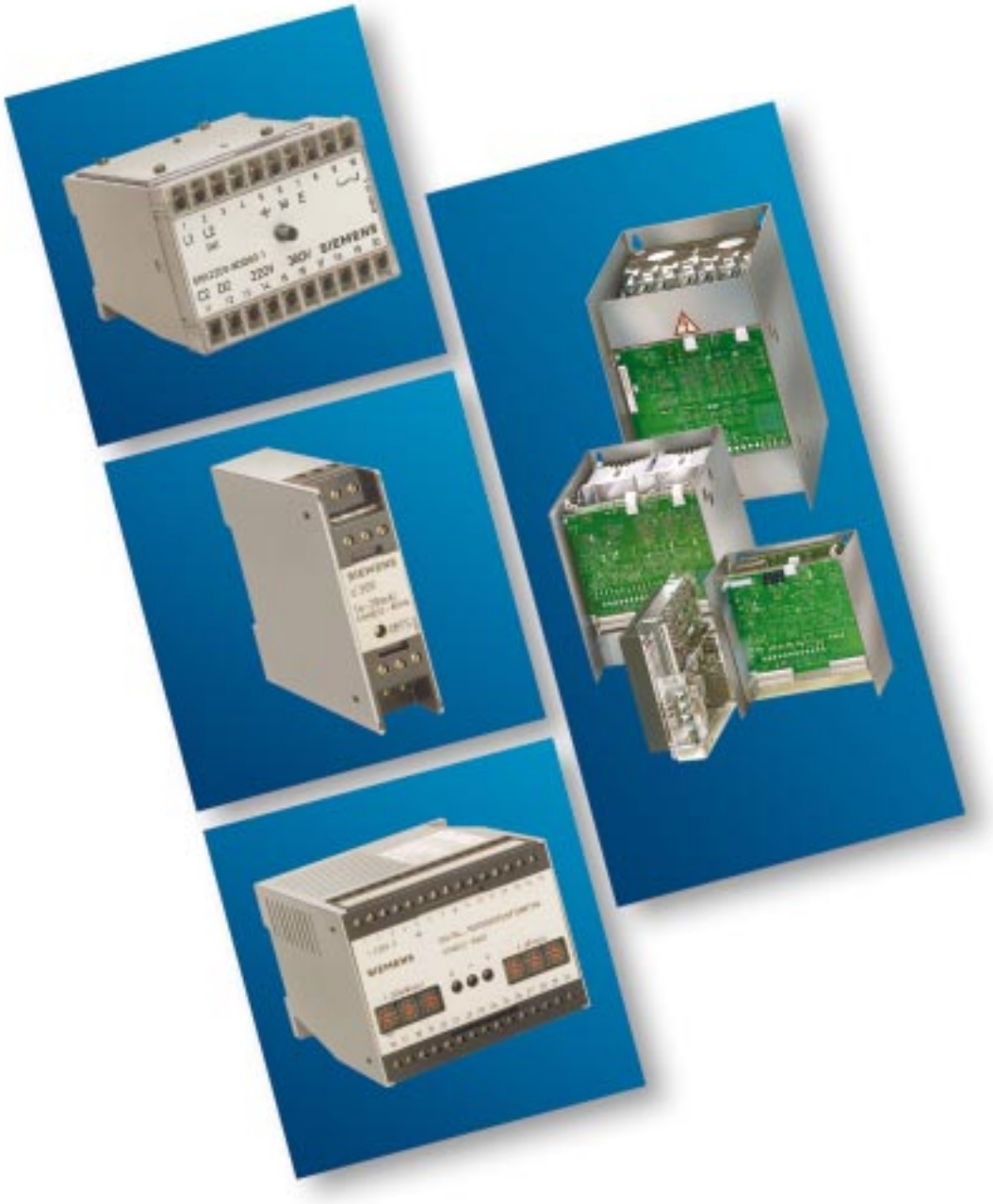
SIEMENS

DC DRIVES

# SIMOREG K 6RA22
# Analog Chassis Converters

## Catalog DA 21.2 · 2001



## Catalogs for "Large Drives"

**DC Motors** — DA 12

Order No.:
German: E20002-K4012-A101-A2
English: E20002-K4012-A101-A2-7600

---

**DC Motors**
**1GG7, 1GH7, 1HS7 and 1HQ7** — DA 12 Supplement July 2001

Order No.:
German: E86060-K5112-E101-A1
English: E86060-K5112-E101-A1-7600

---

**DC Drives**
**Preferred Series up to 500 kW** — DA 12.1

Order No.:
German: E20002-K4012-A111-A2
English: E20002-K4012-A111-A2-7600

---

**DC Drives**
**Preferred Series 215 kW to 1500 kW** — DA 12.2

Order No.:
German: E20002-K4012-A121-A1
English: E20002-K4012-A121-A1-7600

---

**SIMOREG 6RA70 DC MASTER**
**Digital Chassis Converters** — DA 21.1

Order No.:
German: E86060-K5121-A111-A1
English: E86060-K5121-A111-A1-7600

---

**SIMOREG 6RA22 Analog Chassis Converters** — DA 21.2

Order No.:
German: E86060-K4021-A121-A1
English: E86060-K4021-A121-A1-7600

---

**Spare Parts for SIMOREG**
**Converters (Chassis Units)** — DA 21 E

Order No.:
German: E20002-K4021-A900-A4
English: E20002-K4021-A900-A4-7600

---

**SIMOREG Static Converter Cabinets** — DA 22

Order No.:
German: E20002-K4022-A101-A3
English: E20002-K4022-A101-A3-7600

---

**Automation and**
**Drives** — CA 01

Order No.:
German: E86060-D4001-A100-B5
English: E86060-D4001-A110-B4-7600

---

## Internet

Visit Siemens Automation and Drives Group on the Internet at ***http://www.siemens.de/automation***

SIEMENS

# SIMOREG K 6RA22

## Analog Chassis Converters

Catalog DA 21.2 · 2001

Supersedes: Catalog DA 21 · 1998

**Note!**

The technical data is intended for general information.
Please observe the Operating Instructions and the references indicated on the products for installation, operation and maintenance.

® SIMOREG and SITOR are Siemens registered trademarks.
All other products and systems names in this catalog are (registered) trademarks of their respective owners and must be treated accordingly.

- The technical data, selection and ordering data (Order Nos.), accessories and availability are subject to alteration.
- All dimensions in this catalog are stated in mm.

# SIMOREG K
# Chassis
# Converters 6RA22

## Design and mode of operation

### *Applications*

6RA22 SIMOREG K converters for single-phase or three-phase input are used for the armature supply of shunt-wound DC motors. Even in the basic version, 6RA22 converters have several technological functions, such as:

- a ramp-function generator,
- a limit monitor,
- armature voltage actual value sensing with (I x *R*) compensation for units in B2HK and B6C connections (i.e. the tacho-generator is not required),
- an automatic electronic switch-on/off circuit for units in (B2)A(B2)C, (B6)A(B6)C connections,
- for units in (B2)A(B2)C, (B6)A(B6)C connections, additional inputs and outputs are routed to a matrix board for customized circuits.

Function options provide additional advantages, such as:

- separately adjustable P gain and integral action time for the speed controller,
- supplementary current setpoint incorporated in the current limiting,
- speed actual value adaptation with fine adjustment.

### *Design and mode of operation*

6RA22 SIMOREG K converters for single-phase input are available in two types of construction. Units with housing are recommended for single-motor drives. Units without housing, installed in a sub-rack, provide a space-saving arrangement where two or more drives are to be combined to form a unit.

### *Power section*

6RA22 SIMOREG K converters for single-phase, single-quadrant drives have B2HK half-controlled, single-phase bridge connections, and 6RA22 SIMOREG K converters for single-phase, four-quadrant drives have a circulating-current-free inverse-parallel connection with two fully controlled single-phase bridge circuits (B2)A(B2)C.

6RA22 SIMOREG K converters for three-phase single-quadrant drives use a fully-controlled three-phase bridge connection B6C; SIMOREG K converters for three-phase, four-quadrant drives in circulating-current-free inverse-parallel connection use two fully controlled three-phase bridge circuits (B6)A(B6)C.

### *Cooling*

6RA22 SIMOREG K converters with rated DC $\leq$ 160 A are designed for natural air cooling, and units with rated DC $\geq$ 240 A for forced air cooling (fan).

### *Field power supply*

For 6RA22 SIMOREG K converters (except for the (B2)A(B2)C connection), a field rectifier in an uncontrolled single-phase bridge circuit B2 is integrated in the unit. When the rectifier is connected to a two-phase 400 V supply voltage, a rated output voltage of 340 V is obtained at terminals C2/D2, and when connected to a two-phase 230 V supply, a rated output voltage of 200 V is obtained. For 6RA22 SIMOREG K converters with (B2)A(B2)C connection, a field supply unit, e.g. the 6RA2200-8DD00 (refer to Section 3 of this Catalog) should be separately ordered and fitted.

Fig. 1/1
Converters in B2HK connection for single-quadrant drives, without enclosure

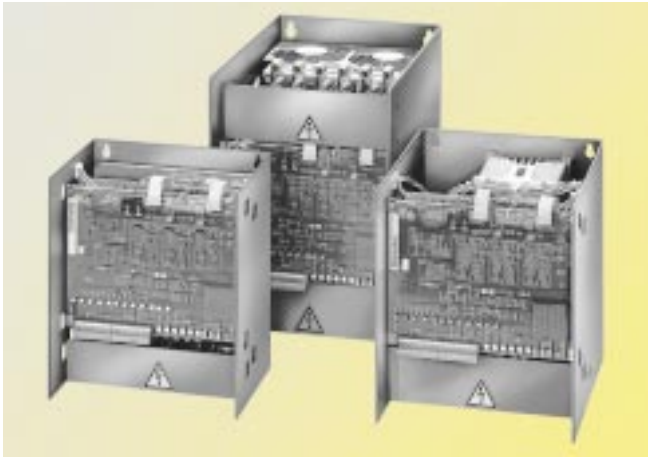


Fig. 1/2
Converters in B6C connection for single-quadrant drives, with enclosure

### *Power supply*

The power supply of the 6RA22 SIMOREG K converter provides the following:

- Unregulated ±24 V voltages for the trigger pulses and relays;
- regulated ±15 V voltages for the controllers and internal signal processing (external ±50 mA max.);
- regulated ±10 V voltages as reference voltages (e.g. for the setpoints; external ±10 mA).

The power supply transformer input for converters in B2HK connection is taken directly from the incoming supply (terminals U1, V1). Depending on the supply voltage (two-phase 400 V or two-phase 230 V), a jumper must be changed at the input of the power supply transformer. Converters in (B2)A(B2)C connection have separate supply terminals for the power supply transformer and the power section. Here too, either the two-phase 400 V or two-phase 230 V can be connected. Converters in B6C and (B6)A(B6)C connection are connected to three-phase 400 V through separate power supply terminals.

The supply voltages for the controllers (±15 V) are regulated with an accuracy of approx. 1%, and the reference voltages (±10 V) with an accuracy of 1‰ so that essentially only the speed actual value sensing values are decisive (DC tacho-generator).

### *Functions of the open-loop and closed-loop control for converters in B2HK and B6C connections*

Ramp-function generator

In response to a step-change in input voltage (external speed setpoint), the ramp-function generator limits the rate of change of the speed setpoint fed to the speed controller to a technologically permissible value for the drive. Ramp-up and ramp-down times are adjustable via a potentiometer. The setting range of the potentiometer can, if necessary, be adapted to other conditions by changing a capacitor.

Speed controller

The speed controller has three inputs:

- The speed actual value can either be supplied from the integral armature voltage actual value sensing with ($I$ x $R$) compensation or from a DC tacho-generator. The actual value voltage is adapted and the maximum speed set using two potentiometers for coarse and fine adjustment.
- The speed setpoint is either supplied from the integral ramp-function generator or directly via a terminal.
- A supplementary speed setpoint can be fed to the speed controller either directly via a terminal or via an adjustment potentiometer (e.g. compensator roll controller) or from the internal current actual value and potentiometer V (for ($I$ x $R$) compensation for EMF control without tacho-generator).

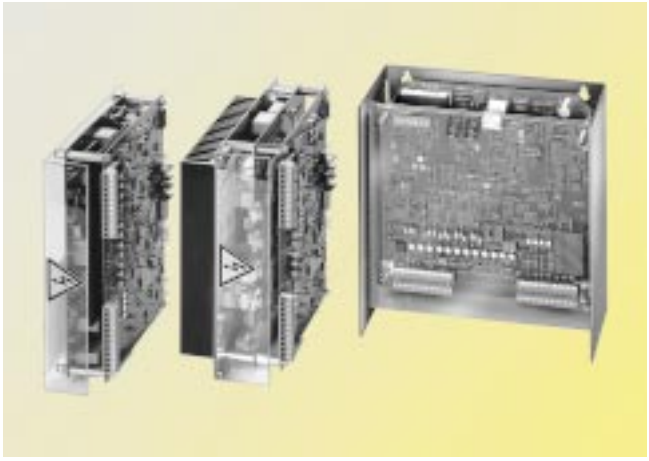


Fig. 1/3
Converters in (B2)A(B2)C connection for four-quadrant drives

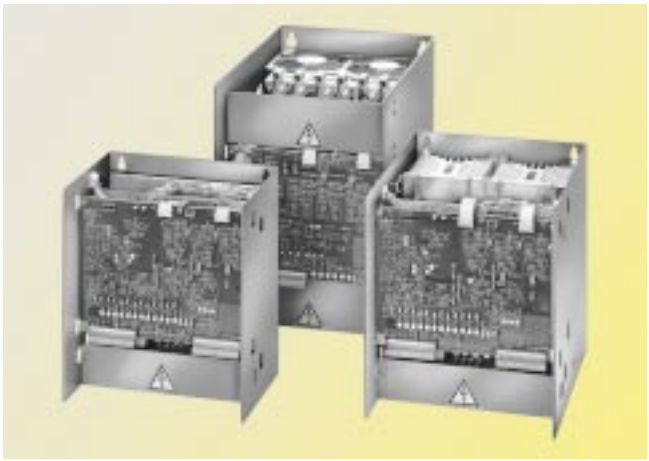


Fig. 1/4
Converters in (B6)A(B6)C connection for four-quadrant drives, with enclosure

The speed controller has separate amplifiers for the P and I components. The P gain and I component can be adjusted separately, and thus very easily at start-up.

A supplementary setpoint, preset via a terminal, can be added to the speed controller output value (current setpoint) via a summing amplifier connected after the speed controller.

The output value (current setpoint + supplementary current setpoint) is limited by a limiting controller (current limiting). Current limiting is internally set to a maximum value (the maximum being the converter's rated DC) and can be externally set to lower values via a terminal.

## Design and mode of operation

Current controller

The current controller is configured as a PI controller with gain and integral-action time designed for armature supply. The feedback can be adapted by soldering-in other components.

The current controller's output voltage is limited by two limiting controllers to values corresponding to the maximum and minimum converter firing-angle setting.

The current actual value is sensed with a current transformer and is fed to the current controller with electrical isolation. The current setpoint is supplied from the speed controller.

Trigger unit

The trigger unit generates the control pulses for triggering the thyristors, according to the output voltage of the current controller. The trigger unit automatically adapts itself to different supply frequencies or supply frequencies which change over the range 45 to 65 Hz during operation.

Automatic switch-on circuit and controller enable for units in the B2HK connection

When the converter has been switched on, the automatic switch-on circuit only enables operation when the power supply has established its voltages and the controllers are enabled.

Controller enable can be initiated immediately with the enable signal by the automatic switch-on circuit (terminals 8/20 jumpered) or in accordance with other operating states (terminals 8 and 20 connected via an enable contact).

Converters in B6C connection have a switch-on control as described for units in (B2)A(B2)C or (B6)A(B6)C.

Limit monitor

The limit monitor serves to detect whether a value has dropped below or exceeded a speed or current setpoint. In the basic configuration, a speed dropping below about 5% of the rated speed is signaled (0 V at terminal 14). The response value can be adapted by changing a resistor or by setting a potentiometer (for units in B6C connection).

Operating state display

The following operating states are indicated by LEDs:

- Converter is switched on.
- Controllers are enabled.
- Limit monitor has responded.

### *Functions of open-loop and closed-loop control for converters in (B2)A(B2)C or (B6)A(B6)C connections*

Ramp-function generator

The ramp-function generator responds to a step-change in input voltage (external speed setpoint) by limiting the rate of change of the speed setpoint fed to the speed controller to a technologically permissible value for the drive. Ramp-up and ramp-down times are adjustable via two potentiometers independently of each other, over the range 2 to 30 s. The setting range can be adapted to other conditions, if necessary, by changing a capacitor.

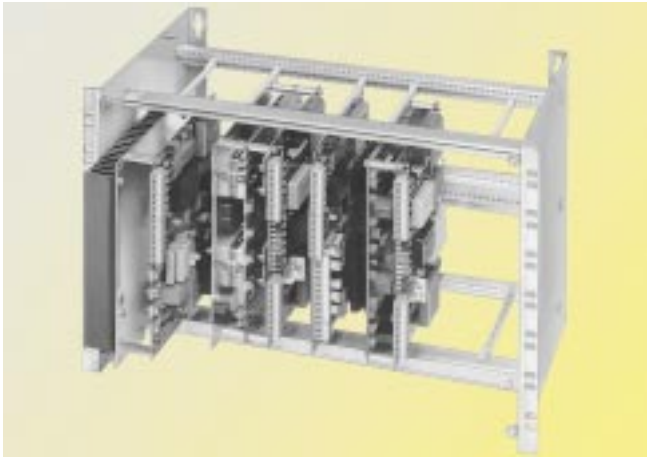


Fig. 1/5
6DM9005 subrack equipped with 6RA22 SIMOREG K converters without enclosure

Speed controller

The speed controller has three inputs:

- The speed actual value is supplied from a DC tacho-generator. The actual value voltage is adapted and the maximum speed set by means of two potentiometers for coarse and fine adjustment.
- The speed setpoint is supplied either from the integral ramp-function generator or through a free input and the matrix board.
- A supplementary speed setpoint can be fed in via a free input and the matrix board.

The speed controller is configured with separate amplifiers for the P and I components. The P gain and I component can be adjusted separately, and thus very easily at start-up.

A supplementary current setpoint, preset via a free input and the matrix board, can be added to the output value of the speed controller (current setpoint) via a summing amplifier connected after the speed controller. The output value (current setpoint + supplementary current setpoint) is limited in the positive and negative directions by two limiting controllers (current limiting). The current limiting is internally set to a maximum value (the maximum being the rated DC). Lower values can be set externally by providing a suitable circuit on the matrix board, and by feeding in via a free (low-resistance) output terminal.

Current controller

The current controller has very high-grade dynamic performance with the following functions:

- Trigger unit feed-forward control with
- PI control with corrective intervention
- Current-dependent stability limit changeover.

The controller can be optimized without measuring instruments, using only the integral LEDs.

The PI controller feedback is designed for armature supply. It can be adapted to other applications by soldering-in other components.

The output voltage of the current controller is limited by two limiting controllers to values corresponding to the maximum and minimum firing-angle setting of the converter.

The current actual value is sensed via an AC current transformer (with series-connected rectifier and load resistor) and fed to the current controller. The current setpoint is supplied by the speed controller.

The trigger unit and auto-reverse stage

The trigger unit generates the control pulses for triggering the thyristors, according to the output voltage of the current controller. By means of the auto-reverse stage, the trigger pulses are fed, according to the required torque direction, to the thyristors associated with the required current direction via pulse amplifiers and the transformer section. The trigger unit automatically adapts itself to different supply frequencies, or supply frequencies which change over the range 45 to 65 Hz during operation.

The auto-reverse stage, together with the current controller and trigger unit, reverses the current direction when the current setpoint polarity changes (torque direction), by logically processing the conditions.

Automatic switch-on and switch-off circuit

The automatic switch-on and switch-off circuit assumes the function of an external interlock comprising an IC system, relays or contactors.

After the switch-on command and after the power supply voltages have developed, the power contactor is switched-in through a relay integrated in the converter, and operation is enabled after a checkback signal and an optional, additional external controller enable signal.

After the switch-off command, the current is first reduced by shifting the trigger pulses to the inverter stability limit and the power contactor is then switched off when the current is zero.

Limit monitor

The limit monitor can be used to detect whether a value has dropped below or exceeded a speed or current setpoint. Responding of the limit monitor is indicated by an LED. The response value can be set on a potentiometer. The output of the limit monitor can also optionally be set to setpoint/actual value monitoring by changing a plug-in jumper (refer to "Setpoint/actual value monitoring and fault signal").

The basic configuration is such that a signal is output when a speed drops below about 5% of the rated speed (P24 at terminal 14). If the speed is not reached, an L signal is output at terminal 14.

Setpoint/actual value monitoring and fault signal

In their basic configuration, the converters have a stall protection function which responds if a long-term speed setpoint/actual value deviation occurs. The protective function can only be practically used in conjunction with the ramp-function generator. However, the protective function can be changed over to a setpoint/actual value signal by removing a diode.

The output signal of the limit monitor can also be set to setpoint/actual value monitoring and used for a protective function (controller inhibit) by changing over a plug-in jumper.

Any fault signal from the protective function is stored and indicated by an LED. It can only be acknowledged and cleared by pressing a button.

Freely usable functions and mounting locations

Required supplementary functions can be created in the converter, to a limited extent, by using these facilities.

Four inputs and four outputs, each routed via terminals, as well as two inputs with switching function, are available. The inputs are equipped with resistors and capacitors for use as analog inputs. The outputs are routed via an RC circuit for noise suppression. The inputs with switching function each transfer an external electronic or contact switching signal in a floating arrangement through an optocoupler.

All signals are fed to a matrix board on which the required supplementary functions can be established. Various values from the power supply and closed-loop control are also fed to the matrix board.

## Technical data

| Order No. | | 6RA22..-8DD21-. | | | | 6RA22..-8DD21-. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 03 | 11 | 16 | 21 | 03 | 11 | 16 | 21 |
| **Converters for single-phase connection and single-quadrant operation (B2HK)** | | | | | | | | | |
| Rated supply voltage [3] | V | 2-ph. 230 (+10%/-10%) | | | | 2-ph. 400 (+10%/-10%) | | | |
| Rated frequency | | Automatic adaptation 45 to 65 Hz | | | | | | | |
| Rated DC voltage | V | 180 | | | | 315 | | | |
| Rated direct current | A | 5 | 12 | 22 | 40 | 5 | 12 | 22 | 40 |
| Rated output | kW | 0.9 | 2.2 | 4.0 | 7.2 | 1.6 | 3.8 | 6.9 | 12.6 |
| Power loss at rated direct current (approx.) | W | 30 | 50 | 80 | 135 | 30 | 50 | 80 | 135 |
| Rated supply voltage, field | V | max. 2-ph. 400 V (+10%) at U2-V2 | | | | | | | |
| Rated DC voltage, field | V | 340 | | | | | | | |
| Rated current, field | A | 1.5 | 1.5 | 5.0 | 5.0 | 1.5 | 1.5 | 5.0 | 5.0 |
| Ambient in-service temperature [5] | ° C | 0 to 45° at rated DC | | | | | | | |
| Temperature during storage and transportation | ° C | -30 to +85 | | | | | | | |
| Site altitude above sea level [6] | m | ≤ 1 000 at rated DC | | | | | | | |
| Control stability [4] | | 0.1% of rated speed | | | | | | | |
| Humidity rating DIN 40 040, SN 26 556 | | F | | | | | | | |
| Degree of protection DIN 40 050, IEC 144 | | IP 00 | | | | | | | |
| Dimensions | | See dimension drawings | | | | | | | |
| Weight (approx.) [1] | kg | 2.2 | 2.2 | 2.8 | 4.4 | 2.2 | 2.2 | 2.8 | 4.4 |
| Weight (approx.) [2] | kg | 1.25 | 1.25 | 1.6 | 3.6 | 1.25 | 1.25 | 1.6 | 3.6 |
| Mounting width (basic grid dimension) [2] | | 22 | 22 | 36 | 50 | 22 | 22 | 36 | 50 |

1) For converters with enclosure: 6RA22..-8DD21-1

2) For draw-out converters: 6RA22..-8DD21-0

3) The rated output voltage for the armature and field circuits is reached at 5% undervoltage in the line-side supply. If the rated input voltage value is present, the output voltage value will be 5% higher. If the undervoltage is more than 5%, the output voltage must be reduced linearly.

4) Conditions:
The control stability is referred to the rated motor speed and applies to SIMOREG K units at operating temperature.

The following conditions apply:

- Temperature fluctuations of ±10 ° K
- Line voltage fluctuations of +10% -5% of rated supply voltage
- Load fluctuations of up to 100% of maximum torque
- Temperature coefficient of temperature-compensated tacho-generator 0.15‰ per 10 ° K
- Constant setpoint

5) Load values as a function of coolant temperature

| Ambient or coolant temperature | Derating in units with natural air cooling |
|---|---|
| +35° C | |
| +40° C | |
| +45° C | 0% |
| +50° C | -6% |
| +55° C | -11% |
| +60° C | -18% |

6) Load values as a function of site altitude

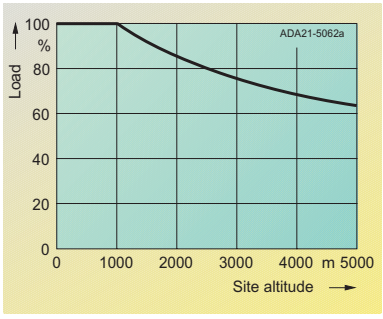



Fig. 1/6

| Order No. | | 6RA22..-8DK27-.. | | | | 6RA22..-8DK27-.. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 03 | 11 | 16 | 21 | 03 | 11 | 16 | 21 |
| **Converters for single-phase connection and four-quadrant operation (B2)A(B2)C** | | | | | | | | | |
| Rated supply voltage [3] | V | 2-ph. 230 (+10%/-10%) | | | | 2-ph. 400 (+10%/-10%) | | | |
| Rated frequency | | Automatic adaptation 45 to 65 Hz | | | | | | | |
| Rated DC voltage | V | 150 | | | | 260 | | | |
| Rated direct current | A | 5 | 12 | 22 | 40 | 5 | 12 | 22 | 40 |
| Rated output | kW | 0.75 | 1.8 | 3.3 | 6 | 1.3 | 3.1 | 5.7 | 10.4 |
| Power loss at rated direct current (approx.) | W | 35 | 60 | 85 | 140 | 35 | 60 | 85 | 140 |
| Current input, terminals U2-V2 | mA | 80 | | | | | | | |
| Ambient in-service temperature [5] | °C | 0 to 45 | | | | | | | |
| Temperature during storage and transportation | °C | -30 to +85 | | | | | | | |
| Site altitude above sea level [6] | m | ≤ 1 000 at rated DC | | | | | | | |
| Control stability [4] | | 0.1% of rated speed | | | | | | | |
| Humidity rating DIN 40 040, SN 26 556 | | F | | | | | | | |
| Degree of protection DIN 40 050, IEC 144 | | IP 00 | | | | | | | |
| Dimensions | | See dimension drawings | | | | | | | |
| Weight (approx.) [1] | kg | 2.8 | 2.8 | 3.1 | 5.4 | 2.8 | 2.8 | 3.1 | 5.4 |
| Weight (approx.) [2] | kg | 1.8 | 1.8 | 2.1 | 4.1 | 1.8 | 1.8 | 2.1 | 4.1 |
| Number of required slots [2] | | 22 | 22 | 52 | 66 | 22 | 22 | 52 | 66 |

1) For converters with enclosure: 6RA22..-8DK27-1

2) For draw-out converters: 6RA22..-8DK27-0

3) The rated output voltage for the armature and field circuits is reached at 5% undervoltage in the line-side supply. If the rated input voltage value is present, the output voltage value will be 5% higher. If the undervoltage is more than 5%, the output voltage must be reduced linearly.

4) Conditions:
The control stability is referred to the rated motor speed and applies to SIMOREG K units at operating temperature.

The following conditions apply:

- Temperature fluctuations of ±10 ° K
- Line voltage fluctuations of +10% -5% of rated supply voltage
- Load fluctuations of up to 100% of maximum torque
- Temperature coefficient of temperature-compensated tacho-generator 0.15‰ per 10 ° K
- Constant setpoint

5) Load values as a function of coolant temperature

| Ambient or coolant temperature | Derating in units with natural air cooling |
|---|---|
| +35° C | |
| +40° C | |
| +45° C | 0% |
| +50° C | -6% |
| +55° C | -11% |
| +60° C | -18% |

6) Load values as a function of site altitude

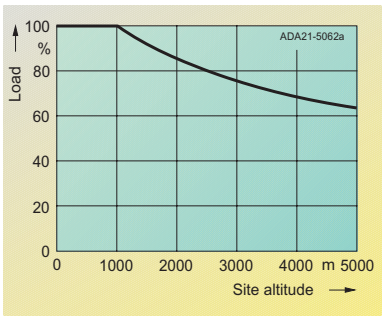



Fig. 1/7

## Technical data

| Order No. | | 6RA22..-8DS31 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 20 | 23 | 26 | 30 | 32 | 33 | 76 | 80 | 83 |
| **Converters for three-phase connection and single-quadrant operation (B6C)** | | | | | | | | | | |
| Rated supply voltage Power [1] | V | 3-ph. 400 (+10%/-15%) | | | | | | | | |
| Rated supply voltage Electronics power supply | V | 3-ph. 400 (+35%/-20% ), 40 mA | | | | | | | | |
| Rated supply voltage Fan | V | | | | | | | 2-ph. 230 (+10% / -10%) 0.12 A Air flow rate 160 m³/h | | 2-ph. 230 (+10%/ -10%) 0.24 A 320 m³/h |
| Rated supply voltage, field | V | 2-ph. max. 400 (+35%) | | | | | | | | |
| Rated frequency | Hz | Automatic adaptation 45 to 65 | | | | | | | | |
| Rated DC voltage | V | 485 | | | | | | | | |
| Rated direct current | A | 35 | 50 | 70 | 110 | 130 | 160 | 240 | 350 | 500 |
| Rated output | kW | 17 | 24 | 34 | 53 | 63 | 78 | 116 | 170 | 242 |
| Power loss at rated direct current (approx.) | W | 130 | 170 | 230 | 350 | 410 | 500 | 760 | 1 100 | 1 580 |
| Rated DC voltage, field | V | 340 | | | | | | | | |
| Rated direct current, field | A | 8 | 8 | 8 | 8 | 8 | 8 | 15 | 15 | 15 |
| Ambient in-service temperature [3] | °C | 0 to 45 at rated DC, natural air cooling | | | | | | 0 to 35 at rated DC, forced-air cooling | | |
| Temperature during storage and transportation | °C | -30 to +85 | | | | | | | | |
| Site altitude above sea level [4] | m | ≤ 1 000 at rated DC | | | | | | | | |
| Control stability [2] | | $\Delta n$ = 0.1% of rated speed | | | | | | | | |
| Humidity rating DIN 40 040, SN 26 556 | | F | | | | | | | | |
| Degree of protection DIN 40 050, IEC 144 | | IP 00 | | | | | | | | |
| Dimensions | | See dimension drawings | | | | | | | | |
| Weight (approx.) | kg | 4.4 | 4.4 | 6.5 | 10.3 | 10.8 | 12.4 | 22.2 | 24 | 30 |

1) The rated output voltage for the armature and field circuits is reached at 5% undervoltage in the line-side supply. If the rated input voltage value is present, the output voltage value will be 5% higher. If the undervoltage is more than 5%, the output voltage must be reduced linearly.

2) Conditions:
The control stability is referred to the rated motor speed and applies to SIMOREG K units at operating temperature.

The following conditions apply:

- Temperature fluctuations of ±10 ° K
- Line voltage fluctuations of +10% -5% of rated supply voltage
- Load fluctuations of up to 100% of maximum torque
- Temperature coefficient of temperature-compensated tacho-generator 0.15‰ per 10 ° K
- Constant setpoint

3) Load values as a function of coolant temperature

| Ambient or coolant temperature | Derating in units with natural air cooling | Derating in units with forced – air cooling |
|---|---|---|
| +35° C | | 0% |
| +40° C | | -6% |
| +45° C | 0% | -12% |
| +50° C | -6% | -17% |
| +55° C | -11% | |
| +60° C | -18% | |

4) Load values as a function of site altitude

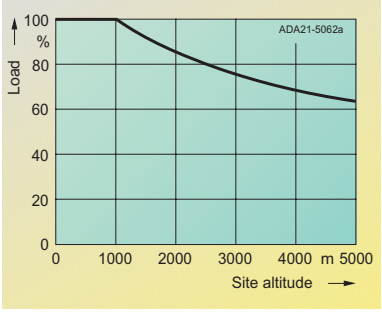



Fig. 1/8

| Order No. | | 6RA22..-8DV71 20 | 23 | 26 | 30 | 32 | 33 | 76 | 80 | 83 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Converters for three-phase connection and four-quadrant operation (B6)A(B6)C)** | | | | | | | | | | |
| Rated supply voltage Power [1] | V | 3-ph. 400 (+15%/-10%) | | | | | | | | |
| Rated supply voltage Electronics power supply | V | 3-ph. 400 (+35%/-20% ), 40 mA | | | | | | | | |
| Rated supply voltage Fan | V | | | | | | | 2-ph. 230 (+10%/-10%) 0.24 A Air flow rate 320 $m^3/h$ | | |
| Rated supply voltage, field | V | 2-ph. max. 400 (+35%) | | | | | | | | |
| Rated frequency | Hz | Automatic adaptation 45 to 65 | | | | | | | | |
| Rated DC voltage | V | 420 | | | | | | | | |
| Rated direct current | A | 35 | 50 | 70 | 110 | 130 | 160 | 240 | 350 | 500 |
| Rated output | kW | 14.7 | 21 | 29 | 46 | 55 | 67 | 100 | 147 | 210 |
| Power loss at rated direct current (approx.) | W | 130 | 170 | 230 | 350 | 410 | 500 | 780 | 1 130 | 1 580 |
| Rated DC voltage, field | V | 340 | | | | | | | | |
| Rated direct current, field | A | 8 | 8 | 8 | 8 | 8 | 8 | 15 | 15 | 15 |
| Ambient in-service temperature [3] | °C | 0 to 45 at rated DC, natural air cooling | | | | | | 0 to 35 at rated DC, forced-air cooling | | |
| Temperature during storage and transportation | °C | -30 to +85 | | | | | | | | |
| Site altitude above sea level [4] | m | ≤ 1 000 at rated DC | | | | | | | | |
| Control stability [2] | | $\Delta n$ = 0.1% of rated speed | | | | | | | | |
| Humidity rating DIN 40 040, SN 26 556 | | F | | | | | | | | |
| Degree of protection DIN 40 050, IEC 144 | | IP 00 | | | | | | | | |
| Dimensions | | See dimension drawings | | | | | | | | |
| Weight (approx.) | kg | 5.4 | 5.4 | 7.3 | 15.4 | 15.9 | 17.5 | 22.2 | 24 | 30 |

1) The rated output voltage for the armature and field circuits is reached at 5% undervoltage in the line-side supply. If the rated input voltage value is present, the output voltage value will be 5% higher. If the undervoltage is more than 5%, the output voltage must be reduced linearly.

2) Conditions:
The control stability is referred to the rated motor speed and applies to SIMOREG K units at operating temperature.

The following conditions apply:

- Temperature fluctuations of ±10 ° K
- Line voltage fluctuations of +10% -5% of rated supply voltage
- Load fluctuations of up to 100% of maximum torque
- Temperature coefficient of temperature-compensated tacho-generator 0.15‰ per 10 ° K
- Constant setpoint

3) Load values as a function of coolant temperature

| Ambient or coolant temperature | Derating in units with natural air cooling | Derating in units with forced – air cooling |
|---|---|---|
| +35° C | | 0% |
| +40° C | | -6% |
| +45° C | 0% | -12% |
| +50° C | -6% | ( -17%) |
| +55° C | -11% | |
| +60° C | -18% | |

4) Load values as a function of site altitude

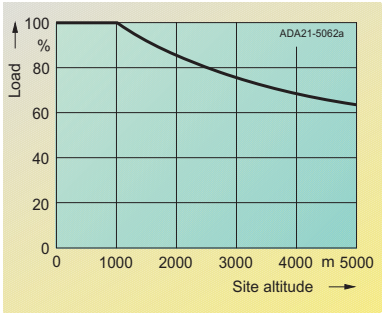



Fig. 1/9

## Block diagrams / Terminal assignment



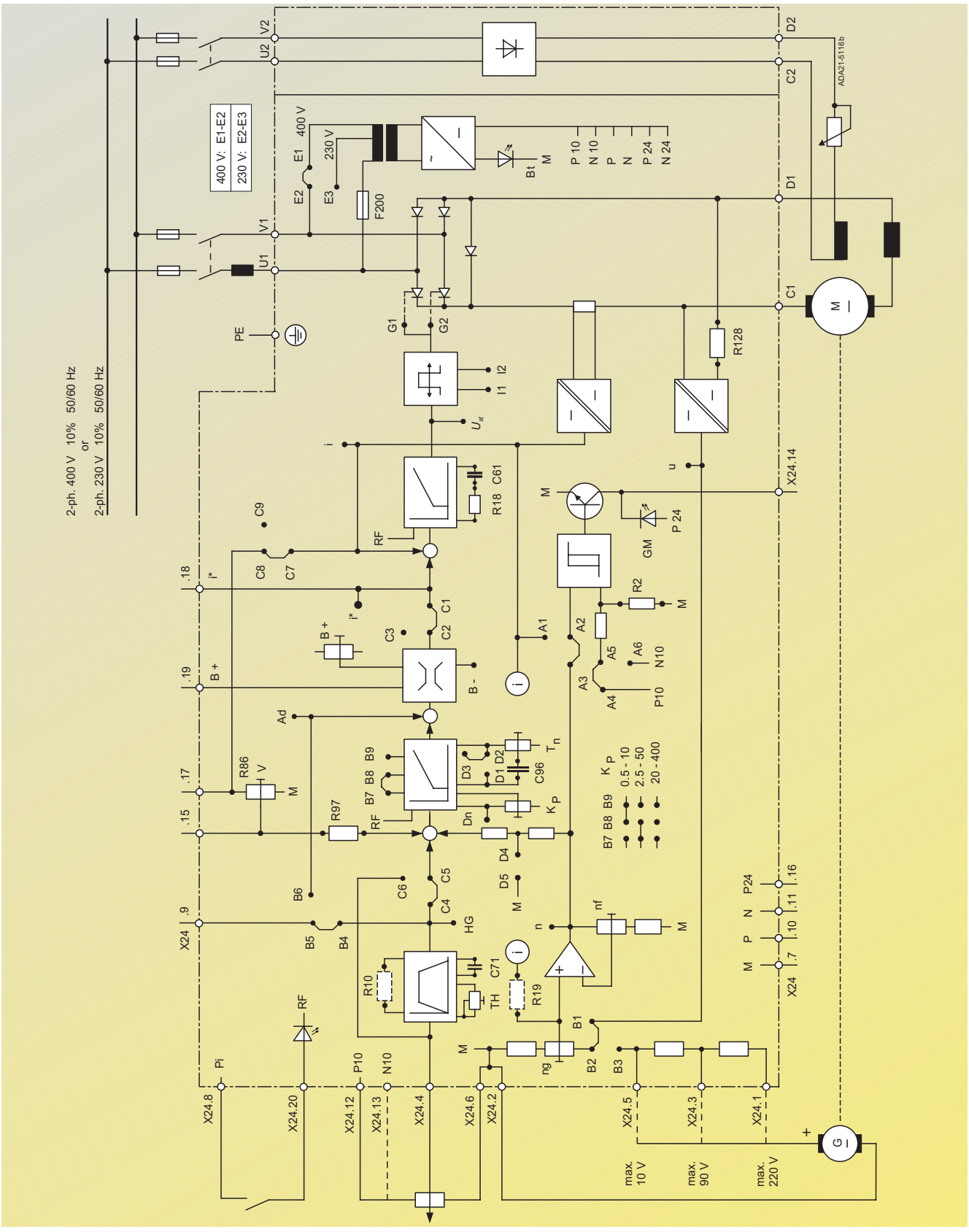



Fig. 1/10
6RA22 SIMOREG K converter in half-controlled, single-phase bridge connection B2HK for single-quadrant drives

| | Function | Terminal | Type | Connection values | Comments |
|---|---|---|---|---|---|
| **Connections of 6RA22 SIMOREG K converters in B2HK connection for single-quadrant drives** | | | | | |
| **Power section** | L1<br>L2 | U1<br>V1 | Input<br>Input | 2-ph. 400 V or<br>2-ph. 230 V | See technical data |
| | +<br>- | C1<br>D1 | Output<br>Output | max. 315 V or 180 V<br>max. 315 V or 180 V | |
| **Field rectifier** | L1<br>L2 | U2<br>V2 | Input<br>Input | 2-ph. 400 V<br>2-ph. 400 V | See technical data |
| | +<br>- | C2<br>D2 | Output<br>Output | 340 V<br>340 V | |
| **Power supply** | L1<br>L2 | –<br>– | –<br>– | 2-ph. 400 V or<br>2-ph. 230 V | Connected internally to terminals U1/V1 of the power section.<br>For 400 V solder jumper E2-E1 closed,<br>for 230 V solder jumper E2-E3 closed. |
| | M<br>P<br>N<br>P24 | 7<br>10<br>11<br>16 | Output<br>Output<br>Output<br>Output | 0 V (M potential)<br>+15 V/50 mA<br>- 15 V/50 mA<br>+24 V/50 mA | Total loading for each polarity: 50 mA |
| | M<br>P10<br>N10 | 6<br>12<br>13 | Output<br>Output<br>Output | 0 V (ref. potential)<br>+10 V/10 mA<br>- 10 V/10 mA | Connection for speed setpoint potentiometer<br>M/P10: with ramp-function generator, jumper C5-C4 closed;<br>M/N10: without ramp-function generator, jumper C5-C6 closed. |
| **Speed controller** | Setpoint | 4 | Input | 0 to +10 V/200 kΩ | Jumper C5-C4 closed: ramp-function generator setpoint input |
| | | 4 | Input | 0 to -10 V/20 kΩ | Jumper C5-C6 closed: speed controller setpoint input |
| | | 9 | Output | 0 to -10 V | Jumper B5-B4 closed: ramp-function generator output (e.g. for 2nd unit) |
| | | 9 | Input | 0 to +10 V | Jumper B5-B6 closed: summing amplifier setpoint input (supplementary current setpoint) |
| | Actual value | 2<br>1<br>3<br>5 | Input<br>Input<br>Input<br>Input | 0 V (ref. potential)<br>80 to 220 V/78 kΩ<br>30 to 90 V/31 kΩ<br>10 to 40 V/13 kΩ | Jumper B2-B3 closed: speed controller actual value input (connection only for speed actual value sensing by tacho-generator) |
| | Ext. current limiting | 19 | Input | 0 to +10 V | Current setpoint + supplementary current setpoint limiting |
| **Current controller** | Setpoint | 18 | Output | 0 to +10 V | Jumper C2-C1 closed: current setpoint from speed controller |
| | | 18 | Input | 0 to +10 V | Jumper C2-C3 closed: external current setpoint |
| **Other functions** | Controller enable (Pi)<br>(Rf) | 8<br>20 | Output<br>Input | +24 V/100 Ω<br>+20 to +30 V/4 mA | Power supply for ext. controller enable<br>Connect to terminal 8 for controller enable |
| | Limit monitor | 14 | Output | Open collector | Jumpers A2-A3 and A5-A4 closed: speed actual value interrogation ($n$ > comparison voltage results in P24 over 2.7 kΩ; jumpers A2-A1 and A5-A6 closed: current actual value interrogation ($i$ > comparison voltage results in M) |
| | Potentiometer R86 | 17 | Input | 0 to -10 V/10 kΩ | Jumper C8-C9 closed: speed controller setpoint input (supplementary speed setpoint) |
| | | 17 | Input | 0 to -10V | Jumper C8-C7 closed: speed controller setpoint input ($I$ x $R$) compensation for EMF control without tacho-generator. |
| | Potentiometer R86 tap | 15 | Output | 0 to -10 V | Jumper C8-C7 closed, resistor R97 removed: current actual value tap |
| | | 15 | Output | 0 to ±10 V/10 kΩ | Jumper C8-C9 closed, resistor R97 removed: potentiometer R86 can be used as required. |

## Block diagrams / Terminal assignment



| Function | Matrix board | Function | Matrix board |
|---|---|---|---|
| **Matrix board assignment for 6RA22 SIMOREG K converters in connection (B2)A(B2)C for four-quadrant drives** | | | |
| Supplementary setpoint input, speed controller | RA1 | Output, free CMOS inverter | RB6 |
| Setpoint filtering, speed controller | RA2 | Input, free CMOS inverter | RB7 |
| Input positive current limit | RA3 | Input, current setpoint to current control loop | RB8 |
| Input negative current limit | RA4 | Input, supplementary current setpoint before current limiting | RB9 |
| Input EMF actual values for EMF precontrol | RA5 | Output n (±10 V) | RB11 |
| Free output via terminal X23.18 (filtered) | RA6 | Output + i (±10 V) | RB13 |
| Free output via terminal X23.17 (filtered) | RA7 | Separate inhibit for ramp-function generator (+15 to +24 V inhibits) | RB15 |
| Free input via 2 x 10 kΩ/10 nF at terminal X23.26 | RA8 | Input, speed setpoint at speed controller | RC1 |
| Free input via 2 x 10 kΩ/10 nF at terminal X23.25 | RA9 | Speed controller output after current limiting | RC3 |
| Free input via 2 x 10 kΩ/10 nF at terminal X23.24 | RA10 | Technology connector X1.7 | RC4 |
| Free input via 2 x 100 kΩ/10 nF at terminal X23.23 | RA11 | Current actual value | RC5 |
| Free FET switch (1) driven via terminal X23.22 | RA12/RA13 | Positive reference voltage +10 V | RD1 |
| Free FET switch (2) driven via terminal X23.21 | RA14/RA15 | Negative reference voltage -10 V | RE1 |
| Free output via 2 x 56 Ω/47 nF at terminal X23.16 | RA 16 | M reference potential 0 V | RF1 |
| Free output via 2 x 56 Ω/47 nF at terminal X23.15 | RA17 | P15 regulated +15 V | RG1 |
| Direct connection to terminal X23.18 | RA18 | N15 regulated -15 V | RH1 |
| Ramp-function generator output | RB1 | Output, fault signal | RM4 |
| Extension input for ramp-function generator | RB3 | Ack. button connection to reset fault signal | RM5/RM6 |
| Technology connector X1.1 | RB4 | Connection to X35.32 | RM8 |
| **Matrix board assignment for SIMOREG K converters in circuit B6C for single-quadrant drives** | | | |
| **Power supply** | | +10 V (P10) | RA4*) |
| | | - 10 V (N10) | RA5*) |
| | | 0 V (M) | RA3*) |
| | | +15 V (P) | RA1*) |
| | | - 15 V (N) | RA2*) |
| **Speed controller** | | Speed setpoint | RA9 |
| | | Speed controller setpoint smoothing | RA13 |
| | | Speed actual value | RA12 |
| | | Ramp-function generator output overdrive amplifier | RA11 |
| | | Controller enable | RA6 |
| | | Current limiting B+ | RA7 |
| | | Current actual value | RA8 |
| | | Extension input, ramp-function generator | RB9 |
| **Other functions** | | Current actual value $V_{actual}$ | RA10 |
| | | Speed actual value decoupled | RH1 |
| | | Supplementary current setpoint | RB11 |
| | | Current actual value decoupled | RR7 |
| | | Input, reset ramp-function generator | RR3 |
| **Matrix board assignment for SIMOREG K converters in circuit (B6)A(B6)C for four-quadrant drives** | | | |
| Selector output terminal X1.18 without smoothing | RA4 | +10 V (P10) | RD1 |
| Selector output terminal X1.18 with smoothing 2 x 50 Ω/47 nF | RA5 | - 10 V (N10) | RE1 |
| Selector output terminal X1.17 with smoothing 2 x 50 Ω/47 nF | RA6 | 0 V (M) | RA1 |
| Selector output terminal X1.16 with smoothing 2 x 50 Ω/47 nF | RA9 | +15 V (P) | RB1 |
| Selector output terminal X1.15 with smoothing 2 x 50 Ω/47 nF | RA10 | - 15 V (N) | RC1 |
| Selector input terminal X1.26 (2 x 10 kΩ/10 nF) | RA7 | Speed setpoints smoothing | RF2 |
| Selector input terminal X1.25 (2 x 10 kΩ/10 nF) | RA8 | Speed actual value | RG2 |
| Selector input terminal X1.24 (2 x 50 kΩ/10 nF) | RA11 | Connection to technology connector (X4.1) | RD2 |
| Selector input terminal X1.23 (2 x 100 kΩ/10 nF) | RA12 | Connection to technology connector (X4.7) | RC2 |
| Free inverter (input) | RB6 | Ramp-function generator supplementary setpoint | RB9 |
| Free inverter (output) | RB7 | Output, speed controller | RB2 |
| Free FET switch (via optocoupler input terminal 21) | RA15, RA16 | Speed supplementary setpoint | RB5 |
| | | Positive current limiting | RE2 |
| Free FET switch (via optocoupler input terminal 22) | RA13, RA14 | Negative current limiting | RB10 |
| | | EMF precontrol external | RA3 |
| Current setpoint | RB4 | Free terminal 27 | RI16 |
| Speed setpoint | RB3 | Free terminal 28 | RK16 |
| Current actual value | RB8 | ± current actual value | RO7 |
| Speed actual value | RH1 | Ramp-function generator | RO3 |
| Ramp-function generator output | RA2 | Fault | RO4 |
| Current supplementary setpoint input | RB11 | Fault acknowledge | RO6 |
| | | Contact for fault acknowledge button | RO5/RO6 |

*) Total loading per polarity: 50 mA

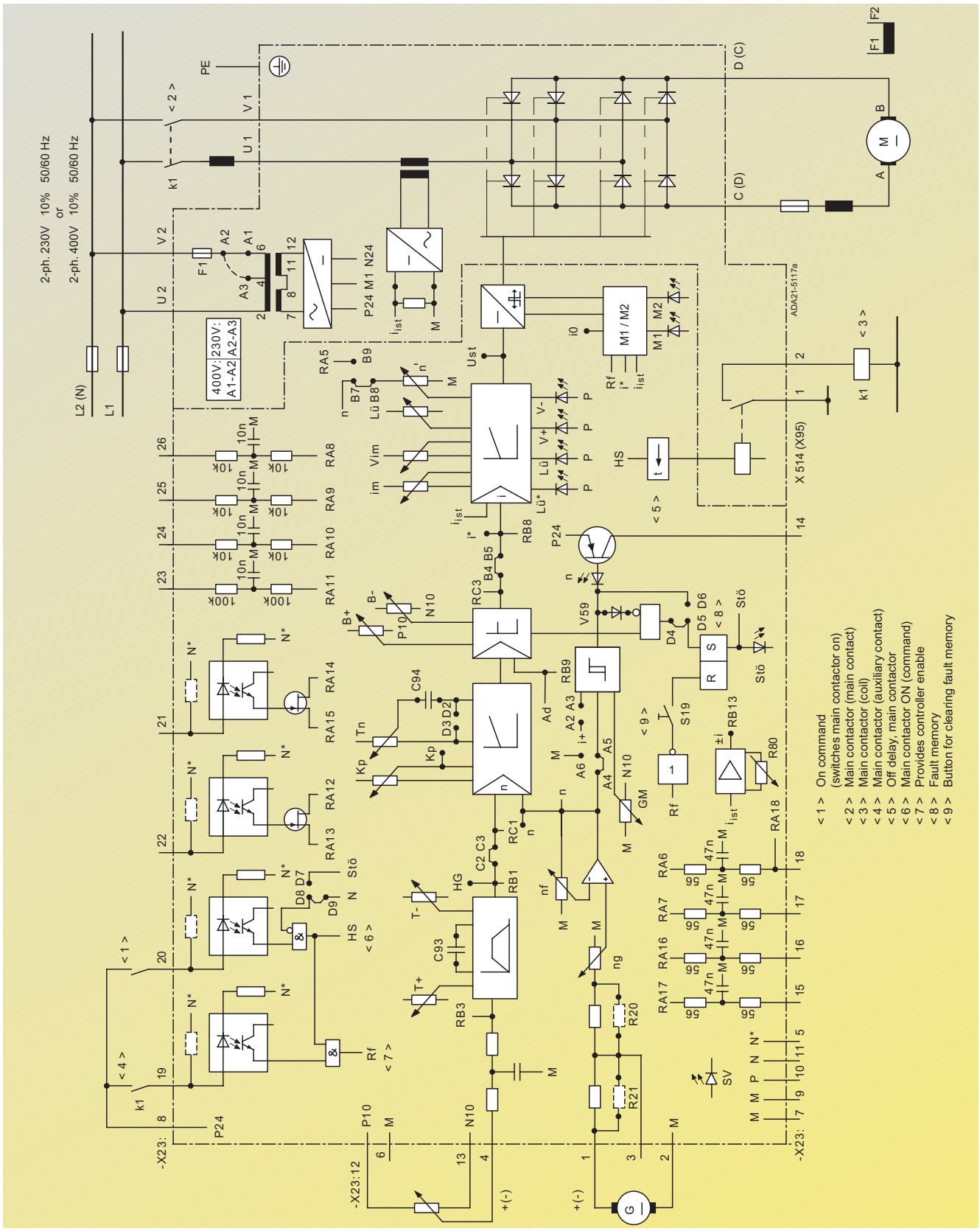



Fig. 1/11
6RA22 SIMOREG K converter in a circulating-current-free inverse-parallel connection using two fully controlled single-phase bridge circuits (B2)A(B2)C for four-quadrant drives

## Block diagrams / Terminal assignment



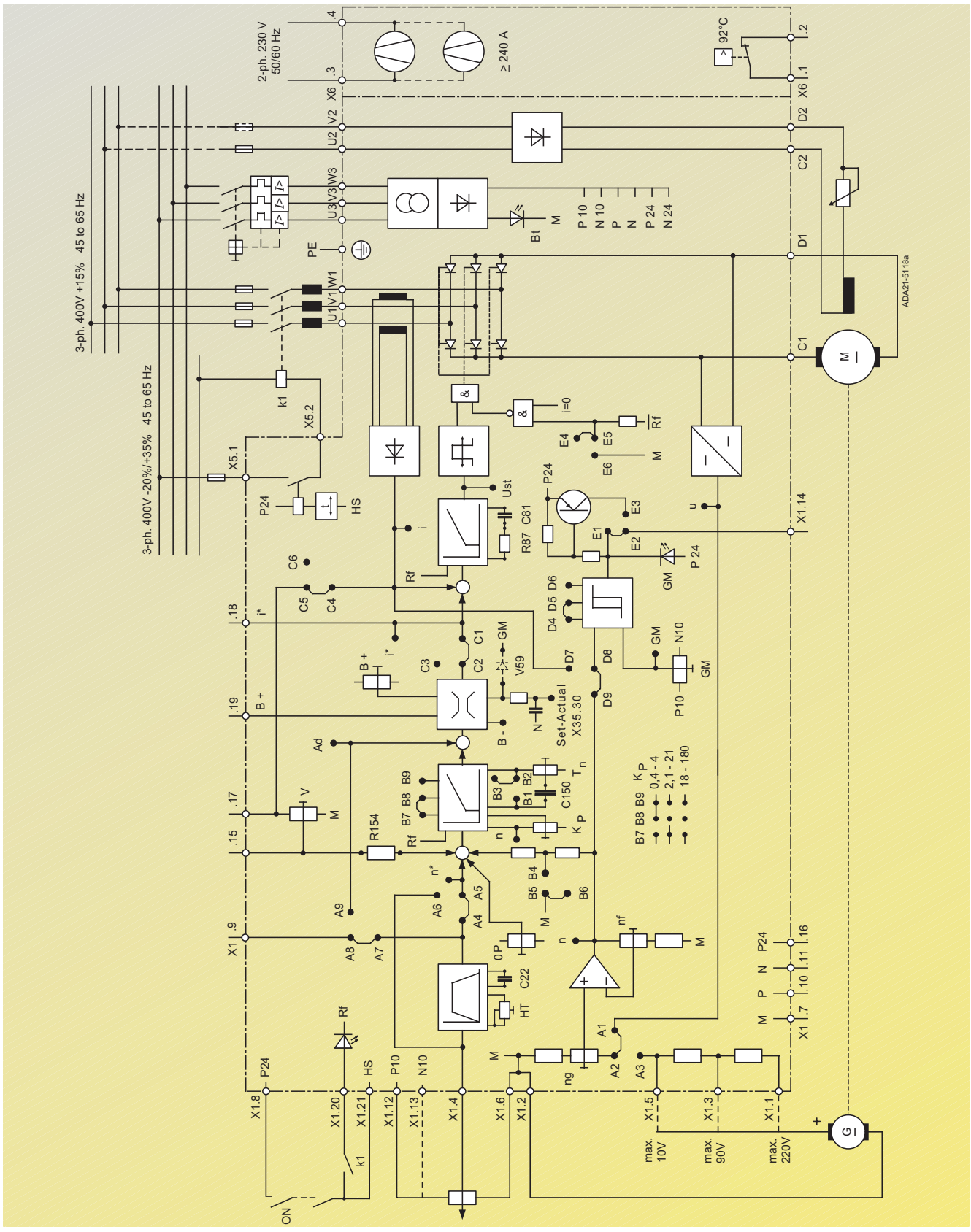



Fig. 1/12
6RA22 SIMOREG K converter in fully-controlled, three-phase bridge connection B6C for single-quadrant drives

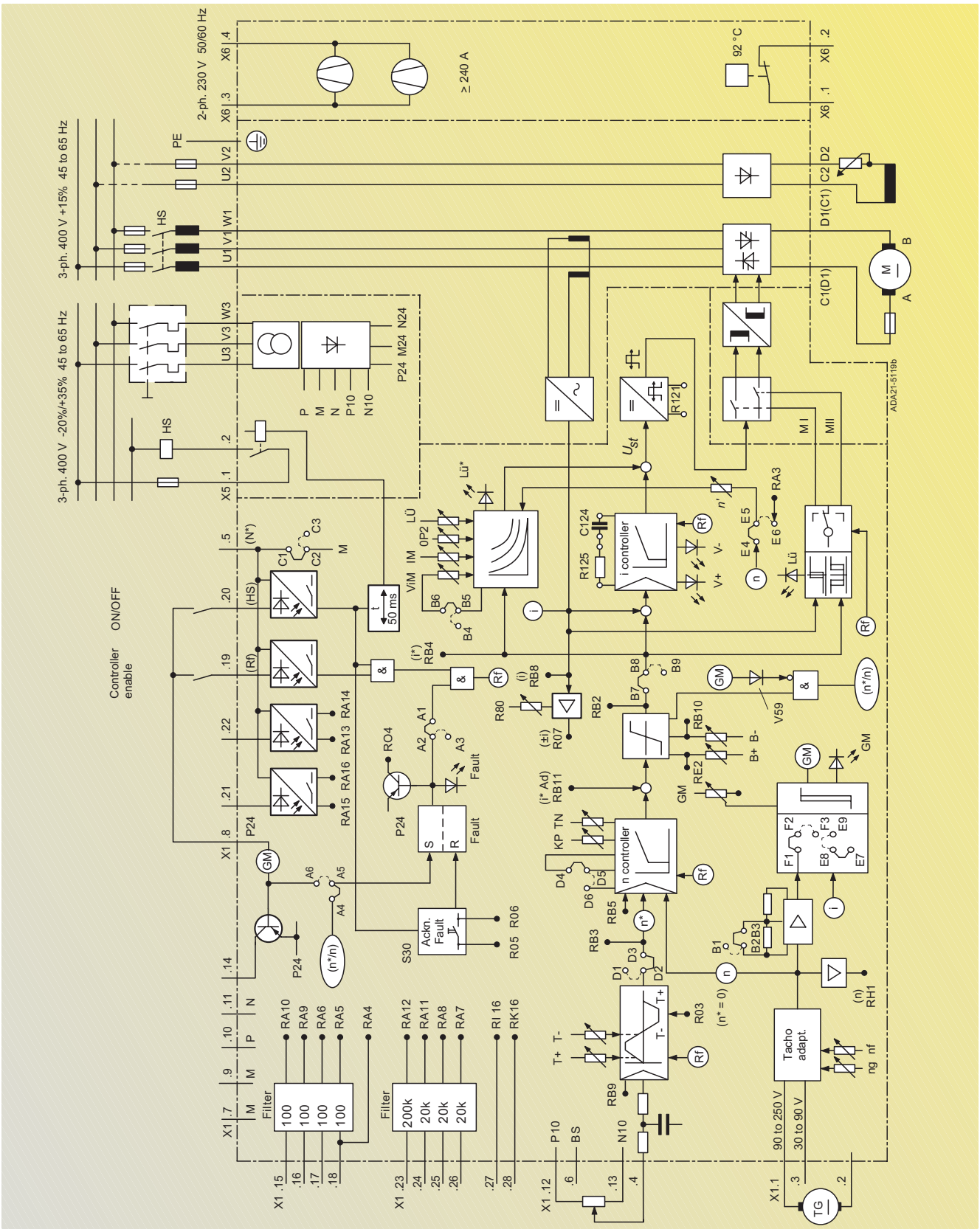



Fig. 1/13
6RA22 SIMOREG K converter in circulating-current-free inverse-parallel connection using two fully-controlled three-phase bridge circuits (B6)A(B6)C for four-quadrant drives

## Block diagrams / Terminal assignment



| | Function | Terminal | Type | Connection values | Comments |
|---|---|---|---|---|---|
| **Connections of 6RA22 SIMOREG K converters in (B2)A(B2)C connection for four-quadrant drives** | | | | | |
| **Power section** | L1<br>L2 | U1<br>V1 | Input<br>Input | 2-ph. 400 V or<br>2-ph. 230 V | See technical data |
| | + (-)<br>- (+) | C (D)<br>D (C) | Output<br>Output | Max. 260 V or 150 V | |
| | Relay contact | X95.1/2 | Output | 250 V/5 A AC<br>Max. switching capacity 1100 VA | For switching-in the main contactor |
| **Power supply** | L1<br>L2 | U2<br>V2 | Input<br>Input | 2-ph. 400 V or<br>2-ph. 230 V | For 400 V solder jumper A2/A1 closed,<br>for 230 V solder jumper A2-A3 closed<br>See technical data |
| | M<br>M<br>P<br>N<br>P24 | X23.7<br>X23.9<br>X23.10<br>X23.11<br>X23.8 | Output<br>Output<br>Output<br>Output<br>Output | 0 V (M potential)<br>0 V (M potential)<br>+15 V<br>- 15 V<br>+24 V | Total loading per polarity: 50 mA |
| | M<br>P10<br>N10 | X23.6<br>X23.12<br>X23.13 | Output<br>Output<br>Output | 0 V (ref. potential)<br>+10 V/10 mA<br>- 10 V/10 mA | Connection for speed setpoint potentiometer<br>M/P10 (with ramp-function generator): direction I;<br>M/N10 (with ramp-function generator): direction II. |
| **Speed controller** | Setpoint | X23.4 | Input | +10 to -10 V/20 kΩ | Jumper C2-C3 closed: ramp-function generator setpoint input |
| | Actual value | X23.2<br>X23.1<br>X23.3<br>X23.3 | Input<br>Input<br>Input<br>Input | 0 V (ref. potential)<br>80 to 220 V/78 kΩ<br>30 to 90 V/31 kΩ<br>10 to 30 V/13 kΩ | Bridge resistor R20 |
| **Other functions** | ON command (power contactor ON) | X23.20 | Input | +20 to +30 V | Reference potential M: jumpers B2-B3 and A8-A7 closed, terminal 5 open |
| | | X23.20 | Input | 0 to +24 V | Reference potential N24: jumpers B2-B3 and A8-A9 closed, terminal 5 open |
| | | X23.20 | Input | +20 to +30 V | Reference potential provided externally via terminal 5: jumper B2-B1 closed (floating control signal) |
| | Controller enable (checkback for power contactor ON) | X23.19 | Input | See terminal X23.20 | See terminal X23.20 |
| | Free optocoupler | X23.21 | Input | See terminal X23.20 | See terminal X23.20 |
| | Free optocoupler | X23.22 | Input | See terminal X23.20 | See terminal X23.20 |
| | Floating control signal | X23.5 | Input | 0 to -30 V | Externally provided reference potential for floating control signal at terminals X23.19, X23.20, X23.21 and X23.22: jumper B2-B1 closed |
| | Limit monitor | X23.14 | Output | +24 V/50 mA | Jumpers A2-A1 and A5-A4 closed: speed actual value interrogation<br>Jumpers A2-A3 and A5-A6 closed: current actual value interrogation |
| | Free input terminals | X23.23<br>X23.24<br>X23.25<br>X23.26 | Input<br>Input<br>Input<br>Input | 2 x 100 kΩ/10 nF<br>2 x 10 kΩ/10 nF<br>2 x 10 kΩ/10 nF<br>2 x 10 kΩ/10 nF | Matrix board RA11<br>Matrix board RA10<br>Matrix board RA9<br>Matrix board RA8 |
| | Free output terminals | X23.15<br>X23.16<br>X23.17<br>X23.18 | Output<br>Output<br>Output<br>Output | 2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF | Matrix board RA17<br>Matrix board RA16<br>Matrix board RA7<br>Matrix board RA6 |

| | Function | Terminal | Type | Connection values | Comments |
|---|---|---|---|---|---|
| **Connections of 6RA22 SIMOREG K converters in B6C connection for single-quadrant drives** | | | | | |
| **Power section** | L1<br>L2<br>L3 | U1<br>V1<br>W1 | Input<br>Input<br>Input | 3-ph. 400 V<br>3-ph. 400 V<br>3-ph. 400 V | See technical data |
| | +<br>- | C1<br>D1 | Output<br>Output | DC 485 V<br>DC 485 V | |
| | Relay contact | X5.1/2 | Output | AC 250 V/5 A | For switching the main contactor |
| **Field rectifier** | L1<br>L2 | U2<br>V2 | Input<br>Input | 2-ph. 400 V<br>2-ph. 400 V | See technical data |
| | +<br>- | C2<br>D2 | Output<br>Output | DC 340 V<br>DC 340 V | See technical data |
| **Power supply** | L1<br>L2<br>L3 | U3<br>V3<br>W3 | Input<br>Input<br>Input | 3-ph. 400 V<br>3-ph. 400 V<br>3-ph. 400 V | See technical data |
| | M<br>P<br>N<br>P24 | X1.7<br>X1.10<br>X1.11<br>X1.8/16 | Output<br>Output<br>Output<br>Output | 0 V (M potential)<br>+15 V/50 mA<br>- 15 V/50 mA<br>+24 V/50 mA | Total loading per polarity: 50 mA |
| | M<br>P10<br>N10 | X1.6<br>X1.12<br>X1.13 | Output<br>Output<br>Output | 0 V (ref. potential)<br>+10 V/10 mA<br>- 10 V/10 mA | Connection for speed setpoint potentiometer |
| **Speed controller** | Setpoint | X1.4 | Input | 0 to +10 V/200 kΩ | Jumper A5-A4 closed:<br>ramp-function generator setpoint input |
| | | X1.4 | Input | 0 to -10 V/ 20 kΩ | Jumper A5-A6 closed:<br>speed controller setpoint input |
| | | X1.9 | Input | 0 to -10V/100kΩ | Jumper A8-A9 closed: summing amplifier input<br>(supplementary current setpoint) |
| | | X1.9 | Output | 0 to -10 V | Jumper A7-A8 closed: ramp-function generator output |
| | Actual value | X1.2<br>X1.1<br>X1.3<br>X1.5 | Input<br>Input<br>Input<br>Input | 0 V (ref. potential)<br>80 to 220 V/78 kΩ<br>30 to 90 V/31 kΩ<br>0 to +10 V | Jumper A2-A3 closed: speed controller<br>actual value input (connection only<br>for speed actual value sensing by means<br>of tacho-generator) |
| | External current limiting | X1.19 | Input | 0 to +10 V/33 kΩ | Limiting the sum of current setpoint<br>+ supplementary current setpoint |
| **Current controller** | Setpoint | X1.18 | Input | 0 to +10 V/100 nF,<br>56 Ω | Jumper C1-C2 closed:<br>current setpoint from speed controller<br>C2-C3 closed: external current setpoint |
| **Other functions** | On/Off command | X1.21 | Input | +20 to +30 V | Switching command, main contactor On |
| | Controller enable | X1.20 | Input | +20 to +30 V | Prerequisite, terminal X1.21 = H signal |
| | Power supply | X1.8 | Output | +24 V across 100 Ω | Exclusively for supply to terminals<br>X1.20 and X1.21 |
| | Limit monitor | X1.14 | Output | +24 V/50 mA | Switch loads with respect to P24,<br>because terminal X1.14 switches to M |
| | Wiper of potentiometer R157 | X1.15 | Input | | Supplementary input for speed<br>controller or ($I \times R$) compensation |
| | Free connection of potentiometer R157 | X1.17 | Input | ±10 V | |
| | Selector input | X1.22 | Input | ±10 V | On matrix board A14 for free use |
| **Fan** | Supply | X6.3<br>X6.4 | Input<br>Input | 2-ph. 230 V<br>2-ph. 230 V | Fan connection for units ≥ 240 A |
| | Temperature switch | X6.1<br>X6.2 | Output<br>Output | Floating relay<br>contact | Opens at overtemperature |

## Block diagrams / Terminal assignment

| | Function | Terminal | Type | Connection values | Comments |
|---|---|---|---|---|---|
| **Connections of 6RA22 SIMOREG K converters in (B6)A(B6)C connection for four-quadrant drives** | | | | | |
| **Power section** | L1<br>L2<br>L3 | U1<br>V1<br>W1 | Input<br>Input<br>Input | 3-ph. 400 V<br>3-ph. 400 V<br>3-ph. 400 V | See technical data |
| | + (-)<br>- (+) | C (D)<br>D(C) | Output<br>Output | DC 420 V<br>DC 420 V | |
| | Relay contact | X5.1/2 | Output | AC 250 V/5 A | For switching the main contactor |
| **Power supply** | L1<br>L2<br>L3 | U3<br>V3<br>W3 | Input<br>Input<br>Input | 3-ph. 400 V<br>3-ph. 400 V<br>3-ph. 400 V | See technical data |
| | M<br>M | X1.7<br>X1.9 | Output<br>Output | 0 V (M potential)<br>0 V (M potential) | See technical data |
| | P<br>N | X1.10<br>X1.11 | Output<br>Output | +15 V/50 mA<br>- 15 V/50 mA | |
| | M<br>P10<br>N10 | X1.6<br>X1.12<br>X1.13 | Output<br>Output<br>Output | 0 V (ref. potential)<br>+10 V/10 mA<br>- 10 V/10 mA | Connection for speed setpoint potentiometer |
| **Field rectifier** | L1<br>L2 | U2<br>V2 | Input<br>Input | 2-ph. 400 V<br>2-ph. 400 V | See technical data |
| | +<br>- | C2<br>D2 | Output<br>Output | DC 340 V<br>DC 340 V | See technical data |
| **Speed controller** | Setpoint | X1.4 | Input | ±10 V/20 kΩ | Setpoint for ramp-function generator (2 to 30 s) |
| | Actual value | X1.2<br>X1.1<br>X1.3<br>X1.3 | Input<br>Input<br>Input<br>Input | 0 V (ref. potential)<br>80 to 220 V/78 kΩ<br>30 to 90 V/31 kΩ<br>10 to 30 V | <br><br><br>Bridge R32 |
| **Other functions** | On command (switches main contactor On) | X1.20<br>X1.20<br>X1.20 | Input<br>Input<br>Input | +20 to +30 V<br>0 to +24 V<br>+20 to +30 V | Reference potential M:<br>jumpers C1-C2 and C4-C5 closed<br>Reference potential N24:<br>jumpers C1-C2 and C5-C6 closed<br>External reference potential via terminal 5:<br>jumpers C2-C3 and C4-C5 closed |
| | Controller enable | X1.19 | Input | As for terminal 20 | As for terminal X1.20 |
| | Free optocoupler | X1.21 | Input | As for terminal 20 | As for terminal X1.20 |
| | Free optocoupler | X1.22 | Input | As for terminal 20 | As for terminal X1.20 |
| | P24 | X1.8 | Output | +24 V (across 100 Ω) | Only for supplying terminals X1.19 to X1.22 |
| | Floating control signal (N*) | X1.5 | Input | 0 to -30 V (ext.) | External reference potential at terminal X1.5 |
| | Limit monitor | X1.14 | Output | +24 V/50 mA | |
| | Free input terminals | X1.23<br>X1.24<br>X1.25<br>X1.26 | Input<br>Input<br>Input<br>Input | ±10 V/2 x 100 kΩ/10 nF<br>±10 V/2 x 10 kΩ/10 nF<br>±10 V/2 x 10 kΩ/10 nF<br>±10 V/2 x 10 kΩ/10 nF | Matrix board RA12<br>Matrix board RA11<br>Matrix board RA8<br>Matrix board RA7 |
| | Free input/output terminals | X1.27<br>X1.28 | Input/Output<br>Input/Output | | Matrix board RI16<br>Matrix board RK16 |
| | Free output terminals | X1.15<br>X1.16<br>X1.17<br>X1.18 | Output<br>Output<br>Output<br>Output | 2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF<br>2 x 50 Ω/47 nF | Matrix board RA10<br>Matrix board RA9<br>Matrix board RA6<br>Matrix board RA5 |
| **Fan** | Supply | X6.3<br>X6.4 | Input<br>Input | 2-ph. 230 V<br>2-ph. 230 V | Fan connection for units ≥ 240 A |
| | Temperature switch | X6.1<br>X6.2 | Output<br>Output | Floating relay contact | Opens at overtemperature |

| Rated supply voltage | Rated direct voltage | Rated DC | Rated output at 2-ph. 400 V | 2-ph. 230 V | SIMOREG K converter Order No. | Type designation accord. to DIN 41 792 | Fuses |
|---|---|---|---|---|---|---|---|
| V | V | A | kW | kW | | | Order No. |
| **SIMOREG K converters in B2HK connection for single-quadrant drives** | | | | | | | |
| Units without enclosure (for mounting in 6DM9005 subracks) | | | | | | | |
| 2-ph. 400 | 315 | 5 | 1.6 | 0.9 | **6RA2203-8DD21-0** | E315/ 5 MRE-GDE8-0 | **5SD4 20** |
| or | or | 12 | 3.8 | 2.2 | **6RA2211-8DD21-0** | E315/12 MRE-GDE8-0 | **5SD4 20** |
| 2-ph. 230 | 180 | 22 | 6.9 | 4.0 | **6RA2216-8DD21-0** | E315/22 MRE-GDE8-0 | **3NE8 015** |
| | | 40 | 12.6 | 7.2 | **6RA2221-8DD21-0** | E315/40 MRE-GDE8-0 | **3NE8 017** |
| Units with enclosure (for individual mounting) | | | | | | | |
| 2-ph. 400 | 315 | 5 | 1.6 | 0.9 | **6RA2203-8DD21-1** | E315/ 5 MRE-GDE8-1 | **5SD4 20** |
| or | or | 12 | 3.8 | 2.2 | **6RA2211-8DD21-1** | E315/12 MRE-GDE8-1 | **5SD4 20** |
| 2-ph. 230 | 180 | 22 | 6.9 | 4.0 | **6RA2216-8DD21-1** | E315/22 MRE-GDE8-1 | **3NE8 015** |
| | | 40 | 12.6 | 7.2 | **6RA2221-8DD21-1** | E315/40 MRE-GDE8-1 | **3NE8 017** |

| Rated supply voltage | Rated direct voltage | Rated DC | Rated output | SIMOREG K converter Order No. | Type designation accord. to DIN 41 792 | Fuses |
|---|---|---|---|---|---|---|
| V | V | A | kW | | | Order No. |
| **SIMOREG K converters in B6C connection for single-quadrant drives** | | | | | | |
| 3-ph. 400 | 485 | 35 | 17 | **6RA2220-8DS31** | D485/ 35 MRE-GDE8 S31 | **3NE8 003** |
| | | 50 | 24 | **6RA2223-8DS31** | D485/ 50 MRE-GDE8 S31 | **3NE8 017** |
| | | 70 | 34 | **6RA2226-8DS31** | D485/ 70 MRE-GDE8 S31 | **3NE8 020** |
| | | 110 | 53 | **6RA2230-8DS31** | D485/110 MRE-GDE8 S31 | **3NE8 021** |
| | | 130 | 63 | **6RA2232-8DS31** | D485/130 MRE-GDE8 S31 | **3NE8 023** |
| | | 160 | 78 | **6RA2233-8DS31** | D485/160 MRE-GDE8 S31 | **3NE8 024** |
| | | 240 | 116 | **6RA2276-8DS31** | D485/240 MRE-GDEF S31 | **3NE4 327-0B** |
| | | 350 | 170 | **6RA2280-8DS31** | D485/350 MRE-GDEF S31 | **3NE4 333-0B** |
| | | 500 | 242 | **6RA2283-8DS31** | D485/500 MRE-GDEF S31 | **3NE4 334-0B** |

## Ordering and engineering data

| Rated supply voltage | Rated direct voltage | Rated DC | Rated output at 2-ph. 400 V | Rated output at 2-ph. 230 V | SIMOREG K converter Order No. | SIMOREG K converter Type designation accord. to DIN 41 792 | Fuses Line fuses | Fuses DC fuses |
|---|---|---|---|---|---|---|---|---|
| V | V | A | kW | kW | | | Order No. | Order No. |
| **SIMOREG K converters in (B2)A(B2)C connection for four-quadrant drives** | | | | | | | | |
| Units without enclosure (for mounting in 6DM9005 subracks) | | | | | | | | |
| 2-ph. 400 | 260 | 5 | 1.3 | 0.75 | **6RA2203-8DK27-0** | E260/ 5 MREQ-GDG8-0 | **5SD4 20** | **5SD4 20** |
| or | or | 12 | 3.1 | 1.8 | **6RA2211-8DK27-0** | E260/10 MREQ-GDG8-0 | **5SD4 20** | **5SD4 20** |
| 2-ph. 230 | 150 | 22 | 5.7 | 3.3 | **6RA2216-8DK27-0** | E260/22 MREQ-GDG8-0 | **3NE8 015** | **3NE8 015** |
| | | 40 | 10.4 | 6 | **6RA2221-8DK27-0** | E260/40 MREQ-GDG8-0 | **3NE8 017** | **3NE8 017** |
| Units with enclosure (for all mounting) | | | | | | | | |
| 2-ph. 400 | 260 | 5 | 1.3 | 0.75 | **6RA2203-8DK27-1** | E260/ 5 MREQ-GDG8-1 | **5SD4 20** | **5SD4 20** |
| or | or | 12 | 3.1 | 1.8 | **6RA2211-8DK27-1** | E260/10 MREQ-GDG8-1 | **5SD4 20** | **5SD4 20** |
| 2-ph. 230 | 150 | 22 | 5.7 | 3.3 | **6RA2216-8DK27-1** | E260/22 MREQ-GDG8-1 | **3NE8 015** | **3NE8 015** |
| | | 40 | 10.4 | 6 | **6RA2221-8DK27-1** | E260/40 MREQ-GDG8-1 | **3NE8 017** | **3NE8 017** |

| Rated supply voltage | Rated direct voltage | Rated DC | Rated output | SIMOREG K converter Order No. | SIMOREG K converter Type designation accord. to DIN 41 792 | Fuses Line fuses | Fuses DC fuses |
|---|---|---|---|---|---|---|---|
| V | V | A | kW | | | Order No. | Order No. |
| **SIMOREG K converters in (B6)A(B6)C connection for four-quadrant drives** | | | | | | | |
| 3-ph. 400 | 420 | 35 | 14.7 | **6RA2220-8DV71** | D420/ 35 MREQ-GDG8 V71 | **3NE8 003** | **3NE8 003** |
| | | 50 | 21 | **6RA2223-8DV71** | D420/ 50 MREQ-GDG8 V71 | **3NE8 017** | **3NE8 017** |
| | | 70 | 29 | **6RA2226-8DV71** | D420/ 70 MREQ-GDG8 V71 | **3NE8 020** | **3NE8 020** |
| | | 110 | 46 | **6RA2230-8DV71** | D420/110 MREQ-GDG8 V71 | **3NE8 021** | **3NE8 021** |
| | | 130 | 55 | **6RA2232-8DV71** | D420/130 MREQ-GDG8 V71 | **3NE8 022** | **3NE8 024** |
| | | 160 | 67 | **6RA2233-8DV71** | D420/160 MREQ-GDG8 V71 | **3NE8 024** | **3NE8 024** |
| | | 240 | 100 | **6RA2276-8DV71** | D420/240 MREQ-GDGF8 V71 | **3NE4 327-0B** | **3NE4 327-0B** |
| | | 350 | 147 | **6RA2280-8DV71** | D420/350 MREQ-GDGF8 V71 | **3NE4 333-0B** | **3NE4 333-0B** |
| | | 500 | 210 | **6RA2283-8DV71** | D420/500 MREQ-GDGF8 V71 | **3NE4 334-0B** | **3NE4 334-0B** |

### *Fuses for the integrated field power supply*

For 6RA22..-8DK27-. converters, an external field supply must be provided (see Part 2 of this catalog).

For 6RA22..-8DD21-. converters, fuses or a circuit breaker must be provided for the line protection of the field supply.

Type 5SD4 20 fuses are specified for the field supply of 6RA22..-8DS31 and 6RA22..-8DV71 converters.

### *Commutating reactors for the armature circuit*

The required commutating reactor can be designed for the rated current of the motor and can be found in Catalog DA 93.1.

| Converter type | Order No. of the German/English operating manual |
|---|---|
| **Other documentation for 6RA22 SIMOREG K converters in analog technology** | |
| 6RA22..-8DD21-. | 6RX1220-0DD 74 |
| 6RA22..-8DK27-. | 6RX1220-0KD 74 |
| 6RA22..-8DS31 | 6RX1220-0SD 74 |
| 6RA22..-8DV71 | 6RX1220-0VD 74 |

| Converter type | Order No. of the French operating manual |
|---|---|
| **Other documentation for 6RA22 SIMOREG K converters in analog technology** | |
| 6RA22..-8DD21-.<br>6RA22..-8DK27-.<br>6RA22..-8DS31<br>6RA22..-8DV71 | 6RX1220-0.D 77<br>Letter according to converter type |

## Dimension drawings

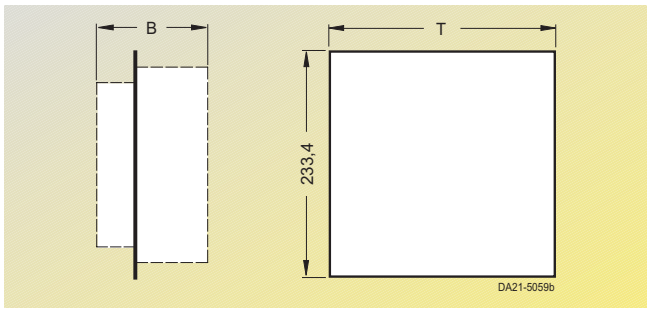



Fig. 1/14

| Converter<br>Order No. | Dimension B [1]<br>mm | Dimension T<br>mm | No. of required basic grid dimensions in the subrack [1] |
|---|---|---|---|
| **Converters in B2HZ connection for single-quadrant drives, without enclosure** | | | |
| 6RA2203-8DD21-0 | 50 | 210 | 24 |
| 6RA2211-8DD21-0 | 50 | 210 | 24 |
| 6RA2216-8DD21-0 | 78 | 233 | 36 |
| 6RA2221-8DD21-0 | 112 | 233 | 50 |
| **Convert. in (B2)A(B2)C connection for four-quadrant drives, without enclosure** | | | |
| 6RA2203-8DK27-0 | 94 | 233 | 42 |
| 6RA2211-8DK27-0 | 94 | 233 | 42 |
| 6RA2216-8DK27-0 | 92 | 238 | 42 |
| 6RA2221-8DK27-0 | 124 | 238 | 54 |

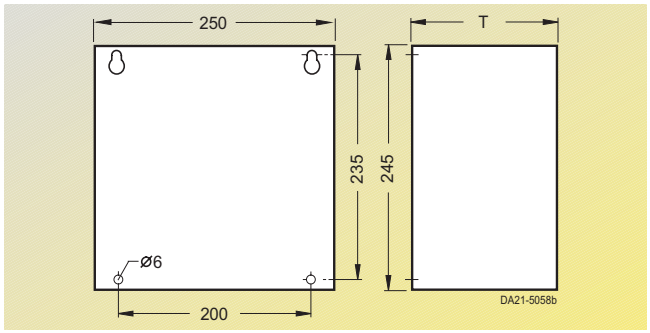



Fig. 1/15

| Converter<br>Order No. | Dimension T<br>mm |
|---|---|
| **Converters in B2HZ connection for single-quadrant drives, with enclosure** | |
| 6RA2203-8DD21-1 | 86 |
| 6RA2211-8DD21-1 | 86 |
| 6RA2216-8DD21-1 | 121 |
| 6RA2221-8DD21-1 | 152 |
| **Converters in (B2)A(B2)C connection for four-quadrant drives, with enclosure** | |
| 6RA2203-8DK27-1 | 137 |
| 6RA2211-8DK27-1 | 137 |
| 6RA2216-8DK27-1 | 152 |
| 6RA2221-8DK27-1 | 182 |

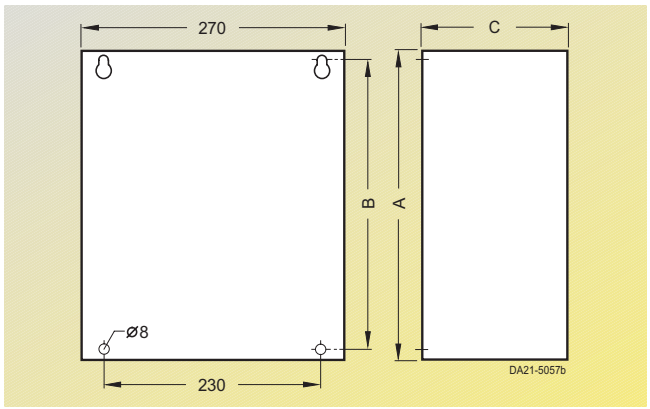



Fig. 1/16

| Converter<br>Order No. | Dimension A<br>mm | Dimension B<br>mm | Dimension C<br>mm |
|---|---|---|---|
| **Converters in B6C connection for single-quadrant drives, with enclosure** | | | |
| 6RA2220-8DS31 | 310 | 290 | 195 |
| 6RA2223-8DS31 | 310 | 290 | 195 |
| 6RA2226-8DS31 | 310 | 290 | 227 |
| 6RA2230-8DS31 | 310 | 290 | 317 |
| 6RA2232-8DS31 | 310 | 290 | 320 |
| 6RA2233-8DS31 | 310 | 290 | 320 |
| 6RA2276-8DS31 | 400 | 373 | 390 |
| 6RA2280-8DS31 | 400 | 373 | 390 |
| 6RA2283-8DS31 | 400 | 373 | 390 |
| **Converters in (B6)A(B6)C connection for four-quadrant drives, with enclosure** | | | |
| 6RA2220-8DV71 | 310 | 290 | 190 |
| 6RA2223-8DV71 | 310 | 290 | 190 |
| 6RA2226-8DV71 | 310 | 290 | 222 |
| 6RA2230-8DV71 | 310 | 290 | 315 |
| 6RA2232-8DV71 | 310 | 290 | 345 |
| 6RA2233-8DV71 | 310 | 290 | 345 |
| 6RA2276-8DV71 | 400 | 373 | 390 |
| 6RA2280-8DV71 | 400 | 373 | 390 |
| 6RA2283-8DV71 | 400 | 373 | 390 |

1) The specifications apply to units without mounted supplementar technology board, but they do include the required clearance between two mounted units.

## Supplementary boards / Accessories



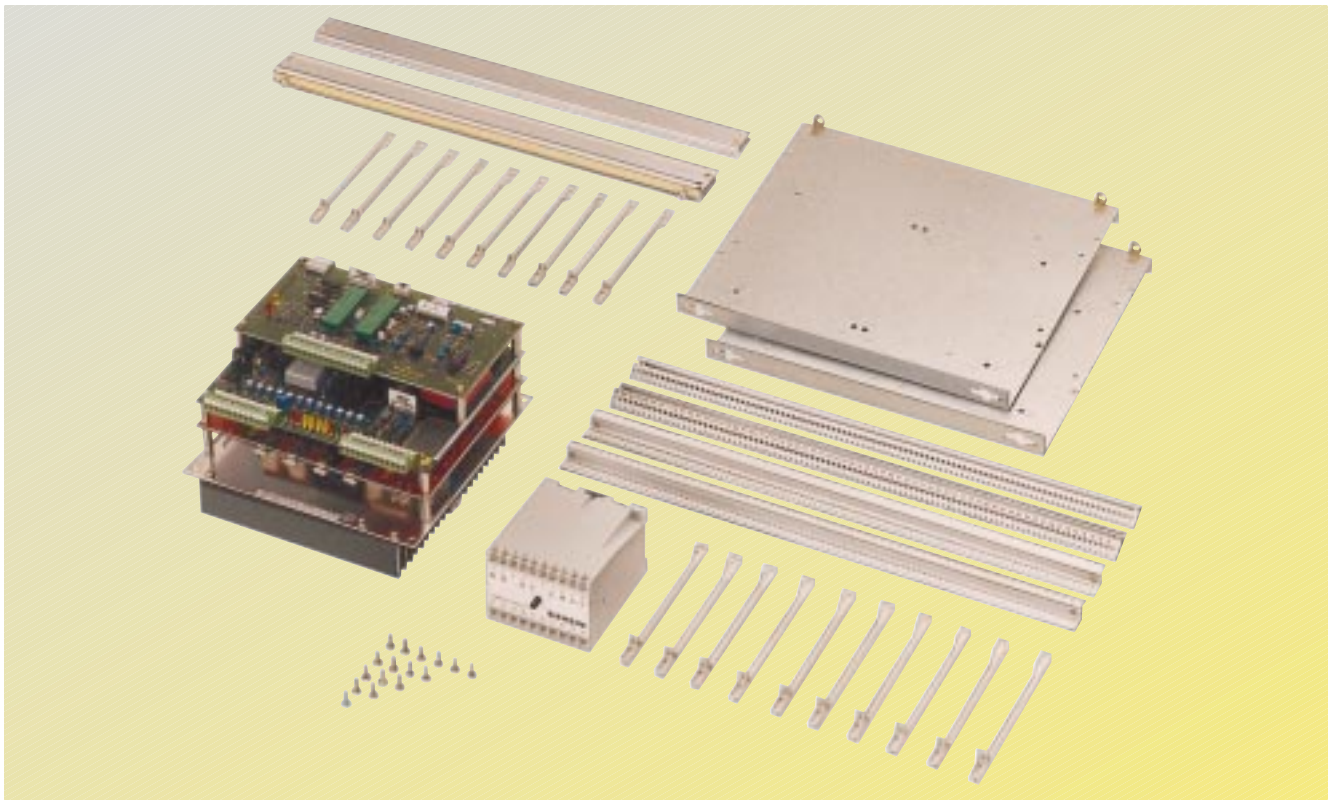


Fig. 1/17
6RA22 SIMOREG K converter with mounted supplementary technology board, 6RA2200-8DD00 field supply unit and 6DM9005 subrack as an assembly kit

### Accessories for 6RA22 SIMOREG K converters

| | Order No. | Comments |
|---|---|---|
| **Subrack**<br>as assembly kit | **6DM9005** | Subrack with 186 basic grid dimensions (1 BGD = 2.54 mm)<br>for mounting 6RA22 SIMOREG K converters without enclosure.<br>External dimensions (W x H x D):<br>537 mm x 336 mm x 300 mm |
| **Uncontrolled field rectifier**<br>alternative to the field supply unit | **6RA8222-8AA0** | Supply voltage: max. 2-ph. 50/60 Hz 400 V +10%<br>Field voltage: 340 V DC<br>Field current: 4 A max. (up to 16 A when mounted on metal)<br>Fuse: 5SD4 20 |

### Z 702 supplementary board for winder drives Order No. 6RA8222-1BB0

#### *Application*

The Z 702 supplementary board is intended for use with SIMOREG compact units for controlled drives for axle-driven winders and unwinders.

Winders and unwinders always require that the material web have a specific tension. It is usually desirable for this tension, also known as "web tension", to be adjustable and to have the required characteristics over the entire winding range.

Winder drives can either be operated with "direct tension control" (sensing of the tension actual value via tension transducer or via compensator roll) or with "indirect tension control."

Both modes are possible with the Z 702 supplementary board.

A prerequisite is that the web speed, the so-called "web velocity *v*" is always specified by the driven machine. The web velocity is either constant (e. g. for paper machines) or variable during acceleration and deceleration (e. g. for calenders).

For *winder operation,* the winding roll speed must be reduced according to the *increasing* roll diameter; for *unwinding operation,* in contrast, the speed must be increased in accordance with the descreasing roll diameter.

The set web tension must be maintained in both cases.

## Z 702 supplementary board for winder drives Order No. 6RA8222-1BB0

### *Description*

The Z 702 supplementary board mainly contains the following functions

- Higher-level controller (tension, position, current)
- Diameter computer
- Speed controller

This is therefore a variable-speed winder drive. The following setpoints act on the speed controller:

1. Master reference voltage $V_L$ determines the basic speed.
2. Signal *n x d* from the diameter computer takes into account the diameter change of the winder roll.
3. Signal $\Delta V_{set}$ from the higher-level controller ensures that the web tension is maintained.
4. If necessary, a supplementary signal from a maneuvering potentiometer to run the winder motor when threading the material web.

A DC tachometer coupled to the winder motor supplies the speed actual value. The winder motor speed is adapted over the complete winding range

$$\left(\text{i.e.} = \frac{\text{Full roll}}{\text{Empty roll}}\right)$$

only via the armature voltage, at constant motor field. Thus a variable field supply is not needed.

Direct or indirect tension control can be provided for the higher-level controller. For direct tension control, the tension actual value is sensed via a tension transducer, and the tension setpoint is adjusted with a potentiometer.

If, however, a compensator roll is provided, the controller operates as a position controller. The material web tension is governed solely by the weight of the compensator roll or its load.

For indirect tension control, the armature current is a measure of the tension in the material web. The higher-level controller has the function of an additional current controller.

For more detailed information, please refer to the Operating Instructions, Order No. E31910-J5035-X-A1.

### *Mounting and connection*

The Z 702 has the same width as the basic unit electronics board but only half its height. It is mounted onto the basic unit with spacers. The board is powered via ribbon cable from the basic unit (X2). A terminal strip is available for external connection (X1).

The mounting components, spacers and ribbon cables are supplied together with the board.

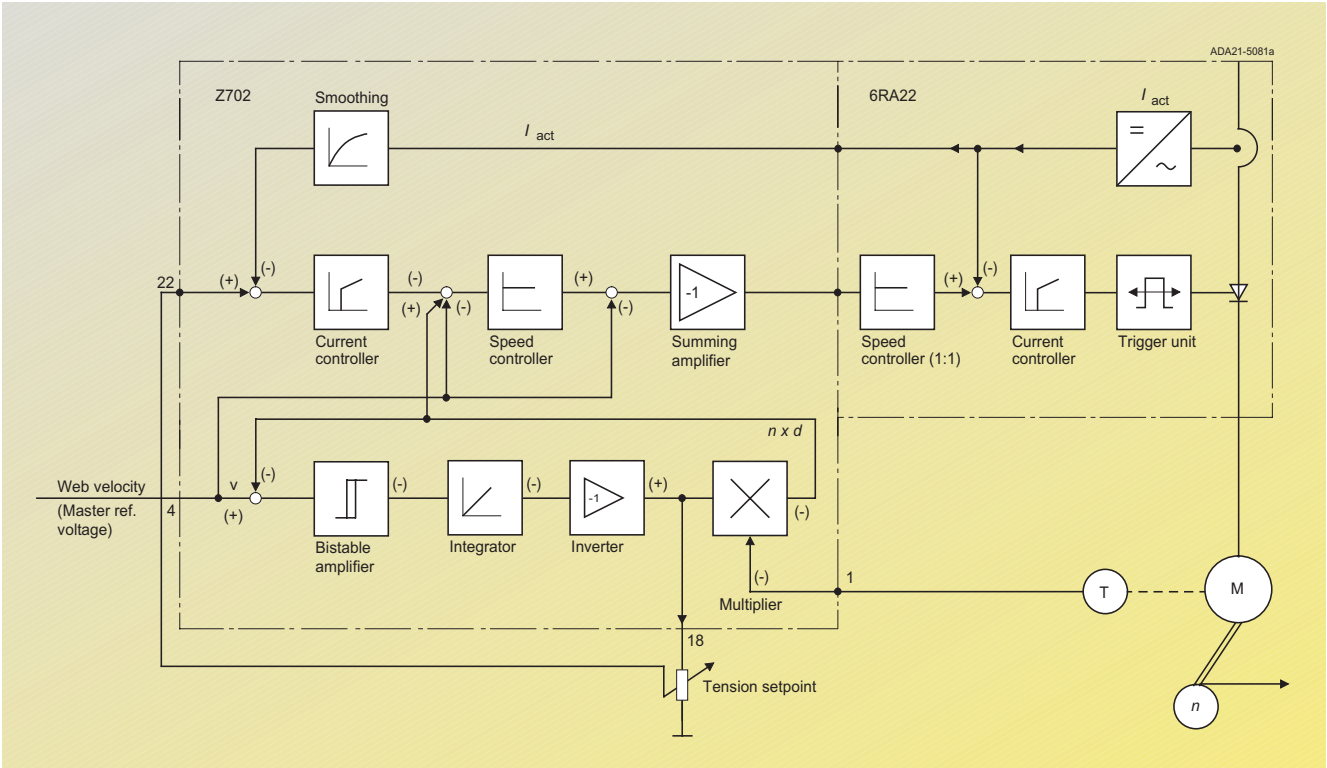



Fig. 1/18
Example: Simplified block diagram of an unwinder with indirect tension control

## Supplementary boards / Accessories

### Z 707 supplementary board for EMF control Order No. 6RA8222-1GB0

#### *Application*

A drive can be operated with EMF control in conjunction with the Z 707 supplementary board.

This is often necessary if, for reasons of space for example, a tachometer cannot be mounted on the machine and the requirements for stability and accuracy of the closed-loop control allow EMF-controlled operation.

Described as an example is a DC door drive for which this board was originally designed.

#### *Description*

The Z 707 supplementary board mainly consists of:

a) Setpoint generator (V*)

b) Two-quadrant voltage converter

For more detailed information, please refer to the Operating Instructions, Order No. BA- 6RA82 22-1GB0.

#### *Mounting and connection*

The Z 707 supplementary board is mounted on the SIMOREG K unit electronics board with spacers and is connected to it with a ribbon cable.

Power is supplied to the voltage converter via two additional leads from the power board to the supplementary board (terminal points 13 - 15).

A terminal strip is available for other connections. The mounting components, spacers and ribbon cable are supplied together with the board.

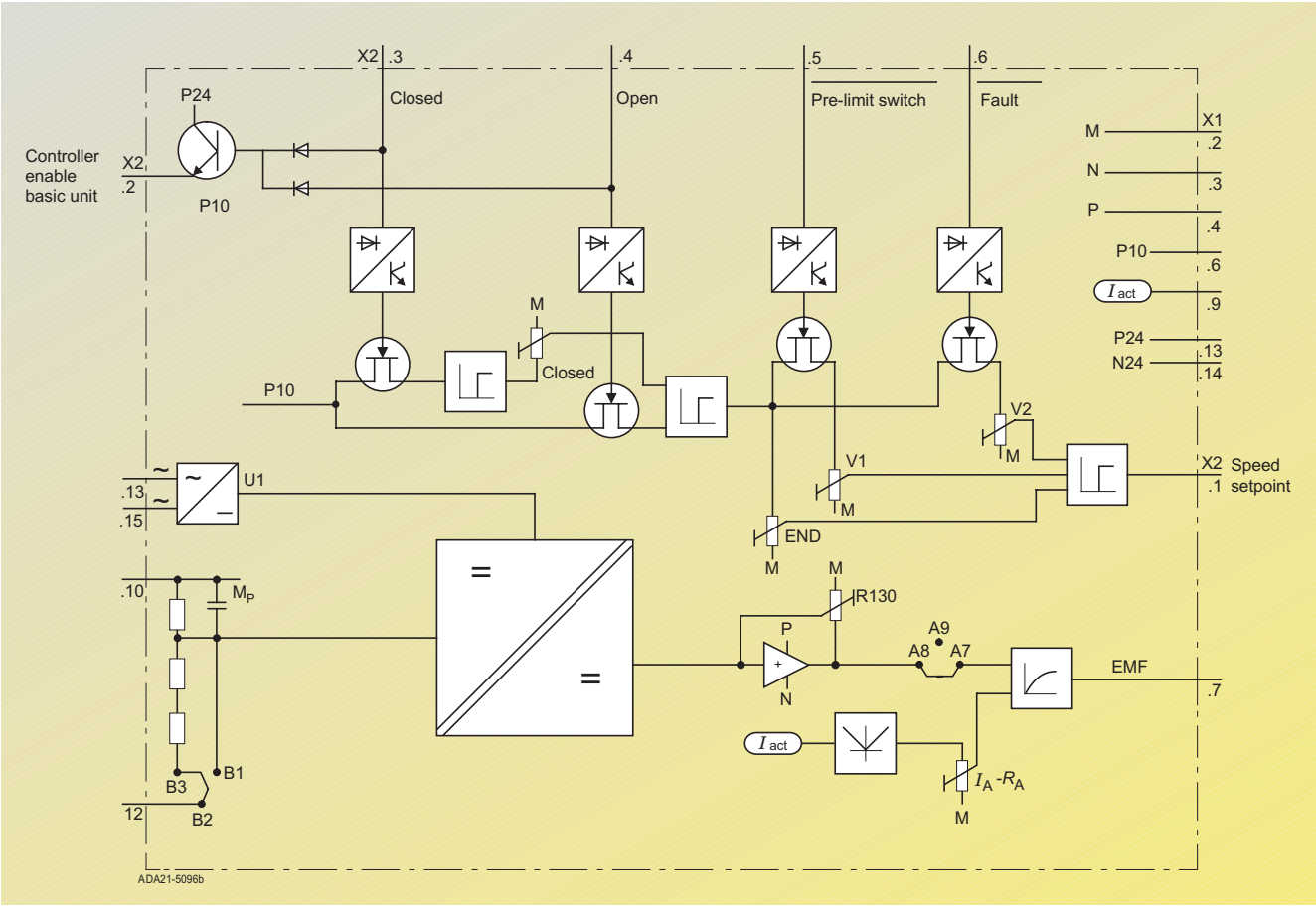



Fig. 1/19

## Z 708 analog, higher-level PID controller Order No. 6RA8222-1HB0

### *Application*

The board is suitable for general higher-level PID control. The P gain, I component and D component of the PID controller are adjusted separately. The controller output is fed directly, or after multiplication by a master voltage $V_{master}$ (e.g. web velocity), to a summing circuit. There, if required, it can be added to a speed setpoint $n_{master}$ and fed to the setpoint output $n^*_{set}$ of the board (e.g. as speed setpoint for the SIMOREG unit).

Typical applications: position, tension and pressure control.

For more detailed information, please refer to the Operating Instructions, Order No. V18-6RA82 22-1HB00.

### *Mounting*

The Z 708 has the same width as the basic unit electronics board but only half the height.

The supplementary board is mounted directly onto the SIMOREG K converter by means of spacers. The SIMOREG K basic converter provides the board with the supply voltage (±15 V and ±24 V) via a ribbon cable.

Supplementary wiring:

Setpoint output X2.12 or X2.13 of the supplementary board must be connected to the setpoint input terminal X_.4 of the basic unit. The setpoint input is situated on the basic unit electronics board.

The mounting components, spacers and ribbon cable are supplied together with the board.

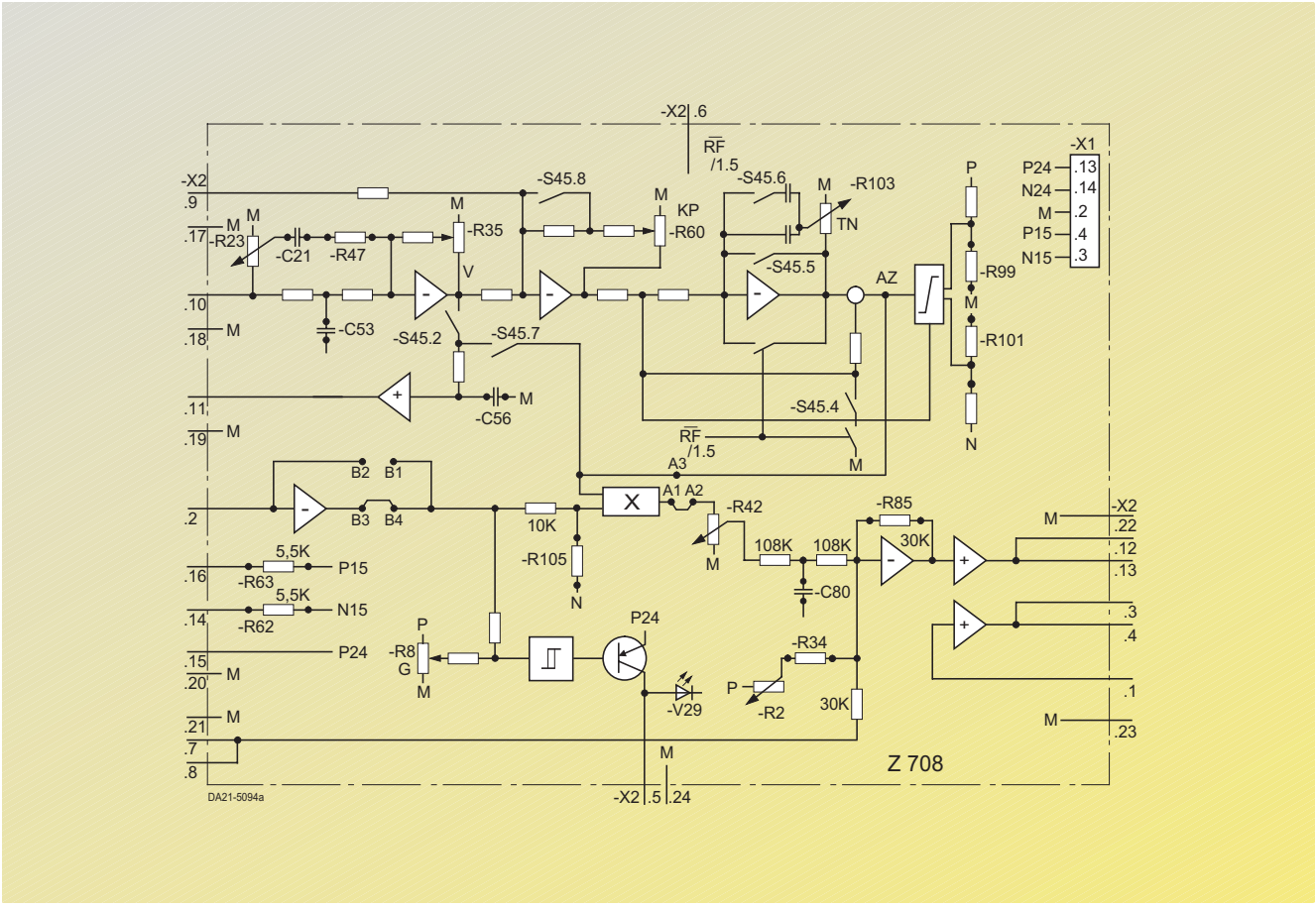



Fig. 1/20

## Supplementary boards / Accessories

### Z 714 technology board for wire-drawing machines Order No. 6RA8222-1PB0

#### *Application*

The Z 714 supplementary board is a technology board for use with SIMOREG K converters of the 6RA22 series in analog technology.

The board is equipped with the I-P-D-position controller functions including limiting, controlled braking and standstill monitoring.

It is used for position-controlled winder drives (e.g. wire-drawing machines) in conjunction with the basic unit.

The position controller has the function of maintaining the wire tension at the specified setpoint during winding. It involves position control. The transducer connected to the compensator roll (e.g. a magnetoresistive potentiometer) should be adjusted so that at the set position (e.g. midpoint of the compensator roll) 0 V is output for the controller. A position deviation results in a proportional value with sign.

For more detailed information, please refer to the Operating Instructions, Order No. BA-6RA8222-1PB0.

#### *Mounting*

The Z 714 has the same width as the basic unit electronics board but only 2/3 of its height.

The board is mounted on the basic unit by means of spacers. The board can either be powered via ribbon cable (X1) or via the terminal strip (X2). The terminal strip (X2) is also provided for external connections.

The mounting components, spacers and ribbon cable are supplied together with the board.

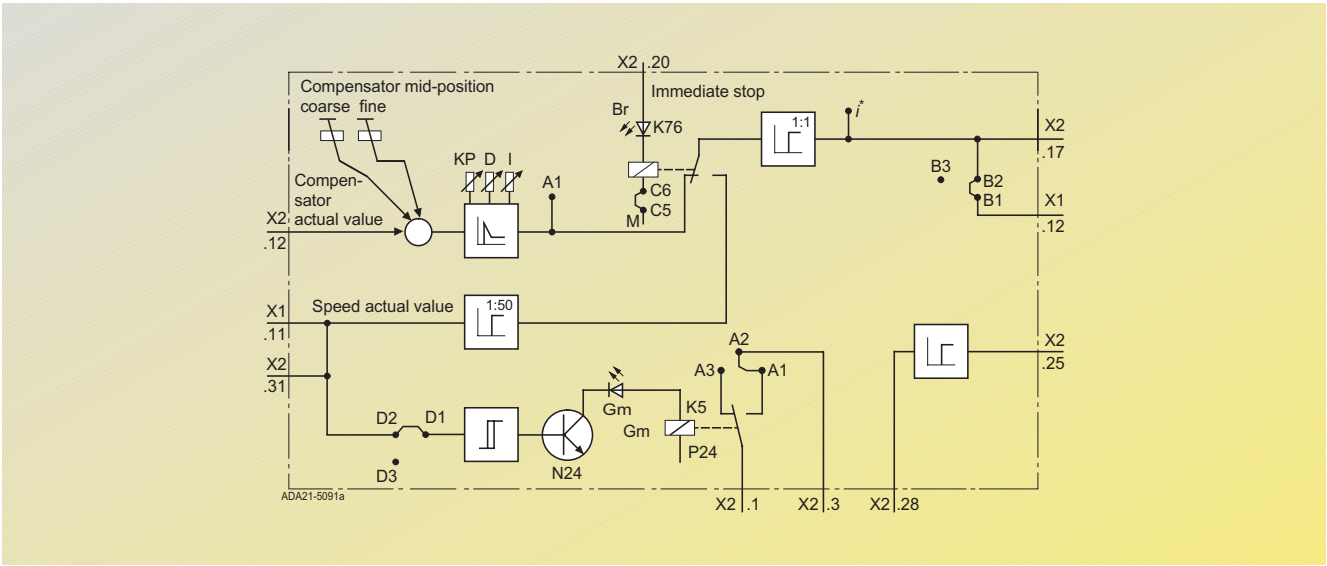



Fig. 1/21

## Z 716 universal supplementary board Order No. 6RA8222-1RB0

### *Application*

The Z 716 supplementary board is intended as a universal supplementary board for all 6RA22 SIMOREG K converters, to allow improved adaptation of the basic units to simple technological processes.

The supplementary board mainly contains the following functions:

- Setpoint cascade with six inputs
- Six limit monitors
- Output for external speed display
- Four switchable amplifier circuits
- Freely available potentiometers

For more detailed information, please refer to the Operating Instructions, Order No. EMA-B1-6RA8222-1RB0.

### *Mounting*

The board is mounted on the electronics board by means of spacers. The signal connection is achieved by ribbon cable X1 to the basic unit. A terminal strip is provided for external connections.

The mounting components, spacers and ribbon cable are supplied with the board.

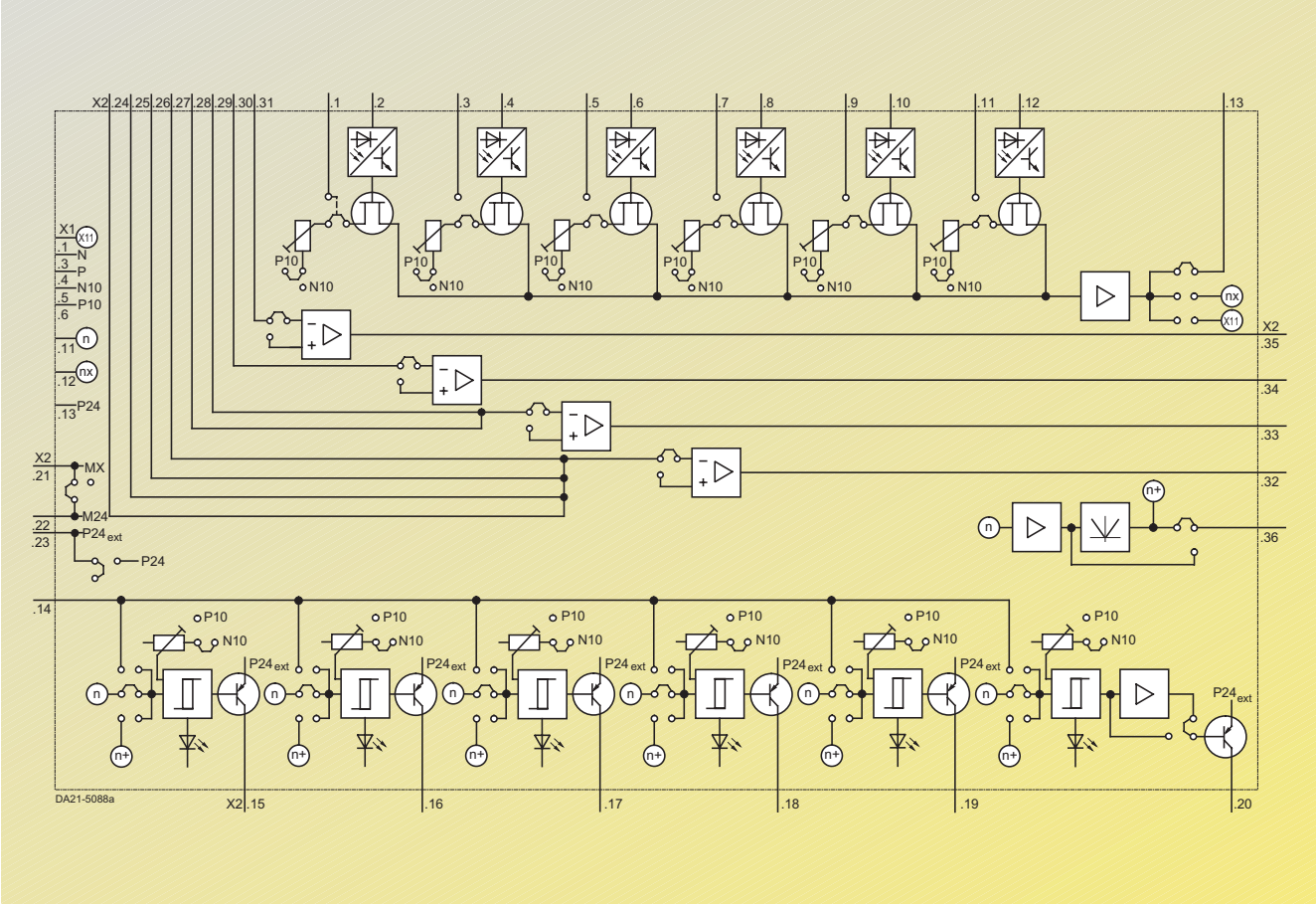



Fig. 1/22

## Z 722 axle winder and unwinder Order No. 6RA8222-2BB0

### Application

The Z 722 supplementary board is suitable, in conjunction with a SIMOREG K unit, for controlling the material web tension of an axle winder motor.

The board is suitable for both winding and unwinding operations.

With the appropriate circuitry, the board can be used for the following control tasks:

- Direct tension control
- Position control with compensator roll
- Indirect tension control
- Winding hardness control

### Description

The Z 722 supplementary board mainly contains the following functions

- Higher-level controller (tension, position, current)
- Diameter computer
- Diameter-dependent field weakening
- Speed controller

This is therefore a variable-speed winder drive. The following setpoints act on the speed controller:

1. Master reference voltage $V_L$ determines the basic speed.
2. Signal $n \times d$ from the diameter computer takes into account the diameter change of the winder roll.
3. Signal $\Delta V_{set}$ from the higher-level controller ensures that the web tension is maintained.
4. If necessary, a supplementary signal from a maneuvering potentiometer to run the winder motor when threading the material web.

A DC tachometer coupled to the winder motor supplies the speed actual value.

The winder motor speed is adapted over the complete winding range

$$\left(\text{i.e.} = \frac{\text{Full roll}}{\text{Empty roll}}\right)$$

Direct or indirect tension control can be provided for the higher-level controller. For direct tension control, the tension actual value is sensed via a tension transducer, and the tension setpoint is adjusted with a potentiometer.

If, however, a compensator roll is provided, the controller operates as a position controller. The material web tension is governed solely by the weight of the compensator roll or its load.

For indirect tension control, the armature current is a measure of the tension in the material web. The higher-level controller has the function of an additional current controller.

Please refer to the Operating Instructions, Order No. E31910-T9008-X-A2 for more detailed information.

### Mounting

The Z 722 has the same width as the basic unit electronics board but only half the height.

The supplementary board is mounted on the basic unit by means of spacers. The board is powered via a ribbon cable. A terminal strip is available for external connections.

The mounting components, spacers and ribbon cable are supplied with the board.

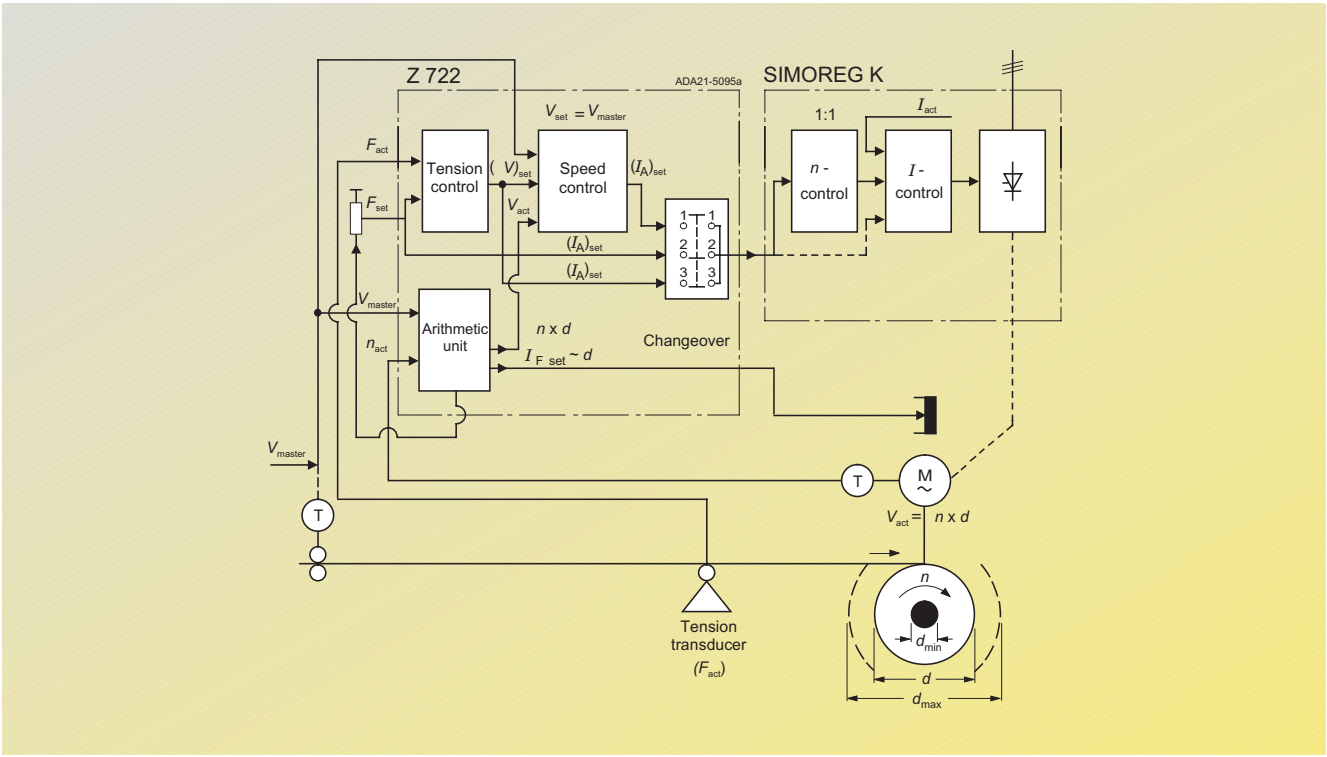



Fig. 1/23
Example: Simplified block diagram of a winder drive (direct tension control with tension transducer)

# SIMOREG K
# Field Supply Units




2

# F 33 Minireg

**Design and mode of operation · Block diagrams**
**Technical data · Dimension drawings**

**F 33 Minireg** Order No. **6DM1001-0WB00-2**



## Application

The "F 33 Minireg" board is a current-controlled thyristor power unit with half-controlled single-phase bridge circuit, which is used for the field supply of DC shunt-wound motors.

## Power section

The power section consists of a module containing two thyristors, two diodes in half-controlled single-phase bridge circuit and an additional free-wheeling diode. An aluminum support plate serves simultaneously as heatsink for the module.

## Current actual value sensing

The current actual value is measured on the DC side of the power section with a chopper converter. With this measuring method, the "zero diode current" of the thyristor circuit is also sensed.

## Current controller

When the F 33 Minireg Version 2 is used for the field supply of DC shunt-wound motors, the current controller has the task of keeping the current through the field winding constant, independently of temperature rise and supply voltage fluctuations, according to a specified setpoint.

The setpoint which, for example, corresponds to the rated field, can be set with potentiometer R120.

## Monitoring

A limit monitor is provided for monitoring the load current by comparing the current actual value to a selectable reference value.

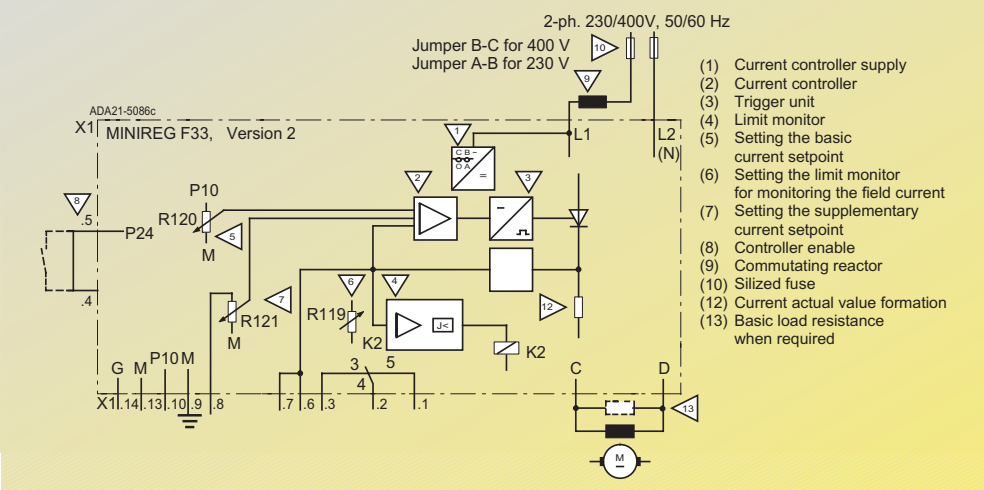



Fig. 2/1

| Terminal | Function | Terminal strip codes | Connection value | Comments |
|---|---|---|---|---|
| L1<br>L2 (N) | Rated supply voltage | | 2-ph. 230 or 400 V 50/60 Hz | ±10% |
| L+<br>L- | Rated DC voltage | | DC 190 V or DC 325 V | |
| X1.1<br>X1.2<br>X1.3 | Contact terminals of relay K2 | NO contact<br>CO contact<br>NC contact | Contact rating AC 230 V, 2.5 | Changeover contact |
| X1.4 | Controller enable | Rf | +24 V ≙ enable | |
| X1.5 | P24 | P24 | | For controller enable |
| X1.6<br>X1.7 | Actual value output | i | 0 to -10 V | e.g. for measuring purposes |
| X1.8 | External supplementary setpoint | i* | 0 to ±10 V | |
| X1.9 | Reference potential M (0 V) | M | 0 V | ⏚ |
| X1.10 | Supply from ext. setpoint potentiometer | P10 | +10 V | 10 kΩ potentiometer |
| X1.13 | Reference potential M (0 V) | M | 0 V | |
| X1.14 | Tag | G | | |
| X3.1<br>X3.2<br>X3.3<br>X3.4<br>X3.5<br>X3.6 | Connector for connecting cable to supplementary board | P<br>N<br>M<br>N24<br>$i_e$ *<br>$ie_{act}$ | | |
| ⏚ | Protective conductor terminal | | | |

| Rated supply voltage (50/60 Hz) V | Rated DC voltage V | Rated DC current [1] A | Order No. | Fuse |
|---|---|---|---|---|
| 2-ph. 230 | 190 | 8 | **6DM1001-0WB00-2** | **5SD4 20** |
| | | 15 | **6DM1001-0WB00-2** | **5SD4 20** |
| | | 22 | **6DM1001-0WB00-2** | **5SD4 40** |
| 2-ph. 400 | 325 | 15 | **6DM1001-0WB00-2** | **5SD4 20** |
| | | 22 | **6DM1001-0WB00-2** | **5SD4 40** |

**Please refer to Catalog DA 93.1 for the required commutating reactors.**

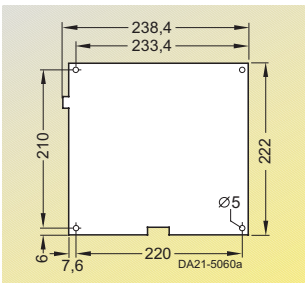



Fig. 2/2
Support plate, overall height approx. 72 mm

## Mounting

Subrack 6DM9005 is intended for mounting a total of seven F 33 Miniregs.

The F 33 Minireg can also be mounted on a vertical surface by means of four spacers, e.g. in a cubicle.

1) The maximum field current of the unit is 22 A. The intermediate values are governed by the commutating rectors and fuses.

## U 315 simple field supply unit Order No. 6RA2200-8DD00

| Function | Terminal | Connection values |
|---|---|---|
| Connection for power section supply and electronics power<br>• Supply phase L1<br>• Supply phase L2 or N | <br>1<br>2 | Rated supply voltages;<br>2-ph. 50/60 Hz 400 V +10 – 15%<br>or<br>2-ph. 50/60 Hz 230 V +10 – 15%<br>(see also terminals 14/15/16)<br>Fuse 2 x 5SD420 |
| Unit ground connection | 5 | |
| Control voltage connection for field weakening<br>• Ground potential<br>• Ext. control voltage E | <br>6<br>7 | <br>0 V<br>0 to +10 V<br>(only field weakening possible) |
| Field current monitoring (floating) | 9<br>10 | 1 NO contact: 230 V/2.5 A AC max.<br>Contact opens at a field current <80 mA |
| Field winding connection<br>• Connection C2(+)<br>• Connection D2(-) | <br>11<br>12 | Rated DC voltage:<br>325 V DC at a rated supply voltage of 2-ph. 400 V;<br>190 V DC at a rated supply voltage of 2-ph. 230 V;<br>max. field current: 3 A |
| Adaptation to rated supply voltages of 2-ph. 400 V or 2-ph. AC 230 V (external jumpers) | 14<br>15<br>16 | Jumper 15 - 16 for a rated supply voltage of 2-ph. 400 V;<br>jumper 15-14 for a rated supply voltage of 2-ph. 230 V |

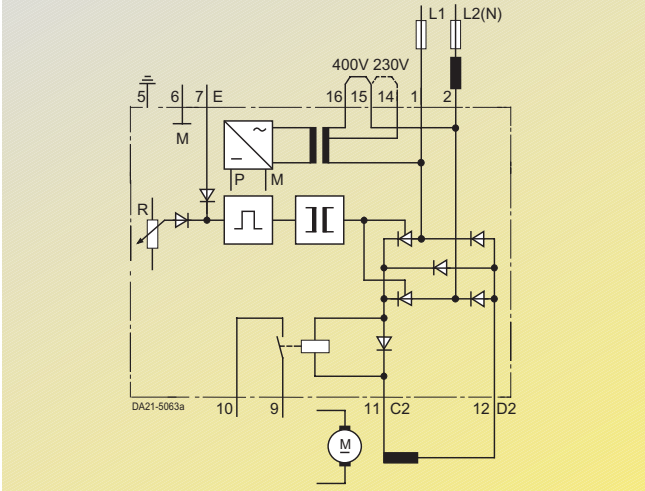



Fig. 2/3

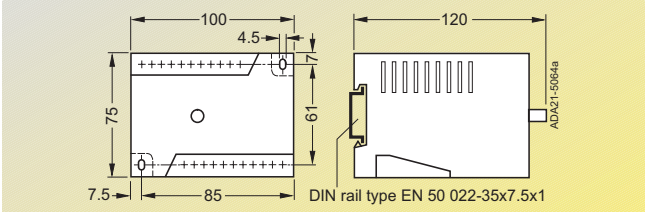



Fig. 2/4

## F 10 Minireg Order No. 6RA8222-8PA0

| Function | Terminal | Connection values | Comments |
|---|---|---|---|
| Rated supply voltage | L1<br>L2 | 2-ph. 50/60 Hz<br>400 V | Tolerance: ±15%<br>Fuses<br>(2 required):<br>5SD4 20 |
| Rated DC voltage | C2<br>D2 | 325 V DC<br>10 A max. | |
| Monitoring relay connection | 1<br>2 | Contact rating<br>230 V AC, 2.5 A | Contact closed as long as current flows |
| Controller enable | 4 | Via internal P or SIMATIC | |
| Reference potential | 5 | M | |
| External analog setpoint | 6 | 0 to +10 V | e.g. from U318 field weakening unit |
| Measured field current | 7 | 0 to -10 V<br>max. 10 mA | For measuring purposes |
| Reference potential | 8 | M | |
| Internal P | 9 | 12 V<br>Short-circuit protected | For controller enable |

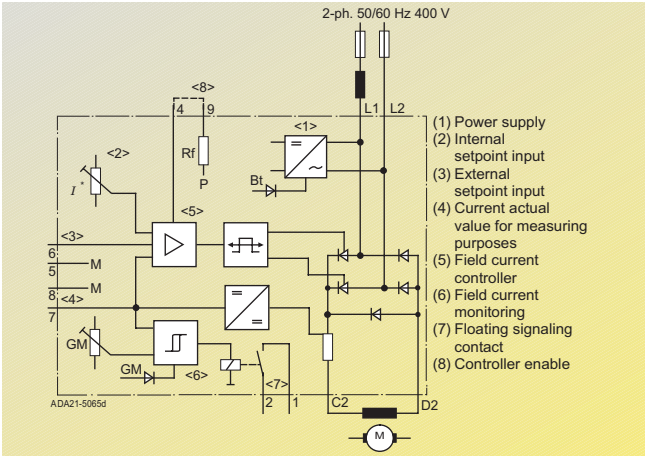



Fig. 2/5

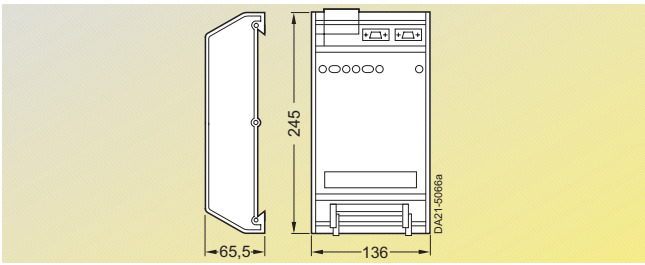



Fig. 2/6

The F 10 Minireg field supply unit is suitable for the supply of controlled fields of up to 10 A.

***Please consult Catalog DA 93.1 for the required commutating reactor.***

# U 318 cut-in field weakening control

**Block diagrams**
**Technical data · Dimension drawings**

## U 318 cut-in field weakening control Order No. 6RA8222-8QA0

### Application

The U 318 module is used for cut-in field weakening control in conjunction with, for example, the F 33 Minireg or F 10 Minireg.

The unit contains the power supply, voltage transformer for sensing the armature voltage with isolation, and cut-in controller. The level of the cut-in voltage is preset via potentiometer V $*_A$ ; the value can be weakened via a switchable input with potentiometer A. Potentiometer $V_A$ serves for adaptation to the armature voltage. The field current setpoint is made available at two different outputs, one from 0 to +10 V and the other from 0 to -10 V, both rated at up to 5 mA max. The maximum or minimum field limit can be set on the potentiometers: Max. and Min.

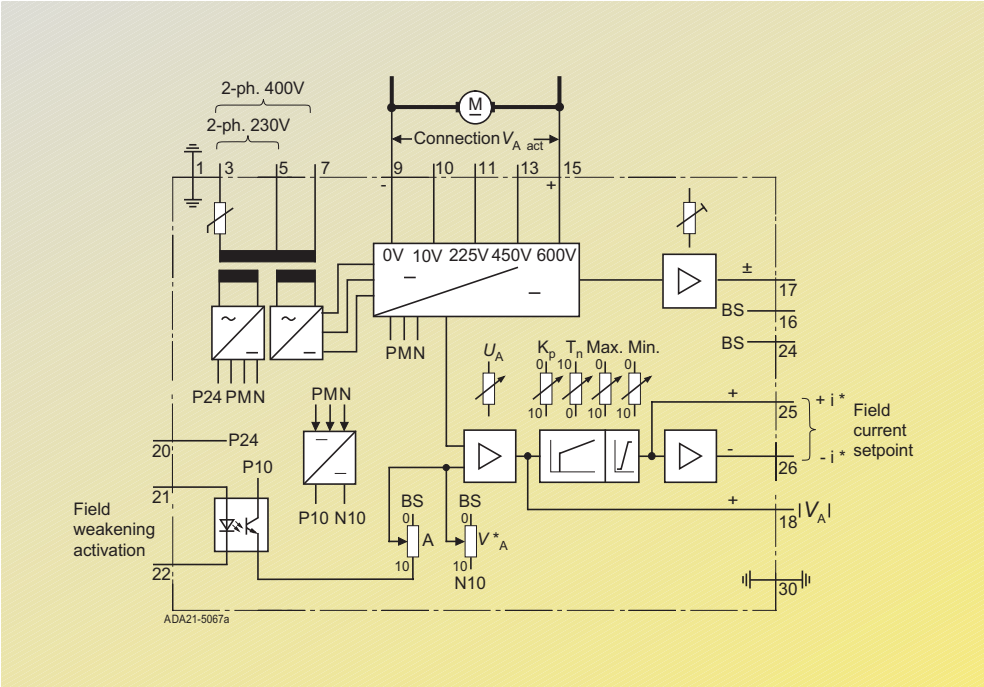



Fig. 2/7

### Mounting

The U 318 cut-in field weakening control can be snapped onto a standard mounting rail to DIN 46 277 (35 mm DIN rail).

The unit can also be mounted directly on a vertical surface using two screwed fixtures to DIN 46 121 and DIN 43 660, e.g. in a cubicle.

For more detailed information, please refer to the Operating Instructions BA-6RA8222-8QA0-X0076.

### Technical data

| | |
|---|---|
| Power supply: | |
| Rated supply voltage | 2-ph. 50/60 Hz, 230/400 V |
| Permissible tolerance | +10%/-15% |
| Current consumption | 50 mA |
| Voltage transformer: | |
| Rated input voltage | 10 V (terminals 9, 10) |
| | 225 V (terminals 9, 11) |
| | 450 V (terminals 9, 13) |
| | 600 V (terminals 9, 15) |
| Input current | ≤ 7 mA |
| Output voltage | ±10 V (5 mA) |
| Linear overdrive capability [1] | 1.1 · $V_{EN}$ |
| Max. overdrive capability [2] | Continuous |
| 10 V input | 12 V |
| 225 V input | 270 V |
| 450 V input | 540 V |
| 600 V input | 720 V |
| Setpoint output | 0 to +10 V (terminal 25) 5 mA |
| | 0 to -10 V (terminal 26) 5 mA |

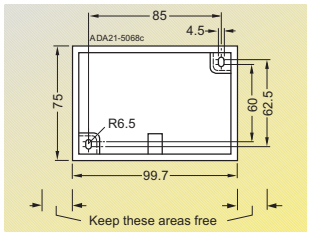



Fig. 2/8

1) Increase of input signal at which the converter still operates linearly (error as in the rated range).

2) Increase of input signal at which the converter is still not damaged.

# Supplementary Units for Drives






3

# U 307 motorized potentiometer

## Design and mode of operation · Technical data

**U 307 digital motorized potentiometer** Order No. **6RA8222-8BA0**

### *Application*

The U 307 digital motorized potentiometer is used as a setpoint generator for closed-loop control equipment. It can serve for the following applications:

- Remote changing of setpoints with separately adjustable ramp-up and ramp-down times
- Ramp-function generator (slope limiter) for analog voltages 0 to -10 V or 0 to +10 V
- Diameter tracking and storage for winder functions (e.g. in conjunction with SIMOREG supplementary boards such as Z 702)

The U 307 operates completely wear-free because a microprocessor is used.

Reliable storage of the output variable is ensured, even when the supply voltage is switched off for any length of time.

The U 307 has its own 230 V power supply.

### *Mode of operation*

Ramp-up and ramp-down times are reproducibly adjustable with quartz accuracy using a thumbwheel switch over the range 1 to 999 s (corresponding to 16:40 min.).

MANUAL mode
(MAN switch setting)

The output voltage is changed via the UP and DOWN control inputs according to the set ramp-up or ramp-down time *t*-UP and *t*-DOWN.

AUTOMATIC mode
(AUTO switch setting)

The output voltage follows an analog reference setpoint along a ramp according to the preset ramp-up/ramp-down time. The reference setpoint can be preset as a voltage signal (0 to -10 V or 0 to +10 V) or as a current signal (0 to 20 mA). Additionally, a potentiometer can serve as the setpoint generator. The U 307 provides a highly accurate +10 V reference voltage for the purpose.

Control inputs

All control inputs are SIMATIC compatible and isolated via optocouplers.

Reset facilities

- The output value can be reset to 0 V at any time via the RESET control input.
- The nonvolatile storage can be canceled by inserting an optional terminal jumper between terminals 27 and 28. When the 230 V supply voltage is switched on, 0 V then appears at the output and not the value in the nonvolatile memory.

External ramp-up time changeover

The external ramp-up time changeover can be activated by inserting a jumper between terminals 29 and 30. In this case, the ramp-up or ramp-down time can be changed during operation with external switch *t*-DN/*t*-UP. At the *t*-DN setting, the time selected at the *t*-DOWN thumbwheel is valid, and at the *t*-UP setting the time selected at the *t*-UP thumbwheel is valid. Whether the motorized potentiometer is ramping-up or ramping-down is insignificant.

For example, the "fast/slow acceleration" function can be implemented in this way.

External reference voltage

An external reference voltage can be applied to terminal 19 for special applications, thus allowing the maximum output voltage to be varied.

### *Mounting*

The U 307 can be snapped onto a standard mounting rail to DIN 46 277. The unit can also be mounted directly on a vertical surface (e.g. in a cubicle) by means of two screw fixtures to DIN 46 121 and DIN 43 660.

A clearance of approx. 15 mm on all sides must be maintained without fail, on account of the temperature rise in the unit.

For more detailed information, please refer to the Operating Instructions, Order No. E31930-T7001-X-A3-7400.

### *Technical data*

| | |
|---|---|
| Design, mounting | Terminal housing for mounting on standard 35 mm DIN rail |
| Dimensions | H x W x D = 75 mm x 99.7 mm x 110 mm (see page 4/4) |
| Rated supply voltage<br>Power supply | 2-ph. 50/60 Hz 230 V +10%/-15%<br>Current consumption 50 mA |
| External control signals | SIMATIC-compatible 24 V signal<br>LOW = 0 to 4.0 V<br>HIGH = 13 to 35 V |
| Resolution (step change) of the output voltage | 2.5 mV |
| Nonvolatile memory | NOVRAM*-IC, storage time > 10 years; backup battery is not necessary |
| Ambient temperature | 0 to +45 °C |


Fig. 3/1

* NOVRAM = Nonvolatile random access memory

## U 307 digital motorized potentiometer (continued)

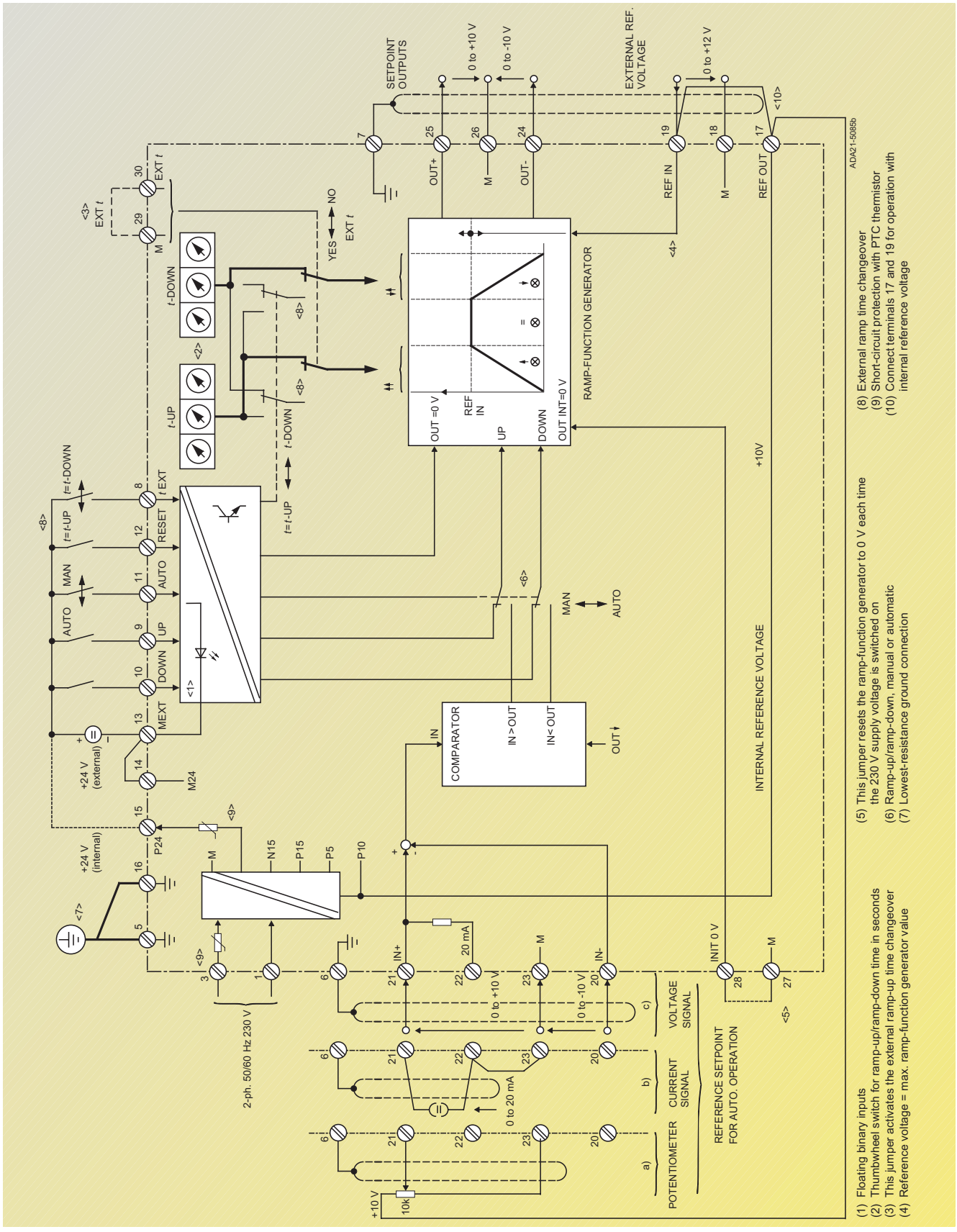



Fig. 3/2

# U 308 A frequency-voltage converter

**Design and mode of operation · Block diagrams**
**Technical data · Dimension drawings**

## U 308 A frequency-voltage converter for pulse generator evaluation Order No. 6RA8222-8CA1

### Application

The U 308 A frequency-voltage converter converts a signal, which is present as a pulse train (frequency), to a direct voltage which is proportional to the pulse frequency.

The direction of rotation can be evaluated by connecting two channels, electrically offset by 90 °, so that the DC output voltage is also available with sign.

On account of its 100 kHz input frequency, the converter is also suitable for fast and dynamic drives.

The *f/V* converter and the preceding rotary pulse encoder are powered by an internal power supply (230 V supply).

The basic function of the U 308 A module can be seen in the figure.

The input signals of channels I and II are available at two decoupled outputs.

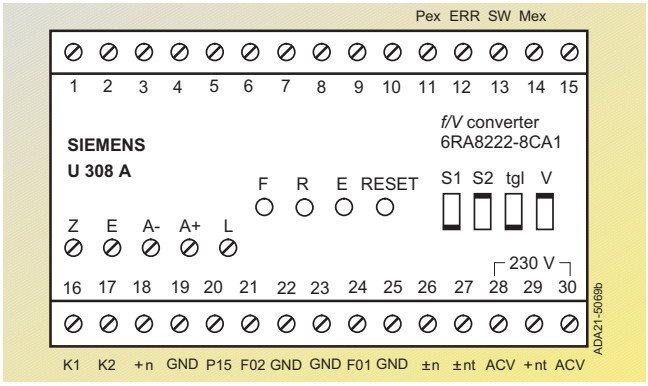



Fig. 3/3
Front view of the U 308 A *f/V* converter

### Technical data

| | |
|---|---|
| Supply | |
| Rated supply voltage | 2-ph. 50 Hz 230 V +10% – 15% |
| Current consumption | 50 mA |
| Rotary encoder supply | |
| Voltage | +15 V with respect to M (0 V) |
| Rating | 80 mA |
| Input level for actual value channels | |
| High | 12 to 30 V |
| Low | -0.6 to 3.5 V |
| Outputs | |
| Positive output | +10 V 5 mA |
| Bipolar output | ±10 V 5 mA |
| Decoupled inverted frequency outputs | Low 0.2 V<br>High 15 V |
| *f/V* converter (N38) | |
| Input frequency range | 0 to 100 kHz (Freq. in) |
| of the DC output voltage | 0 to 9.9 V ±0.05 V |
| Temperature sensitivity of DC output voltage | 1 mV/°C |
| Nonlinearity | 0.01% referred to max. output voltage |
| Short-circuit protection | Continuous with respect to M (0 V) |
| Permissible ambient temperature | 0 to 45 °C |

For more detailed information, please refer to the Operating Instructions, Order No. BA-6RA8222-8CA1.

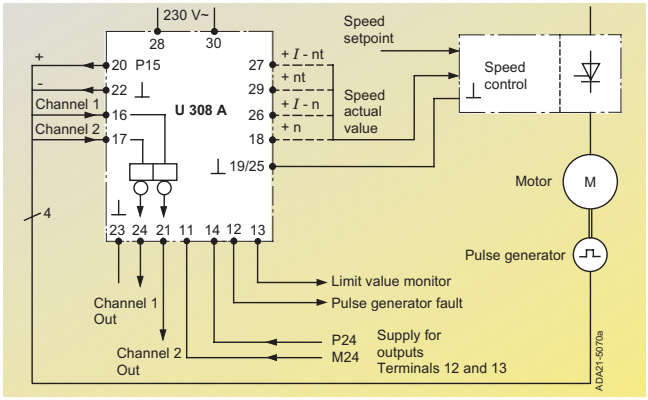



Fig. 3/4
Block diagram

### Mounting

The U 308 A frequency-voltage converter can be snapped onto a standard mounting rail to DIN 46 277 (35 mm DIN rail).

The unit can also be mounted directly on a vertical surface, e.g. in a cabinet, by means of two screw fixtures to DIN 46 121 and DIN 436 60.

Dimensions:
H x W x D = 75 mm x 99.7 mm x 110 mm (see also dimension drawing).

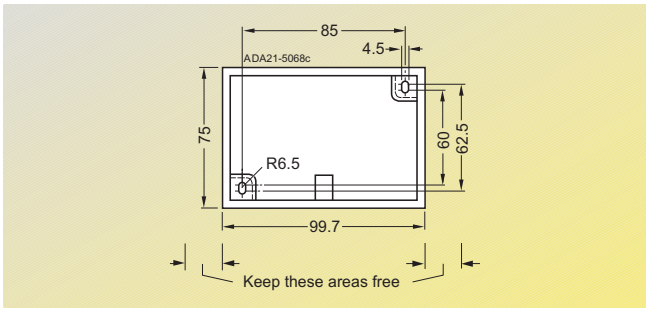



Fig. 3/5

## U 309 adaptor module 4 to 20 mA for U 307 digital motorized potentiometer Order No. 6RA8222-8DA0

### Application

The U 309 adaptor module allows the U 307 digital motorized potentiometer to be operated also in the automatic mode with a reference setpoint of 4 to 20 mA (impressed current with live zero).

Circuit description

The circuit diagram is shown in the figure. A voltage of exactly 2.50 V is obtained via a voltage divider (R4-R7) from the +10.00 V reference voltage available at terminal 17 of the motorized potentiometer. This voltage is applied to input IN- of the motorized potentiometer (terminal 20) and compensates the 4 mA live zero current.

A load resistance of exactly 634 Ω (R1 + R2 + R3) is inserted between terminals 21 and 23 of the motorized potentiometer; the 4 to 20 mA signal source is also connected at that point. The total signal excursion of 16 mA results in a voltage drop of exactly +10.00 V at motorized potentiometer input IN+. The input impedance of IN+ of 44 kΩ was taken into account for the design rating of the resistors.

Fig. 3/6

### Technical data

| | |
|---|---|
| Dimensions<br>Weight | H x W x D = 75 mm x 22.5 mm x 100 mm<br>approx. 0.15 kg |
| Max. zero point error when supplied (without fine adjustment) at $I_{IN}$ = 4 mA | OUT+, OUT- = 0 V ±12 mV |
| Max. gain error at $I_{IN}$ = 20 mA | OUT+ = +10 V ±110 mV<br>OUT- = -10 V ±110 mV |
| Input impedance of the current input (between terminals 32 and 31) | 634 Ω |

For more detailed information, please refer to the Operating Instructions, Order No. E319/An/U 309 BA.

### Mounting

The U 309 adaptor module can be snapped onto a standard mounting rail to DIN 46 277 (35 mm DIN rail). It is not intended for screw fixing.

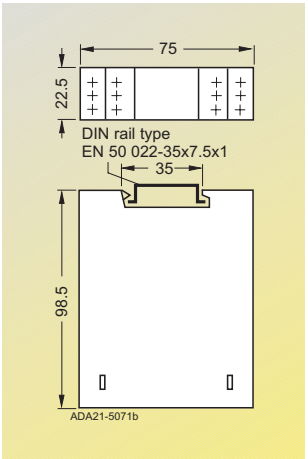



Fig. 3/7

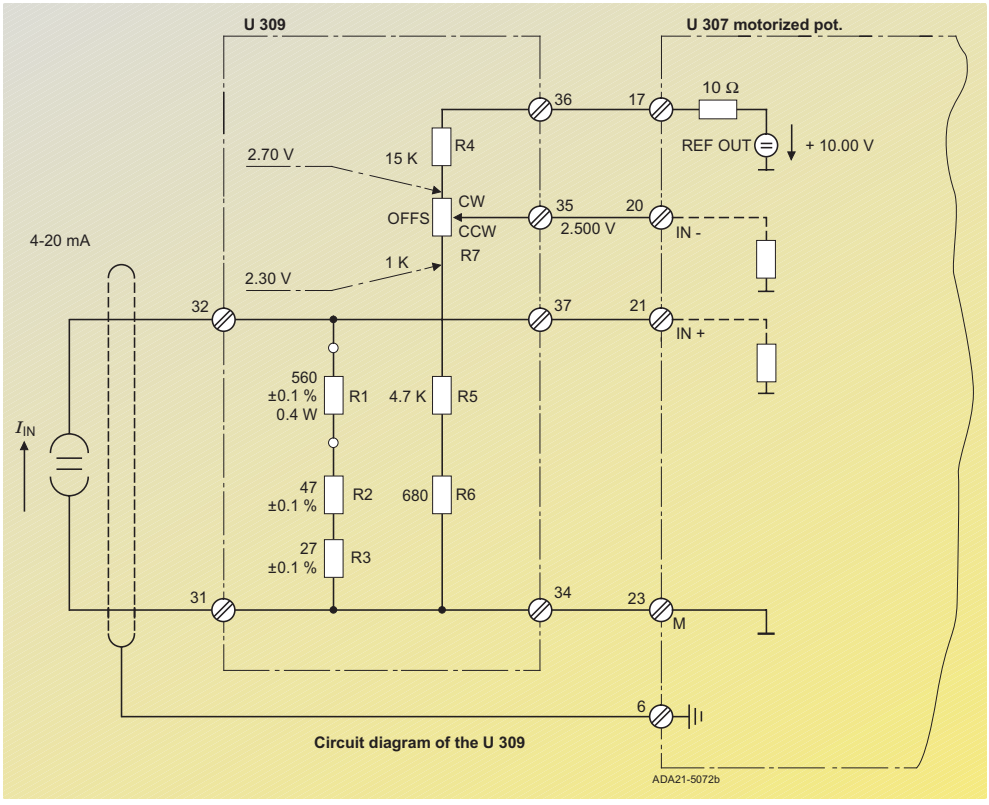



Fig. 3/8

# U 312 voltage converter

**Design and mode of operation · Block diagrams**
**Technical data · Dimension drawings**

## U 312 voltage converter Order No. 6RA8222-8GA0

### Application

The U 312 direct voltage converter is used for sensing the voltage actual value for voltage and EMF closed-loop controls.

It converts the DC input voltage to a floating, proportional voltage with sign of 0 to ±10 V.

### Mounting

The U312 is directly screwed onto the cabinet mounting plate.

The components of the converter are mounted on a PC board and are encapsulated in a vibration-proof molded-plastic enclosure.

If necessary, the transmitter can be installed in the 6KA9902 shielded housing.

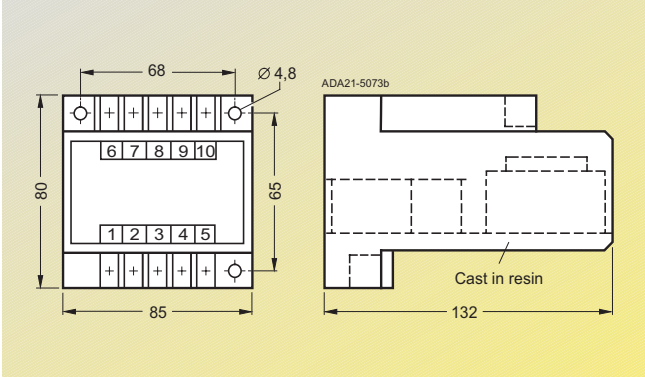



Fig. 3/9

3

### Technical data

| | |
|---|---|
| Power supply | |
| Rated supply voltage | 2-ph. 50/60 Hz 230/400 V |
| Permissible tolerance | +10% to -15% |
| Current consumption | ≤ 10 mA |
| Input | |
| Rated input voltage | 10 V (terminals 9, 10)<br>225 V (terminals 8, 10)<br>450 V (terminals 7, 10)<br>600 V (terminals 6, 10) |
| Rated input current | ≤ 7 mA |
| Linear overdrive capability [1] | 1.1 · $U_{EN}$ |
| Max. overdrive capability [2] | Continuous |
| 10 V input | 12 V |
| 225 V input | 270 V |
| 450 V input | 540 V |
| 600 V input | 720 V |

| | |
|---|---|
| Output | |
| Rated output voltage | ±10 V |
| Max. output current | 5 mA |
| Conversion error (proportional error) | ≤ 1% |
| Zero point error | ≤ 0.2% |
| Short-circuit protection | Continuous |
| No-load protection | Continuous |
| Clock frequency | 4 kHz |
| Ripple $V_{pp}$/V- | |
| of the 4 kHz clock frequency | ≤ 0.5% |
| Test voltage to DIN VDE 0160 | |
| Input with respect to output | 4 kV (rms) |
| Output with respect to supply voltage | 2.5 kV (rms) |
| Permissible ambient temperature | |
| in operation | 0 to 45 ° C |
| for storage | -50 to +85 ° C |

For more detailed information, please refer to the Operating Instructions, Order No. BA-6RA8222-8GA0.

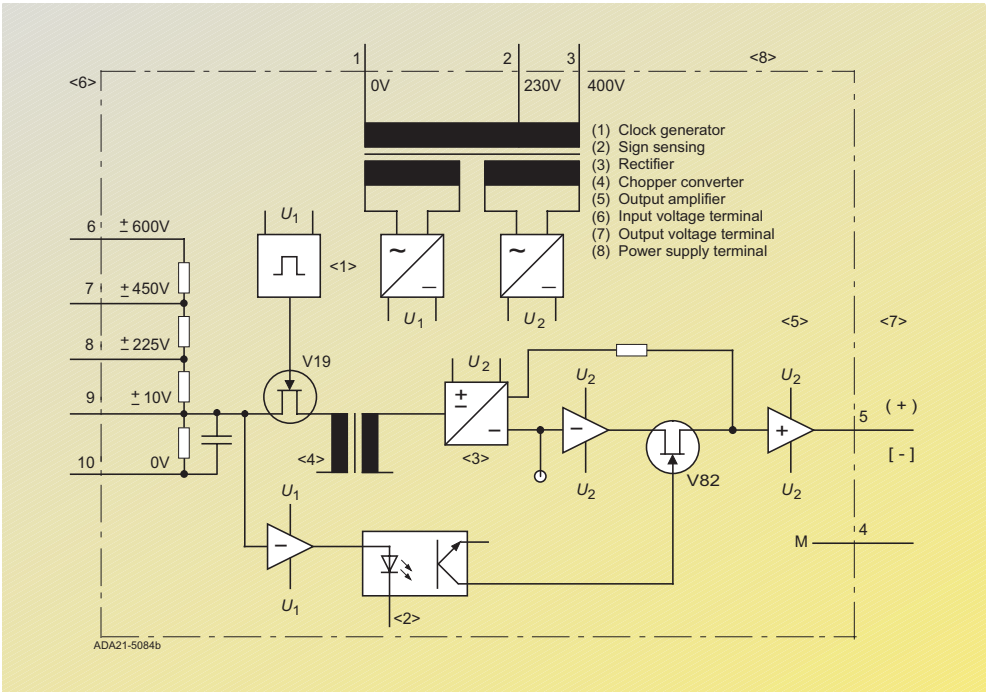



Fig. 3/10

Fig. 3/11

1) Increase of input signal at which the converter still operates (error as in the rated range).

2) Increase of input signal at which the converter is still not damaged.

## U 313 current-voltage / voltage-current converter Order No. 6RA8222-8HA0

### *Description*

The U 313 adaptor module contains two independent circuit branches:

1. Current/voltage conversion (0/4 to 20 mA -> 0 to 10 V)
2. Voltage/current conversion (0 to 10 V -> 0/4 to 20 mA)

The current range 0 to 20 mA or 4 to 20 mA (live zero) can be selected with a switch on the front plate.

The inputs and outputs as well as power supply are referred to unit ground (non-floating).

Fig. 3/12

### *Technical data*

| | |
|---|---|
| Design, mounting | Terminal housing for mounting on 35 mm standard rail to DIN 46 227 and DIN EN 50 022 |
| Terminals | Screw terminals, max. conductor cross-section 2.5 mm² |
| Dimensions | H x W x D = 75 mm x 22.5 mm x 100 mm |
| Supply voltage | +24 V (+20 to +30 V) external |
| Current consumption | 45 mA max. (if both branches are in operation) |
| Storage and transportation temperature | -50 to +85 ° C |
| Ambient temperature | 0 to +45 ° C |
| Humidity rating | F |

| Circuit branch: current-voltage conversion | |
|---|---|
| Input resistance | 167.3 Ω (209.3 Ω for live zero operation) |
| Input current | 0 to 20 mA (4 to 20 mA for live zero operation) |
| Output resistance | 112 Ω |
| Output voltage | 0 to +10 V; 0 to -10 V (+11.5 V max. or -11,5 V max.) |
| Max. output current | 2 mA (≙ 5 kΩ load resistance) |
| Short-circuit protection | Continuous |
| Accuracy | ±25 mV at 10 V (±30 mV for live zero) |
| Zero point error | ±10 mV (±20 mV for live zero) |

| Circuit branch: voltage-current conversion | |
|---|---|
| Input resistance | 10 MΩ |
| Input voltage | 0 to +10 V; 0 to -10 V |
| Output resistance | ≤ 0.1 Ω |
| Output current | 0 to 20 mA (4 to 20 mA for live zero) |
| Permissible load resistance | 0 to 700 Ω |
| Accuracy | ±70 µA at 20 mA (±80 µA for live zero) |
| Zero point error | ±20 µA (±30 µA for live zero) |

For more detailed information, please refer to the Operating Instructions, Order No. E319-6RA8222-8HA0.

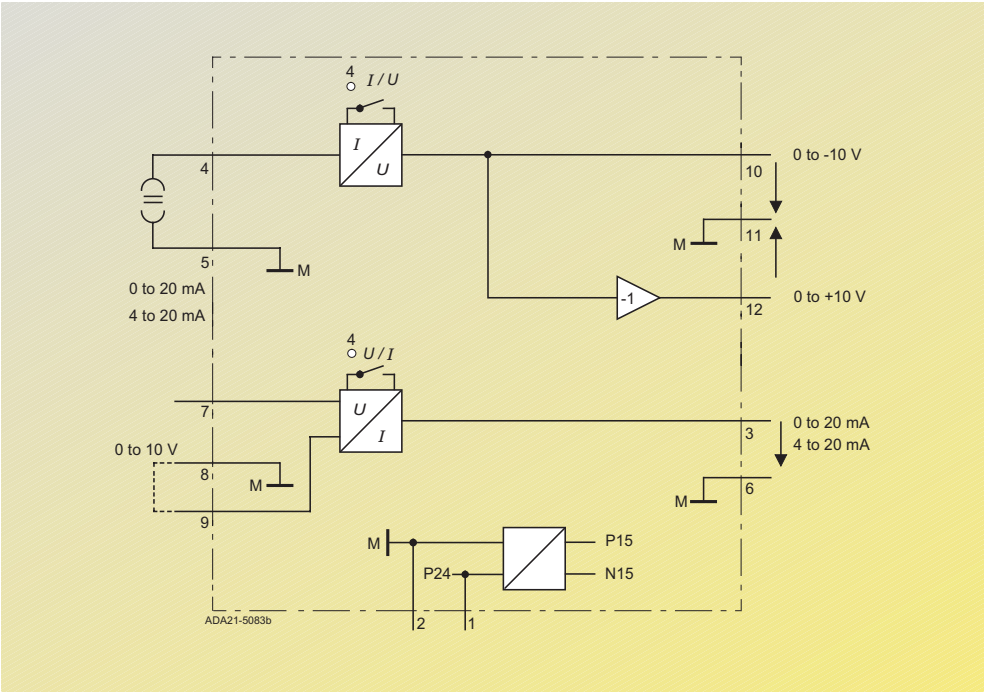



Fig. 3/13

# External power supply

**Design and mode of operation · Technical data**
**Dimension drawings**

## External power supply for Z 7.. supplementary boards Order No. 6RA8222-1WB0

### Application

The 6RA8222-1WB0 unit acts as the power supply and mechanical support for Z 7.. supplementary technology boards with order number 6RA8222-1.. or -2.. which are not installed in a SIMOREG K analog converter from which they are powered. These supplementary boards can therefore also be operated in conjunction with other drive control devices which have not been prepared for the installation of such boards.

### Design

The power supply consists of a power supply unit board with the same dimensions as the Z 7.. supplementary boards, and is mounted on a bracket with spacer bolts. The supplementary board to be powered is mounted, in turn, on the power supply board with spacer bolts. The mounting hardware required is provided with the power supply.

The power supply is designed as standard for connection to three-phase 400 V ±10% 50/60 Hz. It provides all the ±10 V, ±15 V and ±24 V DC voltages required to operate a Z 7.. supplementary board. It does not support boards which require floating AC voltages. The Z 7.. supplementary boards have a non-detachable ribbon cable for the supply of power. The free end of this cable must be inserted into socket X4 on the power supply bo-ard. All supply voltages produced are also available at the plug-in terminal strip X2 of the power supply board. This therefore provides the supply for setpoint potentiometers, actual value sensors, etc.. The maximum permissible loading of individual voltages must be observed according to the technical data table.

One inverting and one non-inverting operational amplifier, the inputs and outputs of which are routed to terminals strip X2, are also provided for optional applications.

Availability of the +15 V and -15 V voltages is indicated by an LED in each case.

All DC voltage outputs of the power supply are short-circuit protected.

### Terminals

| Terminal | Function | Connection values | Comments |
|---|---|---|---|
| X1.1<br>X1.3<br>X1.5 | Input supply | 3-ph. 400 V ±10%<br>50/60 Hz | Input |
| X2.1 | N10 | -10 V/0.01 A | Output |
| X2.2 | M | 0 V | Reference potential |
| X2.3 | P10 | +10 V/0.01 A | Output |
| X2.4 | N15 | -15 V/0.1 A | Output |
| X2.5 | M | 0 V | Reference potential |
| X2.6 | P15 | +15 V/0.1 A | Output |
| X2.7 | N24 | -24 V/0.1 A | Output |
| X2.8 | M | 0 V | Reference potential |
| X2.9 | P24 | +24 V/0.3 A | Output |
| X2.10 | In A- | 0 to ±10 V; 33 kΩ | Input, amplifier A (inverting) |
| X2.11 | Out A | 0 to ±10 V; 10 mA | Output, amplifier A |
| X2.12 | In B+ | 0 to ±10 V; > 1 MΩ | Input, amplifier B (non-inverting) |
| X2.13 | Out B | 0 to ±10 V; 10 mA | Output, amplifier B |
| X3 | ⏚ | PE | Protective conductor |

### Technical data

| | |
|---|---|
| Ambient temperature in operation | 0 to 45 ° C |
| Storage temperature | -30 to +85 ° C |
| Humidity rating DIN 40 040/SN 26 556 | F |
| Degree of protection DIN 40 050/IEC 144 | IP00 |
| Dimensions W x H x D | 270 mm x 155 mm x 80 mm |
| Weight | approx. 1.6 kg |

For further information, please refer to the Operating Instructions, Order No. BA-6RA8222-1WB0.

### Mounting

The power supply is mounted on an L-shaped bracket. The wide side of this bracket can be snapped onto a 35 mm DIN rail. Each arm of the bracket also has four mounting holes of 5.5 mm diameter, allowing the unit to be screwed onto the mounting plate. If the unit is to be screwed on with the wide side of the bracket, the two retaining clips for DIN rail mounting should first be removed.

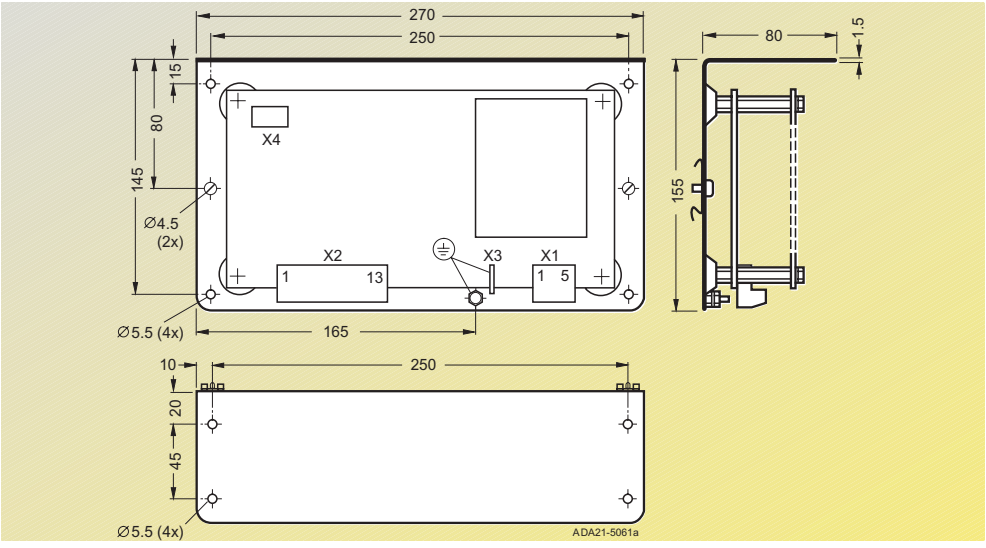



Fig. 3/14

# Planning Guide

## Installation notes for drives with Electromagnetic Compatibility (EMC)

### Fundamentals of EMC

#### What is EMC?

EMC stands for "**e**lectro-**m**agnetic **c**ompatibility"; it describes the capability of a device to operate satisfactorily in the electromagnetic environment, without causing electromagnetic interference which is unacceptable for other devices in this environment. In other words, the different devices must not interfere with each other.

#### Emitted interference and interference immunity

EMC depends on two characteristics of the devices involved: emitted interference and interference immunity. Electrical devices can be interference sources (transmitters) and/or interference sinks (receivers).

Electromagnetic compatibility exists when the interference sources do not affect functioning of the interference sinks.

A device can be simultaneously an interference source and sink. For example, the power section of a converter can be considered as an interference source, and the control section as an interference sink.

#### Limit values

Product standard EN 61 800-3 (IEC 61 800-3, VDE 160 Part 100) covers electrical drives. According to this product standard, not all EMC measures are essential for industrial supply systems; a solution must be defined which is adapted to the actual environment. Thus it may be economically more advantageous to increase the interference immunity of a sensitive device rather than implement interference suppression on the converter. The choice of solution, therefore, also depends on economic factors.

To some extent, adherence to EN 55 011 is required. This defines the limit values for emitted interference in industry and in residential buildings. Conducted interference at the supply connection is measured under standardized conditions as a radio interference voltage, electromagnetically emitted interference as interference emission. The standard defines limit values "A1" and "B1" which apply to radio interference voltage over the range 150 kHz to 30 MHz, and to interference emission over the range 30 MHz to 2 GHz. Since the SIMOREG K converters are used in industry, limit value "A1" applies. To achieve limit value "A1," the SIMOREG K units must be provided with external RFI filters.

Interference immunity describes the behavior of a device under the influence of electromagnetic interference. Standard EN 50 082-2 governs the requirements and assessment criteria for the behavior of the devices in industry. This standard is met by the converters listed in the following chapter.

#### Application in industry

In industry, the interference immunity of the devices must be very high, whilst lower demands are made on emitted interference.

The SIMOREG K converters are components of an electrical drive, as are contactors and switches. Skilled personnel must integrate them in a drive system comprising at least the converter, motor cables and the motor. Commutating reactors and fuses are usually also needed. Proper installation thus also determines whether or not a limit value will be met. To limit the emitted interference according to limit value "A1," at least the corresponding RFI filter and the commutating reactor are also needed in addition to the converter. Without RFI filter, the emitted interference of the SIMOREG K converters exceeds limit value A1 of EN 55 011.

If the drive is part of an installation, it need not initially meet requirements relating to emitted interference. However, the EMC legislation requires that the entire installation be electromagnetically compatible with the environment.

If all the control components of the installation, such as automation equipment, exhibit industrial-grade interference immunity, there is no need for each drive to satisfy limit value "A1."

#### Ungrounded supply systems

In some branches of industry, ungrounded supply systems (IT systems) are used to increase availability of the plant. In the event of a ground fault, there is no ground current and the plant can continue with production. In conjunction with RFI filters, however, there is a fault current in the event of a ground fault which can result in a shutdown of the drives or even the destruction of the RFI filter. The product standard therefore does not specify limit values for these systems. For economic reasons, interference suppression, if required, should be implemented on the grounded primary side of the supply transformer.

#### EMC planning

If two devices are electromagnetically incompatible, you can reduce the emitted interference of the source or increase the interference immunity of the sink. Interference sources are usually devices of power electronics with a high current consumption. To reduce their emitted interference, elaborate filters are required. Interference sinks are, in particular, control units and sensors including their evaluation circuitry. Enhancing the interference immunity of low-power devices is less involved. For economical reasons in industry, therefore, it is often more favorable to increase the interference immunity than to reduce emitted interference. To satisfy limit value class A1 of EN 55 011, for example, the radio interference voltage at the supply terminals must not exceed 79 dB (µV) between 150 and 500 kHz, and 73 dB (µV) (9 mV or 4.5 mV) between 500 kHZ and 30 MHz.

In industry, EMC of devices should be based on a judicious balance between emitted interference and interference immunity.

The least expensive suppression method is to separate the interference sources and sinks, provided that this is allowed for during the planning of a machine/plant. For each device used, the first question is whether it is a potential interference source or sink. Examples of interference sources in this context are converters and contactors. Examples of interference sinks are programmable controllers, encoders and sensors.

The components in the cabinet (interference sources and sinks) should be separated, if necessary with partition plates or by installing them in metal housings. Shown in Fig. 5/1 is a possible arrangement of components in the cabinet.

## Installation of drives with EMC (installation notes)

### *General*

Since the drives are operated in very different environments, and additional electrical components (controllers, switched-mode power supplies, etc.) can differ greatly with regard to interference immunity and emitted interference, each installation guideline can only be a sensible compromise. In individual cases, therefore, after examination, deviation from the EMC rules is permissible.

To ensure electromagnetic compatibility (EMC) in your cabinets in an electrically harsh environment, and to be able to meet the legal standards, the following EMC rules should be observed during design and installation.

Rules 1 to 10 are generally valid. Rules 11 to 15 are necessary to meet the emitted interference standards.

### *Rules for electromagnetically compatible installation*

Rule 1

All metal parts of the cabinet must be joined to each other with good electrical contact (not paintwork on paint-work!). Contact or toothed washers should be used where necessary. The cabinet door should be connected to the cabinet via ground straps (at top, middle and bottom) with as short a path a possible.

Rule 2

Contactors, relays, solenoid valves, electromagnetic hours-run counters, etc. in the cabinet, and if necessary in adjacent cabinets, should be provided with suppression combinations, such as RC networks, varistors, diodes. The circuitry must be implemented directly at the particular coil.

Rule 3

Signal lines [1]) should be routed into the cabinet from one level if possible.

Rule 4

Unshielded conductors of the same circuit (outgoing and return conductors) should be twisted together if possible, i.e. the surface between outgoing and return conductors should be kept as small as possible to prevent the creating of unnecessary frame antennas.

Rule 5

Spare cores should be connected to the cabinet ground [2]). This achieves additional shielding.

Rule 6

Unnecessary line lengths should be avoided. Coupling capacitances and inductances are thus kept low.

Rule 7

In general, crosstalk is reduced when conductors are placed close to the cabinet ground. Wiring should therefore not be placed in free space in the cabinet but, where possible, routed closely along the cabinet housing or installation plates. This also applies to spare cables.

Rule 8

Signal lines and power cables should be laid separately from each other (to avoid coupling paths). A minimum clearance 20 cm is desirable.

If segregation between sensor and motor cables is not possible, the sensor cable should be decoupled by a partition plate or by installing it in a metal conduit. The partition plate or metal conduit should be grounded at several points.

Rule 9

The shields of digital signal cables should have large-area good electrical grounding at each end (source and destination). In the event of poor equipotential bonding between the shield connections, an additional equalizing conductor of at least 10 $mm^2$ should be laid in parallel with the shield to reduce the shield current. In general, shields may be connected to the cabinet housing (ground) at several points. Even outside the cabinet, the shields may be connected in several places.

Foil shields are not satisfactory. Compared to braid shields, their shielding effect is inferior by a factor of at least 5.

Rule 10

With good equipotential bonding, the shields of analog signal lines may be grounded at both ends (with large-area good electrical contact). Good equipotential bonding can be assumed if all metal parts make good contact and the electronic components involved are powered from the same power supply.

Single-ended shield grounding prevents low-frequency, capacitive interference pickup such as 50 Hz hum. The shield connection should be made in the cabinet; a sheath wire may be used to connect the shield.

Rule 11

Positioning the RFI filter in the vicinity of the suspected interference source. The filter should be mounted with its surface on the cabinet housing, mounting plate, etc.. Input and output leads should be separated.

Rule 12

The use of RFI filters is mandatory for meeting limit value class A1. Additional loads should be connected ahead of the filter (supply system side).

The need to install an additional line filter depends on the controller in use and on the type of wiring of the rest of the cabinet.

Rule 13

With a regulated field current supply, a commutating reactor is needed in the field circuit.

Rule 14

A commutating reactor is needed in the armature circuit of the converter.

Rule 15

With SIMOREG drives, the motor cables may be unshielded. The supply cable must have a clearance of at least 20 cm from the motor cables (field, armature). A partition plate should be used if necessary.

1) Signal lines are defined as:
Digital signal line: lines for pulse generators
Serial interfaces, e.g. PROFIBUS-DP or analog signal line (e.g. ±10 V setpoint line).

2) The definition of ground, in general, is all metallically conductive parts which can be connected to a protective conductor, e.g. cabinet housing, motor housing, foundation earth, etc.

## Installation notes for drives with Electromagnetic Compatibility (EMC)

### Cabinet arrangement and shielding

The cabinet arrangement of Fig. 4/1 is intended to draw the user's attention to the EMC-critical parts. The example does not necessarily show all possible cabinet components or arrangements.

Details affecting interference immunity/emitted interference of the cabinet and which do not clearly appear in the block diagram, are described in Figs. 4/2 and 4/3.

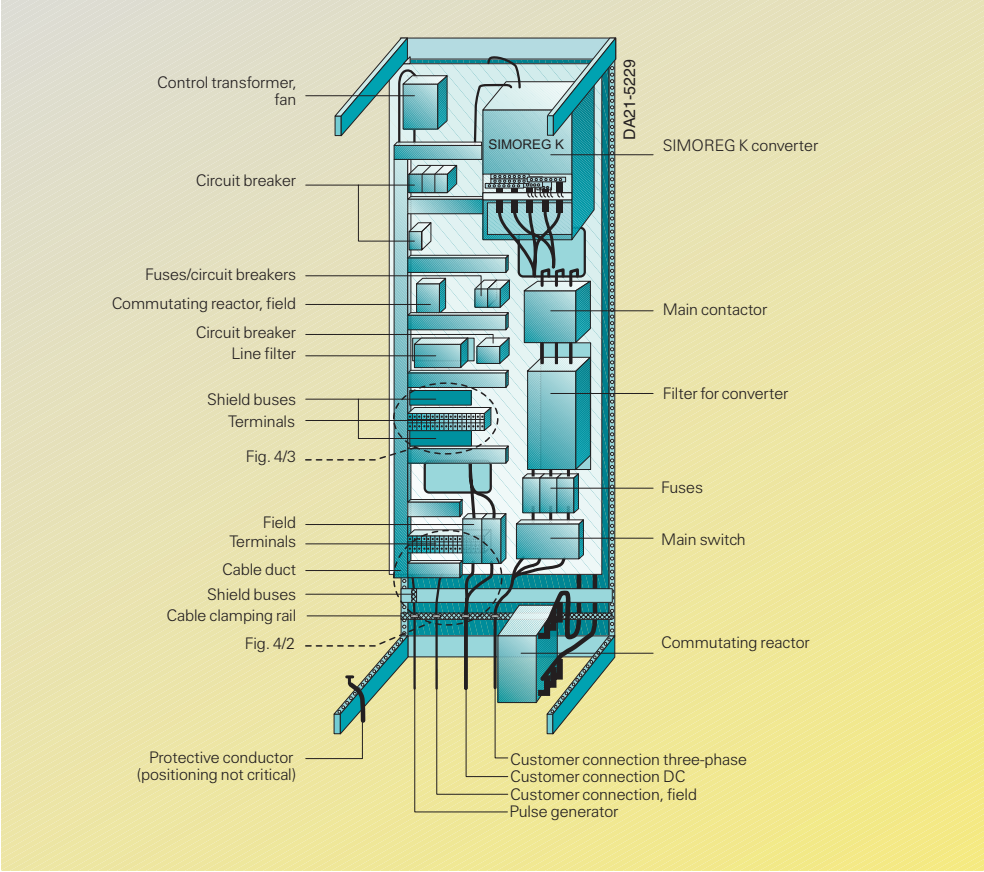



Fig. 4/1
Example of cabinet arrangement with a SIMOREG K

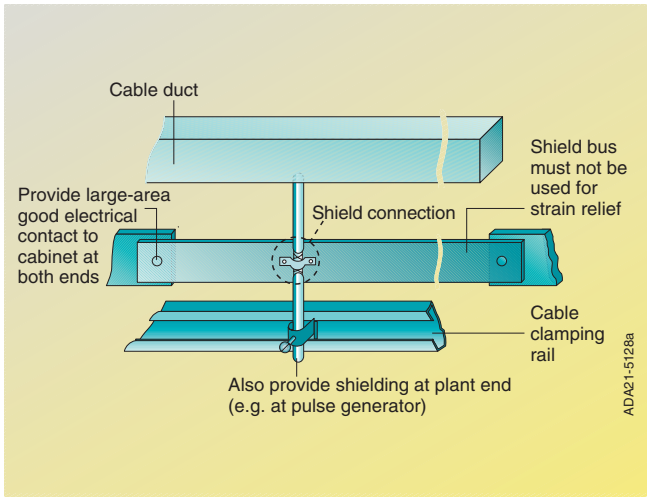



Fig. 4/2
Shielding with routing into the cabinet

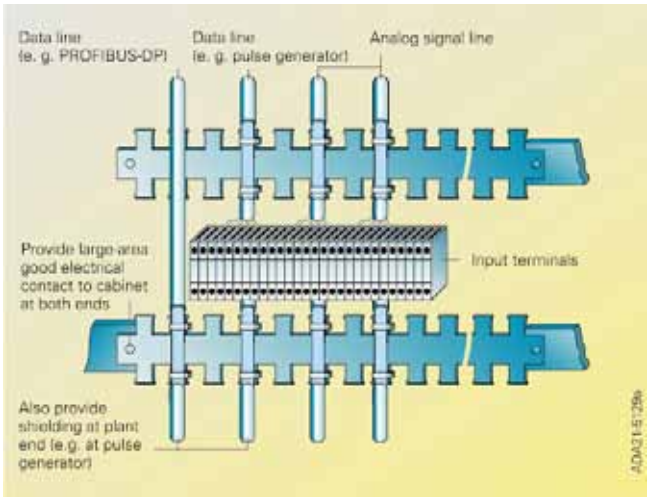



Fig. 4/3
Shielding in the cabinet

### *Arrangement of RFI filters and commutating reactors:*

Shown in the following section is the arrangement of RFI filters and commutating reactors for SIMOREG K converters. The order of installation of reactors and filters must be followed. The choice of fuses for semiconductor protection is based on the operating instructions of the converters.

## Components for the converters

The arrangement of radio interference suppression filters and commutating reactors for SIMOREG K converters is shown in the Figures below. The reactors and filters must be installed in the specified order.

Caution

When filters are used, commutating reactors are always needed between the filter and the input of the unit to decouple the RC circuit.

For selection of the commutating reactors, see page 4/6.
For selection of the radio interference suppression filters, see page 4/7.

### *SIMOREG K 6RA22 for three-phase systems: arrangement of reactors and filters*

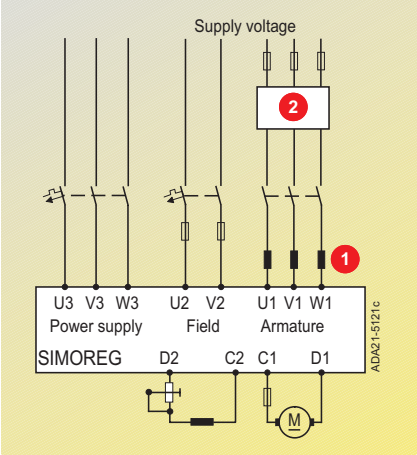



Fig. 4/4

### *SIMOREG K 6RA22..-8DD21-.: arrangement of reactors and filters*

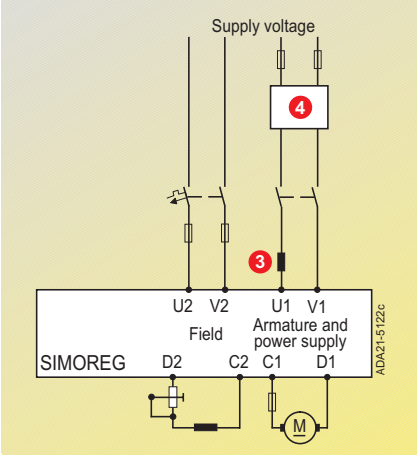



Fig. 4/5

### *SIMOREG K 6RA22..-8DK27-.: arrangement of reactors and filters*

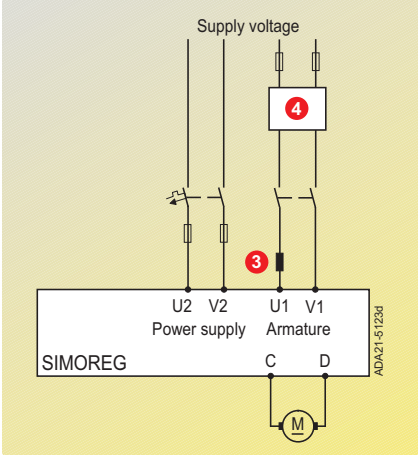



Fig. 4/6

### *U 315 field supply unit: 6RA2200-8DD00: arrangement of reactors and filters*

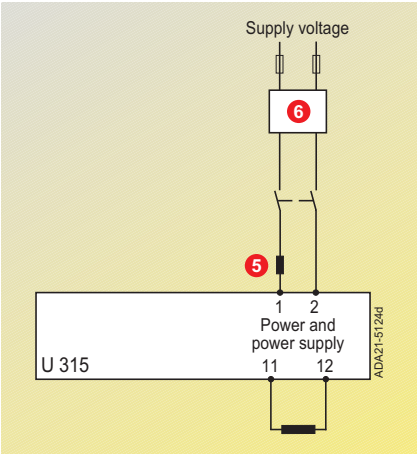



Fig. 4/7

### *F 10 Minireg field supply unit: 6RA8222-8PA0: arrangement of reactors and filters*

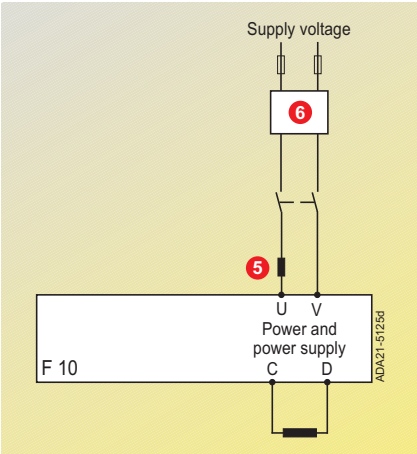



Fig. 4/8

### *F 33 Minireg field supply unit: 6DM1001-0WB00-2: arrangement of reactors and filters*

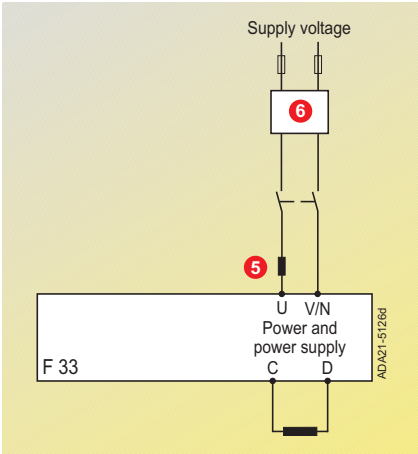



Fig. 4/9

1. The commutating reactor in the armature circuit is designed for the rated motor current in the armature. The supply current is equal to the DC multiplied by 0.82.
2. The filter for the armature circuit is designed for the rated motor current in the armature. The supply current is equal to the DC multiplied by 0.82.
3. The commutating reactor in the armature circuit is designed for the rated motor current in the armature.
4. The filter for the armature circuit is designed for the rated motor current in the armature.
5. The commutating reactor is designed for the rated motor current in the field.
6. The filter is designed for the rated motor current in the field.

## Line commutating reactors

### *Line commutating reactors*

A converter must always be connected to the supply via a commutating inductance. This must be at least 4 % $u_k$! The commutating inductance can be implemented as a converter transformer or, with appropriate mains voltage, as a commutating reactor.

A supply can be regarded as "constant" when the output ratio $P_s/S_k \leq 0.01$. Even in the case of a constant supply, the commutating reactor must have a $u_k$ of at least 4 %!

For high-power converters, the supply reactance, i.e. the total short-circuit power of the supply must be taken into account, which also results in a larger $u_k$ value. The recommended ratio of supply short-circuit power to apparent drive power is > 33:1.

The commutating reactors are dimensioned for the rated motor current in the armature or field circuit.

Operation on a 50 Hz and 60 Hz supply

The rated currents $I_{Ln}$ specified in the Table for the reactors apply for operation at a supply frequency $f = 50$ Hz. Operation of the reactors at a supply frequency $f = 60$ Hz is permissible. In this case, the permissible rated current $I_{Ln}$ is reduced to 90 %.

$I_{Ln}$ (60 Hz) = 0.9 · $I_{Ln}$ (50 Hz)

At the same time, the voltage drop $\Delta U$ increases by 8 %.

For further details, see Catalog PD 30.

| Rated AC current<br>$I_{Ln}$<br>A | Max. AC current<br>$I_{Lmax}$<br>A | Permissible continuous DC current<br>$I_{dn}$ 1)<br>A | Referred voltage drop $u_D$ of the reactor at $I_{Lmax}$ and $U_N$<br>Order No.:<br>**400 V** |
|---|---|---|---|
| ***Single-phase commutating reactors $I_{Ln} = I_{Lmax}$ with inductive load*** | | | |
| 8 | 8 | 9,8 | **4EM48 07-1CB** |
| 10 | 10 | 12,3 | **4EM49 11-7CB** |
| 11.2 | 11.2 | 13.7 | **4EM49 11-8CB** |
| 12.5 | 12.5 | 15.3 | **4EM49 12-0CB** |
| 14 | 14 | 17.2 | **4EM49 12-1CB** |
| 15 | 15 | 18.4 | **4EM50 00-2CB** |
| 18 | 18 | 22 | **4EM50 05-6CB** |
| 20 | 20 | 24.5 | **4EM50 05-7CB** |
| 22.4 | 22.4 | 27.4 | **4EM50 05-8CB** |
| 24 | 24 | 29.4 | **4EM51 00-2CB** |
| 28 | 28 | 34 | **4EM61 00-2CB** |
| 31.5 | 31.5 | 39 | **4EM61 00-3CB** |
| 35.5 | 35.5 | 43 | **4EM52 12-8CB** |
| 40 | 40 | 49 | **4EM52 00-1CB** |
| ***Three-phase commutating reactors $I_{Ln} = 0.8 \cdot I_{Lmax}$ with inductive load, 3-ph. AC 50 Hz*** | | | |
| 16 | 20 | 19.6 | **4EP36 01-3DS** |
| 18 | 22.4 | 22 | **4EP36 01-4DS** |
| 20 | 25 | 24.5 | **4EP36 01-5DS** |
| 22.4 | 28 | 27.4 | **–** |
| 25 | 31.5 | 31 | **4EP37 01-5DS** |
| 28 | 35.5 | 34 | **4EP37 01-6DS** |
| 31.5 | 40 | 39 | **4EP37 01-7DS** |
| 35.5 | 45 | 43 | **4EP37 01-8DS** |
| 40 | 50 | 49 | **4EP38 00-2DS** |
| 45 | 56 | 55 | **4EP38 01-6DS** |
| 50 | 63 | 61 | **4EP38 00-3DS** |
| 56 | 71 | 69 | **4EP39 01-4DS** |
| 63 | 80 | 77 | **4EP39 00-2DS** |
| 71 | 91 | 87 | **4EP40 02-7DS** |
| 80 | 100 | 98 | **4EP40 00-3DS** |
| 91 | 112 | 112 | **4EP40 02-8DS** |
| 100 | 125 | 123 | **4EP40 03-0DS** |
| 112 | 140 | 137 | **4EU24 22-6AA00-0A** |
| 125 | 160 | 153 | **4EU24 22-7AA00-0A** |
| 140 | 180 | 172 | **4EU25 22-2BA00-0A** |
| 160 | 200 | 196 | **4EU25 22-3BA00-0A** |
| 180 | 224 | 221 | **4EU25 22-4BA00-0A** |
| 200 | 250 | 245 | **4EU25 22-5BA00-0A** |
| 224 | 280 | 275 | **4EU27 22-5BA00-0A** |
| 250 | 315 | 306 | **4EU27 22-6BA00-0A** |
| 280 | 355 | 343 | **4EU27 22-7BA00-0A** |
| 315 | 400 | 386 | **4EU27 22-8BA00-0A** |
| 355 | 450 | 435 | **4EU30 22-1BA00-0A** |
| 400 | 500 | 490 | **4EU30 22-2BA00-0A** |
| 450 | 560 | 551 | **4EU30 22-3BA00-0A** |
| 500 | 630 | 613 | **4EU30 22-4BA00-0A** |
| 560 | 710 | 686 | **4EU36 22-0CA00-0A** |

1) With series-connected 6-pulse bridge circuit

## Radio interference suppression filters

SIMOREG applications comply with the EMC product standard EN 61 800-3 for electrical drives provided that the rules for electromagnetically compatible installation of the converters in the plant are observed.

However, the EMC legislation requires that the entire installation be electromagnetically compatible with the environment.

If the system is to comply with the "A1" degree of radio interference suppression according to EN 55011, RI suppression filters must be installed in addition to commutating reactors. In conjunction with the commutating reactors, the RI suppression filters reduce the radio interference voltages that arise due to the converters. RI suppression filters can only be installed in grounded-neutral systems.

The RI suppression filters generate discharge currents.
In accordance with DIN VDE 0160, a PE connection with a cross-sectional area of 10 $mm^2$ is necessary. To ensure the best possible action of the filter it must be mounted with the converter on a common metal plate.

For converters with a three-phase system, the minimum rated current of the filter is equal to the output DC current multiplied by 0.82. For units with a two-phase system (field supply and electronics power supply), only two phases are connected to the three-phase RI suppression filter. The line current is equal to the field DC current (plus 1 A for the electronics power supply).

## List of suggested RI suppression filters from EPCOS

*) In place of *, the identification number for the design type must be inserted:
0 = 480 V
2 = 530 V

*) In place of **, the identification number for the design type must be inserted:
20 = 500 V
21 = 760 V
24 = 690 V

For further information about filters, visit www4.ad.siemens.de. Please enter 65 67 129 under "Article number".

| Rated current Radio interference suppression filters | Radio interference suppression filters | Terminal cross-section $mm^2$ | Weight approx. | Dimensions H x W x D |
|---|---|---|---|---|
| A | Type | Holes for M . . | kg | mm x mm x mm |
| 8 | B84143-G8-R11* | 4 $mm^2$ | 1.3 | 80 x 230 x 50 |
| 20 | B84143-G20-R11* | 4 $mm^2$ | 1.3 | 80 x 230 x 50 |
| 36 | B84143-G36-R11* | 6 $mm^2$ | 2.8 | 150 x 280 x 60 |
| 50 | B84143-G50-R11* | 16 $mm^2$ | 3.3 | 150 x 60 x 330 |
| 66 | B84143-G66-R11* | 25 $mm^2$ | 4.4 | 150 x 330 x 80 |
| 90 | B84143-G90-R11* | 25 $mm^2$ | 4.9 | 150 x 330 x 80 |
| 120 | B84143-G120-R11* | 50 $mm^2$ | 7.5 | 200 x 380 x 90 |
| 150 | B84143-G150-R11* | 50 $mm^2$ | 8.0 | 200 x 380 x 90 |
| 220 | B84143-G220-R11* | 95 $mm^2$ | 11.5 | 220 x 430 x 110 |
| 150 | B84143-B150-S** | M10 | 13 | 140 x 310 x 170 |
| 180 | B84143-B180-S** | M10 | 13 | 140 x 310 x 170 |
| 250 | B84143-B250-S** | M10 | 15 | 115 x 360 x 190 |
| 320 | B84143-B320-S** | M10 | 21 | 115 x 360 x 260 |
| 400 | B84143-B400-S** | M10 | 21 | 115 x 360 x 260 |
| 600 | B84143-B600-S** | M10 | 22 | 115 x 410 x 260 |

## List of suggested RI suppression filters from Siemens

| Rated current Radio interference suppression filters | Radio interference suppression filters | Terminal cross-section | Ground bolt | Weight approx. | Dimensions H x W x D |
|---|---|---|---|---|---|
| A | Type | $mm^2$ | | kg | mm x mm x mm |
| 12 | 6SE7021-0ES87-0FB1 | 4 | M6 | 2.5 | 215 x 90 x 81 |
| 18 | 6SE7021-8ES87-0FB1 | 4 | M6 | 2.5 | 215 x 90 x 81 |
| 36 | 6SE7023-4ES87-0FB1 | 16 | M6 | 4 | 231 x 101 x 86 |
| 80 | 6SE7027-2ES87-0FB1 | 50 | M10 | 9 | 308 x 141 x 141 |
| 120 | 6SE7031-2ES87-0FA1 | 50 | M10 | 10 | 348 x 171 x 141 |
| 180 | 6SE7031-8ES87-0FA0 | 95 | M10 | 10 | 404 x 171 x 141 |
| 320 | 6SE7033-2ES87-0FA1 | Terminal link | M10 x 30 | 21 | 300 x 260 x 116 |
| 600 | 6SE7036-0ES87-0FA1 | Terminal link | M10 x 30 | 22 | 350 x 260 x 116 |

### *Technical Data*

| | |
|---|---|
| Rated supply voltage | 3-ph. AC 380-460 V (±15%) |
| Rated frequency | 50/60 Hz (±6%) |
| Operating temperature | 0 to +40°C |
| Degree of protection | IP 20 (EN 60529); IP 00 from 500 A |

## Supply harmonics

### Data on supply harmonics of converters in fully controlled, three-phase bridge connections B6C and (B6)A(B6)C

Converters for medium power are mainly designed in fully controlled three-phase bridge connection. Shown in the following is an example of harmonics of a typical installed configuration for two delay angles ($\alpha = 20°$ and $\alpha = 60°$).

The values have been adopted from a previous publication: "Oberschwingungen im netzseitigen Strom sechspulsiger netzgeführter Stromrichter" (Harmonics in the supply current of six-pulse line-commutated converters) by H. Arremann and G. Möltgen, Siemens Forschungs- und Entwicklungsberichte, Vol. 7 (1978) No. 2, © Springer-Verlag 1978.

a) $\alpha = 20°$
Fundamental factor $g = 0.962$

| $\nu$ | $I\nu/I_1$ | $\nu$ | $I\nu/I_1$ |
|---|---|---|---|
| 5 | 0.235 | 29 | 0.018 |
| 7 | 0.100 | 31 | 0.016 |
| 11 | 0.083 | 35 | 0.011 |
| 13 | 0.056 | 37 | 0.010 |
| 17 | 0.046 | 41 | 0.006 |
| 19 | 0.035 | 43 | 0.006 |
| 23 | 0.028 | 47 | 0.003 |
| 25 | 0.024 | 49 | 0.003 |

b) $\alpha = 60°$
Fundamental factor $g = 0.953$

| $\nu$ | $I\nu/I_1$ | $\nu$ | $I\nu/I_1$ |
|---|---|---|---|
| 5 | 0.283 | 29 | 0.026 |
| 7 | 0.050 | 31 | 0.019 |
| 11 | 0.089 | 35 | 0.020 |
| 13 | 0.038 | 37 | 0.016 |
| 17 | 0.050 | 41 | 0.016 |
| 19 | 0.029 | 43 | 0.013 |
| 23 | 0.034 | 47 | 0.013 |
| 25 | 0.023 | 49 | 0.011 |

The fundamental current $I_1$ as the reference quantity is calculated with the following formula:

$$I_1 = g \times 0.817 \times I_d$$

where $I_d$ = DC of the examined operating point and $g$ = fundamental factor (see above).

The harmonic currents calculated from the above tables apply **only** to

#### *a) Short-circuit power $S_K$ at the connection point of the converter:*

$$S_K = \frac{U^2_{V0}}{X_N} \text{ (VA)}$$

where

$$X_N = X_K - X_D = 0.03536 \times \frac{U_{V0}}{I_d} - 2\pi f_N \times L_D \text{ (}\Omega\text{)} \quad \text{and}$$

$U_{V0}$ No-load voltage at the connection point of the converter in V
$I_d$ DC of the examined operating point in A
$f_N$ Line frequency in Hz
$L_D$ Inductance of the commutating choke in H

This is accompanied by formulae with which, depending on the operating data in the specific case, supply voltage (no-load voltage $U_{V0}$), line frequency $f_N$ and DC $I_d$), the short-circuit power $S_K$ and armature inductance $L_a$ of the motor are determined, and to which the specified harmonic spectrum applies. If the actual system short-circuit power and/or the actual armature inductance deviate from the values thus calculated, an individual calculation is necessary.

The given harmonic spectrum is attained when the values calculated with the following formulae for short-circuit power $S_K$ at the connection point of the unit, and the armature inductance $L_a$ of the motor coincide with the actual values of the installation. If the values differ, a separate calculation of harmonics is necessary.

#### *b) Armature inductance $L_a$:*

$$L_a = 0.0488 \times \frac{U_{V0}}{f_N \times I_d} \text{ (H)}$$

If the actual values of short-circuit power $S_K$ and/or armature inductance $L_a$ differ from the values calculated using the above formulae, a separate calculation is necessary.

Example:

The given drive has the following data:

$U_{V0} = 400$ V

$I_d = 150$ A

$f_N = 50$ Hz

$L_D = 0.169$ mH (4EU2421-7AA10 with $I_{Ln} = 125$ A)

where

$$X_N = 0.03536 \times \frac{400}{150} - 2\pi \times 50 \times 0.169 \times 10^{-3} = 0.0412\ \Omega$$

resulting in the following required short-circuit power of the system at the connection point of the converter:

$$S_K = \frac{400^2}{0.0412} = 3.88 \text{ MVA}$$

and the following required armature inductance of the motor:

$$L_a = 0.0488 \times \frac{400}{50 \times 150} = 2.0 \text{ mH}$$

The harmonic currents $I_\nu$ (where $I_1 = g \times 0.817 \times I_d$ for delay angle $\alpha = 20°$ and $\alpha = 60°$) apply **only** to the values $S_K$ and $L_a$ thus calculated. If the values differ, a separate calculation is required.

When designing filters and reactor compensations, the harmonic values thus calculated can only serve as a basis if the calculated values for $S_K$ and $L_a$ coincide with the actual values of the drive. In all other cases a separate calculation must be made (especially when compensated machines are used, because of the very low armature inductance).

# Appendix



A

## Environment, resources and recycling

Siemens AG has committed itself to protecting the environment and conserving valuable natural resources. This applies both to production and to the products we sell.

As early as the development phase, the possible impact of future products and systems on the environment is taken into consideration. Our aim is to prevent environmental pollution or, at least, reduce it to a minimum and, in doing so, look beyond existing regulations and legislation.

### *Environmental aspects of development*

The use of dangerous substances (such as arsenic, asbestos, beryllium, cadmium, CFC, halogens and many others) has already been avoided in the development stage.

Easily dismantled joints have been designed and attention has been paid to increased uniformity of types and grades of materials.

Furthermore, recyclable materials have been given priority, or materials which can be disposed of without any problems.

Environmental aspects were an important criteria in selecting the supplied components.

### *Environmental aspects of manufacturing*

The supplied components are mainly transported in reusable packaging. The packaging material itself is reusable, mainly comprising cardboard.

The manufacturing facility produces no emissions.

Materials for manufacturing purposes are identified in accordance with their recyclability. This applies, in particular, to components which contain unavoidable, hazardous materials. These components are installed or mounted in such a way that they can be easily separated, thus facilitating disposal in an environmentally-friendly manner. Wherever possible, recycled components are used.

### *Despatch*

Environmentally-compatible packaging materials are used for shipping and storage. If possible we pack our products in reusable packaging.

### *Environmental aspects of disposal*

We have already made preparations to enable the converters to be disposed of after use in accordance with the regulations governing the disposal of electronic equipment (not yet in force).

This catalog is printed on Chlorine-free bleached paper.

C E R T I F I C A T E

DQS Deutsche Gesellschaft zur Zertifizierung von Managementsystemen mbH

Siemens AG
Industrial Solutions and Services (I&S)
Industrial Services (I&S IS)

Quality Management System,

DIN EN ISO 9001 : 2000

Annex 1 to Certificate Registration No.: 001784 QM

Siemens AG
Industrial Solutions and Services (I&S)
Industrial Services (I&S IS)

Annex 2 to Certificate Registration No.: 001784 QM

Siemens AG
Industrial Solutions and Services (I&S)
Industrial Services (I&S IS)

# Appendix

## Siemens companies and representatives inside Europe

### Albania
BINDI sh. p. k.
**Tirana**

### Armenia
Representative of Siemens AG
**Yerevan**

### Austria
Siemens AG Österreich
**Vienna**
**Bregenz**
**Deutschlandsberg**
**Eisenstadt**
**Graz**
**Innsbruck**
**Klagenfurt**
**Klosterneuburg**
**Linz**
**Salzburg**
**St. Pölten**
**Villach**

### Azerbaijan
Representative of SIMKO AS
**Baku**

### Belarus
Representative of Siemens AG
**Minsk**

### Belgium
Siemens S. A.
**Brussels**
**Antwerpen**
**Boussu**
**Colfontaine**
**Dilsen-Stokkem**
**Gent**
**Haasrode**
**Herentals**
**Huizingen**
**Liège**
**Namur**
**Oostkamp**
**Zaventem**

### Bulgaria
Siemens AG Representative in Bulgaria
**Sofia**

### Croatia
Siemens d.d.
**Zagreb**

### Cyprus
GEVO Ltd.
**Nicosia**

### Czech Republic
Siemens s.r.o.
**Prague**
**Brno**
**Děčín**
**Stříbro**
**Trutnov**

### Denmark
Siemens A/S
**Ballerup**
**Alborg**
**Brønshøj**
**Esbjerg**
**Hedensted**
**Højbjerg**
**Odense**
**Skensved**
**Tåstrup**
**Vejle**

### Eire (Ireland)
Siemens Ltd.
**Dublin**

### Estonia
AS Siemens
**Tallinn**

### Finland
Siemens
**Osakeyhtiö**
**Espoo**
**Helsinki**

### France
Siemens S. A. S.
**Saint-Denis**
**Bihorel**
**Caluire-et-Cuire**
**Cesson Sévigné**
**Dijon**
**Haguenau**
**La Garenne Colombes**
**La-Suze-sur-Sarthe**
**Lesquin**
**Les Ulis**
**Lissess**
**Lormont**
**Marseille**
**Mérignac**
**Metz**
**Montrouge**
**Molsheim**
**Nanterre**
**Nantes**
**Nice**
**Pantin**
**Paris La Défense**
**Reims**
**Saint-Denis**
**Saint-Quentin**
**Strasbourg**
**Toulouse**

### Georgia
Representative of Siemens AG
**Tbilisi**

### Great Britain
Siemens plc
**Bracknell**
**Beeston**
**Belfast**
**Bellshill**
**Birmingham**
**Bristol**
**Camberley**
**Cambridge**
**Chessington**
**Christchurch**
**Clevedon**
**Corby**
**Congleton**
**Crawley**
**Cumbernauld**
**East Kilbridge**
**Fareham**
**Glasgow**
**Hemel Hempstead**
**Hounslow**
**Ilford**
**Isle of Wight**
**London**
**Luton**
**Manchester**
**Milton Keynes**
**Newcastle-upon-Tyne**
**Oldham**
**Oxford**
**Poole**
**Purley**
**Romsey**
**Telford**
**Wellingborough**
**Wembley**

### Greece
Siemens A. E.
**Athen, Amaroussio**
**Acharnes**
**Thessaloniki**
**Vassiliko Evias**

### Hungary
Siemens Rt.
**Budapest**
**Bicske**
**Cegled**
**Szombathely**

### Iceland
Smith & Nordland HF
**Reykjavik**

### Italy
Siemens S. p. A.
**Milano**
**Bari**
**Bologna**
**Brescia**
**Cagliari**
**Casoria**
**Cassina de Pecchi**
**Fanglia**
**Firenze**
**Genova**
**Napoli**
**Padova**
**Palermo**
**Pescara**
**Roma**
**Torino**
**Verona**

### Latvia
Siemens S/A
**Riga**

### Lithuania
Lietuvos ELTIKA
**Vilnius**
**Klaipeda**

### Luxembourg
Siemens S. A.
**Luxembourg-Hamm**

### Macedonia
SITAI d.o.o.
**Skopje**

### Malta
J.R.D. SYSTEMS Ltd.
**Harun**

### Moldavia
Siemens s.r.l.
**Chisinau**

### Netherlands
Siemens Nederland N. V.
**Den Haag**
**Alphen a/d Rijn**
**Zoetermeer**

### Norway
Siemens A/S
**Oslo**
**Fyllingsdalen**
**Trondheim**

### Poland
Siemens Sp.z.o.o.
**Warsaw**
**Gdańsk-Wrzeszcz**
**Katowice**
**Kratów**
**Poznań**
**Wroclaw**

### Portugal
Siemens S. A.
**Lisbon**
**Amadora**
**Albufeira**
**Carnaxide**
**Coimbra**
**Evora**
**Loures**
**Matosinhos Codex**
**Mem Martins**
**Seixal**

### Romania
Siemens birou de consultaţii tehnice
**Bucharest**
**Slatina**

### Russia
Siemens GmbH Moskau
**Moscow**
**Barnaul**
**Jakutsk**
**Yekaterinburg**
**Irkutsk**
**Yshewsk**
**Kaluga**
**Krasnodar**
**Novosibirsk**
**Perm**
**St. Petersburg**
**Tbilissi**
**Tjumen**
**Tomsk**
**Ufa**
**Vladivostok**

### Slovak Republic
Siemens s.r.o.
**Bratislava**
**Dolný Kubin**
**Horná Streda**
**Michalovce**
**Nitra**
**Nové Zámky**
**Trnava**

### Slowenia
Siemens d.o.o.
**Ljubljana**
**Kranj**
**Maribor**

### Spain
Siemens S. A.
**Bilbao**
**Cornellá de Llobregat**
**Gijoñ**
**La Coruña**
**Las Palmas de Gran Canaria**
**León**
**Málaga**
**Murcia**
**Palma de Mallorca**
**Santa Cruz de Tenerife**
**Sevilla**
**Tres Cantos (Madrid)**
**Valencia**
**Vallodolid**
**Vigo**
**Zaragoza**

### Sweden
Siemens AB
**Upplands Väsby**
**Göteborg**
**Haninge**
**Jönköping**
**Kista**
**Malmö**
**Solna**
**Sundsvall**

### Switzerland
Siemens Schweiz AG
**Zürich**
**Adliswil**
**Basel**
**Bioggio**
**Bronschhofen**
**Dietikon-Fahrweid**
**Fahrweid**
**Winterthur-Töss**

### Turkey
SIMKO Ticaret ve Sanayi A.S.
**Findikli Istanbul**
**Adana**
**Alsancak-Izmir**
**Ayazag-Istanbul**
**Beşiktaş-Istanbul**
**Bursa**
**Cerkezköy-Tekikdag**
**Kartal-Istanbul**
**Kavaklidere-Ankara**
**Mecidiyeköy-Istanbul**
**Mudanya**
**Samsun**

### Ukraine
Representative of Siemens AG
**Kiew**
**Charkiw**
**Odessa**
**Wischgorod**

### Yugoslavia
Siemens d.o.o.
**Beograd**

A

## Siemens companies and representatives outside Europe

## Africa

### Algeria
Siemens Bureau d'Alger
**Hydra**

### Angola
Escritório de Representacão da Siemens em Angola
**Luanda**

### Botswana
Siemens (Pty) Ltd.
**Gaborone**
**Iwaneng**

### Congo
SOFAMATEL S.P.R.L.
**Kinshasa**

### Côte d'Ivoire
Siemens AG
S.A.R.L.
**Abidjan**

### Egypt
Siemens Limited
**Cairo-Mohandessin**
**Smouha Alexandria**

Centech
**Cairo-Zamalek**

### Ethiopia
Siemens (Pvt)
**Addis Abeba**

### Ghana
Impromex ACCRA
**Accra**

### Guinea
André & Cie. S. A.
**Lausanne**

### Kenya
Siemens Communications Ltd.
**Nairobi**

### Lesotho
Range Telecommunication Systems (Pty) Ltd
**Maseru**

### Libya
Siemens A. G. Branch Libya
**Tripoli**

### Malawi
Ecolectric Ltd.
**Blantyre**

### Mauritius
Ireland Blyth Ltd
**Port Louis**

### Morocco
SETEL
Société Electrotechnique
et de Télécommunication S. A.
**Casablanca**

### Mosambique
Siemens Limitada
**Maputo**

### Namibia
Siemens (Pty.) Ltd.
**Windhoek**

### Nigeria
Siemens Limited
**Lagos**
**Abuja**
**Kaduna**

### Republic of South Africa
Siemens Ltd.
**Halfway House**
**Centurion**
**Isando**
**Pretoria**
**Springs**
**Woodmead**

### Sudan
National Electrical
**Commercial Co.**
**Khartoum**

### Swaziland
Siemens (Pty) Ltd
**Matsapha**

### Tansania
Tanzania Electrical Services Ltd.
**Dar-es-Salaam**

### Tunesia
Siemens Bureau de Liaison
**Tunis**

### Zambia
Siemens (Z) Ltd.
**Kitwe**
**Lusaka**

### Zimbabwe
Siemens (Pvt.) Ltd.
**Harare**
**Alexandra Park**

## America

### Argentina
Siemens S. A.
**Buenos Aires**
**San Martin**
**Bahia Blanca**
**Córdoba**
**Las Heras**
**Mar del Plata**
**Rosario**
**Boulogne sur Mer**

### Bolivia
Sociedad Comercial é Industrial Hansa Ltda.
**La Paz**

### Brazil
Siemens Ltda.
**Sao Paulo**
**Belo Horizonte**
**Brasilia**
**Campinas**
**Curitiba**
**Florianópolis**
**Fortaleza**
**Fravatai**
**Jaboatao dos Guararapes**
**Jundiai**
**Manaus**
**Pôrto Alegre**
**Ribeirao Preto**
**Rio de Janeiro**
**Salto**
**Salvador**
**S. Bernado do Campo**
**Vila Sao Joao**

### Canada
Siemens Canada Limited
**Mississanga**
**Ajax**
**Brampton**
**Burnaby**
**Calgary**
**Cambridge**
**Clatham**
**Dartmouth**
**Drummondville**
**Edmonton**
**Kanata**
**London**
**Moncton**
**Montreal**
**Mount Pearl**
**Ottawa**
**Pointe Claire**
**Saçkatoon**
**Sherbrooke**
**Tilbury**
**Vanier**
**Windsor**
**Winnipeg**

### Chile
Siemens S.A.
**Santiago de Chile**

### Colombia
Siemens S. A.
**Santafé de Bogotá**
**Barranquilla**
**Cali-Occidente**
**Medellin**

### Costa Rica
Siemens S. A.
**San José**

### Cuba
EUMEDA
Representación Consultiva de Siemens Electromedicina
**Ciudad de la Habana**

### Curaçao
SANTRACO N. V.
**Willemstad**

### Dominican Republic
Electromédica S. A.
**Santo Domingo**

### Ecuador
Siemens S. A.
**Quito**
**Guayaquil**

### El Salvador
Siemens S. A.
**San Salvador**

### Guatemala
Siemens S. A.
**Ciudad de Guatemala**

### Honduras
Representaciones Electroindustriales S. de R.L.
**San Pedro Sula**
**Tegucigalpa**

### Jamaica
Meditron Ltd.
**Kingston**

### Martinique
Périé Medical
**Fort-de-France**

### Mexico
Siemens S A de CV
**México, D.F.**
**Aguascalientes**
**Apodaca**
**Chihuahua**
**Cd. Juárez**
**Culiacán**
**Gómez Palacio**
**Hermosillo**
**León**
**Mérida**
**Puebla**
**San Juan Cuautlancingo**
**Tijuana**
**Tlajomulco de Zuniga**
**Veracruz**
**Villa Corregidora**

### Nicaragua
Siemens S. A.
**Managua**

### Panama
Siemens S. A.
**Panama**

### Paraguay
Rieder & Cia. S. A. C. I.
**Asunción**

### Peru
Siemens S. A.
**Lima**

### Trinidad and Tobago
Biomedical Technologies Ltd.
**St. Augustin**

### United States of America
Siemens Corporation
**New York**
**Allentown**
**Alpharetta**
**Arlington**
**Atlanta**
**Auburn Hills**
**Boca Raton**
**Bridgewater**
**Brooklyn Park**
**Camarillo**
**Charlotte**
**Columbus**
**Concord**
**Cupertino**
**Danvers**
**Duluth**
**Fountain Inn**
**Gainsville**
**Hickory**
**Hoffman Estates**
**Issaguah**
**Iselin**
**Johnson City**
**Lake Oswego**
**Lima**
**Milwaukee**
**Newport News**
**Norcross**
**Oklahoma City**
**Palo Alto**
**Piscataway**
**Princeton**
**Richardson**
**Richland**
**Sacramento**
**Santa Clara**
**Santa Fe Springs**
**San Jose**
**Sunnyvale**
**Totawa**
**Washington**
**Wendell**

### Uruguay
Conatel S.A.
**Montevideo**

### Venezuela
Siemens S. A.
**Caracas**
**Barcelona**
**Maracaibo**
**Perto Ordaz**
**Valencia**

A

# Appendix

## Siemens companies and representatives outside Europe

### Asia

#### Bahrain
Siemens AG Service Center
Transitec Gulf
**Manama**

#### Bangladesh
Siemens Bangladesh Ltd.
**Dhaka**
**Khulna**

#### Brunei
AMS Technologies
**Sdn Bhd**
**Negara**
**Brunei**
**Darussalam**

#### India
Siemens Ltd.
**Ahmedabad**
**Bangalore**
**Calcutta**
**Chandigarh**
**Chennai**
**Coimbatore**
**Gurgaon**
**Kaloor**
**Mumbai**
**Nashik**
**Navi Mumbai**
**New Dehli**
**Pune**
**Secunderabad**
**Vadodara**

#### Indonesia
Representative Office Siemens AG
**Jakarta**
**Batam**
**Cilegon**
**Surabaya**

#### Iraq
Siemens AG
**Baghdad**

#### Iran
Siemens S.S.K.
**Teheran**

#### Israel
Siemens Ltd.
**Tel Aviv**
**Holon**
**Herzeliya**
**Ramat Hakhaiyal**

#### Japan
Siemens K. K.
**Tokyo**
**Kobe**
**Fukuoka**
**Hiroshima**
**Ishikawa**
**Kanagawa**
**Nagoya**
**Osaka**
**Sapporo**
**Sendai**
**Yokohama**

#### Jordan
Siemens AG
**Jordan Branch**
**Shmeisani-Amman**
**Amman**

#### Kazakhstan
Representative of Siemens AG
**Almaty**

#### Kirghizstan
Representative of Siemens AG
**Bischkek**

#### Korea (Republic)
Siemens Ltd.
**Seoul**
**Changwon**
**Kyungki-Do**

#### Kuwait
National & German Electrical and Electronic Services Co. (NGEECO)
**Kuwait**

#### Lebanon
Siemens AG Lebanon Branch
**Beyrouth**

#### Malaysia
Siemens Electrical Engineering Sdn. Bhd.
**Petaling Jaya**
**Kuala Lumpur**
**Kajang**

#### Myanmar
Siemens Ltd.
**Yangon**

#### Nepal
Amatya Enterprises (Pvt.) Ltd.
**Kathmandu**

#### Oman
Siemens AG
**Muscat Branch**
**Ruwi**
**Muscat**

#### Pakistan
Siemens Pakistan Engineering Co. Ltd.
**Karachi**
**Faisalabad**
**Islamabad**
**Lahore**
**Peshawar**
**Quetta**

#### People's Republic of China
Siemens Ltd., China
**Beijing**
**Changchun**
**Chengdu**
**Chongqing**
**Chuzhou**
**Dalian**
**Fuqing**
**Fuzhou**
**Guangzhou**
**Hangzhou**
**Jilin**
**Jinan**
**Nanhai**
**Nanjing**
**Panyu**
**Rizhao**
**Shanghai**
**Shenyang**
**Shenzhen**
**Suzhou**
**Tianjin**
**Wuhan**
**Wuxi**
**Xi'an**
**Xiaogan City**
**Zibo**

#### Philippines
Siemens Inc.
**Makati City**
**Pasig City**
**Cebu**
**Davao City**

#### Qatar
Arabian Construction Engineering Company
**Doha**

#### Saudi Arabia
Arabia Electric Ltd. (Equipement)
**Jeddah**
**Al Khobar**
**Riyadh**

#### Singapore
Siemens Advanced Engineering (Pte.) Ltd.
**Singapore**

#### Sri Lanka
Dimo Limited
**Colombo**

#### Syria
Siemens AG
**Damascus Branch**
**Dasmascus**

#### Taiwan
Siemens Ltd.
**Taipei**
**Taichung**
**Kaohsiung**
**Taoyuan Hsien**

#### Thailand
Siemens Limited
**Bangkok**
**Rayong**

#### Turkmenistan
Representative of Siemens AG
**Aschgabad**

#### Uzbekistan
Representative of Siemens AG
**Taschkent**

#### United Arab Emirates
Siemens Resident Engineers
**Dubai**
**Abu Dhabi**

#### Vietnam
Siemens AG Representation
**Hanoi**
**Ho Chi Minh City**

#### Yemen
Tihama Tractors & Engineering Co. Ltd.
**Sanaa**
**Aden**

### Australia
Siemens Ltd.
**Melbourne**
**Adelaide**
**Bayswater**
**Brisbane**
**Gladesville**
**Milton**
**Pennant Hills**
**Perth**
**Silverwater**
**St. Leonards**
**Sydney**

#### New Zealand
Siemens (NZ) Limited
**Auckland**
**Wellington**

## A&D in the WWW


Detailed information about the product range to be used and the services that are available is essential at the planning and project engineering phases of plant automation projects. It is a fact that this information has to be as up-to-date as possible.

For this reason, the Siemens Group Automation and Drives (A&D) provides a comprehensive information service on the World Wide Web that makes it easy for our customers to access all the necessary information.

You will find everything you need to know about products, systems and service contracts at:

***http://www.siemens.de/automation***

## Product selection with the interactive catalogs


Providing comprehensive information and user-friendly interactive functions:
The interactive catalogs, CA 01 and ET 01, featuring over 80000 products, provide a comprehensive overview of the Siemens Automation and Drives product spectrum.

You will find everything that you need to fulfill any task in the fields of automation, controlgear, electrical installation and drives. All the information is embedded in a user-interface that supports easy, intuitive operation.

When you have selected you products, you can submit your order by fax or via an online link at the press of a button.

You will find Information on the interactive catalogs on the Internet at:

***http://www.siemens.de/automation/ca01***

or on CD-ROM:

Automation and Drives, CA 01
Order No.:
E86060-D4001-A100-B5

Installation Systems, ET 01
Order No.:
E86060-D8200-A107-A2

## Easy shopping with the Siemens Mall


The Siemens Mall is the virtual department store of Siemens AG on the Internet. You can access a gigantic product spectrum that is presented clearly and informatively in electronic catalogs.

Data transfer via EDIFACT allows the complete ordering process, from selection to ordering and order tracking, to take place online via the Internet.

Numerous functions are available to you which make the job easier.

Powerful search functions make it easy to find the required products and check their availability immediately. Individual customer discounts and quotations are available online as well as tracking and tracing of your order.

You will find the Siemens Mall on the Internet at:

***http://www.siemens.de/automation/mall***

A

# Appendix

## Customer support

### Automation & Drives customer support

Whether you need a service specialist or a spare part, advice from a product expert or just an answer to a question: Contact the Service & Support Team – The team for your success.

### Helpline for service and support

You need help and are not sure who to contact. We will ensure that you get assistance quickly.

The helplines guarantee that the right local specialist provides you with technical support. The helpline, for example in Germany, provides assistance 365 days a year round-the-clock in English and German.

**Tel.: +49 (0)180 50 50 111**

### Online support

Our online support provides fast, effective assistance – round-the-clock, worldwide and in five different languages.

Online support offers a wide range of technical information:

- FAQs, Tips and Tricks, downloads and news
- Free manuals
- Helpful programs and software products – payment accepted with the SIMATIC Card

***http://www.siemens.de/automation/service&support***

A

### Field service

Your plant is installed and you need help quickly on site. We have the specialists with the necessary expertise near you wherever you are in the world.

Our dense service network means that you will receive attention quickly and reliably.

In Germany, you can request an expert 365 days a year round-the-clock.

**Tel.: 0180 50 50 444** [1)]

Naturally we also offer service contracts tailored to your individual needs. Please contact your local Siemens representative for further information.

### Spare parts and repairs

Our worldwide network of regional spare parts warehouses and repair shops responds quickly and reliably with the latest in logistics.

In the event of queries concerning repairs or spare parts, please call the following number (in Germany):

**Tel.: 0180 50 50 446** [1)]

Out of office hours and at the weekend, you can contact our emergency spare parts service under the following number.

### Technical support

Technical support with using our products, systems and solutions in the field of automation and drives is available in English and German. Capable, trained and experienced specialists also offer Teleservice and Video Conferencing for particularly difficult problems.

FreeContact – the route to technical support free of charge

- European and African time zones

**Tel.: +49 (0)180 50 50 222**
**Fax: +49 (0)180 50 50 223**
**E-mail: techsupport@ad.siemens.de**
Mo.-Fr.: 7:00 to 17:00 (CET)

- USA time zones

**24h hotline toll-free: +1 (0)800 241-4453**

**Tel.: +1 (0)770 740-3505**
**Fax: +1 (0)770 740-3396**
**E-mail: drives.support@sea.siemens.com**
Mo.-Fr.: 8:00 to 20:00
(local time: Eastern Time)

- Asian/Australian time zones

**Tel.: +65 (0)740-7000**
**Fax: +65 (0)740-7001**
**E-mail: drives.support@sea.siemens.com.sg**
Mo.-Fr.: 8:30 to 17:30
(local time: Singapore)

1) Germany only, for local "Länder" telephone numbers visit: http://www.siemens.de/automation/service&support

## Knowledge Base on CD-ROM

For working environments without an online connection to the Internet, an extract of the information provided free of charge is available on CD-ROM (Service & Support Knowledge Base). This CD-ROM contains all the up-to-date product information (FAQs, downloads, Tips and Tricks, news) as well as general information about service and technical support.

You will also find on the CD-ROM a complete text search function and our Knowledge Manager which will help you to locate solutions. The CD-ROM is updated every 4 months.

As with our online service on the Internet, the CD Service & Support Knowledge Base is available complete in 5 languages (English, German, French, Italian and Spanish).

You can order the CD **Service und Support Knowledge Base** from your Siemens contact partner.

Order No.
**6ZB5310-0EP30-0BA1**

Order over the Internet (using the SIMATIC Card or a credit card) at:

***http://www.siemens.de/automation/service&support***

under “Shop”.

## SIMATIC Card

You can use the SIMATIC Card to purchase service credit.
This credit can then be used to access the technical support services that are subject to charge (FastContact, ServiceLine) or to download software products and application examples from the Internet.

The SIMATIC Card operates on the same principle as a telephone card.

You can access your credit using the SIMATIC Card number and the SIMATIC Card PIN (both numbers are on the rear of your SIMATIC Card or will be supplied by e-mail when you purchase over the Internet).

On the Internet you can also view the account for your SIMATIC Card at:

***http://www.siemens.de/automation/simatic-card***

The **SIMATIC Card** can be ordered as follows:

From your Siemens contact partner

| **SIMATIC Card** | |
|---|---|
| Units | Order No. |
| 200 | **6ES7 997-0AA00-0XA0** |
| 500 | **6ES7 997-0AB00-0XA0** |
| 1000 | **6ES7 997-0AC00-0XA0** |

Validity: 2 years from date of purchase

On the Internet in conjunction with a credit card, the SIMATIC Card can be used immediately:

***http://www.siemens.de/automation/simatic-card***

***Tel.: +49 (0)911 895 7777***
***Fax: +49 (0)911 895 7001***

A

# Appendix

## Conditions of sale and delivery, export regulations

### *In Germany*

Subject to the General Conditions of Sale as well as the General Conditions of Supply and Delivery for Products and Services of the Electrical and Electronics Industry.

### *For Export*

Subject to the General Conditions of Supply and Delivery for Products and Services of the Electrical and Electronics Industry and to any other conditions agreed upon with the recipients of catalogs/ price lists.

■

Software products are subject to the General Licence Conditions for Software Products for Automation and Drives.

■

Prices are listed in € (Euro) ex delivery point, excluding packaging.

Turnover tax (VAT) is not included in the prices. It will be added according to legal provisions at the applicable rate.

We reserve the right to adjust prices and shall charge the prices applying on the date of delivery.

### *Notes*

All dimensions in this catalog/price list are in mm. The illustrations are for reference only.

We reserve the right to make changes, in particular to the specified values, dimensions and weights, unless specified otherwise on the individual pages of this catalog/price list.

### *Export regulations*

The products listed in this catalog/price list may be subject to European/German and/or US export provisions.

Any export requiring approval is therefore subject to authorization by the relevant authorities.

For the products listed in this catalog/price list, the following export regulations must be adhered to in accordance with currently valid regulations.

| | |
|---|---|
| AL | Number of the German export list<br><br>Products with a code other than “N” must be approved for export.<br><br>The export codes of the respective data medium must also be adhered to for software products.<br><br>Goods labeled with “AL not equal to N” are subject to European or German export authorization when being exported out of the EU. |
| ECCN | Number of US export list<br>(Export Control Classification Number)<br><br>Products with a code other than “N” require approval for reexport to certain countries.<br><br>The export codes of the respective data medium must also be adhered to for software products.<br><br>Goods labeled with “ECCN not equal to N” are subject to US reexport authorization. |

Even without a label, or with label “AL: N” or “ECCN: N”, authorization may be required due to the final whereabouts and purpose for which the goods are to be used.

The AL and ECCN export codes specified in our confirmations, delivery notes and invoices apply.

Subject to change without prior notice.

A

Responsible for

Technical Contents:
Siemens AG, A&D LD M PM, Nuremberg

General Editing:
Siemens AG, A&D PT 5, Erlangen

Siemens AG
Automation & Drives Group
Large Drives Division
PO Box 4743, 90025 Nuremberg
Germany
http://www.siemens.de/automation/ld

Order No.
**E86060-K5121-A121-A1-7600**

Printed in the Federal Republic of Germany
KG K 1001 3.0 SV/BD 60 En/122375

# Catalogs of the Automation and Drives Group (A&D)

**Further information can be obtained from our branch offices listed in the appendix of this catalog**

| **Automation and Drives** | *Catalog* |
|---|---|
| Interactive catalogs on CD-ROM | |
| • Components for Automation & Drives | CA 01 |
| • Installation Systems | ET 01 |

| **Analysis Systems** | |
|---|---|
| Gas Analysis Equipment | PA 10 |
| Components for Sample Preparation | PA 11 |
| Liquid Analysis | PA 20 |

| **Drive Systems** | |
|---|---|
| Variable-Speed Drives | |
| DC Motors | DA 12 |
| SIMOREG Chassis Converters | DA 21 |
| SIMOREG Static Converter Cabinets | DA 22 |
| SIMOVERT PM Modular Converter Systems | DA 45 |
| SIEMOSYN Motors | DA 48 |
| MICROMASTER 420/440 Converters | DA 51.2 |
| COMBIMASTER 411/MICROMASTER 411 | DA 51.3 |
| SIMOVERT A Current-Source DC Link Converters | DA 62 |
| SIMOVERT MV Medium-Voltage Drives | DA 63 |
| MICROMASTER, MIDIMASTER Voltage-Source DC Link Converters | DA 64 |
| SIMOVERT MASTERDRIVES Voltage-Source DC Link Converters | DA 65 |
| SIMOVERT P Voltage-Source DC Link Converters | DA 66 |
| SIVOLT AC and Three-Phase Power Controllers | DA 68 |
| SITOR Thyristor Assemblies | DA 91 |
| SITOR Units and Static Converter Cabinets | DA 92 |
| Chokes | DA 93 |
| SITOR Semiconductor Protection Fuses | DA 94 |
| SITOR Control Devices | DA 95 |
| SIMADYN C Control System | DA 97 |
| MODULPAC C Control System | DA 98 |
| SIMADYN D Digital Control System | DA 99 |
| Drive Systems for Machine Tools SIMODRIVE | NC 60 |
| • AC Main Spindle Motors 1FE1, 1PH2, 1PH3, 1PH4, | |
| • AC Servomotors 1FK6, 1FT5, 1FT6 | |
| • Linear Motors 1FN1, 1FN3 | |
| • Converter System SIMODRIVE 611 | |
| • Converter Systems SIMODRIVE POSMO A/CD/CA/SI | |
| Low-Voltage Three-Phase Motors | |
| • Project Manual | M 10 |
| • Squirrel-Cage Motors | M 11 |
| High-Voltage Three-Phase Motors | M 2 |
| Starters and Resistor Units | AW 1 |
| Drive and Control Components for Lifting Gear | HE 1 |

| **Automation Systems for Machine Tools** | |
|---|---|
| Complete Catalog SINUMERIK & SIMODRIVE | NC 60 |
| Cables, Connectors and System Components | NC Z |

| **SIMATIC Industrial Automation Systems** | |
|---|---|
| SIMATIC PCS Process Control System | ST 45 |
| SIMATIC S5/PC/505 Automation Systems | ST 50 |
| Components for Totally Integrated Automation | ST 70 |
| SIMATIC PCS 7 Process Control System | ST PCS 7 |

| **Industrial Communication and Field Devices** | IK PI |
|---|---|

| **Installation Systems** | |
|---|---|
| Characteristic Curves of LV Fuses (see CD-ROM ET 01) | |
| *N System* | I 2.1 |
| STAB Wall-Mounting Distribution Boards | I 2.31 |
| SIKUS Floor-Mounting Distribution Boards | I 2.32 |
| SIPRO Meter Cabinet Catalogs | I 2.33/01 to I 2.33/12 |
| Busbar System 8PU | I 2.36 |
| DELTA Programs | I 2.4 |

| **SITRAIN Information and Training** | *Catalog* |
|---|---|
| Courses and Computer Based Training | ITC |

| **SIMATIC HMI Human-Machine Interface Products and Systems** | ST 80 |
|---|---|

| **Systems Engineering** | |
|---|---|
| Power Supplies SITOP power | KT 10.1 |
| System Cables SIMATIC TOP connect | KT 10.2 |
| MOBY identification systems | KT 21 |
| Industrial Microcomputers SICOMP | KT 51 |
| Industrial Microcomputers SICOMP SMP | KT 52 |
| Printers and Monitors | KT 61 |
| Cabinet Packaging System for SIMATIC PCS 7 | KT 71 |

| **Controlgear, Switchgear and Systems** | |
|---|---|
| Low-Voltage Controlgear, Switchgear and Systems | NS K |
| Communication-Capable Controlgear, Switchgear for Load Feeders, SIRIUS 3R, SIGUARD Safety Systems, Control and Signaling Devices, Switchgear for Power Distribution, Transformers and Power Supplies, Control Switches, Terminal Blocks | |
| BERO - Sensors for Automation | NS BERO |
| Supplementary Catalog Supplementary Range, Superseded Devices, Spare | NS E |
| Products and Systems for Low-Voltage Power | NS PS |
| SENTRON WL | NS WL |
| SICUBE System Cabinets 8MC and 8MF | NV |
| Fans | V |
| Power Supplies & Components for Drives (Catalog) | PD |

| **TELEPERM M Process Control System** | |
|---|---|
| AS 235, AS 235H and AS 235K Automation Systems | PLT 111 |
| AS 388/TM and AS 488/TM Automation Systems | PLT 112 |
| OS 525 Operating and Monitoring System | PLT 122 |
| Operating and Monitoring with WinCC/TM | PLT 123 |
| CS 275 bus system | PLT 130 |

| **Process Engineering** | |
|---|---|
| Field Instruments for Process Automation Measuring Instruments for Pressure, Differential Pressure, Flow, Level and Temperature, Positioners and Liquid Meters | FI 01 |
| SIWAREX Weighing Systems | KT 30 |
| Analog Indicators and Limit-Value Monitors, Standard Flush-Mounting Instruments | MP 12 B |
| Digital and Bargraph Indicators, Standard Flush-Mounting Instruments | MP 12 D |
| Process Recorders and Accessories | MP 20 |
| SIPART, Controllers and Software | MP 31 |

| **MASTERGUARD Uninterruptable Power Supplies** | USV |
|---|---|

| **Vacuum Pumps/Compressors** | |
|---|---|
| Oil-Free Vacuum Pumps, Compressors, Radial-Flow Fans | PV |

| **SIPOS Electrical Actuators** | |
|---|---|
| Electrical Rotary, Linear and Part-Turn Actuators | MP 35 |
| Electrical Rotary Actuators for Nuclear Power Plants | MP 35.1/.2 |

| **System Solutions for Industry** | |
|---|---|
| Combined Catalog: Applications and Products for Automation Solutions in the Plastics Industry | SL 01 |
| • With SIMATIC S7 | SL 10 |
| • With SIMATIC S5 | ST 58 |

Siemens AG
Automation and Drives Group
Large Drives Division
P.O. Box 47 43, 90025 Nuremberg
Germany

*http://www.siemens.de/automation/ld*

Siemens Aktiengesellschaft **Order No.: E86060-K5121-A121-A1-7600**