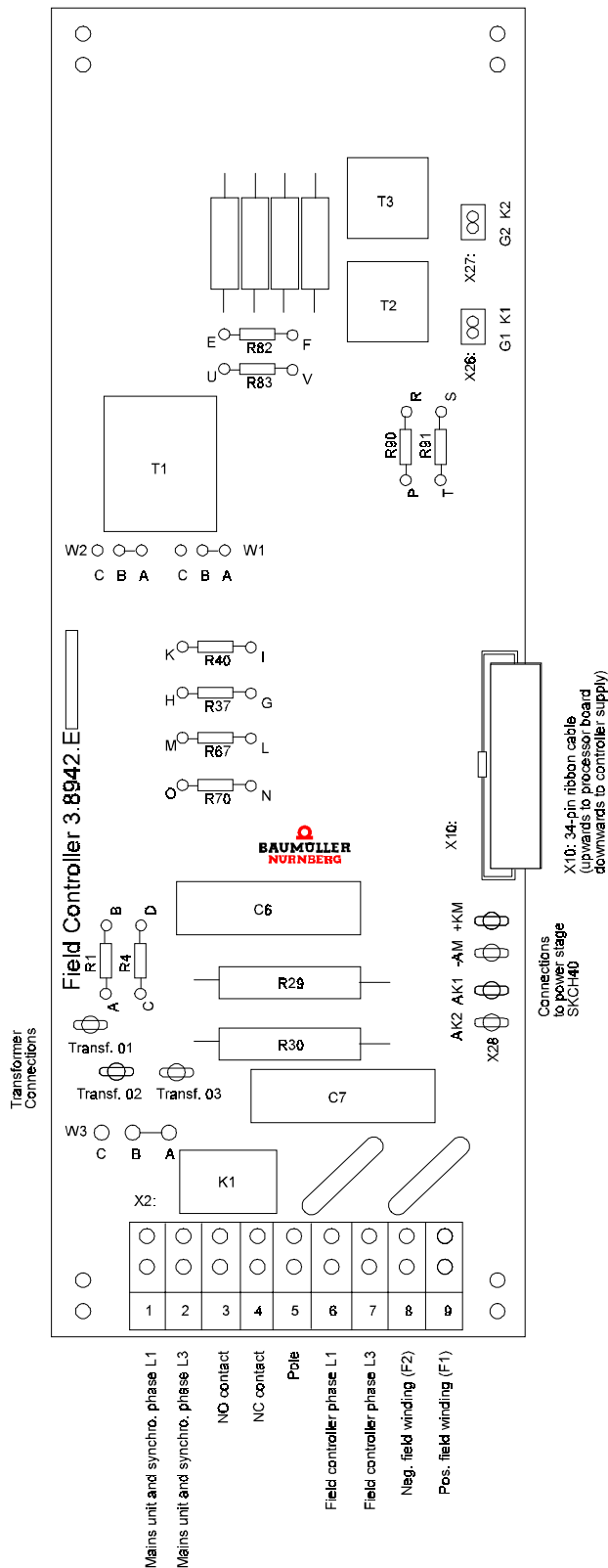
2.10.2 Field Supply 3.8942

- PCB Version up to 3.8942 C inclusive



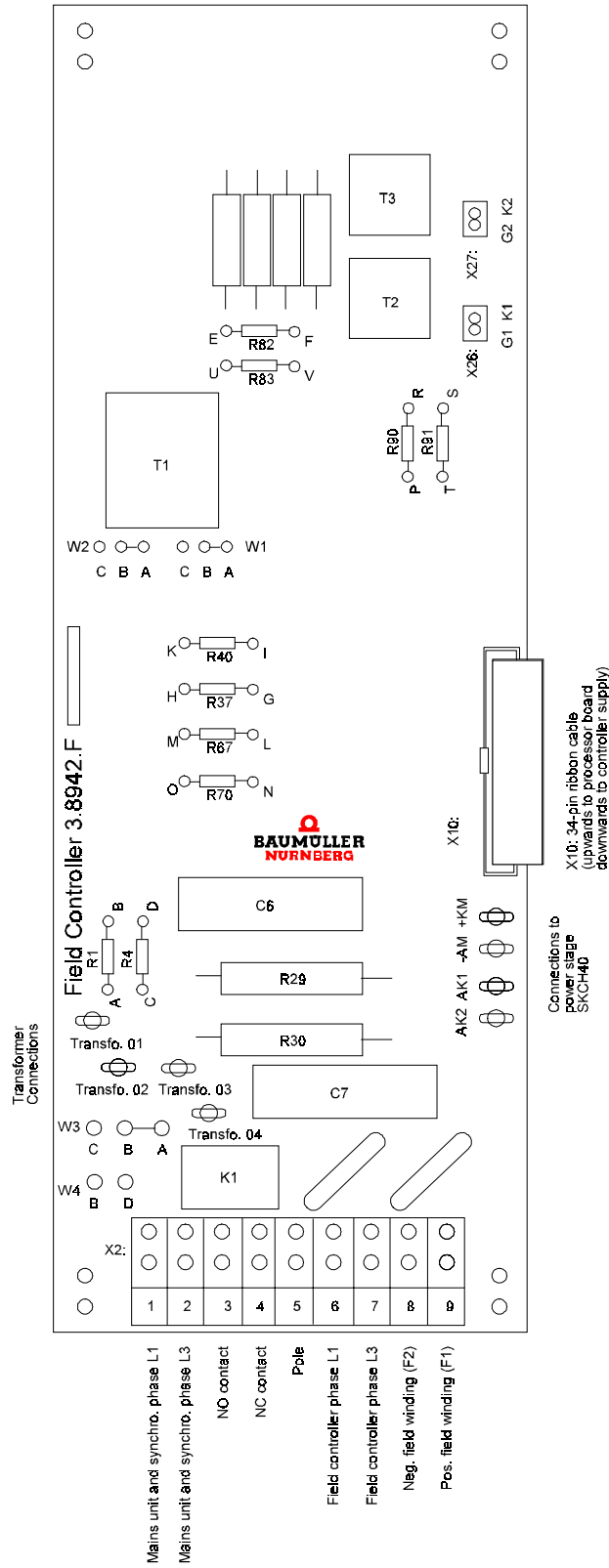
|                     |  |
|---------------------|--|
| Transformer conns.: | Transformer 01, transformer 02<br>400 V connection voltage: Transformer Order No. 19007175<br>500 V connection voltage: Transformer Order No. 19007178 |
| R1, R2:             | Input resistors for acquiring the connection voltage for the mains unit  |
| R37, R40:           | Input resistors for acquiring the field voltage (AC side)  |
| R67, R70:           | Input resistors for acquiring the field voltage (DC side)  |
| R82:                | Load impedance for matching the field unit rated current   |
| W1, W2:             | Specification of the field current range<br>[0.5 .. 4 A, 5 ... 10 A]   |

• PCB Version 3.8942 E



|                     |   |
|---------------------|---|
| W3:                 | Mains voltage adaptation  |
| A-B:                | 500 V mains   |
| C-B:                | 400 V mains   |
| Transformer conns.: | Transformer 01: 0 V      black  |
|                     | Transformer 02: 400 V      blue   |
|                     | Transformer 03: 500 V      brown  |
|                     | Transformer Order No. 19007178  |
| R1, R2:             | Input resistors for acquiring the connection voltage for the mains unit |
| R37, R40:           | Input resistors for acquiring the field voltage (AC side)               |
| R67, R70:           | Input resistors for acquiring the field voltage (DC side)               |
| R82, R83:           | Load impedance for matching the field unit rated current                |
| W1, W2:             | Specification of the field current range<br>[0.5 .. 4 A, 5 ... 10 A]    |

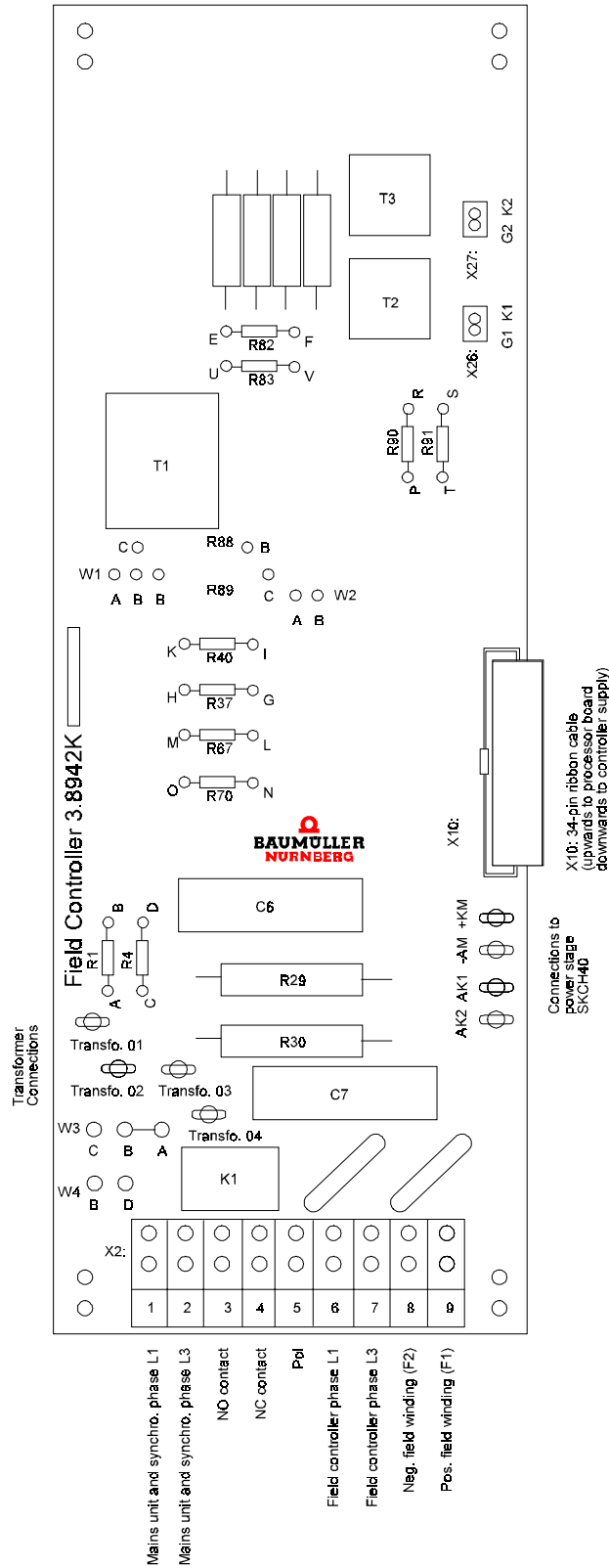
• PCB Version 3.8942 F





|                     |   |       |             |
|---------------------|---|-------|-------------|
| W3, W4:             | Mains voltage adaptation  |       |             |
|                     | W3:   | B-C:  | 400 V mains |
|                     | W3:   | A-B:  | 500 V mains |
|                     | W4:   | B-D:  | 460 V mains |
| Transformer conns.: | Transformer 01:   | 0 V   | black       |
|                     | Transformer 02:   | 400 V | blue        |
|                     | Transformer 03:   | 500 V | brown       |
|                     | Transformer 04:   | 460 V | green       |
|                     | Transformer Order No. 19007183  |       |             |
| R1, R2:             | Input resistors for acquiring the connection voltage for the mains unit |       |             |
| R37, R40:           | Input resistors for acquiring the field voltage (AC side)               |       |             |
| R67, R70:           | Input resistors for acquiring the field voltage (DC side)               |       |             |
| R82, R83:           | Load impedance for matching the field unit rated current                |       |             |
| W1, W2:             | Specification of the field current range<br>[0.5 .. 4 A, 5 ... 10 A]    |       |             |

• PCB Version 3.8942 K



|                     |   |             |       |
|---------------------|---|-------------|-------|
| W3, W4:             | Mains voltage adaptation  |             |       |
| W3:                 | B-C:  | 400 V mains |       |
| W3:                 | A-B:  | 500 V mains |       |
| W4:                 | B-D:  | 460 V mains |       |
| Transformer conns.: | Transformer 01:   | 0 V         | black |
|                     | Transformer 02:   | 400 V       | blue  |
|                     | Transformer 03:   | 500 V       | brown |
|                     | Transformer 04:   | 460 V       | green |
|                     | Transformer Order No. 19007183  |             |       |
| R1, R2:             | Input resistors for acquiring the connection voltage for the mains unit                         |             |       |
| R37, R40:           | Input resistors for acquiring the field voltage (AC side)                                       |             |       |
| R67, R70:           | Input resistors for acquiring the field voltage (DC side)                                       |             |       |
| R82, R83:           | Load impedance for matching the field unit rated current  |             |       |
| W1, W2, R88, R89:   | Components for specification of the field current range<br>[0.5 .. 4 A, 5 ... 10 A, 15 A, 25 A] |             |       |

2.11 Adapting Power Converters to Different Connection Voltages

|  | Power Demand                                      | 220 V<br>±10%   | 230 V<br>+6%<br>-15%  | 230 V<br>±10%         | 220 V<br>±10%   | 230 V<br>+6%<br>-15%  | 230 V<br>±10%         |
|--|---|---|-----------------------|-----------------------|---|-----------------------|-----------------------|
| Nominal direct voltage *<br>BKD 6 /... 6000  |   | 260 V   | 260 V                 | 275 V                 | 460 V   | 460 V                 | 460 V                 |
| Nominal direct voltage *<br>BKF 12 /... 6000   |   | 230 V   | 230 V                 | 240 V                 | 400 V   | 400 V                 | 400 V                 |
| Field weakening control unit **<br>3.8942  |   | 400-V version<br>Bridge W3: B-C   |                       |                       |   |                       |                       |
| Power stage ***  |   | 400-V version   |                       |                       |   |                       |                       |
| Mains unit ***   | ≈ 50 VA   | No adaptation necessary   |                       |                       |   |                       |                       |
| Fan:<br>Size I: 30 A<br>50 A ... 200 A   | Unventilated<br>24 V/4.5 W<br>supplied internally | No adaptation necessary   |                       |                       |   |                       |                       |
| Size II: 300 A ... 600 A   | 400 V/3 -/50<br>Hz/0.23 A/120 W                   | By means of an autotransformer  |                       |                       |   |                       |                       |
| Size III: BKD: 750 A ... 1100 A<br>BKF: 850 A  | 230 V/1 -/50<br>Hz/0.94 A                         | No adaptation necessary   |                       |                       |   |                       |                       |
| Size IV: BKD: 1550 A ... 2050 A<br>BKF: 1250 A ... 1650 A                                    | 400 V/3 -/50<br>Hz/1.2 A                          | By means of an autotransformer  |                       |                       |   |                       |                       |
| Parameters:<br>P105: Rated mains voltage<br>P110: Rated armature/mains volt. *<br>BKD<br>BKF |   | 220 V<br>1.21<br>1.05   | 220 V<br>1.21<br>1.05 | 230 V<br>1.21<br>1.05 | 400 V<br>1.21<br>1.05   | 400 V<br>1.21<br>1.05 | 400 V<br>1.21<br>1.05 |
| Miscellaneous  |   | Possible only with special<br>version of unit with switch-<br>ing power supply <b>and</b> ex-<br>ternal 24-V supply |                       |                       | Possible only with a trans-<br>former for the power and<br>mains units (220 V to 400 V<br>and 230 V to 400 V respec-<br>tively) |                       |                       |

\* Maximum permissible values relative to the lower tolerance level

\*\* The field supply may be connected to another mains supply with a different voltage if it can be guaranteed that the phase relation to the other mains connections is correct on the power converter (refer to the connection suggestion). Observe the field voltage of the motor!

\*\*\* The power stage and the mains unit must be connected to the same mains supply taking into account the phase relation.

|   |                                     |                       |                       |                       |                                     |                       |                       |                       |
|---|-------------------------------------|-----------------------|-----------------------|-----------------------|-------------------------------------|-----------------------|-----------------------|-----------------------|
|   | 380 V<br>±10%                       | 400 V<br>+6%<br>-15%  | 400 V<br>±10%         | 415 V<br>+6%<br>-15%  | 415 V<br>±10%                       | 440 V<br>±10%         | 460 V<br>±10%         | 500 V<br>±10%         |
| Nominal direct voltage *<br>BKD 6 /... 6000   | 460 V                               | 460 V                 | 485 V                 | 485 V                 | 500 V                               | 530 V                 | 550 V                 | 600 V                 |
| Nominal direct voltage *<br>BKF 12 /... 6000  | 400 V                               | 400 V                 | 420 V                 | 420 V                 | 435 V                               | 460 V                 | 480 V                 | 520 V                 |
| Field weakening control unit **<br>3.8942   | 400-V version<br><br>Bridge W3: B-C |                       |                       |                       | 500-V version<br><br>Bridge W4: B-D |                       |                       | Bridge<br>W3:<br>A-B  |
| Power stage ***   | 400-V version                       |                       |                       |                       | 500-V version                       |                       |                       |                       |
| Mains unit ***  | No adaptation necessary             |                       |                       |                       |                                     |                       |                       |                       |
| Fan: Size I: 30 A<br>50 A ... 200 A   | No adaptation necessary             |                       |                       |                       |                                     |                       |                       |                       |
| Size II: 300 A ... 600 A  | No adaptation                       |                       |                       |                       | By means of an autotransformer      |                       |                       |                       |
| Size III: BKD: 750 A ... 1100 A<br>BKF: 850 A   | By means of an autotransformer      |                       |                       |                       |                                     |                       |                       |                       |
| Size IV: BKD: 1550 A ... 2050 A<br>BKF: 1250 A ... 1650 A                                 | No adaptation                       |                       |                       |                       | By means of an autotransformer      |                       |                       |                       |
| Parameters:<br>P105: Rated mains voltage<br>P110: Rated armature/mains volt. * BKD<br>BKF | 380 V<br>1.21<br>1.05               | 380 V<br>1.21<br>1.05 | 400 V<br>1.21<br>1.05 | 400 V<br>1.21<br>1.05 | 415 V<br>1.21<br>1.05               | 440 V<br>1.21<br>1.05 | 460 V<br>1.21<br>1.05 | 500 V<br>1.21<br>1.05 |
| Miscellaneous   |                                     |                       |                       |                       | ****                                |                       |                       |                       |

\* Maximum permissible values relative to the lower tolerance level

\*\* The field supply may be connected to another mains supply with a different voltage if it can be guaranteed that the phase relation to the other mains connections is correct on the power converter (refer to the connection suggestion). Observe the field voltage of the motor!

\*\*\* The power stage and the mains unit must be connected to the same mains supply taking into account the phase relation.

\*\*\*\* Possible only with the special version of the unit with switching power supply and external 24-V supply



### 3 TRANSPORTATION AND UNPACKING

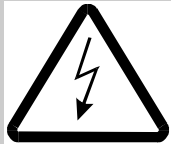
The equipment is packed at the factory in accordance with the order.

You should avoid jolting or dropping the package during transportation.

You can start assembly after unpacking the equipment and checking that it is complete and undamaged.

The equipment is packed in cardboard, corrugated sheeting and or wooden packaging material that you should dispose of in accordance with local regulations.

Report any damage in transit immediately.



#### DANGER

If the equipment was damaged in transit, a qualified person must check, repair and test it before it may be connected.

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





## 4 ASSEMBLY



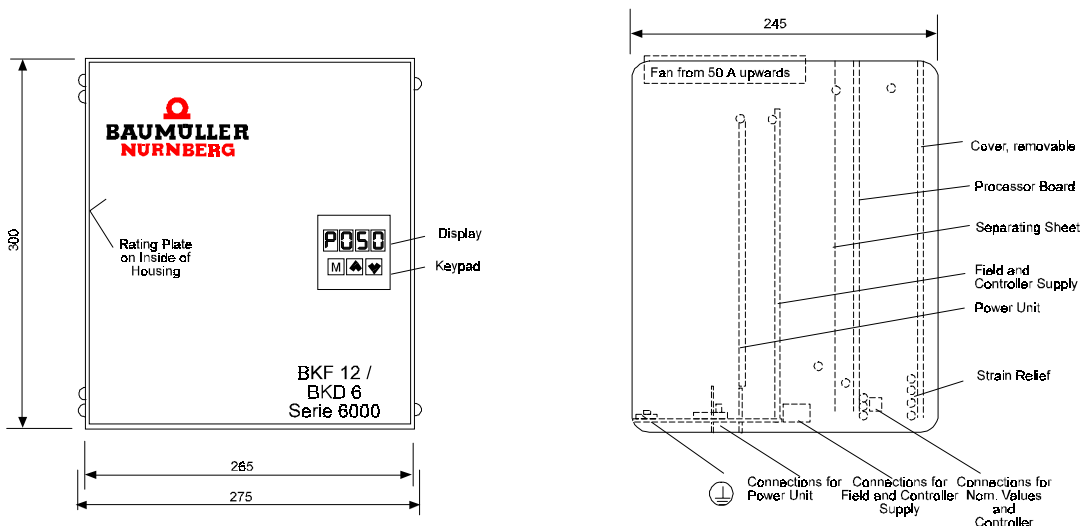
### WARNING

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

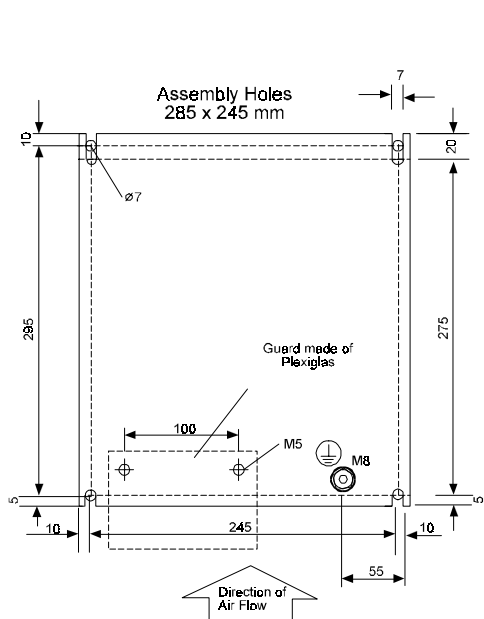
During operation, the equipment is protected from direct contact such that it is suitable for use in enclosed electrical premises (DIN VDE 0558 Part 1/07.87, Section 5.4.3.2, preliminary standard EN 50178/VDE 0160/11.94, Section 5.2.6, 5.2.7).

4.1 Dimensions

4.1.1 BKD 6 and BKF12 .../6000, Size I (30 A to 200 A)

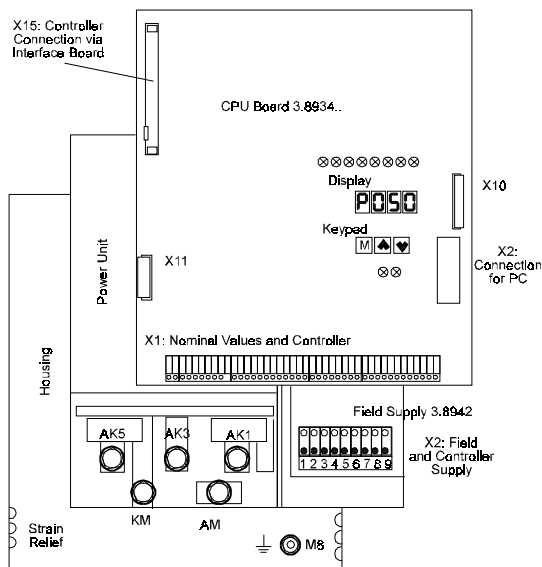


Dimensions



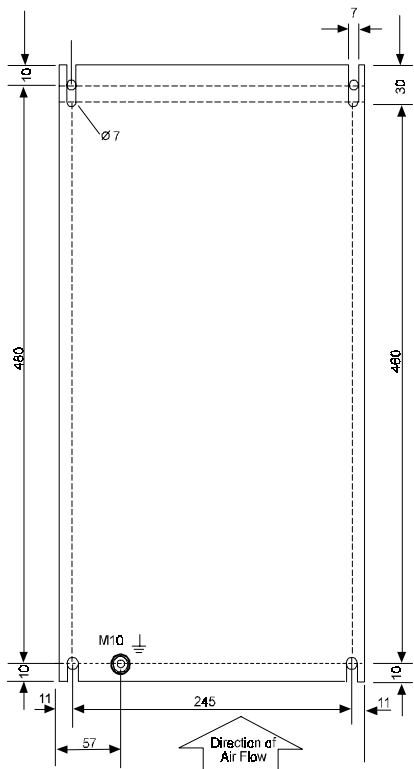
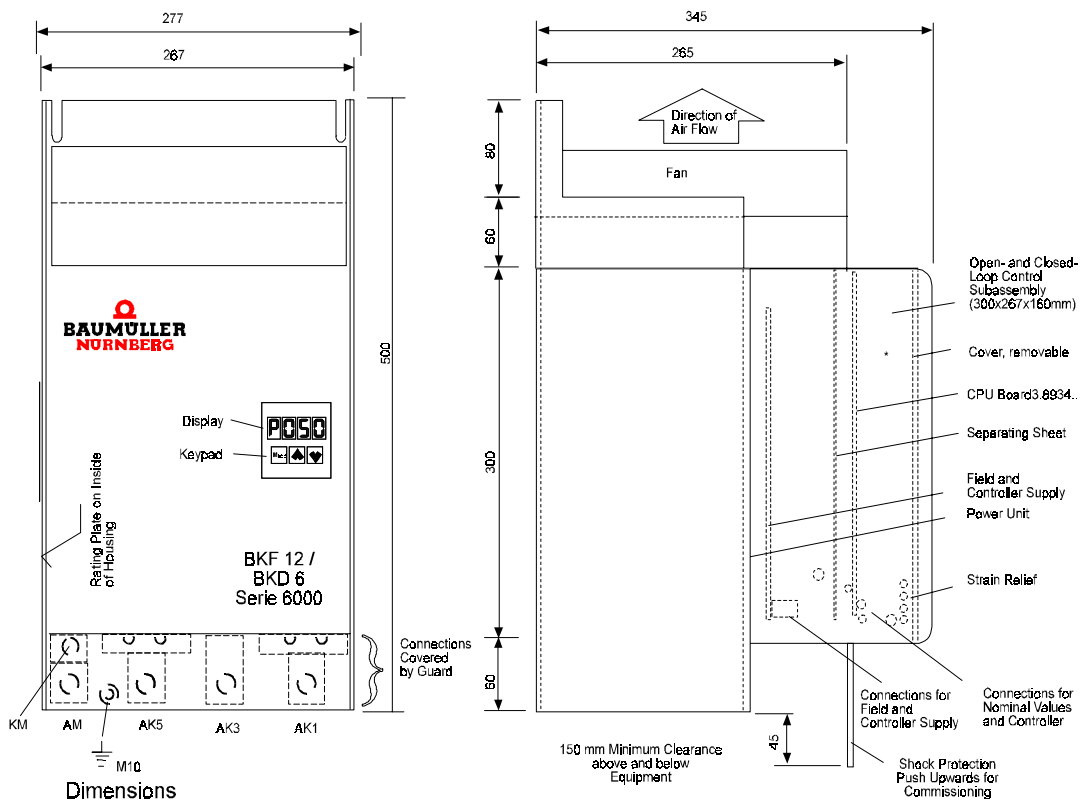
Fastening Holes

⊕ Terminal Stud M8x20,  
Power Terminals AK1, AK3, AK5, AM, KM : M8

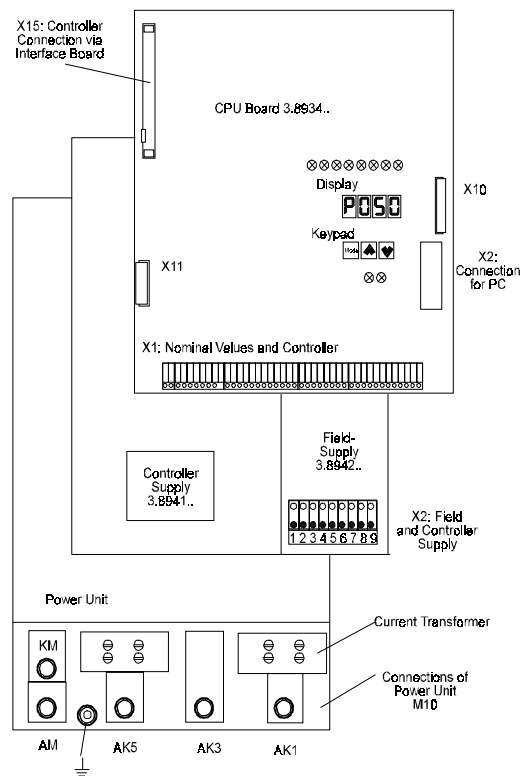


Arrangement of the Modules

4.1.2 BKD 6 and BKF12 .../6000, Size II (300 A to 600 A)



Fastening Holes



Arrangement of the Modules

⊕ Terminal Stud M10x25,  
Power Terminals AK1, AK3, AK5, AM, KM : M10

### **4.1.3 BKD 6 and BKF 12 .../6000 Sizes III and IV**

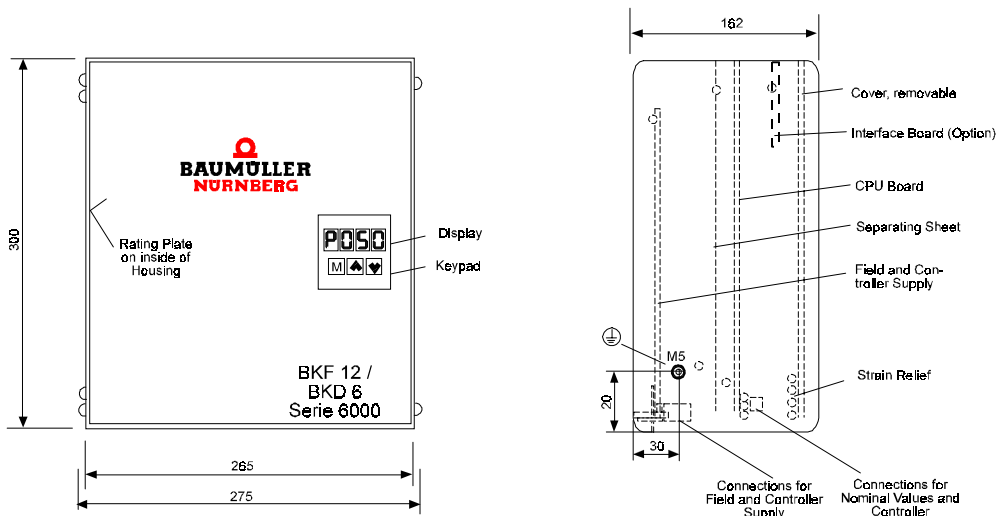
Size III and IV power converters comprise two modules:

1. Module for closed-loop control (containing amongst other things the controller, the mains unit and the field unit)
2. Power stage module (BKD 6: fully controlled three-phase current bridge circuit B6C; BKF12: two antiparallel switched circular current-free three-phase current bridge circuits (B6C)2I).

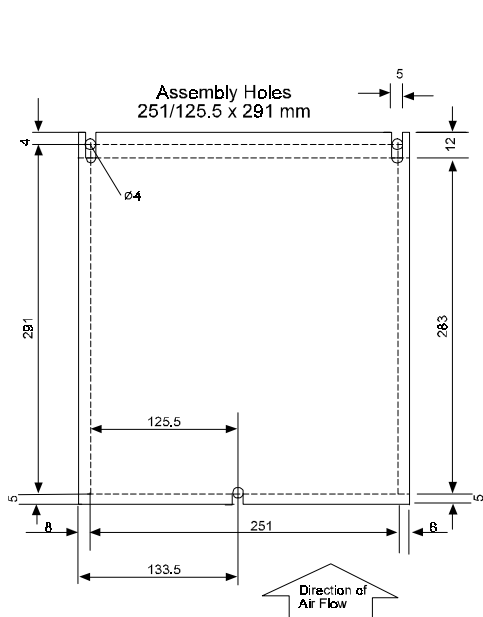
The two modules are mounted next to one another; by preference, you should set-up the controller on the left. The modules are electrically connected by an X11 bus cable that is approximately one metre long.

Apart from the depth of the housing, this controller module is electrically and mechanically identical with size I and II controller modules.

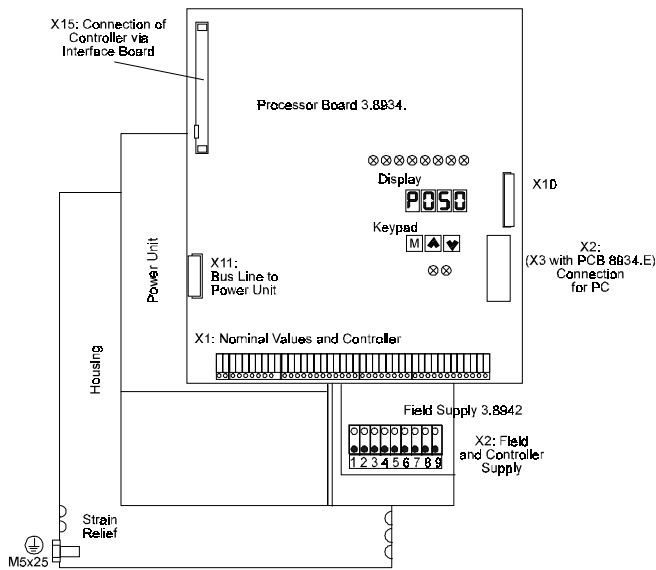
• Controller and Field Supply for Sizes III and IV (750 A ... 2050A)



Dimensions



Fastening

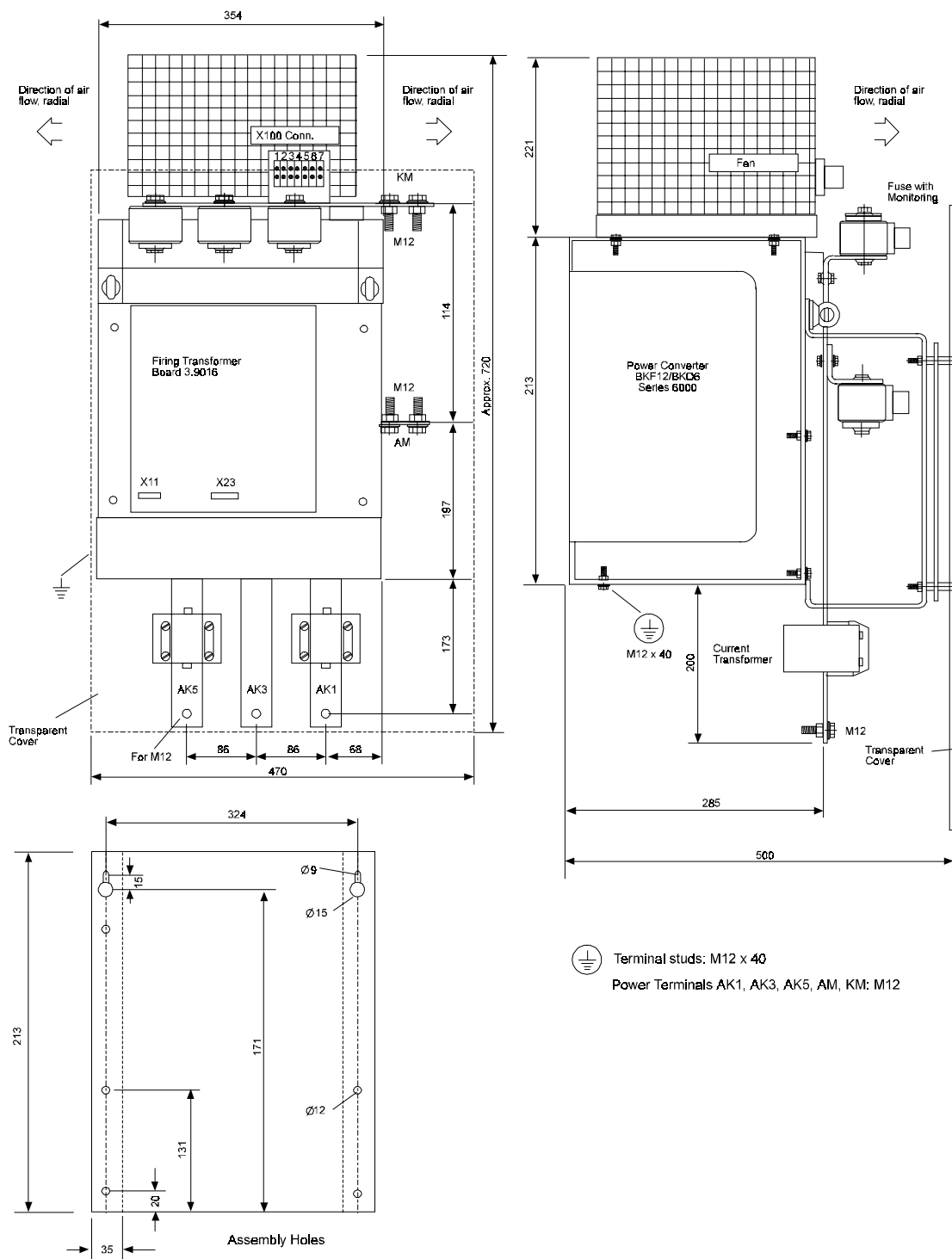


Arrangement of the Modules

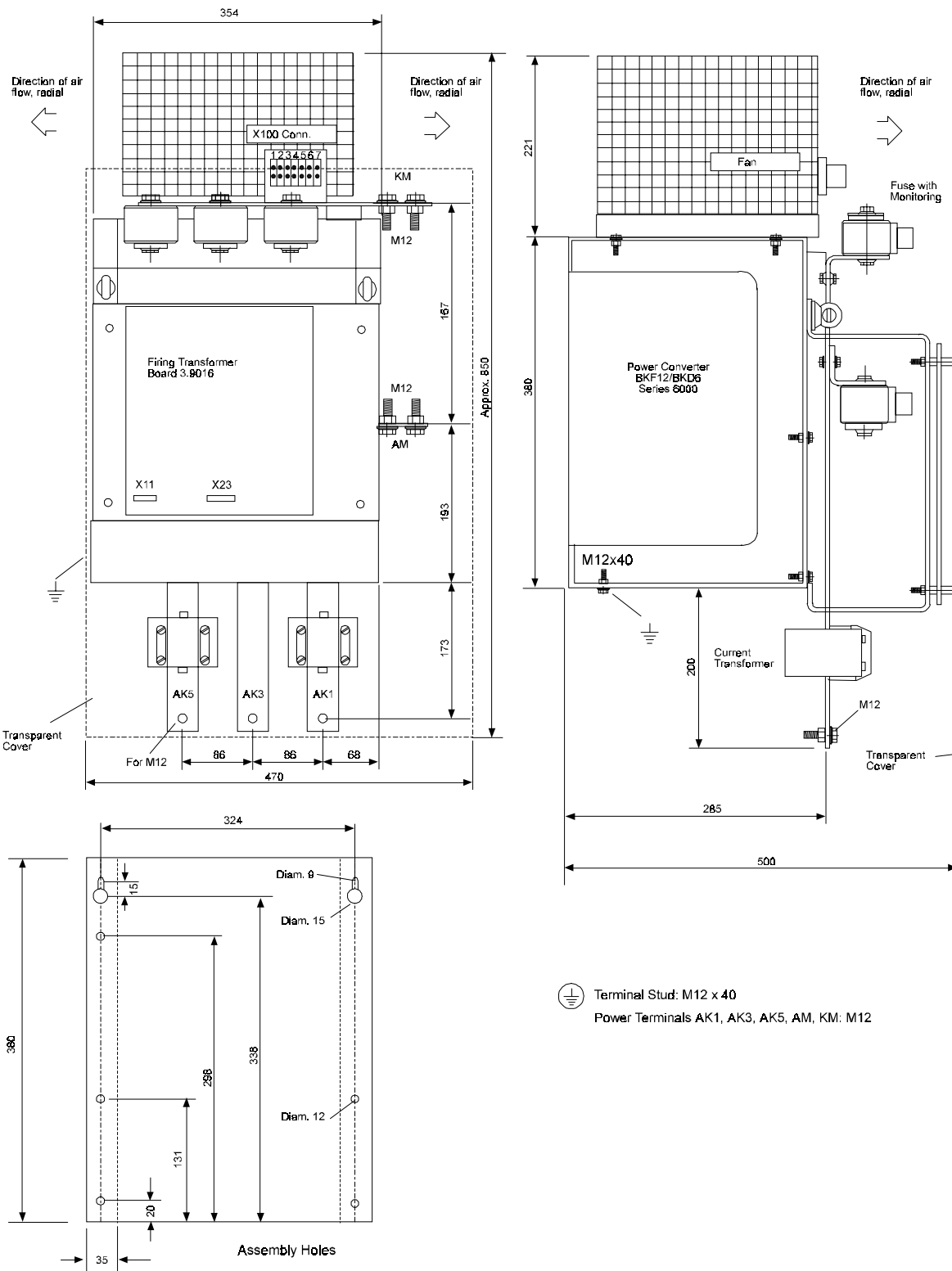
Terminal Stud M5x25

• Power stages for Unit Sizes III and IV

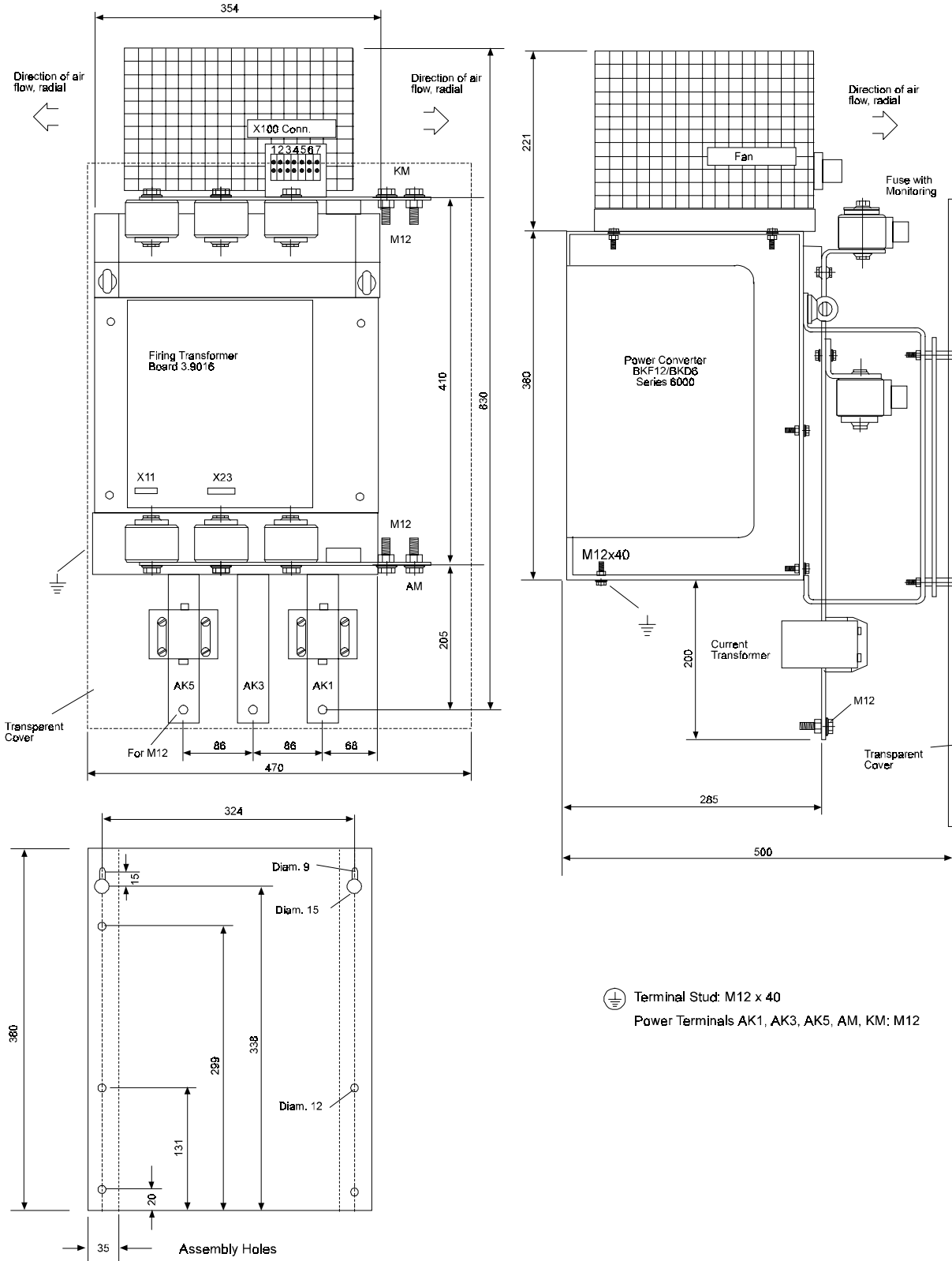
Power stage BKD 6../6000 Size III (750A, 920A)



Power stage BKD 6../6000 Size III (1100 A)



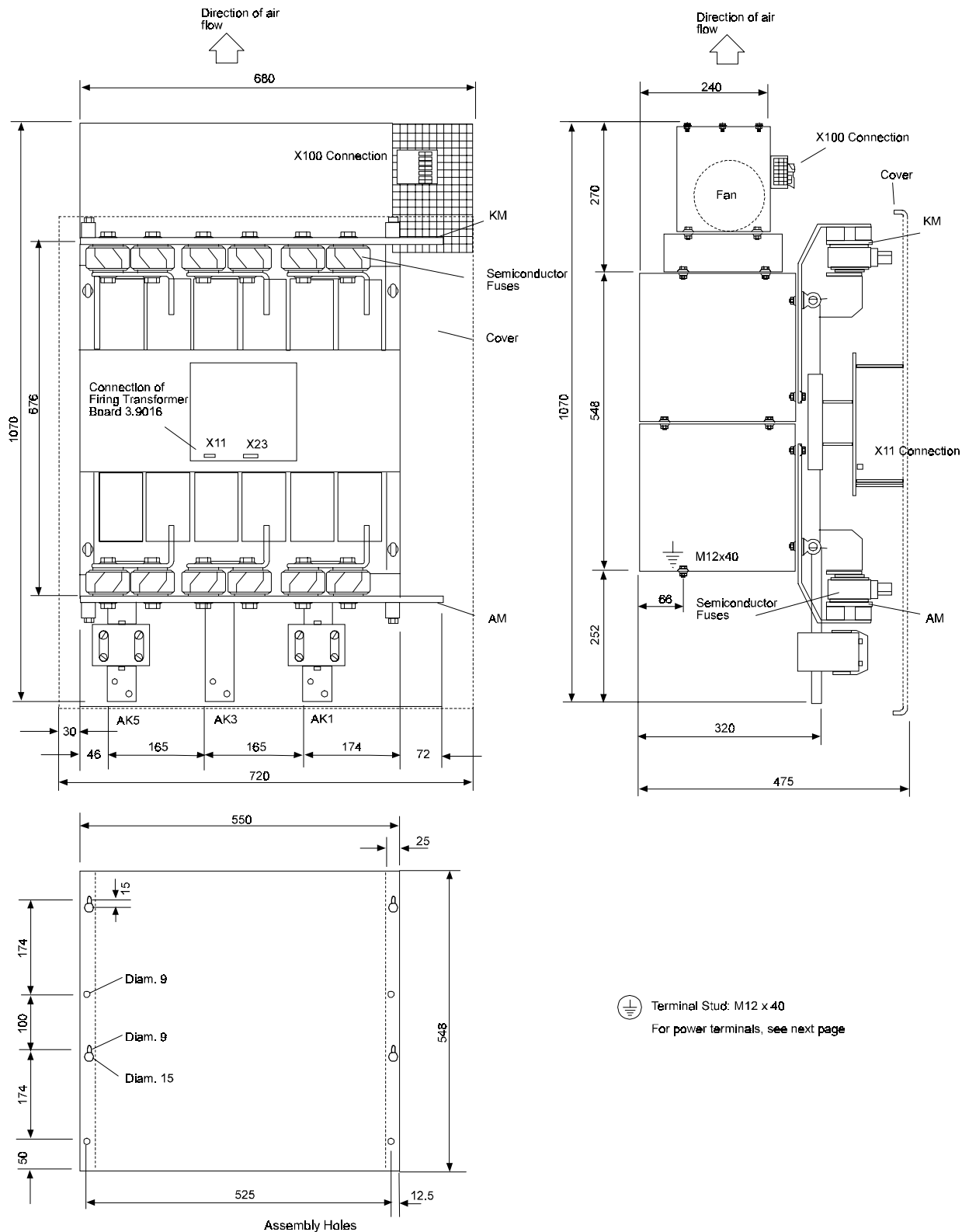
Power stage BKF 12../6000 Size III (850A)





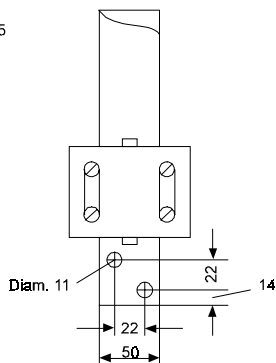
Power stage to Size IV

BKD 6 .../6000: 1550 A, 1750 A, 2050 A  
 BKF 12 .../6000: 1250 A, 1400 A, 1650 A

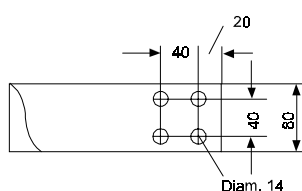


Power connections:

Busbars AK1, AK3 and AK5

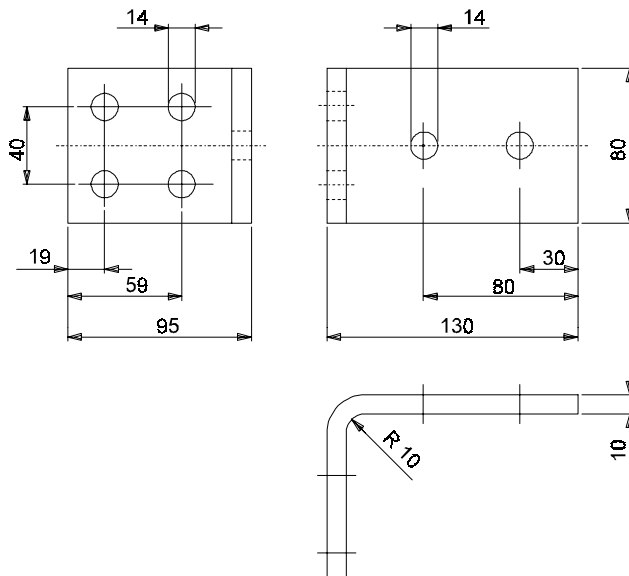


Busbars KM and AM



The brackets below are available as an option for connection to DC bars KM and AM:

Order No. 1231965



The use of these brackets depends on the type of electrical connection to the DC bars:

If you use crimping cable lugs, the distance between the mounting holes on bars AM and KM may in some circumstances be too small for you to carry out assembly correctly.

**4.2 Weights**

- Compact units of sizes I and II:

|          |                                |       |
|----------|--------------------------------|-------|
| Size I:  | 30 A nominal current:          | 15 kg |
|          | 50 A ... 200 A nominal current | 16 kg |
| Size II: |                                | 30 kg |
  
- Power stages of sizes III and IV:

|           |     |                   |
|-----------|-----|-------------------|
| Size III: | BKD | 43 kg ... 54 kg   |
|           | BKF | 55 kg             |
| Size IV:  | BKD | 124 kg ... 128 kg |
|           | BKF | 124 kg ... 130 kg |
  
- Open-loop control sections of sizes III and IV: 8 kg

### 4.3 Assembly Information



#### WARNING

Personal injury or damage to property can be caused by lifting the equipment incorrectly. The unit may only be lifted by qualified personnel using appropriate equipment.

- You must install the units in a closed control cabinet.



#### WARNING

It is vital to carry out the ventilation measures listed below. Ignoring these measures may lead to the equipment overheating.

- Power converters are designed to be mounted vertically.  
If you want to mount the unit in another position ask for more information at the factory
- The equipment must be ventilated from the bottom to the top.
- Ensure that the flow of air is not obstructed.
- The clearance above and below the equipment must be at least
  - 150 mm with size I units
  - 200 mm with size II units
  - 250 mm (beside the fan too) with size III units
  - 300 mm with size IV units

Ignoring these measures may lead to the equipment overheating.

- Temperature of coolant 50 mm below the equipment:
  - Power stage
 

|   |            |
|---|------------|
| 30-A power converter (self-ventilated): | up to 45°C |
| All other units (force-ventilated):     | up to 35°C |

At relatively high temperatures (up to a maximum of 55°C) the unit's nominal current must be reduced by 1% per degree Centigrade.

- Field current converter
  - referred to the rated-load field currents
  - 10 A, 15 A and 25 A up to 45°C

At relatively high temperatures (up to a maximum of 55°C), the unit's nominal current must be reduced by 1% per degree Centigrade.

- Do not mount any additional sources of heat above or below the equipment.
- Avoid soiling grades 3 and 4 according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.15.2.
- Make the PE connection to the central grounding point as short as possible.
- Size III and IV power converters comprise two modules. By preference, you should place the smaller module – the controller with the mains unit and field supply – on the left hand side at a distance of about 100 mm from the power stage.



## 5 INSTALLATION

### 5.1 Danger and Warning Information



#### WARNING

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

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

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

The power converter's terminal connections are energized!

Even when the main contactor has tripped, parts of the power converter (the mains unit, the field power converter) still carry a dangerous voltage.

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

In the case of a short-circuit to frame or to ground, a direct proportion may arise in the leakage current that makes triggering of a higher-level current-operated e.l.c.b. either more difficult or totally impossible.

You must make the protective earth connection in accordance with DIN EN 60204 Part 1/VDE 0113 Part 1/06.93/Section 8.2.2 taking into account provisional standard EN 50178/VDE 0160/11.94, Sections 5.3.2.1 and 8.3.4.4.

You may only use variable speed drives in applications corresponding to applicable VDE regulations.

Speed monitoring systems in the equipment must not just be complemented by a stand-alone monitoring system on the motor. You can implement this control of the RPM speed, which is independent of the controller, by means of inductive, optical or torque-dependent encoders. Refer to the appropriate motor's operating and maintenance instructions.

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

Safety devices must never be deactivated.

According to applicable regulations (DIN EN 60204 Part 1/VDE 0113 Part 1/06.93/Section 8.2.2), stopping the drive by means of the four enabling inputs at terminals X1:22 ... 25, does not, on its own, represent a safe stop condition. A disturbance in the control electronics can lead to accidental starting of the motor.

## 5.2 Standardization Information

Series BKD 6/...- and BKF 12/...6000 are built-in units in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.6 and DIN VDE 0558 Part 1/07.87, Section 5.4.3.2.1. They are intended for installation in commercially available control cabinets whose degrees of protection meet the minimum requirements of provisional standard EN 50178/VDE 0160/11.94, Section 5.2.4 (IP 2x, possibly IP4x according to EN 60529/5.1).

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

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

Power converters are intended for permanent mains connection to conventional TN and TT systems according to DIN VDE 0100 Part 410/11.83 with a diametric voltage of up to  $3 \times 500 V_{\text{eff}}$ .

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

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

The storage and transportation temperature of the equipment varies from this information in as much as it may be between  $-30 \dots +70^{\circ}\text{C}$  (refer to Chapter 2.3 of the Power Converter's Technical Data).

The units are in protection class IP 00 according to EN 60529 (DIN VDE 0470-1)

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

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

The power converters' control terminals are designed for connection of FELV circuits that must be protected from direct and indirect contact. The rated insulation voltage is  $300 V_{\text{eff}}$ , i.e. you can use normal plastic-insulated control lines.

You may not connect SELV and PELV circuits without taking special measures.

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

- Soiling grade 2 according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.15.2, Table 2, Line 3:  
Normally, only non-conducting pollutants are produced. When the equipment is out of service, brief conductivity can occur due to condensation.
- Overvoltage category III according to IEC 664-1, Table 1 for the air clearances of mains circuits to their environment according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.16.1.
- The rated insulation voltage of the mains circuits for TN and TT systems according to DIN VDE 0100 Part 410/11.83 with a diametric voltage of  $3 \times 500 \text{ V}$ .
- Insulation material IIIa for creepage distances according to provisional standard EN 50178/VDE 0160/11.94, Section 5.2.17.

Series 6000 line-commutated power converters are short-circuit-proof in the sense of provisional standard EN 50178/VDE 0160/11.94, Section 6.3.4, assuming that you use the protective semiconductor fuses specified in Section 5.4 of this technical description to protect the thyristors.



### 5.3 Connection Plans

The open- and closed-loop control module is the same with all the power converters, regardless of the size of the unit, or whether it is used as a single-quadrant power converter or as a four-quadrant one.

The only differences are in the type and version of the power stage fitted.

For this reason, the terminal diagrams shown below are subdivided as follows

- terminal diagram for the controller module
- terminal diagrams for the individual power stages
- terminal diagrams for various daughterboards

#### NOTE

You must wire the equipment according to the connection suggestion or the terminal connection diagram.

The nominal value and actual value cables must be screened and run separate from the power lines (the motor armature, the field and the mains connection). You must also run the control lines separate from the power lines in their own cable ducts.

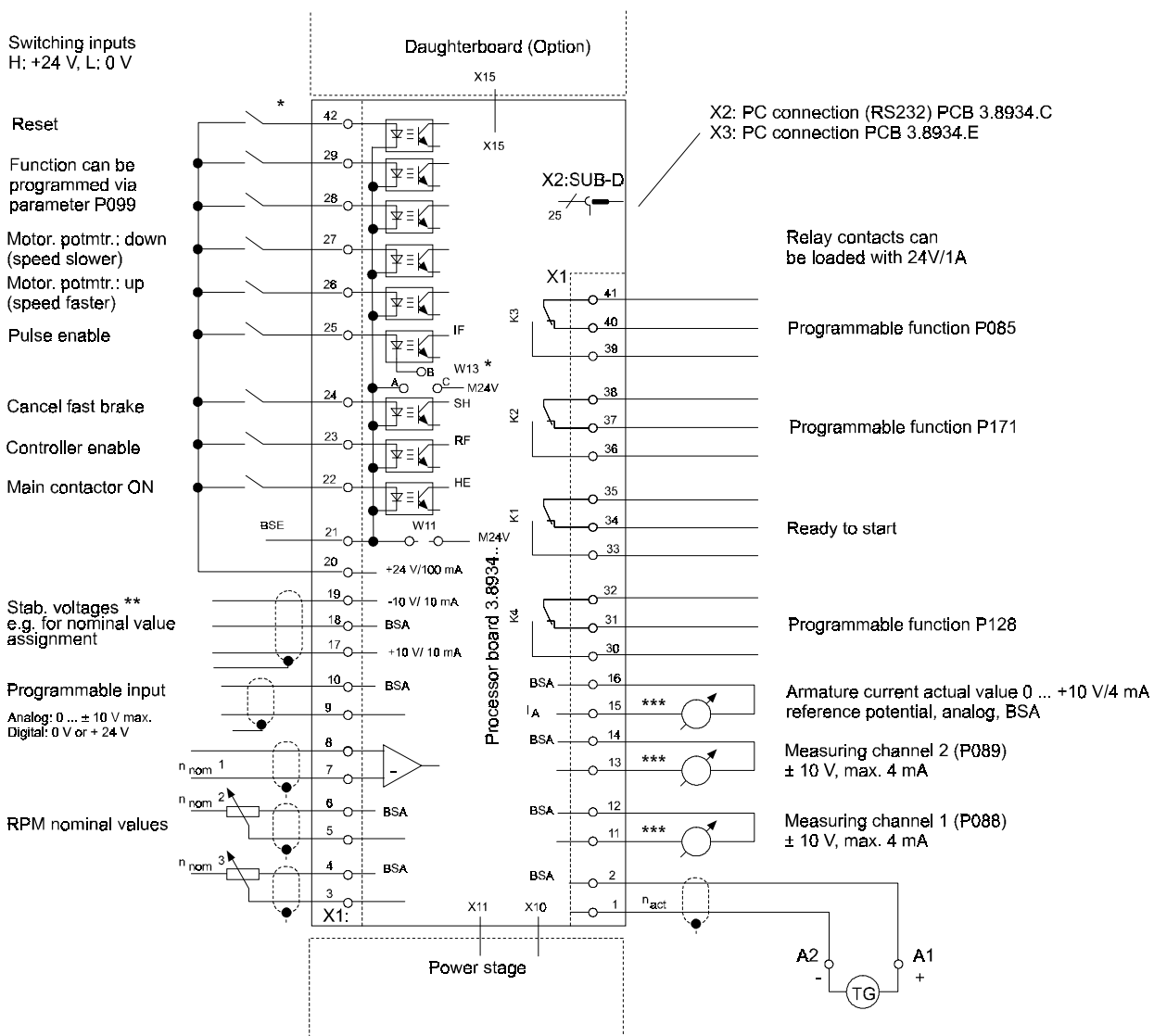
Ensure that the contactors in the vicinity of the unit are protected by appropriate fuses. A faulty equipment connection can result in the power converter being damaged or completely destroyed.

5.3.1 Connecting Controller Module Sizes I ... IV

Screening of the electrical signal lines:

You must screen the signal lines on the cable clamps mounted on the side of the power converter (next to terminal strip X1).

- Standard Unit (Type Code BKF 12/.../... -60400... and BKD 6/.../... -60400...)



\* PCB version 3.8934.E and above

\*\*  $R_i = 100 \Omega$

\*\*\*  $R_i = 100 \Omega$



## Connection Information

Soldering jumpers:

W11: Reference point for control inputs X1:22 ... 29

is fitted if the +24 V is to be taken at the unit for power converter enables; do not fit it if the enables come directly from the PLC or the controller!

In this case, the reference potential is terminal X1:21 (BSE); the jumper is fitted at the factory.

W13: Specifying the reference point for control input X1:25 (pulse enable).

Jumper A-B selects the reference point that was specified with W11 for the other control inputs.

You use jumper B-C to permanently connect the reference point to the device-internal ground reference (M24V). This makes possible connection of pulse enable to the power converter's 24V even when the higher-level controller supplies the other enables.

With this control variant, voltage failures in the external controller, which would otherwise result in pulse inhibit do not negatively affect the power converter:

Uncontrolled removal of pulse enable at the power converter can damage the unit:

Pulse enable is a completely hardware function that intervenes directly in the output stage (pulse generation). If the firing pulses are suppressed during braking, this can lead to the fuse in the mains line dropping. In a worst case situation, the thyristors can be damaged (inverter tilting)!

Terminal strip X1:

Terminal blocks

Terminal cross-section 0.2 ... 2.5 mm<sup>2</sup>

|       |                            |   |
|-------|----------------------------|---|
| X1: 1 | RPM actual value           | Polarity negative with clockwise rotation of motor (A-side)   |
| X1: 2 | Reference potential<br>BSA | For RPM actual value  |
| X1: 3 | RPM spec. value 3          | 0 ... ±10 V, summing amplifier input. The sum of RPM nominal values 2 and 3 together should not exceed 10 V. Values above 10 V are limited.<br>Input resistance R <sub>E</sub> = 55 kΩ. |
| X1: 4 | Reference potential<br>BSA | For RPM actual value 3  |
| X1: 5 | RPM nom. value 2           | 0 ... ±10 V, summing amplifier input. The sum of RPM nominal values 2 and 3 together should not exceed 10 V. Values above 10 V are limited.<br>Input resistance R <sub>E</sub> = 55 kΩ. |

|           |                               |  |
|-----------|-------------------------------|--|
| X1: 6     | Reference potential BSA       | For RPM nominal value 2  |
| X1: 7,8   | RPM spec. value 1             | 0 ... $\pm 10$ V, differential amplifier input. Nominal value adaptation to 10 V by means of potentiometer R 100. Input resistance $R_E = 55$ k $\Omega$ .   |
| X1: 9,10  | Programmable input            | Can be programmed via P084<br>Analog input: 0 ... $\pm 10$ V<br>Switching input: 0 V or +24 V  |
| X1: 11,12 | Meas. channel 1               | 0 ... $\pm 10$ V, maximum of 4 mA, selection of test point using P088; Resolution 150 mV; highest resolution with daughterboard 3.9201: Dual DAC 12, for example. For interference immunity, use screened cables.  |
| X1: 13,14 | Meas. channel 2               | 0 ... $\pm 10$ V, maximum of 4 mA, selection of test point using P089; Resolution 150 mV; highest resolution with daughterboard 3.9201: Dual DAC 12, for example. For interference immunity, use screened cables.  |
| X1: 15    | Armature current actual value | 0 ... $\pm 10$ V, 4 mA, corresponds to nominal current with P025=1; with P025 < 1, the value reduces proportionally. The system takes the value directly from the load resistor so that it is not digitized; the signal is not decoupled. For interference immunity, use screened cables.  |
| X1: 16    | Reference potential           | BSA for armature current actual value  |
| X1: 17    | Nom. value supply             | RPM specified voltage value stabilized, +10 V/10 mA, $R_i = 100$ $\Omega$  |
| X1: 18    | BSA                           | Reference potential for RPM nominal values $\pm 10$ V  |
| X1: 19    | Nom. value supply             | RPM specified voltage value stabilized, -10 V/10 mA, $R_i = 100$ $\Omega$  |
| X1: 20    | + 24 V/100 mA                 | For enables only, voltage not stabilized, short-circuit-protected (PTC)  |
| X1: 21    | Reference potential BSE       | For enables; when using the device-internal 24 V from X1 :20, jumper W11 must be fitted. When using the 24 V from the controller, W11 must not be fitted. This electrically isolates the controller from the electronic ground (optocoupler inputs). In the case of electrical isolation, a difference in potential to the electronic ground of 50 V is permissible. |
| X1: 22    | Main contactor                | ON   |
| X1: 23    | Controller enable             |  |
| X1: 24    | Cancel fast brake             |  |
| X1: 25    | Pulse enable                  |  |

|           |                     |  |
|-----------|---------------------|--|
| X1: 26    | Motor pot. function | Increase speed; on applying +24 V, the motor accelerates, you can set the ramp and the maximum nominal value. The switching input is decoupled via an optocoupler, input resistance $R_E = 3 \text{ k}\Omega$ .  |
| X1: 27    | Motor pot. function | Decrease speed; on applying +24 V, the motor decelerates, you can set the ramp and the maximum nominal value. The switching input is decoupled via an optocoupler, input resistance $R_E = 3 \text{ k}\Omega$ .  |
| X1: 28,29 | Switching inputs    | Function can be programmed by means of parameter P099, switching inputs via optocoupler, input resistance $R_E = 3 \text{ k}\Omega$ .  |
| X1: 30    | Temperature         | Option of:   |
| 31        | monitoring,         | Relay K4 picks up at P128=0 if the temperature of the power stage or the motor ( $I^2t$ ) is too high,   |
| 32        | Drive ON            | Relay K4 picks up at P128=1 if the temperature of the power stage and the motor ( $I^2t$ ) are OK and the controller is enabled.<br>Relay contacts can be loaded with 24 V/1 A.  |
| X1: 33    |                     | Ready relay K1 picks up if the equipment is ready for operation.   |
| 34        |                     | In the case of an error, the relay releases for at least one second.   |
| 35        |                     | Relay contacts can be loaded with 24 V/1 A.  |
| X1: 36    | Programmable        | Option of:   |
| 37        | monitoring          | Relay K2 picks up if RPM speed $n_x$ is exceeded (P171=0).   |
| 38        |                     | Relay K2 picks up if armature current $I_x$ is exceeded (P171=1).<br>Relay contacts can be loaded with 24 V/1 A.   |
| X1: 39    | Programmable        | Option of:   |
| 40        | monitoring          | Relay K3 picks up when the operating speed is reached (P085=0)<br>Speed nominal value at ramp function generator input;  |
| 41        |                     | Relay K3 picks up if armature current $I_x$ is exceeded; (P085=1)<br>Relay K3 picks up if RPM speed $n_x$ is exceeded; (P085=2)<br>Relay K3 picks up if the drive is ready-to-start; (P085=3)<br>Relay K3 picks up if the field current is OK; (P085=4)<br>Relay K3 picks up on reaching operating RPM speed; (P085=5)<br>RPM nominal value at speed controller input;<br>Relay contacts can be loaded with 24 V/1 A |
| X1: 42    | Reset               | Processor board 3.8934.E and above (+24 V: Reset active)   |

**NOTE**

You must only specify a reset for the power converter when the controller is disabled **and** the motor is idle.

X2: RS232 25-pin SUB-D socket for PC connection (terminal strip)

### NOTE

Do not confuse with terminal X2 on field controller 3.8942 (power terminals).

| Pin No.  | Assignment   |
|----------|--------------|
| 1        | 5-V ground   |
| 2        | RxD RS232    |
| 3        | TxD RS232    |
| 4        | Not assigned |
| 5        | +15 V        |
| 6        | +15 V        |
| 7        | 5-V ground   |
| 8        | +15 V        |
| 9 ... 25 | Not assigned |

X10: 34-pin ribbon cable to mains unit 3.8941 and to field controller 3.8942; only disconnect internally when the unit is deenergized!

X11: 26-pin ribbon cable to power stage 3.8938, 3.8939 or 3.9016; only disconnect internally when the unit is deenergized!

X15: 64-pin ribbon cable to interface card; only disconnect internally when the unit is deenergized!

Terminal strip X34: Terminal block terminal cross-section 0.2 ... 2.5 mm<sup>2</sup>

X34:1,2 Connection for uninterruptible power supply (UPS) 24 V (21 V ... 30 V), 50 W

X34:1 +24 V connection

X34:2 Reference point is electrically isolated from the electronic ground BSA

F Line protection Observe the starting current inrush!  
The rating and characteristic of the fuse depend on the level of the inrush current. AT  $\hat{I} = 50$  A: it must be at least 6 A slow-blow according to DIN 41571

R1 Limiting of the starting current inrush to a maximum of 50 A!

The following measures are allowed for current limitation at terminal X34:1:

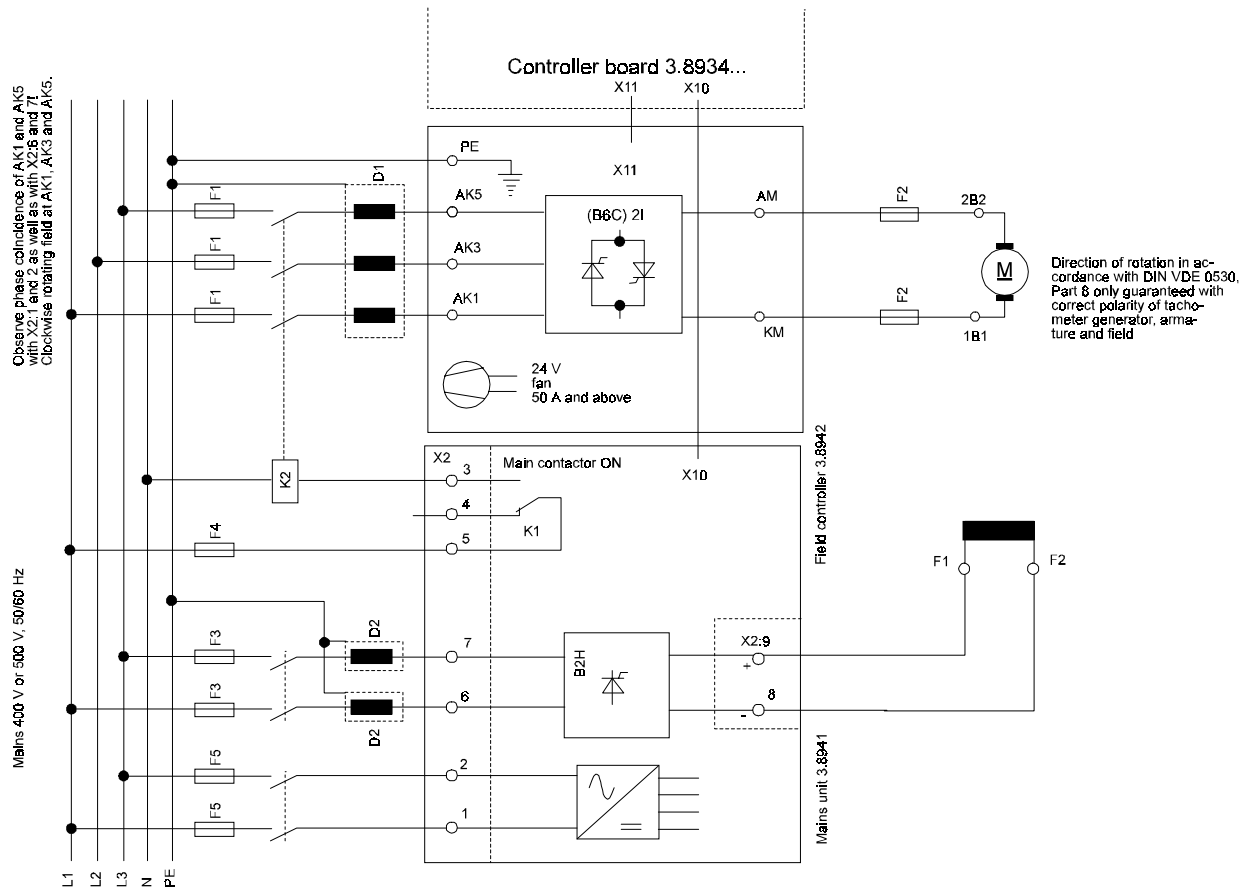
- Using an external current supply with integrated current limitation
- Current limitation by means of a series resistor ( $\geq 0.5 \Omega$ , 4 W). The resistor may be permanently switched on if it can be guaranteed that the permissible input voltage range is not fallen below ( $U_{\text{inp}} = 21 \text{ V} \dots 30 \text{ V}$ , current consumption 1.7 A max.). Otherwise, bridging of the resistor after an ON period of 100 ms at the earliest (this applies to  $R = 0.5 \Omega$ , higher resistance values need a correspondingly long ON period).
- Switching-in the external 24-V supply is possible even without current limiting if it can be guaranteed that
  - a) the 24 V is applied at least 100 ms after application of the mains voltage (at X2:1,2)  
and
  - b) the mains voltage is within the tolerance band of 400 V/460 V/500 V -15 % + 10 %.

With applications in which you intend to connect the switching power supply to mains voltages that differ from the power converter's rated values, switching-in may not be carried out under any circumstances without additional current-limiting measures being taken!

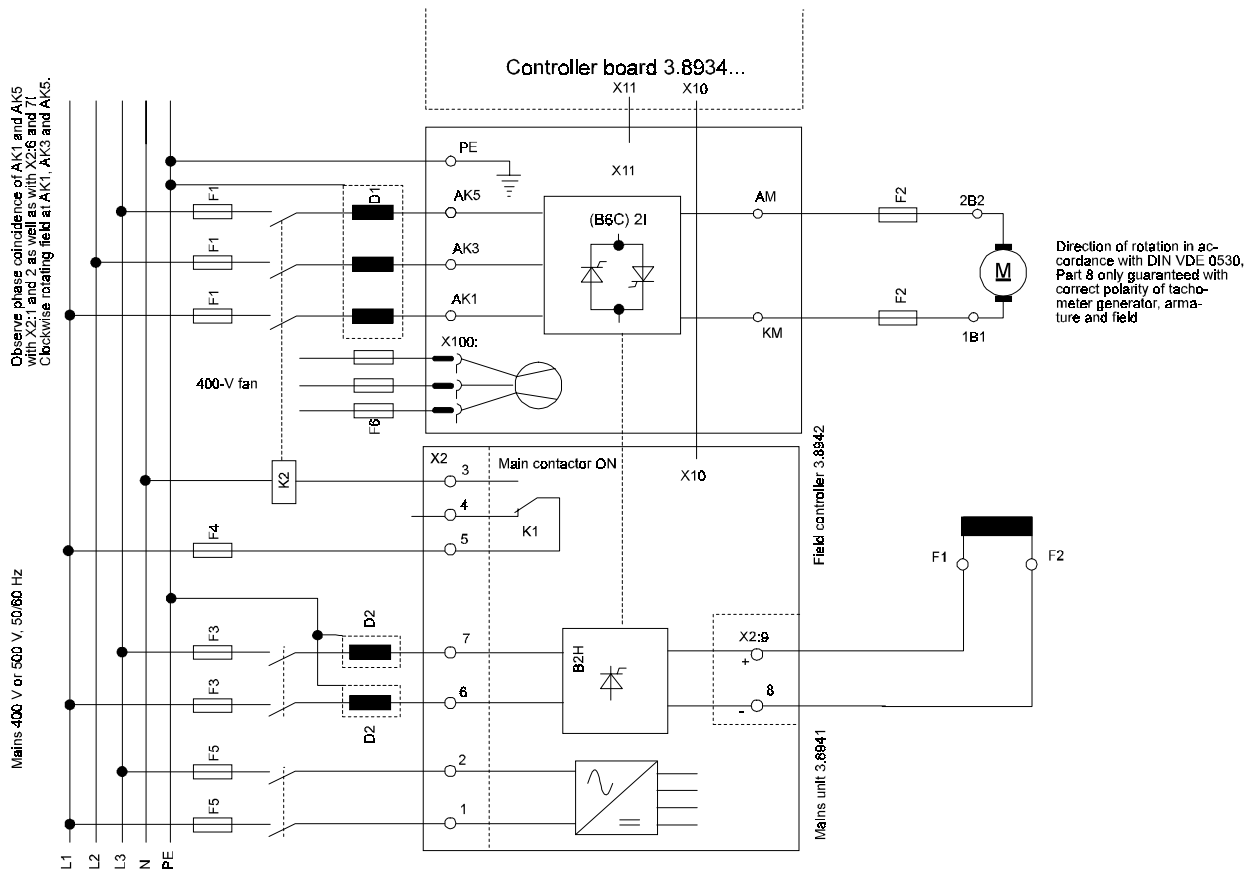


5.3.2 Connecting Power Stage BKF 12/6000 Sizes I ... IV

- Connecting Power Stage BKF 12/6000 Size I



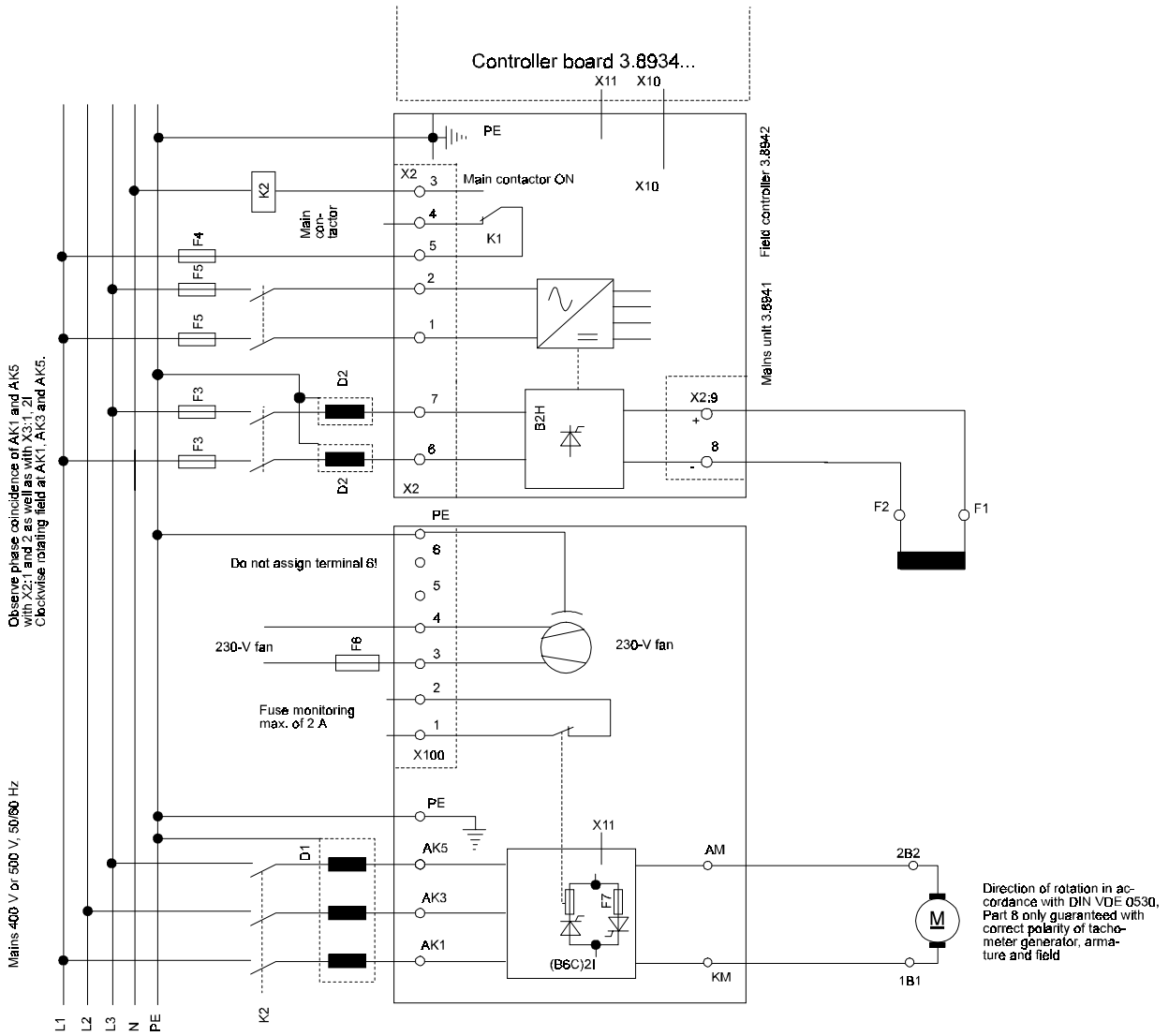
- **Connecting Power Stage BKF 12/6000 Size II with Field Supply for 15 A max.**



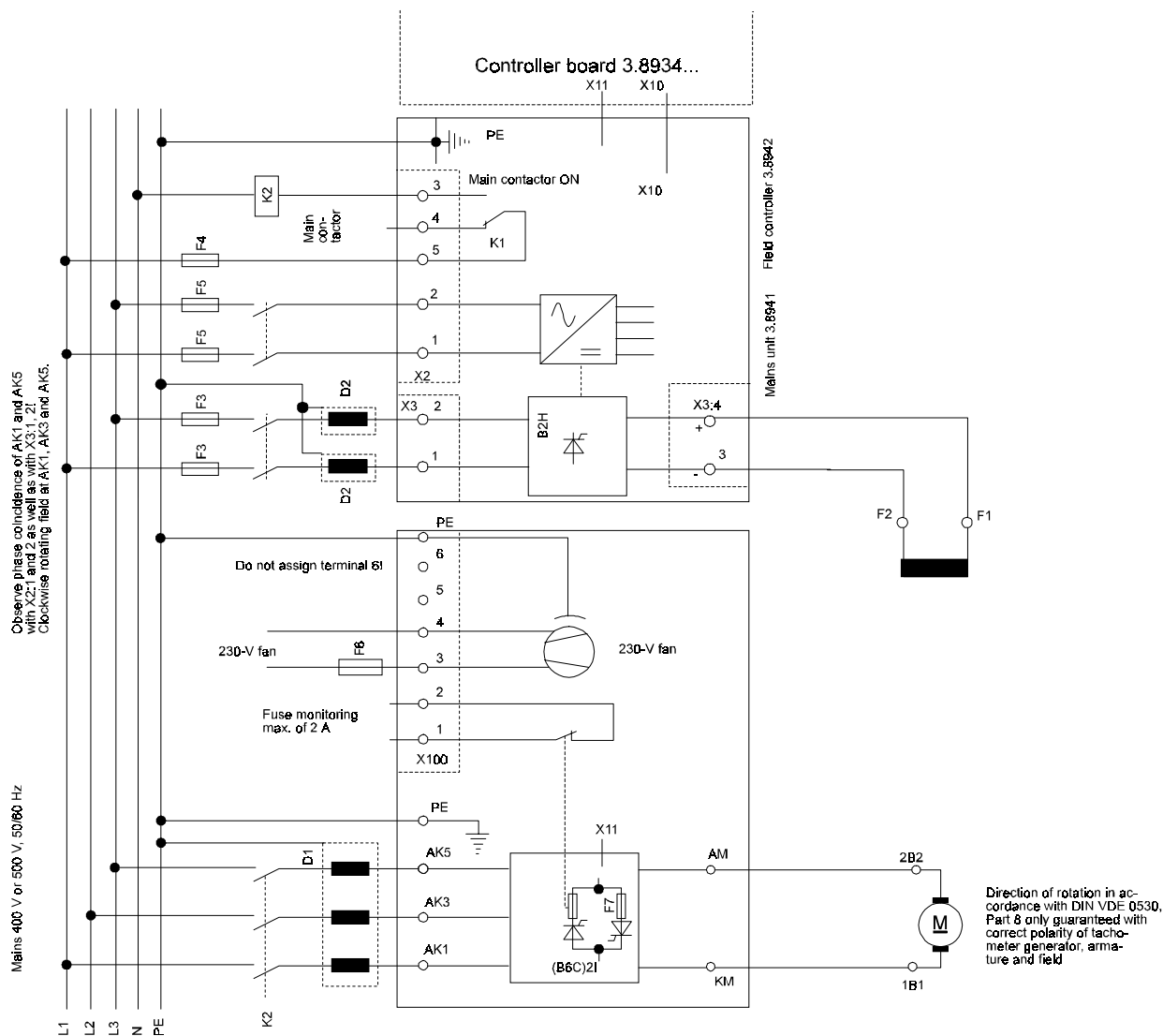
## with 25-A Field Supply



- **Connecting Power Stage BKF 12/6000 Size III with Field Supply for 15 A max.**

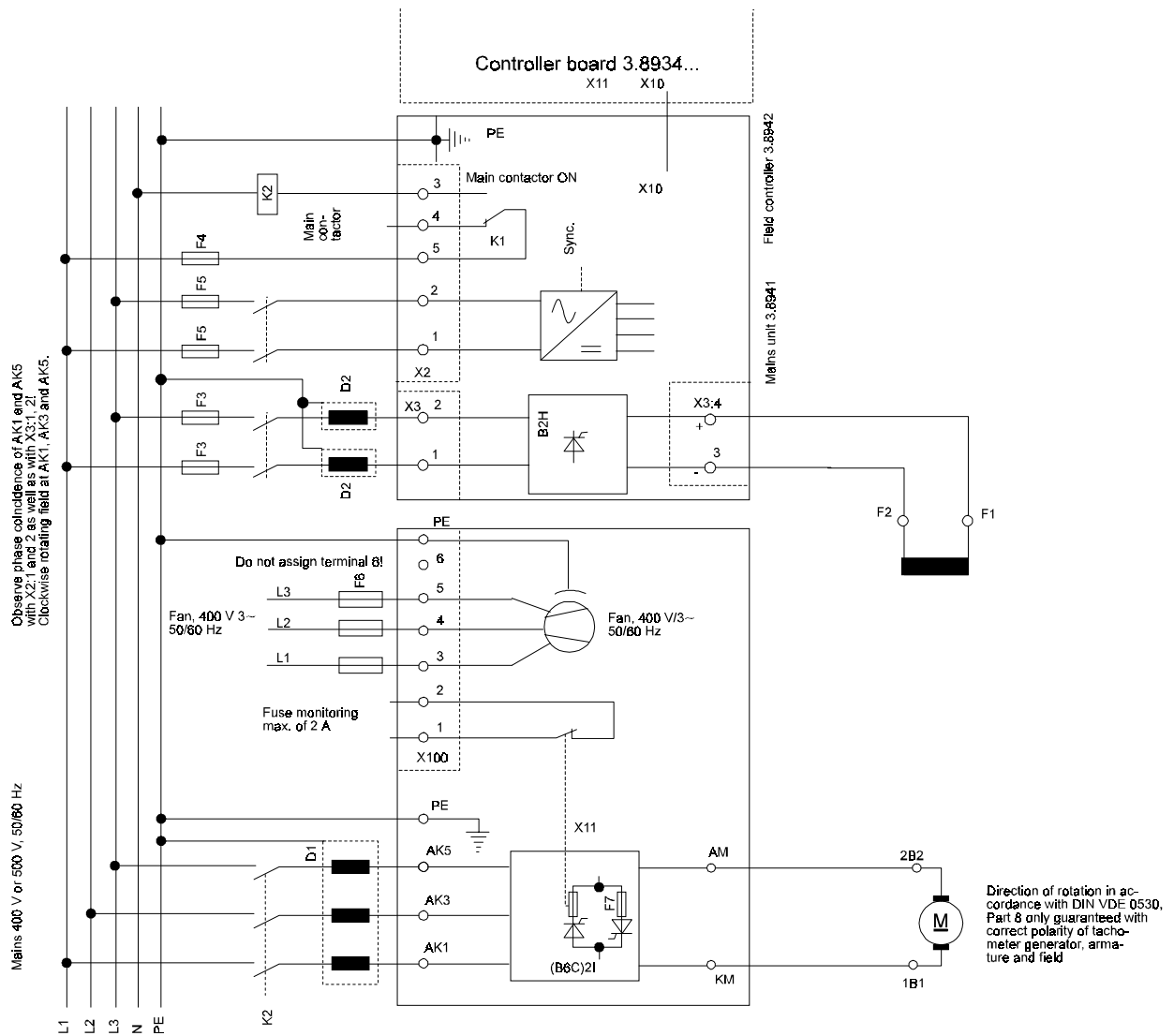


with 25-A Field Supply



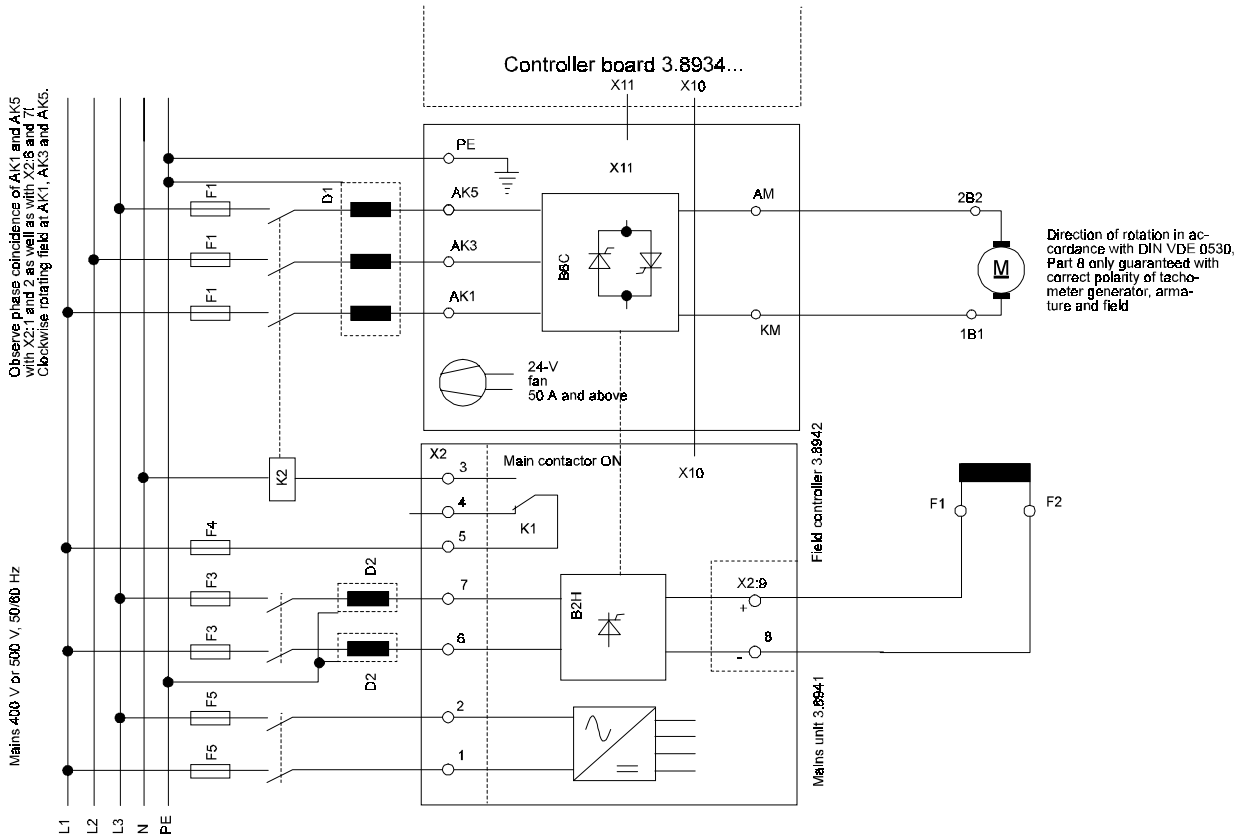


with 25-A Field Supply



5.3.3 Connecting Power Stage BKD 6/6000 Sizes I ... IV

- Connecting Power Stage BKD 6/6000 Size I

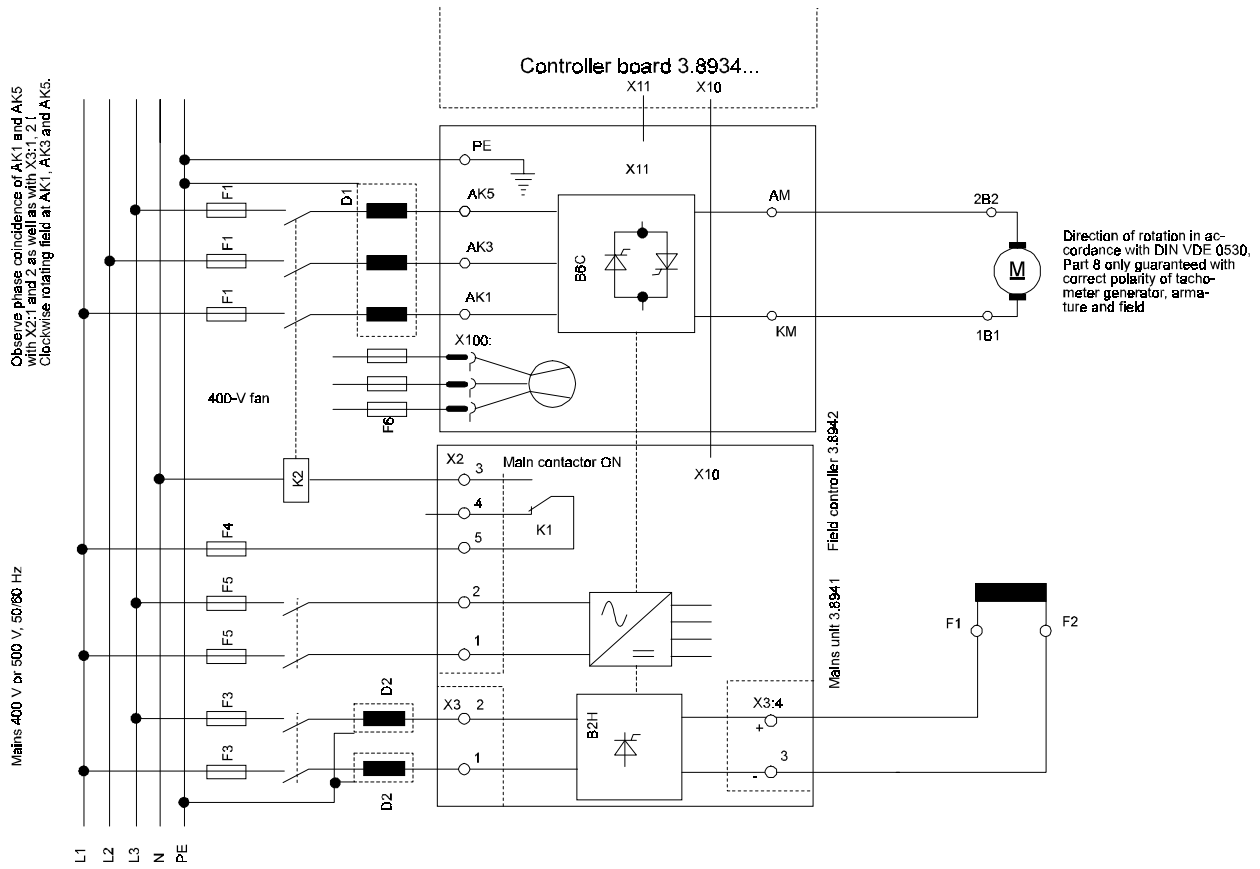




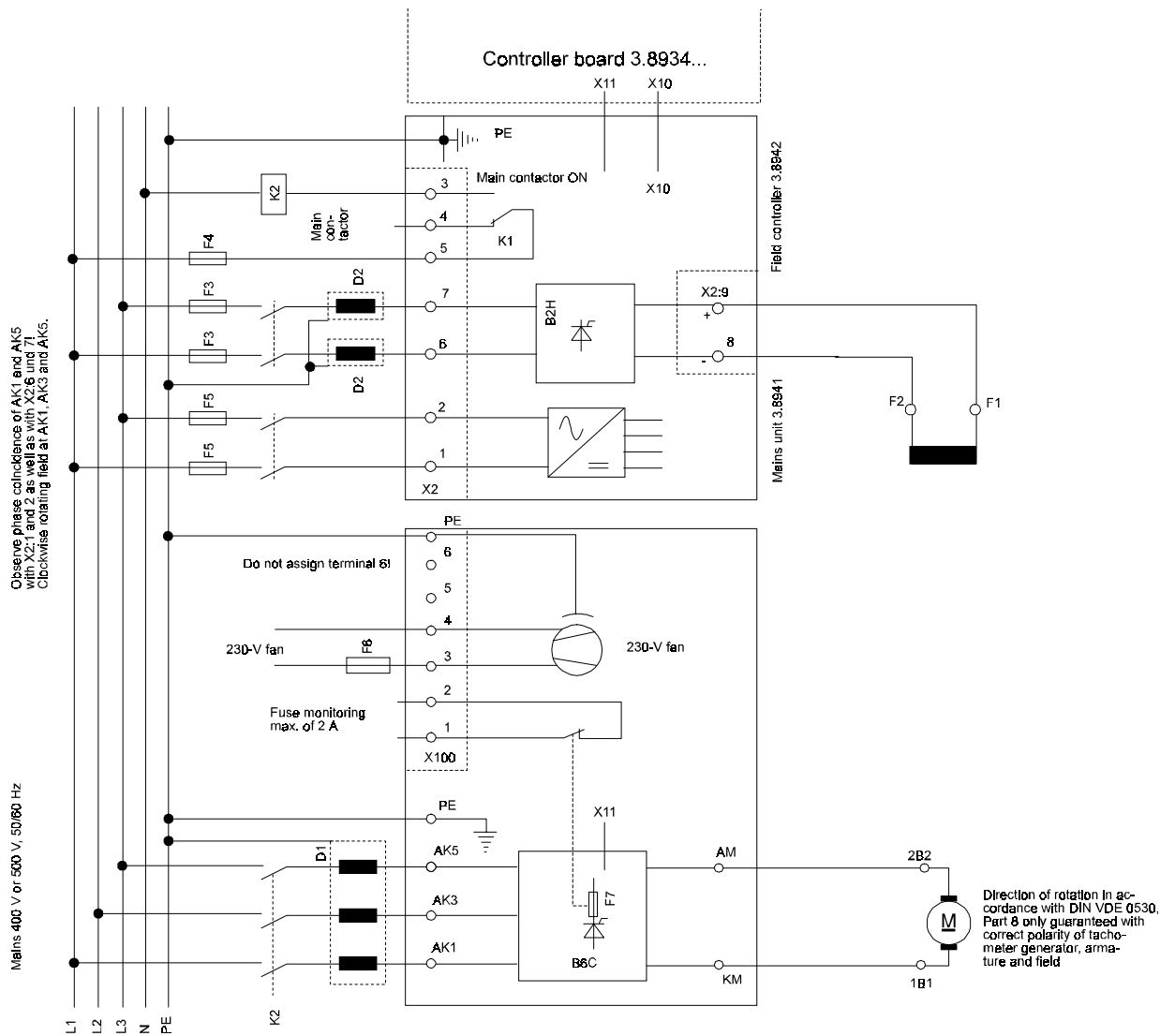
- Connecting Power Stage BKD 6/6000 Size II**  
**with Field Supply for 15 A max.**



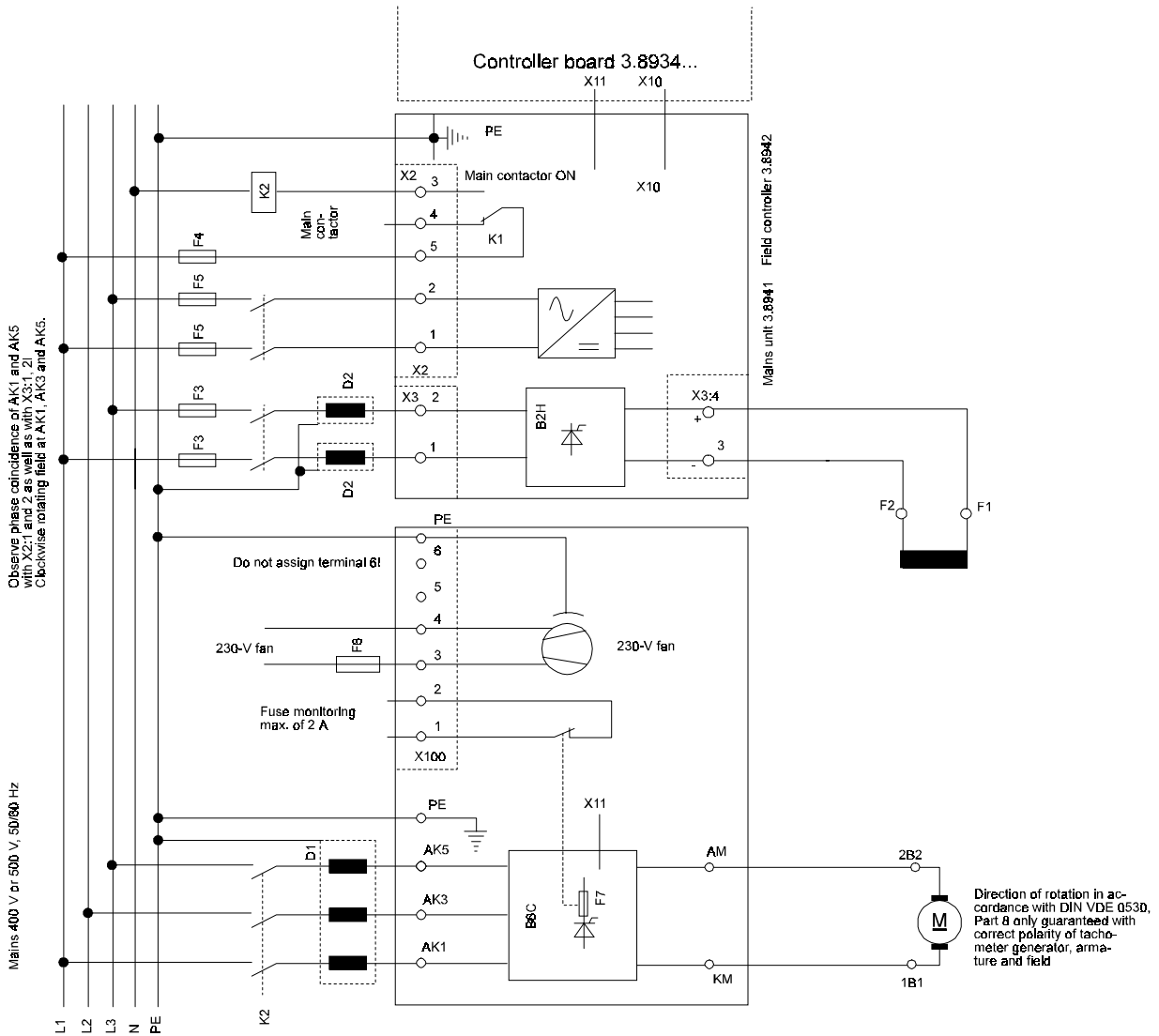
with 25-A Field Supply



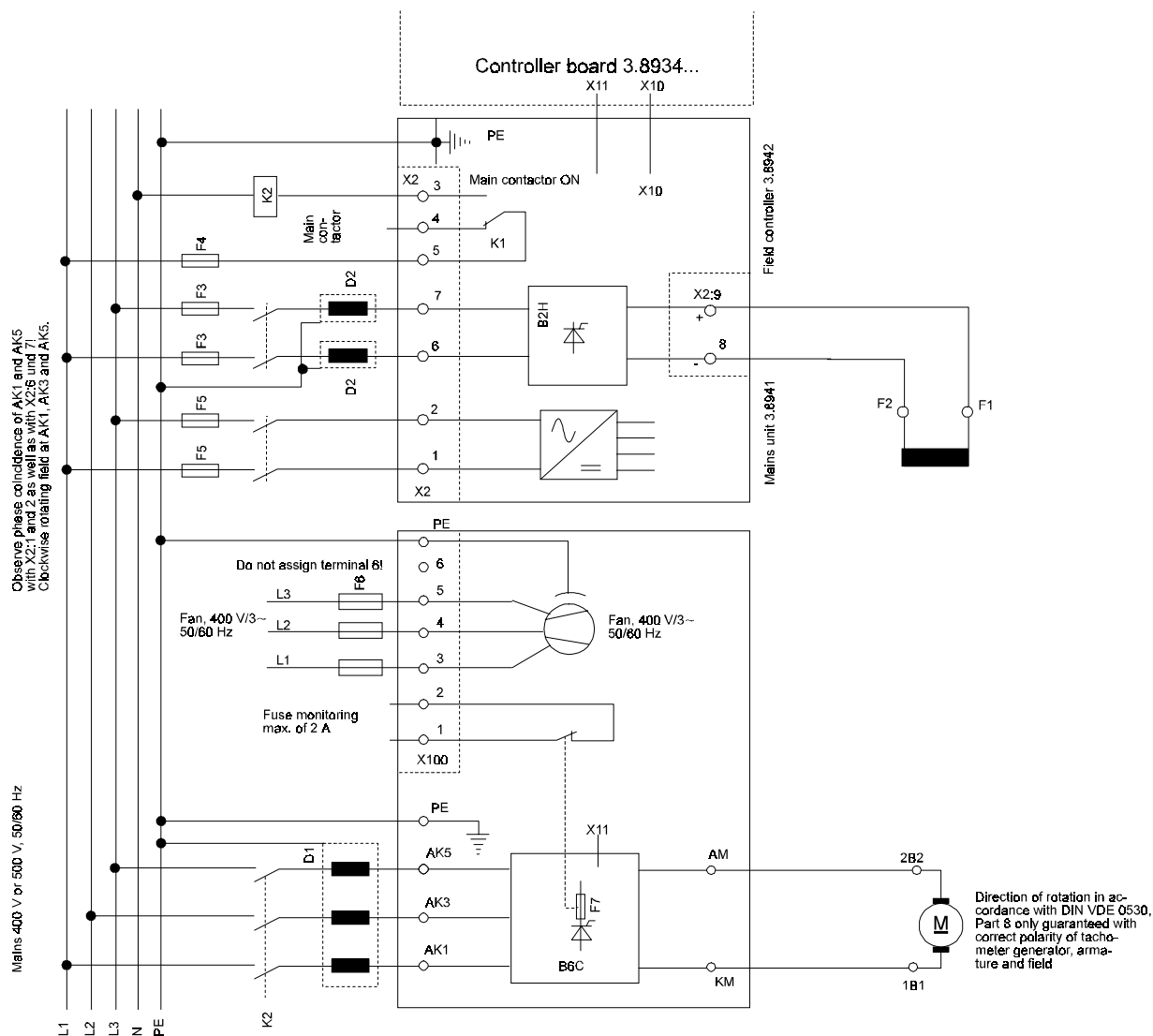
- **Connecting Power Stage BKD 6/6000 Size III**  
with Field Supply for 15 A max.



with 25-A Field Supply



- **Connecting Power Stage BKD 6/6000 Size IV**  
with Field Supply for 15 A max.



with 25-A Field Supply



**Connection Information**

|               |  |  |
|---------------|--|--|
| X2            | Terminal strip                             | Terminal cross-section 0.2 ... 2.5 mm <sup>2</sup>   |
| X3            | Terminal strip                             | Terminal cross-section 0.5 ... 4.0 mm <sup>2</sup>   |
| F1            | Sizes 1 and 2:<br>Size 3:                  | Phase fuses, refer to 5.6<br>Arm-circuit fuses integrated in the thyristor set, use original-manufacturer semiconductor fuses only, due to this, there are no fuses in the phase and armature circuits, see section 5.4.   |
| F2            | Armature circuit fuses                     | For recommendations, refer to 5.6 With BKD power converters, armature circuit fuses F2 are eliminated.   |
| K2            | Main contactor                             | If operated in the deenergized condition, deenergizes the power stage (armature).  |
| D1            | Three-phase current line commutator        | For recommendations, refer to line commutators, reduces the power converter's feedback effect on the feed mains and protects the thyristors from impermissible rates of current rise (VDE 0160). The stated rated currents are referred to the direct current side, see Section 5.5.                 |
| L1, L2, L3    | Connection lines                           | Cross-section acc. to DIN EN 60204 Part 1/VDE 0113 Part 1/06.93, Sections 14 and 15, Appendix C, or VDE 0298/Part 4  |
| 1B1, 2B2      | Motor connections                          | Cross-section acc. to DIN EN 60204 Part 1/VDE 0113 Part 1/06.93, Sections 14 and 15, Appendix C, or VDE 0298/Part 4, connection 1B1 is positive with a clockwise-rotating shaft  |
| PE            | Protective earth connection                | Cross-section acc. to DIN EN 60204 Part 1/VDE 0113 Part 1/06.93, Section 8.2.2, taking into account provisional standard EN 50178/VDE 0160/11.94, Sections 5.3.2.1 and 8.3.4.4<br>For the connection screw, refer to the dimensional drawing   |
| AK1, AK3, AK5 | Connections of the thyristor set           | By means of choke D1, mains contactor K2 (and with sizes I and II by means of the phase fuses) connect L1, L2, L3 to the three-phase mains. Observe the clockwise-rotating field and phase coincidence with mains units X2:1 and X2:2! For the connection screws, refer to the dimensional drawings. |
| AM, KM        | Motor connections                          | KM is positive with a clockwise-rotating motor   |
| F3            | Semiconductor fuse in the field connection | Two 5SD4.. 16 A ... 30 A/500 V~ screwed-type fuses, depending on the field current converter's rated current, refer to 5.6 Semiconductor Fuses   |
| F4            | Power protection                           | Rating depends on main contactor K1  |
| F5            | Power protection                           | 0.4 A MTL/500 V fuse or 0.4 ... 0.63 A motor protection switch   |

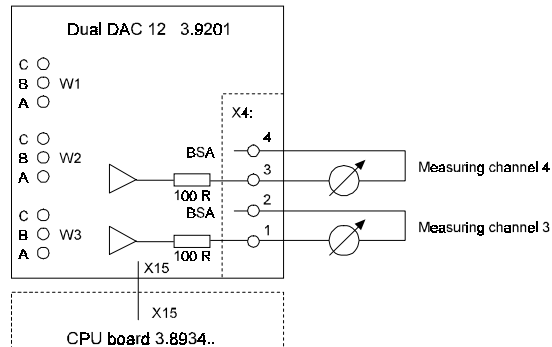
|                        |                             |   |
|------------------------|-----------------------------|---|
| Fan Connection         |                             |   |
|                        | Size I                      | 30 A unventilated<br>50 A and above: no external connection, since the fan is supplied internally   |
| X100                   | Size II                     | 400 V, 3~, 50/60 Hz, 0.23/0.30 A<br>AMP plug-in connector for 0.5 ... 2.1 mm <sup>2</sup> (contained in the included accessories); observe the direction of rotation. Ignoring the direction of rotation may lead to the equipment overheating. |
| X100:3,4               | Size III                    | 230 V, 1~, 0.94 A at 50/60 Hz<br>Terminal strip for 0.5 ... 2.5 mm <sup>2</sup>   |
| X100:<br>3,4,5         | Size IV                     | 400 V, 3~, 1.2 A at 50 Hz, 1.5 A at 60 Hz<br>Terminal strip for 0.5 ... 2.5 mm <sup>2</sup><br>Observe the direction of rotation. Ignoring the direction of rotation may lead to the equipment overheating.                                     |
| X100:PE                | Sizes III and IV<br>Size II | Protective earth connection for the fan.<br>The protective earth is wired inside the unit.  |
| X100:6                 |                             | Do not assign this terminal   |
| X100:1,2               | Fuse monitoring             | With power stages of sizes III and IV only,<br>Contacts can be loaded with a maximum of 250 V~, 2 A or 30 V <sub>-</sub> , 2 A, and a minimum of 24 V <sub>-</sub> /100 mA  |
| F6                     | Back-up fuse for fan        | Size II: 3 x 400 mA MTL or 0.24 ... 0.4 A motor protection switch<br>Size III: 1 x 1.6 A MTL or 1.00 ... 1.6 A motor protection switch<br>Size IV: 3 x 1.6 A MTL or 1.00 ... 1.6 A motor protection switch                                      |
| F7                     | Arm-circuit fuses           | With power stages of sizes III and IV only: Protection of the disk-type thyristors the fuses are integrated in the thyristor set.   |
| X2:8,9<br>or<br>X3:3,4 | Field connection            | Connection of F1 to X2:9 or X3:4 (+), connection of F2 to X2:8 or X3:3 (-) of the field and controller supply   |
| F1, F2                 | Connection of field winding | Cross-section acc. to DIN EN 60204 Part 1/VDE 0113 Part 1/06.93, Sections 14 and 15, Appendix C, or VDE 0298/Part 4, connection F1 is positive with a clockwise-rotating shaft.   |
| D2                     | Field line commutator       | One line commutator in each feed line, rating in accordance with the field device's rated current, refer to Section 5.5   |
| X2:1,2                 | Connection of mains unit    | Observe phase coincidence with AK1 and AK5, avoid phase shifts between L1 and X2:1, since the firing pulses for the power stages of the field and the armature are synchronized from the mains unit.  |



|                        |                                      |  |
|------------------------|--------------------------------------|--|
| X2:3,4,5               | Control of main contactor K1         | Relay contacts that can be loaded with 230 V/1 A~ or 24V/1 A <sub>L</sub> (non-inductive load); the "main contactor ON" relay is activated by the control command at terminal X1:22. |
| X2:6,7<br>or<br>X3:1,2 | Connections of the field power stage | Connect in-phase to the mains unit at L1 and L3, cross-section according to DIN EN 60204 Part 1/VDE 0113 Part 1/06.93/Sections 14 and 15, Appendix C or VDE 0298/Part 4.             |

## 5.4 Connecting Daughterboards

### 5.4.1 "Dual DAC 12", 3.9201 Daughterboard



Terminal strip X4:

Terminal block

Terminal cross-section 0.2 ... 2.5 mm<sup>2</sup>

X4: 1,2 Measuring channel 3 0 .. ± 10 V, max. of 4 mA, selection of test point using P130; resolution approx. 10 mV, use screened cables.

X4: 3,4 Measuring channel 4 0 .. ± 10 V, max. of 4 mA, selection of test point using P131; resolution approx. 10 mV, scaling using P132 possible, use screened cables.

#### Jumper assignment:

You can fit up to two daughterboards on the power converter.

The way jumpers W2 and W3 are fitted specifies the address of the PCB on the unit:

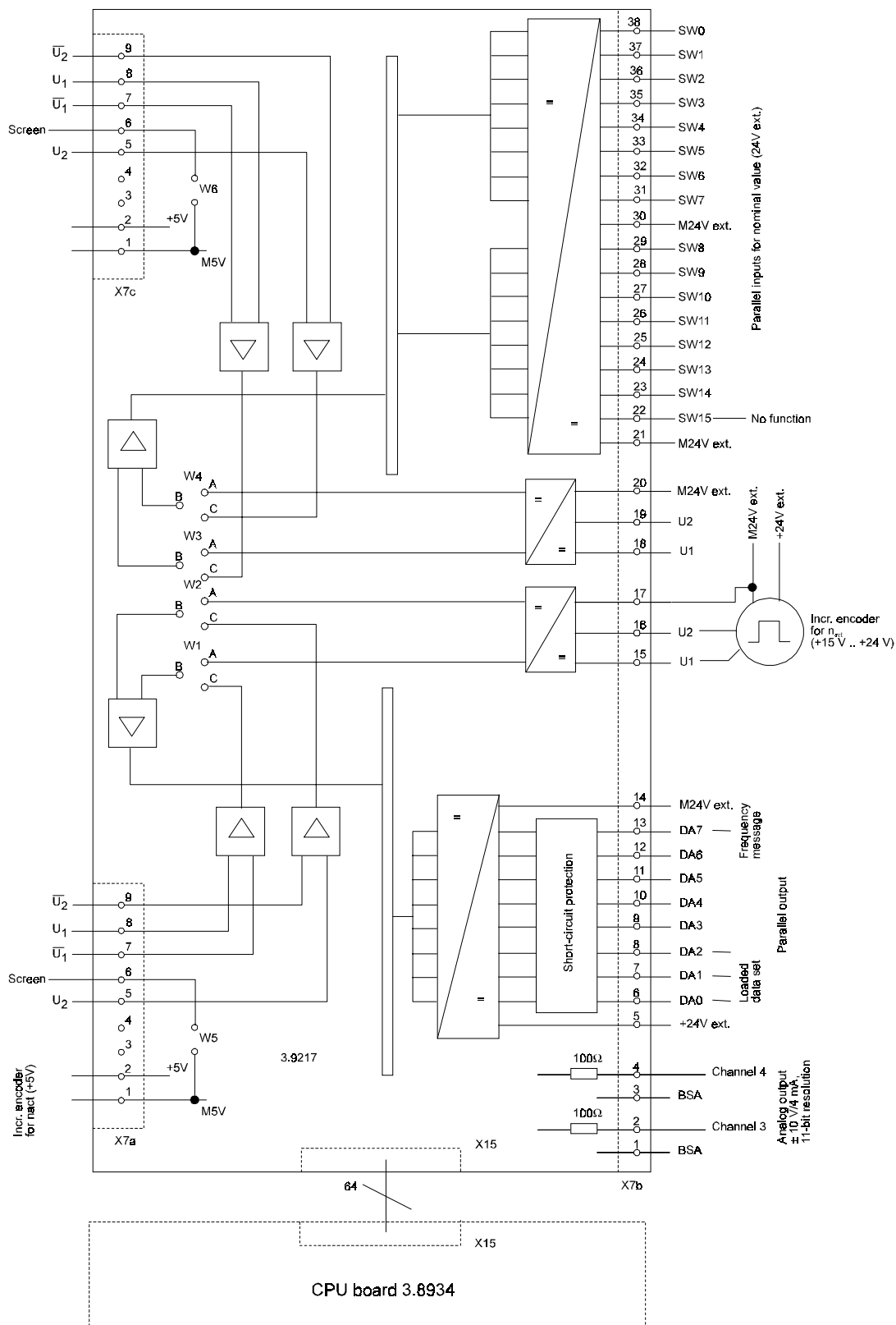
- W2:A-B and W3:A-B  
3.9201 is the only supplementary module
- W2:B-C and W3:B-C  
3.9201 is the second supplementary module

Up to motherboard 3.8934 C, W1 must be jumpered to B-C, with 3.8934 D and above, W1 must be jumpered to A-B.

Resistance networks RN1 to RN4 function as bus terminators.

If there are two supplementary modules, and PCB 3.9201 is mounted as the bottom card, you must remove resistance networks RN1 to RN4 (fitted on skirting ducts).

5.4.2 "Input/Output Expansion", 3.9217 Daughterboard



**NOTE**

Terminals M24V ext. (X7b: 14, 17, 20, 21, 30) have no electrical connection on the PCB!

**Pin assignment**

**X7a:** 15-pin SUB-D socket connector  
 Incremental encoder input for speed measurement with +5-V supply for two 90° phase-shifted differential impulses  
 Signal level: LOW signal = 0 ... 0.45 V, HIGH signal = 2.4 V ... 5.25 V

| Pin No.   | Assignment                  |
|-----------|-----------------------------|
| 1         | Ground                      |
| 2         | +5V (internal power supply) |
| 3         | Not assigned                |
| 4         | Not assigned                |
| 5         | Incremental encoder +U2     |
| 6         | Screen                      |
| 7         | Incremental encoder -U1     |
| 8         | Incremental encoder +U1     |
| 9         | Incremental encoder -U2     |
| 10 ... 15 | Not assigned                |

**X7b:** Terminal blocks  
 Terminal cross-section 0.2 mm<sup>2</sup> ... 2.5 mm<sup>2</sup>

**X7b:1, 2** Measuring channel 3  
 0 ... ±10 V, max. of 4 mA, selection of test point using P130; resolution approx. 10 mV, use screened cables.

**X7b:3, 4** Measuring channel 4  
 0 ... ±10 V, max. of 4 mA, selection of test point using P131; resolution approx. 10 mV, scaling using P132 possible, use screened cables.

**X7b:5-14** 8 digital outputs  
 isolated; each can be loaded with 35 V/100 mA

**X7b:15-17** Incremental encoder input for speed measurement  
 with +24-V supply for two 90° phase-shifted differential impulses  
 Signal level: LOW signal = 0 ... 4 V, HIGH signal = +15 V ... +30 V  
 $R_i = 3 \text{ k}\Omega$ . The power supply must be external.

**X7b:18-20** Incremental encoder input for speed nominal value setting (in preparation)  
 with +24-V supply for two 90° phase-shifted differential impulses  
 Signal level: LOW signal = 0 ... 4 V, HIGH signal = +15 V ... +30 V  
 $R_i = 3 \text{ k}\Omega$ . The power supply must be external.  
 The software does not support this.

**X7b:21-38** 16 digital inputs for digital nominal value assignment; isolated via optocoupler  
 Signal level:           LOW signal = 0 ... 4 V,           HIGH signal = +15 V ... +30 V  
 $R_i = 3 \text{ k}\Omega$ . The power supply must be external.

**X7b:**

|   | Pin No. | Assignment  |
|---|---------|---|
| Analog Outputs  | 1       | BSA (internal reference voltage)  |
|   | 2       | Analog channel 3  |
|   | 3       | BSA (internal reference voltage)  |
|   | 4       | Analog channel 4  |
| Digital Outputs   | 5       | +24 V ext.  |
|   | 6       | DA0   |
|   | 7       | DA1   |
|   | 8       | DA2   |
|   | 9       | DA3   |
|   | 10      | DA4   |
|   | 11      | DA5   |
|   | 12      | DA6   |
|   | 13      | DA7   |
|   | 14      | M24 V ext.  |
| Incremental encoder input<br>for speed measurement  | 15      | U1 actual value incr. with ext. +24-V supply.                             |
|   | 16      | U2 actual value incr. with ext. +24-V supply                              |
|   | 17      | Ext. reference voltage for<br>actual value incr. with ext. +24-V supply.  |
| Incremental encoder input<br>for speed nominal value<br>setting (the software does<br>not support this) | 18      | U1 nominal value incr. with ext. +24-V supply                             |
|   | 19      | U2 nominal value incr. with ext. +24-V supply                             |
|   | 20      | Ext. reference voltage for<br>nominal value incr. with ext. +24-V supply. |
| Digital nominal value<br>setting  | 21      | Ext. reference voltage for SW8-SW15                                       |
|   | 22      | No function   |
|   | 23      | SW14 (sign bit)   |
|   | 24      | SW13  |
|   | 25      | SW12  |
|   | 26      | SW11  |
|   | 27      | SW10  |
|   | 28      | SW9   |
|   | 29      | SW8   |
|   | 30      | (Ext. reference voltage for SW0-SW7                                       |
|   | 31      | SW7   |
|   | 32      | SW6   |
|   | 33      | SW5   |
|   | 34      | SW4   |
|   | 35      | SW3   |
|   | 36      | SW2   |
|   | 37      | SW1   |
|   | 38      | SW0   |

**X7c:** 15-pin SUB-D socket connector  
 Incremental encoder input for speed nominal value assignment with +24-V supply for two 90° phase-shifted differential impulses (in preparation)  
 Signal level: LOW signal = 0 ... 0.45 V, HIGH signal = 2.4 V ... 5.25 V

| Pin No.   | Assignment                  |
|-----------|-----------------------------|
| 1         | Ground                      |
| 2         | +5V (internal power supply) |
| 3         | Not assigned                |
| 4         | Not assigned                |
| 5         | Incremental encoder +U2     |
| 6         | Screen                      |
| 7         | Incremental encoder -U1     |
| 8         | Incremental encoder +U1     |
| 9         | Incremental encoder -U2     |
| 10 ... 15 | Not assigned                |

Not supported by the software!

**Plug-in jumpers**

Using jumpers W1 and W2, you choose between actual value incremental encoders with an internal +5-V supply (X7a) and actual value incremental encoders with an external +24-V supply (X7b:15-17):

- W1 and W2: A-B Actual value incremental encoder with an external +24-V supply
- W1 and W2: B-C Actual value incremental encoder with an internal +5-V supply

Using jumpers W3 and W4 you choose between nominal value incremental encoders with an internal +5-V supply (X7c) and nominal value incremental encoders with an external +24-V supply (X7b:18-20):

- W3 and W4: A-B Nominal value incremental encoder with an external +24-V supply
  - W3 and W4: B-C Nominal value incremental encoder with an internal +5-V supply
- Not supported by the software!

Jumper W5 connects the screen of X7a (pin 6) to the electronic potential (M5V) with jumper W6 connecting the screen of X7c (Pin 6) to the electronic potential (M5V).

The way jumpers W7 and W8 are fitted specifies the address of the PCB on the unit:

- W7 and W8:A-B 3.9217 is the only supplementary module
- W7 and W8:B-C 3.9201 is the second supplementary module

Up to motherboard 3.8934 C, W9 must be jumpered to B-C, with 3.8934 D and above, W9 must be jumpered to A-B.

Resistance networks RN3 to RN8 function as bus terminators.

If there are two supplementary modules, and PCB 3.9217 is mounted as the bottom card, you must remove resistance networks RN3 to RN8.



### 5.4.3 InterBus-S Interface Board

For PCB 3.9208, refer to supplementary description.

**Pin assignment:**

InterBus-S IN      X8b: 15-pin SUB-D plug connector

| Pin No. | Assignment                |
|---------|---------------------------|
| 1       | UVO    + 9 V              |
| 2       | UVO    + 9 V              |
| 3       | Not assigned              |
| 4       | Not assigned              |
| 5       | SLI1    Select Line IN1   |
| 6       | CKI1    Clock Line IN1    |
| 7       | CRI1    Control Line IN1  |
| 8       | DI1     Data Line IN1     |
| 9       | Ground                    |
| 10      | Ground                    |
| 11      | ResIn    Reset IN         |
| 12      | SLO1    Select Line OUT1  |
| 13      | CKO1    Clock Line OUT1   |
| 14      | CRO1    Control Line OUT1 |
| 15      | DO1     Data Line OUT1    |

InterBus-S OUT    X8c: 15- pin SUB-D socket connector

| Pin No. | Assignment                        |
|---------|-----------------------------------|
| 1       | UVO    + 9 V                      |
| 2       | UVO    + 9 V                      |
| 3       | + 5 V    Connector identification |
| 4       | + 5 V    Connector identification |
| 5       | SLI2    Select Line IN2           |
| 6       | CKI2    Clock Line IN2            |
| 7       | CRI2    Control Line IN2          |
| 8       | DI2     Data Line IN2             |
| 9       | Ground                            |
| 10      | Ground                            |
| 11      | LBRes    Reset OUT                |
| 12      | SLO2    Select Line OUT2          |
| 13      | CKO2    Clock Line OUT2           |
| 14      | CRO2    Control Line OUT2         |
| 15      | DO2     Data Line OUT2            |





RS485 X3: 9-pin SUB-D socket connector

| Pin No. | Assignment |
|---------|------------|
| 1       | -TxD       |
| 2       | +5V        |
| 3       | Ground     |
| 4       | Ground     |
| 5       | -RxD       |
| 6       | +RxD       |
| 7       | Ground     |
| 8       | Ground     |
| 9       | +TxD       |

X4: 9-pin SUB-D plug connector  
 identical with X3  
 X3 and X4 are connected in-parallel!

### 5.4.5 RS485 with USS Protocol or as a CS31 System Bus Interface, 3.9493

For PCB 3.9493, refer to supplementary description.

**Pin assignment:**

CS31 (PCB versions 3.9493.01 and 3.9493.02)

X601: 9-pin SUB-D plug connector  
 X602: 9-pin SUB-D socket connector  
 X601 and X602 are electrically connected in-parallel

| Pin No. | Assignment   |
|---------|--------------|
| 1       | Screen       |
| 2 ... 4 | Not assigned |
| 5       | BUS2         |
| 6       | BUS1         |
| 7 ... 9 | Not assigned |
| Housing | Screen       |

USS protocol (PCB versions 3.9493.03 and 3.9493.04)

X601: 9-pin SUB-D plug connector

X602: 9-pin SUB-D socket connector

X601 and X602 are electrically connected in-parallel

| Pin No. | Assignment |
|---------|------------|
| 1       | -TxD       |
| 2       | +5V        |
| 3       | Ground     |
| 4       | Ground     |
| 5       | -RxD       |
| 6       | +RxD       |
| 7       | Ground     |
| 8       | Ground     |
| 9       | +TxD       |

X603: 2-pin print terminal for 1-mm<sup>2</sup> terminal cross-section:  
PE terminal

Incremental encoder (PCB versions 3.9493.02 and 3.9493.04)

X8: 15-pin SUB-D plug connector

X9: 15-pin SUB-D socket connector

X8 and X9 are electrically connected in-parallel

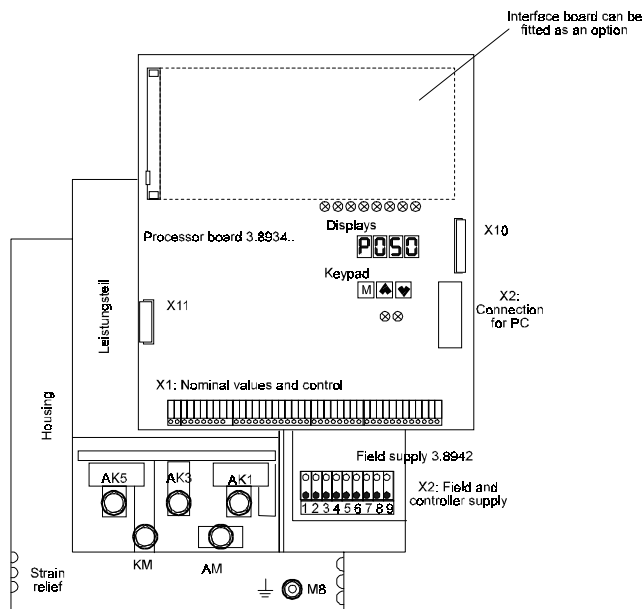
Incremental encoder input for speed measurement with +5-V supply for two 90° phase-shifted differential impulses

Signal level: LOW signal: 0 ... 0.45 V, HIGH signal: 2.4 ... 5.25 V

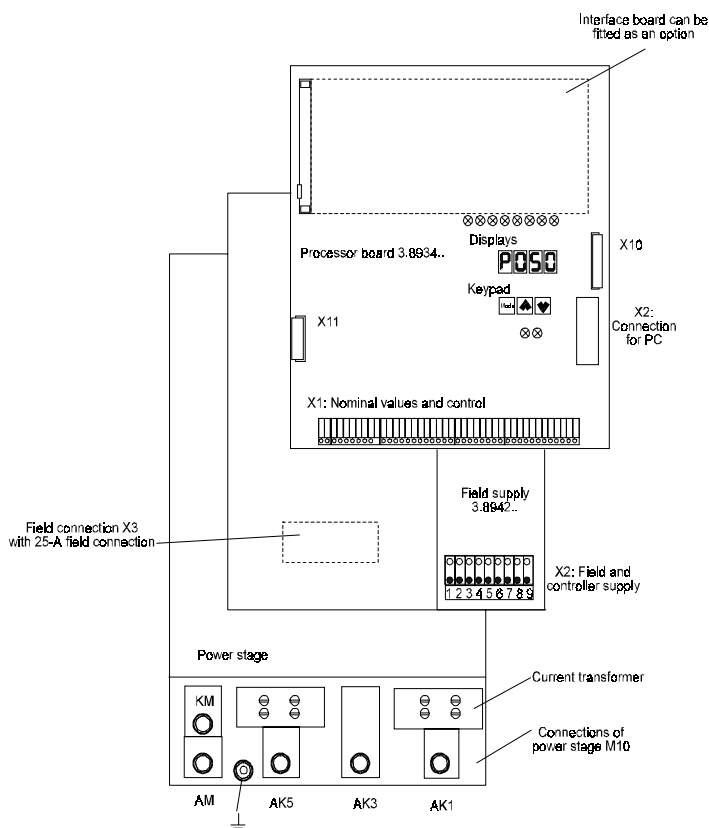
| Pin No.   | Assignment                  |
|-----------|-----------------------------|
| 1         | Ground                      |
| 2         | +5V (internal power supply) |
| 3         | Not assigned                |
| 4         | Not assigned                |
| 5         | Incremental encoder +U2     |
| 6         | Screen                      |
| 7         | Incremental encoder -U1     |
| 8         | Incremental encoder +U1     |
| 9         | Incremental encoder -U2     |
| 10 ... 15 | Not assigned                |

5.5 Position of the Electrical Connections and Modules

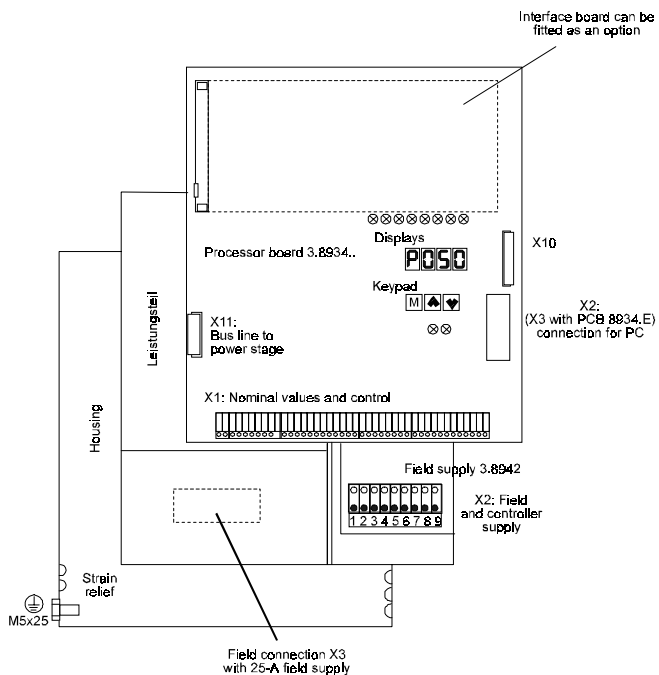
5.5.1 BKD 6 and BKF 12 .../6000, Size I (30 A to 200 A)



5.5.2 BKD 6 and BKF 12 .../6000, Size II (300 A to 600 A)



5.5.3 Controller and Field Supply for Sizes III and IV (750 A to 2050 A)



5.6 Semiconductor Fuses

**NOTE**

Safe protection of the power stage cannot be guaranteed if you use fuses that are not listed!

To protect the thyristors, you must connect super-high speed semiconductor fuses in the three-phase current supply line.

With sizes I and II, the semiconductor fuses on the mains side (phase fuses) must be arranged outside the power converter in the control cabinet. In the case of the BKF, you must additionally consider the armature circuit fuses.

Unit sizes III and IV have arm-circuit fuses that are integrated in the equipment.

5.6.1 Unit Size I

- a) Connection voltage 3 x 400 V  
Manufacturer: SIEMENS

| Power Converter Type<br>BKD or BKF | Phase Current (eff) | Rated DC Current | Phase Fuse           | Nominal Current/Nominal Voltage | Order No. 1900... | Armature Circuit Fuse (with BKF power converters only) | Nominal Current/Nominal Voltage | Order No. 1900... |
|------------------------------------|---------------------|------------------|----------------------|---------------------------------|-------------------|--|---------------------------------|-------------------|
| BK.../30/400-6...                  | 24.6 A              | 30 A             | 3NE8 003<br>3NE4 101 | 35 A/660 V<br>32 A/1000 V       | 8566<br>8528      | 3NE8 003<br>3NE4 101                                   | 35 A/660 V<br>32 A/1000 V       | 8566<br>8528      |
| BK.../50/400-6...                  | 41.0 A              | 50 A             | 3NE8 017<br>3NE4 117 | 50 A/660 V<br>50 A/1000 V       | 8567<br>8529      | 3NE8 018<br>3NE4 118                                   | 63 A/660 V<br>63 A/1000 V       | 8575<br>8530      |
| BK.../70/400-6...                  | 57.4 A              | 70 A             | 3NE4 118             | 63 A/1000 V                     | 8530              | 3NE4 120   | 80 A/1000 V                     | 8531              |
| BK.../100/400-6...                 | 82.0 A              | 100 A            | 3NE8 021<br>3NE4 121 | 100 A/660 V<br>100 A/1000 V     | 8573<br>8526      | 3NE8 022<br>3NE4 122                                   | 125 A/660 V<br>125 A/1000 V     | 8576<br>8532      |
| BK.../120/400-6...                 | 98.4 A              | 120 A            | 3NE8 022<br>3NE4 122 | 125 A/660 V<br>125 A/1000 V     | 8576<br>8532      | 3NE8 024<br>3NE4 124                                   | 160 A/660 V<br>160 A/1000 V     | 8700<br>8545      |
| BK.../150/400-6...                 | 123.0 A             | 150 A            | 3NE8 024<br>3NE4 124 | 160 A/660 V<br>160 A/1000 V     | 8700<br>8545      | 3NE8 024<br>3NE4 124                                   | 160 A/660 V<br>160 A/1000 V     | 8700<br>8545      |
| BK.../200/400-6...                 | 164.0 A             | 200 A            | 3NE4 327-0B          | 250 A/800 V                     | 8619              | 3NE4 327-0B  | 250 A/800 V                     | 8619              |

Manufacturer: SIBA

| Power Converter Type<br>BKD or BKF | Phase Current (eff) | Rated DC Current | Phase Fuse  | Nominal Current/Nominal Voltage | Order No. 1900... | Armature Circuit Fuse (with BKF power converters only) | Nominal Current/Nominal Voltage | Order No. 1900... |
|------------------------------------|---------------------|------------------|-------------|---------------------------------|-------------------|--|---------------------------------|-------------------|
| BK.../30/400-6...                  | 24.6 A              | 30 A             | 2038404/32  | 32 A/1000 V                     | 8528              | 2038404/50   | 50 A/1000 V                     | 8529              |
| BK.../50/400-6...                  | 41.0 A              | 50 A             | 2038404/50  | 50 A/1000 V                     | 8529              | 2038404/63   | 63 A/1000 V                     | 8530              |
| BK.../70/400-6...                  | 57.4 A              | 70 A             | 2038404/63  | 63 A/1000 V                     | 8530              | 2038404/80   | 80 A/1000 V                     | -                 |
| BK.../100/400-6...                 | 82.0 A              | 100 A            | 2038404/100 | 100 A/1000 V                    | 8526              | 2038404/125  | 125 A/1000 V                    | 8532              |
| BK.../120/400-6...                 | 98.4 A              | 120 A            | 2038404/125 | 125 A/1000 V                    | 8532              | 2038404/160  | 160 A/1000 V                    | 8545              |
| BK.../150/400-6...                 | 123.0 A             | 150 A            | 2038404/160 | 160 A/1000 V                    | 8545              | -  | -                               | -                 |
| BK.../200/400-6...                 | 164.0 A             | 200 A            | -           | -                               | -                 | -  | -                               | -                 |

b) Connection voltage 3 x 500 V

Manufacturer: SIEMENS

| Power Converter Type<br>BKD or BKF | Phase Current (eff) | Rated DC Current | Phase Fuse  | Nominal Current/Nominal Voltage | Order No. 1900... | Armature Circuit Fuse (with BKF power converters only) | Nominal Current/Nominal Voltage | Order No. 1900... |
|------------------------------------|---------------------|------------------|-------------|---------------------------------|-------------------|--|---------------------------------|-------------------|
| BK.../30/520-6...                  | 24.6 A              | 30 A             | 3NE4 101    | 32 A/1000 V                     | 8528              | 3NE4 101   | 32 A/1000 V                     | 8528              |
| BK.../50/520-6...                  | 41.0 A              | 50 A             | 3NE4 117    | 50 A/1000 V                     | 8529              | 3NE4 118   | 63 A/1000 V                     | 8530              |
| BK.../70/520-6...                  | 57.4 A              | 70 A             | 3NE4 120    | 80 A/1000 V                     | 8531              | 3NE4 120   | 80 A/1000 V                     | 8531              |
| BK.../100/520-6...                 | 82.0 A              | 100 A            | 3NE4 121    | 100 A/1000 V                    | 8526              | 3NE4 122   | 125 A/1000 V                    | 8532              |
| BK.../120/520-6...                 | 98.4 A              | 120 A            | 3NE4 122    | 125 A/1000 V                    | 8532              | 3NE4 124   | 160 A/1000 V                    | 8545              |
| BK.../150/520-6...                 | 123.0 A             | 150 A            | 3NE4 122    | 125 A/1000 V                    | 8532              | 3NE4 124   | 160 A/1000 V                    | 8545              |
| BK.../200/520-6...                 | 164.0 A             | 200 A            | 3NE4 327-0B | 250 A/800 V                     | 8619              | 3NE4 327-0B  | 250 A/800 V                     | 8619              |

Manufacturer: SIBA

| Power Converter Type<br>BKD or BKF | Phase Current (eff) | Rated DC Current | Phase Fuse  | Nominal Current/Nominal Voltage | Order No. 1900... | Armature Circuit Fuse (with BKF power converters only) | Nominal Current/Nominal Voltage | Order No. 1900... |
|------------------------------------|---------------------|------------------|-------------|---------------------------------|-------------------|--|---------------------------------|-------------------|
| BK.../30/520-6...                  | 24.6 A              | 30 A             | 2038404/32  | 32 A/1000 V                     | 8528              | 2038404/50   | 50 A/1000 V                     | 8529              |
| BK.../50/520-6...                  | 41.0 A              | 50 A             | 2038404/50  | 50 A/1000 V                     | 8529              | 2038404/63   | 63 A/1000 V                     | 8530              |
| BK.../70/520-6...                  | 57.4 A              | 70 A             | 2038404/63  | 63 A/1000 V                     | 8530              | 2038404/80   | 80 A/1000 V                     | -                 |
| BK.../100/520-6...                 | 82.0 A              | 100 A            | 2038404/100 | 100 A/1000 V                    | 8526              | 2038404/125  | 125 A/1000 V                    | 8532              |
| BK.../120/520-6...                 | 98.4 A              | 120 A            | 2038404/125 | 125 A/1000 V                    | 8532              | 2038404/160  | 160 A/1000 V                    | 8545              |
| BK.../150/520-6...                 | 123.0 A             | 150 A            | 2038404/160 | 160 A/1000 V                    | 8545              | -  | -                               | -                 |
| BK.../200/520-6...                 | 164.0 A             | 200 A            | -           | -                               | -                 | -  | -                               | -                 |

**5.6.2 Unit Size II**

Connection Voltage 3 x 400 V  
3 x 500 V

Manufacturer: SIEMENS

| Power Converter Type<br>BKD or BKF | Phase Current (eff) | Rated DC Current | Phase Fuse  | Nominal Current/Nominal Voltage | Order No. 1900... | Armature Circuit Fuse (with BKF power converters only) | Nominal Current/Nominal Voltage | Order No. 1900... |
|------------------------------------|---------------------|------------------|-------------|---------------------------------|-------------------|--|---------------------------------|-------------------|
| BK.../300/...-6...                 | 246.0 A             | 300 A            | 3NE3 230-0B | 315 A/1000 V                    | 8620              | 3NE3 230-0B  | 315 A/1000 V                    | 8620              |
| BK.../400/...-6...                 | 328.0 A             | 400 A            | 3NE3 231    | 350 A/1000 V                    | 8621              | 3NE3 233   | 450 A/1000 V                    | 8622              |
| BK.../500/...-6...                 | 410.0 A             | 500 A            | 3NE3 334-0B | 500 A/1000 V                    | 8623              | 3NE3 335   | 560 A/1000 V                    | 8624              |
| BK.../600/...-6...                 | 492.0 A             | 600 A            | 3NE3 335    | 560 A/1000 V                    | 8624              | 3NE3 336   | 630 A/1000 V                    | 8625              |

**5.6.3 Unit Size III**

With unit size III, arm circuit fuses are used that are integrated in the power converter's power stage.

Connection voltage 3 x 400 V  
3 x 500 V

Manufacturer: Ferraz

| Power converter type | Current of an Arm (eff) | Rated DC Current | Arm-Circuit Fuse    | Nominal Current/Nominal Voltage | Order No. 1900... |
|----------------------|-------------------------|------------------|---------------------|---------------------------------|-------------------|
| BKD6/750/...-6...    | 433 A                   | 750 A            | 6.6 URD 32 TTF 0500 | 500 A                           | -                 |
| BKD6/920/...-6...    | 531 A                   | 920 A            | 6.6 URD 32 TTF 0630 | 630 A                           | -                 |
| BKD6/1100/...-6...   | 635 A                   | 1100 A           | 6.6 URD 32 TTF 0700 | 700 A                           | -                 |
| BKF6/850/...-6...    | 491 A                   | 850 A            | 6.6 URD 32 TTF 0630 | 630 A                           | -                 |



### 5.6.4 Unit Size IV

With unit size IV, arm circuit fuses are used that are integrated in the power converter's power stage.

Connection voltage    3 x 400 V  
                                  3 x 500 V

Manufacturer: Ferraz

| Power converter type | Current of an Arm (eff) | Rated DC Current | Arm-Circuit Fuse                     | Nominal Current/Nominal Voltage | Order No. 1900... |
|----------------------|-------------------------|------------------|--------------------------------------|---------------------------------|-------------------|
| BKD6/1550/...-6...   | 895 A                   | 1550 A           | 6,6 URD 33<br>TTF 1000               | 1000 A                          | -                 |
| BKD6/1750/...-6...   | 1010 A                  | 1750 A           | 6,6 URD 33<br>TTF 1250               | 1250 A                          | -                 |
| BKD6/2050/...-6...   | 1184 A                  | 2050 A           | 6,6 URD 32<br>TTF 0700<br>2 parallel | 700 A                           | -                 |
| BKF12/1250/...-6...  | 722 A                   | 1250 A           | 6,6 URD 33<br>TTF 1000               | 1000 A                          | -                 |
| BKF12/1400/...-6...  | 808 A                   | 1400 A           | 6,6 URD 33<br>TTF 1000               | 1000 A                          | -                 |
| BKF12/1650/...-6...  | 953 A                   | 1650 A           | 6,6 URD 33<br>TTF 1100               | 1100 A                          | -                 |

### 5.6.5 Fuse Sizes

Manufacturer: SIEMENS

3NE8..        Size 00,    DIN 43620  
 3NE4 1..     Size 0,     DIN 43620  
 3NE4 3..-0B Size 2,     inside dimension 110 mm  
 3NE3 2..     Size 1,     inside dimension 110 mm  
 3NE3 3..     Size 2,     inside dimension 110 mm

Manufacturer: SIBA

2038404      Size 0    DIN 43620

### 5.6.6 Field Semiconductor Fuses

Connection voltage:    2 x 400 V  
                                  2 x 500 V

5 SD 420 16 A/500 V Size E27  
 5 SD 430 20 A/500 V Size E27  
 5 SD 440 25 A/500 V Size E27  
 5 SD 480 30 A/500 V Size E27

### 5.7 Line Commutators

In accordance with VDE 0160, you must install a line commutator between the power converter and the mains.

The line commutator protects the thyristors from impermissible rates of current rise and reduces the power converter's feedback effect on the feed mains.

- Three-phase current line commutators for 400 V connection voltage;  $U_N = 400 \text{ V } 50/60 \text{ Hz}$ ,  $T_A = 55^\circ\text{C}$ ,  $U_K = 4\%/4.8\%$  with flat terminal, IP00

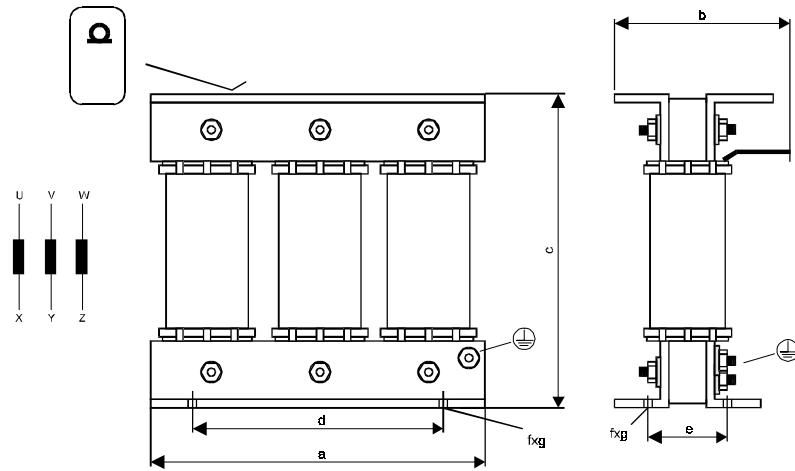
| Commutator<br>DR3-40-4 | Rated DC<br>Current<br>A | a<br>mm | b<br>mm | c<br>mm | d<br>mm | e<br>mm | f x g<br>mm | Flat Terminal<br>Diameter<br>mm x mm | Dim.<br>Drwg. | Weight<br>kg | Losses<br>W | Internal<br>Identifier<br>1900 .. |
|------------------------|--------------------------|---------|---------|---------|---------|---------|-------------|--------------------------------------|---------------|--------------|-------------|-----------------------------------|
| - 0035                 | 35                       | 150     | 105     | 130     | 113     | 65      | 5.8 x 11    | Diameter 7                           | A1            | 6.0          | 45          | - 7466                            |
| - 0040                 | 40                       | 150     | 105     | 130     | 113     | 65      | 5.8 x 11    | Diameter 7                           | A1            | 6.0          | 50          | - 7467                            |
| - 0050                 | 50                       | 150     | 105     | 130     | 113     | 65      | 5.8 x 11    | Diameter 7                           | A1            | 6.0          | 55          | - 7468                            |
| - 0080                 | 80                       | 180     | 130     | 158     | 136     | 75      | 7 x 14      | Terminals 35 mm <sup>2</sup>         | A2            | 9.8          | 65          | - 7822                            |
| - 0100                 | 100                      | 225     | 125     | 200     | 176     | 73      | 7 x 13      | Diameter 9                           | A1            | 12.7         | 90          | - 7471                            |
| - 0120                 | 120                      | 225     | 125     | 200     | 176     | 71      | 7 x 13      | Diameter 9                           | A1            | 13.0         | 100         | - 7472                            |
| - 0160                 | 160                      | 240     | 165     | 210     | 220     | 120     | 9 x 14      | 25 x 4/Diam. 11                      | A1            | 19.0         | 105         | - 7473                            |
| - 0200                 | 200                      | 310     | 170     | 255     | 280     | 106     | 11 x 18     | 25 x 4/Diam. 11                      | A1            | 28.0         | 120         | - 7474                            |
| - 0300                 | 300                      | 310     | 220     | 260     | 280     | 131     | 11 x 18     | 40 x 4/Diam. 14                      | A1            | 50.0         | 170         | - 7475                            |
| - 0400                 | 400                      | 310     | 220     | 260     | 280     | 131     | 11 x 18     | 40 x 4/Diam. 14                      | A1            | 50.0         | 180         | - 7476                            |
| - 0500                 | 500                      | 420     | 260     | 260     | 380     | 161     | 11 x 18     | 40 x 8/Diam. 14                      | A1            | 70.0         | 185         | - 7477                            |
| - 0600                 | 600                      | 420     | 260     | 260     | 380     | 161     | 11 x 18     | 40 x 8/Diam. 14                      | A1            | 70.0         | 300         | - 7478                            |
| - 0750                 | 750                      | 520     | 230     | 400     | 470     | 120     | 11 x 18     | 50 x 10/2x Diam. 14                  | A3            | 110.0        | 350         | - 7479                            |
| - 1050                 | 1050                     | 520     | 240     | 405     | 470     | 150     | 11 x 18     | 50 x 10/2x Diam. 14                  | A3            | 130.0        | 400         | - 7480                            |

- Three-phase current line commutators for 500 V connection voltage;  $U_N = 420 \text{ V ... } 500 \text{ V}$ , 50/60 Hz,  $T_A = 55^\circ\text{C max.}$ ,  $U_K = 4\%/4.8\%$  with flat terminal, IP00

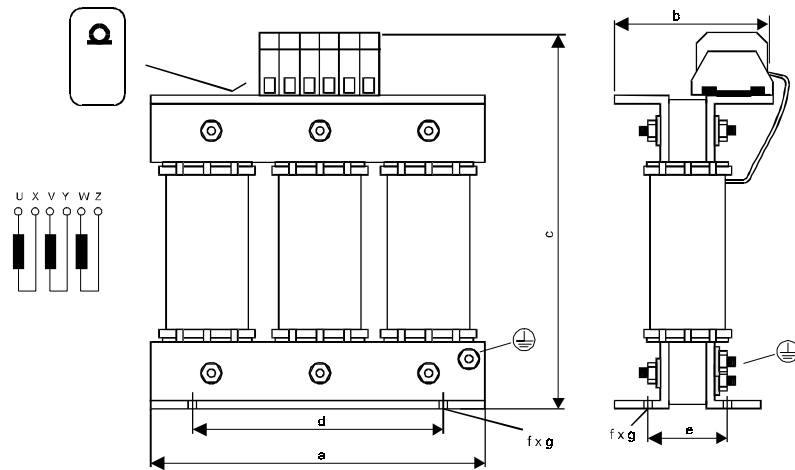
| Commutator<br>DR3-50-4 | Rated DC<br>Current<br>A | a<br>mm | b<br>mm | c<br>mm | d<br>mm | e<br>mm | f x g<br>mm | Flat Terminal<br>Diameter<br>mm x mm | Dim.<br>Drwg. | Weight<br>kg | Losses<br>W | Internal<br>Identifier<br>1900 .. |
|------------------------|--------------------------|---------|---------|---------|---------|---------|-------------|--------------------------------------|---------------|--------------|-------------|-----------------------------------|
| - 0030                 | 30                       | 150     | 105     | 130     | 113     | 65      | 5.8 x 11    | Diameter 7                           | A1            | 6.1          | 30          | - 7481                            |
| - 0050                 | 50                       | 180     | 130     | 155     | 136     | 75      | 7 x 14      | Diameter 7                           | A1            | 9.8          | 50          | - 7482                            |
| - 0070                 | 70                       | 230     | 125     | 200     | 176     | 70      | 7 x 14      | Diameter 9                           | A1            | 13.0         | 65          | - 7483                            |
| - 0100                 | 100                      | 230     | 125     | 200     | 176     | 70      | 7 x 13      | Diameter 9                           | A1            | 13.5         | 85          | - 7484                            |
| - 0120                 | 120                      | 240     | 140     | 210     | 200     | 80      | 8.5         | 25 x 3/Diam. 9                       | A1            | 16.8         | 95          | - 7485                            |
| - 0150                 | 150                      | 240     | 160     | 210     | 200     | 100     | 8.5         | 25 x 3/Diam. 11                      | A1            | 20.5         | 95          | - 7486                            |
| - 0200                 | 200                      | 270     | 170     | 230     | 200     | 102     | 10 x 18     | 30 x 4/Diam. 11                      | A1            | 27.5         | 135         | - 7487                            |
| - 0300                 | 300                      | 300     | 210     | 265     | 240     | 125     | 9 x 14      | 30 x 5/Diam. 14                      | A1            | 47.5         | 170         | - 7488                            |
| - 0400                 | 400                      | 360     | 230     | 315     | 300     | 150     | 9 x 14      | 40 x 5/Diam. 14                      | A1            | 73.0         | 225         | - 7489                            |
| - 0600                 | 600                      | 470     | 240     | 370     | 320     | 155     | 9 x 14      | 40 x 8/Diam. 14                      | A1            | 95.0         | 315         | - 7490                            |
| - 0800                 | 800                      | 520     | 240     | 410     | 470     | 150     | 9 x 14      | 50 x 10/2x Diam. 14                  | A3            | 110.0        | 365         | - 7491                            |
| - 1000                 | 1000                     | 480     | 300     | 420     | 360     | 170     | 14 x 19     | 50 x 10/2x Diam. 14                  | A3            | 140.0        | 445         | - 7492                            |

Dimensional Drawings and Diagrams of Connections

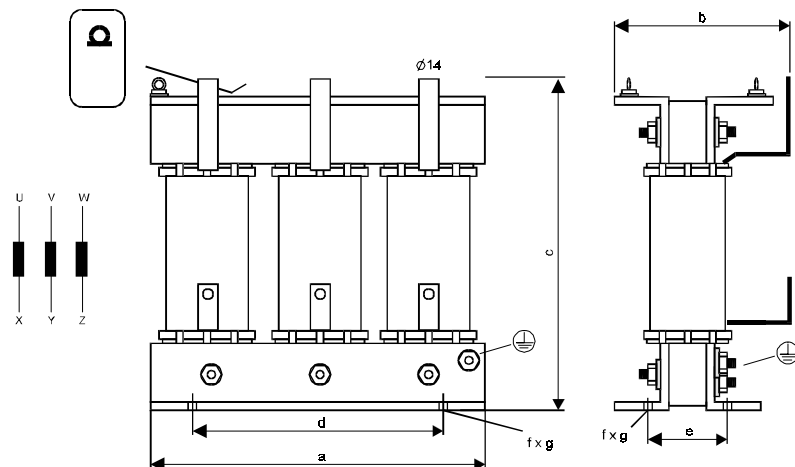
Dimensional drawing and diagram of connections A1



Dimensional drawing and diagram of connections A2



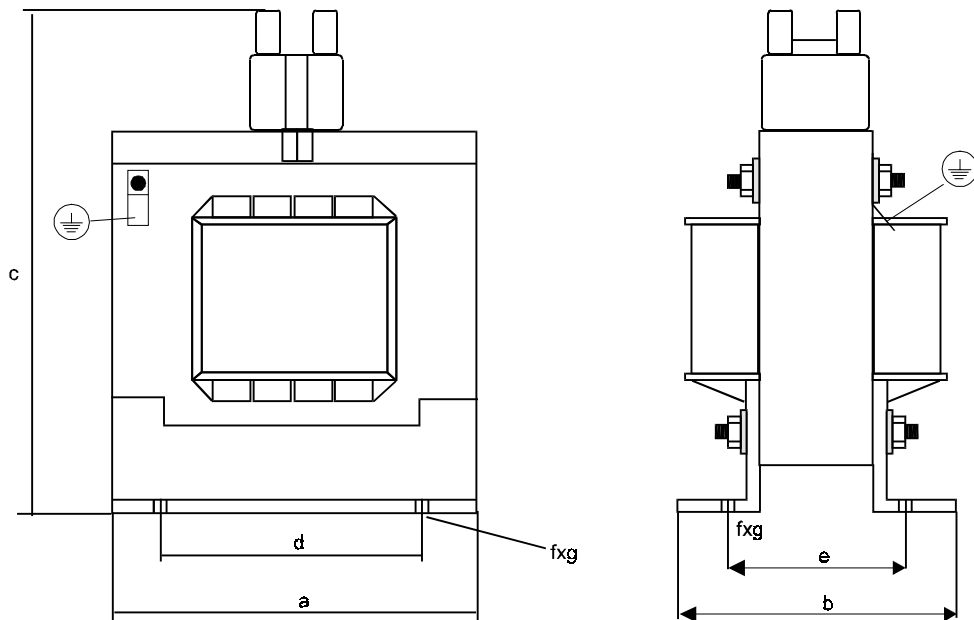
Dimensional drawing and diagram of connections A3



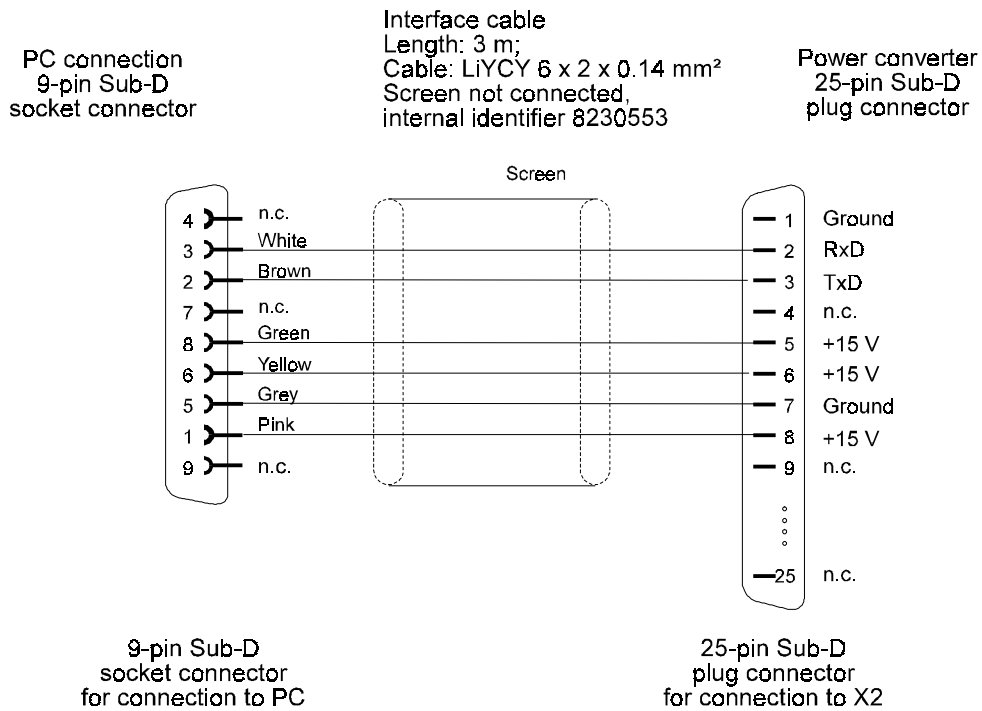
- Single-phase line commutator for 400 V or 500 V connection voltage  
 $U_N = 230 \text{ V } 50/60 \text{ Hz}$ ,  $U_K = 3 \%$ ,  $T_A = 55 \text{ }^\circ\text{C}$ , IP00, one commutator per incoming line

| Commutator<br>DR1-23-3 | Rated DC<br>Current<br>A | a  | b  | c   | d  | e    | f x g    | Weight<br>kg | Losses<br>W | Internal<br>Identifier<br>1900 .. |
|------------------------|--------------------------|----|----|-----|----|------|----------|--------------|-------------|-----------------------------------|
|                        |                          | mm | mm | mm  | mm | mm   | mm       |              |             |                                   |
| 0003                   | 3                        | 56 | 47 | 72  | 44 | 34.5 | 7 x 3.5  | 0.4          | 6           | - 7460                            |
| 0008                   | 8                        | 67 | 55 | 81  | 55 | 41   | 6 x 4.5  | 0.75         | 8           | - 7461                            |
| 0015                   | 15                       | 85 | 64 | 97  | 64 | 49   | 9 x 4.8  | 1.65         |             | - 7462                            |
| 0025                   | 25                       | 96 | 80 | 112 | 84 | 64   | 11 x 5.8 | 2.3          |             | - 7463                            |

Dimensional Drawing for Field Line Commutators





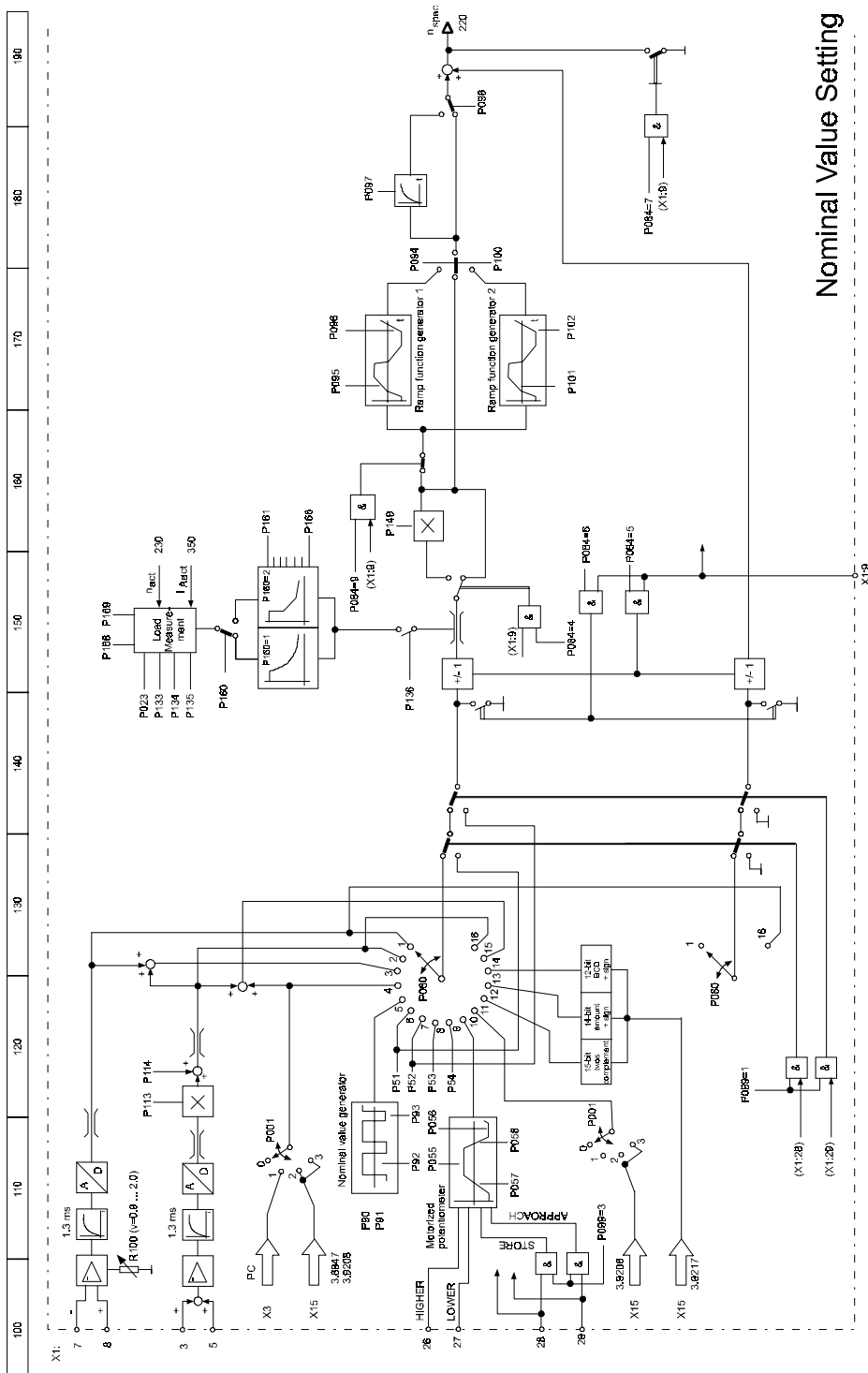


2) Operation Software

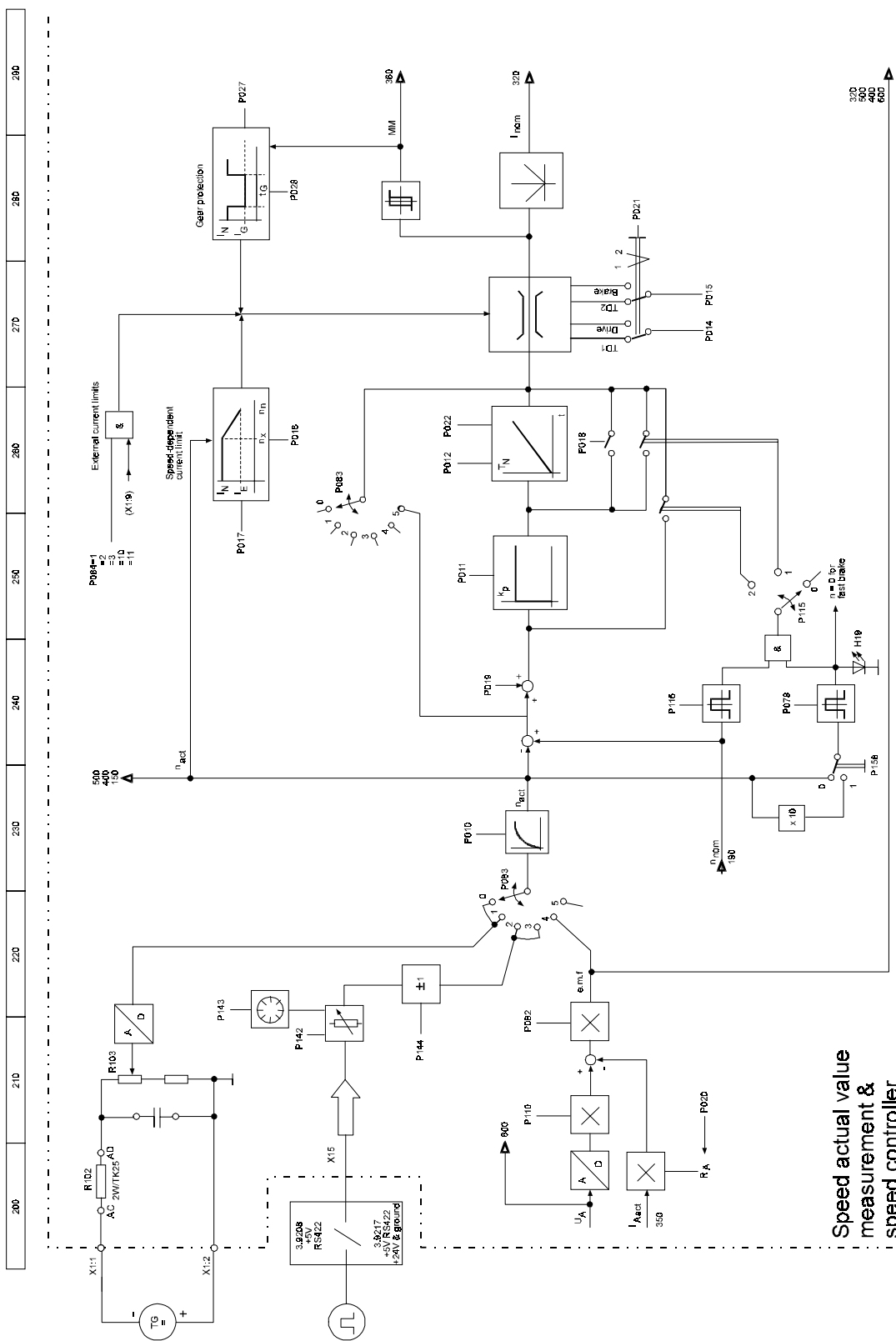
A floppy disk is available containing the software necessary for operating the equipment using a PC. On your order, please state the power converter's software version, which is shown on the two EPROMs at ports D501 and D502 on microprocessor PCB 3.8942 (state S04.xx).

# 6 FUNCTIONS

## 6.1 Function Plans



Nominal Value Setting



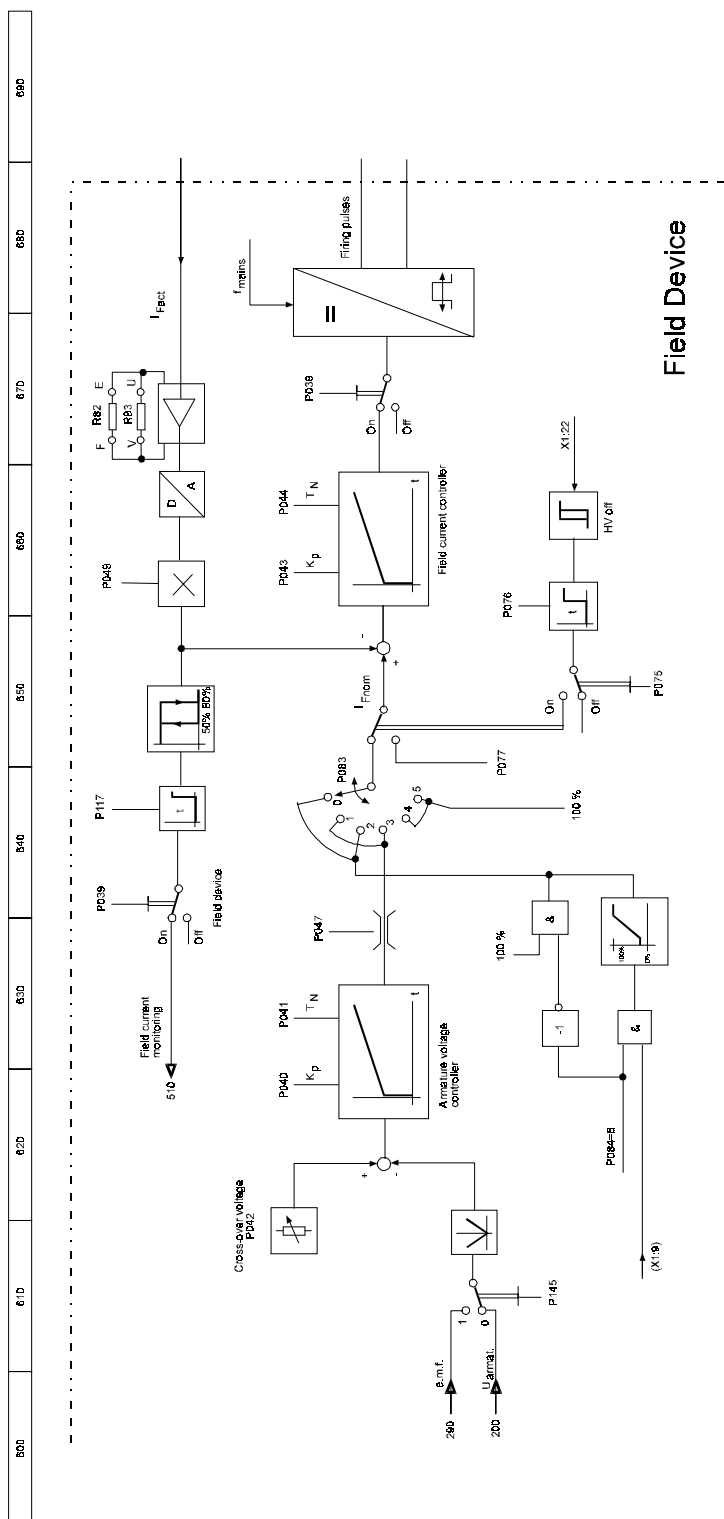
Speed actual value measurement & speed controller











## 6.2 Specifying the Controller Structure

Parameter: P083=0 ... 5

| Value                   | Meaning  |
|-------------------------|--|
| 0                       | Speed control using analog tachometer and constant field<br>Speed matching using R103            |
| 1                       | Speed control using analog tachometer and field weakening<br>Speed matching using R103           |
| 2<br>(S04.09 and above) | Speed control using actual value incremental encoder and constant field (see also P142 to P144)  |
| 3<br>(S04.09 and above) | Speed control using actual value incremental encoder and field weakening (see also P142 to P144) |
| 4                       | e.m.f. control using constant field  |
| 5                       | Current control using constant field   |

- **Speed control using analog tachometer**

P083 = 0, 1

Tachometer adaptation is carried out in two places:

- Coarse adaptation using R102  
Calculate the maximum tachometer voltage,  $U_{TG}$  and select a resistance value from the table below.
- If there are several options, always use the lower value:

| R102               | 6.8k    | 10k     | 15k      | 22k      | 27k      | 33k      |
|--------------------|---------|---------|----------|----------|----------|----------|
| Tachometer voltage | 25 V..  | 40 V..  | 60 V..   | 80 V..   | 100 V..  | 120 V..  |
| $U_T$ at $n_{max}$ | .. 50 V | .. 80 V | .. 110 V | .. 150 V | .. 200 V | .. 230 V |

- Carry out fine adaptation at commissioning using potentiometer R103

Actual value smoothing:

- Hardware: C17 (on LSP [solder bridge] AE - AF)  
Default value: 0.47  $\mu$ F
- Software: P010  
Default value: 10 ms

Positions of R102, R103 and C17 on PCB 3.8934:



With P083 = 1 additionally

P042: Set release/armature nominal voltage

P047: Specify minimum field current

$$I_{Fmin}/I_{Fmax} \times 0.80$$

P145: Field weakening mode

0: Armature voltage

1: e.m.f.

When operating the motor in the field weakening range, the power converter carries out closed-loop control to the constant armature voltage if P145 is set to 0.

This means that the controller corresponds to the familiar conditions of analog controllers BKF 12/.../2000 and BKF 12/.../3000.

If P145 = 1, the controller carries out closed-loop control to the constant motor e.m.f. (e.m.f. =  $U_{armature} \pm I_A \times R_A$ ; negative when driving, positive when braking).

We recommend: P145 = 1

• **Speed control using actual value incremental encoder**

P083 = 2, 3

Conditions:

- InterBus-S interface board, 3.9208 version 02 with encoder evaluation, suitable for encoders with two 90° phase-shifted differential impulses and 5-V supply from the power converter  
or  
Input/output expansion daughterboard, 3.9217  
Suitable for encoders with two 90° phase-shifted differential impulses and 5-V supply from the power converter as well as for encoders with two 90° phase-shifted differential impulses with separate 24-V supplies  
or  
Daughterboard RS484 with USS protocol or as a CS31 system bus interface, 3.9493, versions 02 and 04 with encoder evaluation.
- Power converter software version S04.09 and higher

## Parameters

- P142: Nominal speed with incremental encoder

Range: 500 RPM ... 6000 RPM S04.09 and above  
 100 RPM ... 6000 RPM S04.11 and above

- P143: Number of graduations of incremental encoder

Range: 250 ... 4096

Achievable maximum speed in dependence on number of encoder graduations:

$$n_{\max} = \frac{60 \cdot 100}{P143} \text{ [RPM]} \quad \text{S04.09 and above}$$

$$n_{\max} = \frac{60 \cdot 300}{P143} \text{ [RPM]} \quad \text{S04.25 and above}$$

- P144: Polarity reversal of incremental encoder

This is needed if the directions of rotation of the motor and the encoder are different, due to the way in which the incremental encoder is mounted.

Actual value smoothing P010  
 Default value: 10 ms

With P083 = 3 additionally

- P042: Set release armature nominal voltage

- P047: Minimum field current  
 Specify  $I_{Fmin}/I_{Fmax} \times 0.80$

P145: See previous page

- **e.m.f. control with constant field**

P083 = 4 (default setting)

Speed adaptation using

- P082: Armature voltage matching  
 Range: 0.90 ... 1.10

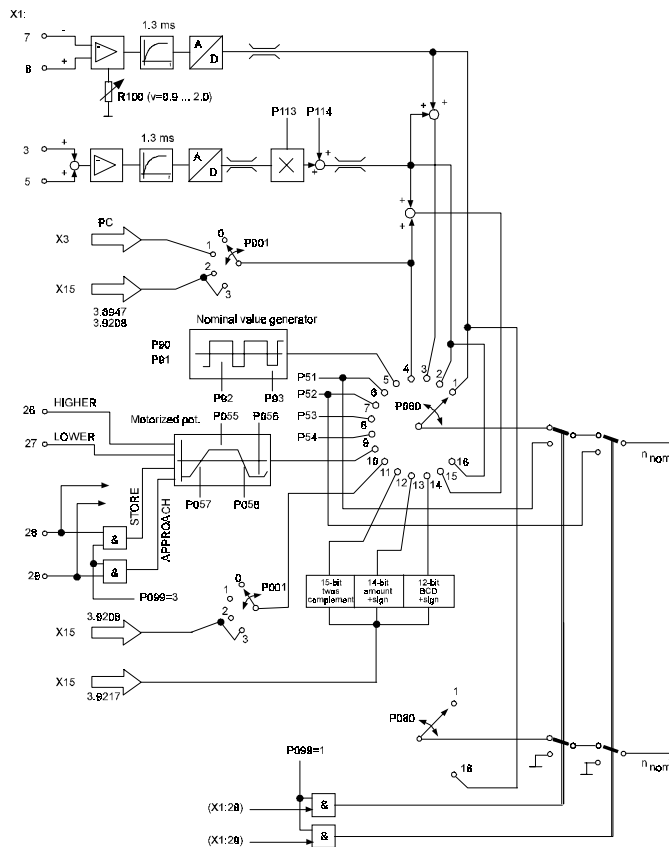
- P110: Armature/mains voltage  
 Range: 0.50 ... 1.21

Actual value smoothing P010  
 Default value: 10 ms

- **Current control with constant field**

P083 = 5

### 6.3 Nominal Value Assignment



- Nominal value source

Parameter: P080 = 0...16

You can assign the speed in an analog or digital fashion (serial or parallel) as well as in the form of the total of the analog and serial digital values.

If you use nominal value sources 12, 13 and 14, note that the system does not accept a new value until it has been pending in a stable fashion at the input for at least four controller cycles (approximately 15 ms).

Internally, the maximum nominal values are limited to the specified format.

You can use parameter P050 to show the current speed nominal value on the power converter's display. With values greater than 100%, the display flashes and indicates that the software limit at the nominal value input is active.



- P080 = 1    Analog nominal value  
Differential amplifier input with nominal value adaptation by means of potentiometer R100 in the range 0.9 ... 2.0 of the set specified voltage value. Terminal X1:7 has an inverting effect, terminal X1:8 has a non-inverting one. Nominal value adaptation is set at the factory to a gain of 1. With different specified voltage values, you must adjust R100 such that when setting the maximum specified voltage value (with the drive disabled!), display parameter P050 = 100% is indicated.
- P080 = 2    Analog nominal value  
Non-inverting summing amplifier with nominal value adaptation by means of potentiometer P113 in the range 0.00 ... 2.00 and offset setting (P114) in the range -100%...+100%. Terminal for nominal value 1 at X1:3 and nominal value 2 at X1:5; reference voltage BSA at X1:4,6.
- P080 = 3    Analog nominal value  
Formed from the nominal values at the differential amplifier (nominal value source 1) and at the summing amplifier (nominal value source 2), the software limits the resulting nominal value to +100% or -100%, the scaling and the offset are the same as before (R100, P113, P114).
- P080 = 4    Serial nominal value setting  
Setting the nominal value using a PC or a controller (an interface board, such as the 3.8947 or 3.9208, is necessary). Using parameter P050, you can set serial nominal values in the range -100%...+100%. With PC setting, the resolution is 0.1%. After a controller inhibit and a subsequent controller enable, you must reenter the serial nominal value.
- P080 = 5    Nominal value generator  

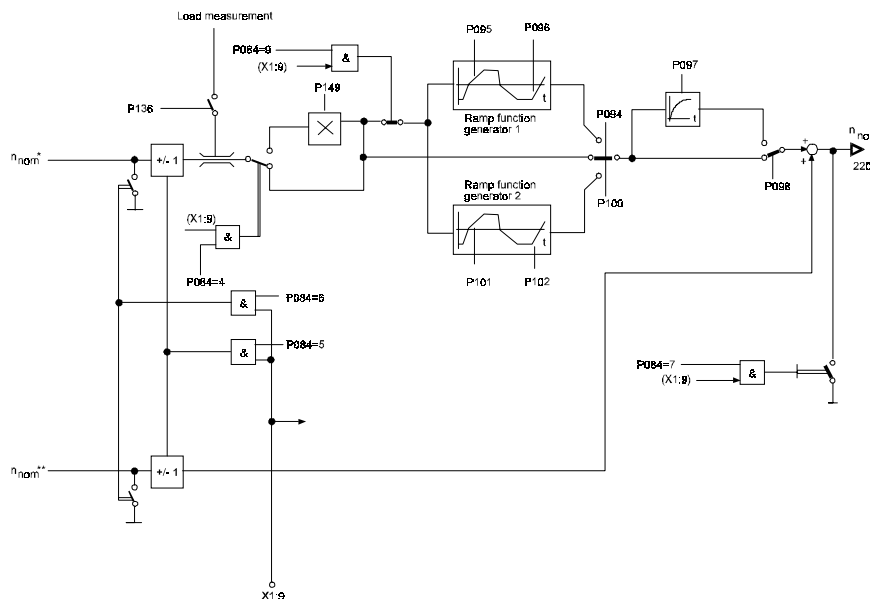
|  |                        |
|--|------------------------|
| P090: Int. nominal value generator for nominal value 1 | range -100%...+100%    |
| P091: Int. nominal value generator for nominal value 2 | range -100%...+100%    |
| P092: Time for nominal value 1                         | range 0.1 s ...100.0 s |
| P093: Time for nominal value 2                         | range 0.1 s ...100.0 s |
- P080 = 6    Internal nominal value 1  
Can be set via P051 in the range -100%...+100%; the set value of P051 can be used for inching (print machine option) by programming switching input X1:28 (P099=1). The inching function means that the system switches to internal nominal value 1, regardless of the programmed nominal value source. At switchover, the system automatically switches in ramp function generator 1 to prevent nominal value step-changes. On cancelling the inching function, the original nominal value comes into effect again.

- P080 = 7 Internal nominal value 2  
Can be set via P052 in the range -100%...+100%; the set value of P052 can be used for inching by programming switching input X1:29 (P099=1). The inching function means that the system switches to internal nominal value 2, regardless of the programmed nominal value source. At switchover, the system automatically switches in ramp function generator 2 to prevent nominal value step-changes. On cancelling the inching function, the original nominal value comes into effect again.
- P080 = 8 Internal nominal value 3  
Can be set via parameter P053 in the range -100%...+100%
- P080 = 9 Internal nominal value 4  
Can be set via parameter P054 in the range -100%...+100%
- P080 = 10 Motorized potentiometer function  
Refer to 6.7.2 Additional Switching and Control Inputs, motorized potentiometer function
- P080 = 11 Nominal value setting using dual-port RAM, 16-bit no protocol.  
Can be used in conjunction with InterBus-S daughterboard, 3.9208 only.
- P080 = 12 Parallel nominal value setting  
Can be used with daughterboard 3.9217 only.  
Value: 15-bit twos complement  
Permissible value range: \$ 3FF0 to \$ 4010 (where \$ is the prefix for hexadecimal numbers)
- P080 = 13 Parallel nominal value setting  
Can be used with daughterboard 3.9217 only.  
Value: 14-bit and sign  
Permissible value range: \$ 0 to \$ 3FF0 (where \$ is the prefix for hexadecimal numbers)  
If bit no. 15 = 1, the system interprets the value as a negative number (amount + sign)
- P080 = 14 Parallel nominal value setting  
Can be used with daughterboard 3.9137 only.  
Value: 12-bit and sign. Decimal nominal value setting (amount + sign)  
Permissible value range: 0 to 999 (percentual setting, 0.0 ... 99.9%).  
If bit no. 15 = 1, the system interprets the value as a negative number.  
If you set a code in one of the three places that is not a decimal number, the system does not accept the nominal value.
- P080 = 15 Total of nominal value sources 2 and 4
- P080 = 16 Analog nominal value  
Formed from the nominal values at the differential amplifier (nominal value source 1) and at the summing amplifier (nominal value source 2), the scaling and the offset are the same as before.  
Difference from nominal value source 3: The system feeds the nominal value from the differential amplifier directly to the speed controller and the nominal value from the summing amplifier is applied via the ramp function generator to the speed encoder.  
Parameter P149 has no effect on this nominal value source!

- Inching see above under P080 = 6,7

See P051, P052: Internal nominal values 1, 2

See 6.7.2.: Additional switching and control inputs: programmable switching inputs X1:28 and X1:29, parameter P099 = 1



- Nominal value multiplication

There are two options:

- Multiplication of the analog nominal values at the non-inverting amplifier input (terminal X1:3,5) with nominal value source P080 = 2, 3 and 15, 16 by the value of parameter P113: 0.00 ... 2.00
- Multiplication of the nominal value pending at the ramp function generator input by the parameter value of P149 if P084 (programmable input) = 4 and a low signal is applied to terminal X1:9 (see the diagram above).

This function works with nominal value sources P080 = 1...15, but not with P080 = 16!

Parameter P149 "nominal value multiplier" has a value range of 0.00 ... 1.00, see 6.7.2:

Additional switching and control inputs, Programmable input X1:9: P084 = 4

- Reverse direction of rotation

With P084 = 5, the system inverts the polarity of the nominal value at the ramp function generator input if a low signal is applied to terminal X1:9. See 6.7.2: Additional switching and control inputs, Programmable input X1:9: P084 = 5

- Nominal value zeroing

With P084 = 6 or 7, the system sets the speed nominal value to  $n = 0$  if a high signal is applied to terminal X1:9.

Two variants are available:

- P084 = 6 sets the nominal value at the ramp function generator input to 0. As a result, the ramp function generator's shutdown ramp remains active and the drive is synchronously decelerated.
- With P084 = 7, the ramp function generator output is set to 0. In this case, the drive is shut-down at the unit current limit.

In both cases, when the nominal value zeroing command is cancelled, the system approaches the original nominal value via the acceleration ramp set on the ramp function generator. See 6.7.2: Additional switching and control inputs, Programmable input X1:9 : P084 =6, 7

- Ramp function generator

Two ramp function generators are available:

- Ramp function generator 1:
 

|  |                        |
|--|------------------------|
| P094: "Ramp function generator 1":                   | Range: On/Off          |
| P095: "Ramp function generator 1" Acceleration time: | Range: 0.0 ... 850.0 s |
| P096: "Ramp function generator 1" Deceleration time: | Range: 0.0 ... 850.0 s |
- Ramp function generator 2
 

|  |                        |
|--|------------------------|
| P100: "Ramp function generator 2":                   | Range: On/Off          |
| P101: "Ramp function generator 2" Acceleration time: | Range: 0.0 ... 850.0 s |
| P102: "Ramp function generator 2" Deceleration time: | Range: 0.0 ... 850.0 s |

**NOTE:**

When you select the Inching function, the system automatically switches to ramp function generator 2.

- Ramp function generator stop

With P084 = 9 and a high signal at X1:9, the ramp function generator's output is kept at the current value.

- S-ramp generator

With the S-ramp generator activated, the system additionally routes the nominal value via a first-order time-delay element that is located before the speed controller. This first-order time-delay element ensures a smooth speed curve at the drive.

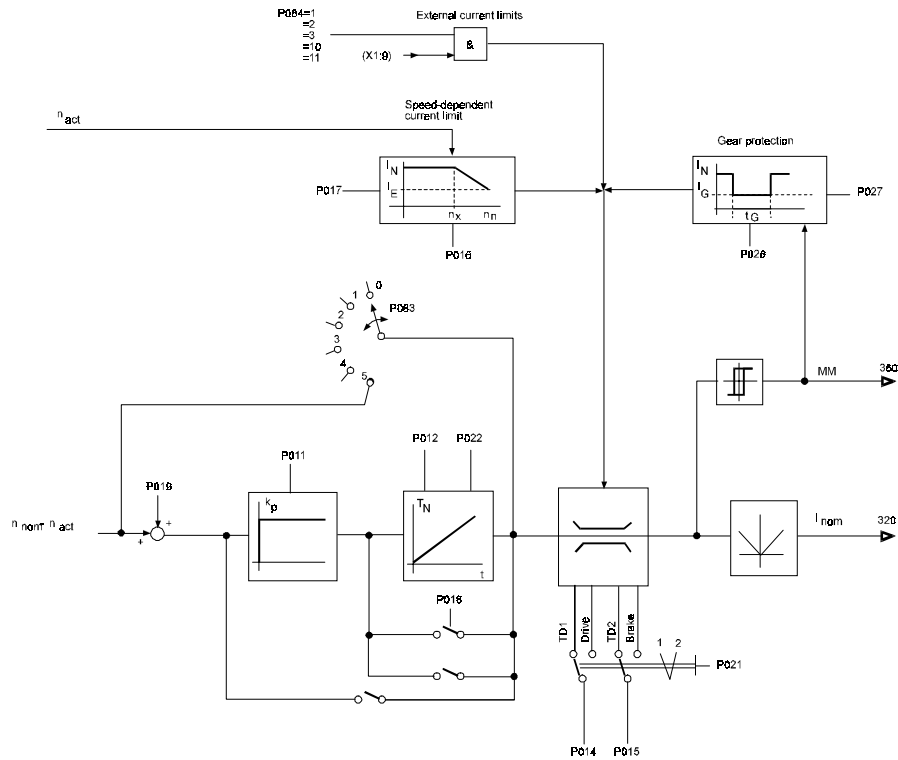
The S-ramp generator makes it possible to smooth the hook in the characteristic curve at the end of the ramp function generator's acceleration and deceleration ramp, thus preventing any torque surges and oscillations that may occur.

- |   |                            |
|---|----------------------------|
| P098: "S-ramp generator"                  | Range: On/Off              |
| P097: "Time constant of S-ramp generator" | Range: 0.01 sec...6.50 sec |

Setting note: Time constant P097 is usually set to a maximum of 20% of the acceleration and deceleration time at the ramp function generator (P095/P096 or P101/P102).

## 6.4 Current Limits

### 6.4.1 Current Limits for the Armature



#### Internal current limits

- Armature current adaptation P025  
Setting the maximum unit output current

$$P025 = \frac{\text{Max. permissible armature current of motor}^1}{\text{Unit's rated current}^2}$$

1. Maximum permissible armature current or rated motor current (S1, S3, S6 operation) according to motor rating plate
2. Rated current according to unit rating plate or display parameter P000

The armature current set with P025 is shown in display parameter P062, "actual value of armature current" as 100%.

- Additional current limits for both torque directions and driving and braking

P014: Current limit for torque direction 1 Range: 0%...100%  
 P015: Current limit for torque direction 2 Range: 0%...100%  
 P021: Current limit switchover Range: 1...2

| Value | Meaning  |
|-------|--|
| 1     | P014 = Current limit for torque direction 1<br>P015 = Current limit for torque direction 2 |
| 2     | P014 = Current limit for driving<br>P015 = Current limit for braking                       |

- Speed-dependent current limiting

This limit is needed with motors that are run in the overload range at the black band. Refer to the motor's rating plate for the power converter setting values.

P016:  $n_x$ , start of speed-dependent current limit Range: 0%...100% of  $n_{nom}$   
 P017:  $I_{end}$ , end of speed-dependent current limit Range: 0%...100% of  $I_{Anom}$

- Gear protection

Limiting the armature voltage on changing the torque direction for a selectable time period. May be needed to protect some of the drive's mechanical components, e.g. the gears.

P027: Gear protection current Range: 0% ... 100% of  $I_{Anom}$   
 P028: Gear protection time Range: 0 ms ... 500 ms

The time for which the current limit set using P027 is to be in effect following a change of torque direction.

**External Current Limitation**

Parameterization: P084 = 1, 2, 3, 10, 11  
 Programmable input X1:9 as an analog input

P084: possible current limitation modes:

- a) 0 ... +10 V corresponds to 0 ... 100% current limit  
 < 0 V corresponds to 0% current limit

| Value | Meaning  |
|-------|--|
| 0     | No function, input deactivated   |
| 1     | Current limit for torque direction 1<br>0 V to +10 V corresponds to 0 to 100% current limit<br>< 0 V corresponds to 0% current limit |
| 2     | Current limit for torque direction 2 (same setting as 1)   |
| 3     | Current limits for torque directions 1 and 2 (variable)  |

- b)

|                          |   |
|--------------------------|---|
| 10<br>(S04.21 and above) | 0 V to + 10 V corresponds to 0 to 100% external current limit for torque direction 1 and to 0% for torque direction 2<br>0 V to -10 V corresponds to 0 to 100% external current limit for torque direction 2 and to 0% for torque direction 1 |
| 11<br>(S04.21 and above) | 0 V to + 10 V corresponds to 0 to 100% external current limit for torque direction 2 and to 0% for torque direction 1<br>0 V to -10 V corresponds to 0 to 100% external current limit for torque direction 1 and to 0% for torque direction 2 |

**6.4.2 Current Limitation at the Field Current Converter**

- Field current adaptation P049

$$P049 = \frac{\text{Motor field current}}{\text{Field unit rated current}}$$

The field current that you set using P049 is shown in parameter P064, "Actual value of field current" as 100%.

- Minimum field current P047

This is only needed in the case of controller structures with field weakening control: P083 = 1, 3

$$P047 = 80\% \times \frac{\text{Min. motor field current}}{\text{Max. motor rated current}}$$

The factor 80% is needed so that at the maximum speed there is still enough controller reserve available. Ignoring this may lead to the armature voltage assuming impermissibly high values.

## 6.5 Monitoring

The relay contacts can be loaded with a maximum of 24 V/1 A, and a minimum of 1 V/1 mA. The maximum potential to electronic ground that is allowed is 50 V.

### 6.5.1 Ready for Use Relay K1

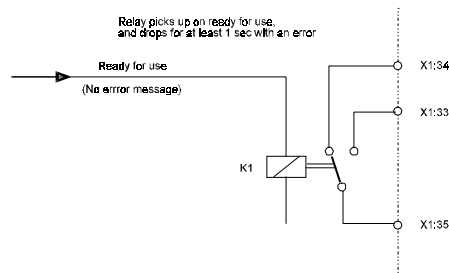
Relay K1 picks up in the ready for use condition. If there is an operational disturbance, the relay drops for at least one second. In the case of an operational disturbance, relay K1 "Main contactor ON" on PCB 3.8942 also drops and, with this, deenergizes the power unit.

#### NOTE

In this unit, two relays are designated as K1!

Relay K1 "Main contactor ON" is on field controller board 3.8942, (X2:3,4,5).

Relay K1 "Ready for use" is on CPU board 3.8934 (X1:33,34,35).



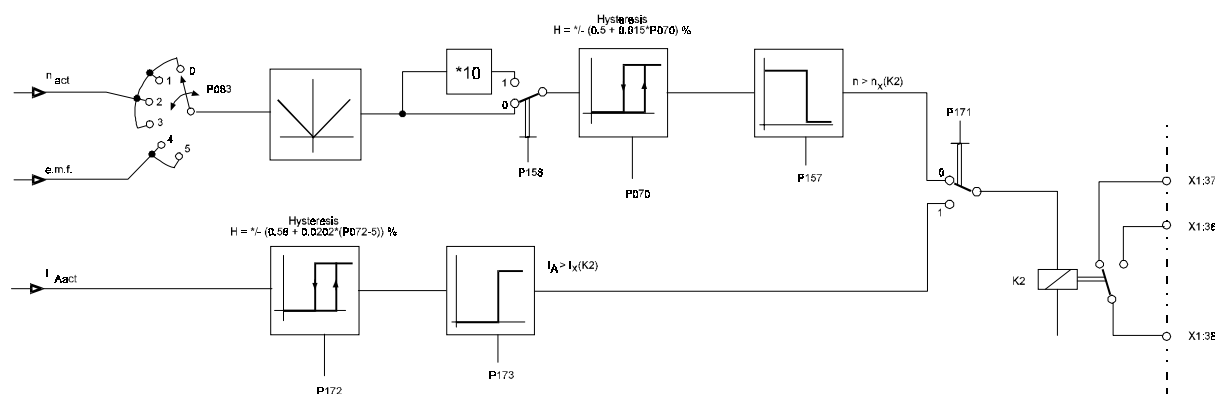
Relay K1 on the CPU board drops in the case of all error messages numbered 01 to 99. In addition, activation of the relay leads to an internal controller inhibit (the drive is instantaneously torque-free). Error numbers above 100 are messages that do not interrupt ongoing operation. The system merely displays them and they do not lead to a controller inhibit or to operational disturbance K1. For a description of errors, refer to chapter 9.3, List of Errors.



### 6.5.2 Relay K2

Parameterize using P171: "Relay output K2"

| Value | Meaning  |
|-------|--|
| 0     | $n > n_x$ message. The switching threshold is specified using P070.  |
| 1     | $I_A \geq I_x$ message. The switching threshold is specified using parameter P172 and refers to the maximum equipment output current (P025). |



- Speed monitoring via relay K2

Programming of relay K2  
 Switching threshold  $n > n_x$   
 Multiplier for P070

Shutdown delay of K2/0  
 Hysteresis

P171 = 0  
 P070 = ... % of the maximum speed  
 P158 = 0: P070 = 1 ... 105% of  $n_{nom}$   
 P158 = 1: P070 = 0.1 ... 10.5% of  $n_{nom}$   
 P157 = 0.00 ... 30.00 s  
 $H = \pm (0.5 + 0.015 * P070)$  in % of  $n_{nom}$   
 Contact X1:36 - 38 is closed at  $n > n_x$

- Armature current monitoring via relay K2

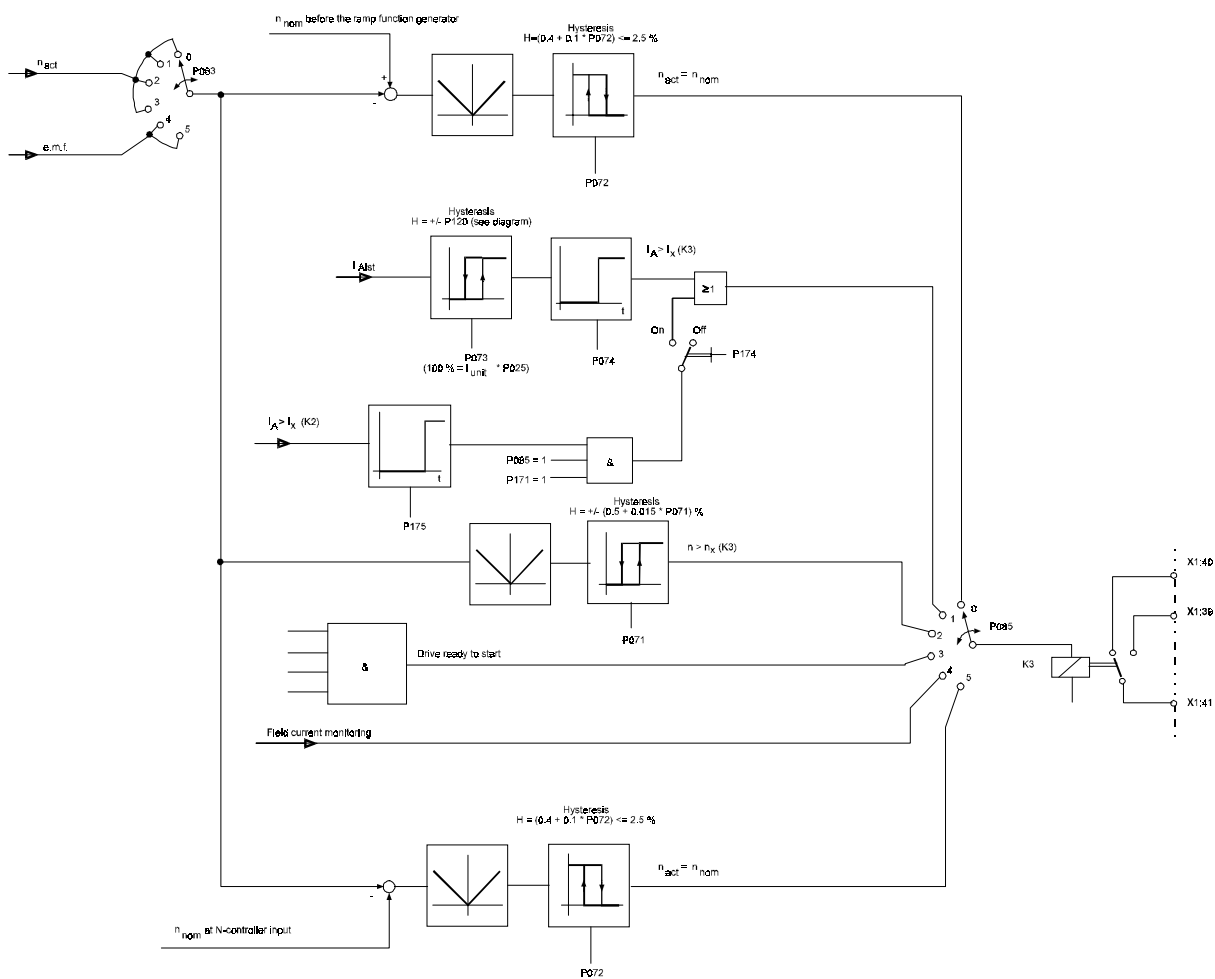
Programming of relay K2  
 Switching threshold  $I_A > I_x$   
 Response time  $I_A > I_x$   
 Release time  
 Hysteresis

P171 = 1  
 P172 = 5 ... 120% of P025  
 P173 = 0.0 ... 30.0 s  
 100 ms constant  
 $H = \pm (0.58 + 0.0202 * (P072-5))$  in % of  $I_{Anom}$   
 Contact X1:36 - 38 is closed at  $I_A > I_x$

### 6.5.3 Relay K3

Parameterize using parameter P085: "Relay output K3"

| Value                   | Meaning   |
|-------------------------|---|
| 0                       | Operating speed reached<br>$n_{act} = n_{set}$ at the ramp function generator input   |
| 1                       | Armature current monitoring $I_A > I_x$   |
| 2                       | Speed monitoring $n > n_x$  |
| 3<br>(S04.04 and above) | Drive ready to start  |
| 4                       | Field monitoring  |
| 5                       | Operating speed reached<br>$n_{act} = n_{nom}$ at the ramp function generator input,<br>$n_{nom}$ after the ramp function generator input |



- Operating speed reached Message ( $n_{set} = n_{act}$ ) using relay K3, optionally:

- $n_{set}$  before the ramp function generator      P085 = 0
- $n_{set}$  after the ramp function generator      P085 = 5

Switching threshold  $n_{set} = n_{act}$       P072 = 1 ... 60% of  $n_{nom}$

Hysteresis       $H = \pm (0.4 + 0.1 * P072) \leq 2.5\%$  of  $n_{nom}$

Contact X1:39 - 41 is closed (relay picked up) at  $n_{nom} = n_{act}$

- Armature current monitoring via relay K3

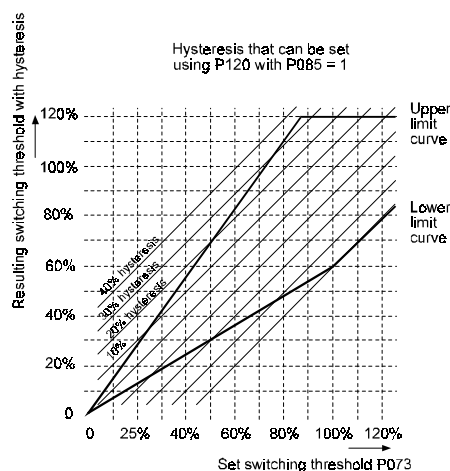
Programming of relay K3      P085 = 1

Switching threshold  $I_A > I_x$       P073 = 5 ... 120% of P025

Response time  $I_A > I_x$       P074 = 0.0 ... 30.0 s

Release time      100 ms constant

Hysteresis      P120 =  $\pm 1$  ... 40% of P025



$I_A > I_x$ .

- Speed monitoring via relay K3

Programming of relay K3      P085 = 2

Switching threshold  $n > n_x$       P071 = 1 ... 105% of  $n_{nom}$

Hysteresis       $H = \pm (0.5 + 0.015 * P071)$  in % of  $n_{nom}$

Contact X1:39 - 41 is closed (relay picked up) at  $n > n_x$

- Drive ready to start message via relay K3

Programming of relay K3

P085 = 3

Drive ready to start means that

main contactor is ON  
pulse enable, cancellation of fast brake and unit ready to start have been given

Contact X1:39 - 41 is closed, i.e. relay picks up as soon as the following enables are pending:

on the PC  
and then on the unit:

F8 and F9 to ON (P001 = 1, 2 or 3)  
pulse enable: X1:25  
fast brake: X1:24  
main contactor ON X1:22

Relay drops (contact X1:40 - 41 is closed) when:

on the PC  
or:

F8 or F9 are OFF  
in the case of fast braking or main contactor OFF

or:

in the case of an operational disturbance

The relay does not drop when the controller enable is removed.

- Field current monitoring using relay K3

Programming of relay K3

P085 = 4

Contact X1:39 - 41 is closed (relay K3 picked-up) if the field current is  $> 80\% I_{Fset}$ . K3 drops at a field current of  $< 50\% I_{Fset}$ .

You cannot change the switching threshold. The function is independent of all the enables.

### 6.5.4 Linking the Armature Current Monitoring Relays of K2 and K3

Parameter P174:

| Value | Meaning  |
|-------|--|
| ON    | This is only effective if relays K2 and K3 are assigned with the function $I_A \geq I_x$ (P085 = 1 and P171 = 1).    |
| OFF   | K2 and K3 switch independently of one another. This means that two separate current monitoring relays are available. |

Relay K2 picks up if the armature current exceeds the threshold you set with P172 and the timeout set with P173 is exceeded. If the armature current now no longer exceeds the threshold you set with P172, relay K3 also picks up after the timeout you set with P175 even if the armature voltage does not reach the threshold set for K3 (P073).

Condition: You must set the switching threshold for K2 (P172) lower than that for K3 (P073).

Setting:

Linking relay K2/1 to K3/1

P174 = ON

Linking the functions

P175 = 0 ... 900 s

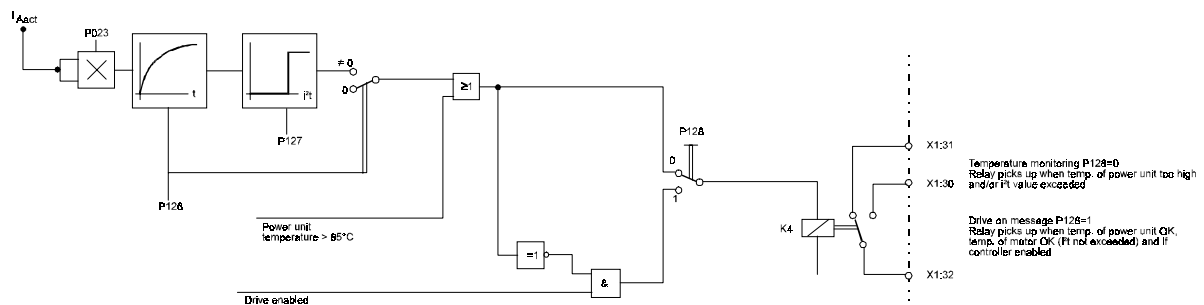
Switching threshold  $I_A > I_x$  for K2

P172 = 5 ... 120% of P025

Switching threshold  $I_A > I_x$  for K3

P073 = 5 ... 120% of P025

### 6.5.5 Relay K4



Parameterize using parameter P128: "Relay output K4"

| Value | Meaning                |
|-------|------------------------|
| 0     | Temperature monitoring |
| 1     | Drive ON               |

- Temperature monitoring using relay K4 P128 = 0

Contact X1:30 - 32 is closed (K4 picked-up) if the temperature of the power unit is too high or the motor's I<sup>2</sup>t value is exceeded.

The temperature of the power unit is shown by parameter P063, with parameter P069 showing the motor's I<sup>2</sup>t value. This value allows you to draw conclusions about the temperature of the motor.

Contact X1:31 - 32 is closed (K4 has dropped) if the temperature of the power unit is below the release threshold of 85 °C and the motor's I<sup>2</sup>t is fallen below.
- Drive ON message with relay K4

Contact X1:30 - 32 is closed (K4 picked-up) if the temperature of the power unit is OK, the I<sup>2</sup>t value has not been reached and the controller is enabled.

Contact X1:31 - 32 is closed if either the temperature of the power unit is too high, the motor's I<sup>2</sup>t value is exceeded, or the controller is not enabled.
- Setting the I<sup>2</sup>t monitoring relay (P126 and P127)

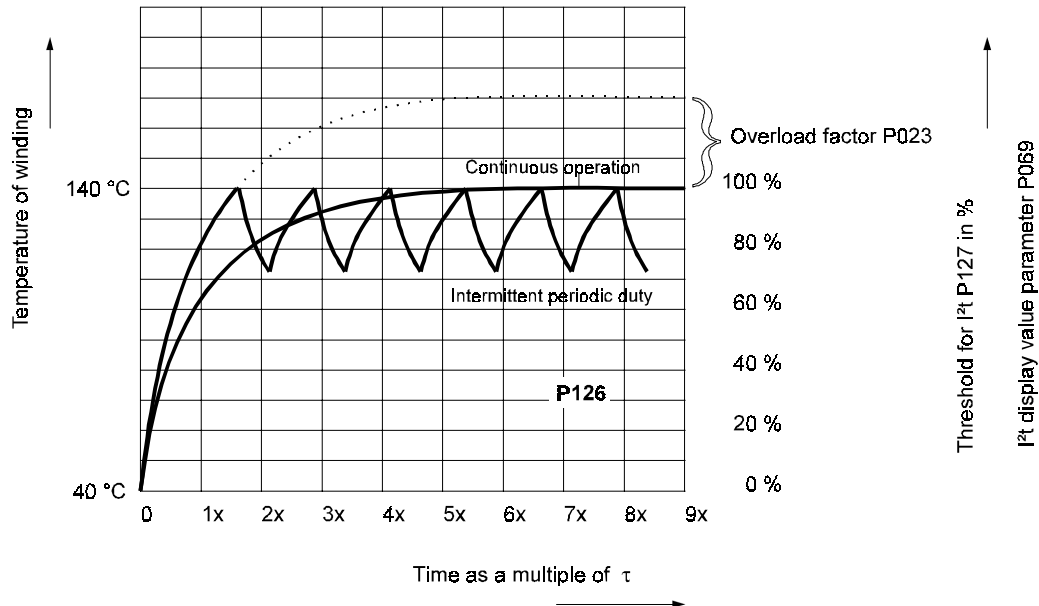
The I<sup>2</sup>t value is calculated from the armature current and the time, starting from the time of switch-on. The system displays the value via P069 and reports via relay K4 the instant when the preset value of P127 is exceeded.

As an alternative, it is also possible to externally analyze the I<sup>2</sup>t by means of one of the measuring channels (P088 or P089 = 37).

The parameters below must be determined from the motor and operating data:

- Armature current, controlled  $P025 = 0.5 \dots 1.0$
- $P025 = \frac{\text{Max. motor current in A}}{\text{Rated unit current in A}}$
- Motor's therm. time constant  $\tau$   $P126 = 0 \dots 180 \text{ min}$
- Motor's overload factor  $P023 = 0.5 \dots 1.0$
- $P023 = \frac{\text{Rated motor current (S1)}}{\text{Motor overload current (Sx mode)}}$
- I<sup>2</sup>t release threshold  $P127 = 50 \dots 110\%$   
usually set to 100%, since the temperature of the winding rises too much at 110%

Example:



Motor temperature in continuous operation (S1) and intermittent periodic duty.

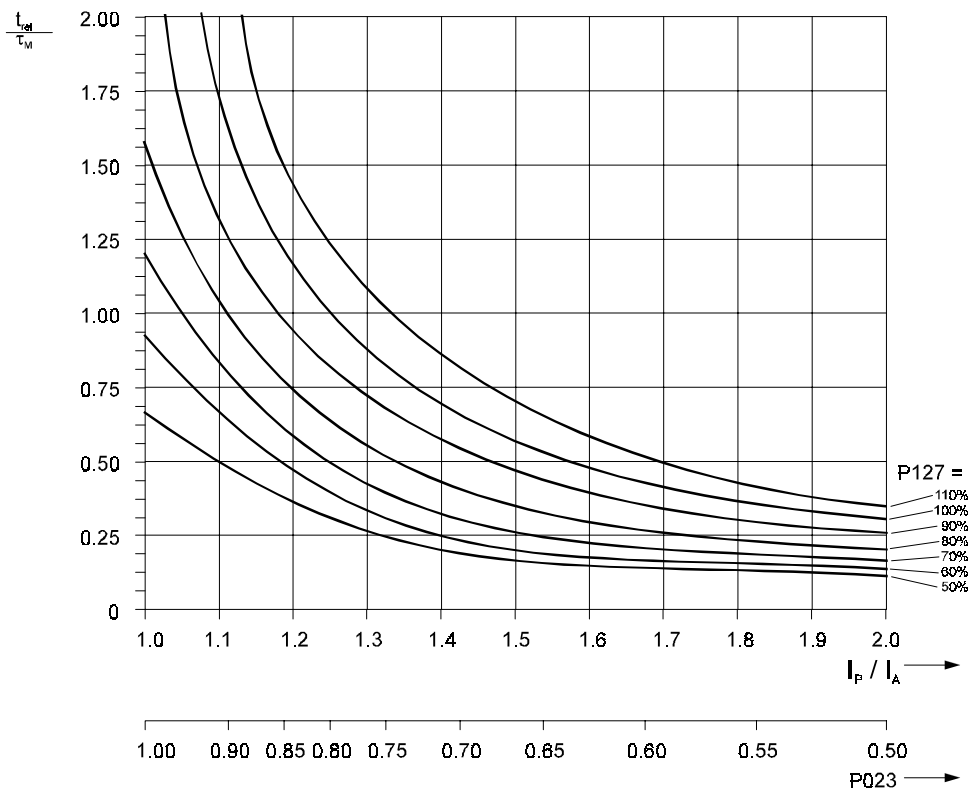
τ: Motor's thermic time constant

Determining the release time  $t_{rel}$

- The release time  $t_{rel}$  is dependent on the motor's thermic time constant,  $\tau_M$ , on the overload factor, P023, and on the release threshold P127.
- You can calculate the release time or the time constant as follows:

$$\frac{t_{rel}}{\tau_M} = -\ln \left\{ 1 - \frac{P127}{100\%} \cdot (P023)^2 \right\}$$

- Motor's overload factor:  $P023 = 0.5 \dots 1.0$
- I<sup>2</sup>t release threshold  $P127 = 50 \dots 110\%$



Factor  $t_{rel}/\tau_M$  in dependence on the overload factor P023 and the release threshold P127

If you reset the system or switch the power supply to the electronics on or off, the calculated value is lost. The system then assumes that the motor is not under load.

### 6.5.6 Displaying and Checking the Relay Functions



**6.6 Analog Output on Measuring Channels 1 ... 4**

P088: Analog output channel 1  
 PCB 3.8934: X1:11, reference potential at X1:12

P089: Analog output channel 2  
 PCB 3.8934: X1:13, reference potential at X1:14

Output standardized to 0 ... ± 10 V, refresh rate 3.3 ms, resolution 150 mV  
 scaling of channel 2 via P125

P130: Analog output channel 3  
 Option of: PCB 3.9201: X4:1, reference potential at X4:2  
 or: PCB 3.9217: X7B:2, reference potential at X7B:1

P131: Analog output channel 4  
 Option of: PCB 3.9201: X4:3, reference potential at X4:4  
 or: PCB 3.9217: X7B:4, reference potential at X7B:3

Output standardized to 0 ... ± 10 V, refresh rate 3.3 ms, resolution 150 mV  
 scaling of channel 4 via P132

| Value | Meaning                               | Polarity   |      |
|-------|---------------------------------------|--|------|
|       |                                       | Pos.   | Neg. |
| 1     | Speed nominal value                   | Pos.   | Neg. |
| 2     | Ramp function generator output        | Pos.   | Neg. |
| 3     | Nominal value at speed controller     | Pos.   | Neg. |
| 4     | Speed actual value                    | Neg.   | Pos. |
| 5     | Armature voltage                      | Pos.   | Neg. |
| 6     | e.m.f.                                | Pos.   | Neg. |
| 7     | Speed controller output               | Pos. with torque dir. 1, neg. with torque dir. 2 |      |
| 8     | Amount of speed controller output     | Pos.   |      |
| 9     | Amount of $I_{act}$ ( $ +I_{Aact} $ ) | Pos.   |      |
| 10    | Current controller output             |  |      |
| 11    | Power                                 | Pos. with driving, neg. with braking             |      |
| 12    | Field current nominal value           | Pos.   |      |
| 13    | Field current actual value            | Pos.   |      |
| 14    | Field current controller output       | Pos.   |      |
| 15    | Converter input                       |  |      |
| 16    | Converter output                      |  |      |
| 17    | Speed controller for P component      |  |      |
| 18    | Speed controller for I component      |  |      |
| 19    | Torque indicator                      | 0 V with torque dir. 1, +5 V with torque dir. 2  |      |

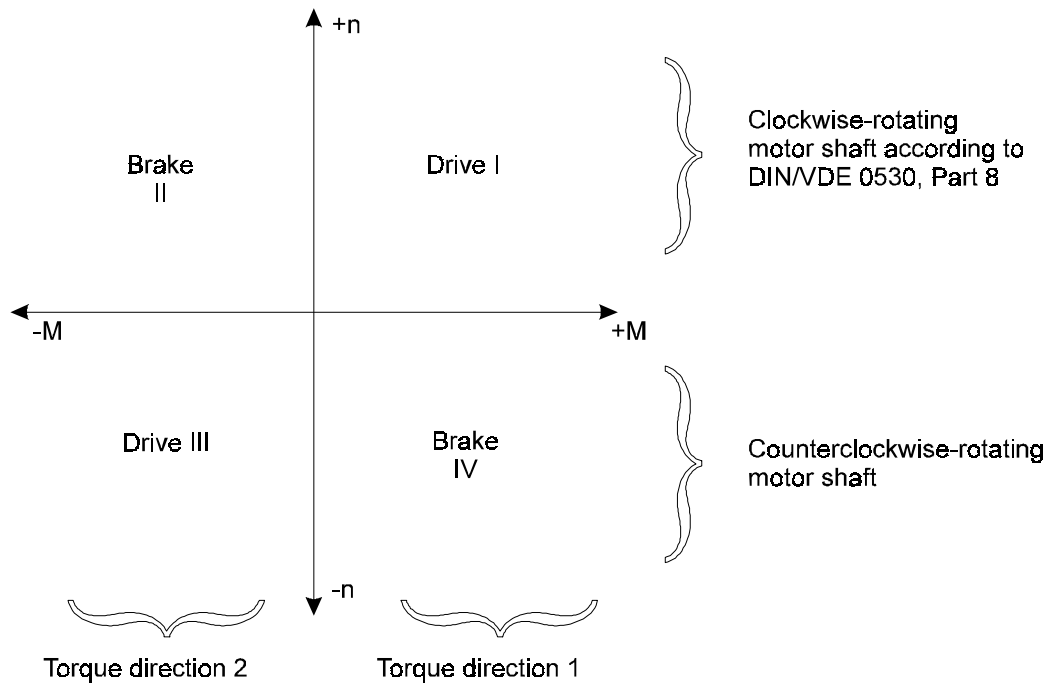


| Value                    | Meaning   | Polarity  |
|--------------------------|---|---|
| 20                       | ZIL (second pulse suppr.)   | 0 V with ZIL, otherwise +5 V                              |
| 21                       | Pulsating limit   |   |
| 22                       | Pulsating curve   |   |
| 23                       | e.m.f. correction   |   |
| 24                       | $I \times R$  | Pos.  |
| 25                       | $U_{\alpha}$  |   |
| 26                       | Queue   |   |
| 27                       | Current controller for P component  |   |
| 28                       | Current controller for I component  |   |
| 29                       | Field current controller for P component  |   |
| 30                       | Field current controller for I component  |   |
| 31                       | Field voltage controller for P component  |   |
| 32                       | Field voltage controller for I component  |   |
| 33                       | Controller inhibit/enable   | 0 V with inhibit, +5 V with enable                        |
| 34                       | Current limit   | Pos./neg.   |
| 35                       | Amount of speed actual value  | Pos.  |
| 36                       | Armature current actual value (+/-)   | Pos. with TD1, neg. with TD2                              |
| 37                       | $I^2t$ value  | Pos.  |
| 38                       | Driving/Braking   | Driving: +5 V, braking: 0 V                               |
| 39                       | Polarity of $n_{act}$   | 0 V with $n_{nom} = pos$                                  |
| 40<br>(S04.05 and above) | Load torque   |   |
| 41<br>(S04.05 and above) | Permissible $n_{nom}$ with load measurement   |   |
| 42<br>(S04.05 and above) | Threshold of field monitoring   |   |
| 43<br>(S04.22 and above) | Torque indicator, inverted to 19  | +5 V with torque direction 1, 0 V with torque direction 2 |
| 44<br>(S04.27 and above) | Current reserve $(-1) \times (I_{act} - 10 V)$<br>With a current actual value of 0 V (test point 9), this test point has an output voltage of +10 V; with a current actual value of +10 V, its output value is 0 V. |   |
| 45<br>(S04.28 and above) | $-  I_{aact} $ inverted to test point 9   | Neg.  |
| 46<br>(S04.28 and above) | Inverted to test point 36   | Neg. with TD1, pos. with TD2                              |
| 47<br>(S04.29 and above) | Mains voltage, e.g. +4.00 V corresponds to a mains voltage of 400 V <sub>eff</sub>  |   |

TD1: Torque direction 1, indicated by LED H18/green

TD2: Torque direction 2, indicated by LED H17/yellow

Definition of Four-Quadrant Operation:



With positive speed values, LED H18/green (TD1) is lit-up, when the motor is being driven (driving torque direction 1 = operation in quadrant I). If you wire the motor and the power converter with the polarity of the armature, field and tachometer connections in accordance with the connection suggestion, the motor shaft rotates clockwise.

## 6.7 Controlling the Power Converter, Sequence of Switching On and Off

On terminal strip X1 on the microprocessor board, there are four switching inputs available (X1:22 ... 25) for controlling the unit.

By means of these terminals, you can enable or inhibit the controller, and bring the drive to a defined stop and switch it off.

When operating the power converter with a service PC (e.g. at commissioning) or via one of the possible interfaces, these functions are also available as software commands.

A total of five additional switching inputs are available for advanced control tasks; three of these inputs have parameterizable functions:

### 6.7.1 Enables on the Power Converter and Main Contactor Control

Four enable signals:

- |                          |   |                    |       |
|--------------------------|---|--------------------|-------|
| • Main contactor ON (HE) | / | Main contactor OFF | X1:22 |
| • Controller enable (RF) | / | Controller inhibit | X1:23 |
| • Cancel fast brake      | / | Fast brake (SH)    | X1:24 |
| • Pulse enable (IF)      | / | Pulse inhibit      | X1:25 |

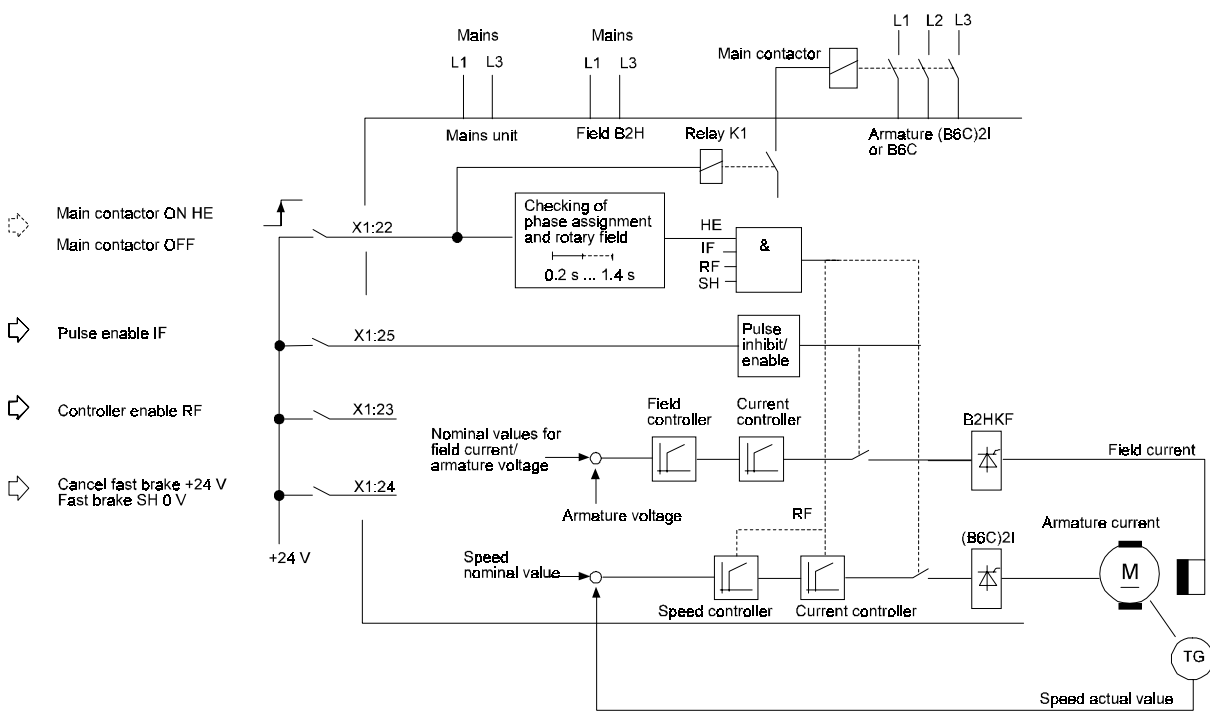
The enable commands are logically ANDed:

The power converter is enabled if X1:23, 24, 25 are connected to +24 V and, in addition, a switching operation from 0 V  $\Rightarrow$  +24 V takes place at X1:22. Normally, input X1:22 is edge-triggered; during operation with a service PC or via an interface board, it can be parameterized as a static signal input.

The power converter is disabled as soon as a terminal is connected to 0 V or is open.

|               |     |                         |
|---------------|-----|-------------------------|
| Signal level: | ON  | +24 V (+15 V ... +30 V) |
|               | OFF | 0 V (0 V ... +5 V)      |

Input resistance:  $R_i = 3 \text{ k}\Omega$



• **Controlling the Unit with Communication Source P001=0: Keypad on Power Converter**

The power converter is run in this mode if no service PC is connected and no interface boards are present to link to an external bus system.

Main contactor ON

Switching input X1:22  
 Enable: Edge control 0 V ⇒ +24 V  
 Disable: 0 V or open contact

Function:

Enable: Relay K1 on the PCB for field and mains unit supply 3.8942 picks up and connects the power unit to the mains via the main contactor, unless there is an error condition.  
 This always takes place with P124=1, even if other enables are still missing.  
 To enable the unit with P124 = 2, you must specify "Cancel fast brake" before "Main contactor ON".

**P124 Main Contactor/Controller Inhibit Function**

| Value | Meaning  |
|-------|--|
| 1     | Fast brake<br>Main contactor stays on,<br>Controller inhibit at $n < n_x$ (P078) switched-off  |
| 2     | Fast brake<br>In addition, the main contactor is switched-off at $n < n_x$ (P078),<br>at enabling, Cancel fast brake must be applied <b>before</b> Main<br>contactor ON. |

After Main contactor ON, the system waits approximately 70 ms at a mains frequency of 50 Hz (approximately 55 ms at 60 Hz) before checking the phase assignment of the power unit connection, the field connection and the mains unit (electronics supply). Additionally, phase failure and rotary field monitoring are active. Measuring takes approximately 130 ms at 50 Hz. Due to the different pick-up times of the contactors used for mains supply (caused by the switching capacity, etc.), the system repeats the measuring procedure (waiting and measuring times) up to seven times until an error message is generated, with the maximum delay amounting to approximately 1.4 seconds at 50 Hz. You must consider these times (minimum of 0.2 s and maximum of 1.4 s) assuming that the Main contactor ON contact was the last one to be applied in the enable sequence.

Input " Main contactor ON" is edge-triggered: this means you cannot permanently connect it to +24 V. At this input, a switching operation must **always** take place to enable the power converter.

**NOTE**

Unit sizes III and IV:

In the case of units up to and including software version 04.16, if you are not going to use the function of relay K1, "Main contactor ON" on the power converter on PCB 3.8942 (terminals X2: 3 ... 5), you must wait at least five seconds after switching in mains unit (X2:1, 2) before you may connect the power unit to the mains.

Disable:

The drive is switched torque-free and, once the armature current has dropped to zero, the power unit is disconnected from the mains via the mains contactor. The drive coasts to a standstill without being braked.

In this case, contacts X1:23 and X1:24 do not affect the power converter.

**NOTE**

After opening the Main contactor ON contact, you may not close it again until the time set with P146 plus 150 ms has elapsed so that a controller enable can be carried out. If you ignore this safety period, the power converter remains disabled!

You must also take this time into account with an armature circuit switchover (two motors alternately on one power converter).

Ignoring this results in the error message "Tachometer breakage"

Controller enable

Switching input: X1:23  
 Enable: +24 V  
 Inhibit: 0 V or open contact

Function:  
 Enable: Undelayed enabling of the firing pulses and of the controller if the other enables are pending.  
 Inhibit: Unbraked off; the drive is switched torque-free. During deceleration, the power converter can be enabled again.  
 If, after opening the contact, you additionally cancel "Main contactor ON", the power converter's power unit is disconnected from the mains.

Fast brake

Switching input: X1:24  
 Enable: +24 V  
 Inhibit: 0 V or open contact

Function:

**P123 Emergency Stop: Ramp/Max. Torque**

| Value | Meaning   |
|-------|---|
| 1     | Fast brake at maximum torque  |
| 2     | Fast brake on the ramp (only if a ramp function generator is switched on: P094 or P100) |

**P124 Main Contactor/Controller Inhibit Function**

| Value | Meaning   |
|-------|---|
| 1     | Fast brake<br>Main contactor stays on,<br>controller inhibit switched-off at $n < n_x$ (P078)   |
| 2     | Fast brake<br>In addition, the main contactor is switched off at $n < n_x$ (P078),<br>at enabling, Cancel fast brake must be applied <b>before</b> Main contactor ON. |

a) P123=1, P124=1

Enable: "Cancel fast brake"  
 Undelayed enabling of the controller if the other enables are pending.

Inhibit: "Fast brake"  
 Fast brake at maximum torque up to  $RPM = 0$  (P078); at  $n = 0$  the controller is disabled; the main contactor stays on. The fast brake function can be interrupted: On reenabling, the system accelerates to the previous speed on the ramp function generator's ramp, assuming that the generator is switched on.

b) P123=2, P124=1

**Enable:** Undelayed enabling of the controller if the other enables are pending.

**Inhibit:** Fast brake via the ramp function generator's ramp up to RPM = 0 (P078); at n = 0 the controller is disabled, the main contactor stays on.  
The fast brake function can be interrupted.

c) P124=2

**Enable:** For starting, "Cancel fast brake" must be applied first, then Main contactor ON by means of an L ⇒ H edge change.

**Inhibit:** Option of fast brake at maximum torque or via the nominal value integrator's ramp (P123=1 or 2) up to RPM = 0, at n = 0 there is an internal controller inhibit and the main contactor drops via K1 on PCB 3.8942. This procedure cannot be interrupted.

**Reclosure:** Cancel fast brake, switch main contactor OFF and then ON again by means of an L ⇒ H edge change.

Pulse inhibit – For emergency use only –

**Switching input:** X1:25

**Enable:** +24 V

**Inhibit:** 0 V or open contact

**Enable:** Undelayed enabling of the firing pulses and of the controller if the other enables are pending.

**Inhibit:** Regardless of the operating status, the system switches off the pulses for triggering the power units of the armature and the field after 3 ms. Pulse enable/inhibit are completely hardware functions that intervene directly in the output stage (pulse generation). Pulse enable can lead to the fuse dropping. In a worst case situation, the thyristors can be damaged (inverter tilting)! You should therefore use this function as a high-level switch-off facility only.

• **Controlling the Unit Using Communication Source P001 = 1, 2 or 3:**

- Service PC
- Control via interface board
- Control via interface board and keyboard

The hardware enables at control inputs X1:22 ... 24 are logically ANDed with the serial enables via PC or controller.

Pulse disable is routed directly to the control block and cannot be serially influenced.

While PC enables are pending, you can only operate the power converter by means of the hardware contacts.

- \* **Controller enable**  
Contact X1:23 and F7 key on the PC  
In the case of an operational disturbance, the serial enable on the power converter is set to "OFF", but only if parameter P079 (main contactor edge) is "OFF".
- \* **Fast brake**  
Contact X1:24 and F8 key on the PC
- \* **Main contactor ON**  
Contact X1:22 and F9 key on the PC

Main contactor ON

**Function:** Refer to Main contactor ON with communication source P001 = 0

**Enable:** Optionally by means of an edge change or a static signal (P079).  
In the case of P079 = ON, an L ⇒ H switching operation must be carried out at input X1:22 for starting up and following an error and its removal. You must first press F9 on the PC and then apply the switching edge at X1:22.  
In the case of P079 = OFF, the main contactor stays on. After removing the error, you can switch on the drive again by means of the serial enable (F7).  
Switching off the main contactor edge is an option at commissioning, since you can completely operate the drive (enables and nominal values) from the PC if all the hardware enables are switched HIGH.

**Inhibit:** The drive is switched torque-free. After the armature current has dropped to zero, the power unit is disconnected from the mains via the mains connector. The drive coasts to a standstill without being braked.  
  
In this case, contacts X1:23 and X1:24 do not affect the power converter.

Controller enable Refer to controller enable with communication source P001 = 0

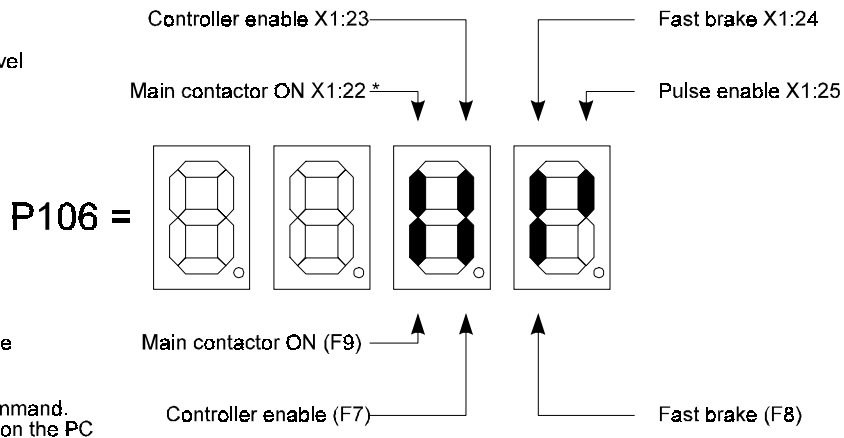
Fast brake Refer to fast brake with communication source P001 = 0

Pulse inhibit Refer to pulse inhibit with communication source P001 = 0



• **Showing Controller Enables on the Power Converter's Display Using Parameter P106**

The upper bars show the status at input terminals X1:22 ... 24. The bars light up with a HIGH level



Lower bars show the status of the serial commands from the PC or the controller. The bars light up with an ON command. F7, F8 and F9 are function keys on the PC

\* Display of the static status. The switching edge at X1:22 may still be missing for controller enable

**6.7.2 Additional Switching and Control Inputs**

Terminals X1:9, 26, 27, 28, 29

• **Programmable Input X1:9**

Parameter: P084=0 ... 13 (0 = no function)

As an analog input Possible current limiting modes:

- a) 0 ... +10 V corresponds to 0 ... 100% current limit  
< 0 V corresponds to 0% current limit

| Value | Meaning  |
|-------|--|
| 1     | Current limit of torque direction 1 variable<br>Current limit of torque direction 2 = not influenced |
| 2     | Current limit of torque direction 2 variable<br>Current limit of torque direction 1 = not influenced |
| 3     | Current limit of torque directions 1 and 2 variable, symmetrical                                     |

b)

|                          |  |
|--------------------------|--|
| 10<br>(S04.21 and above) | 0 V to +10 V corresponds to 0 to 100% external current limit for TD1 and 0% for TD2<br>0 V to -10 V corresponds to 0 to 100% external current limit for TD2 and 0% for TD1 |
| 11<br>(S04.21 and above) | 0 V to +10 V corresponds to 0 to 100% external current limit for TD2 and 0% for TD1<br>0 V to -10 V corresponds to 0 to 100% external current limit for TD1 and 0% for TD2 |

Analog specification of the field current nominal value

|                         |  |
|-------------------------|--|
| 8<br>(S04.05 and above) | Analog specification of the field current nominal value<br>+10 V corresponds to 100% field current nominal value (referred to P049),<br>-10 V to +1 V and terminal open corresponds to 10% field current nominal value. The field current nominal value is accepted with controller structures without field weakening only.<br>(see also parameters P046, P049, P083) |
|-------------------------|--|

As a switching input :

LOW level: 0 V or input open (approx. 0 ... 5 V)

HIGH level: 24 V (approx. 7.5 ... 30 V)

Switch-on hysteresis: approx. 5 V

Input resistance: 55 kΩ

With a HIGH level, the described action is carried out (except with P084 = 4)!

Nominal value multiplication:

| Value                   | Meaning  |
|-------------------------|--|
| 4<br>(S04.15 and above) | The current nominal value is multiplied by the value of P149 once/while a LOW level is pending at terminal X1:9. This has no effect with P080 = 16 |

Polarity reversal of the nominal value

|   |   |
|---|---|
| 5 | Nominal value polarity reversal switch (on the ramp function generator input) |
|---|---|

Nominal value zeroing

|   |  |
|---|--|
| 6 | Nominal value zeroing<br>On the ramp function generator input without resetting the ramp function generator ⇒ ramp-down time effective |
| 7 | Nominal value zeroing<br>On the speed controller input with resetting of the ramp function generator                                   |

Ramp function generator stop

|                         |   |
|-------------------------|---|
| 9<br>(S04.17 and above) | Ramp function generator stop with a HIGH level at terminal X1:9 |
|-------------------------|---|

Automatic restart after brief mains power failures/power failure buffering/"Quick start"

Can only be used with communication source P001 = 0!

|                          |  |
|--------------------------|--|
| 13<br>(S04.27 and above) | <p>Quick start (after a brief mains power failure)<br/>                 If there is a voltage of &gt; +12.5 V on X1:9 when the electronics supply is connected, the system is initialized more quickly (approximately 800 to 900 ms) and the drive starts automatically, assuming that all the enables (X1:22 to X1:25) are available.<br/>                 In the case of an interruption of phase L2, for example, the restart takes approximately 500 to 600 ms.</p> <p><b>IMPORTANT!</b></p> <p>Terminal X1:9 may not be hard-wired; instead, you must control it by means of a contact, taking into account the machine's safety regulations.</p> |
|--------------------------|--|

ON/STOP simulation

|                          |  |
|--------------------------|--|
| 12<br>(S04.22 and above) | <p>ON/STOP simulation<br/>                 A special function that is only active with communication source P001 = 3</p> |
|--------------------------|--|

• **Motorized potentiometer function**

Activation by means of P080: nominal value source = 10

Motorized potentiometer RPM higher/faster: X1:26 HIGH level

Motorized potentiometer RPM lower/slower: X1:27 HIGH level

If X1:26 and X1:27 are set HIGH at the same time, the motorized potentiometer stays at the current value.

Setting parameters:

P055: motorized potentiometer upper limit -99.9 ... +100.0%

P056: motorized potentiometer lower limit -100.0 ... +99.9%

P057: motorized potentiometer ramp-up time 0.1 ... 100.0 s (850 s S04.27 and above)

P058: motorized potentiometer ramp-down time 0.1 ... 100.0 s (850 s S04.27 and above)

The motorized potentiometer mode can be supplemented by the memory function:

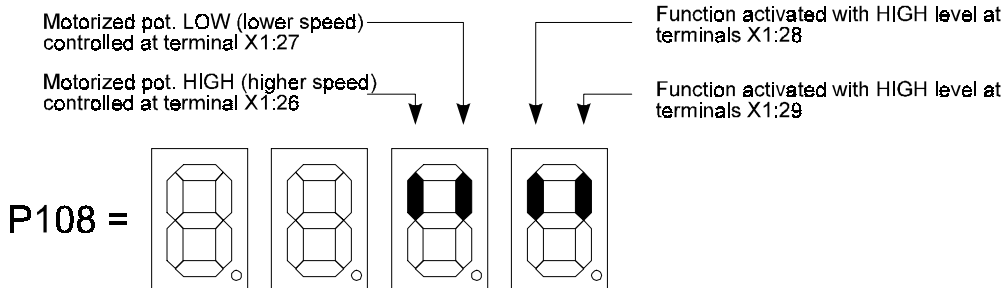
P099: Inputs X1:28, 29 = 3 (refer to the next point entitled Programmable switching inputs)

Storing the current motorized potentiometer nominal value in the EEPROM: X1:28 LOW ⇒ HIGH switching operation

Approaching the stored motorized potentiometer nominal value: X1:29 HIGH

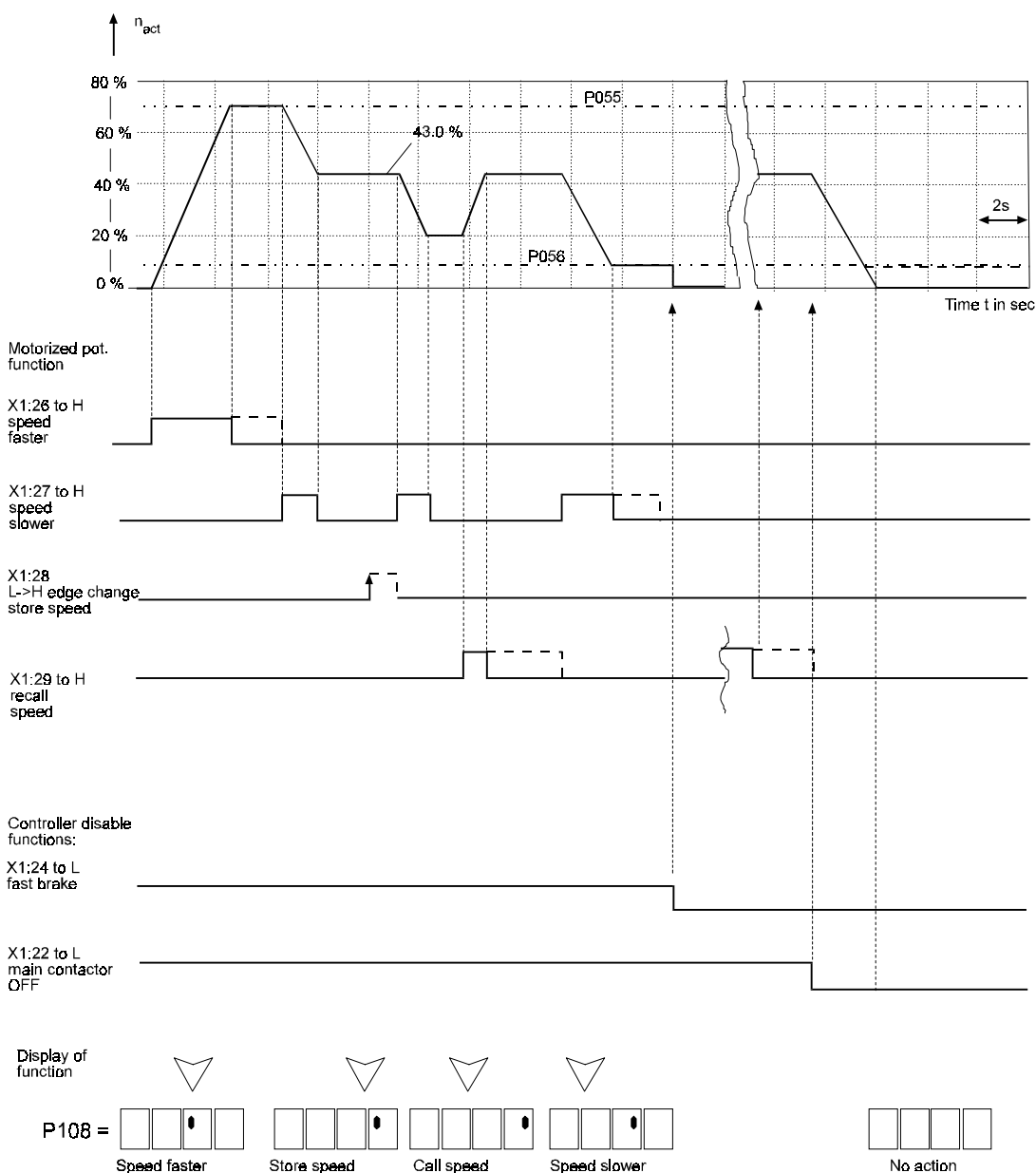
P059: Display of the motorized potentiometer nominal value

Display of the switching status conditions at terminals X1:26 ... 29 using parameter P108



The segments are only lit up while there is a HIGH level on the respective terminal.

Example: RPM actual value in dependence on the individual motorized potentiometer functions



• Programmable switching inputs X1:28 and X1:29

Parameter: P099=0 ... 4

| Value | Meaning  |
|-------|--|
| 0     | Switching inputs inactive  |
| 1     | Inching mode<br>Ramp function generator 2 is switched on automatically for the duration of inching mode. Once inching mode is finished, the original nominal value and ramp function generator apply.<br><br>X1:28 HIGH level activates internal nominal value 1 (P051)<br>X1:29 HIGH level activates internal nominal value 2 (P052)  |
| 2     | No function  |
| 3     | Motorized potentiometer memory function<br><br>X1:28 LOW ⇒ HIGH edge change saves the current motorized potentiometer nominal value in the EEPROM (display with P059)<br><br>X1:29 HIGH level: the system approaches the saved motorized potentiometer nominal value as soon as all the enables are active   |
| 4     | Reloading and activating data sets<br><br>The power converter gives you the option of programming various data sets. You can then call these blocks via the switching inputs on the microprocessor CPU as well as by means of the serial interface. When you do this, the system loads the selected data set from the EEPROM into RAM.<br><br>X1:28 X1:29<br>LOW LOW No function, RAM data is unchanged<br>HIGH LOW data set 1<br>LOW HIGH data set 2<br>HIGH HIGH data set 3<br><br>Parameter P099 = 4 must be set in all the data sets that are to be reloaded. Since it is not possible to secure switching over of data sets from impermissible or dangerous conditions, you must ensure with controller structure switchovers during operation, for example, that the system does not switch from field weakening to constant field.<br><br>Refer to: Load data set mode (P148)<br>If controller enable is applied during loading of a data set, controller enable is delayed until the data set has been loaded, regardless of the setting of P148. In addition, relay K4 "Drive ON" (P128 = 1) does not pick up until the drive has actually been enabled.<br><br>Assuming that the controller is enabled and P148 = 2, and P099 = 4 and you then choose a new data set by means of terminals X1:28 and X1:29 on PCB 3.8934 and if the signals at these terminals are retained, the new data set is loaded immediately when the controller is inhibited!<br><br>The setting of parameter P148 does not affect P118 "Gear stage". You can therefore change the protective circuit of the speed controller at all times, i.e. even when the controller is enabled. See also parameter P008.<br><br>P148 = 1: Data set can always be loaded, i.e. even when the controller is enabled<br><br>P148 = 2: Data set can only be loaded with the controller inhibited. If the system tries to load a data set with the controller enabled, message 113 is issued. |

### 6.7.3 Sequence of Switching On and Off

You must apply and remove the mains voltage to the mains unit (X2:1, 2), the field supply (X2:6, 7 or X3:1, 2) and the power unit (AK1, AK3, AK5) according to the guidelines below and take into account the enable criteria described in Chapter 6.7.1:

In this context, see also the connection suggestions and connection information in Chapter 5, Installation.

Check the phase coincidence of the three connection voltages, otherwise error messages of P159 will be issued: e.g. 02 (anti-clockwise rotating field on power unit connection), 45 (field connection not correct), 46 (power unit connection not correct).

- **Switch-on sequence**

We recommend that you proceed as follows:

- Connect the mains unit and the field supply to the mains at the same time, here, at the latest, apply pulse enable.

**NOTE**

By means of "Pulse enable", the hardware enables the firing pulses for the armature and the field. In the standard unit configuration, the system tests the field connection at switch-on (mains unit connected to the mains) or after a reset at initialization.

A delayed pulse enable triggers error message 24 (min. field current out of lower range). If the field current is switched-in too late, the system additionally displays error message 45 (field connection not correct).

With motors that have a very high field time constant, the system may issue error message 24 (min. field current out of lower range) despite the procedure being correct.

Remedy: Increase P117 (response time of  $I_F$  monitoring) or use one of the variants listed below.

- Trigger the line connector for the power unit by means of "Main contactor ON" via relay K1 (terminals X2:3..5) on the power converter (with P124 "main contactor/controller inhibit function" = 1).

**NOTE**

With P124 "main contactor/controller inhibit function" = 2, the system additionally switches off the main contactor with "Fast brake" and  $n < n_x$ .

**P124 Drive inhibit function**

| Value | Meaning   |
|-------|---|
| 1     | Fast brake<br>Controller inhibit at $n < n_x$ (P078)<br>Main contactor stays on,  |
| 2     | Fast brake<br>In addition, the main contactor is switched-off at $n < n_x$ (P078), at enabling. Cancel fast brake must be applied <b>before</b> Main contactor ON.. |

To reenble the power converter, you must apply Cancel fast brake before Main contactor ON.

Depending on the setting values of P001 and P079, the following enable procedure results:

**P001 Communication source (can only be changed with keypad)**

| Input Value | Meaning  |
|-------------|--|
| 0           | Keyboard on power converter                    |
| 1           | Service PC                                     |
| 2           | Control via interface board                    |
| 3           | Control via interface board and keyboard input |

**P079 Main contactor edge (can only be switched off when P001 = 1, 2 or 3)**

| Value | Meaning   |
|-------|---|
| ON    | At switch on or after an error and its removal, an L ⇒ H switching operation must take place at input X1:22.                    |
| OFF   | The main contactor stays on; after the error has been removed, you must switch on the drive via the serial enable of the drive. |

P001 = 0, P124 = 2

or

P001 = 1, 2, or 3, P079 = ON, P124 = 2:

Initial position: The drive was shut down by means of "fast brake" at terminal X1:24 and the main contactor dropped.

- "Main contactor OFF" at terminal X1:22, "Controller inhibit" at terminal X1:23 \*
- "Cancel fast brake" at terminal X1:23
- "Main contactor ON" at terminal X1:22
- Apply "Controller enable" at terminal X1:23 with a delay of at least 1.4 s: this results in delay-free starting. \*

\* See next page

P001 = 1, P079 = OFF, P124 = 2

See above for the initial position, software enable F9 for "Main contactor ON" was cancelled internally

- Apply "Controller enable" at terminal X1:23 or cancel software enable F7 (controller enable). \*
- "Cancel fast brake" at terminal X1:24
- Apply software enable F9 for "Main contactor ON"
- Apply "Controller enable" for delay-free start-up (X1:23/F7) \*

\* "Controller enable" may also be permanently pending; in this case, however, you must take into account the delay of a maximum of 1.4 s between applying "Main contactor ON" and start-up of the drive.

- As the final step in defined and delay-free start-up, apply "Controller enable" or "Cancel fast brake" (or both of them at the same time).  
Take into account parameter P124!

As an alternative, the following variants are possible:

- Field supply
  - This may be connected to the mains before the mains unit without any additional measures being needed.
  - With P122 (Field feed in monitoring) = OFF, it is also possible to connect the field to the mains after the mains unit.  
At the latest, you must connect the unit to the mains on applying the "Main contactor ON" enable command, since the system checks the field connection and activates the field monitoring relay.
- Line contactor for the power unit
  - Connection to the mains is possible without using relay K1 on the power converter.  
The power unit may be connected to the mains before the mains unit.

**NOTE**

Unit sizes III and IV

In the case of units up to and including software version 04.16, if you are not going to use the function of relay K1, "Main contactor ON" on the power converter on PCB 3.8942 (terminals X2: 3 ... 5), you must wait at least five seconds after switching in mains unit (X2:1, 2) before you are allowed to connect the power unit to the mains.

The power contactor must switch in on the "Main contactor ON" command at the latest, otherwise the system issues an error message.



- **Switch-off sequence-**

**NOTE**

Never disconnect the power unit from the mains until the firing pulses are in the inverter limit and the armature current has dropped to zero.

Ignoring this procedure can lead to the fuse dropping. In a worst case situation, the thyristors can be damaged.

For this reason, you should always cancel one of the enable conditions (except for pulse enable!) first.

You decide how you want to shut-down the drive :

- Cancel the "Main contactor ON" command:  
This immediately resets the pulses into the inverter limit and sets  $I_A = 0$ , the mains contactor is then switched off via K1 (X2: 3 ... 5).
- Cancel the controller enable which has the same effect as "Main contactor OFF" but without switching the main contactor.
- Fast brake “  
Braking to  $n = 0$  either at the current limit or at the ramp of the ramp function generator; then the system carries out an internal controller inhibit ( $I_A = 0$ ) with or without switching off the main contactor contact (P124).

After this, first disconnect the power unit from the mains (if this has not already been done by one of the controller inhibit commands), then disconnect the mains unit and the field power converter. Switching off the field power converter before the mains unit triggers error message 24 (min. field current out of lower range).

## 6.8 Automatic Restarting after Brief Mains Disturbances

This function is intended to prevent the power converter being disturbed in the case of short mains failures or brown outs, and then having to be enabled again by the controller when power is returned.

A total of three variants are available that are activated depending on the unit version, i.e. standard version with conventional mains unit in the power supply, special version with switching power supply.

### NOTE

Only when the power converter is rectifying is it possible to guarantee safe operation in the case of a power failure.

### 6.8.1 Standard Unit

Type codes of the units:

BKF12/... .. - 6 04 00 ..

BKD06/... .. - 6 04 00 ..

For this, programmable input X1:9 is needed; parameterize P084 = 13!

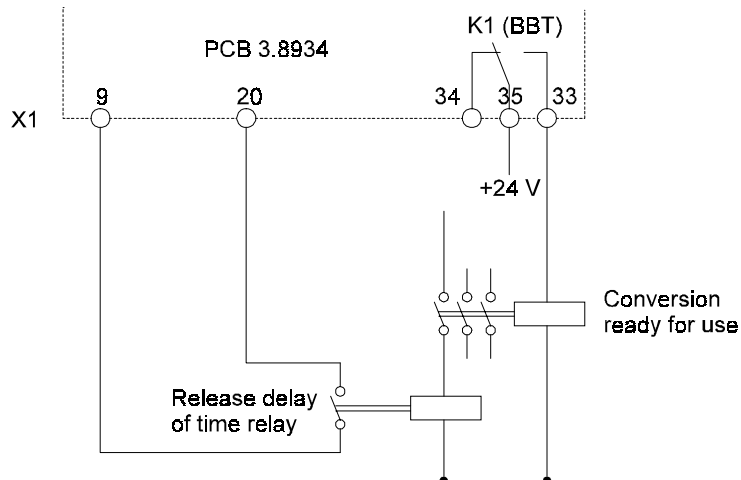
### NOTE

This function can only be used with communication source P001 = 0.  
Parameter P147 must be set to "OFF" and P156 must be set to 0.0 s.

The function is available with software version S04.27 and above!

With the standard unit, even very short power failures can lead to the failure of its power supply; this means that when power is returned, the power converter must be reinitialized. Since the unit was operating properly before the power failure, the system knows the connection conditions on the mains side (rotary field on the power unit, phase relation of the connections on the mains unit, the field supply and the power unit). As a result, shortened initialization is needed at the restart. This is always carried out if input X1:9 is HIGH and all the enables (X1:22 ... 25) are pending.

Circuit diagram and principle of operation:



After applying the supply voltage to the power converter's mains unit, relay K1 (BBT) on PCB 3.8934 stays dropped until booting is completed. Only then is programmable input X1:9 switched HIGH via the externally fitted relay. This means that the normal initialization sequence takes a maximum of 3 to 4 seconds.

With a brief mains failure, by contrast, the dropout-delay relay stays picked-up and applies +24 V to input X1:9 immediately on restoration of power. As early as the start of the initialization stage, the system interrogates the input with regard to the automatic restart; because of this, a shortened initialization period of 500 to 900 ms will result.

The time needed for initialization depends on the type of mains disturbance (one or several phases disturbed, the affected phases, etc.).

The user specifies the length of the buffering period on the time relay.



## WARNING

Terminal X1:9 may not be hard-wired; instead, you must control it by means of a contact, taking into account the machine's safety regulations. It is vital to prevent shortened initialization on switching on for the first time!

## 6.8.2 Automatic Restart for Special Versions with a Switching Mains Unit

Type codes of the units:

BKF12/.../... - 6 04 01 ..

BKD06/.../... - 6 04 01 ..

With this version, you can use the function in two ways:

- buffering mains disturbances lasting up to 400 ms
- buffering relatively long mains disturbances lasting up to 6 s

Both variants have the following in common:

During the mains disturbance, all the controller enables on the unit must stay active.

As soon as the power converter has detected a mains disturbance, internal measures inhibit the drive which is then torque-free. This can lead to a serious drop in the speed or even to a machine standstill.

If relay K4 is assigned the function "Drive on" (P128 = 1), it reports "Drive inactive" for the duration of the internal controller inhibit.

To suppress error message 24 (min. field current out of lower range) during the mains failure, you must, if necessary, adapt the field current monitoring relay's using parameter P117. The initializing period at restarting lasts 400 ... 500 ms.

You may not program parameter P084 with the value 13.

- Special features in the case of mains failure buffering for a maximum of 400 ms  
You must program parameter P147 ("Phase failure < 400 ms") to ON; set parameter P156 ("Mains failure timeout") to 0.0 s.  
With mains failures that last longer than 400 ms, the drive stays disabled.  
This variant for buffering mains failures with the help of the integrated switching mains unit is available with S04.17 A and above.
- Special features in the case of mains failure buffering for up to 6 s  
This function can only be carried out with an external 24 V., 50 W UPS. You must connect the supply voltage to terminals X34:1, 2 (+24 V to X34:2, GND to X34:1) on PCB 3.9415. Reverse voltage protection is contained in the unit (see also 5.2.1, Connection Plan).

### NOTE

The user must enforce external measures to ensure that the starting current inrush on connection of the 24-V UPS does not exceed 50 A!

This starting current inrush is caused by the buffer condensers in the unit.

Options for limiting the starting current inrush

- Use an external power supply with current limitation
- Limit the current by means of a series resistor (rated at  $\geq 0.5 \Omega$ , 4 W). The resistor may be permanently switched-in if it can be guaranteed that the permissible input voltage range will not be fallen short of ( $U_{inp} = 21 \text{ V} \dots 30 \text{ V}$ , current consumption 1.7 A max.)  
Otherwise: the resistor is shunted-out after 100 ms at the earliest (this applies to  $R = 0.5 \Omega$ , higher resistances require an on period that is appropriately longer).
- Switching-in the external 24 V is possible without additional current limiting, assuming that it can be guaranteed that:
  - a) the external 24 V is applied at least 100 ms after the mains voltage (at terminals X2:1,2)
  - b) the mains voltage is within the tolerance band of 400 V/460 V/500 V +10% -15%.  
Under no circumstances is switching through without additional current-limiting measures allowed in applications in which the switching power supply is used for adaptation to different mains conditions!

Using P156, "Mains failure Timeout", set the bridging period in the range 0.0 ... 6.0 s. Set parameter P147 ("Phase failure < 400 ms) to OFF!

This function is available with S04.29 and above.

### 6.9 Load Measurement with Cranes (S04.12 and above)

Load measurement is needed with the hoisting mechanisms on cranes if the drives are run with field weakening control.

Field weakening characteristic:



In the field weakening range, the system is run at constant power from the basic speed,  $n_G$ , onwards. As a result, the available driving torque ( $P = \text{const.} = M \cdot \omega$ ) reduces as the speed increases. As the diagram above shows, with a field weakening range of  $\frac{n_G}{n_{\max}} = 0.5$  only half the rated torque is available at maximum speed. You can determine intermediate values by means of the relationship  $n = \frac{M_N}{M} \cdot n_G$ .

The drive torque  $M_a$  that the motor requests is composed of the sum of the load torque  $M_L$  and the accelerating torque  $M_b$ :  $M_a = M_L + M_b$ .

The speed specified is routed via the unit's start-up integrator, which ensures that drive start-up is load-independent. As a result, you can determine as early as the commissioning stage the dynamic component,  $M_b$ , of the drive torque (P133: acceleration factor) by means of an optimization run (P086 = 6 and no load).

At the start of commissioning, you should also determine the system losses by means of tests (of the motor, the transmission, other friction losses). You can enter these in the form of a P135, "Transmission efficiency". The value is set correctly when the same load value is determined when lifting and lowering the same load.

If you measure the motor current while traversing the armature adjusting range ( $n = 0$  to  $n_G$ ), you can directly derive the load torque  $M_L$  taking into account the acceleration and friction torques.

In practice, measurement is carried out between 20% and 80% of the motor's basic RPM speed. To activate load measurement, the system must run from a speed that is less than 20% of the basic RPM speed to a speed in the range 20% to 80% of the basic RPM speed. After exceeding the 80% value, load measurement is switched off and the system stores the value which was previously determined. Load measurement is not activated if the system runs from a higher speed into the measuring range.

By means of the load torque,  $M_L$ , derived in this way, it is possible to draw a direct conclusion about the moved load. This load can be measured on one of the analog output channels if the channel is parameterized with the value 40. In this connection, +10 V represents a load of 100%.

You can determine the measuring results with an adequate level of precision if the ramp-up time of the integrator's nominal value is set to at least  $\frac{4}{3} \cdot \frac{n_{\max}}{n_G}$  approximately. With a field weakening range of  $\frac{n_{\max}}{n_G} = 2$ , this is a ramp-up time of around 3 seconds.

The value for the load is used to calculate the maximum possible speed nominal value to which the ramp function generator input is limited. (See Function Plans: Nominal Value Setting).

You need the following parameters for load measurement:

- P023**     **$I_{A_{\text{mot}}}/I_{A_{\text{max}}}$**   
Here, you enter the motor's overload factor.
- P081**    **Optimization run**  
P081 = 6:    Determining the acceleration factor
- P088**    **Analog output channels 1 ... 4**
- P089**    40: Load torque
- P130**    41: Permissible speed nominal value
  
- P125**
- P132**    **Scaling analog output channel 2/4**
  
- P094**
- P100**    **Ramp generator 1/2**
  
- P095**
- P101**    **RG 1/2 acceleration time**
  
- P096**
- P102**    **RG 1/2 deceleration time**

**P133 Acceleration factor**

This value can be determined by optimization run P081 = 6 no load(!). After setting the optimization run, you must set a nominal value that is higher than the basic RPM speed. As soon as the speed is higher than 80% of the basic RPM speed, the system finishes the optimization run and determines the acceleration value. See also parameter P167.

**P134 Field weakening range**

You must enter the field weakening range of the motor being used. The system then uses this value to calculate the basic RPM speed and the limit values for the RPM window to determine the load.

**P135 Gear efficiency factor**

You must enter the efficiency of the transmission being used. If you do not know what it is, you must carry out tests to determine it. Even if you do know the efficiency, tests under load are necessary. The value is set correctly when the same load value is determined when lifting and lowering the same load.

**P136 Load measurement ON/OFF**

This parameter must be ON to allow load measurement to be carried out in the specified speed window. This parameter must also be ON to determine the acceleration factor, otherwise the setting of P081 = 6 is not accepted.

**P160 n\_nom limit mode**

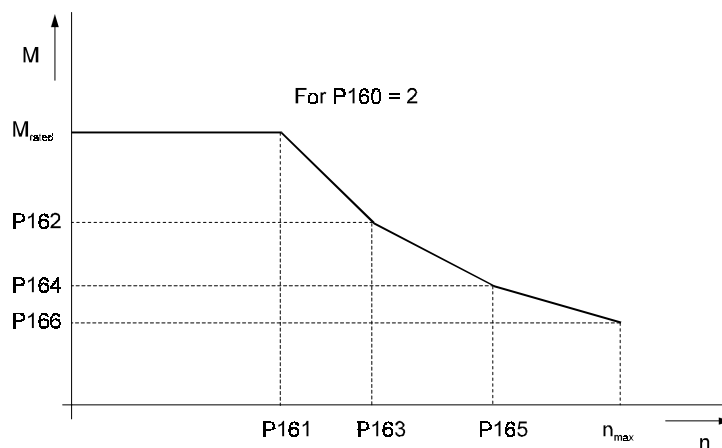
| Value | Meaning   |
|-------|---|
| 1     | Calculation of the maximum permissible speed at load measurement with constant power (hyperbola; $Load \cdot n_{per} = constant$ )                          |
| 2     | Calculation of the maximum permissible speed at load measurement on three straight sections (4 interpolation points).<br>Effective parameters P161 ... P167 |



**P161 to**

**P166 n-interpolation points**

Speed and rotary torque values for the characteristic curve in the field weakening range at P160 = 2.



**P167 Base load**

This is needed to determine the acceleration factor, P133. Optimization run P081 = 6 must be carried out with no load (spreader empty). Before carrying out the optimization run, you must enter the basic load (weight of spreader/rated load). The value is not stored in the data set and is of no consequence during load measurement!

Example:

|                    |                  |
|--------------------|------------------|
| Weight of spreader | of 10 tonnes     |
| Max. loading       | 40 tonnes        |
| Rated load         | 50 tonnes        |
| Basic load         | 10 t/50 t = 0.20 |
| P167               | 20%              |

**P168 Lower measuring limit**

Lower limit of the load measuring range. The default value is 20% of the basic RPM speed.

**P169 Upper measuring limit**

Upper limit of the load measuring range. The default value is 80% of the basic RPM speed.



## 7 COMMISSIONING

### 7.1 Danger and Warning Information



#### WARNING

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

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

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

The power converter's power cables are energized!  
The DC side is not galvanically isolated from the mains!

The mains unit and the field connector of the power converter carry a dangerous voltage even when the main contactor has dropped.

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

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

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

You may only reset the power converter with the controller disabled **and** the motor idle.

If an error occurs, the drive is deenergized and then coasts unbraked to a standstill. You should consider this situation particularly with motion and lifting drives.



## WARNING

Faulty drive response

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

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

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

Contact Protection In Accordance with Paragraph 4 Section 4 VBG 4

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

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

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

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

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

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

## NOTE

When commissioning using a PC, you must connect the interface cable to the power converter's RS 232 service interface.

For safety reasons, you are advised to only handle this plug with the motor idle and the controller disabled.

Observe electrostatic discharge protection: Before touching the plug, discharge electrostatic energy from your body by touching a grounded conductive object, for example.



## WARNING

Follow the safety information on the motor and tachometer in the appropriate operating and maintenance instructions.

Avoid any working practices that jeopardize safety at the machine.

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

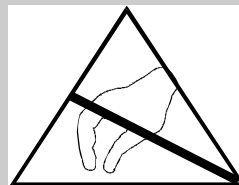
This is not a complete list of all the procedures necessary for safe operation of the unit. If you need further information or have particular problems, contact BAUMÜLLER NÜRNBERG or one of our distributors.

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

## NOTE

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

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



- **Electromagnetic Compatibility (EMC) Measures**  
Due to the principle of operation, power converters produce conducted and radiated high-frequency energy. Eliminating interference in power converter-controlled drives is technically very complicated. It is made even more difficult, since the assembly of individual components means that impedance and interference conditions are not consistent. For this reason, German law demands that the manufacturer or owner of the complete unit, rather than the manufacturer of the individual components eliminates interference in accordance with applicable regulations.

## 7.2 Operating the Power Converter

### 7.2.1 Overview

Series 6000 power converters are set by means of parameters and parameter values. The following procedures are possible:

- **Setting using the keypad and display on the power converter**

No additional aids are needed



- **Setting using a PC with operating software, online operation**

Advantages:

- easy handling by means of menus
- direct comparison possible between the specification and the drive's response
- actual values and enables are constantly shown at the bottom of the menu
- complete documentation on a printer is possible after work is completed



- **Setting using a PC with operating software, offline operation**

Advantages:

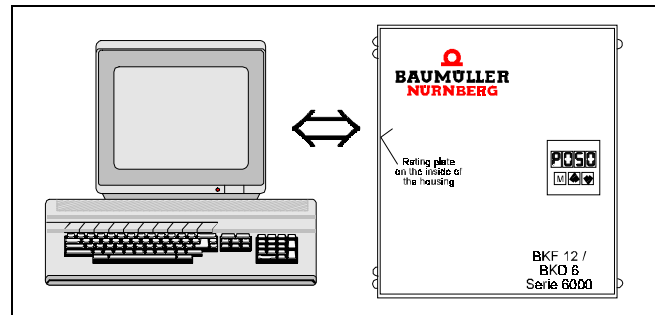
- calculation of setting values in advance
- easy offline handling
- actual values/enables are not displayed, since the unit is not connected
- fast transfer of data at the machine from the PC to the drive by means of floppy disks
- short commissioning times
- absolutely identical setting values and, with this, identical properties with the same applications



- **Parameterizing by means of the controller and the optional interface boards**

Advantages:




- flexible adaptation of parameters when operating conditions change by directly accessing RAM



### 7.2.2 Keypad and Display on the Power Converter


The keypad for manual parameterization is at the bottom right of the power converter's microprocessor PCB 3.8934.

It has three keys:

- Mode 
- Higher 
- Lower 

Directly above it is the four-character seven-segment display for showing parameters, parameter values and any errors that may have occurred.



#### Functions of the keys:

- Mode key 
  - Changing between Choose parameter mode and Set parameter value mode
  - In Choose parameter mode, the system cyclically ( $f = 0.33$  Hz) displays the parameter number and its associated value one after the other. The parameter number is shown for 1 s; the parameter value is displayed for 2 s.
  - Transfer of the displayed parameter value to RAM on changing from Set parameter value mode to Choose parameter mode
  - Programming a data block in the EEPROM with P004 = 1, 2, 3 or 4
  - Acknowledging error messages with parameter P005



- Higher key 
  - Choosing higher parameter numbers in Choose parameter mode
  - Increasing the set parameter value in Set parameter value mode
- Lower key :
  - Choosing lower parameter numbers in Choose parameter mode
  - Decreasing the set parameter value in Set parameter value mode

### Handling the keypad

#### NOTE




On pressing either the  or  key to choose another parameter number or another parameter value, the system first counts up or counts down the displayed number/value in a 250-ms cycle. If you keep the key pressed for more than 20 counting operations, the counting frequency increases five-fold.

- **Switching on the display :**

Press  or  once for at least one second.

When you release the key, the display lights up. The operating unit is now in Choose parameter mode (the system cyclically displays the parameter number and the parameter value one after the other)






- **Switching off the display:**

In Choose parameter mode, press  or -to select parameter P103 and then press the  key twice.

#### NOTE


The display is switched on manually (see above) or by a power converter error message (S04.08 and above). In the event of an error, the system cyclically displays one after the other parameter P159 and the number(s) of the pending error(s).

- **Enabling the keypad: P104 = 17**

- In Choose parameter mode, use the  or  key to select parameter P104
- Press the  key once
- Use  to set the value 17
- Press the  key again

#### NOTE

After transfer, the value 17 is not displayed!

With P104 = 17, the keypad has input rights on the unit, assuming that P001 = 0 or 3. During counting up of the parameter value, you should briefly release the  key once to keep to the low counting frequency. Otherwise the frequency would increase five-fold at the value 14 (see above).



- **Disabling the keypad**

See Enabling the keypad. All values for P104 that are not 17 disable the keypad for manual inputs. Display of parameter values is still possible. Changing P001 automatically disables keypad input.

- **Changing and activating parameter values**

- Use  $\uparrow$  or  $\downarrow$  to set the desired parameter
- Press the  $\text{M}$  key to change from Choose parameter mode to Set parameter mode
- Press  $\uparrow$  or  $\downarrow$  to choose the desired value
- Press the  $\text{M}$  key once: The value is stored in RAM and the keypad is in Choose parameter mode again

- **Storing parameter values**

Program the EEPROM with a data block (1 ... 4).

### NOTE

During commissioning, it is advisable to save (i.e. transfer to the EEPROM) changed data frequently. You can only program a data block when the controller is disabled!

- Use  $\uparrow$  or  $\downarrow$  to set parameter P004
- Press the  $\text{M}$  key once
- Press  $\uparrow$  or  $\downarrow$  to choose the desired data block (1 ... 4)
- Press the  $\text{M}$  key once: Changing to Choose parameter mode transfers the data block to the EEPROM.

- **Changing the communication source: P001 = 0 ... 3**

- 0: Keypad on the power converter
- 1: Service PC
- 2: Control via optional interface board
- 3: Control via interface board and keypad

Changing of the communication source is possible **manually** on the keypad only.

The factory default parameterization of the unit is P001 = 0 (keypad).

**Every time you change the communication source, the main contactor drops and the keypad is locked. With the change to P001 = 0, you may have to enable the keypad again.**

This is not necessary with the change to P001 = 1, since the PC is accepted as the communication source without the keyboard needing to be reenabled.

The system displays parameter P001 to one decimal place. In this connection, the place before the decimal point indicates the communication source stored in the EEPROM. (Exception: With EEPROM programming, a 9 is shown). The place after the decimal point shows the communication source that is currently stored in RAM.

Two examples of changing the communication source:

a) From keypad to PC operation

Starting point: The keypad is enabled and in Choose parameter mode

- Use  $\uparrow$  or  $\downarrow$  to choose parameter P001: The display alternately shows P001 and then 0.0.
- Press the  $\text{M}$  key once: Value 0.0 is now shown permanently (Set parameter value)
- Keep pressing  $\uparrow$  or  $\downarrow$  until 0.1 appears
- Press the  $\text{M}$  key once: Operation on the Service PC is now set and the value 1 has been stored in the EEPROM. The system shows 1.1 in the display to confirm this fact.

### NOTE

This change of setting is always necessary if the power converter was commissioned with the PC and you want to run it later without communications. If you do not reparameterize, on disconnection of the PC the system issues error 18 (data traffic interrupted for longer than 1200 ms) and inhibits the controller.

b) Reparameterizing from PC operation to keypad

- First unlock the keypad (P104 = 17). You can use the keypad or the user program to choose parameter P104.
- Choose parameter P001: The display cyclically shows P001 and the value 1.1 one after the other
- Press the  $\text{M}$  key once: 1.1 is shown (Set parameter value mode)
- Keep pressing  $\uparrow$  or  $\downarrow$  until 1.0 is shown on the display.
- Press the  $\text{M}$  key once: Changing operating modes (from Set parameter value to Choose parameter) stores the value 0 in the EEPROM. This parameterizes the communication source to keypad operation and the display alternately shows P001 and 0.0.

### 7.2.3 Operation Using a PC

An IBM-compatible PC with at least one serial port (COM1) is adequate for parameterization and commissioning

The plug for connecting to the power converter's RS232 service interface is at the bottom right of microprocessor PCB 3.8934 (X2 with PCB version 3.8934C and X3 with version 3.8934E).

#### NOTE

For safety reasons, you are advised to only handle this plug with the motor idle and the controller disabled.

Observe electrostatic discharge protection: Before touching the plug, discharge electrostatic energy from your body by touching a grounded conductive object, for example.

Two cables are available that match the most common types of PC serial ports. On the PC side, cable 8230383 has a 25-pin SUB-D female connector whereas cable 8230553 is fitted with a 9-pin SUB-D female connector (see also 5.8 Accessories).

In addition, you need the user software which is supplied on a 3.5" system floppy disk (the disk must not be write-protected!)

The floppy disk contains the following files:

S04xx.EXE

S04xx\_D.EXE (software version S04.20 and above)

S04xx\_E.EXE (software version S04.20 and above)

D04xx.68k

Up to version S04.19, the user program is available in German only; from version S04.20 onwards, both German- and English-language versions are obtainable. The language is shown by the addition of \_D (for German) or \_E (for English) to the filenames.

Series S04xx.EXE user programs – like the equipment user software S04.xx – are upward-compatible. This means that, although it is advantageous to use the two matching software packages with the same system designation, it is not absolutely necessary.

If you utilize user software with a lower version number, it may not be possible to control some parameters at all or control may only be within limited operating ranges (refer to the chapter entitled Parameters). Before the release of the most current software, it is therefore advisable to initially commission the equipment using the existing program. After this, you can change the communication source and manually set the parameters on the keypad that cannot be operated.

In the opposite case, i.e. if you utilize user software with a higher version number, the system displays the problem parameters while UPLOADING or DOWNLOADING during online operation (described in the next point). If you do not need this list of parameters, you can continue commissioning without problems. Otherwise, you need current EPROMs for the user software.

Calling the user programUp to and including software version S0419.EXE:

S04xx [BW] [COM2]

with the switches:

[BW] if your system has a black and white screen

[COM2] if you are using the second serial port

There must be a space between each of the switches [...].

– Software version S0420.EXE and above:

S04xx\_D [BW] [COM2] if you are using the German version

S04xx\_E [BW] [COM2] if you are using the English version

with the switches:

[BW] if your system has a black and white screen

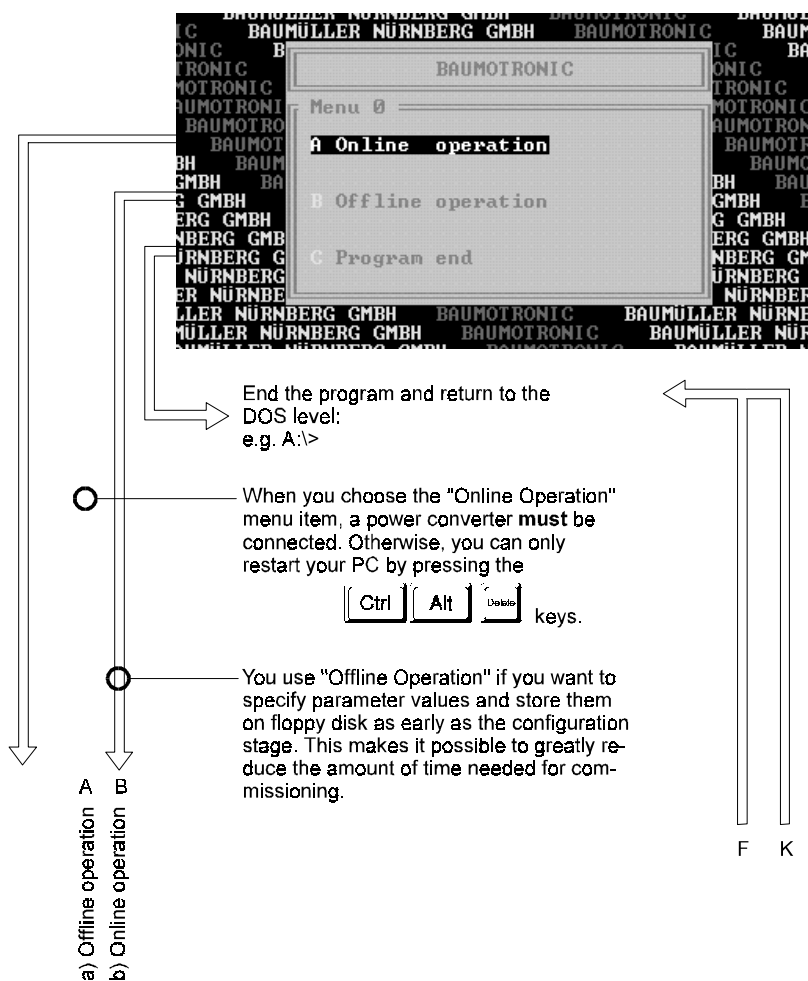
[COM2] if you are using the second serial port

There must be a space between each of the switches [...].

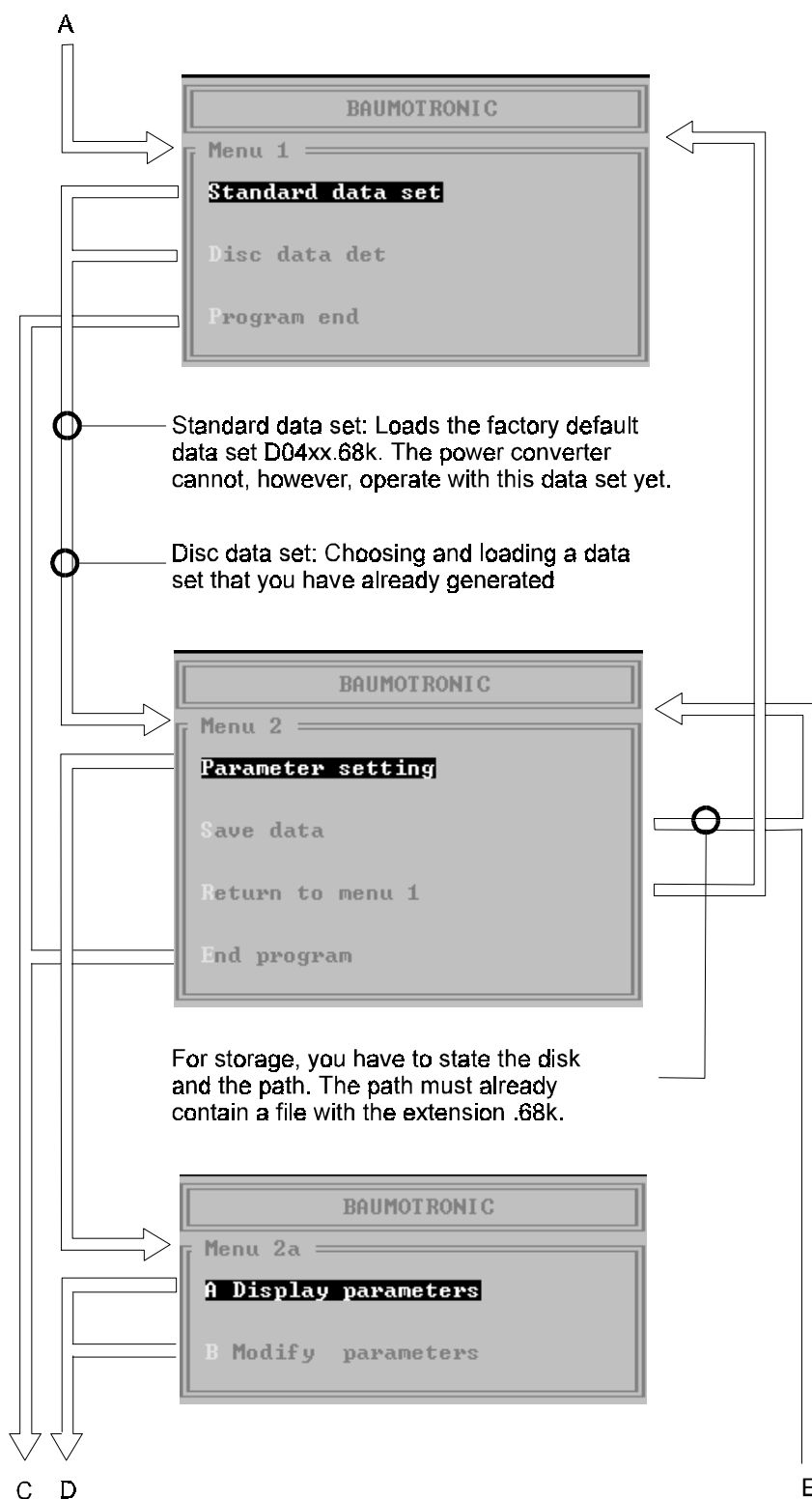
The user program is menu-driven and is easy to handle.

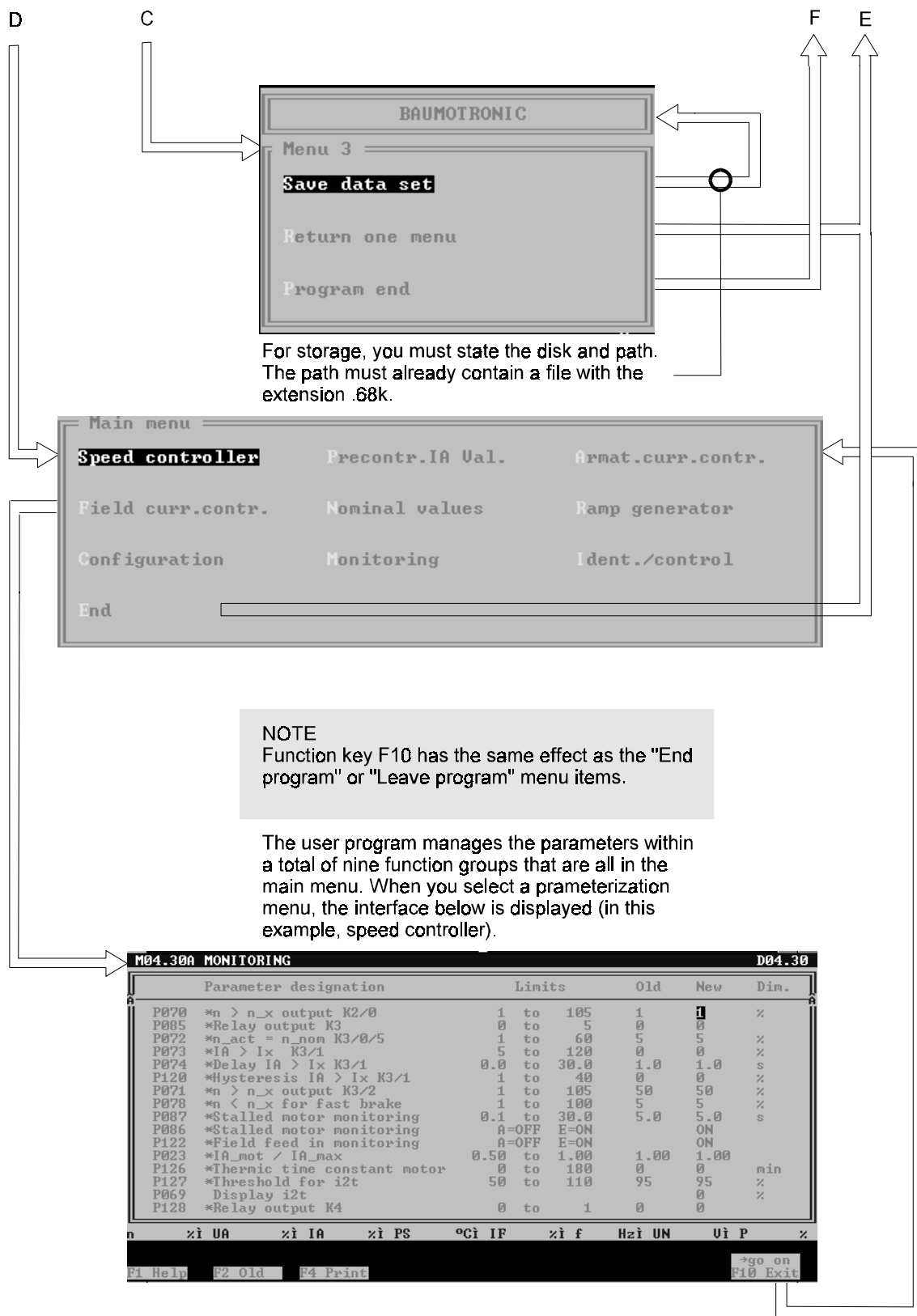
To choose the individual menu items, you can either use the arrow keys to move to the item and then press the Return key or simply press the initial letter of the menu item.

After the program has started, the system menu below is displayed:



a) Offline operation





The parameter menus are divided into a header, a parameter area with an actual value bar and a footer:

• Header

**M04.30A SPEED CONTROLLER** **D04.30**

- M04.30: Software version of the user program
- Speed controller: Name of the menu
- D04.30 Software version of the standard data file on the floppy disk

• Parameter area

| Parameter designation              | Limits       | Old  | New  | Dim. |
|------------------------------------|--------------|------|------|------|
| P011 *P-amplification              | 1 to 100     | 10   | 10   |      |
| P012 *Integral-action time         | 20 to 9990   | 500  | 500  | ms   |
| P014 *Current limit TD1/Drive      | 0 to 100     | 100  | 100  | %    |
| P015 *Current limit TD2/Brake      | 0 to 100     | 100  | 100  | %    |
| P010 *n_act - smoothing            | 5 to 100     | 10   | 10   | ms   |
| P018 *Integral-action time         | A=OFF E=ON   |      | ON   |      |
| P019 *speed controller offset      | -400 to +400 | 0    | 0    |      |
| P002 *Armature voltage adjustment  | 0.90 to 1.10 | 1.00 | 1.00 |      |
| P016 *Curr. limit reduction at n_x | 0 to 100     | 100  | 100  | %    |
| P017 *Current limit at n_max       | 0 to 100     | 100  | 100  | %    |
| P022 *speed controller preset      | -100 to +100 | 0    | 0    | %    |
| P021 *Current limit switching      | 1 to 2       | 1    | 1    |      |
| P118 Gear ratio                    | 1 to 4       |      | 0    |      |
| P142 *Maximum speed value          | 100 to 6000  | 1000 | 1000 | rpm  |
| P143 *Rotary encoder resolution    | 250 to 4096  | 1024 | 1024 |      |
| P144 *Rot. enc. polarity change    | A=OFF E=ON   |      | OFF  |      |

n %i UA %i IA %i PS °C i IF %i f Hz i UN U i P %

Parameter list: e.g. speed controller

Parameter: In the menu, parameters are sorted by their functions. Most of the parameters for which limits are not stated are displays that you cannot set.

Parameter designation: \* These parameters are components of the data set  
 + These are basic parameters that apply to all the data sets (P001, P006, P007, P009). The undesignated parameters' functions and displays can only be used in conjunction with the power converter.

Limits The value or range that can be set is stated. With many of the parameters, you can press the **F1** key to call a submenu which lists possible alternatives.

Column "old": Every time a parameter value is changed, the system writes the previous value to the Old column. Press the **F2** key to switch between the old value and the new one.

Column "new" Display of the current value.





Example:

You should prepare parameterization of a power converter in advance on paper such that you have available a functioning data set that can be transferred.

The user program (including the file D04xx.68k) is installed on the hard disk in the path C:\BKF12\.

Software version S04.30 is used with standard data set D04.30 serving as the basis of parameterization. The newly generated data set is to be stored on the hard disk and on floppy drive A: as data set XYZ.68k. In addition, we want to generate a listing of the data set.

The parameter values to be changed have already been established:

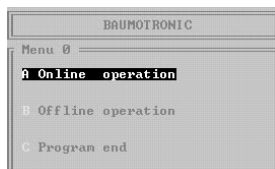
P021 (current limit switching in the speed controller menu) = 2, P171 (relay output K2 on page 2 of the monitoring menu) = 1.

- 1 Prepare a floppy disk:  
Since this is a blank disk, you must first copy programs S0430\_D.exe and S0430\_E.exe and data file D0430.68k to it. To do this, you can use normal DOS commands.

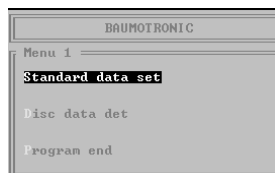
Operator action

Response on the screen

- 2 Call the program:  
C:\BKF12>S0430\_D



OFFLINE operation



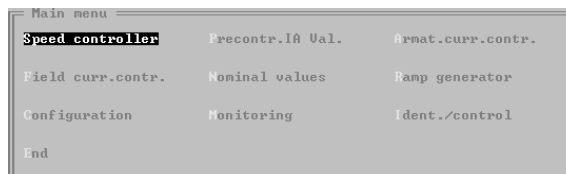
- 3 Choose a data set:  
Default data set



- 4 Parameterization



- 5 Change Parameter



- 6 Choose speed controller with cursor P021

There are two options:

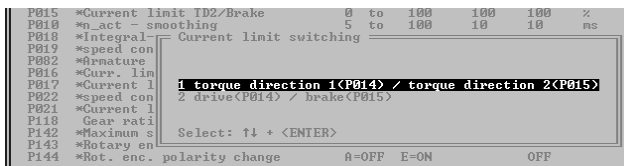
| MB4.300 MONITORING                |              | D04.30 |      |      |  |
|-----------------------------------|--------------|--------|------|------|--|
| Parameter designation             | Limits       | Old    | New  | Dim. |  |
| P070 *n > n_x output K2/0         | 1 to 105     | 1      | 1    | %    |  |
| P085 *Relay output K3             | 0 to 5       | 0      | 0    | %    |  |
| P072 *n_act = n_nom K3/0/5        | 1 to 60      | 5      | 5    | %    |  |
| P073 *IA > Ix K3/1                | 5 to 120     | 0      | 0    | %    |  |
| P074 *Delay IA > Ix K3/1          | 0.0 to 30.0  | 1.0    | 1.0  | s    |  |
| P120 *Hysteresis IA > Ix K3/1     | 1 to 40      | 0      | 0    | %    |  |
| P071 *n > n_x output K3/2         | 1 to 105     | 50     | 50   | %    |  |
| P078 *n < n_x For fast brake      | 1 to 100     | 5      | 5    | %    |  |
| P087 *Stalled motor monitoring    | 0.1 to 30.0  | 5.0    | 5.0  | s    |  |
| P086 *Stalled motor monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P122 *Field feed in monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P023 *IA_not / IA_max             | 0.50 to 1.00 | 1.00   | 1.00 |      |  |
| P126 *Thermic time constant motor | 0 to 100     | 0      | 0    | min  |  |
| P127 *Threshold for i2t           | 50 to 110    | 95     | 95   | %    |  |
| P069 Display i2t                  |              | 0      | 0    | %    |  |
| P120 *Relay output K4             | 0 to 1       | 0      | 0    | %    |  |

n xi UA xi IA xi PS °C iF xi f Hz i UN U i P %  
 F1 Help F2 Old F4 Print F8 on F10 Exit

Operator action

Response on the screen

- 6.1 Press F1 for help
- Choose 2 with cursor
- Press Return



or

- 6.2 Enter 2
- Press Return

P021 Current limit switchover = 2

- 7 Go back to main menu:
- Press F10



- 8 Monitoring

| M04.30A MONITORING                |              | D04.30 |      |      |  |
|-----------------------------------|--------------|--------|------|------|--|
| Parameter designation             | Limits       | Old    | New  | Dim. |  |
| P070 *n > n_x output K2/0         | 1 to 105     | 1      | 1    | %    |  |
| P005 *Relay output K3             | 0 to 5       | 0      | 0    | %    |  |
| P072 *n_act = n_non K3/0/5        | 1 to 60      | 5      | 5    | %    |  |
| P073 *IA > Ix K3/1                | 5 to 120     | 0      | 0    | %    |  |
| P074 *Delay IA > Ix K3/1          | 0.0 to 30.0  | 1.0    | 1.0  | s    |  |
| P120 *Hysteresis IA > Ix K3/1     | 1 to 40      | 0      | 0    | %    |  |
| P071 *n > n_x output K3/2         | 1 to 105     | 50     | 50   | %    |  |
| P078 *n < n_x for fast brake      | 1 to 100     | 5      | 5    | %    |  |
| P007 *Stalled motor monitoring    | 0.1 to 30.0  | 5.0    | 5.0  | s    |  |
| P006 *Stalled motor monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P122 *Field feed in monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P023 *IA_mot / IA_max             | 0.50 to 1.00 | 1.00   | 1.00 |      |  |
| P126 *Thermic time constant motor | 0 to 180     | 0      | 0    | min  |  |
| P127 *Threshold for I2t           | 50 to 110    | 95     | 95   | %    |  |
| P069 Display I2t                  |              | 0      | 0    | %    |  |
| P128 *Relay output K4             | 0 to 1       | 0      | 0    | %    |  |

- Choose 2nd page:
- Press right arrow key
- Choose P171
- Enter 1
- Press Return

| M04.30A MONITORING                  |             | D04.30 |     |      |  |
|-------------------------------------|-------------|--------|-----|------|--|
| Parameter designation               | Limits      | Old    | New | Dim. |  |
| P130 *Threshold tacho polarity      | 10 to 62    | 10     | 10  | %    |  |
| P140 *Threshold tacho wire break    | 5 to 65     | 20     | 20  | %    |  |
| P141 *Delay time armature open      | 1.0 to 10.0 | 1.0    | 1.0 | s    |  |
| P171 *Relay output K2               | 0 to 1      | 0      | 0   | %    |  |
| P172 *IA > Ix K2/1                  | 5 to 120    | 95     | 95  | %    |  |
| P173 *Response time IA>Ix K2/1      | 0.0 to 30.0 | 0.0    | 0.0 | s    |  |
| P174 *Linking relay K2/1-K3/1       | a=OFF E=ON  | OFF    | OFF |      |  |
| P175 *Linking time K2/1-K3/1        | 0 to 900    | 60     | 60  | s    |  |
| P146 *Timeout firing pulses disable | 0.1 to 2.0  | 0.2    | 0.2 | s    |  |
| P158 *Multiplier P070/P078          | 0 to 1      | 0      | 0   | %    |  |
| P157 *Release delay K2/0            | 0.0 to 30.0 | 0.0    | 0.0 | s    |  |
| P156 *mains failure timeout         | 0.0 to 6.0  | 0.0    | 0.0 | s    |  |

- 9 Go back to main menu:
- Press left arrow key or F10

| M04.30A MONITORING                |              | D04.30 |      |      |  |
|-----------------------------------|--------------|--------|------|------|--|
| Parameter designation             | Limits       | Old    | New  | Dim. |  |
| P070 *n > n_x output K2/0         | 1 to 105     | 1      | 1    | %    |  |
| P005 *Relay output K3             | 0 to 5       | 0      | 0    | %    |  |
| P072 *n_act = n_non K3/0/5        | 1 to 60      | 5      | 5    | %    |  |
| P073 *IA > Ix K3/1                | 5 to 120     | 0      | 0    | %    |  |
| P074 *Delay IA > Ix K3/1          | 0.0 to 30.0  | 1.0    | 1.0  | s    |  |
| P120 *Hysteresis IA > Ix K3/1     | 1 to 40      | 0      | 0    | %    |  |
| P071 *n > n_x output K3/2         | 1 to 105     | 50     | 50   | %    |  |
| P078 *n < n_x for fast brake      | 1 to 100     | 5      | 5    | %    |  |
| P007 *Stalled motor monitoring    | 0.1 to 30.0  | 5.0    | 5.0  | s    |  |
| P006 *Stalled motor monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P122 *Field feed in monitoring    | a=OFF E=ON   | ON     | ON   |      |  |
| P023 *IA_mot / IA_max             | 0.50 to 1.00 | 1.00   | 1.00 |      |  |
| P126 *Thermic time constant motor | 0 to 180     | 0      | 0    | min  |  |
| P127 *Threshold for I2t           | 50 to 110    | 95     | 95   | %    |  |
| P069 Display I2t                  |              | 0      | 0    | %    |  |
| P128 *Relay output K4             | 0 to 1       | 0      | 0    | %    |  |

Operator action

Response on the screen

Press F10 again



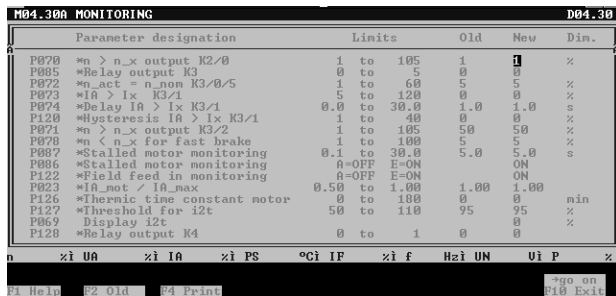
10

**Preparing a listing**

Choose any menu except "End" (e.g. speed controller)

Press F4

Comment: max. of 72 characters min. of 1 character otherwise program terminates!



Press Return

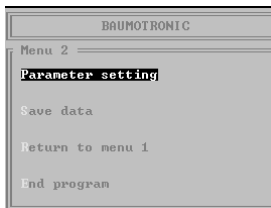
**NOTE**

You can only issue the print command within the nine parameterization menus.

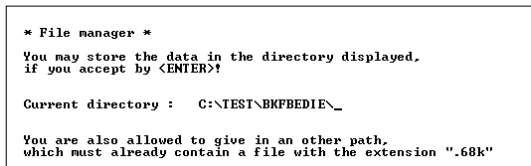
11

**Save data**

Keep pressing F10 until menu 2 is displayed

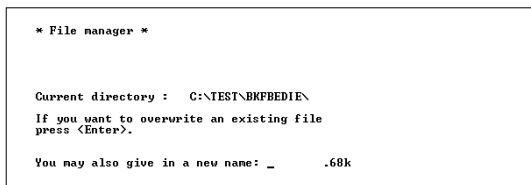


Save your data



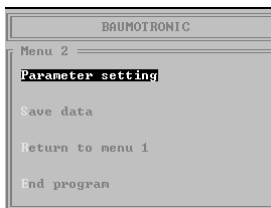
To save to hard disk

Press Return



Enter XYZ

Press Return



Save your data  
 Save on floppy disk  
 Drive A:

```
* File manager *
You may store the data in the directory displayed,
if you accept by <ENTER>!

Current directory : C:\TEST\BKFBDIE\_

You are also allowed to give in an other path,
which must already contain a file with the extension ".68k"
```

Enter A:  
 Press Return

```
* File manager *
You may store the data in the directory displayed,
if you accept by <ENTER>!

Current directory : a:\_

You are also allowed to give in an other path,
which must already contain a file with the extension ".68k"
```

Press Return

```
* File manager *

Current directory : a:\

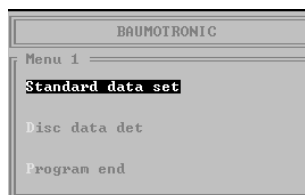
If you want to overwrite an existing file
press <Enter>.

You may also give in a new name: _ .68k
```

Enter XYZ  
 Press Return



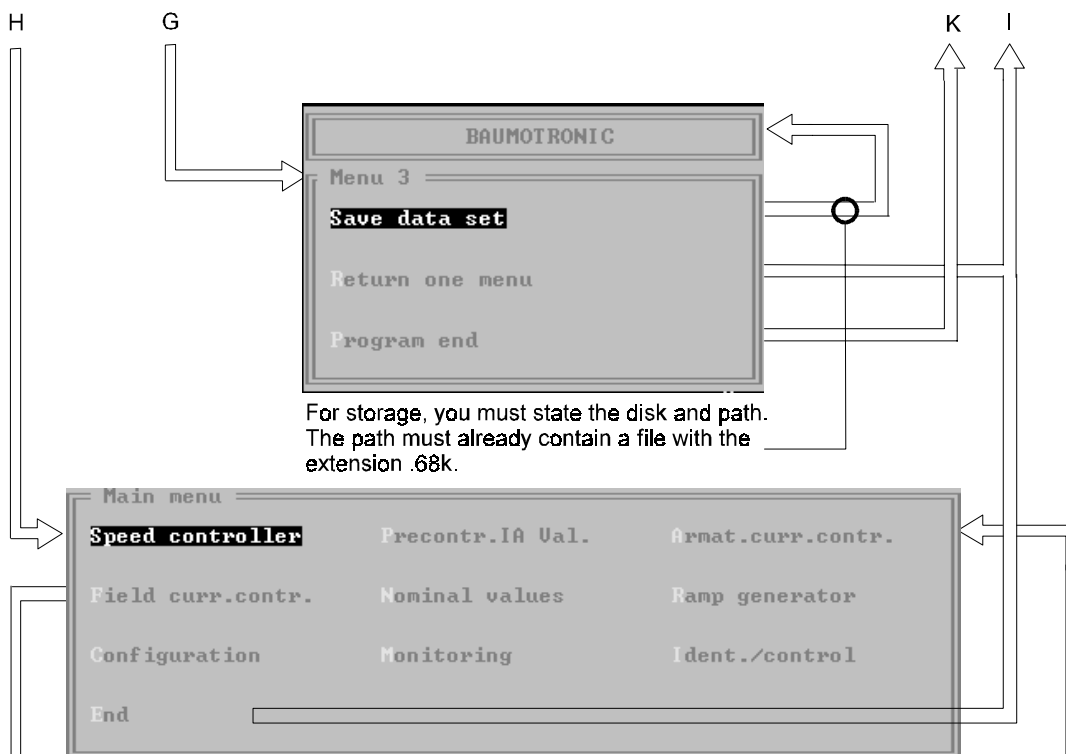
12 Exit the program:  
 End program



Exit the program

b) Online Operation





For storage, you must state the disk and path.  
The path must already contain a file with the extension .68k.

In ONLINE operation, the system displays in the footer function keys F7 for controller enable, F8 for fast brake and F9 for main contactor OFF.  
In ONLINE operation, you use the function keys to issue the power converter software enables. These are logically ANDed with the hardware enables at the unit's control inputs X1:22 ... 24.

M04.30A SPEED CONTROLLER      BKF12-6000    U04.30    150A/4.0A      D04.30

| Parameter designation              | Limits       | Old  | New  | Din. |
|------------------------------------|--------------|------|------|------|
| P011 *P-amplification              | 1 to 100     | 10   | 10   |      |
| P012 *Integral-action time         | 20 to 9990   | 500  | 500  | ms   |
| P014 *Current limit ID1/Drive      | 0 to 100     | 100  | 100  | %    |
| P015 *Current limit ID2/Brake      | 0 to 100     | 100  | 100  | %    |
| P010 *n_act - smoothing            | 5 to 100     | 10   | 12   | ms   |
| P018 *Integral-action time         | A=OFF E=ON   | 0    | ON   |      |
| P019 *speed controller offset      | -400 to +400 | 0    | 0    |      |
| P002 *armature voltage adjustment  | 0.90 to 1.10 | 1.00 | 1.00 |      |
| P016 *Curr. limit reduction at n_x | 0 to 100     | 100  | 100  | %    |
| P017 *Current limit at n_max       | 0 to 100     | 100  | 100  | %    |
| P022 *speed controller preset      | -100 to +100 | 0    | 0    | %    |
| P021 *Current limit switching      | 1 to 2       | 1    | 1    |      |
| P118 Gear ratio                    | 1 to 4       | 0    | 1    |      |
| P142 *Maximum speed value          | 100 to 6000  | 1000 | 1000 | rpm  |
| P143 *Rotary encoder resolution    | 250 to 4096  | 1024 | 1024 |      |
| P144 *Rot. enc. polarity change    | A=OFF E=ON   | OFF  | OFF  |      |

n 0 xi UA 0 xi IA 0 xi PS 23 °Ci IF --- xi f 50 Hz i UN 405 Ui P 0 x

Drive Off      Get message via F3

F1 Help    F2 Old    F4 Print    F7 Enable    F8 F.B    F9 M.O    F10 Exit

The parameter menus are divided into a header, a parameter area with an actual value bar and a footer:

• Header

**M04.30A SPEED CONTROLLER      BKF12-6000 U04.30    150A/4.0A      D04.30**

- M04.30:                      Software version of the user program
- Speed controller:           Name of the parameterization menu
- BKF12 - 6000                Type of power converter
- V04.30                        Software version of the power converter's user program
- 30 A/2.0 A                    Rated DC currents of the connected unit for the armature and field
- D04.30                        Software version of the standard data file on the floppy disk

• Parameter range with actual value bar

Parameterliste:              e.g. speed controller

| Parameter designation              | Limits       | Old  | New       | Dim. |
|------------------------------------|--------------|------|-----------|------|
| P011 *P-amplification              | 1 to 100     | 10   | <b>10</b> |      |
| P012 *Integral-action time         | 20 to 9990   | 500  | 500       | ms   |
| P014 *Current limit ID1/Drive      | 0 to 100     | 100  | 100       | %    |
| P015 *Current limit ID2/Brake      | 0 to 100     | 100  | 100       | %    |
| P010 *n_act - smoothing            | 5 to 100     | 10   | 10        | ms   |
| P018 *Integral-action time         | A=OFF E=ON   |      | ON        |      |
| P019 *speed controller offset      | -400 to +400 | 0    | 0         |      |
| P002 *Armature voltage adjustment  | 0.90 to 1.10 | 1.00 | 1.00      |      |
| P016 *Curr. limit reduction at n_x | 0 to 100     | 100  | 100       | %    |
| P017 *Current limit at n_max       | 0 to 100     | 100  | 100       | %    |
| P022 *speed controller preset      | -100 to +100 | 0    | 0         | %    |
| P021 *Current limit switching      | 1 to 2       | 1    | 1         |      |
| P118 Gear ratio                    | 1 to 4       | 0    | 0         |      |
| P142 *Maximum speed value          | 100 to 6000  | 1000 | 1000      | rpm  |
| P143 *Rotary encoder resolution    | 250 to 4096  | 1024 | 1024      |      |
| P144 *Rot. enc. polarity change    | A=OFF E=ON   |      | OFF       |      |

- Parameterbezeichnung      See offline operation
- Grenzen                      See offline operation
- Spalte "alt":                See offline operation
- Spalte "neu":                See offline operation
- Dimension:                    See offline operation



• Actual value bar:














n 0 % | U<sub>A</sub> 0 % | I<sub>A</sub> 0 % | L<sub>T</sub> 29 °C | I<sub>F</sub> 0 % | f 50 Hz | U<sub>N</sub> 395 U | P 0 %

|      |                               |                |   |
|------|-------------------------------|----------------|---|
| P060 | Speed actual value            | n              | [% of n <sub>max</sub> ]                              |
| P061 | Armature voltage actual value | U <sub>A</sub> | [% of U <sub>anom</sub> ]                             |
| P062 | Armature current actual value | I <sub>A</sub> | [% of max. armature current]                          |
| P063 | Temperature of power stage    | L <sub>T</sub> | [°C]  |
| P064 | Field current actual value    | I <sub>F</sub> | [% of rated field current]                            |
| P066 | Mains frequency               | f              | [Hz]  |
| P067 | Mains voltage                 | U <sub>n</sub> | [V <sub>eff</sub> ]                                   |
| P068 | Power consumption             | P              | [% of the max. power U <sub>A</sub> *I <sub>A</sub> ] |

• Footer:

Drive Off      Get message via F3  
 F1 Help    F2 Old    F4 Print      OFF      OFF      OFF  
 F7 Enable   F8 F\_B    F9 M\_O    F10 Exit

Function keys:

-  Help:                      Makes parameterization easier and makes it unnecessary to keep looking in the manual. With many of the parameters, you can press the  key to call a submenu which lists possible alternative settings.
-  Old:                              Changes between the old parameter value and the new one
-  Error:                         As soon as an error occurs, the system displays "Fetch message F3". When you press , the error is displayed in plain text. Pressing  closes the error display.
-  Print:                         See offline operation
-  Enable:                        Logically ANDed with switching input X1:23 (controller enable)
-  F\_B:                            Logically ANDed with switching input X1:24 (emergency stop)
-  M\_O:                            Logically ANDed with switching input X1:22
-  Exit:                            This closes the menu and brings you back to the main menu!
-  next page:
-  previous page:                With menus that have more than one page, e.g. the Precontr. IA Val menu, you press the appropriate arrow key to go to the next page or the previous page respectively.

Messages:

Drive OFF: Drive is disabled

Drive ON: Drive is enabled

Get message  Displayed in the event of an error

Example in 7.2.3 a) (continued)

You use the floppy disk, which now contains data sets D0430.68k and xyz.68k and program S0430\_D.EXE and possibly S0430\_E.EXE, to parameterize the drive on another PC that has a black and white monitor. Serial port COM2 is used.

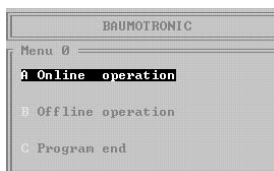
Starting point: The power converter's mains unit is connected to a voltage and the communication source has already been set to P001 = 1 (PC operation).

Operator action

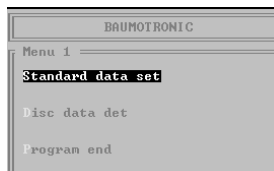
Response on the screen

1

**Call the program:**  
A:\>S0430\_D\_bw\_com2



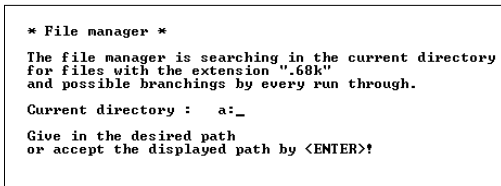
ONLINE operation



2

**Disk-Parameter-Down**

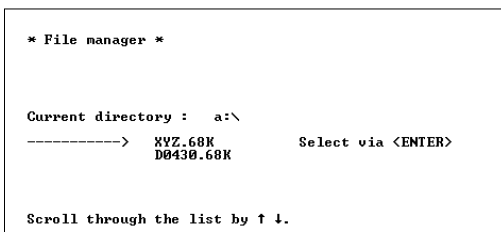
:



Press Return

Use the cursor keys to choose XYZ.68k

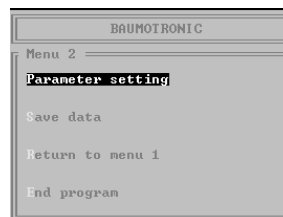
Press Return



During the transfer, "Download" is displayed in the middle of the screen. At the bottom right, the message "Transfer active" flashes.

3 Two possibilities

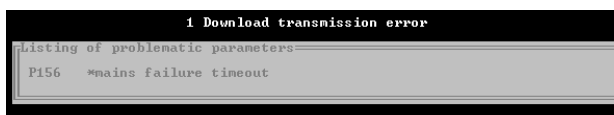
3.1 Transfer functions with no problems



3.2 Problem parameters occur

If errors occur during downloading, the system displays them after transfer is completed:

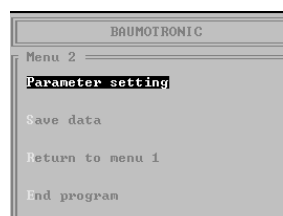
Example:  
User software S04.30 is being used with a unit with operation software S04.24.



Cause:  
P157 and P158 are not yet available in power converter software S04.24 so the system issues negative confirmation at downloading.

Acknowledge:

Press Return



4 Parameterization:

For an explanation of further procedure, refer to "Commissioning Guidelines".

### 7.3 Commissioning Guidelines

#### 7.3.1 Stock-Taking

Record the data of machines, the motor, the power converter and additional components and enter it in the configuration and commissioning log.

**Note:** A .. T: These values are needed at parameterization to calculate drive-specific values.

- Machine: Type, serial number, customer
- Mains connected load, frequency, type of mains (TN or TT system)
  - e.g.: voltage: 3 x 400 V A
  - rotating field: Clockwise rotating field B
- Power converter The rating plate is on the left-hand side inside the casing.
  - acc. to rating plate e.g.

**Built in power converter for conversion and inversion**

Type: BKF 12/050/400-60400000

Input: 3 AC 400 V      50 ... 60 Hz      C

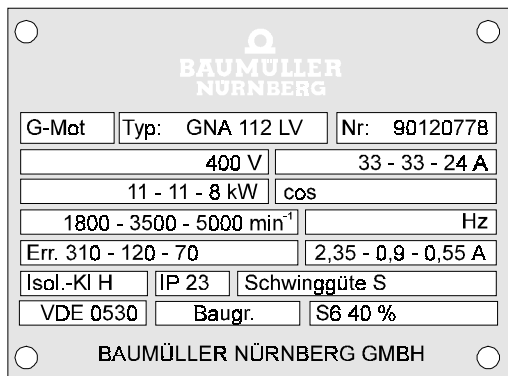
Output:                      DC 0 ... 400 V      50 A      D, E

Mode:                      DB mains: TN or TT      No. 90316556J

- Field supply acc. to rating plate The rating plate is below terminal strip X2 on PCB 3.8942.
  - e.g.: type: BKFN 400F 400R
  - E-No.: 90316556J
  - rated unit field current: 4A F
- Software version of processor board Printed on both EPROMs
  - e.g.: 8934.501      8934.502
  - H00.01      H00.02      ⇔      Version S04.30
  - S04.30      S04.30
- Daughterboard fitted for connection to a controller?
  - e.g.: type 3.8947.01A: RS232, RS 485
  - software version: 8947.002
  - H02.00      ⇔      Version S01.12
  - S01.12
- Tachometer resistance: R102: .... kΩ / 2W / TK 25 G
  - Position on processor board 3.8934
  - refer to: 6.2 Speed Control with Analog Tachometer
- Supply of switching inputs
 

|  |                 |                 |
|--|-----------------|-----------------|
| X1/22...29,42:                                       | +24 V from unit | W11: fitted     |
|  |                 | W13: A-B        |
| X1/22...29,42:                                       | +24 V external  | W11: not fitted |
|  |                 | W13: A-B        |
| X1/22...24,26...29,42:                               | +24 V external  | W11: not fitted |
| X1/25  | +24 V from unit | W13: B-C        |
| See 5.2 Connection of Controller Modules BKD and BKF |                 |                 |

- Motor data e.g.: according to rating plate:



Meaning:

| DC Motor         |       | Type   | GNA                      | 112 LV   | Serial No. 90120778   |                          |
|------------------|-------|--------|--------------------------|----------|-----------------------|--------------------------|
| Armature Voltage | $U_A$ | 0      | 400 V                    | 400 V    | 400 V                 |                          |
| Armature Current | $I_A$ | 33 A   | 33 A                     | 33 A     | 24 A                  |                          |
| Power            | P     | 0      | 11 kW                    | 11 kW    | 8 kW                  |                          |
| Speed            | n     | 0      | 1800 RPM                 | 3500 RPM | 5000 RPM              |                          |
| Field Voltage    | $U_F$ | 310 V  | 310 V                    | 120 V    | 70 V                  |                          |
| Field Current    | $I_F$ | 2.35 A | 2.35 A                   | 0.9 A    | 0.55 A                |                          |
|                  |       |        | Armature Adjusting Range |          | Field Adjusting Range |                          |
|                  |       |        | Constant Torque          |          | At constant power     | At the commutation limit |

H

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P

Rated values at basic speed  
Operating mode S6 40% according to VDE 0530

- Tachometer generator e.g.: Type: GHTS42  
No.: 003319  
Current: max. of 10 mA  
Voltage: 20 V/1000 RPM
- Incremental encoder e.g.: Type  
No. of pulses: 1024 pulses/rev.  
Max. speed: ..... RPM  
Supply voltage: .... V
- Three-phase line reactor for the armature power converter
- Single-phase line reactor for the field power converter
- Semiconductor fuses

Q

R

S

T












### 7.3.2 Parameterization

At commissioning of the power converter using the unit's keypad, it is advisable to first enter in the parameter documentation (sections 7.4 and 7.5) the parameters below that have to be established. You can then input the values when you actually program the unit.

#### NOTE

The customer must carry out documentation and administration of user-specific parameter sets.

- Specification of motor-specific parameter values

|   |  |   |
|---|--|---|
| P105 Nominal mains voltage  | e.g.: 400 V  |    |
| P110 Armature/mains voltage<br>$P110 = \frac{\text{Armature voltage}}{\text{Nominal mains voltage}}$                                | e.g.: $\frac{400 \text{ V}}{400 \text{ V}} = 1$                            |  ,      |
| P025 $I_{A_{\max}}$ /device nom. current<br>$P025 = \frac{\text{Max. armature current of motor}}{\text{Unit's nominal current}}$    | (see chapter 6.4.1)<br>e.g.: $\frac{33 \text{ A}}{50 \text{ A}} = 0.66$    |  ,      |
| P016 Current limit reduction at $n_x$<br>P017 Only with motors that are run in the high speed range at the commutation limit curve  | (see chapter 6.4.1)  |   |
| $P016 = \frac{\text{Application speed}}{\text{Max. motor speed}}$   | e.g.: $\frac{3500 \text{ RPM}}{5000 \text{ RPM}} * 100\% = 70 \%$          |  ,  |
| $P017 = \frac{\text{Motor current at } n_{\max}}{\text{Max. armature current of motor}}$  | e.g.: $\frac{24 \text{ A}}{33 \text{ A}} * 100\% = 72 \%$                  |  ,  |
| P049 $I_{F_{\max}}$ /device nom. current<br>$P049 = \frac{\text{Nominal motor field current}}{\text{Nominal field device current}}$ | (see chapter 6.4.2)<br>e.g.: $\frac{2.35 \text{ A}}{4.0 \text{ A}} = 0.59$ |  ,  |

P083: Controller structure  
(see chapter 6.2)

Control by means of tachometer generator  or incremental encoder  (constant field ⇔ field weakening), e.m.f. control or current control?

| Value | Meaning   |
|-------|---|
| 0     | Tachometer generator, constant field<br>Tachometer adaptation R102, fine matching R103  |
| 1     | Tachometer generator, field weakening<br>additional parameters to be set<br>P047: Minimal field current<br>$P047 = \frac{\text{Min. field current}}{\text{Max. field current}} \cdot 80\% \quad \text{e.g.: } \frac{0.55 \text{ A}}{2.35 \text{ A}} \cdot 80 \% = 20 \%$<br>P042: Cross-over/arma. voltage<br>Default value: 0.95· rated armature voltage<br>P145: Field weakening mode |
| 2     | Rotary encoder, constant field<br>additional parameters to be set<br>P142: Rated speed of motor<br>e.g.: 5000 RPM<br>P143: Rotary encoder resolution<br>e.g.: 1024 incr./rev.<br>P144: Rotary encoder polarity change   |
| 3     | Rotary encoder, field weakening<br>see P083 = 1, 2  |
| 4     | e.m.f. control with constant field<br>speed adaptation using P082 and P110  |
| 5     | Current control with constant field   |

O,  P

H

L

R

– Specifying the drive-specific parameter values

- Specified value source (see chapter 6.3)  
P080 = 0 ... 16

List of the parameters that are assigned to individual specified value sources

| Value                    | Meaning   |
|--------------------------|---|
| 1                        | Analog 1 (differential amplifier)<br>Analog adaptation: potentiometer R100 (v = 0.9 ... 2.0)  |
| 2                        | Analog 2 (summing amplifier)<br>Digital adaptation: P113, P114  |
| 3                        | Analog 1 + 2; P113, P114  |
| 4                        | Digital (serial)<br>Setting via P050 when P001 = 1, 2, 3  |
| 5                        | Internal specified value generator<br>For value, see P090 ... P093  |
| 6                        | Internal specified value 1<br>For value, see P051   |
| 7                        | Internal specified value 2<br>For value, see P052   |
| 8                        | Internal specified value 3<br>For value, see P053   |
| 9                        | Internal specified value 4<br>For value, see P054   |
| 10                       | Motorized potentiometer<br>For value, see P055 ... P058   |
| 11<br>(S04.11 and above) | Specified value setting via DPRAM no protocol 16-bit. Can only be used in conjunction with InterBus-S daughterboard PCB 3.9208.   |
| 12<br>(S04.11 and above) | Parallel specified value setting 15-bit twos complement. Permissible value range.: \$3FF0 to \$4010. PCB 3.9217 needed.   |
| 13<br>(S04.11 and above) | Parallel specified value setting 14-bit and sign. Permissible value range: \$0 to \$3FF0. If bit no. 15 = 1, the value is interpreted as a negative number (amount + sign). PCB 3.9217 needed.  |
| 14<br>(S04.11 and above) | Parallel specified value setting 12-bit and sign. Decimal specified value setting (amount + sign). Permissible value range: 0 to 999 (percentual setting). If bit no. 15 = 1, the value is interpreted as a negative number. If a code is entered in on of the three places that is not a decimal number, the system does not accept the specified value. PCB 3.9217 needed.  |
| 15<br>(S04.28 and above) | Sum of specified value sources 2 and 4<br>P113, P114, P001  |
| 16<br>(S04.15 and above) | Analog specified value via differential amplifier and analog additional specified value via summing amplifier. Has a similar effect to P080 = 3, however the specified value from the differential amplifier is routed directly to the speed controller and the specified value from the summing amplifier is transferred to the speed controller via the ramp function generator. P149 does not affect P080 = 16, P113, P114, P094, P095, P096 or P100, P101, P102 |



- Ramp function generator (see chapter 6.3)
  - Ramp function generator 1: P094: ON/OFF
  - P095: RG1 Acceleration time
  - P096: RG1 Deceleration time
  - Ramp function generator 2: P100: ON/OFF
  - P101: RG2 Acceleration time
  - P102: RG2 Deceleration time
- S-ramp generator (see chapter 6.3)
  - P097: time constant
  - P098: ON/OFF
- Enabling the power converter and main contactor control (see chapters 6.7.1, 6.7.3)

Affected parameters:

  - P001: Communication source
  - P124: Drive inhibit function
  - P146: Timeout firing pulses disable  
(leave at default setting)
  - P123: Fast brake
  - P079: Main contactor edge
  - P078:  $n < n_x$  for fast brake

When commissioning using a PC (P001 = 1), it is advisable to initially set P124 = 1 and P079 = OFF and to leave the hardware enables permanently pending. In this way, the drive can be controlled by means of the three software enables that are activated using the function keys.
- Current limitation (see chapter 6.4)
  - P014: Current limit TD1/Drive
  - P015: Current limit TD2/Brake
  - P021: Current limit switching

It is advisable to leave P014 and P015 at the default value of 100% until optimization run P081 = 1 has been carried out at equipment setting.

If you set the current limit too low, it may not be possible to specify the characteristic curve parameters. At the optimization run, this results in error message F102 or F103.

  - Gear protection: P027: current  
P028: time
- Programmable input X1:9 (see chapter 6.7.2)
  - P084: 0 ... 13
- Inputs X1:28 and X1:29 (see chapter 6.7.2)
  - P099: 0 ... 4
- Analog output to measuring channels 1 ... 4 (see chapter 6.6)

Measuring channels 3 and 4 are only available with daughterboards 3.9201/3.9217.

  - P088, P089, P125
  - P130, P131, P132

- Monitoring

(see chapter 6.5)

- P171: Relay output K2  
affected parameters:  
P070, P158, P157, P172, P173, P174, P175
- P085: Relay output K3  
affected parameters:  
P072, P073, P074, P120, P071, P174, P175
- P128: Relay output K4  
affected parameters:  
P126, P023, P127
- P122: Field feed in monitoring  
P086,
- P087: Stalled motor monitoring
- P138: Threshold tacho polarity
- P140: Threshold tacho wire break
- P141: Delay time armature open
- P117: Pull-in time  $I_F$  monitoring

- Other special parameters

- P147: Phase failure < 400 msec
- P156: Mains failure timeout
- P007: Counterclockwise rotating field inhibit  
Set to ON! Operation with counterclockwise rotating field in exceptional cases only
- P148: Load data set
- P075: Reduced field  
P076: Time for reduced field  
P077:  $I_{F\_nom}$  for reduced field
- P039: Field unit ON/OFF
- P118: Gear stage  
The system transfers the values for the speed controller protective circuit (P011 and P012) to the active data set from the data set specified by means of P118. All the other setting values stay the same. Switchover is only possible by means of the available interface boards or the PC.
- P149: Nominal value multiplier see P084 = 4
- P115, See parameter list
- P116:  $n_{nom} = 0$  lock/threshold

- Controller parameters

Field current controller ( $I_F$  controller)

- P043: P-amplification
- P044: Integr. act. time ( $I_F$  contr.)

Armature voltage controller ( $U_A$  controller)

Is only in effect with controller structures (P083) with field weakening control

- P040: P-amplification
- P041: Integr. act. time ( $U_A$  controller)

Armature current controller ( $I_A$  controller)

- P030:  $I_{anom}$  integrator
- P031: P-amplification
- P032: Integral-action time
- P033: Integ. act. time ( $I_A$  gapping)
- P034: Gapping current adaption ON
- P035: Integral-action time ON
- P038: Source  $I_A$  precontrolling

Speed controller

- P011: P-amplification
- P012: Integral-action time
- P010:  $n_{act}$  - smoothing
- P018: Integral-action time ON/OFF

Setting controller parameters:

Experience has shown that, with most applications, you can use the default values for the field current, armature voltage and current controllers regardless of the motor size.

With special applications or third-party motors, it may be necessary to carry out reoptimization (refer to Equipment Set-up below).

You must adapt the speed controller to the drive- and system-specific conditions (e.g. the motor moment of inertia, the drive torque, special requirements).

Empirical values:

1. Controller structure P083 = 0 ... 3 (n-controller with analog tachometer or rotary encoder)

- a) Motors with rated speeds  $\geq 2000$  RPM

- P011:  $\geq 10$
- P012: 200 ... 500 ms
- P010: 10 ms

- b) Slow-running motors (rated speed approx. 1000 RPM)

- P011: 5 ... 10
- P012: 200 ... 500 ms
- P010: 10 ms

2. Controller structure P083 = 4 (e.m.f. control)

- P011: 8
- P012: 500 ms
- P010: 20 ms

### 7.3.3 Equipment Set-Up

#### Before switching on

##### 1. General checks

- Check the cabling and cable cross-sections
- Check the equipment connections and protective measures



## WARNING

During operation, the power stage and the mains and motor connections are live!

- Check higher-level safety equipment (e.g. Emergency Stop on the machine).

##### 2. Adapting speed measurement (option of 2.1 or 2.2)

###### 2.1 Speed control with analog tachometer

- Fit the correct tachometer series resistor R102 (see 6.2 Specifying the Controller Structure).
- Set potentiometer R103 (fine-tuning the maximum speed) all the way anticlockwise to the lowest value.

###### 2.2 Speed control with actual value rotary encoder

- Check the encoder connection on the supplementary module (see 2.8 Technical Data of Supplementary Modules as well as 5.3 Connection Plans and the detailed descriptions of supplementary modules)

###### a) Input/Output Expansion, 3.9217

Version 3.9217.01

Rotary encoder input with 5-V supply for two 90° phase-shifted differential pulses:

Plug: X7A

Jumpers W1, W2 B-C

Rotary encoder input with +24-V supply for two 90° phase-shifted differential pulses:

Plug: X7B: 15 - 17

Jumpers W1, W2 A-B

###### b) InterBus-S Interface Board, 3.9208

Version 3.9208.02

Rotary encoder input with 5-V supply for two 90° phase-shifted differential pulses:

Plug: X8D

###### c) RS485 Interface Board for CS31 System Bus or with USS protocol, 3.9493

Version 3.9493.02, 3.9493.04

Rotary encoder input with 5-V supply for two 90° phase-shifted differential pulses:

Plug: X8, X9

3. Adaptation of the voltage supply for inputs X1:22-29, 42:  
See 5.3.1 Connecting Controller Module Sizes I ... IV
  - Jumpers W11, W13 fitted according to requirements
  
4. Triggering:
  - Controller and main contactor not yet enabled:
 

|                   |       |   |       |       |
|-------------------|-------|---|-------|-------|
| Main contactor ON | = OFF | ⇔ | X1:22 | = 0 V |
| Controller enable | = OFF | ⇔ | X1:23 | = 0 V |
| Cancel fast brake | = OFF | ⇔ | X1:24 | = 0 V |
  - Pulse enable = OFF ⇔ X1:25 = 0 V

As a result, the field current = 0 A while no data set is applied and the motor's rated field current has not yet been specified with P049. This is to protect the field winding

  - If several data sets are to be programmed only (P099 = 4):  
interrupt X1:28,29.  
This prevents uncontrolled switchover of data sets during parameterization and provides protection from parameterization errors.

### Working with the unit switched-on

5. Mains connection:
  - Switch on the power converter: connect to the mains at the same time the mains unit, the field supply, the fan (with unit sizes II and above) and the motor fan  
The following are carried out:
    - a lamp test
    - initialization
    - booting, i.e. transferring a data set (1 ... 4) from the EEPROM to RAM. At initial commissioning, data set 0 (the default data set) is booted from the EPROM.
  - Check the directions of rotation of the fans of the equipment and the motor
  - Operating displays:
 

|               |              |                         |
|---------------|--------------|-------------------------|
| LED messages: | - H18/green  | (torque direction 1) or |
|               | H17/yellow   | (torque direction 2)    |
|               | - H19/yellow | (speed = 0)             |
|               | - H21/red    | (controller disable)    |
|               | - H22/red    | (message)               |

  
 Messages on the display:
 

|               |      |   |   |
|---------------|------|---|---|
| P159          | = 24 | ⇔ | Field current out of lower range                                    |
| P159          | = 61 | ⇔ | No data set programmed  |
| Possibly P159 | = 45 | ⇔ | Field connection not correct (field unit was switched on too late). |
  
6. Default settings for operation at commissioning:
  - Keypad enabled  
Use the keypad to set P104 = 17 (see 7.2.2)  
After transfer, the value 17 is not displayed!
  - When carrying out commissioning with a PC: change the communication source to P001 = 1  
(The factory default setting is P001 = 0 ⇔ keypad on power converter)

## 7. Basic settings at initial commissioning

- Generate a data set:  
Program the EEPROM data set P004 = 1 ... 4
- Specify the boot source  
Setting to the data set stored with P004 = 1 ... 4  
⇒ Error message P159 = 61 ⇔ "No data set programmed" goes out.

## 8. Parameterization (choice of 8.1 or 8.2)

### 8.1 Parameterization manually or on the power converter's keypad

- See 7.2.2, Keypad and Display on the Power Converter
- Transfer of parameter values according to the parameter list in numerical order



### 8.2 Parameterization on a PC with user software

- See 7.2.3, Operation using a PC  
Choice of:
  - Downloading preset parameter values
  - Parameterizing online directly at the drive

## 9. After completing parameterization

- Program the EEPROM: P004: 1 .. 4  
Store the changed values in the EEPROM

## 10. Clear error P159 = 24

- Pulse enable = ON ⇔ X1:25 = 24 V
- Choice of:
  - With keypad operation (P001 = 0):  
Choose P005: (read single error), after this press the mode key and then one of the counter keys  
LED H22/red (message) goes out.
  - With PC operation (P001 = 1):  
Press the F3 key: The error is displayed on the screen.  
Press F10 to acknowledge the error.  
LED H22/red (message) goes out.
  - Trigger a reset on the power converter.  
Switch on the display by keeping the  or  key pressed for at least 1 second.  
(In the case of parameterization by means of the keypad, you must then reenble the keypad with P104 = 17.)
  - Switch the mains unit briefly off and then on again (motor protective switch in the mains lead)

## 11. Characteristic curve optimization

- Block the motor
- Enter P081 = 1
- Enable the controller:
 

|                     |      |   |               |
|---------------------|------|---|---------------|
| – Main contactor ON | = ON | ↔ | X1:22 = +24 V |
| – Controller enable | = ON | ↔ | X1:23 = +24 V |
| – Cancel fast brake | = ON | ↔ | X1:24 = +24 V |

### NOTE

With P081 = 1, 2 or 4 and drive ON, the system switches off the field internally and tests the armature circuit with current pulses. After optimization, the unit switches automatically to drive OFF.

If P014 and P015 are set too low, it may not be possible to determine some characteristic curve parameters. In this case, error message P159 = 102, 103 is issued. In this instance, you must set P014 and P015 to 100% for the duration of the optimization run.

Program the EEPROM: P004 = 1 ... 4

Store the changed values in the EEPROM

## 12. Check the nominal value setting

- Disable the controller
- Specify 100% nominal value
- On the power converter's display, set parameter P050 and check the specified value, see 6.3 Nominal Value Setting.

## 13. Speed setting, see 6.2 Specifying the Controller Structure

Procedure:

- Specify 10% nominal value (percentual display via P050)
- Enable the controller
- Using LED H17 for torque direction 1, check that the motor is running true and that the speed controller is optimized; use LED H18 to do the same for torque direction 2:  
If both LEDs flicker, this may indicate controller oscillation; if necessary, reduce the P-amplification (P011) and increase the integral-action time (P012).
- Use a hand tachometer to measure and match the motor speed (see 13.1, 13.2, 13.3).
- Increase the speed step-by-step to the maximum level and adjust it if necessary
- At maximum speed, check the armature voltage (P061). This is particularly important for drives with field weakening.

In the case of drives with controller structure P083 = 0 and 2, reduce P049, "I<sub>F</sub> max./device nom. current" if necessary; with drives with controller structure P083 = 1 and 3 reduce P047 "Minimal field current".

### 13.1 Speed setting with tachometer control

Potentiometer R103

### 13.2 Speed setting with rotary encoder control

Parameter P142 "Maximum speed value"

### 13.3 Speed setting with e.m.f. control

Parameter P082: "Armature voltage adjustment"

Parameter P110 "Armature/mains voltage"

14. Offset compensation  
Set nominal value = 0 and compensate the offset with P019. You can also use P019 to balance the speeds with counterclockwise/clockwise running.
  15. Speed controller optimization
    - Set empirical values or carry out optimization according to generally applicable optimization criteria
    - Preset n-controller P022  
This leads to jerk-free starting at controller enable on motors that carry torque when idling (e.g. lifting equipment). Positive values of P022 result, at controller enable, in clockwise counter-torque, with negative values having the opposite result.  
You must determine the size of the counter-torques by trial and error.
  16. Check the ramp function generator and the S-ramp generator  
see 6.3 Nominal Value Setting
    - Program the EEPROM: P004 = 1 .. 4  
Store the changed values in the EEPROM
  17. Check the monitoring
    - Check relay functions K1 .. K4  
For display parameter P107: Display of relay controls, refer to list of parameters
  18. Postoptimization of the current controller and the field current controller; only carry out postoptimization of the armature voltage controller at P083 = 1, 3
    - Set empirical values or carry out optimization according to generally applicable optimization criteria
    - Program the EEPROM: P004 = 1 .. 4  
Store the changed values in the EEPROM
  19. Programming further data sets  
If necessary
    - Repeat points 7. to 18.
- NOTE:**

Point 7: The boot source that was initially saved does not need to be changed!

Point 10: Not applicable

Point 11: You only need to carry out characteristic curve optimization again if parameter value P025 "I<sub>F</sub> max./device nom. current" has changed in the newly created data set.
20. Set correctly any parameters that you assigned with different values during commissioning to make handling of the power converter easier.  
If necessary  
Possible parameters: P014, P015, P079, P080, P124, etc.



21. If several data sets were programmed only (P099 = 4)
  - Reconnect X1: 28 , 29
  - Check data set switchover by the external controller using display parameter P129 "Display loaded/programmed data set" on the power converter's display.
  
22. Change the communication source  
If necessary

### **NOTE**

Before changing from P001 = 1 (PC operation) to P001 = 0 (keypad operation), you must first unlock the keypad on the unit (P104 = 17)!

7.4 Configuration and Commissioning Record

|                           |   | Changes: | By/Date |
|---------------------------|---|----------|---------|
| Machine                   | Type: .....                                 | .....    | .....   |
|                           | Factory number: .....                       | .....    | .....   |
|                           | Client: .....                               | .....    | .....   |
| Mains                     | Voltage/Tolerance: .....                    | .....    | .....   |
|                           | Rotating field: .....                       | .....    | .....   |
| Power converter           | Type: .....                                 | .....    | .....   |
|                           | Serial number: .....                        | .....    | .....   |
|                           | Input:        voltage: .....                | .....    | .....   |
|                           | Output:       voltage: ..... current: ..... | .....    | .....   |
|                           | Field:         current: .....               | .....    | .....   |
|                           | Software version: .....                     | .....    | .....   |
|                           | Interface board: .....                      | .....    | .....   |
|                           | R102: .....kΩ/2 W/TK25                      | .....    | .....   |
| W11: ..... W13: A B C     | .....                                       | .....    |         |
| DC motor                  | Type: .....                                 | .....    | .....   |
|                           | No.: .....                                  | .....    | .....   |
|                           | Armature voltage: .....                     | .....    | .....   |
|                           | Armature current: .....                     | .....    | .....   |
|                           | Power: .....                                | .....    | .....   |
|                           | RPM speed: .....                            | .....    | .....   |
|                           | Field voltage: .....                        | .....    | .....   |
|                           | Field current: .....                        | .....    | .....   |
| Speed measurement         | Tachom. gen.    Type: .....                 | .....    | .....   |
|                           | Voltage: .....                              | .....    | .....   |
|                           | Rotary encoder   Type: .....                | .....    | .....   |
|                           | Number of pulses: .....                     | .....    | .....   |
| 3-phase current reactor   | Type: .....                                 | .....    | .....   |
| Single-phase line reactor | Type: .....                                 | .....    | .....   |
| Semiconductor fuse        | Phase fuses: .....                          | .....    | .....   |
|                           | Armature circuit fuses: .....               | .....    | .....   |
|                           | Field fuses: .....                          | .....    | .....   |

7.5 Parameter Documentation

| No.    | Name                                    | Range  | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|---|--|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P000   | Power stage                             | 30 A ... > 600 A   | Display                        |                     |                     |                     |                     |
| P001 + | Communication source                    | 0.0 ... 3.3  | 0                              |                     |                     |                     |                     |
| P002   | Rotating field                          | u: not specified<br>rdf: clockwise<br>ldf: counterclockwise  | Display                        |                     |                     |                     |                     |
| P003   | Software version                        | 04.xx  | Display                        |                     |                     |                     |                     |
| P004   | Program EEPROM data set X               | 1 ... 4  | 0                              |                     |                     |                     |                     |
| P005   | Read single error                       | 000 ... 115  | See error list                 |                     |                     |                     |                     |
| P006 + | Boot source                             | 0 ... 4  | 0                              |                     |                     |                     |                     |
| P007 + | Left rotary field lock                  | ON or OFF  | ON                             |                     |                     |                     |                     |
| P008   | Load data set X                         | 0 = EPROM Standard<br>1 = EEPROM data set 1<br>1 = EEPROM data set 2<br>1 = EEPROM data set 3<br>1 = EEPROM data set 4 | 0                              |                     |                     |                     |                     |
| P009 + | Start parameter                         | 0 ... 175  | 1                              |                     |                     |                     |                     |
| P010 * | n_act smoothing                         | 5 ... 100 ms   | 10                             |                     |                     |                     |                     |
| P011 * | P-amplification                         | 1 ... 100  | 10                             |                     |                     |                     |                     |
| P012 * | Integral-action time                    | 20 ms ... 9.99 s   | 500                            |                     |                     |                     |                     |
| P013   | Reserved                                |  |                                |                     |                     |                     |                     |
| P014 * | Current limit TD1                       | 0 ... 100%   | 100                            |                     |                     |                     |                     |
| P015 * | Current limit TD2                       | 0 ... 100%   | 100                            |                     |                     |                     |                     |
| P016 * | Curr. limit reduction at n <sub>x</sub> | 0 ... 100%   | 100                            |                     |                     |                     |                     |
| P017 * | Current limit at n <sub>max</sub>       | 0 ... 100%   | 100                            |                     |                     |                     |                     |
| P018 * | Integral-action time                    | ON/OFF   | ON                             |                     |                     |                     |                     |
| P019 * | Speed controller offset                 | -400 ... +400 (-2.4 ... +2.4 %)  | 0                              |                     |                     |                     |                     |
| P020 * | I x R                                   | 0.0 ... 50%  | 4.5                            |                     |                     |                     |                     |
| P021 * | Current limit switching                 | 1, 2   | 1                              |                     |                     |                     |                     |
| P022 * | Speed controller preset                 | -100.0 ... 100.0%  | 0.0                            |                     |                     |                     |                     |

| No.    | Name                                   | Range   | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|--|---|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P023 * | IA <sub>mot</sub> /IA <sub>max</sub>   | Motor I <sub>t</sub> monitoring in operation at overstress<br>Setting range 0.50 ... 1.00 | 1.00                           |                     |                     |                     |                     |
| P024 * | Gapping current limit                  | 1 ... 100%  | 30                             |                     |                     |                     |                     |
| P025 * | IA <sub>max</sub> /device nom. current | 0.50 ... 1.00   | 1.00                           |                     |                     |                     |                     |
| P026 * | IA <sub>nom</sub> idle time            | 0, 1, 2   | 1                              |                     |                     |                     |                     |
| P027 * | Gear protection current                | 0 ... 100%  | 100                            |                     |                     |                     |                     |
| P028 * | Gear protection time                   | 0 ... 500 ms  | 0                              |                     |                     |                     |                     |
| P029 * | Armature inductivity                   | 0.0 ... 150.0   | 10.0                           |                     |                     |                     |                     |
| P030 * | IA <sub>nom</sub> integrator           | 0 ... 100 ms  | 6                              |                     |                     |                     |                     |
| P031 * | P-amplification                        | 0.05 ... 0.80   | 0.12                           |                     |                     |                     |                     |
| P032 * | Integral-action time                   | 5 ... 100 ms  | 32                             |                     |                     |                     |                     |
| P033 * | Integral-action time (IA-gapping)      | 0.2 ... 100ms   | 8                              |                     |                     |                     |                     |
| P034 * | Gapping current adaption               | ON/OFF  | ON                             |                     |                     |                     |                     |
| P035 * | Integral-action time                   | ON/OFF  | ON                             |                     |                     |                     |                     |
| P036 * | Current precontrolling                 | ON/OFF  | ON                             |                     |                     |                     |                     |
| P037 * | Scaling IA precontrol                  | 0.00 ... 1.00   | 1.00                           |                     |                     |                     |                     |
| P038 * | Source IA precontrolling               | 1 or 2  | 1                              |                     |                     |                     |                     |
| P039 * | Field device                           | ON/OFF  | ON                             |                     |                     |                     |                     |
| P040 * | P-amplific. UA controller              | 0.1 .. 20.0   | 1.5                            |                     |                     |                     |                     |
| P041 * | Integ.-act. time UA controller         | 20 ... 999 ms   | 180                            |                     |                     |                     |                     |
| P042 * | Cross-over/nom. arma. voltage          | 0.50 ... 1.00   | 0.95                           |                     |                     |                     |                     |
| P043 * | P-amplific. IF controller              | 0.1 ... 20 .0   | 1.0                            |                     |                     |                     |                     |
| P044 * | Integ.-act. time IF controller         | 20 ... 999 ms   | 180                            |                     |                     |                     |                     |
| P045   | Reserved                               |   |                                |                     |                     |                     |                     |

| No.    | Name   | Range                | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|--|----------------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P046   | Field current nominal value                    | ... 100%             | Display                        |                     |                     |                     |                     |
| P047 * | Minimal field current                          | 20 ... 99 %          | 90                             |                     |                     |                     |                     |
| P048 * | Field current monitoring                       | ... %                | Display                        |                     |                     |                     |                     |
| P049 * | IF <sub>max</sub> /device nom. current         | 0.20 ... 1.00        | 1.00                           |                     |                     |                     |                     |
| P050   | Speed nominal value                            | -100.0 ... +100.0%   | Display                        |                     |                     |                     |                     |
| P051 * | Internal nominal value 1                       | -100.0 ... +100.0%   | 10.0                           |                     |                     |                     |                     |
| P052 * | Internal nominal value 2                       | -100.0 ... +100.0%   | -10.0                          |                     |                     |                     |                     |
| P053 * | Internal nominal value 3                       | -100.0 ... +100.0%   | 5.0                            |                     |                     |                     |                     |
| P054 * | Internal nominal value 4                       | -100.0 ... +100.0%   | -5.0                           |                     |                     |                     |                     |
| P055 * | Motorized pot. upper limit                     | -99.9 ... +100.0     | 100.0                          |                     |                     |                     |                     |
| P056 * | Motorized pot. lower limit                     | -100.0 ... +99.9     | 0.0                            |                     |                     |                     |                     |
| P057 * | Motorized pot. accel. time                     | 0.1 ... 100.0 s      | 5                              |                     |                     |                     |                     |
| P058 * | Motorized pot. decel. time                     | 0.1 ... 100.0 s      | 5                              |                     |                     |                     |                     |
| P059 + | Motor pot. memory value                        | 0 ... ± 100%         |                                |                     |                     |                     |                     |
| P060   | Speed actual value                             | ... %                | Display                        |                     |                     |                     |                     |
| P061   | Armature voltage actual value                  | ... %                | Display                        |                     |                     |                     |                     |
| P062   | Armature current actual value                  | ... %                | Display                        |                     |                     |                     |                     |
| P063   | Temperature of power stage                     | ... °C               | Display                        |                     |                     |                     |                     |
| P064   | Field current actual value                     | ... %                | Display                        |                     |                     |                     |                     |
| P065   | Reserved                                       |                      |                                |                     |                     |                     |                     |
| P066   | Mains frequency                                | ... Hz               | Display                        |                     |                     |                     |                     |
| P067   | Mains voltage                                  | ... V <sub>eff</sub> | Display                        |                     |                     |                     |                     |
| P068   | Consumed power                                 | ... %                | Display                        |                     |                     |                     |                     |
| P069   | I <sup>2</sup> t value                         | ... %                | Display                        |                     |                     |                     |                     |
| P070 * | n > n <sub>x</sub> output K2/0                 | 1 ... 105 %          | 1                              |                     |                     |                     |                     |
| P071 * | n > n <sub>x</sub> output K3/2                 | 1 ... 105 %          | 50                             |                     |                     |                     |                     |
| P072 * | n <sub>act</sub> = n <sub>nom</sub> for K3/0/5 | 1 ... 60%            | 5                              |                     |                     |                     |                     |

| No.    | Name                        | Range            | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|-----------------------------|------------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P073 * | $I_A > I_x$ K3/1            | 5 ... 120%       | 95                             |                     |                     |                     |                     |
| P074 * | Delay $I_A > I_x$ K3/1      | 0.0 ... 30.0 s   | 1.0                            |                     |                     |                     |                     |
| P075 * | Reduced field               | ON/OFF           | OFF                            |                     |                     |                     |                     |
| P076 * | Time for reduced field      | 0 ... 180 s      | 30                             |                     |                     |                     |                     |
| P077 * | $I_{F_{nom}}$ reduced field | 20 ... 100%      | 30                             |                     |                     |                     |                     |
| P078 * | $n < n_x$ for fast brake    | 1 ... 100%       | 5                              |                     |                     |                     |                     |
| P079 * | Main contactor edge         | ON/OFF           | ON                             |                     |                     |                     |                     |
| P080 * | Nominal value source        | 1 ... 16         | 1                              |                     |                     |                     |                     |
| P081   | Optimization run            | 0, 1, 2, 4 or 6  |                                |                     |                     |                     |                     |
| P082 * | Armature voltage adjustment | 0.90 ... 1.10    | 1.0                            |                     |                     |                     |                     |
| P083 * | Controller structure        | 0 ... 5          | 4                              |                     |                     |                     |                     |
| P084 * | Programmable input X1:9     | 0 ... 11         | 0                              |                     |                     |                     |                     |
| P085 * | Relay output K3             | 0 ... 5          | 0                              |                     |                     |                     |                     |
| P086 * | Stalled motor monitoring    | ON/OFF           | ON                             |                     |                     |                     |                     |
| P087 * | Stalled motor monitoring    | 0.1 ... 30 s     | 5.0 s                          |                     |                     |                     |                     |
| P088 * | Analog output channel 1     | 0 ... $\pm 10$ V | 2                              |                     |                     |                     |                     |
| P089 * | Analog output channel 2     | 0 ... $\pm 10$ V | 3                              |                     |                     |                     |                     |

1 Speed nominal value  
 2 Ramp function generator output  
 3 Nominal value on n-controller  
 4 Speed actual value  
 5 Armature voltage  
 6 EMF  
 7 n-controller output  
 8 Amount n-controller output  
 9 Amount  $I_{act}$   
 10 I-controller output  
 11 Power  
 12 Field current nominal value  
 13 Field current nominal value  
 14  $I_f$  controller output  
 15 Inverter input  
 16 Inverter output  
 17 n-controller P component  
 18 n-controller I component  
 19 Torque signalling

| No.    | Name                      | Range                                      | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|---------------------------|--|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P088 * | Continued                 | 20 ZIL (second pulse suppr.)               |                                |                     |                     |                     |                     |
| P089   |                           | 21 Ripple limit                            |                                |                     |                     |                     |                     |
|        |                           | 22 Ripple characteristic                   |                                |                     |                     |                     |                     |
|        |                           | 23 e.m.f. compensation                     |                                |                     |                     |                     |                     |
|        |                           | 24 IxR                                     |                                |                     |                     |                     |                     |
|        |                           | 25 U-α                                     |                                |                     |                     |                     |                     |
|        |                           | 26 Queue                                   |                                |                     |                     |                     |                     |
|        |                           | 27 I controller P component                |                                |                     |                     |                     |                     |
|        |                           | 28 I controller I component                |                                |                     |                     |                     |                     |
|        |                           | 29 I <sub>r</sub> controller P component   |                                |                     |                     |                     |                     |
|        |                           | 30 I <sub>r</sub> controller I component   |                                |                     |                     |                     |                     |
|        |                           | 31 Field U <sub>A</sub> controller P comp. |                                |                     |                     |                     |                     |
|        |                           | 32 Field U <sub>A</sub> controller I comp. |                                |                     |                     |                     |                     |
|        |                           | 33 Controller enable/disable               |                                |                     |                     |                     |                     |
|        |                           | 34 Current limit                           |                                |                     |                     |                     |                     |
|        |                           | 35 Amount n <sub>act</sub>                 |                                |                     |                     |                     |                     |
|        |                           | 36 I <sub>Aact</sub>                       |                                |                     |                     |                     |                     |
|        |                           | 37 I <sup>2</sup> t value                  |                                |                     |                     |                     |                     |
|        |                           | 38 Drive/brake                             |                                |                     |                     |                     |                     |
|        |                           | 39 Polarity n <sub>act</sub>               |                                |                     |                     |                     |                     |
|        |                           | 40 Load torque                             |                                |                     |                     |                     |                     |
|        |                           | 41 Permissible nominal value               |                                |                     |                     |                     |                     |
|        |                           | 42 Field curr. monit. thresh.              |                                |                     |                     |                     |                     |
|        |                           | 43 Inverted to 19                          |                                |                     |                     |                     |                     |
|        |                           | 44 Current reserve                         |                                |                     |                     |                     |                     |
|        |                           | 45 Inverted to 199                         |                                |                     |                     |                     |                     |
|        |                           | 46 Inverted to 1936                        |                                |                     |                     |                     |                     |
|        |                           | 47 Mains voltage                           |                                |                     |                     |                     |                     |
| P090 * | Generator nominal value 1 | -100.0 ... +100.0%                         | 10.0                           |                     |                     |                     |                     |
| P091 * | Generator nominal value 2 | -100.0 ... +100.0%                         | -10.0                          |                     |                     |                     |                     |
| P092 * | Generator time 1          | 0.1 ... 100 s                              | 1.0                            |                     |                     |                     |                     |
| P093 * | Generator time 2          | 0.1 ... 100 s                              | 1.0                            |                     |                     |                     |                     |
| P094 * | Ramp generator 1          | ON/OFF                                     | OFF                            |                     |                     |                     |                     |
| P095 * | RG1 acceleration time     | 0.0 ... 850 s                              | 0.0                            |                     |                     |                     |                     |
| P096 * | RG1 deceleration time     | 0.0 ... 850 s                              | 0.0                            |                     |                     |                     |                     |
| P097 * | S-ramp generator          | 0.01 ... 6.50 s                            | 0.01                           |                     |                     |                     |                     |
| P098 * | S-ramp generator          | ON/OFF                                     | OFF                            |                     |                     |                     |                     |
| P099 * | Inputs X1:28/X1:29        | 0, 1, 2, 3 or 4                            | 0                              |                     |                     |                     |                     |
| P100 * | Ramp generator 2          | ON/OFF                                     | OFF                            |                     |                     |                     |                     |
| P101 * | RG2 acceleration time     | 0.0 ... 850 s                              | 0.0                            |                     |                     |                     |                     |
| P102 * | RG2 deceleration time     | 0.0 ... 850 s                              | 0.0                            |                     |                     |                     |                     |

| No.    | Name   | Range                         | Value in Data set 0 (SV 04.30)  | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|--|-------------------------------|---|---------------------|---------------------|---------------------|---------------------|
| P103 * | Display off<br>Display on  | 0                             | Press mode key twice,<br>display is off, keyboard disabled<br>Keep counter key pressed for at least 1 s |                     |                     |                     |                     |
| P104 * | Keypad enable  | 17                            |   |                     |                     |                     |                     |
| P105   | Nominal mains voltage  | 200 ... 500 V <sub>eff</sub>  | 400 V   |                     |                     |                     |                     |
| P106   | Display of all controller enables<br>(see section 8, Parameters)                 | ON/OFF                        |   |                     |                     |                     |                     |
| P107   | Display of the relay functions<br>(see section 8, Parameters)                    | ON/OFF                        |   |                     |                     |                     |                     |
| P108   | Display of the status of terminals<br>X1:26,27,28,29 (see section 8, Parameters) | ON/OFF                        |   |                     |                     |                     |                     |
| P109   | Clear EEPROM   | 6                             |   |                     |                     |                     |                     |
| P110 * | Armature/mains voltage   | 0.50 ... 1.21                 | 1.00  |                     |                     |                     |                     |
| P111   | Final rectifier position   | 35°                           | Display   |                     |                     |                     |                     |
| P112   | Final inverter position  | 150°                          | Display   |                     |                     |                     |                     |
| P113 * | Scaling nominal value source 2   | 0.00 ... 2.00                 | 1.00  |                     |                     |                     |                     |
| P114 * | Offset nominal value source 2  | -100 ... +100%                | 0   |                     |                     |                     |                     |
| P115 * | n <sub>nom</sub> = 0 lock  | 0, 1 or 2                     | 0   |                     |                     |                     |                     |
| P116 * | n <sub>nom</sub> = 0 threshold   | 0.1 % ... 5.0%                | 0.5   |                     |                     |                     |                     |
| P117 * | Pull-in time I <sub>F</sub> monitoring   | 0.5 ... 30.0 s                | 0.8   |                     |                     |                     |                     |
| P118   | Gear stage   | 1 ... 4                       |   |                     |                     |                     |                     |
| P119   | Nominal current of field device  | 0.5 ... 25 A                  | Display   |                     |                     |                     |                     |
| P120 * | Hysteresis I <sub>A</sub> > I <sub>x</sub> K3/1                                  | 1 ... 40%                     | 2   |                     |                     |                     |                     |
| P121 * | Delay I <sub>A</sub> = 0 message   | 0 ... 30 (sampling intervals) | 0   |                     |                     |                     |                     |
| P122 * | Field feed in monitoring   | ON/OFF                        | ON  |                     |                     |                     |                     |
| P123 * | Fast brake   | 1 or 2                        | 1   |                     |                     |                     |                     |
| P124 * | Drive inhibit function   | 1 or 2                        | 1   |                     |                     |                     |                     |
| P125 * | Scaling analog output 2  | 0.20 ... 1.00                 | 1.00  |                     |                     |                     |                     |
| P126 * | Thermic time constant motor  | 0 ... 180 min                 | 0   |                     |                     |                     |                     |
| P127 * | Threshold for I <sup>2</sup> t   | 50 ... 110%                   | 95  |                     |                     |                     |                     |



| No.    | Name   | Range               | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|--|---------------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P128 * | Relay output K4  | 0 or 1              | 0                              |                     |                     |                     |                     |
| P129   | Display loaded/programmed data set (see chapter 8, Parameters) |                     |                                |                     |                     |                     |                     |
| P130 * | Analog output channel 3  | 0 ... 47 (see P088) | 1                              |                     |                     |                     |                     |
| P131 * | Analog output channel 4  | 0 ... 47 (see P088) | 4                              |                     |                     |                     |                     |
| P132 * | Scaling analog output channel 4                                | 0.20 ... 1.00       | 1                              |                     |                     |                     |                     |
| P133 * | Acceleration factor (lifting equipment)                        | 0.5 ... 50.0        | 1.0                            |                     |                     |                     |                     |
| P134 * | Field weakening range (lifting equipment)                      | 1.0 ... 4.0         | 1.0                            |                     |                     |                     |                     |
| P135 * | Gear efficiency factor (lifting equipment)                     | 0.58 ... 1.00       | 1.0                            |                     |                     |                     |                     |
| P136 * | Load measurement (lifting equipment)                           | ON/OFF              | OFF                            |                     |                     |                     |                     |
| P137 * | Scaling max. nom. value (lifting equipment)                    | 0.50 ... 1.00       | 1.00                           |                     |                     |                     |                     |
| P138 * | Threshold tacho polarity (error 39)                            | 10 ... 62%          | 10                             |                     |                     |                     |                     |
| P139   | Device type  | d = BKD6/F = BKF12  | Display                        |                     |                     |                     |                     |
| P140 * | Threshold tacho wire break (error 38)                          | 20 ... 65%          | 10                             |                     |                     |                     |                     |
| P141 * | Delay time armature open                                       | 1.0 ... 10.0 s      | 1.0                            |                     |                     |                     |                     |
| P142 * | Maximum speed value  | 100 ... 6000 RPM    | 1000                           |                     |                     |                     |                     |
| P143 * | Rotary encoder resolution                                      | 250 ... 4096        | 1024                           |                     |                     |                     |                     |
| P144 * | Rot. enc. polarity change                                      | ON/OFF              | OFF                            |                     |                     |                     |                     |
| P145 * | Field weakening mode   | 0 or 1              | 0                              |                     |                     |                     |                     |
| P146 * | Timeout firing pulses disable                                  | 0.2 ... 2.0 s       | 0.2                            |                     |                     |                     |                     |
| P147 * | Phase failure < 400 msec                                       | ON/OFF              | OFF                            |                     |                     |                     |                     |
| P148 * | Load data set mode   | 1 or 2              | 1                              |                     |                     |                     |                     |
| P149 * | Nominal value multiplier                                       | 0.00 ... 1.00       | 1.00                           |                     |                     |                     |                     |

| No.    | Name  | Range            | Value in<br>Data set 0<br>(SV 04.30) | Value in<br>Data set 1 | Value in<br>Data set 2 | Value in<br>Data set 3 | Value in<br>Data set 4 |
|--------|---|------------------|--------------------------------------|------------------------|------------------------|------------------------|------------------------|
| P150 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P151 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P152 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P153 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P154 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P155 * | Reserved                                    |                  |                                      |                        |                        |                        |                        |
| P156 * | Mains failure timeout                       | 0.0 to 6.0       | 0.0                                  |                        |                        |                        |                        |
| P157 * | Release delay K2/0                          | 0.0 ... 30.0     | 0.0                                  |                        |                        |                        |                        |
| P158 * | Multiplier P070/P078                        | 0 or 1           | 0                                    |                        |                        |                        |                        |
| P159 * | Cyclical error display<br>(see error list)  | 1 ... 115        |                                      |                        |                        |                        |                        |
| P160 * | $n_{nom}$ limit mode (lifting equipment)    | 1 or 2           | 1                                    |                        |                        |                        |                        |
| P161 * | n-interpolation point 1 (lifting equipment) | 25 ... 100%      | 100                                  |                        |                        |                        |                        |
| P162   | M-interpolation point 2 (lifting equipment) | 10 ... 100%      | 100                                  |                        |                        |                        |                        |
| P163 * | n-interpolation point 2 (lifting equipment) | 25 .. 100%       | 100                                  |                        |                        |                        |                        |
| P164 * | M-interpolation point 3 (lifting equipment) | 10 ... 100%      | 100                                  |                        |                        |                        |                        |
| P165 * | n-interpolation point 3 (lifting equipment) | 25 .. 100%       | 100                                  |                        |                        |                        |                        |
| P166 * | M-interpolation point 4 (lifting equipment) | 10 ... 100%      | 100                                  |                        |                        |                        |                        |
| P167   | Base load (lifting equipment)               | 0 ... 100%       | 0                                    |                        |                        |                        |                        |
| P168 * | Lower measuring limit (lifting equipment)   | 5 ... 50%        | 20                                   |                        |                        |                        |                        |
| P169 * | Upper measuring limit (lifting equipment)   | 50 ... 95 %      | 80                                   |                        |                        |                        |                        |
| P170 * | Frequency limit                             | 45.0 ... 65.0 Hz | 65                                   |                        |                        |                        |                        |
| P171 * | Relay output K2                             | 0 or 1           | 0                                    |                        |                        |                        |                        |
| P172 * | $I_A > I_x$ K2/1                            | 5 .. 120%        | 95                                   |                        |                        |                        |                        |
| P173 * | Response time $I_A > I_x$ K2/1              | 0.0 ... 30.0 s   | 1.0                                  |                        |                        |                        |                        |

| No.    | Name  | Range       | Value in Data set 0 (SV 04.30) | Value in Data set 1 | Value in Data set 2 | Value in Data set 3 | Value in Data set 4 |
|--------|---|-------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| P174 * | Linking relay K2/1 - K3/1                     | ON/OFF      | OFF                            |                     |                     |                     |                     |
| P175 * | Linking time relay K2/1 - K3/1                | 0 ... 900 s | 60                             |                     |                     |                     |                     |
| P01F   | Check sum BDS                                 |             | Display via<br>PC              |                     |                     |                     |                     |
| P07F   | Display parameters<br>(Setting on PC display) | 0 ... 175   | 1                              |                     |                     |                     |                     |



## 8 PARAMETERS

### Parameter List Software Version S04.03 and Above

#### NOTES

- \* These parameters are components of a data set.  
Use command P004 = 1, 2, 3 or 4 (corresponding to data set 1, 2, 3 or 4) to store changed parameters in the EEPROM. This overwrites existing values.
- + These are parameters with basic functions that apply to all data sets of the unit (P001, P006, P007, P009).  
With no designation: functions or displays that can only be used in conjunction with the power converter.
- The specified times apply at  $f = 50 \text{ Hz}$ ! At different mains frequencies, the following applies
- $$t' = t \cdot \frac{50 \text{ Hz}}{f_{\text{mains}}}$$

**P000**      **Power stage**      Ident./control menu  
Display of the device's nominal current in amps to calculate parameter P025.  
**Range:**              30 A ... 600 A and > 600 A

**P001** + **Communication source** (can only be changed with the keypad)      Ident./control menu  
When you change the communication source, the main contactor is switched off and the keypad is locked! The display is to one decimal place. The place before the decimal point indicates the communication source stored in the EEPROM. (Exception: During EEPROM programming, a 9 is displayed). The place after the decimal point indicates the current communication source that is stored in RAM.  
**Range:**              0 ... 3

| Input Values | Meaning  |
|--------------|--|
| 0            | Keypad on power converter  |
| 1            | Service PC   |
| 2            | Control via interface board  |
| 3            | Control via interface board<br>and parameterization via keypad input |

**Default value:**      0

## Parameters

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**P002**      **Rotating field**      Ident./control menu

Before switching on the main contactor for the first time, "u" is displayed.

**Range:**

| Displayed Value | Meaning          |
|-----------------|------------------|
| u               | Not specified    |
| Rdf             | Clockwise        |
| Ldf             | Counterclockwise |

**P003**      **Software version**

Under this parameter, the system displays the current software version of the power converter.

**P004**      **Program EEPROM data set**      Ident./control menu

The parameters that are marked with an asterisk (\*) are stored in the EEPROM by means of command P004. The existing values are overwritten.

**Range:**            1 ... 4

| Input Values | Meaning            |
|--------------|--------------------|
| 1            | Program data set 1 |
| 2            | Program data set 2 |
| 3            | Program data set 3 |
| 4            | Program data set 4 |

**Default value:**    0

**P005**      **Read single error**

For error list, see the chapter entitled Maintenance.

**Range:**            0 ... 113

**P006 + Boot source** Ident./control menu

Sets the boot source on the stored data set (P004 = 1, 2, 3 or 4). When you switch on again, this allows you to start working with the correct data set straight away.

**Range:** 1 ... 4

| Value | Meaning                          |
|-------|----------------------------------|
| 1     | Boot source is EEPROM data set 1 |
| 2     | Boot source is EEPROM data set 2 |
| 3     | Boot source is EEPROM data set 3 |
| 4     | Boot source is EEPROM data set 4 |

**Default value:** 0

**P007 + Left rotary field lock** Ident./control menu, S04.07 and above

**Range:** ON ... OFF

| Value | Meaning  |
|-------|--|
| ON    | Operation with left rotary field is not possible |
| OFF   | Operation with left rotary field is possible     |

With OFF set, you must switch on components in the order below:

| Power unit                          | Electronic feed          | Field feed  |
|-------------------------------------|--------------------------|---|
| AK1 to L3<br>AK3 to L2<br>AK5 to L1 | X2:1 to L3<br>X2:2 to L1 | X2:6 to L3<br>X2:7 to L1<br>or<br>X3:1 to L3 at 25 A<br>X3:2 to L1 Field device |

Connection monitoring of the power unit and the field feed are still active.

**Default value:** ON

## Parameters

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**P008**      **Load data set**      Ident./control menu  
Data set can be changed during operation, see P148.

### NOTE

During operation, do not change from field weakening to constant field!

**Range:**            0 ... 4

| Value | Meaning                     |
|-------|-----------------------------|
| 0     | EPROM default data set      |
| 1     | EEPROM data set 1 is loaded |
| 2     | EEPROM data set 2 is loaded |
| 3     | EEPROM data set 3 is loaded |
| 4     | EEPROM data set 4 is loaded |

**Default value:**    0

**P009** + **Start parameter**      Ident./control menu  
Sets the parameter that is shown after switching on the display.

**Range:**            0 ... 175

**Default value:**    1

**P010** \* **n<sub>act</sub> smoothing**      Speed controller menu

**Range:**            5 ms ... 100 ms

**Default value:**    5 ms  
10 ms      S04.25 and above

**P011** \* **P–amplification**      Speed controller menu

**Range:**            1 ... 100

**Default value:**    10

**P012** \* **Integral–action time**      Speed controller menu

**Range:**            20 ms ... 9.99 s

**Default value:**    200 ms  
500 ms      S04.08 and above



**P013**      **Reserved**

**P014** \*    **Current limit TD1** Speed controller menu

For current limit switching, refer to P021.

**Range:**            0% ... 100%

**Default value:**    100%

**P015** \*    **Current limit TD2** Speed controller menu

For current limit switching, refer to P021.

**Range:**            0% ... 100%

**Default value:**    100%

**P016** \*    **Current limit reduction at  $n_x$**  Speed controller menu

**Range:**            0% ... 100% of  $n_{nom}$

**Default value:**    100%

**P017** \*    **Current limit at  $n_{max}$**  Speed controller menu

**Range:**            0% ... 100% of  $I_{Anom}$

**Default value:**    100%

**P018** \*    **Integral-action time** Speed controller menu

**Range:**            ON ... OFF

| Value | Meaning                     |
|-------|-----------------------------|
| ON    | n-controller with PI action |
| OFF   | n-controller with P action  |

**Default value:**    ON

**P019** \*    **Speed controller offset** Speed controller menu

**Range:**            -400 ... +400

Corresponds to:   -2.4% ... +2.4% of  $n_{nom}$

**Default value:**    0

## Parameters

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**P020** \* **I x R** Precontr. IA Val. menu

Measured at P081 = 1 or P081 = 4

**Range:** 0.0% ... 30.0%  
0.0% ... 50.0%

S04.15 and above

**Default value:** 4.5%

**P021** \* **Current limit switching** Speed controller menu

**Range:** 1 ... 2

| Value | Meaning  |
|-------|--|
| 1     | P014 = Current limit for torque direction 1<br>P015 = Current limit for torque direction 2 |
| 2     | P014 = Current limit for driving<br>P015 = Current limit for braking                       |

**Default value:** 1

**P022** \* **Speed controller preset** Speed controller menu

This improves the starting response of hoist drives. With BKF's, a preferred torque direction is set at the same time, which corresponds to the polarity of the preset value. With the controller disabled, the system immediately takes the value into the speed controller's I component; with an enabled controller, this does not take place until the next time the drive is disabled.

**Range:** -100.0% ... +100.0% of  $I_{Anom}$

**Default value:** 0.0%

**P023** \*  **$I_{A_{mot}}/I_{A_{max}}$**  Monitoring menu

This sets the motor I<sub>t</sub> monitoring in operation at overstress.

Example: The motor is to be operated at 1.6-fold overstress.  $P023 = 1 \div 1.6 = 0.63$

(see also parameters P025, P069, P126, P127)

In addition, parameter P023 has an effect on load measurement (S04.12 and above)

**Range:** 0.50 ... 1.00

**Default value:** 1.00

**P024** \* **Gapping current limit** Precontr. IA Val. menu

This is set with P081 = 1 or P081 = 4

**Range:** 1% ... 100% of  $I_{Anom}$

**Default value:** 30%

**P025** \* **IA<sub>max</sub>/device nom. current** Precontr. IA Val. menu

P025 = Motor nominal current/device nominal current in S1 operation or  
P025 = Max. armature current/ device nominal current in intermittent operation  
In P062, the armature current set with P025 (i.e. the device output current/device nominal current) is displayed as 100%!

**Range:** 0.50 ... 1.00 of the device nominal current

**Default value:** 1.00

**P026** \* **IA<sub>nom</sub>-idle time** Precontr. IA Val. menu

This parameter is set to 1 and you may not change it.

**Range:** 0 ... 2

**Default value:** 1

**P027** \* **Gear protection current** Precontr. IA Val. menu

Brief current limitation to protect the gears when the torque changes.

**Range:** 0% ... 100% of I<sub>Anom</sub>

**Default value:** 100%

**P028** \* **Gear protection time** Precontr. IA Val. menu

Brief current limitation to protect the gears when the torque changes.

**Range:** 0 ms ... 100 ms

0 ms ... 500 ms

S04.05 and above

**Default value:** 0 ms

**P029** \* **Armature inductivity** Precontr. IA Val. menu

This is measured with P081 = 1 or P081 = 4.

**Range:** 0.0 ... 150.0

**Default value:** 10.0

**P030** \* **IA<sub>nom</sub>-integrator** Armat. curr. contr. menu

Specifying the current rise in the armature circuit.

**Range:** 0 ms ... 100 ms

**Default value:** 6 ms

## Parameters

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**P031 \* P–amplification** Armat. curr. contr. menu

This is optimized with P081 = 2 or P081 = 4

**Range:** 0.05 ... 0.80

**Default value:** 0.12

**P032 \* Integral–action time** Armat. curr. contr. menu

This is optimized with P081 = 2 or P081 = 4.

**Range:** 5 ms ... 100 ms

**Default value:** 32 ms

**P033 \* Integral–action time (IA–gapping)** Armat. curr. contr. menu

**Range:** 0.2 ms ... 10.0 ms

**Default value:** 8 ms

**P034 \* Gapping current adaption** Armat. curr. contr. menu

**Range:** ON ... OFF

| Value | Meaning  |
|-------|--|
| ON    | P033 effective, adaptive armature current controller |
| OFF   | P033 not effective                                   |

**Default value:** ON

**P035 \* Integral–action time** Armat. curr. contr. menu

If P035 is OFF, gapping current adaption is also switched off.

**Range:** ON ... OFF

| Value | Meaning                        |
|-------|--------------------------------|
| ON    | PI armature current controller |
| OFF   | P armature current controller  |

**Default value:** ON

**P036 \* Current precontrolling** Precontr. IA Val. menu

**Range:** ON ... OFF

| Value | Meaning                       |
|-------|-------------------------------|
| ON    | Current precontrolling active |
| OFF   | No current precontrolling     |

**Default value:** ON

**P037 \* Scaling IA precontrol** Precontr. IA Val. menu  
S04.08 and above

Influencing current precontrolling. With a value of 1.00, current precontrolling is completely effective; at 0.00, current precontrolling is not effective. If the value is set to 0.00, it is not possible to determine the armature inductivity with optimization run P081 = 1! The system cancels the optimization run with a controller disable.

**Range:** 0.00 ... 1.00

**Default value:** 1.00

**P038 \* Source IA precontrolling** Armat. curr. contr. menu  
S04.13 and above

**Range:** 1 ... 2

| Value | Meaning  |
|-------|--|
| 1     | e.m.f. is used for current precontrolling  |
| 2     | Analog tachometer or rotary encoder is used for current precontrolling. This is only effective with controller structures "0" and "2" (P083). With all other controller structures, you can, it is true, set P038 to "2" but the system still uses e.m.f. for current precontrolling |

**Default value:** 1

## Parameters

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**P039** \* **Field unit ON/OFF** Field current controller menu  
S04.05 and above

**Range:** ON ... OFF

| Value | Meaning   |
|-------|---|
| ON    | Internal field unit in operation  |
| OFF   | The field power converter's firing pulses are disabled; the field current monitoring is switched off and error message "24" (min. field current out of lower range) is no longer active, the field unit is switched off |

**Default value:** ON

**P040** \* **P-amplific. UA controller (P083 = 1, 3)** , ,  
Field current controller menu  
S04.08 and above

**Range:** 0.1 ... 20.0

**Default value:** 3.0  
1.5

**P041** \* **Integ.-act. time UA controller- (P083 = 1, 3)** Field current controller menu

**Range:** 20 ms ... 999 ms

**Default value:** 180 ms

**P042** \* **Cross-over/Arma. voltage** Field current controller menu

Effective with field weakening P083 = 1, 3.  
Setting of the armature voltage/e.m.f. from which onwards field weakening starts to become effective (see also P145).

**Range:** 0.50 ... 1.00

**Default value:** 0.95

**P043** \* **P-amplific. IF controller** Field current controller menu

**Range:** 0.1 ... 20.0

**Default value:** 1.0

**P044** \* **Integ.-act. time IF controller** Field current controller menu  
S04.08 and above

**Range:** 20 ms ... 999 ms

**Default value:** 120 ms  
180 ms

|             |  |                               |
|-------------|--|-------------------------------|
| <b>P045</b> | <b>Reserved</b>  |                               |
| <b>P046</b> | <b>Field current nominal value</b>   | Field current controller menu |
|             | For display only!  |                               |
|             | <b>Range:</b> 0% ... 100% of $I_{Fnom}$  |                               |
| <b>P047</b> | <b>* Minimal field current</b>   | Field current controller menu |
|             | Only effective with field weakening P083 = 1, 3.   |                               |
|             | $P047 = 80\% \cdot \frac{\text{Min. field current}}{\text{Max. field current}}$                        |                               |
|             | <b>Range:</b> 20% ... 99%  |                               |
|             | <b>Default value:</b> 90%  |                               |
| <b>P048</b> | <b>Field current monitoring</b>  | Field current controller menu |
|             | For display only, 50% of P047 or P049.   |                               |
| <b>P049</b> | <b>* <math>I_{Fmax}</math>/device nom. current</b>   | Field current controller menu |
|             | $P049 = \frac{\text{Motor field current}}{\text{Field device nominal current}}$                        |                               |
|             | If the calculated value is outside the setting range, you must use a larger or a smaller field device. |                               |
|             | The field current that you set with P049 is shown in P064 as 100%!                                     |                               |
|             | <b>Range:</b> 0.40 ... 1.00  |                               |
|             | 0.20 ... 1.00  | S04.15 and above              |
|             | <b>Default value:</b> 1.00   |                               |
| <b>P050</b> | <b>Speed nominal value</b>   | Nominal values menu           |
|             | P080 ≠ 4: Display only   |                               |
|             | P080 = 4: Nominal value with serial setting using a PC or controller (P001 = 1, 2, 3)                  |                               |
|             | <b>Range:</b> -100% ... +100%  |                               |
|             | -100.0% ... +100.0% (displayed)  | S04.09 and above              |
| <b>P051</b> | <b>* Internal nominal value 1</b>  | Nominal values menu           |
|             | See also P099 = 1.   |                               |
|             | <b>Range:</b> -100.0% ... +100.0%  |                               |
|             | <b>Default value:</b> 10.0%  |                               |

## Parameters

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|             |          |  |                     |
|-------------|----------|--|---------------------|
| <b>P052</b> | <b>*</b> | <b>Internal nominal value 2</b>  | Nominal values menu |
|             |          | See also P099 = 1.   |                     |
|             |          | <b>Range:</b> -100.0% ... +100.0%  |                     |
|             |          | <b>Default value:</b> -10.0%   |                     |
| <b>P053</b> | <b>*</b> | <b>Internal nominal value 3</b>  | Nominal values menu |
|             |          | <b>Range:</b> -100.0% ... +100.0%  |                     |
|             |          | <b>Default value:</b> 5.0%   |                     |
| <b>P054</b> | <b>*</b> | <b>Internal nominal value 4</b>  | Nominal values menu |
|             |          | <b>Range:</b> -100.0% ... +100.0%  |                     |
|             |          | <b>Default value:</b> -5.0%  |                     |
| <b>P055</b> | <b>*</b> | <b>Motorized pot. upper limit</b>  | Nominal values menu |
|             |          | Only effective with P080 = 10.   |                     |
|             |          | <b>Range:</b> -99.9% ... +100.0%   |                     |
|             |          | <b>Default value:</b> 100.0%   |                     |
| <b>P056</b> | <b>*</b> | <b>Motorized pot. lower limit</b>  | Nominal values menu |
|             |          | Only effective with P080 = 10; P056 must be lower than P055.   |                     |
|             |          | <b>Range:</b> -100.0% ... +99.9%   |                     |
|             |          | <b>Default value:</b> 0.0%   |                     |
| <b>P057</b> | <b>*</b> | <b>Motorized pot. accel. time</b>  | Nominal values menu |
|             |          | The time applies to a 100% change of speed. P057 applies to positive nominal values and to deceleration with negative nominal values and is only effective with P080 = 10. |                     |
|             |          | <b>Range:</b> 0.1 s ... 100.0 s  |                     |
|             |          | 0.1 s ... 850.0 s  | S04.27 and above    |
|             |          | <b>Default value:</b> 5.0 s  |                     |



**P058 \* Motorized pot. decel. time** Nominal values menu

The time applies to a 100% change of speed. P058 applies to negative nominal values and to deceleration with positive nominal values and is only effective with P080 = 10.

**Range:**                    0.1 s ... 100.0 s  
                                  0.1 s ... 850.0 s S04.27 and above

**Default value:**    5.0 s

**P059 + Motor pot. memory value** Nominal values menu

This is activated via P099 = 3 and X1:28. For display purposes only.

**Range:**                    0% ... ±100%

**P060 Speed actual value**

This is for display purposes only. The system shows the current speed in percent. 100% corresponds to the set nominal value of the motor.

**P061 Armature voltage actual value**

This is for display purposes only. The system shows the current armature voltage in percent. 100% corresponds to the set nominal armature voltage of the motor.

**P062 Armature current actual value**

This is for display purposes only. The system shows the current armature current in percent. This corresponds to the armature current you set using P025.

**P063 Temperature of power stage**

This is for display purposes only.

**Range:**                    0 ... +100 °C

**P064 Field current actual value**

This is for display purposes only. The system shows the current field current in percent. This corresponds to the field current you set using P049.

**P065 Reserved**

## Parameters

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- P066 Mains frequency**  
This is for display purposes only. The system shows the current mains frequency in Hertz.
- P067 Mains voltage**  
This is for display purposes only. The system shows the current mains voltage in  $V_{\text{eff}}$ .
- P068 Consumed power**  
This is for displaying  $U_A \cdot I_A$  only. The system shows the power supplied to the motor in percent. 100% corresponds to the motor's rated power.
- P069 I<sup>2</sup>t value** Monitoring menu  
This is for display purposes only. 100% corresponds to the motor's rated temperature (calculated from the armature current).
- P070 \* n > n<sub>x</sub> output K2/0** Monitoring menu  
100% corresponds to the set rated motor speed, with P158 = 0.  
**Range:**            1% ... 105%    with P158 = 0  
                         0.1% ... 10.5%   with P158 = 1  
**Default value:**   1%
- P071 \* n > n<sub>x</sub> K3/2** Monitoring menu  
100% corresponds to the set rated motor speed.  
**Range:**            1% ... 105%  
**Default value:**   50%
- P072 \* n<sub>act</sub> > n<sub>nom</sub> K3/0/5** Monitoring menu  
Hysteresis:  $\pm (0.1 \cdot \text{setting value} + 0.4\%)$ , above a setting value of 21% constant  $\pm 2.5\%$   
**Range:**            1% ... 15%  
                         1% ... 60% S04.15 and above  
**Default value:**   5%

**P073** \*  **$I_A > I_x$  K3/1** Monitoring menu

Hysteresis refer to the diagram in chapter 6.5.  
100% corresponds to the device output current you set using P025.

**Range:** 5% ... 120%

**Default value:** 95%

**P074** \* **Delay  $I_a > I_x$  K3/1** Monitoring menu

Release delay constant 100 ms.

**Range:** 0.0 s ... 30.0 s

**Default value:** 1.0 s

**P075** \* **Reduced field** Field current controller menu

This is for reducing the temperature of the motor in breaks in operation; it is only effective with main contactor OFF (X1:22 open).

**Range:** ON ... OFF

| Value | Meaning  |
|-------|--|
| ON    | Field current is reduced with main contactor OFF     |
| OFF   | Field current is not reduced with main contactor OFF |

**Default value:** OFF

**P076** \* **Time for reduced field P075** Field current controller menu

Delay for P075. Is only effective with P075 = ON.

**Range:** 0 s ... 180 s

**Default value:** 30 s

**P077** \*  **$I_{F_{nom}}$  reduced field** Field current controller menu

Referred to the field current you set using P049. Is only effective with P075 = ON.

**Range:** 20% ... 100%

**Default value:** 30%

## Parameters

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**P078 \* n < n<sub>x</sub> for fast brake** Monitoring menu

Brakes the drive on  $n < P078$  and then switches off the drive on fast braking; this also affects LED H19.

**Range:**            1% ... 20%  
                         1% ... 100%    with P158 = 0            S04.15 and above  
                         0.1% ... 10.0%   with P158 = 1

**Default value:**    5%

**P079 \* Main contactor edge** Ident./Control menu

Can only be switched off in the case of P001 = 1, 2 or 3.

**Range:**            ON ... OFF

| Value | Meaning  |
|-------|--|
| ON    | On switch-on or following an error which you removed, the system must carry out an L⇒H switching operation at input X1:22. |
| OFF   | The main contactor stays on, after you remove the error, the drive must be switched on by means of a serial enable.        |

**Default value:**    ON

**P080 \* Nominal value source**

Configuration menu

To use nominal value sources 12 to 14, you need supplementary module 3.9217 (Digital Input/Output Expansion). The system transfers a new nominal value if it has been pending and stable at the input for four controller cycles (approx. 15 ms). The system limits the nominal values internally to the specified format.

**Range:** 1 ... 16

| Value                    | Meaning   |
|--------------------------|---|
| 1                        | Analog 1 (differential amplifier)<br>Analog adaptation: potentiometer R100 (v = 0.9 ... 2.0)  |
| 2                        | Analog 2 (summing amplifier)<br>Digital adaptation: P113, P114  |
| 3                        | Analog 1 + 2; P113, P114  |
| 4                        | Digital (serial)<br>Setting via P050 when P001 = 1, 2, 3  |
| 5                        | Internal specified value generator<br>For value, see P090 ... P093  |
| 6                        | Internal specified value 1<br>For value, see P051   |
| 7                        | Internal specified value 2<br>For value, see P052   |
| 8                        | Internal specified value 3<br>For value, see P053   |
| 9                        | Internal specified value 4<br>For value, see P054   |
| 10                       | Motorized potentiometer<br>For value, see P055 ... P058   |
| 11<br>(S04.11 and above) | Specified value setting via dual-port RAM no protocol 16-bit. Can only be used in conjunction with InterBus-S daughterboard PCB 3.9208.   |
| 12<br>(S04.11 and above) | Parallel specified value setting 15-bit twos complement. Permissible value range: \$3FF0 to \$4010. PCB 3.9217 needed.  |
| 13<br>(S04.11 and above) | Parallel specified value setting 14-bit and sign. Permissible value range: \$0 to \$3FF0.<br>If bit no. 15 = 1, the value is interpreted as a negative number (amount + sign). PCB 3.9217 needed.   |
| 14<br>(S04.11 and above) | Parallel specified value setting 12-bit and sign. Decimal specified value setting (amount + sign). Permissible value range: 0 to 999 (percentual setting).<br>If bit no. 15 = 1, the value is interpreted as a negative number. If a code is entered in one of the three places that is not a decimal number, the system does not accept the specified value. PCB 3.9217 needed.  |
| 15<br>(S04.28 and above) | Sum of specified value sources 2 and 4<br>P113, P114, P001  |
| 16<br>(S04.15 and above) | Analog specified value via differential amplifier and analog additional specified value via summing amplifier. Has a similar effect to P080 = 3, however the specified value from the differential amplifier is routed directly to the speed controller and the specified value from the summing amplifier is transferred to the speed controller via the ramp function generator. P149 does not affect P080 = 16, P113, P114, P094, P095, P096 or P100, P101, P102 |

**Default value:** 1

**P081 \* Optimization run** Configuration menu

Specify the value with the controller disabled, enable the controller, block the motor. The field is switched off while optimization run P081 = 1, 2 and 4.

If there is a controller disable in the optimization run and with S04.20 and above, P081 is set to 0.

**Range:** 0 ... 6

| Value                   | Meaning  |
|-------------------------|--|
| 0                       | No optimization run selected   |
| 1                       | Characteristic curve optimization  |
| 2                       | Current controller optimization  |
| 3                       | Reserved   |
| 4                       | Characteristic curve and current controller  |
| 5                       | Reserved   |
| 6<br>(S04.05 and above) | Determination of the acceleration factor. This is only important in the context of parameters P134 to P137. The system determines the value of parameter P133. See also P133, P167 and P136. |

**Default value:** 0

**P082 \* Armature voltage adjustment** Speed controller menu

Speed adjustment in the case of e.m.f. control

**Range:** 0.90 ... 1.10

**Default value:** 1.00

**P083 \* Controller structure** Configuration menu

### NOTE!

Switch from field weakening to constant field with controller disable and n = 0 only!

**Range:** 0 ... 5

| Value                   | Meaning   |
|-------------------------|---|
| 0                       | Speed control with analog tachometer and constant field<br>Speed adjustment with R 103        |
| 1                       | Speed control with analog tachometer and field weakening<br>Speed adjustment with R103        |
| 2<br>(S04.09 and above) | Speed control with actual value rotary encoder and constant field<br>(see also P142 to P144)  |
| 3<br>(S04.09 and above) | Speed control with actual value rotary encoder and field weakening<br>(see also P142 to P144) |
| 4                       | e.m.f. control with constant field  |
| 5                       | Current control with constant field   |

**Default value:** 4

## P084 \* Programmable analog input X1:9

Configuration menu

Range: 0 ... 13

| Value   | Meaning  |
|---|--|
| 0   | No function, input deactivated   |
| 1   | Current limit for torque direction 1, torque direction 2 is unaffected<br>0 V to +10 V corresponds to 0 to 100% current limit<br>< 0 V corresponds to 0% current limit, torque direction 2 is unaffected   |
| 2   | Current limit for torque direction 2 (setting same as 1), TD1 is unaffected  |
| 3   | Current limit for torque directions 1 and 2 symmetrical (setting same as 1)  |
| 4<br>(S04.15 and above)   | The current nominal value is multiplied by the value of P149 once/while a LOW level is pending at terminal X1:9.<br>This has no effect with P080 = 16  |
| 5   | Nominal value polarity reversal switch (on the ramp function generator input)<br>LOW level: 0 V or input open (approx. 0 V ... 5 V)<br>HIGH level: 24 V (approx. 7.5 V ... 30 V) = polarity reversal active  |
| 6   | Nominal value zeroing<br>On the ramp function generator input without resetting the ramp function generator ⇒ ramp-down time effective<br>LOW level: 0 V or input open (approx. 0 V ... 5 V)<br>HIGH level: 24 V (approx. 7.5 V ... 30 V) = nominal value zeroing active   |
| 7   | Nominal value zeroing on the ramp function generator input with resetting of the ramp function generator, active with HIGH level at X1:9   |
| 8<br>(S04.05 and above)   | Analog setting of the field current nominal value<br>+10 V corresponds to 100% of the field current value (referred to P049),<br>-10 V to +1 V and open terminal corresponds to 10% of the field current value. The field current nominal value is accepted with controller structures without field weakening only.<br>(See also parameters P046, P049, P083)   |
| 9<br>(S04.17 and above)   | Ramp function generator stop with a HIGH level at terminal X1:9  |
| 10<br>(S04.21 and above)  | 0 V to +10 V corresponds to 0 to 100% external current limit for TD1 and 0% for TD2<br>0 V to -10 V corresponds to 0 to 100% external current limit for TD2 and 0% for TD1   |
| 11<br>(S04.21 and above)  | 0 V to +10 V corresponds to 0 to 100% external current limit for TD2 and 0% for TD1<br>0 V to -10 V corresponds to 0 to 100% external current limit for TD1 and 0% for TD2   |
| 12<br>(S04.22 and above)  | ON/STOP simulation<br>A special function that is only active with communications source P001 = 3   |
| 13<br>(S04.27 and above)  | Quick start (after a brief mains power outage)<br>If there is a voltage of > +12.5 V on X1:9 when the electronics supply is connected, the system is initialized more quickly (approximately 800 to 900 ms) and the drive starts automatically, assuming that all the enables (X1:22 to X1:25) are available.<br>In the case of an interruption of phase L2, for example, the restart takes approximately 500 to 600 ms. |
| <b>DANGER</b><br>Terminal X1:9 may not be hard-wired; instead, you must control it by means of a contact, taking into account the machine's safety regulations. |  |

Default value: 0

## P085 \* Relay output K3

Monitoring menu

Range: 0 ... 5

| Value                   | Meaning   |
|-------------------------|---|
| 0                       | $n_{nom} = n_{act}$ at ramp function generator input<br>Picks up: if the deviation is less than the threshold set with P072<br>Drops: if the threshold set with P072 is exceeded  |
| 1                       | $I_A > I_X$ Armature current monitoring<br>Picks up: if the armature current exceeds the switching threshold (P073) for longer than the specified response time (P074). Hysteresis can be set via P120.   |
| 2                       | $n > n_X$<br>Picks up: if the speed exceeds threshold $n > n_X$ (P071)  |
| 3<br>(S04.04 and above) | Drive ready to start<br>Picks up: if cancellation has been carried out of pulse enable, main contactor ON, fast brake and ready for use. In this context, controller enable X1:23 and serial controller enable are ignored.<br>Drops: If one of the conditions is missing |
| 4                       | Field monitoring<br>Picks up: if the field current is $> 80\%$ of $I_{fnom}$<br>Drops: if the field current is $< 50\%$ of $I_{fnom}$   |
| 5                       | $n_{act} = n_{nom}$ at speed controller input<br>Picks up: if the deviation is less than the threshold set with P072<br>Drops: if the threshold is exceeded   |

Default value: 0

## P086 \* Stalled motor monitoring

Monitoring menu

Range: ON ... OFF

| Value | Meaning                    |
|-------|----------------------------|
| ON    | Monitoring is switched-on  |
| OFF   | Monitoring is switched-off |

Default value: ON

## P087 \* Stalled motor monitoring

Monitoring menu

Range: 0.1 s ... 30.0 s

Default value: 5.0 s



- P088** \* **Analog output channel 1 (X1:11, reference potential to 12)** Configuration menu
- P089** \* **Analog output channel 2 (X1:13, reference potential to 14)** Configuration menu

Output standardized to 0 ... ± 10 V. Refresh rate 3.3 ms, resolution 150 mV.

Scaling of channel 2 via P125, higher 10–mV resolution possible using supplementary module "2 x DAC 12" (PCB 3.9201 or PCB 3.9217).

**Range:** 1 ... 47

| Value | Meaning                                     |
|-------|---|
| 1     | Speed nominal value                         |
| 2     | Ramp function generator output              |
| 3     | Nominal value on n–controller               |
| 4     | Speed actual value                          |
| 5     | Armature voltage                            |
| 6     | EMF   |
| 7     | n–controller output                         |
| 8     | Amount n–controller output                  |
| 9     | Amount $I_{act}$ ( $+I_{Aact}$ )            |
| 10    | I–controller output                         |
| 11    | Power                                       |
| 12    | Field current nominal value                 |
| 13    | Field current actual value                  |
| 14    | Field current controller output             |
| 15    | Inverter input                              |
| 16    | Inverter output                             |
| 17    | n–controller P component                    |
| 18    | n–controller I component                    |
| 19    | Torque signalling                           |
| 20    | ZIL (second pulse suppr.)                   |
| 21    | Ripple limit                                |
| 22    | Ripple characteristic                       |
| 23    | e.m.f. compensation                         |
| 24    | I x R                                       |
| 25    | U–α   |
| 26    | Queue                                       |
| 27    | I controller P component                    |
| 28    | I controller I component                    |
| 29    | I <sub>f</sub> controller P component       |
| 30    | I <sub>f</sub> controller I component       |
| 31    | Field U <sub>A</sub> controller P component |
| 32    | Field U <sub>A</sub> controller I component |
| 33    | Controller enable/disable                   |

## Parameters

- P088** \* **Analog output channel 1 (X1:11, reference potential to 12)** Configuration menu
- P089** \* **Analog output channel 2 (X1:13, reference potential to 14)** Configuration menu

| Value                    | Meaning  |
|--------------------------|--|
| 34                       | Current limit  |
| 35                       | Amount $n_{act}$   |
| 36                       | $I_{act}$ (+/-)  |
| 37                       | $I^2t$ value   |
| 38                       | Drive/Brake  |
| 39                       | Polarity $n_{act}$   |
| 40<br>(S04.05 and above) | Load, 0 ... 10 V corresponds to a load torque of 0 ... 100%.   |
| 41<br>(S04.05 and above) | Permissible nominal value  |
| 42<br>(S04.05 and above) | Field curr. monitoring threshold   |
| 43<br>(S04.22 and above) | Torque signalling inverted to 19   |
| 44<br>(S04.27 and above) | Current reserve $(-1) \cdot (I_{act} - 10 \text{ V})$<br>With a current actual value of 0 V (test point 9), this test point has an output voltage of +10 V; with a current actual value of +10 V, it has an output voltage of 0 V. |
| 45<br>(S04.28 and above) | $- I_{act} $ inverted to 9   |
| 46<br>(S04.28 and above) | Inverted to 36   |
| 47<br>(S04.29 and above) | Mains voltage, e.g. +4.00 V corresponds to a mains voltage of 400 V <sub>eff</sub>   |

**Default value:** 2 (measuring channel 1) = P088  
3 (measuring channel 2) = P089

- P090** \* **Generator nominal value 1** Nominal values menu

Effective at P080 = 5.

**Range:** -100.0% ... +100.0%

**Default value:** 10.0%

- P091** \* **Generator nominal value 2** Nominal values menu

Effective at P080 = 5.

**Range:** -100.0% ... +100.0%

**Default value:** -10.0%

**P092 \* Generator time 1** Nominal values menu

Effective at P080 = 5.

**Range:** 0.1 s ... 100.0 s

**Default value:** 1.0 s

**P093 \* Generator time 2** Nominal values menu

Effective at P080 = 5.

**Range:** 0.1 s ... 100.0 s

**Default value:** 1.0 s

**P094 \* Ramp generator 1** Ramp generator menu

Only one ramp function generator at a time can ever be switched on, see P100!

**Range:** ON ... OFF

| Value | Meaning                                |
|-------|--|
| ON    | Ramp function generator 1 switched-on  |
| OFF   | Ramp function generator 1 switched-off |

**Default value:** OFF

**P095 \* RG1 acceleration time** Ramp generator menu

The time applies to a 100% nominal value change.

**Range:** 0.0 s ... 850.0 s

**Default value:** 0.0 s

**P096 \* RG1 deceleration time** Ramp generator menu

The time applies to a 100% nominal value change.

**Range:** 0.0 s ... 850.0 s

**Default value:** 0.0 s

**P097 \* S-ramp generator** Ramp generator menu

Set the time to about 20% of P095/P096 or P101/P102.

**Range:** 0.01 s ... 6.50 s

**Default value:** 0.01 s

## Parameters

### P098 \* S-ramp generator

Ramp generator menu

Range: ON ... OFF

| Value | Meaning                       |
|-------|-------------------------------|
| ON    | S-ramp generator switched-on  |
| OFF   | S-ramp generator switched-off |

Default value: OFF

### P099 \* Inputs X1:28/X1:29

Ident./Control menu

LOW level: 0 V or input open (0 V ... + 5 V)

HIGH level: +24 V at input (+15 V ... + 30 V)

Range: 0 ... 4

| Value | Meaning   |
|-------|---|
| 0     | Switching inputs inactive   |
| 1     | Inching<br>For the duration of inching, ramp function generator 2 is switched-on automatically. After inching is completed, the original nominal value and ramp function generator apply.<br>X1:28 HIGH level activates internal nominal value 1 (P051)<br>X1:29 HIGH level activates internal nominal value 2 (P052)   |
| 2     | No function   |
| 3     | Motorized potentiometer memory function<br>X1:28 A LOW $\Rightarrow$ HIGH edge change stores the current motorized potentiometer value in the EEPROM (display with P059)<br>X1:29 The HIGH level of the stored motorized potentiometer value is approached once all enables are active.   |
| 4     | Reload and activate data set<br>X1:28 X21:9 Data set is loaded to RAM<br>LOW LOW No function, RAM data is not changed<br>HIGH LOW Data set 1<br>LOW HIGH Data set 2<br>HIGH HIGH Data set 3<br><br>Parameter P099 = 4 must be set in all the data sets that are to be reloaded. It is not possible to secure switchover of data sets against impermissible or dangerous conditions, i.e. you must ensure that in the case of controller structure switchovers, the system cannot change over during operation from field weakening to constant field. For display, see P129. For locking, use P148. |

Default value: 0

**P 100 \* Ramp generator 2** Ramp generator menu

Only one ramp function generator at a time can ever be switched on, see P094.

**Range:** ON ... OFF

| Value | Meaning                                |
|-------|--|
| ON    | Ramp function generator 2 switched-on  |
| OFF   | Ramp function generator 2 switched-off |

**Default value:** OFF

**P 101 \* RG2 acceleration time** Ramp generator menu

The time applies to a 100% nominal value change.

**Range:** 0.0 s ... 850.0 s

**Default value:** 0.0 s

**P 102 \* RG2 deceleration time** Ramp generator menu

The time applies to a 100% nominal value change.

**Range:** 0.0 s ... 850.0 s

**Default value:** 0.0 s

**P 103 Display OFF, Display ON**

Press the Mode key twice ⇒ display is off, keypad is locked

Press the ^ or v counter key for a relatively long period of time ⇒ display is switched on.

**Default value:** 0

**P 104 Keypad enable**

If P001 = 0, the value 17 gives the keypad access rights on the unit.

### NOTE!

The value 17 is not shown after transfer! All other values block the keypad for manual inputs; reading out of parameter values is still possible.  
You can only change parameter P001 (communication source) using the keypad!

## P 105 \* Nominal mains voltage

Ident./Control menu

Set this parameter to the nominal mains voltage.

### NOTE!

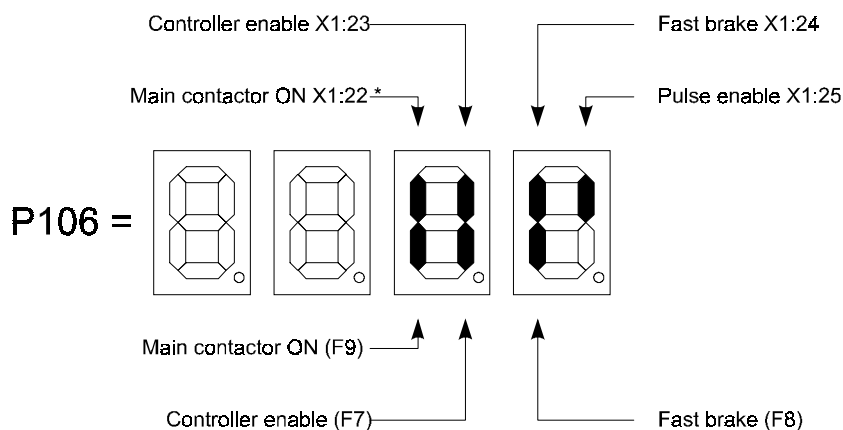
400-V devices must not be run on a 500-V mains supply! Amongst other things, the setting is crucial for mains monitoring.

**Range:** 200 V<sub>eff</sub> ... 500 V<sub>eff</sub>

**Default value:** 400 V<sub>eff</sub>

## P 106 Display of all controller enables

The top bars show the status at input terminals X1:22 ... 24. The bars are lit-up with a HIGH level.



The bottom bars show the status of the serial command from the PC or the controller. The bars light up with an ON command. F7, F8 and F9 are function keys on the PC.

\* Display of the static status. The switching edge at X1:22 may still be missing for controller enable.

**P 107**      **Display of the relay functions**



The bar lights up when the associated relay is triggered.

**P 108**      **Display of the status of terminals X1:26, 27, 28, 29**



The bar lights up when a HIGH level is pending at the corresponding terminal.

**P 109**      **Clear EEPROM**

This is only possible with data collisions or memory errors in the EEPROM. During clearing, the system displays CLr in parameter P109 and then error 61 in P159.

**Input value:**      6

## Parameters

---

**P 110** \* **Armature/mains voltage** Ident./Control menu

You must set this parameter correctly, since it affects the final rectifier position!

**Range:** 0.50 ... 1.21

Input values above 1.05 are possible with devices of series BKD only (see parameter P139)

**Default value:** 1.00

**P 111** **Final rectifier position** Armat. curr. contr. menu

The setting is conditional on P110 and cannot be changed directly.

**P 112** **Final inverter position** Armat. curr. contr. menu

Cannot be changed, 150° constant.

**P 113** \* **Scaling nominal value source 2** Configuration menu

**Range:** 0.00 ... 1.00

0.00 ... 2.00

S04.14 and above

**Default value:** 1.00

If you want to form a nominal value of -10 V ... +10 V from a nominal voltage of 0 V ... +10 V, for example, you must set P113 = 2.00 and P114 = -100%.

**P 114** \* **Offset nominal value source 2** Configuration menu

**Range:** -100% ... +100%

**Default value:** 0%

**P 115** \*  **$n_{nom} = 0$  lock** Configuration menu

If the nominal value falls below the threshold (P116) you set using P116 and the speed actual value falls below the threshold set with P078, the system triggers the action set with P115.

**Range:** 0 ... 2

| Value | Meaning   |
|-------|---|
| 0     | Not active  |
| 1     | Speed controller's I component is short-circuited   |
| 2     | Speed controller feedback is short-circuited. Enabling is carried out if the threshold set with P116 is exceeded. The lock is activated if the nominal value set with P116 and the actual value threshold set with P078 are fallen short of (drift lock). |

**Default value:** 0



- P 116** \*  **$n_{\text{nom}} = 0$  threshold** Configuration menu
- Range:** 0.1% ... 5.0%
- Default value:** 0.5%
- 
- P 117** \* **Pull-in time  $I_F$  monitoring** Field current controller menu
- Triggering time for monitoring the minimum field current (threshold is 50% of the field current nominal value).
- Range:** 0.5 s ... 30.0 s
- Default value:** 0.8 s
- 
- P 118** **Gear stage** Speed controller menu  
S04.04 and above
- The system takes the values of the speed controller protective circuits (P011 and P012) from the data set specified with P118. All the other setting values are unchanged.
- Condition: The data set selected using P118 must have been programmed.
- If a complete data set is loaded, the system also changes the display value of parameter P118. Changing parameter P118 does not affect display of parameter P008. See also P008, P011, P012, P129.
- Range:** 1 ... 4
- Default value:** Same as boot source P006
- 
- P 119** \* **Nominal current of field device**
- Display only, is used for calculation of parameter P049.
- 
- P 120** \* **Hysteresis  $I_A > I_x$  K3/1** Monitoring menu
- For the upper and lower limits, refer to the function plans.
- Range:** 1% ... 40%
- Default value:** 2%

## Parameters

---

**P 121 \* Delay  $I_A = 0$  message** Precontr. IA Val. menu

The value is set internally in dependence on the armature inductivity P029, without this value being changed; however, the system uses the higher value in each case.

**Range:** 0 ... 30 (sampling interval is 3.3 ms at 50 Hz)

**Default value:** 0

**P 122 \* Field feed in monitoring** Monitoring menu

**Range:** ON ... OFF

| Value | Meaning   |
|-------|---|
| ON    | After a reset, the system checks the field connection at initialization, field current monitoring is active!  |
| OFF   | The system does not check the field connection until the Main contactor ON command has been issued and field current monitoring has been activated. |

**Default value:** ON

**P 123 \* Fast brake** Configuration menu

**Range:** 1 ... 2

| Value | Meaning  |
|-------|--|
| 1     | Fast braking at maximum torque   |
| 2     | Fast braking at the ramp (P094 or P100 only if a ramp function generator is switched on) |

**Default value:** 1

**P 124 \* Drive inhibit function** Configuration menu

**Range:** 1 ... 2

| Value | Meaning  |
|-------|--|
| 1     | Fast brake<br>Controller disable at $n < n_x$ (P078)<br>Main contactor stays on  |
| 2     | Fast brake<br>Additionally, main contactor is switched off at $n < n_x$ (P078)<br>with enable, you must specify "Cancel fast brake" <b>before</b> "Main contactor ON". |

**Default value:** 1

**P 125 \* Scaling analog output 2** Configuration menu

This parameter is for adaptation to a display instrument.  
 $U = 10V \times P125$  for the nominal value of the selected test point.

**Range:**                    0.20 ... 1.00  
                                   0.20 ... 2.00 S04.30 and above

**Default value:**    1.00

**P 126 \* Thermic time constant motor** Monitoring menu

Consult the motor manufacturer for the time constant.  
 0 corresponds to monitoring inactive. With software version S04.23 and above, monitoring is not active during an optimization run.

**Range:**                    0 min ... 180 min

**Default value:**    0 min

**P 127 \* Threshold for I<sup>2</sup>t** Monitoring menu

Threshold for triggering I<sup>2</sup>t monitoring.

**Range:**                    50% ... 110%

**Default value:**    95%

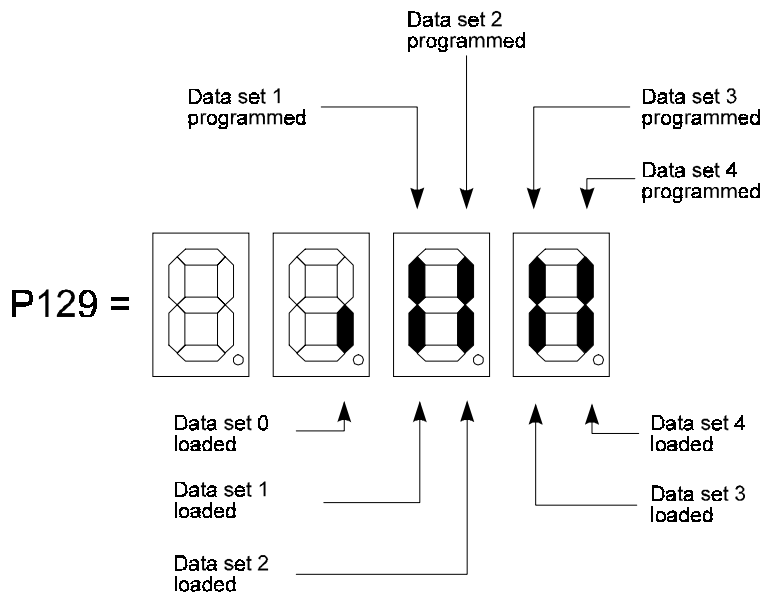
**P 128 \* Relay output K4** Monitoring menu

**Range:**                    0 ... 1

| Value | Meaning  |
|-------|--|
| 0     | Temperature monitoring<br>This drops if the temperature of the power stage is OK and the motor's I <sup>2</sup> t value (P127) has been fallen short of.<br>It picks up if the temperature of the power stage is too high or the motor's I <sup>2</sup> t value has been exceeded. Temperature LT is accessible via P063, motor's I <sup>2</sup> t value (P069). Using this value, you can draw conclusions about the motor temperature. |
| 1     | Drive ON<br>This drops if the temperature of the power stage is too high, the motor's I <sup>2</sup> t value has been exceeded or the controller has not been enabled.<br>It picks up if the temperature of the power stage is OK, the motor's I <sup>2</sup> t value (P127) has been fallen short of and the controller has been enabled.   |

**Default value:**    0

## P 129 Display loaded/programmed data set



## P 130 \* Analog output channel 3

Configuration menu  
S04.05 and above

## P 131 \* Analog output channel 4

Configuration menu  
S04.05 and above

For function and description, refer to P088/P089, output standardized to  $0 \dots \pm 10 \text{ V}$ .  
scaling of channel 4 via P132, 11-bit resolution (10 mV),

You need a supplementary module with the corresponding DACs.

|             |                  |                               |
|-------------|------------------|-------------------------------|
| PCB 3.9201: | Terminal X4:1    | Signal of measuring channel 3 |
|             | Terminal X4:3    | Signal of measuring channel 4 |
|             | Terminal X4:2/4  | Reference potential           |
| PCB 3.9217: | Terminal X7b:2   | Signal of measuring channel 3 |
|             | Terminal X7b: 4  | Signal of measuring channel 4 |
|             | Terminal X7b:1/3 | Reference potential           |

**Range:** 1 ... 47

**Default value:** 1 (measuring channel 3) = P130  
4 (measuring channel 4) = P131

## P 132 \* Scaling analog output channel 4

Configuration menu  
S04.05 and above

This parameter is for adaptation to a display instrument.

$U = 10 \text{ V} \times P132$  for the nominal value of the selected test point.

**Range:** 0.20 ... 1.00  
0.20 ... 2.00

S04.30 and above

**Default value:** 1.00

**P 133 \* Acceleration factor** Precontr. IA Val. menu  
S04.05 and above

In the case of load measurement with lifting drives or cranes with field weakening, this is needed for correct load calculation. See also P081, P134... P137 and P167.

**Range:** 0.5 ... 50.0

**Default value:** 1.0

**P 134 \* Field weakening range** Precontr. IA Val. menu  
S04.05 and above

This is needed for load measurement with lifting drives or cranes with field weakening. The setting value is the field weakening range of the motor being used. See also parameters P133, P135, P136, P137.

**Range:** 1.0 ... 3.0

1.0 ... 4.0

S04.12 and above

**Default value:** 1.0

**P 135 \* Gear efficiency factor** Precontr. IA Val. menu  
S04.05 and above

This is needed for load measurement with lifting drives or cranes with field weakening. The value is set correctly when the same load value is determined when lifting and lowering the same load. See also P133, P134, P136, P137 and P160 ... P166.

**Range:** 0.58 ... 1.00

**Default value:** 1.00

**P 136 \* Load measurement ON/OFF** Precontr. IA Val. menu  
S04.05 and above

This is needed for load measurement with lifting drives or cranes with field weakening. It is used to activate load measurement (P133 ... P135, P137 and P160 ... P167 effective/not effective). See also parameters P133 ... P135, P137 and P160 ... P167.

**Range:** ON ... OFF

| Value | Meaning                       |
|-------|-------------------------------|
| ON    | Load measurement switched-on  |
| OFF   | Load measurement switched-off |

**Default value:** OFF

## Parameters

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**P 137 \* Scaling max. nom. value** Precontr. IA Val. menu  
S04.05 and above

This is needed for load measurement with lifting drives or cranes with field weakening. It is used to weaken the maximum permissible nominal value at load measurement, which the power converter calculated. See also P133, P134, P135, P136.

|                       |               |                  |
|-----------------------|---------------|------------------|
| <b>Range:</b>         | 0.50 ... 1.00 |                  |
|                       | 0.50 ... 0.95 | S04.09 and above |
|                       | 0.50 ... 1.00 | S04.12 and above |
| <b>Default value:</b> | 1.00          |                  |
|                       | 0.80          | S04.09 and above |
|                       | 1.00          | S04.12 and above |

**P 138 \* Threshold tacho polarity (error 39)** Monitoring menu  
S04.04 and above

This is for setting the threshold from which onwards monitoring of the tachometer polarity is to become effective. The setting value is referred to the tachometer signal. A setting value of 50% means that the tachometer polarity is not monitored until  $\pm 50\%$  of the speed has been reached. With setting values of 61% and 62%, monitoring is **switched off**. The power converter's display shows the message **OFF**.



### DANGER

If you set P138 to 61% or 62%, monitoring of the tachometer/encoder polarity is switched-off. In this case, the system does not detect polarity reversal of the tachometer/encoder. In the event of an error, this can lead to uncontrolled running!

|                       |             |
|-----------------------|-------------|
| <b>Range:</b>         | 10% ... 62% |
| <b>Default value:</b> | 10%         |

### NOTE

If the input value is increased and there is a tachometer/encoder failure, the drive is not switched off until a higher speed is reached!

**P 139 Device type**

|               |                       |
|---------------|-----------------------|
| <b>Range:</b> | d = BKD6<br>f = BKF12 |
|---------------|-----------------------|

**P 140 \* Threshold tacho wire break (error 38)** Monitoring menu  
S04.05 and above

Setting the threshold from which onwards monitoring of the tachometer wire break is to become effective. The setting value is referred to the armature voltage measured by the drive. A setting value of 30% means that tachometer wire break is not monitored until an armature voltage of 30% of the nominal armature voltage (P110) is reached. You cannot switch off monitoring.

Since the speed actual value determined by the power converter indicates the status of the actual value encoder, this does not represent a redundant safety system. Observe the regulations for the protection of people!

**Range:** 20% ... 65%  
5% ... 65% S04.23 and above

**Default value:** 10%

### NOTE

If the input value is increased and there is a tachometer/encoder failure, the drive is not switched off until a higher speed is reached!

Since the speed actual value determined by the power converter indicates the status of the actual value encoder, this does not represent a redundant safety system. Observe the regulations for the protection of people!

**P 141 \* Delay time armature open (error 17)** Monitoring menu  
S04.05 and above

**Range:** 1.0 ... 10.0 s

**Default value:** 1.0 s

**P 142 \* Maximum speed value** Speed controller menu  
S04.09 and above

See also parameters P083, P143 and P144.

**Range:** 500 RPM ... 6000 RPM  
100 RPM ... 6000 RPM S04.11 and above

**Default value:** 1000 RPM

**P 143 \* Rotary encoder resolution** Speed controller menu  
S04.09 and above

The maximum speed that can be achieved with a rotary encoder is calculated as follows:

$$n_{\max} = \frac{(60 \cdot 100 \text{ kHz})}{P143} \quad [\text{RPM}]$$

With a 1024-increment encoder, parameter P142 can be set to a maximum of 5859 RPM. If you assign a higher value, the system sets P142 to 5859 RPM and error message 115 is issued. See also parameters P083, P142 and P144).

$$n_{\max} = \frac{(60 \cdot 300 \text{ kHz})}{P143} \quad [\text{RPM}] \quad \text{S04.25 and above}$$

**Range:** 250 ... 4096

**Default value:** 1024

**P 144 \* Rot. enc. polarity change** Speed controller menu  
S04.09 and above

This is needed if the directions of rotation of the motor and the encoder are different, due to the way in which the incremental encoder is mounted. See also parameters P083, P142 and P143.

**Range:** ON ... OFF

| Value | Meaning                        |
|-------|--------------------------------|
| ON    | Polarity reversal switched-on  |
| OFF   | Polarity reversal switched-off |

**Default value:** OFF

**P 145 \* Field weakening mode** Field current controller menu  
S04.15 and above

**Range:** 0 ... 1

| Value | Meaning   |
|-------|---|
| 0     | The armature voltage is used for field weakening control. |
| 1     | The e.m.f. is used for field weakening control.           |

**Default value:** 0



**P 146** \* **Timeout firing pulses disable** Monitoring menu  
S04.15 and above

A settable watchdog timeout for the switchover logic. You add the 40–ms watchdog timeout to the entered value.

This also affects controller enable or main contactor OFF. With controller disable, the firing pulses stay in the inverter limit for this time until pulse clearance is issued. The main contactor is not switched off until this time +50 ms has elapsed.

**Range:**                    0.2 s ... 2.0 s  
                                  0.1 s ... 2.0 s S04.27 and above

**Default value:**    0.2 s

**P 147** \* **Phase failure < 400 ms** Ident./Control menu  
S04.17 and above

**Range:**                    ON ... OFF

| Value | Meaning   |
|-------|---|
| ON    | With an appropriate switching mains unit, it is possible to buffer power failures lasting up to 400 ms. |
| OFF   | In the case of a power failure, the drive issues an error and locks itself.                             |

**Default value:**    OFF

**P 148** \* **Load data set mode** Ident./Control menu  
S04.10 and above

If a controller enable is issued during loading of a data set, the system delays the controller enable until the data set has been loaded, regardless of the setting of P148. Relay K4 "Drive ON" (P128 = 1) does not pick up either until the drive has really been enabled.

If the controller is enabled and P148 = 2, P099 = 4 and you choose a new data set by means of terminals X1:28 and X1:29 on PCB 3.8934 and the signals remain, the new data set is loaded immediately on inhibiting of the controller!

The setting of parameter P148 has no effect on P118 "Gear stage". You can always change the speed controller's protective circuit, i.e. even when the controller is enabled. See also parameters P008, P099, P118 and P128.

**Range:**                    1 ... 2

| Value | Meaning   |
|-------|---|
| 1     | It is always possible to load a data set, even if the controller is enabled   |
| 2     | A data set can only be loaded when the controller is disabled. If the system tries to load a data set with the controller enabled, message 113 is issued. |

**Default value:**    1

## Parameters

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**P 149** \* **Nominal value multiplier** Configuration menu  
S04.15 and above

For function, see parameter P084. Has no effect with nominal value source 16 (P080 = 16).

**Range:** 0.00 ... 1.00

**Default value:** 1.00

**P 150** \*  
to **P 155** Reserved

**P 156** \* **Mains failure timeout** Monitoring menu  
S04.29 and above

You can only use this parameter with an external 24-V<sub>dc</sub> UPS and an appropriate switching power supply in the power converter. P156 can only be set to values not equal to 0.0 s if P084 ≠ 13 and P147 = OFF.

In the case of mains failures that are shorter than the period set using P156, the drive starts automatically on restoration of power, assuming that all the enables on the unit are still present. With longer mains failures, the power converter takes on the disturbed state.



### WARNING

Due to the fact that the machine starts automatically on restoration of power, you must observe applicable safety regulations of the machine when setting the time!

**Range:** 0.0 ... 6.0 s

**Default value:** 0.0 s

**P 157** \* **Release delay K2/0** Monitoring menu  
S04.25 and above

This parameter is only effective if relay K2 with parameter P171 = 0 is assigned the function  $n > n_x$ .

**Range:** 0.00 s ... 30.00 s

**Default value:** 0.00 s

**P 158 \* Multiplier P070/P078**Monitoring menu  
S04.15 and above

For parameters P070 ( $n < n_{\min}$  for K2) and P078 ( $n < n_{\min}$  for fast brake), the speed actual value is multiplied by 1 or "10" before the system polls the threshold. This results in a minimum monitoring threshold of 0.1% of  $n_{\text{nom}}$ .

**Range:** 0 ... 1

| Value | Meaning  |
|-------|--|
| 0     | P070 = 1 ... 105% of $n_{\text{nom}}$<br>P078 = 1 ... 100% of $n_{\text{nom}}$   |
| 1     | P070 = 0.1 ... 10.5% of $n_{\text{nom}}$<br>P078 = 0.1 ... 10.0% of $n_{\text{nom}}$<br>The decimal point is not shown on the display! |

**Default value:** 0**P 159 Cyclical error display**

S04.05 and above

If there is an error, the system automatically switches on the display and shows parameter P159 (S04.08 and above).

The stored errors are shown completely one after another.

The MODE key on the power converter is **not** effective.

The errors are retained and are not acknowledged by the display. Use parameter P005 (applies where P001 = 0 only) to acknowledge errors.

# Parameters

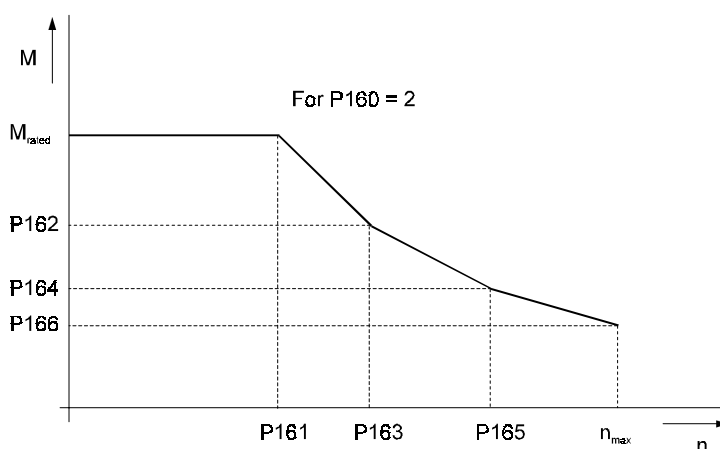
**P 160 \* n<sub>nom</sub> limit mode**

Precontr. IA Val. menu, S04.12 and above

Range: 1 ... 2

| Value | Meaning   |
|-------|---|
| 1     | Calculation of the maximum permissible speed at load measurement with constant power (hyperbola; $\text{load} \cdot n_{\text{per}} = \text{constant}$ )<br>Effective parameters: P133 ... P137 and P167 |
| 2     | Calculation of the maximum permissible speed at load measurement on three straight sections (4 interpolation points).<br>Effective parameters P133, P135 ... P137 and P161 ... P167                     |

Default value: 1



**P 161 \* n-interpolation point 1**

Precontr. IA Val. menu  
S04.12 and above

Speed interpolation point 1 up to which the system can run at maximum torque (maximum load). Is effective only when parameter P160 = 2.

Range: 25% ... 100%

Default value: 100%

**P 162 \* M-interpolation point 2**

Precontr. IA Val. menu  
S04.12 and above

The system runs at up to this torque on straight section 1. Is effective when parameter P160 = 2.

Range: 10% ... 100%

Default value: 100%

**P 163** \* **n–interpolation point 2** Precontr. IA Val. menu  
S04.12 and above

Speed interpolation point 2 at up to which the system runs on straight section 1. Is effective when parameter P160 = 2.

**Range:** 25% ... 100%

**Default value:** 100%

**P 164** \* **M–interpolation point 3** Precontr. IA Val. menu  
S04.12 and above

The system runs at up to this torque on straight section 2. Is effective when parameter P160 = 2.

**Range:** 10% ... 100%

**Default value:** 100%

**P 165** \* **n–interpolation point 3** Precontr. IA Val. menu  
S04.12 and above

Speed interpolation point 3 at up to which the system runs on straight section 2. Is effective when parameter P160 = 2.

**Range:** 25% ... 100%

**Default value:** 100%

**P 166** \* **M–interpolation point 4** Precontr. IA Val. menu  
S04.12 and above

Permissible torque at maximum speed. Is effective when parameter P160 = 2.

**Range:** 10% ... 100%

**Default value:** 100%

**P 167**      **Base load**      Precontr. IA Val. menu  
S04.12 and above

This is needed to determine the acceleration factor, P133. If optimization run "6" (P081) is to be carried out with load (e.g. spreader), you must enter the appropriate value of the basic load (weight of spreader/rated load) before executing the optimization run. The value is not stored in the data set and is of no consequence during load measurement!

Example:

|                    |                  |
|--------------------|------------------|
| Weight of spreader | 10 tonnes        |
| Max. loading       | 40 tonnes        |
| Rated load         | 50 tonnes        |
| Basic load         | 10 t/50 t = 0.20 |
| P167               | 20%              |

**Range:**      0% ... 100%

**Default value:**      0%

**P 168** \*      **Lower measuring limit**      Precontr. IA Val. menu  
S04.14 and above

This parameter is only effective if P136 = ON (load measurement ON).  
The speed threshold from which onwards load measurement is active.

P160 = 1:

The **basic speed** results from the value of parameter P134 (field weakening range).  
If you set P134 = 2.0, for example, the basic speed is 50% of the drive's maximum speed.

P160 = 2:

The **basic speed** is identical with the set value of parameter P161.

**Range:**      5% ... 50% of the basic speed

**Default value:**      20%

**P 169** \*      **Upper measuring limit**      Precontr. IA Val. menu  
S04.14 and above

This parameter is only effective if P136 = ON (load measurement ON).  
The speed threshold up to which load measurement is active.  
For the **basic speed**, see parameter P168.

**Range:**      50% ... 95% of the basic speed

**Default value:**      80%

**P 170 \* Frequency limit** Precontr. IA Val. menu  
S04.14 and above

Hardware output via supplementary module 3.9217 (Input/Output Expansion). If the mains frequency reaches the set value or exceeds it, output DA7 is set (X7b:13 on 3.9217). If the mains frequency falls below the set value, DA7 is reset. Typical pickup and release delays are around 60 ms. Can be used with operation of the power converter on a mains supply with a diesel generator.

**Range:** 45.0 Hz ... 65.0 Hz

**Default value:** 65.0 Hz

**P 171 \* Relay output K2** Monitoring menu  
S04.14 and above

**Range:** 0 ... 1

| Value | Meaning   |
|-------|---|
| 0     | n>n <sub>x</sub> message. The switching threshold is specified with P070.   |
| 1     | I <sub>A</sub> ≥ I <sub>x</sub> message. The switching threshold is specified with parameter P172 and refers to the maximum device output current (P025). |

**Default value:** 0

**P 172 \* I<sub>A</sub> ≥ I<sub>x</sub> K2/1** Monitoring menu  
S04.14 and above

The switching threshold refers to the maximum device output current (P025).

**Range:** 5% ... 120%

**Default value:** 95%

**P 173 \* Response time I<sub>A</sub> ≥ I<sub>x</sub> K2/1** Monitoring menu  
S04.14 and above

The release delay is always 100 ms.

**Range:** 0.0 s ... 30.0 s

**Default value:** 1.0 s

## Parameters

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**P 174** \* **Linking relay K2/1 – K3/1**

Monitoring menu  
S04.14 and above

**Range:** ON ... OFF

| Value | Meaning   |
|-------|---|
| ON    | Is only effective if relay K2 and relay K3 are assigned with function $I_A \geq I_x$ (P085 = 1 and P171 = 1).<br>If the armature current exceeds the threshold set with P172 and the time set with P173 has expired, relay K3 also picks up after the time set with P175 has expired, even if the armature current does not reach the threshold set for K3 (P073).<br>Condition: The threshold set for K2 (P172) must be less than the threshold for K3 (P073). |
| OFF   | K2 and K3 switch independently of one another. This means that two separate current monitoring facilities are available.  |

**Default value:** OFF

**P 175** \* **Linking time relay K2/1 – K3/1**

Monitoring menu  
S04.14 and above

For function, see parameter P174.

**Range:** 0 s ... 900 s

**Default value:** 60 s

**P 00C** **Software reset**

Ident./Control menu

If the PC or the controller writes (any value) to this parameter, the system **decelerates** the drive to speed = 0 and then triggers a reset.

**P 01F** \* **Check sum BDS**

Ident./Control menu

Interrogation of the boot data set's checksum; the checksum is modulo 256. If no boot data set is present or it is faulty, a value greater than or equal to 256 is transferred as the checksum (for serial communication only).

**P 07F** \* **Display parameters**

Ident./Control menu

Must be entered on the PC/controller.

**Range:** 0 ... 175

**Default value:** 1



## 9 MAINTENANCE



### WARNING

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

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

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

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

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

In addition, you should observe the warning information in the previous chapter.

When mounting and dismantling, you must never use force on the bus bars.

Use the provided lifting eyes when raising the power stages of size III and IV units.

If you have to change the fuses in size III and IV units, tighten the screws to the torque values shown below to ensure perfect contact:

|            |              |
|------------|--------------|
| M8 screw:  | 10 ... 13 Nm |
| M10 screw: | 20 ... 26 Nm |
| M12 screw: | 35 ... 46 Nm |

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

You may only use manufacturer-approved spares.

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

## 9.1 Maintenance Information

The supplied units are maintenance-free.

### Prohibition of Unauthorized Modifications

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

#### NOTE

- Before touching the modules, you must discharge electrostatic energy from your body to protect electronic components from high voltages resulting from electrostatic charging. The easiest way to do this is to touch a grounded conductive object before handling components. Units containing components or modules at risk from electrostatic energy are clearly marked as such by the sticker below.



- Electronic components may not be touched by highly insulating materials such as man-made fibres from clothing, insulating mats or plastic sheeting/film. Always rest components on a conductive base.

## 9.2 Error Messages

### LED H22 lights up red with a message or an error

All errors and messages are shown in numerical order in the error list. Errors numbered up to 99 result in a controller disable and main contactor off. Errors numbered 100 and above are messages that do not affect ongoing operation. In the case of a message or an error, the display shows the number via parameter P159.



### Meanings of operational and error displays

- H15 Control lights up red if the current controller is overloaded. In this case, the firing angle,  $\alpha$ , is in the final position ( $\alpha_G$  or  $\alpha_W$ ). H15 may only briefly light up when the speed changes and must never light up during operation!
- H16 The current limit lights up red if the speed controller is overloaded and the armature current  $I_A$  is  
 $> 93\%$  of  $I_N$
- H17 Torque direction 2 yellow
- H18 Torque direction 1 green
- H19 Lights up yellow with speed  $n = 0$ ; parameter P078 determines the threshold
- H20 Lights up green with controller enable
- H21 Lights up red with controller inhibit
- H22 Message or error; apart from at the initialization stage, this only lights up red in the case of an operational disturbance; the display on the power converter shows via parameter P159 all the errors that have occurred, for error assignments, refer to the error list. Read off the individual error and clear it if necessary using parameter P005. On the PC, press function key F3 to display errors.
- H1 Red with STOP
- H2 Yellow with watchdog

- **Display of errors on the power converter's display**



- **Display of all errors via parameter P159**

Cyclical display of all the errors that have occurred; they can be evaluated using the comments in the error list; if there is an error, the display switches on automatically (S04.08 and above) and shows parameter P159. Parameter 159 then shows all the errors one after the other. By contrast with parameter P005, it is not possible with P159 to clear errors by mistake (assuming that the error can be cleared at all).

The MODE key on the power converter is not effective! While the unit is switched-on, the errors are retained and are not acknowledged with the display. Use parameter P005 to acknowledge errors (applies when P001 = 0 only).

- **Reading an individual error via parameter P005**

Display of an error; using the keys, you can read, acknowledge and delete individual errors. To acknowledge the displayed error and display the next one: press the mode key and then one of the counter keys. The keypad must first have been enabled using P104 = 17.

### Display of errors on the PC

Press F3: The error is displayed;

the system shows the status of the error on the bottom line of the menu and by means of LED H22 on the device, which lights up red if there is a message. You press F3 to acknowledge the message and return to the menu by pressing F10.

### 9.3 Error List

Error numbers 01 to 99 lead to a controller inhibit and an operational disturbance. As a result of the controller inhibit, the power converter is deenergized and the main contactor drops. This leads to the motor coasting to a standstill without being braked. You must take this into account with motion and lifting drives especially. After removing the error, a switching operation from 0 V ⇒ +24 V must take place at X1:22 to switch on the main contactor again.

**This prevents the drive from automatically starting!**

As a result of the operational disturbance signal, relay K1 "ready for use" drops for at least 1 second.

| Error No. | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error   | Effect/Action   |
|-----------|----------------------------|--------------------------------------|--|---|
| 00        | No                         | No                                   | Not an error   | Normal operation  |
| 01        | Yes                        | Yes                                  | ±15 V disturbed or missing   | Controller inhibit  |
| 02        | Yes                        | Yes                                  | Counterclockwise rotating field on power stage connection or power stage not connected (see also P007) | Controller enable not possible, deenergize the device, correct the power stage connection observe phase coincidence for feeding the control electronics   |
| 03        | Yes                        | Yes                                  | Synchronization with mains missing, possible loose contact in electronics supply                       | Control block is no longer synchronized with the mains, controller is disabled, controller enable no longer possible  |
| 04        | Yes                        | Yes                                  | Program watchdog has triggered   | The system has not processed the controller program properly for the last 40 ms. Controller inhibit, H2 on PCB 3.8439 lit up (yellow LED) during a change of torque, the release time is 200 ms ⇒ RESET |
| 05        | Yes                        | Yes                                  | Actual value of armature current negative several times; armature current acquisition faulty           | Controller inhibit<br>Controller reenable possible  |
| 06        | Yes                        | Yes                                  | Firing pulse interval different from specified value   | Controller inhibit<br>⇒ RESET   |
| 07        | Yes                        | Yes                                  | Mains voltage out of range (rated mains connection voltage ±20%)                                       | Controller inhibit<br>⇒ RESET   |
| 08        | –                          | –                                    | Reserved   | None  |
| 09        | Yes                        | Yes                                  | "End of Conversion" ADC signal missing (analog data acquisition faulty)                                | Controller inhibit<br>Controller reenable possible  |
| 10        | –                          | –                                    | Reserved   | None  |
| 11        | –                          | –                                    | Reserved   | None  |
| 12        | Yes                        | Yes                                  | Armature voltage value wrong at $U_A = 0$ V (measured during booting)                                  | No controller enable possible<br>⇒ RESET  |
| 13        | –                          | –                                    | Reserved   |   |
| 14        | Yes                        | Yes                                  | Phase failure, mains or power unit not connected (measured at Main contactor ON)                       | Controller inhibit<br>⇒ RESET   |
| 15        | –                          | –                                    | Not assigned   | None  |

RESET: Hardware reset or switch unit off and back on again

| Error No. | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error  | Effect/Action  |
|-----------|----------------------------|--------------------------------------|---|--|
| 16        | Yes                        | Yes                                  | The drive blocks if<br>1) P086 is set to ON<br>2) the drive runs at the current limit for longer than the time set using P087 and, during this time,<br>3) the speed set with P078 is continually fallen short of   | Controller inhibit<br>Controller reenable possible   |
| 17        | Yes                        | Yes                                  | Armature circuit open, armature not connected, armature circuit fuse has tripped, wrong speed standardization with tachometer control (P083 = 0/1)  | Controller inhibit<br>⇒ RESET  |
| 18        | Yes                        | Yes                                  | Data traffic interrupted for longer than 1200 ms (in the case of serial communication, no data was exchanged during the last 1.2 s). It is assumed that there is an interruption in the connection between the computer/controller and the power converter; with P001 = 1/2/3 | Controller inhibit<br>Controller reenable possible, assuming that the connection is available again and all enables are at ON. |
| 19        | –                          | –                                    | Not assigned  | None   |
| 20        | Yes                        | Yes                                  | Mains frequency out of upper or lower measuring range $f < 44 \text{ Hz}$ or $f > 66 \text{ Hz}$  | Controller inhibit<br>⇒ RESET  |
| 21        | –                          | –                                    | Reserved  | None   |
| 22        | –                          | –                                    | Reserved  | None   |
| 23        | –                          | –                                    | Reserved  | None   |
| 24        | Yes                        | Yes                                  | Min. field current out of lower range (Field current $< 50\%$ of rated field current if <b>no</b> field weakening is set and field current $< 50\%$ of the minimum field current with field weakening)  | Controller inhibit<br>Controller reenable possible   |
| 25        | –                          | –                                    | Not assigned  | None   |
| 26        | –                          | –                                    | Not assigned  | None   |
| 27        | Yes                        | Yes                                  | Program execution disturbed   | Controller inhibit ⇒ RESET   |
| 28        | Yes                        | Yes                                  | Hardware defect in digital section  | Controller inhibit ⇒ RESET   |
| 29        | Yes                        | Yes                                  | Armature current 0 message disturbed/ defective (is acquired during booting; without a message, the system does not switch in torque direction TD1)   | No controller enable<br>⇒ RESET  |
| 30        | Yes                        | Yes                                  | Armature current measurement offset error (is determined during booting, armature current measurement is disturbed or defective)  | No controller enable<br>⇒ RESET  |
| 31        | –                          | –                                    | Reserved  | None   |
| 32        | –                          | –                                    | Reserved  | None   |
| 33        | Yes                        | Yes                                  | Overcurrent bridge 1 (TD1)<br>Armature current actual value $> 2 \cdot$ rated value   | Controller inhibit<br>Controller enable possible   |
| 34        | Yes                        | Yes                                  | Overcurrent bridge 2 (TD2)<br>Armature current actual value $> 2 \cdot$ rated value   | Controller inhibit<br>Controller enable possible   |

RESET: Hardware reset or switch unit off and back on again

| Error No.                 | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error  | Effect/Action   |
|---------------------------|----------------------------|--------------------------------------|---|---|
| 35                        | –                          | –                                    | Not assigned  | None  |
| 36                        | Yes                        | Yes                                  | Signal for mains synchronization missing (e.g. plug X10 loose)  | No controller enable<br>⇒ RESET   |
| 37                        | Yes                        | Yes                                  | Interface X11 defective<br>Ribbon cable missing or defective  | No controller enable<br>⇒ RESET   |
| 38                        | Yes                        | Yes                                  | Tachometer/encoder wire break<br>No speed actual value signal with P083 = 0/1/2/3 or wrong I*R value (P020) or armature circuit open                                      | Controller inhibit<br>⇒ RESET   |
| 39                        | Yes                        | Yes                                  | Actual value polarity wrong; tachometer/encoder, field or armature connected wrongly with P083 = 0/1/2/3 or wrong I*R value   | Controller inhibit<br>⇒ RESET   |
| 40                        | Yes                        | Yes                                  | Tachometer offset error (is determined during booting, speed actual value measurement is disturbed or defective); e.g. RESET with rotating machine), with P083 = 0/1 only | No controller enable possible<br>⇒ RESET  |
| 41<br>S04.09<br>and above | Yes                        | Yes                                  | Incremental encoder evaluation not available. Monitoring with controller structure P083 = 2/3 (at initialization of the power converter or data set loading only)         | No controller enable possible<br>⇒ Fit daughterboard<br>⇒ RESET   |
| 42                        | Yes                        | Yes                                  | EEPROM data set X is not from the same software group   | Data set is unusable and is not loaded<br>Generate a new data set and store it (P004)   |
| 43                        | –                          | –                                    | Not assigned  |   |
| 44                        | Yes                        | Yes                                  | $n > 1.15 \cdot n_{rated}$ , only with tachometer/encoder control P083 = 0/1/2/3 and <b>error-free</b> tachometer generator/encoder                                       | Controller inhibit<br>Controller reenable possible  |
| 45                        | Yes                        | Yes                                  | Field connection not correct<br>Field connection not available or not connected in-phase  | No controller enable possible, deenergize the field device connection, correct the field device connection<br>⇒ RESET   |
| 46                        | Yes                        | Yes                                  | Power stage connection not correct (phase sequence incorrect)   | No controller enable possible, deenergize the device, correct the power stage connection  |
| 47<br>S04.11<br>and above | Yes                        | Yes                                  | Daughterboard (3.9217) for parallel nominal value setting is not available. The system checks at initialization of the power converter or data set loading (P008) only.   | No controller enable possible<br>⇒ Fit daughterboard<br>⇒ RESET   |
| 48                        | –                          | –                                    | Not assigned  |   |
| 49                        | Yes                        | Yes                                  | EEPROM formatting faulty  | No controller enable possible, data set is loaded from EPROM. EEPROM is unusable! Can be cleared with P109 (max. time for clearing = 10 s). After this, AUTO-RESET and formatting of the EEPROM. Communication source = 0. Generate new data sets |
| 50                        | Yes                        | Yes                                  | EEPROM not fitted or EEPROM storage area too small, error during EEPROM formatting  | No controller enable possible, data set is loaded from EPROM (P109 possible, see error number 49)   |

RESET: Hardware reset or switch unit off and back on again

| Error No. | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error  | Effect/Action  |
|-----------|----------------------------|--------------------------------------|---|--|
| 51        | Yes                        | Yes                                  | Checksum or boot data set termination faulty  | No controller enable possible, data set loaded from EPROM. (Generate new data set and store with P004)                                   |
| 52        | Yes                        | Yes                                  | EEPROM is not software-compatible EEPROM and program EEPROMs are not from the same software group | No controller enable possible data set loaded from EPROM (P109 possible, see error number 49)  |
| 53        | Yes                        | Yes                                  | Boot data set is not from the same software group   | No controller enable possible, data set loaded from EPROM. Generate new data set and store with P004 ⇒ RESET                             |
| 54        | Yes                        | Yes                                  | EEPROM boot data set is too long  | No controller enable possible, data set loaded from EPROM (see error number 53) ⇒ RESET  |
| 55        | Yes                        | Yes                                  | EEPROM can not be cleared (after carrying out P109)   | EEPROM is defective, fit a new EEPROM 2816 ⇒ RESET<br>Generate data sets, specify the boot source  |
| 56        | Yes                        | Yes                                  | Boot source entry in EEPROM is outside range or not available                                     | No controller enable possible, data set loaded from EPROM, possibly generate a new data set<br>Enter boot source again with P006 ⇒ RESET |
| 57        | Yes                        | Yes                                  | EEPROM data set X is too long (with P008 or when using P099/4)                                    | Data set X is unusable and is not loaded, generate a new data set X and store it with P004   |
| 58        | Yes                        | Yes                                  | EEPROM data set X, checksum or data set termination not correct (with P008 or when using P099/4)  | Data set X is unusable and is not loaded, generate a new data set X and store it with P004   |
| 59        | Yes                        | Yes                                  | EEPROM data set X is not available (with P008 or when using P099/4)                               | Selected data set X is not available controller inhibit, create a data set or load an existing one                                       |
| 60        | –                          | –                                    | Not assigned  | None   |
| 61        | Yes                        | Yes                                  | No data set programmed  | No controller enable possible, the system booted from the EPROM, generate a data set, enter the boot source                              |
| 62        | Yes                        | Yes                                  | Device type is not software-compatible  | EPROM "D5xx" is not suitable for the power converter type! Deenergize the device and fit new EPROMs                                      |
| 63        | Yes                        | Yes                                  | Individual EEPROM datum defective, P001, P006, P007, P009 have values that are outside the limits | Check the values of parameters P001/P006/P007/P009 and correct them if necessary ⇒ RESET   |
| 64        | –                          | –                                    | Not assigned  |  |
| 65        | –                          | –                                    | Reserved  | None   |
| 66        | –                          | –                                    | Reserved  | None   |
| 67        | –                          | –                                    | Reserved  | None   |
| 68        | –                          | –                                    | Not assigned  | None   |
| 69        | –                          | –                                    | Not assigned  | None   |

RESET: Hardware reset or switch unit off and back on again



| Error No.                 | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error   | Effect/Action  |
|---------------------------|----------------------------|--------------------------------------|--|--|
| 70                        | –                          | –                                    | Not assigned   | None   |
| 71                        | Yes                        | Yes                                  | Phase difference 90° synchronous filter  | Hardware defect on V31 PCB 3.8934 or mains disturbance<br>Enable not possible  |
| 72                        | Yes                        | Yes                                  | PC software and power converter software not compatible  | Use PC software from the same software group. No enable possible   |
| 73                        | Yes                        | Yes                                  | PC data file and power converter software not compatible   | Use PC software from the same software group (data file *.68K), no enable possible   |
| 74                        | Yes                        | Yes                                  | Communication source outside range   | Reprogram communication source (P001)<br>no enable possible ⇒ RESET  |
| 75                        | –                          | –                                    | Not assigned   | None   |
| 76                        | Yes                        | Yes                                  | Timeout exceeded programming individual datum  | Reprogram parameters P001 or P006 or P007 or P009, no enable possible  |
| 78<br>S04.23<br>and above | Yes                        | Yes                                  | RAM defective  |  |
| 100                       | –                          | –                                    | Power stage detection not possible   | None, display cannot be used with P000,<br>check device type P139  |
| 101                       | –                          | –                                    | Power stage detection of field device <b>not</b> possible  | None, display cannot be used with P119   |
| 102                       | –                          | –                                    | Ripple limit cannot be determined (with optimization run 1 or 4.1) device current or current limit too low | Default value = 30%<br>Current precontrolling not working correctly  |
| 103                       | –                          | –                                    | Armature circuit inductivity cannot be determined with optimization run 1 or 4.1<br>Possibly P037 = 0.00   | Suboptimal current precontrolling, probable armature current overshoot, default value = 0  |
| 104                       | –                          | –                                    | Motorized potentiometer memory value unusable<br>(with P099/3)   | Motorized potentiometer value is set to 0! Enable possible, store value again  |
| 105                       | –                          | –                                    | Temperature of motor has exceeded the set threshold (I <sup>2</sup> t monitoring)                          | Operation can continue for another five minutes at the most, the equipment must then be turned off. For relay K4, see function P128. The operator <b>must</b> respond                                      |
| 106                       | –                          | –                                    | Mains frequency is outside the range of 47 Hz < f < 63 Hz, the power converter can still function          | None   |
| 107                       | –                          | –                                    | Temperature of heat sink in the power stage > 85° C  | Temperature of power stage too high; operation can continue for another five minutes at the most, the equipment must then be turned off. For relay K4, see function P128. The operator <b>must</b> respond |
| 108                       | –                          | –                                    | Temperature measurement of the heat sink in the power stage not possible                                   | Relay K4 picks up,<br>The operator <b>must</b> respond   |
| 109                       | –                          | –                                    | Verify error on data set programming with P004 = 1/2/3/4   | Data set programming was cancelled<br>The system marks the data set as not available   |
| 110                       | –                          | –                                    | Data set programming cancelled due to timeout being exceeded (max. of 5 s with P004 = 1/2/3/4)             | Data set is not transferred and is marked as not available   |

RESET: Hardware reset or switch unit off and back on again

| Error No. | Con-<br>troller<br>Inhibit | Opera-<br>tional<br>Dis-<br>turbance | Description of Error   | Effect/Action  |
|-----------|----------------------------|--------------------------------------|--|--|
| 111       | –                          | –                                    | Boot source entry is invalid   | Selected data set is not available (with P006)   |
| 112       | –                          | –                                    | EEPROM data set was not programmed (data set not saved)                      | Programming not carried out because<br>– drive is not inhibited or<br>– optimization run is selected or<br>– data set is being loaded or<br>– data set is still being programmed |
| 113       | –                          | –                                    | EEPROM data set was not loaded (P008 or P099/4)                              | Data set was not loaded because optimization run is selected, or EEPROM is just being programmed or a previous "Load data set" has not yet been completed                        |
| 114       | –                          | –                                    | Acceleration factor cannot be determined (P081 = 6/P136 = ON)                | Speed change = 0 or acceleration current is less than 1% of the rated current. Set a shorter ramp-up time on the integrator or set the nominal value lower than the basic speed. |
| 115       | –                          | –                                    | Entered maximum speed (P142) for selected rotary encoder (P143) is too high. | Power converter limited the input value of parameter P142.   |

## 9.4 Spares

### 9.4.1 Modules and Complete Units

Power converters BKF12 or BKD6 comprise the following modules:

|   |  |
|---|--|
| Open- and closed-loop control unit PCB 3.8934.. |  |
| Field supply and mains unit                     | BKF N 400F 400R for 400-V connection voltage<br>Field XX.A<br>or<br>BKF N 500F 500R for 500-V connection voltage<br>Field XX.A |
| Power stage                                     | No. 933 14 765 J (example)   |
| Housing and assembly parts                      |  |

Simply stating the module is not enough to ensure that the correct spares are delivered!

You must therefore state in addition:

the machine manufacturer

the type designation and the serial number of the power converter

You can find this information on the rating plate on the inside of the housing

Example of a rating plate:



For delivery of a complete replacement unit, you only need to state type BKF... or BKD..., the serial number, the desired software version and the amperage of the field device.

### 9.4.2 Replacement boards, Daughterboards and Individual Parts

#### NOTE

In principle, the use of replacement boards is possible but is not without problems if you do not observe the handling regulations for components at risk from electrostatic charges (EGB)!

Boards for power converters BKF or BKD:

|                                    |            |
|------------------------------------|------------|
| Open- and closed-loop control unit | PCB 3.8934 |
| Field supply XX.A                  | PCB 3.8942 |

the latest version of the board is always supplied

Individual parts for power converters BKF or BKD:

|   |                                   |
|---|-----------------------------------|
| Current converter                               | See technical data of power stage |
| Fan   | See technical data of power stage |
| Fuses   | See semiconductor fuses           |
| Cover plate for closed-loop control subassembly | Order no. 319009335               |
| Cover plate for power stage                     | Order no. 319009336               |
| 2-pin sub-unit terminal                         | Order no. 319012811               |
| 8-pin sub-unit terminal                         | Order no. 319012809               |
| 12-pin sub-unit terminal                        | Order no. 319009064               |

Add-on boards for power converters BKF or BKD:

|  |            |
|--|------------|
| Input/output expansion                                   | PCB 3.9217 |
| Dual DAC 12  | PCB 3.9201 |
| InterBus-S   | PCB 3.9208 |
| RS232 and RS485 interfaces                               | PCB 3.8947 |
| RS485 interface for CS31 system bus or with USS protocol | PCB 3.9493 |

Accessories for add-on boards:

|  |                    |
|--|--------------------|
| Spacer bolt  | Order no. 19009808 |
| Cover plate for open- and closed-loop control unit | Order no. 19009339 |
| 64-pin ribbon cable                                | Order no. 19017794 |

Simply stating the module is not enough to ensure that the correct spares are delivered!

You must therefore state in addition:

the machine manufacturer

the type designation and the serial number of the power converter

You can find this information on the rating plate on the inside of the housing

**9.5 Disposal**

For the most part, the equipment consists of the following components and materials:

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

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

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

In case of fire, dangerous compounds may result or hazardous materials may be released.

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



## 10 APPENDIX

### 10.1 Complementary Documentation

As of 09/95

| Title  | Document No. | Edition Dated |
|--|--------------|---------------|
| Regelbare Antriebssysteme, Steuerungen, Dienstleistungen 1995  | 2.095        | 01/95         |
| EMV-Applikation für Umrichterantriebe  | 5.95098.01   | 03/95         |
| Technische Beschreibung InterBus-S für BKF/BKD Serie 6000  | 5.93011.01   | 05/93         |
| Technische Beschreibung Schnittstellenkarte RS232 / RS485 zum BKF/BKD Serie 6000                       | 5.93013.01   | 08/93         |
| Technische Beschreibung Schnittstellenkarte RS485 als CS31-Systembusanschaltung für BKF/BKD Serie 6000 | 5.95078.01   | 09/95         |
| Technische Beschreibung Schnittstellenkarte RS485 mit USS-Protokoll für BKF/BKD Serie 6000             | 5.95223.01   | 09/95         |
| Technische Beschreibung Netzfilter für Baumüller Leistungselektronik BFN                               | 5.95237.01   | 10/95         |

## 10.2 Manufacturer Declaration

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

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

**Specification of the machine component:**

**Type:**

Built-in Power Converter for Conversion and Inversion

BKF 12/.../...–6.....

BKD 6/.../...–6.....

Date/Signature of the Manufacturer:



---

Information regarding the Undersigned:

Head Division Electronics



10.3 Declaration of Conformity

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

**Specification of the machine component:**

**Type:**

Built-in Power Converter for Conversion and Inversion

BKF 12/.../...-6.....

BKD 6/.../...-6.....

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

pr EN 50178: 1994 (VDE 0160/11.94)

"Equipment of power installation concerned electronic operating materials"

Nürnberg, 10. January 1996

Signature of the Manufacturer



Dr.-Ing. P. Kreisfeld

Head Division Electronics



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

CE-Agent Electronic

## 10.4 Conditions of Business and Delivery

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

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