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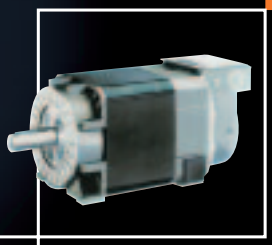
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Catalog DA 65.11 • 2003/2004









# motion control

# SIMOVERT MASTERDRIVES MC

Single-Motor and Multi-Motor Drives
0.55 kW to 250 kW (0.75 HP to 335 HP)

SIEMENS



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# Configuring with PATH Plus

With the PATH Plus program, three-phase drives fed by frequency converters for SIMOVERT® MASTER-DRIVES Vector Control and Motion Control units can be configured easily and quickly.

The program is a powerful engineering tool which supports the user in all stages of configuration - from power supply to the motor.

Menu-guided selection and layout of the frequency converters enable the system components and the motors necessary for a specific drive task to be determined. Automatically displayed information makes fault-free planning possible.

A comprehensive help system also supports the first-time user of the program. PATH Plus provides a logical and easy-to-use dialog procedure to guide the planning engineer towards a reproducible and economically efficient drive configuration, starting with the mechanical requirements of the machine and the drive task involved. The technical data of the frequency converters and motors, the selected system components and the necessary accessories are listed in detail.

PATH Plus enables drives to be configured on the basis of a load characteristic or a load cycle and enables planning of applications such as the following:



- traversing and hoisting gear,
- slewing gear,
- spindle drives,
- center winders and
- thrust crank.

PATH Plus also includes a comfortable graphic display for showing

- torque, speed, output, current, velocity and acceleration versus time and
- torque versus the rotational speed.

Supply harmonic disturbances can also be calculated and graphically displayed.

The planning and configuring results can be stored, printed out or copied to other user programs via the clipboard.

PATH Plus is available with either a German or English user interface.

You can download the demo version of PATH Plus from the following Internet address:
**http://www.siemens.com/automation/mc**
(products&systems/drive systems/software)
or use the fax form attached to the catalog.

If you need the full version of PATH Plus, contact your local Siemens office and quote the following order number:
**6SW1710-0JA00-2FC0**
You will find the address in the appendix to this catalog.

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# SIMOVERT MASTERDRIVES Motion Control

0.55 kW to 250 kW
(0.75 HP to 335 HP)

Catalog DA 65.11
2003/2004



Supersedes:
Catalog DA 65.11 · 2001
General Motion Control Catalog
Part 1 · 1999[1])

The products in this catalog are also included in the CD-ROM catalog CA 01
Order No.:
E86060-D4001-A100-B9-7600

Contact your local Siemens representative for further information

*The products and systems described in this catalog are manufactured under application of a quality management system certified by DQS in accordance with DIN EN ISO 9001 and DIN EN ISO 14001. The DQS Certificate is recognized in all EQ Net countries*

SIEMENS

1) North American Catalog


Overview 1

Technical data 2

Selection and ordering data 3

Motor selection 4

Documentation and training 5

Engineering information 6

Dimension drawings 7

Appendix · Index A


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**Note**

These technical data are intended for general information purposes.
Please observe the operating instructions and the references indicated on the products for installation, operation and maintenance.

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- 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 (inches).

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# Motion Control
# Overview




1/2 Application

1/4 Guidelines

1/6 Selection guidelines




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# SIMOVERT® MASTERDRIVES Motion Control

## Overview

### Application

The MASTERDRIVES Motion Control (MC) frequency converters are specially designed for industrial servo drive applications.

In addition to the well-proven modular hardware concept, MASTERDRIVES Motion Control offers a modular software featuring

- freely interconnectable function blocks and
- integrated technology functions.

The MASTERDRIVES Motion Control series is compatible regarding

- communication,
- technology,
- operator control and visualization

and is available for line voltages of 3-ph. 380 V to 480 V AC, 50/60 Hz, and in the following designs, depending on the power rating:

- Compact PLUS 0.55 kW to 18.5 kW (0.75 HP to 25 HP)
- Compact units 2.2 kW to 37 kW (3 HP to 50 HP)
- Chassis units 45 kW to 250 kW (60 HP to 335 HP).

The MASTERDRIVES Motion Control concept is characterized by:

- a very high-level dynamic response
- positioning
- angular synchronism between drives
- cam plates.

It thus satisfies the most stringent demands placed on servo technology.

The MASTERDRIVES Motion Control converters are excellently matched to Siemens compact and highly dynamic servomotors.

These synchronous servomotors and asynchronous servomotors are primarily suited for highly dynamic applications.

Corresponding to highly dynamic MC control on the motor side, MASTERDRIVES AFE (Active Front End) using active line-angle-oriented vector control is now available on the line side for optimum energy supply.

MASTERDRIVES AFE is characterized by:

- absence of system perturbations, i.e. very good overall power factor
- stall-protected operation even in the event of supply dips and supply failure
- highly dynamic rectifier and regenerative units
- reactive-power compensation possible
- four-quadrant operation.

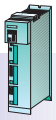
The program is rounded off by a complete spectrum of system components and accessories.

Customer-specific, integrated solutions (automation – converter – motor) are available for many applications in all industrial sectors.

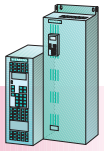
For MASTERDRIVES, easy-to-use project-planning tools (PATH) and start-up tools (DriveMonitor) are available.

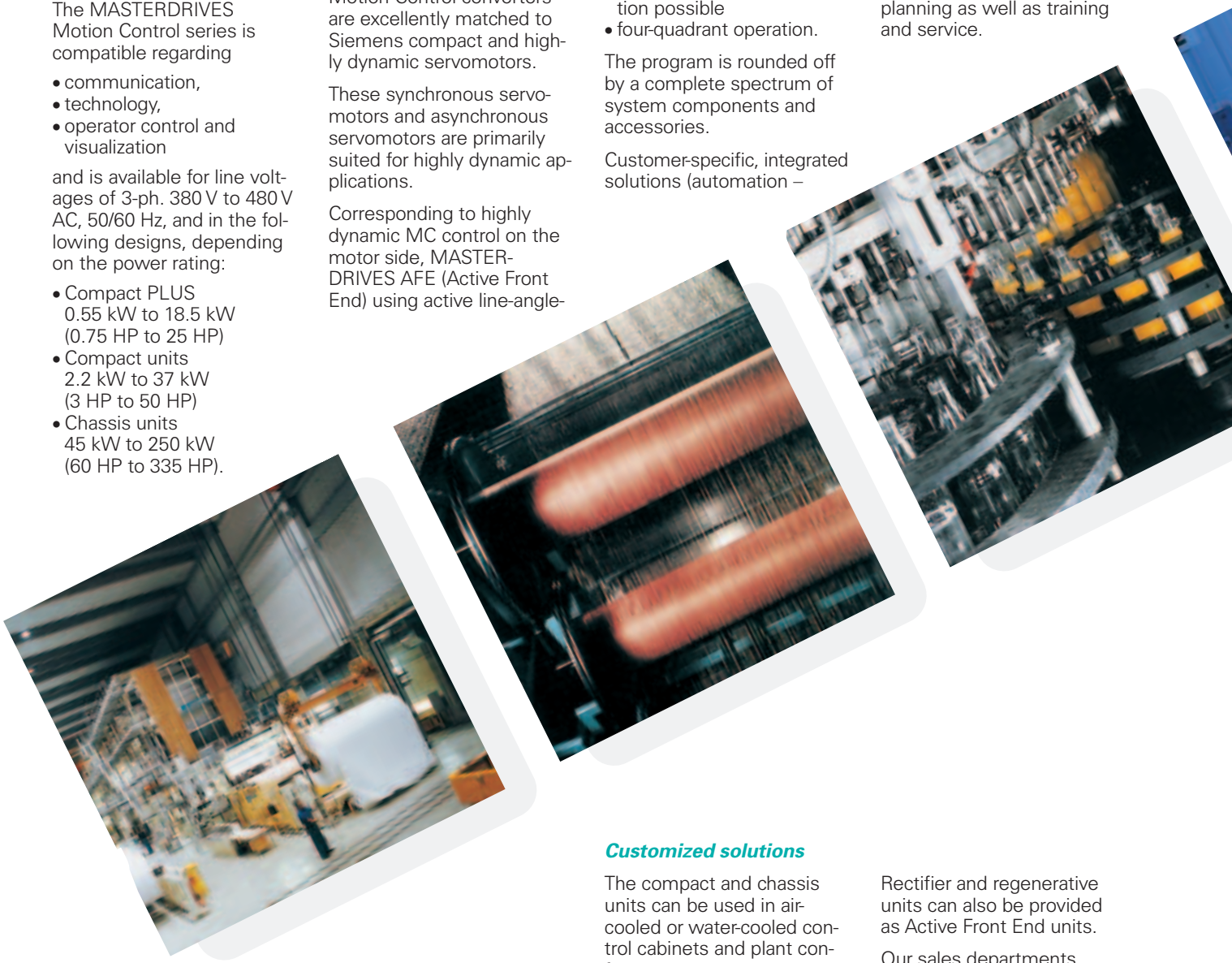
Siemens' world-wide service and sales network enable all our customers and MASTERDRIVES users to obtain direct access to expert advice and project planning as well as training and service.

**Compact PLUS units**



**Compact and chassis units**





### *Customized solutions*

The compact and chassis units can be used in air-cooled or water-cooled control cabinets and plant configurations.

Rectifier and regenerative units can also be provided as Active Front End units.

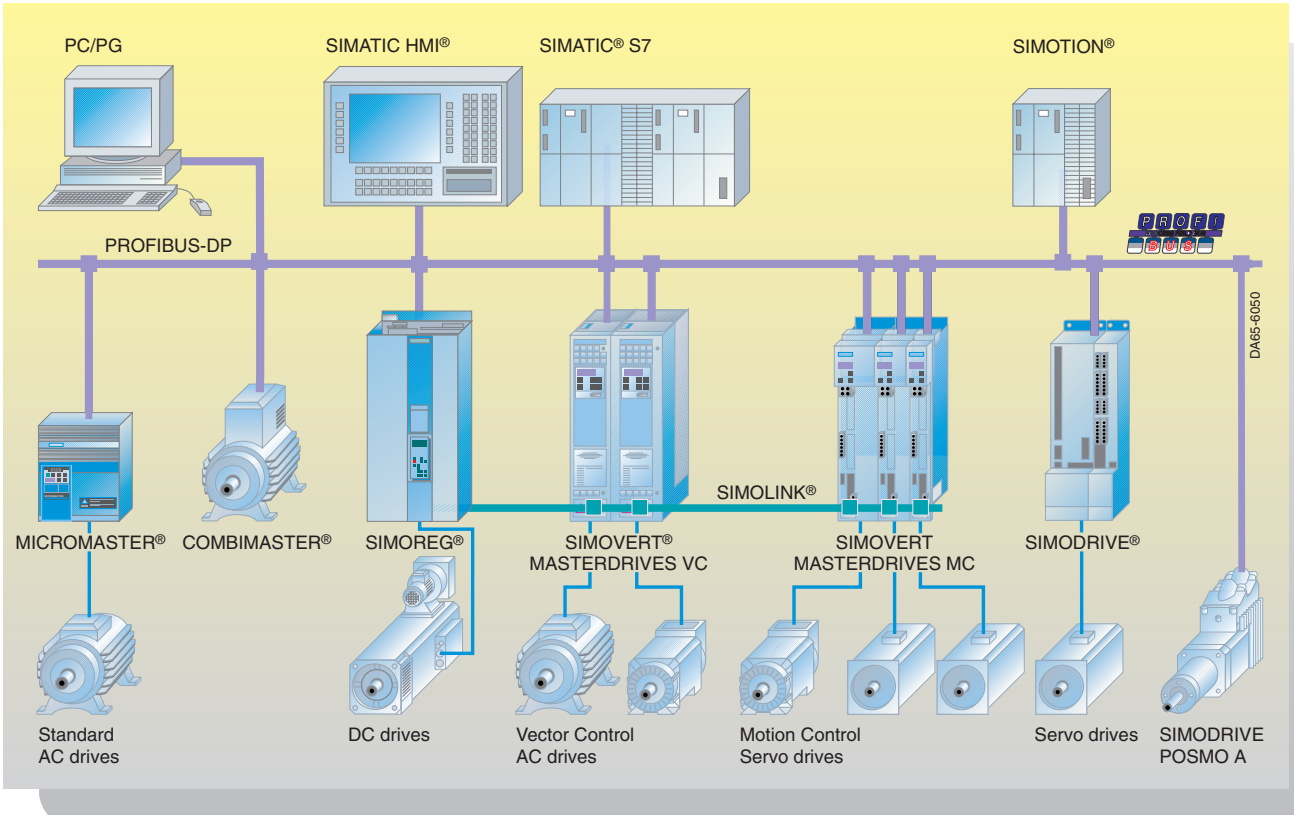
Our sales departments, working with our applications workshops, will help you to find the best solution for your requirements.



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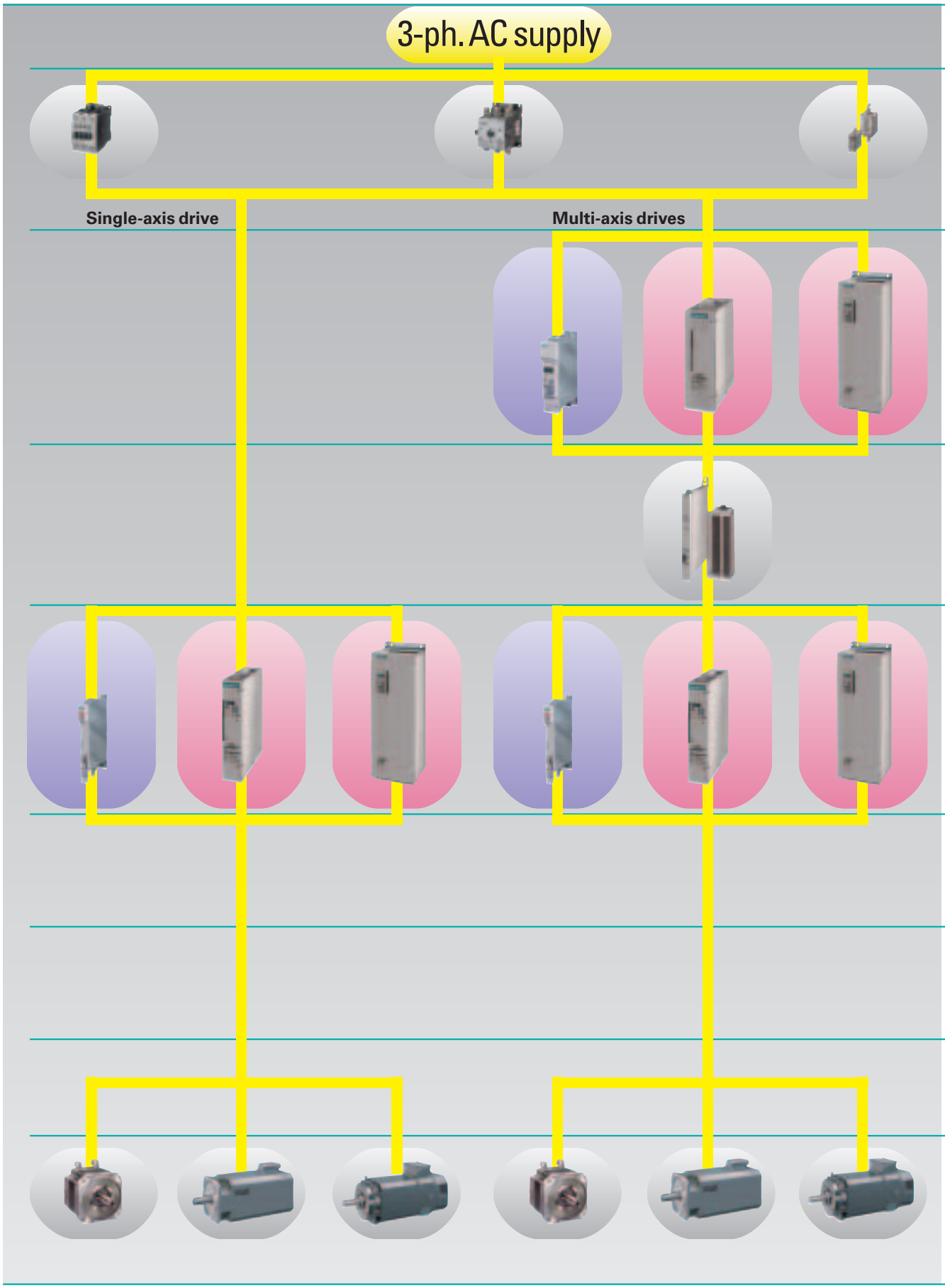


## Optimal integration of drives into the world of automation



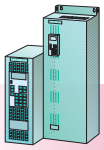



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Compact and chassis units

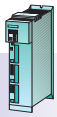

Compact PLUS units

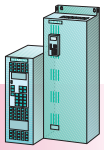
Guidelines

| | Technical data Page | Selection and ordering data Page | Engineering information Page | Dimension drawings Page |
|---|---|---|---|---|
| **Line-side components** | | | | |
| Main circuit-breakers | – | 3/20 | – | – |
| Fuses | 2/5 | 3/21 | 6/23, 6/50 | – |
| Reactors | 2/5 | 3/22 | 6/50 | 7/8–7/10 |
| Radio-interference suppression filters | 2/5 | 3/22 | 6/50 | 7/13–7/14 |
| Clean-Power-Filter | | 3/26 | 6/53, 6/54 | – |
| **Rectifier units** | 2/2, 2/4 | 3/10, 3/16 | 6/6, 6/22, 6/23, 6/33, 6/34 6/45, 6/46, 6/51 | 7/2–7/4 |
| **AFE rectifier/regenerative units** | 2/4 | 3/10, 3/16 | 6/52–6/55 | 7/3, 7/4 |
| **Rectifier/regenerative units** | 2/2, 2/4 | 3/14, 3/16 | 6/45, 6/46 | 7/3, 7/4 |
| **System components** | | | | |
| Braking units | 2/5 | 3/18 | 6/20, 6/48, 6/56, 6/57 | 7/6 |
| Braking resistors | 2/5 | 3/18 | 6/2, 6/6, 6/20–6/22, 6/26, 6/28, 6/33, 6/48 | 7/6, 7/7 |
| Capacitor module | – | 3/19 | 6/7, 6/20–6/23, 6/26–6/28, 6/33, 6/35 | 7/2 |
| DC link module | – | 3/19 | 6/35 | 7/2 |
| DC link rail | – | 3/19 | – | – |
| **Power Sections** | | | | |
| **Converters** | 2/2, 2/3 | 3/2–3/9, 4/8–4/15 | 6/6–6/11, 6/26–6/30, 6/37, 6/38, 6/41, 6/42 6/59–6/65 | 7/2–7/5 |
| **Inverters** | 2/2, 2/3 | 3/2–3/9 4/4–4/15 | 6/5, 6/6, 6/19, 6/21–6/23, 6/32, 6/39, 6/40, 6/43, 6/44, 6/50, 6/51, 6/57, 6/59–6/61 | 7/2–7/5 |
| **Electronic options** | | | | |
| Encoder boards | – | 3/6 | 6/60, 6/61 | – |
| Communication boards | – | 3/6 | 6/60, 6/61, 6/78–6/85 | – |
| SIMOLINK drive coupling | – | 3/6 | 6/2, 6/79–6/81, 6/93, | – |
| Technology boards | – | 3/6 | 6/96 | – |
| **Software packages** | | | | |
| Freely-programmable function blocks | – | 3/36 | | – |
| Technology functions • Positioning | – | 3/9 | 6/87, 6/88, 6/91 | – |
| • Angular synchronism | – | 3/9 | 6/87, 6/88, 6/93, 6/94 | – |
| Engineering package Drive ES | | 3/42 | 3/42 | |
| **Interconnecting Systems** | | | | |
| Encoder cables | 2/6, 3/31 | 3/32 | 6/62–6/67, 6/102 | – |
| Power cables | 2/6, 3/31 | 3/32 | 6/102 | – |
| **Motors** | | | | |
| 1FK. and 1FT6 synchronous motors | – | 4/4–4/11 | 6/2–6/7 | 7/16–7/27 |
| 1PH7 compact asynchronous motors | – | 4/8, 4/9 | 6/2–6/7 | 7/28–7/32 |



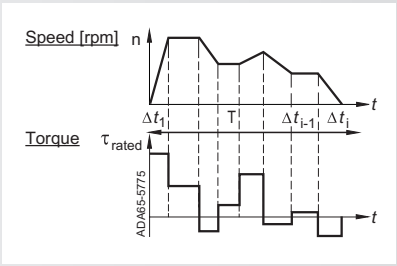
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**Basis information**

**Note:**
These selection guidelines are also supported by the PATH Plus planning tool.




In order to select the correct drive, the speed and the load torque curves must be known.

**Step 1**

**Determining the degree of protection of the motor:**
IP23; IP55; IP64; IP65; IP67 For details, see Catalog DA 65.3 Section 1

**Step 2**

**Determining the supply voltage/motor voltage:**
380 V to 400 V; 460 V to 480 V

**Step 3**

**Determining the type of construction of the motor:** For details, see Catalog DA 65.3 Section 7
IM B 3 (foot mounting); IM B 5 (flange mounting); IM B 35 (foot and flange mounting)

**Step 4**

**Determining the maximum torque $\tau_{max}$ from the load torque curve**

**Step 5**

**Determining the average (rms) torque $\tau_{rms}$**

**For details, see Section 6**

**Step 6**

**Determining the type of motor needed:** For allocation, see pages 4/2, 4/3
1FK., 1FT6 synchronous servomotor or 1PH7, 1PL6, 1PH4 asynchronous servomotor

**Step 7**

**Selection of the motor which satisfies the following criteria:**

**Synchronous motor:**
$n_{max} \leq n_{rated}$
$\tau_{rms} \leq \tau_{rated}$
The load points ($n_i$, $\tau_i$) must be below $\tau_{max,\ perm}$ or below the voltage limit curve.

**Asynchronous motor:**
$n_{max}$ must not be exceeded
$\tau_{rms} \leq \tau_{rated}$
The load points ($n_i$, $\tau_i$) must be at least 30 % lower than the stalling torque curve.

**Step 8**

**Determining the type of encoder system needed:**
Incremental encoder TTL (only asynchronous servomotors); resolver; incremental encoder; absolute-value encoder For details, see Catalog DA 65.3, Section 4

**Step 9**

**Complete order number for the motor with all the options needed:**

**Order number for motor:** **1FK6** □□□–□□□□□–□□□□
**1FK7** □□□–□□□□□–□□□□
**1FT6** □□□–□□□□□–□□□□
**1PH7** □□□–□□□□□–□□□□
**1PL6** □□□–□□□□□–□□□□
**1PH4** □□□–□□□□□– **Z**
**Codes**

**Step 10**

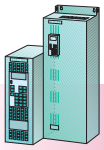
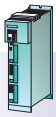
**Selection of the power cable required:** see Section 3; Engineering information Section 6
**Order number for power cable:**
**Order number for coupling:**
(for non-preassembled cables)

**Step 11**

Motor selection and accessories



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**Step 11**

**Selection of the encoder cable required:** see Section 3; Engineering information Section 6
**Order number for encoder cable:**
**Order number for couplings:**
(for non-preassembled cables)

**Step 12**

**Specifying the type of unit:**
**Converter** preferred for single-axis systems
**Inverter** preferred for multi-axis systems
**Specifying the design and the relevant type** [standard or Performance 2 (P2)]:
**Compact PLUS**
0.55 kW (0.75 HP) to 18.5 kW (25 HP)
**Compact and chassis units**
2.2 kW (3 HP) to 250 kW (335 HP)

In the case of standard overload[1])

**Step 13**

**Selection of the appropriate converter/inverter:**
Converter/inverter for motors 1FK., 1FT6 — see pages 4/4 to 4/12
Converter/inverter for motors 1PH7, 1PL6, 1PH4 — see pages 4/12 and 4/15 and Catalog DA 65.3, Section 3
**Order number for converter/inverter:**

In the case of high overload conditions

**Step 14**

**Selection of the converter/inverter which meets the overload requirements:**
$I_{rms} < I_{n\ conv}$
$I_{max} < 1.6 \times I_{n\ conv}$ [up to 160 kW (215 HP)];
$I_{max} < 1.36 \times I_{n\ conv}$ [200 kW (270 HP) to 250 kW (335 HP)]
$I_{max} < 3.0 \times I_{n\ conv}$, 250 ms, cycle time 1 s (Compact PLUS units)
**Order number for converter/inverter:**

**Step 15**

**Selection of the rectifier unit or rectifier/regenerative unit:** see Section 3
(if rectifier unit or rectifier/regenerative unit is necessary)

**Step 16**

**Determining the encoder boards:** see Sections 3 and 6
SBP; SBR 1/2; SBM2
Integration of the option boards — see page 6/61
**Slot:**
**Order number/code(s):**

**Step 17**

**Is a communication board necessary?**
For USS and for analog RS485/232 as standard, no option.
For PROFIBUS DP, a CBP2 is necessary. For SIMOLINK, an SLB is necessary.
Further communication options — see Sections 3 and 6
Integration of the option boards — see page 6/61
**Slot:**
**Order number/code(s):**

**Step 18**

**EB1 or EB2 expansion board for additional inputs/outputs:**
Description — see pages 6/68 to 6/71
Integration of the option boards — see page 6/61
**Slot:**
**Order number/code(s):**

**Step 19**

**Are optional technology functions needed?**
Description of technology software — see page 6/87
Description of technology board (only compact and chassis units) — see page 6/96
**Order number for technology software:**
**or Order number for technology board and LBA:**

**Step 20**

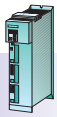
**For additional options such as commutating reactors, radio-interference suppression filters, capacitor module, OP1S** see Section 3

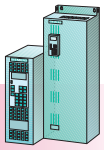
1) $I_{max} < 1.6 \times I_{n\ conv}$, 30 s, cycle time 300 s [up to 160 kW (215 HP)]; $I_{max} < 1.36 \times I_{n\ conv}$ [200 kW (270 HP) to 250 kW (335 HP)];
$I_{max} < 3.0 \times I_{n\ conv}$, 250 ms, cycle time 1 s (Compact PLUS units).





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# Motion Control
# Technical data






2/2 **General technical data**

2/3 **Converters/inverters**

2/4 **Rectifier units**

2/4 **AFE rectifier/regenerative units**

2/4 **Rectifier/regenerative units**

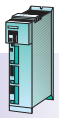
2/5 **Braking units and braking resistors**

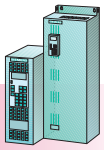
**Line-side components**
2/5 • Line fuses
2/5 • Line commutating reactors
2/5 • Line filters

**Interconnecting systems**
2/6 • 6FX5 and 6FX8 cables




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## Converters, inverters, AFE inverters, rectifier units, rectifier/regenerative units and braking units

| | |
|---|---|
| Cooling types<br>Air cooling<br>Permissible ambient and cooling-medium temperature during operation | Forced ventilation with integral fan<br><br>0 °C to +40 °C or 0 °C to +45 °C[3] (32 °F to 104 °F or 32 °F to 113 °F[3]) |
| Water cooling[4]<br>● Operating pressure<br>● Cooling water inlet temperature<br>● Cooling-water requirement<br>● Particle size<br>● Permissible ambient temperature during operation | <br>0.8 to 1 bar<br>+5 °C to 30 °C (41 °F to 86 °F)<br>dependent on enclosure size (see selection table)<br>≤ 0.5 mm (0.02 in)<br>0 °C to +40 °C (32 °F to +104 °F)[2] |
| Permissible ambient temperature<br>● During storage and transport | <br>–25 °C to +70 °C (–13 °F to +158 °F) |
| Installation altitude | ≤ 1,000 m (3,281 ft) above sea level (100 % load capability)<br>> 1,000 m (3,281 ft) to 4,000 m (13,123 ft) above sea level<br>(for reduction curves, see Section 6) |
| Humidity rating | Relative humidity ≤ 95 %. Moisture condensation not permissible |
| Climatic category | Class 3K3 to EN 60 721-3-3 |
| Environmental class | Class 3C2 to EN 60 721-3-3 |
| Insulation | Pollution degree 2 to DIN VDE 0110-1 (HD 625.1 S1: 1996)<br>Moisture condensation not permissible |
| Overvoltage category | Category III to DIN VDE 0110-1 (HD 625.1 S1: 1996) |
| Overvoltage strength | Class 1 to DIN VDE 0160 |
| Degree of protection | To DIN VDE 0470, Part 1 (EN 60 529) IP00 and IP20 |
| Protection class | Class I to EN 61 140 |
| Shock protection | To DIN VDE 0106 Part 100 and BGV A2 (previously VBG 4) |
| Radio-interference level<br>● Standard<br>● Options | To EMC product standard EN 61 800-3 for variable-speed drives<br>No radio-interference suppression<br>Class B1 or Class A1 to EN 61 800-3 |
| Additional information | The units are motor-side ground-fault-protected, short-circuit-proof and may be operated under no-load conditions |
| Paint finish | For indoor installation |
| **Mechanical specifications**<br>For stationary applications:<br>Constant amplitude<br>● of deflection<br>● of acceleration<br>During transport:<br>● of deflection<br>● of acceleration | To EN 60 068-2-6<br><br><br>0.075 mm (0.003 in) in the frequency range 10 Hz to 58 Hz<br>9.8 $ms^{-2}$ (32 $ft/s^2$) (1 x g) in the frequency range > 58 Hz to 500 Hz<br><br>3.5 mm (0.14 in) in the frequency range 5 Hz to 9 Hz<br>9.8 $ms^{-2}$ (32 $ft/s^2$) (1 x g) in the frequency range > 9 Hz to 500 Hz |

| **Approvals according to UL/CSA** | UL File No. | CSA File No. |
|---|---|---|
| Converters and inverters | E 145 153 | LR 21927, LR 219278-67[3] |
| Rectifier units and rectifier/regenerative units[1] | E 145 153 | LR 21927 |
| Braking units and load resistors | E 145 153 | LR 21927 |
| Radio interference suppression filter[5] | E 145 153 | LR 21927-67R |
| Free-wheeling diode on the DC bus[1] | E 145 153 | LR 21927 |
| Line commutating and outputreactors (iron) | E 103 902 | |
| 3NE3 and 3NE8 series fuses are | E167357/JFHR2 | |

1) UL and CSA only apply in combination with SIMOVERT MASTERDRIVES converters or inverters.

2) With derating to 50 °C (122 °F).

3) For Compact PLUS units.

4) For compact and chassis units.

5) In preparation for radio-interference suppression filter 6SE70 . . . – . EP87– . . . for Compact PLUS units.

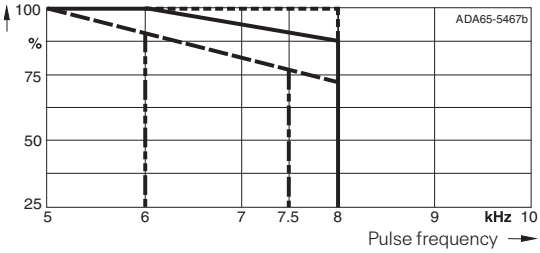


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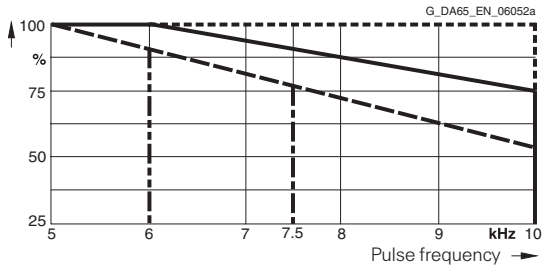
| | Compact PLUS units | Compact and chassis units |
|---|---|---|
| **Rated voltage**<br>Line voltage | 3-ph. 380 V AC (–15 %) to 480 V AC (+10 %) | 3-ph. 380 V AC (–15 %) to 480 V AC (+10 %) |
| DC link voltage | 510 V DC (–15 %) to 650 V DC (+10 %) | 510 V DC (–15 %) to 650 V DC (+10 %) |
| Output voltage | 3-ph. 0 V AC to 0.86 x line voltage | 3-ph. 0 V AC to 0.86 x line voltage |
| Output voltage, inverter | 3-ph. 0 V AC to 0.64 x DC link voltage | 3-ph. 0 V AC to 0.64 x DC link voltage |
| **Rated frequency**<br>Line frequency | 50/60 Hz (±6 %) | 50/60 Hz (±6 %) |
| Output frequency/max. digital resolution | 0 Hz to 400 Hz/0.001 Hz | 0 Hz to 400 Hz/0.001 Hz |
| Pulse frequency | 5 kHz to 8 kHz[2]) P2: 2.5 to 10 kHz[1]) | 5 kHz to 8 kHz[1])[2]) P2: 2.5 to 10 kHz[1]) |
| Rated motor output | 0.55 kW (0.75 HP) to 18.5 kW (25 HP) | 2.2 kW (3 HP) to 250 kW (335 HP) |
| **Load class II to EN 60 146-1-1**<br>Base load current | 0.91 x rated output current | 0.91 x rated output current |
| Short-time current | 3 x rated output current | – |
| Short-time duration | 250 ms | – |
| Short-time cycle | 1 s | – |
| Overload current | 1.6 x rated output current | 1.6 x rated output current[3]) |
| Overload duration | 30 s (10 % of the cycle time) | 30 s (10 % of the cycle time)[3]) |
| Overload cycle time | 300 s | 300 s |
| Power factor[4])<br>• fundamental<br>• overall | <br>≥ 0.98<br>0.93 to 0.96 | <br>≥ 0.98<br>0.93 to 0.96 |
| Efficiency | 0.90 to 0.98 | 0.96 to 0.98 |

**Reduction curves**

Permissible rated current




Permissible rated current for Performance 2 units




**Max. pulse frequency, depending on output and enclosure size**

for Compact PLUS units
8 kHz
(up to 10 kHz with Performance 2)

for type A, B, C and D units, chassis ratings 45 kW (60 HP) and 55 kW (75 HP)
8 kHz
(up to 10 kHz with Performance 2)

chassis ratings with 75 kW (100 HP) and 90 kW (120 HP)
8 kHz
(up to 10 kHz with Performance 2)

chassis ratings with 110 kW (150 HP) and 132 kW (175 HP)
7.5 kHz

chassis ratings with 160 kW (215 HP) and 200 kW (270 HP)
6 kHz

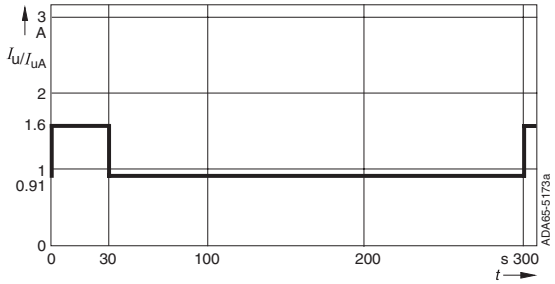
For the 250 kW (335 HP) unit, only 5 kHz is possible.

From firmware version 2.1 and upwards with Performance 2, a pulse frequency of 2.5 kHz for higher outputs is also possible.

These units can be delivered on request with up to 710 kW (952 HP).

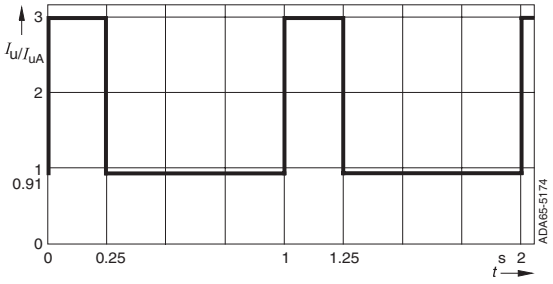
**Overload characteristic**

Output current/rated output current




**Short-time characteristic for Compact PLUS units**

Output current/rated output current




The short-time overload capacity of the Compact PLUS units is additionally limited by the $I^2t$-calculation (overload characteristic).

1) See reduction curves.

2) For standard units, the pulse frequency is limited to 8 kHz due to processor utilization, with Performance 2 to 10 kHz.

3) 1.36 x rated output current for 200 kW (270 HP) and 250 kW (335 HP) units with 60 s overload duration.

4) With a $V_D$ = 2 % commutating reactor.

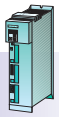


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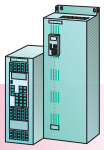
# Technical data



## Rectifier units



Compact PLUS units



Compact and chassis units

| | Compact PLUS units | Compact and chassis units |
|---|---|---|
| **Rated voltage**<br>Line voltage | 3-ph. 380 V AC (–15 %) to 480 V AC (+10 %) | 3-ph. 380 V AC (–15 %) to 480 V AC (+10 %) |
| Output voltage | 510 V DC (–15 %) to 650 V DC (+10 %) | 510 V DC (–15 %) to 650 V DC (+10 %) |
| **Rated frequency**<br>Line frequency | 50/60 Hz (±6 %) | 50/60 Hz (±6 %) |
| **Rated motor output** | 15 kW, 50 kW, 100 kW | 15 kW to 250 kW |
| **Load class II to EN 60 146-1-1**<br>Base load current | 0.91 x rated output current | 0.91 x rated output current |
| Short-time current | 3 x rated output current | – |
| Short-time duration | 250 ms | – |
| Short-time cycle | 1 s at 15 kW, 12 s at 50 kW and 100 kW | – |
| Overload current | 1.6 x rated output current for max. 30 s | 1.36 x rated output current |
| Overload duration | 30 s | 60 s (20 % of the cycle time) |
| Overload cycle time | 300 s | 300 s |
| Power factor[1])<br>• fundamental<br>• overall | <br>≥ 0.98<br>0.93 to 0.96 | <br>≥ 0.98<br>0.93 to 0.96 |
| Efficiency | 0.995 | 0.99 to 0.995 |

## AFE rectifier/regenerative units

| | Compact and chassis units |
|---|---|
| **Rated voltage**<br>Line voltage | 3-ph. 380 V AC (–20 %) to 460 V AC (+5 %) |
| Output voltage<br>Operating range of the DC link voltage control | Factory setting:<br>600 V DC for compact units<br>632 V DC for chassis units<br>Minimum: 1.5-fold of the rms value of the applied voltage<br>Maximum: 740 V |
| **Rated frequency**<br>Line frequency | 50/60 Hz (±10 %) |
| **Rectifier/regenerative output** | 6.8 to 250 kW |
| **Load class II to EN 60 146-1-1**<br>Base load current | 0.91 x rated input current (from/to the line supply) |
| Short-time current | 1.36 x rated input current for 60 s<br>1.6 x rated input current for 30 s for units up to enclosure size G |
| Cycle time | 300 s |
| Supply power factor<br>• fundamental<br>• overall | <br>1 (factory setting)<br>> 0.99 |
| Efficiency | > 0.98 |

## Rectifier/regenerative units[2])

| | Compact and chassis units |
|---|---|
| **Rated voltage**<br>Line voltage<br>motoring | 3-ph. 380 V AC (–15 %) to 480 V AC (+10 %) |
| Line voltage<br>regenerating | 3-ph. 455 V AC (–15 %) to 576 V AC (+10 %) |
| Output voltage | 510 V DC (–15 %) to 650 V DC (+10 %) |
| **Rated frequency**<br>Line frequency | 50/60 Hz (±6 %) |
| **Rated motor output** | 7.5 kW to 250 kW |
| **Load class II to EN 60 146-1-1**<br>Base load current | 0.91 x rated output current |
| Short-time current | 1.36 x rated output current |
| Cycle time | 300 s |
| Overload duration | 60 s (20 % of the cycle time) |
| Power factor, motoring<br>• fundamental<br>• overall | <br>≥ 0.98<br>0.93 to 0.96 |
| Efficiency | 0.99 to 0.995 |

1) With a $V_D$ = 2 % commutating reactor.

2) Where there is a fast changeover from motoring mode to generating mode, a deadtime of 15 ms is to be taken into account.



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| | |
|---|---|
| **Rated voltage**<br>DC link voltage | 510 V DC (–15 %) to 650 V DC (+10 %) |
| **Switch-on thresholds**<br>Upper threshold | 774 V[1]) |
| Lower threshold | 673 V |
| **Load class II to EN 60 146-1-1**<br>Rated power $P_{20}$ | 5 kW to 170 kW; $P_{20}$ power at the upper switch-on threshold: the duration depends on the internal or external resistor |
| Continuous power $P_D$ | Continuous power: value is dependent on the internal or external resistor |
| Short-time power rating $P_3$ | 1.5 x $P_{20}$ power at the upper resistor threshold: the duration depends on the internal or external resistor |
| Cycle time | 90 s |
| Overload duration | 20 s (22 % of the cycle time) |



## Line fuses

For technical data of the line fuses, see Catalog "SITOR Semiconductor Protection Fuses for Converters" DA 94.1
(Order No.: E20002–K4094–A111–A2–7600)

## Line commutating reactors

| | |
|---|---|
| Permissible ambient temperature during operation | –25 °C to +70 °C (–13 °F to +158 °F) (4EP)<br>–25 °C to +80 °C (–13 °F to +176 °F) (4EU) |
| Storage temperature | –25 °C to +80 °C (–13 °F to +176 °F) |
| Permissible moisture conditions | Relative humidity at +40 °C (+104 °F)<br>Occasionally up to 100 %<br>Yearly average up to 80 %<br>Occasional moisture condensation permissible |
| Degree of protection | IP00 |
| Rating of the creepage distance and air distance | Pollution degree 2 to DIN VDE 0110 |
| Rated voltage for the insulation (for installation altitudes up to 2000 m above sea level) | Type 4EP, 4EU24 to 4EU43 (DIN VDE 0550)<br>500 V AC at $V_L$ (line voltage) ≤ 500 V |
| Recommended ratio of the system fault power to the drive power | > 33 : 1 |
| Use with converters and rectifier units | 2 % line commutating reactor |
| Use with converters and rectifier/regenerative feedback units | 4 % line commutating reactor |

For further technical data regarding the mechanical design, see Catalog PD 30
(Order No.: E86060–K2803–A101–A1, only available in German).

## Line filters[2])

| | |
|---|---|
| Line filters to DIN VDE 0875, Part 11 (EN 55 011) Class B1 | Reduction of radio-interference voltages of the converters, rectifier units, rectifier/regenerative feedback units with a power output of up to 37 kW to the limit values for public power systems (filters also comply with limit values according to Class A1). |
| Line filters to DIN VDE 0875, Part 11 (EN 55 011) Class A1 | Reduction of radio-interference voltages of the converters, rectifier units, rectifier/regenerative feedback units with a power output of up to 200 kW to the limit values for industrial power systems. |

1) Compact PLUS 750 V. A brake chopper is built into the standard version of the Compact PLUS converter and rectifier units.

2) Line filters for the Compact PLUS series up to 7.5 kW contain a commutating reactor $V_D$ = 2 %.




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## 6FX5 and 6FX8 cables

### *Technical characteristics and applications*

The 6FX5 and 6FX8 cables are suitable for use with an extremely wide range of production and processing machinery.

The cables can be used universally and are:

- resistant to mechanical and chemical stress,
- CFC and silicone free,
- EMC-tested,
- UL-certified.

They satisfy very high requirements and are characterized by

- long bending cycles with small bending radii
- resistance to aggressive agents
- environmental friendliness (CFC, silicone and halogen free)
- high contribution to electromagnetic compatibility.

The cables are sold by the meter but can also be supplied as prefabricated cables (with plugs).

The prefabricated cables offer the following advantages:

- The exact length can be ordered to the meter.
- They are subject to extensive tests, thus ensuring outstanding quality.
- They are safe and reliable, as they are optimally matched to the components to be connected.
- The savings in logistics, construction and purchasing reduce overall costs.

The 6FX cables, prefabricated and sold by the meter, are described in detail in Catalog NC Z.

### *Technical data*

| | MOTION CONNECT 500<br>6FX500 . – . . . . – . . . . type | MOTION CONNECT 800<br>6FX800 . – . . . . – . . . . type |
|---|---|---|
| **Certifications** | | |
| Power/signal cables | | |
| • VDE[1] | yes | yes |
| • c/UL or UL/CSA | 758/C22.2N.210.2–M9C | 758/C22.2N.210.2–M9C |
| • UL/CSA File No.[2] | yes | yes |
| **Electrical data acc. to DIN VDE 0472** | | |
| Rated voltage | | |
| • power cable $V_0/V$ | | |
| – supply cores | 600/1000 V | 600/1000 V |
| – signal cores | 24 V (VDE) 1000 V (UL) | 24 V (VDE) 1000 V (UL/CSA) |
| • signal cable | 30 V | 30 V |
| Test voltage | | |
| • power cable | | |
| – supply cores | 4 $kV_{rms}$ | 4 $kV_{rms}$ |
| – signal cores | 2 $kV_{rms}$ | 2 $kV_{rms}$ |
| • signal cable | 500 $V_{rms}$ | 500 $V_{rms}$ |
| **Operating temperature** | | |
| on the surface | | |
| rated voltage | | |
| • fixed cable | –20 °C to +80 °C (–4 °F to +176 °F) | –50 °C to +80 °C (–58 °F to +176 °F) |
| • moving cable | 0 °C to +60 °C (32 °F to +140 °F) | –20 °C to +60 °C (–4 °F to +140 °F) |
| **Mechanical data** | | |
| Max. tensile stress per conductor cross-section | | |
| • fixed cable | 50 N/mm² | 50 N/mm² |
| • moving cable | – | 20 N/mm² |
| Smallest permissible bending radius | | |
| • fixed cable (power cable) | 5 x $D_{max}$ | 6 x $D_{max}$ |
| fixed cable (signal cable) | see Catalog NC Z | see Catalog NC Z |
| • moving cable (power cable) | see Catalog NC Z | see Catalog NC Z |
| moving cable (signal cable) | see Catalog NC Z | see Catalog NC Z |
| Torsional stress | 30 °/m absolute | 30 °/m absolute |
| Power cable bends | | |
| • 1.5 to 6 mm² + signal | 100 x $10^3$ | 10 x $10^6$ |
| • 10 to 50 mm² | 100 x $10^3$ | 3 x $10^6$ |
| Signal cable bends | 2 x $10^6$ | 10 x $10^6$ |
| Traverse rate (power cables) | | |
| • 1.5 to 6 mm² + signal | 30 m/min. | 180 m/min. |
| • 10 to 50 mm² | 30 m/min. | 100 m/min. |
| Traverse rate (signal cables) | 180 m/min. (5 m); 100 m/min. (15 m) | 180 m/min. |
| Acceleration (power cables) | 2 m/s² | 5 m/s² (5 m); 10 m/s² (2.5 m) |
| Acceleration (signal cables) | 5 m/s² | 5 m/s² (5 m); 10 m/s² (2.5 m) |
| **Chemical data** | | |
| Insulation material | CFC free | halogen, silicone and CFC free, DIN 47 2815/IEC 60 754-1 |
| Oil resistance | DIN VDE 0472, part 803, type of test B hydraulic oil only | VDE 0472, part 803, type of test B |
| Outer sheath | | |
| • power cable | PVC, color DESINA: orange RAL 2003 | PUR DIN VDE 0282, part 10, color DESINA: orange RAL 2003 |
| • signal cable | PVC, color DESINA: green RAL 6018 | PUR DIN VDE 0282, part 10, color DESINA: green RAL 6018 |
| Flame resistant[3] | IEC 60 332.3 | IEC 60 332.3 |

The cables are not suitable for outdoor use.
The technical data of these cables only apply to simple bends with horizontal travel of up to five meters.
Degree of protection for the customized power and signal cables and their extension cables **when plugged and closed: IP67**

1) The corresponding registration numbers are printed on the cable sheath.

2) The File No. of the respective manufacturers are printed on the cable sheath.

3) VW1 is printed on the cable sheath for UL/CSA, but not for c/UL.



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# Motion Control
# Selection and ordering data





**Converters and inverters**
- 3/2 Order number examples
- 3/3 Basic units
- 3/6 Electronics options
- 3/9 Control board for compact and chassis units
- 3/9 Technology software

3/10 **Rectifier units**

3/12 **AFE rectifier/regenerative units**

3/14 **Rectifier/regenerative units**

**Options**
- 3/16 Supplementary Order codes
- 3/17 Isolation amplifier boards
- 3/17 SCI1 and SCI2 interface boards
- 3/17 Rectifier units and 24 V DC power supply unit
- 3/17 Coupling relay

**DC link system components**
- 3/18 Braking units and braking resistors
- 3/19 Capacitor module
- 3/19 DC link module
- 3/19 DC link bus bars

**Line-side power options**
- 3/20 Converters
- 3/23 Rectifier units
- 3/24 AFE rectifier/regenerative units
- 3/27 Rectifier/regenerative units, 25 % power-on duration

3/29 **DC link power options**

3/30 **System components for braking units and braking resistors**

**Interconnecting systems**
- 3/31 Connection overview
- 3/31 Current carrying capacity of PVC-insulated copper conductors
- 3/31 Correction factors
- 3/32 Power cables for 1FK., 1FT6, 1PH, 1PL6
- 3/34 Encoder cables

3/38 **Mechanical system components**

**Operator control, visualization and communication with SIMATIC**
- 3/39 OP1S comfort operator control panel
- 3/39 APMU adapter for cabinet-door mounting
- 3/40 Communication package for SIMATIC S5
- 3/41 Start-up, parameterization and diagnostics with DriveMonitor

3/42 **Engineering system Drive ES**






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# Selection and ordering data



## Order number examples

**Compact PLUS, compact and chassis units**

e.g. **6 S E 7 0 3 1 – 0 E E 5 0 – Z**

**SIMOVERT MASTERDRIVES 6SE7 series**

**Compact PLUS units, compact units, chassis units**

**Multiplier for output current**
e.g.: 2 ≙ × 1
3 ≙ × 10
4 ≙ × 100

Example:

Multiplier = 10
First two positions of output current: 10
Output current rounded off = 100 A

**First two positions for output current**

**Supply voltage code** e.g. **E** ≙ 3-ph. 400 – 480 V AC

**Size** e.g. chassis size **E** (**P** for Compact PLUS units, **A** to **D** for compact units, **E** to **K** for chassis units)

**Control version 5** ≙ SIMOVERT MASTERDRIVES Motion Control
**7** ≙ SIMOVERT MASTERDRIVES Motion Control Performance 2

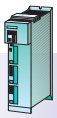
**Function release**

**Supplementary order codes for options**





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Compact PLUS units

New Performance 2

Converters and inverters

## Basic units

| Nominal power rating[1] | Selection data: Rated output current | Short-time current/ Overload current[3] | Rated DC link current | Line current (only for converters) | Converter units | Inverter units | Total power loss at 5 kHz/ 10 kHz[2]: Conv. | Total power loss at 5 kHz/ 10 kHz[2]: Inv. | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight | Cooling-air requirement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{n\,conv}$ | $I_{max.}$ | $I_{DCrated}$ | | | | | | | | | |
| kW (HP) | A | A | A | A | Order No. | Order No. | kW | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V to 480 V AC and DC voltage 510 V to 650 V DC** | | | | | | | | | | | | |
| **Compact PLUS units** | | | | | | | | | | | | |
| **0.55 (0.75)** | 1.5 | 4.5/2.4 | – | 1.7 | ▲ **6SE7011–5EP□0**[4)6)] | | 0.070 | | 45 x 360 x 260 (1.8 x 14.2 x 10.2) | 2 | 3.4 (7.5) | 0.002 (0.071) |
| **1.1 (1.5)** | 3.0 | 9.0/4.8 | – | 3.3 | ▲ **6SE7013–0EP□0**[4)6)] | | 0.104 | | 67.5 x 360 x 260 (2.7 x 14.2 x 10.2) | 2 | 3.9 (8.6) | 0.009 (0.318) |
| **1.5 (2)** | 5.0 | 15/8 | – | 5.5 | ▲ **6SE7015–0EP□0**[4)6)] | | 0.150 | | 67.5 x 360 x 260 (2.7 x 14.2 x 10.2) | 2 | 4.1 (9) | 0.009 (0.318) |
| **3 (4)** | 8.0 | 24/12.8 | – | 8.8 | ▲ **6SE7018–0EP□0**[4)6)] | | 0.216 | | 90 x 360 x 260 (3.5 x 14.2 x 10.2) | 2 | 4.5 (9.9) | 0.018 (0.636) |
| **4 (5)** | 10 | 30/16 | – | 9.7 | ▲ **6SE7021–0EP□0**[4)6)] | | 0.240 | | 90 x 360 x 260 (3.5 x 14.2 x 10.2) | 2 | 4.5 (9.9) | 0.018 (0.636) |
| **5.5 (7.5)** | 14 | 42/22.4 | – | 12.6 | ▲ **6SE7021–4EP□0**[4)] | | 0.270 | | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 2 | 10.8 (23.8) | 0.042 (1.483) |
| **7.5 (10)** | 20.5 | 61.5/32.8 | – | 16.7 | ▲ **6SE7022–1EP□0**[4)] | | 0.340 | | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 2 | 10.9 (24) | 0.042 (1.483) |
| **11 (15)** | 27 | 81/43.2 | – | 23.2 | ▲ **6SE7022–7EP□0**[4)] | | 0.470 | | 180 x 360 x 260 (7.1 x 14.2 x 10.2) | 2 | 14.7 (32.4) | 0.061 (2.154) |
| **15 (20)** | 34 | 102/54.4 | – | 31.7 | ▲ **6SE7023–4EP□0**[4)] | | 0.630 | | 180 x 360 x 260 (7.1 x 14.2 x 10.2) | 2 | 14.9 (32.9) | 0.061 (2.154) |
| **0.75 (1)** | 2.0 | 6.0/3.2 | 2.5 | – | | ▲ **6SE7012–0TP□0** | | 0.066 | 45 x 360 x 260 (1.8 x 14.2 x 10.2) | 2 | 3.0 (6.6) | 0.002 (0.071) |
| **1.5 (2)** | 4.0 | 12/6.4 | 5.0 | – | | ▲ **6SE7014–0TP□0** | | 0.086 | 67.5 x 360 x 260 (2.7 x 14.2 x 10.2) | 2 | 3.4 (7.5) | 0.009 (0.318) |
| **2.2 (3)** | 6.1 | 18.3/9.6 | 7.3 | – | | ▲ **6SE7016–0TP□0** | | 0.116 | 67.5 x 360 x 260 (2.7 x 14.2 x 10.2) | 2 | 3.4 (7.5) | 0.009 (0.318) |
| **4 (5)** | 10.2 | 30.6/16.3 | 12.1 | – | | ▲ **6SE7021–0TP□0** | | 0.156 | 90 x 360 x 260 (3.5 x 14.2 x 10.2) | 2 | 3.8 (8.4) | 0.018 (0.636) |
| **5.5 (7.5)** | 13.2 | 39.6/21.1 | 15.7 | – | | ▲ **6SE7021–3TP□0** | | 0.240 | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 2 | 8.8 (19.4) | 0.042 (1.483) |
| **7.5 (10)** | 17.5 | 52.5/28 | 20.8 | – | | ▲ **6SE7021–8TP□0** | | 0.300 | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 2 | 8.9 (19.6) | 0.042 (1.483) |
| **11 (15)** | 25.5 | 76.5/40.8 | 30.4 | – | | ▲ **6SE7022–6TP□0** | | 0.410 | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 2 | 9.0 (19.8) | 0.042 (1.483) |
| **15 (20)** | 34 | 102/54.4 | 40.5 | – | | ▲ **6SE7023–4TP□0** | | 0.560 | 180 x 360 x 260 (7.1 x 14.2 x 10.2) | 2 | 12.7 (28) | 0.061 (2.154) |
| **18.5 (25)** | 37.5 | 112.5/60 | 44.6 | – | | ▲ **6SE7023–8TP□0** | | 0.660 | 180 x 360 x 260 (7.1 x 14.2 x 10.2) | 2 | 12.9 (28.4) | 0.061 (2.154) |

▲ "Safe Stop" option possible with code **K80**

| | | |
|---|---|---|
| SIMOVERT MASTERDRIVES Motion Control | 5 | 5 |
| SIMOVERT MASTERDRIVES Motion Control Performance 2[5)] | 7 | 7 |

Power ratings over 250 kW (335 HP) to 710 kW (951 HP) possible on request for Performance 2 units.

Conv. = Converters (AC – AC)
Inv. = Inverters (DC – AC)

1) The quoted nominal power ratings for SIMOVERT MASTERDRIVES serve only as a guide for the selection of other components. The exact drive output depends on the motors connected, and this should be taken into account when planning.

2) 10 kHz with Compact PLUS units, 5 kHz with compact and chassis units. 2.5 kHz for power ratings over 250 kW (335 HP) only possible on request with Performance 2 units.

3) Short time current: 3 x $I_{n\,conv}$ for 250 ms (only for Compact PLUS units)/Overload current: 1.6 x $I_{n\,conv}$ for 30 s. For the 200 kW (268 HP) and 250 kW (335 HP) units, this is 1.36 x the rated output current for 60 s.

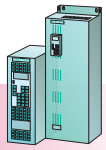
4) In the Compact PLUS converters, the brake chopper is integrated.
The braking resistor should be selected accordingly and must be mounted externally (see Page 3/18).

5) Performance 2 stands for a performance increase by a factor of 2. Doubling of computing power and consequently halving of computing times for all functions.

6) A firmware version ≥ 1.63 is an absolute prerequisite for standard units ("5" in digit 11 of the order no.) with option K80.



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## Basic units (continued)

| Nominal power rating[1] | Selection data: Rated output current | Short-time current/ Overload current[3] | Rated DC link current | Line current (only for converters) | Converter units | Inverter units | Total power loss at 5 kHz/ 10 kHz[2]: Conv. | Total power loss at 5 kHz/ 10 kHz[2]: Inv. | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight | Cooling-air requirement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{n\,conv}$ | $I_{max.}$ | $I_{DCrated}$ | | | | | | | | | |
| kW (HP) | A | A | A | A | Order No. | Order No. | kW | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V to 480 V AC and DC voltage 510 V to 650 V DC** | | | | | | | | | | | | |
| **Compact units** | | | | | | | | | | | | |
| **2.2 (3)** | 6.1 | 9.8 | 7.3 | 6.7 | ■ **6SE7016–1EA□1** | ● **6SE7016–1TA□1** | 0.15 | 0.13 | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 5 | 8.5 (18.7) | 0.009 (0.318) |
| **3 (4)** | 8.0 | 12.8 | 9.5 | 8.8 | ■ **6SE7018–0EA□1** | ● **6SE7018–0TA□1** | 0.17 | 0.15 | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 5 | 8.5 (18.7) | 0.009 (0.318) |
| **4 (5)** | 10.2 | 16.3 | 12.1 | 11.2 | ■ **6SE7021–0EA□1** | ● **6SE7021–0TA□1** | 0.21 | 0.17 | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 5 | 8.5 (18.7) | 0.009 (0.318) |
| **5.5 (7.5)** | 13.2 | 21.1 | 15.7 | 14.5 | ■ **6SE7021–3EB□1** | ● **6SE7021–3TB□1** | 0.23 | 0.20 | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 5 | 12.5 (27.6) | 0.022 (0.777) |
| **7.5 (10)** | 17.5 | 28 | 20.8 | 19.3 | ■ **6SE7021–8EB□1** | ● **6SE7021–8TB□1** | 0.30 | 0.25 | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 5 | 12.5 (27.6) | 0.022 (0.777) |
| **11 (15)** | 25.5 | 40.8 | 30.4 | 28.1 | ■ **6SE7022–6EC□1** | ● **6SE7022–6TC□1** | 0.43 | 0.36 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 5 | 21 (46.3) | 0.028 (0.989) |
| **15 (20)** | 34 | 54.4 | 40.5 | 37.4 | ■ **6SE7023–4EC□1** | ● **6SE7023–4TC□1** | 0.59 | 0.49 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 5 | 21 (46.3) | 0.028 (0.989) |
| **18.5 (25)** | 37.5 | 60 | 44.6 | 41.3 | ▲ **6SE7023–8ED□1** | ● **6SE7023–8TD□1** | 0.70 | 0.60 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 32 (70.5) | 0.054 (1.907) |
| **22 (30)** | 47 | 75.2 | 55.9 | 51.7 | ▲ **6SE7024–7ED□1** | ● **6SE7024–7TD□1** | 0.87 | 0.74 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 32 (70.5) | 0.054 (1.907) |
| **30 (40)** | 59 | 94.4 | 70.2 | 64.9 | ▲ **6SE7026–0ED□1** | ● **6SE7026–0TD□1** | 1.02 | 0.86 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 32 (70.5) | 0.054 (1.907) |
| **37 (50)** | 72 | 115.2 | 85.7 | 79.2 | ▲ **6SE7027–2ED□1** | ● **6SE7027–2TD□1** | 1.27 | 1.06 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 32 (70.5) | 0.054 (1.907) |

● "Safe Stop" option provided as standard
▲ "Safe Stop" option possible with code **K80**
■ "Safe Stop" option not possible

| | Conv. | Inv. |
|---|---|---|
| SIMOVERT MASTERDRIVES Motion Control | 5 | 5 |
| SIMOVERT MASTERDRIVES Motion Control Performance 2[4] | 7 | 7 |

Power ratings over 250 kW (335 HP) to 710 kW (951 HP) possible on request for Performance 2 units.

Conv. = Converters (AC – AC)
Inv. = Inverters (DC – AC)

1) The quoted nominal power ratings for SIMOVERT MASTERDRIVES serve only as a guide for the selection of other components. The exact drive output depends on the motors connected, and this should be taken into account when planning.

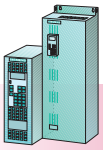
2) 10 kHz with Compact PLUS units, 5 kHz with compact and chassis units. 2.5 kHz for power ratings over 250 kW (335 HP) only possible on request with Performance 2 units.

3) Short time current: 3 x $I_{n\,conv}$ for 250 ms (only for Compact PLUS units)/Overload current: 1.6 x $I_{n\,conv}$ for 30 s. For the 200 kW (268 HP) and 250 kW (335 HP) units, this is 1.36 x the rated output current for 60 s.

4) Performance 2 stands for a performance increase by a factor of 2. Doubling of computing power and consequently halving of computing times for all functions.



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Compact and chassis units

New Performance 2

## Basic units (continued)

| Nominal power rating[1] | Selection data: Rated output current | Short-time current/ Overload current[3] | Rated DC link current | Line current (only for converters) | Converter units | Inverter units | Total power loss at 5 kHz/ 10 kHz[2]: Conv. | Total power loss at 5 kHz/ 10 kHz[2]: Inv. | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight | Cooling-air requirement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{n\,conv}$ | $I_{max.}$ | $I_{DCrated}$ | | | | | | | | | |
| kW (HP) | A | A | A | A | Order No. | Order No. | kW | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V to 480 V AC and DC voltage 510 V to 650 V DC** | | | | | | | | | | | | |
| **Chassis units** | | | | | | | | | | | | |
| **45 (60)** | 92 | 147 | 110 | 101 | ▲ **6SE7031–0EE□0** | ▲ **6SE7031–0TE□0** | 1.38 | 1.25 | 270 x 1050 x 365 (10.6 x 41.3 x 14.3) | 7 | 65 (143.3) | 0.10 (3.531) |
| **55 (75)** | 124 | 198 | 148 | 136 | ▲ **6SE7031–2EF□0** | ▲ **6SE7031–2TF□0** | 1.83 | 1.51 | 360 x 1050 x 365 (14.1 x 41.3 x 14.3) | 7 | 75 (165.4) | 0.14 (4.943) |
| **75 (100)** | 155 | 248 | 184 | 171 | ▲ **6SE7031–8EF□0** | ▲ **6SE7031–8TF□0** | 2.43 | 2.04 | 360 x 1050 x 365 (14.1 x 41.3 x 14.3) | 7 | 75 (165.4) | 0.14 (4.943) |
| **90 (120)** | 175 | 280 | 208 | 192 | ▲ **6SE7032–1EG□0** | ▲ **6SE7032–1TG□0** | 2.77 | 2.30 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 160 (352.8) | 0.31 (0.946) |
| **110 (150)** | 218 | 345 | 254 | 238 | ▲ **6SE7032–6EG□0** | ▲ **6SE7032–6TG□0** | 3.45 | 3.00 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 160 (352.8) | 0.31 (10.946) |
| **132 (175)** | 262 | 419 | 312 | 288 | ▲ **6SE7033–2EG□0** | ▲ **6SE7033–2TG□0** | 4.25 | 3.60 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 180 (396.8) | 0.41 (14.477) |
| **160 (215)** | 308 | 493 | 367 | 339 | ▲ **6SE7033–7EG□0** | ▲ **6SE7033–7TG□0** | 5.30 | 4.50 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 180 (396.8) | 0.41 (14.477) |
| **200 (270)** | 423 | 575 | – | 465 | ▲ **6SE7035–1EK□0** | – | 6.30 | – | 800 x 1750 x 565 (31.5 x 68.9 x 22.2) | 9 | 400 (881.8) | 0.46 (16.243) |
| **200 (270)** | 423 | 575 | 504 | – | – | ▲ **6SE7035–1TJ□0** | – | 5.20 | 800 x 1400 x 565 (31.5 x 55.1 x 22.2) | 8 | 350 (771.8) | 0.46 (16.243) |
| **250 (335)** | 491 | 667 | – | 539 | ▲ **6SE7036–0EK□0** | – | 8.9 | – | 800 x 1750 x 565 (31.5 x 68.9 x 22.2) | 9 | 400 (881.8) | 0.46 (16.243) |
| **250 (335)** | 491 | 667 | 584 | – | – | ▲ **6SE7036–0TJ□0** | – | 7.6 | 800 x 1400 x 565 (31.5 x 55.1 x 22.2) | 8 | 350 (771.8) | 0.46 (16.243) |

▲ "Safe Stop" option possible with code **K80**

| | | |
|---|---|---|
| SIMOVERT MASTERDRIVES Motion Control | 5 | 5 |
| SIMOVERT MASTERDRIVES Motion Control Performance 2[4] | 7 | 7 |

Power ratings over 250 kW (335 HP) to 710 kW (951 HP) possible on request for Performance 2 units.

Conv. = Converters (AC – AC)
Inv. = Inverters (DC – AC)

1) The quoted nominal power ratings for SIMOVERT MASTERDRIVES serve only as a guide for the selection of other components. The exact drive output depends on the motors connected, and this should be taken into account when planning.

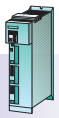
2) 10 kHz with Compact PLUS units, 5 kHz with compact and chassis units. 2.5 kHz for power ratings over 250 kW (335 HP) only possible on request with Performance 2 units.

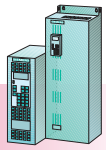
3) Short time current: 3 x $I_{n\,conv}$ for 250 ms (only for Compact PLUS units)/Overload current: 1.6 x $I_{n\,conv}$ for 30 s. For the 200 kW (268 HP) and 250 kW (335 HP) units, this is 1.36 x the rated output current for 60 s.

4) Performance 2 stands for a performance increase by a factor of 2. Doubling of computing power and consequently halving of computing times for all functions.



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## Electronics options · Board/slot preconfiguration[1]

| Designation | | Order No. | Supplementary order code[6] | Weight, approx. kg (lb) | Dimensions W x H x D mm x mm x mm (in x in x in) |
|---|---|---|---|---|---|
| **Encoder boards (An encoder board must always be ordered. Exception: *V/f* control)** | | | | | |
| **SBP** | Incremental-encoder evaluation | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FA0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FA00** | | | |
| | Plugged into slot A[4] | | **C11** | | |
| | Plugged into slot B[4] | **(only for Compact PLUS units!)** | **C12** | | |
| | Plugged into slot C[4] | (motor encoder) | **C13** | | |
| | Plugged into slot D[4] | (only for compact and chassis units) | **C14** | | |
| | Plugged into slot E[4] | | **C15** | | |
| | Plugged into slot F[4] | | **C16** | | |
| | Plugged into slot G[4] | | **C17** | | |
| **SBR1** | Resolver evaluation without incremental-encoder simulation | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FB0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FB00** | | | |
| | Plugged into slot C[4] | | **C23** | | |
| **SBR2** | Resolver evaluation with incremental-encoder simulation | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FC0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FC00** | | | |
| | Plugged into slot C[4] | | **C33** | | |
| **SBM** | Absolute-value encoder evaluation/incremental-encoder evaluation (only as spare part for existing systems) | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FD0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| **SBM2** | Absolute-value encoder evaluation/incremental-encoder evaluation (MC firmware versions ≥ 1.3) | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FE0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FE00** | | | |
| | Plugged into slot C[4] (motor encoder) | | **C43** | | |
| | Plugged into slots A, B, D, E, F, G[4] (machine encoder) | | **C41/C42/C44 to C47** | | |
| **Expansion boards** | | | | | |
| **EB1** | Expansion board | | | | |
| | Spare part[2] | **6SE7090–0XX84–0KB0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0KB00** | | | |
| | Plugged into slots A to G[4] | | **G61 to G67** | | |
| **EB2** | Expansion board | | | | |
| | Spare part[2] | **6SE7090–0XX84–0KC0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0KC00** | | | |
| | Plugged into slots A to G | | **G71 to G77** | | |
| **Drive coupling (rapid data exchange via fiber-optic cable)** | | | | | |
| **SLB** | for SIMOLINK | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FJ0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3][5] | **6SX7010–0FJ00** | | | |
| | Plugged into slots A to G[4][5] | | **G41 to G47** | | |
| **Communication boards (for slot location, see page 6/60)** | | | | | |
| **CBP2** | for PROFIBUS DP | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FF5** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FF05** | | | |
| | Plugged into slots A, B, C, E, G | | **G91/G92/G93/G95/G97** | | |
| **CBC** | for CAN | | | | |
| | Spare part[2] | **6SE7090–0XX84–0FG0** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |
| | Retrofit kit[3] | **6SX7010–0FG00** | | | |
| | Plugged into slots A, B, C, E, G | | **G21/G22/G23/G25/G27** | | |
| **CBD** | **C**ommunication **B**oard **D**eviceNet for DeviceNet | **6SX7010–0FK00** | | 0.3 (0.7) | 20 x 90 x 95 (0.8 x 3.5 x 3.7) |

1) The Compact PLUS units have three slots A, B and C. Compact and chassis units can be expanded to have up to 6 slots, A, C, D, E, F and G. For the various possible configurations, see Page 6/61.

2) Excluding connector, excluding documentation.

3) For retrospective mounting. The retrofit kit usually contains a board, plug-in connector and documentation but not adapter boards or LBA (see Page 3/8).

4) With appropriate connector.

5) With 2 FOC connectors, 1 connector for X470 and 5 m all-plastic FOC (fiber-optic cable).

6) When ordering the board, **"–Z"** and the corresponding code for direct mounting in the corresponding slot must be appended to the converter/inverter order no.



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## Electronics options · Boards for direct mounting in the electronics box[1]

| Designation | | Order No. | Weight, approx. kg (lb) | Dimensions W x H x D mm x mm x mm (in x in x in) |
|---|---|---|---|---|
| **Interface boards** (only for compact and chassis units)[2] | | | | |
| **SCB1** | Interface board with FOC (fiber-optic cable) connection. For a more detailed description of the SCB1 interface board and how it is integrated, see Engineering Information, Section 6. Supplied loose, including 10 m (33 ft) fiber-optic cable. | **6SE7090–0XX84–0BC0** | 0.5 (1.1) | 25 x 235 x 125 (1.0 x 9.3 x 4.9) |
| **SCB2** | Interface board with floating RS485 interface. For a more detailed description of the SCB2 interface board and how it is integrated, see Engineering Information, Section 6. Supplied loose. | **6SE7090–0XX84–0BD1** | 0.5 (1.1) | 25 x 235 x 125 (1.0 x 9.3 x 4.9) |
| **Technology boards** (only for compact and chassis units)[3] | | | | |
| **T100** | T100 technology board for drive-related technology functions. For a more detailed description of the T100 board accessories and how they are integrated, see Catalog DA 65,10. SIMOVERT MASTERDRIVES Vector Control or the North American version. Supplied loose without software module. | **6SE7090–0XX87–0BB0** | 0.5 (1.1) | 25 x 235 x 125 (1.0 x 9.3 x 4.9) |
| **T300** | T300 technology board hardware package for standard planning, (T300 with two connecting cables SC58 and SC60. SE300 terminal block and hardware instruction manual in German/English) For a more detailed description of the T300 board and accessories and how they are integrated, see Catalog DA 65,10. SIMOVERT MASTERDRIVES Vector Control or the North American version. Supplied loose without manual. | **6SE7090–0XX87–4AH0** | 2 (4.4) | 300 x 400 x 300 (11.8 x 15.7 x 11.8)) |
| | T300 technology board as spare part | **6SE7090–0XX84–0AH2** | | |
| **T400** | T400 technology board. For a more detailed description of the T400 board and accessories and how they are integrated, see Catalog DA 65,10. SIMOVERT MASTERDRIVES Vector Control or contact your local Siemens office. Supplied loose without configuration. | **6DD1606–0AD0** | 0.5 (1.1) | 25 x 235 x 125 (1.0 x 9.3 x 4.9) |

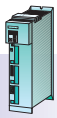
1) See "Integration of the electronics options", page 6/60.

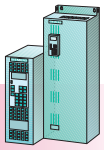
2) In mounting position 2 or 3.

3) In mounting position 2.




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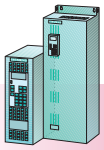
## Electronics options · Additional boards and options

| Designation | | Order No. | Code[1] | Weight, approx. kg (lb) | Dimensions W x H x D mm x mm x mm (in x in x in) |
|---|---|---|---|---|---|
| **Accessories for compact and chassis units for expanding the electronic slots** | | | | | |
| **ADB** | Adapter board | **6SE7090–0XX84–0KA0** | | | |
| | Adapter board, plugged into mounting position 2 (slots D and E) | | **K01** | | |
| | Adapter board, plugged into mounting position 3 (slots F and G) | | **K02** | | |
| **LBA** | Bus adapter for electronics box | **6SE7090–0XX84–4HA0** | | | |
| | Bus adapter for electronics box, integrated | | **K11** | | |
| **Accessories for SIMOLINK** | | | | | |
| **SLP** | SIMOLINK pulse generator<br>An incremental-encoder signal proportional to the speed is generated from a setpoint in the SIMOLINK telegram; RS422, track A, B | **6SX7005–0AD00** | | 0.3 (0.7) | 35 x 118 x 88 (1.4 x 4.6 x 3.5) |
| **SLE-DP** | SIMOLINK incremental encoder<br>With PROFIBUS DP station at SIMOLINK, generates pulse series and zero pulse from position setpoint telegram acc. to an RS422 incremental encoder with either 1024, 2048, 4096 or 8192 S/R | **6SX7005–0AG01** | | 0.4 (0.9) | 52 x 118 x 88 (2.0 x 4.6 x 3.5) |
| **SLS** | SIMOLINK switch<br>Changeover switch for SIMOLINK fiber-optic cables, 4 inputs/outputs to 4 outputs/inputs, 12 different switching positions | **6SX7005–0AE00** | | 0.3 (0.7) | 35 x 118 x 88 (1.4 x 4.6 x 3.5) |
| **SLM** | SIMOLINK monitor<br>Diagnostics box for monitoring the SIMOLINK telegrams, connection to a measuring PC, evaluation of the data with diagnostic/analysis software (PC software items are to be ordered separately) | **6SX7005–0AF00** | | 0.8 (1.8) | 54 x 194 x 155 (2.1 x 7.6 x 6.1) |
| | **Extra package for SLB board**<br>5 m/16.4 ft plastic FOC cable, 2 FOC plug-in connectors, 1 plug-in connector for the terminal strip, supplied with rough and fine glass paper (comes together with the SLB board). | **6SY7000–0AD15** | | | |
| | **System package for SLB board**<br>100 m/328 ft all-plastic FOC cable, 40 x FOC plug-in connectors, 20 x plug-in connectors for the terminal strip | **6SX7010–0FJ50** | | | |
| | **Glass fiber-optic cable**<br>(PCF = Polymer Cladding Fiber), up to a max. of 300 m/984.25 ft between two SLB boards.<br>The following fiber-optic cable modules from Hewlett Packard are on the SLB board<br>Transmitter: HFBR 1528<br>Receiver: HFBR 2528 | on request | | | |
| | **PROFIBUS plastic fiber optic, duplex-core**<br>Plastic FOC with 2 cores,<br>PVC sheath, without connector for use in environments with low mechanical stress<br>50 m (164 ft) ring | **6XV1 821–2AN50** | | | |
| | **PROFIBUS plastic fiber optic, simplex connector/polishing set**<br>100 simplex connectors and 5 polishing sets for assembling PROFIBUS plastic fiber-optic cables for the optical PROFIBUS DP | **6GK1 901–0FB00–0AA0** | | | |
| **Additional options** | | | | | |
| **OP1S** | Comfort operator control panel | **6SE7090–0XX84–2FK0** | | | |
| | OP1S cable (3 m/10 ft) | **6SX7010–0AB03** | | | |
| | OP1S cable (5 m/16.4 ft) | **6SX7010–0AB05** | | | |
| | PC cable (3 m/10 ft) for DriveMonitor and software/firmware downloading | **9AK1012–1AA00** | | | |

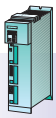
1) When ordering the board, **"–Z"** and the corresponding code for direct mounting in the relevant slot must be appended to the inverters/converters order no.



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## Control board for compact and chassis units

| Designation | Order No. | Weight, approx. kg (lb) | Dimensions W x H x D mm x mm x mm (in x in x in) |
|---|---|---|---|
| **CUMC control board** | | | |
| CUMC (60 MHz)<br>(standard board of the basic unit)<br>Board, single | **6SE7090–0XX84–0AD1** | 0.5<br>(1.1) | 25 x 235 x 125<br>(1.0 x 9.3 x 4.9) |
| **CUPM control board** | | | |
| CUPM – Performance 2<br>(standard board of the basic unit)<br>Board, single | **6SE7090–0XX84–0AD5** | 0.5<br>(1.1) | 25 x 235 x 125<br>(1.0 x 9.3 x 4.9) |

## Plugs/Terminal blocks

| Designation | Order No. |
|---|---|
| **Plugs/Terminal blocks** | |
| MC plug set/terminal block set | |
| for Compact PLUS units | **6SY7000–0AE51** |
| for compact units | **6SY7000–0AD38** |
| for chassis units (E to G type of construction) | **6SY7000–0AD26** |

## Technology software

| Designation | Order No. | Code |
|---|---|---|
| **Technology software** | | |
| Positioning, angular synchronism with cam disc, electronic coupling and more<br>Supplied factory enabled | | **F01** |
| Enabled later using a 2 x 4 digit PIN Number | **6SW1700–5AD00–1XX0** | |
| The board-FID (Product Identification, 2 x 4-digit number) must be stated. The FID can be read out from the parameters U976.1 and U976.2. | | |
| **Documentation · Compendium for MASTERDRIVES Motion Control** | | |
| Description, function diagrams and parameter list. Compendium in English (for other languages, see Section 5).<br>Supplied as a manual | **6SE7087–6QX50** | |

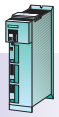




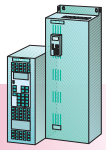
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# Selection and ordering data

## Rectifier units



**Compact PLUS units**



**Compact and chassis units**

| Nominal power rating[1] | Selection data: Rated DC link current | DC link base load current | Short-time current of DC link | Max. DC link inverter current[2] | Input current[3] | Rectifier unit | Total power loss | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight, approx. | Cooling air requirement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{DCrated}$ | $I_{DCG}$ | $I_{DCmax.}$ | | | | | | | | |
| kW | A | A | A | A | A | Order No. | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | | | |
| **Compact PLUS units with integrated brake chopper** | | | | | | | | | | | |
| **15** | 41 | 37 | 123/65[4] | 80 | 36 | **6SE7024–1EP85–0AA0**[6] | 0.13 | 90 x 360 x 260 (3.5 x 14.2 x 10.2) | 1 | 3.9 (8.6) | 0.018 (0.636) |
| **50** | 120 | 109 | 360/192[4] | [5] | 108 | **6SE7031–2EP85–0AA0**[6] | 0.27 | 135 x 360 x 260 (5.3 x 14.2 x 10.2) | 1 | 8.3 (18.3) | 0.041 (1.448) |
| **100** | 230 | 209 | 690/368[4] | [5] | 207 | **6SE7032–3EP85–0AA0**[6] | 0.60 | 180 x 360 x 260 (7.1 x 14.2 x 10.2) | 1 | 13.3 (29.3) | 0.053 (1.871) |
| **Compact units** | | | | | | | | | | | |
| **15** | 41 | 37 | 56 | 45 | 36 | **6SE7024–1EB85–0AA0** | 0.12 | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 4 | 12 (26.5) | 0.022 (0.777) |
| **37** | 86 | 78 | 117 | 95 | 75 | **6SE7028–6EC85–0AA0** | 0.26 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 4 | 18 (39.7) | 0.028 (0.989) |
| **Chassis units** | | | | | | | | | | | |
| **75** | 173 | 157 | 235 | [5] | 149 | **6SE7031–7EE85–0AA0** | 0.62 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **110** | 270 | 246 | 367 | [5] | 233 | **6SE7032–7EE85–0AA0** | 0.86 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **160** | 375 | 341 | 510 | [5] | 326 | **6SE7033–8EE85–0AA0** | 1.07 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **200** | 463 | 421 | 630 | [5] | 403 | **6SE7034–6EE85–0AA0** | 1.32 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **250** | 605 | 551 | 823 | [5] | 526 | **6SE7036–1EE85–0AA0** | 1.67 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |

1) The quoted nominal power ratings serve only as a guide for the selection of other components. The exact drive output depends on the connected inverters and this should be taken into account when planning.

2) The connected inverter units must not exceed the specified total DC link current.

3) The currents are based on a line inductance of **3 %** in relation to the equipment impedance ***Z***, i.e. the ratio of the line short-circuit power to the converter power ***S*** is **33 : 1** or 100 : 1 if a 2 % line reactor is used as well.
Equipment impedance: $Z = \frac{V_{Line}}{\sqrt{3} \cdot I_{V_{Line}}}$

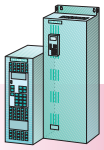
4) 3 x $I_{DC}$ for 250 ms (only for Compact PLUS rectifier units)/1.6 x $I_{DC}$ for 30 s.

5) No limitation due to precharging via controlled thyristor bridge. For maximum dimensioning, see Section 6, "Dimensioning of the system components for multi-axis drives".

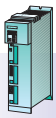
6) The brake chopper is built into the Compact PLUS rectifier unit. The brake resistor (see Page 3/18) is to be selected accordingly and mounted externally. The 24 V current requirement is approx. 0.5 A per rectifier unit at 15 kW, 0.7 A at 50 kW and 100 kW.



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Compact and chassis units



Compact PLUS units

Rectifier units

| Sound pressure level with standard protection degree IP20/IP00 | Power connections – Terminals for sizes B, C and P – Lugs for size E – Location: at top for DC, at bottom for AC | | | Auxiliary current requirement | | | |
|---|---|---|---|---|---|---|---|
| 50 Hz | Finely stranded | Single- and multi-stranded | Retaining bolt | DC 24 V Standard version max. at 20 V | DC 24 V Max. version max. at 20 V | 1-ph. or 2-ph. 230 V AC fan 50 Hz | 60 Hz |
| dB (A) | $mm^2$ (AWG) | $mm^2$ (AWG) | | A | A | A | A |
| | | | | | | | |
| 60 | max. 10 (8) | max. 10 (8) | – | 0.5 | – | none | none |
| 68 | max. 50 (1/0) | max. 50 (1/0) | – | 0.7 | – | none | none |
| 65 | max. 95 (4/0) | max. 95 (4/0) | – | 0.7 | – | none | none |
| | | | | | | | |
| 60 | 2.5 to 10 (12 – 8) | 2.5 to 16 (12 – 4) | | 0.5 | – | none | none |
| 60 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 0.5 | – | none | none |
| | | | | | | | |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.3 | – | 0.6 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.3 | – | 0.6 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.3 | – | 0.6 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.3 | – | 0.6 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 16 | 0.3 | – | 0.6 | 0.75 |

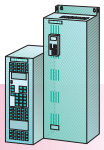
3



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# Selection and ordering data

## Self-commutating, pulsed rectifier/regenerative units Active Front End AFE



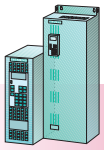
**Compact and chassis units**

| Rated rectifier/ regenerative output at cos φ = 1 and 400 V supply voltage | Selection data: Short-time rectifier/ regenerative output at cos φ = 1 and 400 V supply voltage | Selection data: Rated input current 3 AC from/to line | Selection data: Base load input current 3 AC from/to line | Selection data: Short-time input current 3 AC from/to line | **AFE inverters** with CUSA control board 6SE7090-0XX84-0BJ0 | Power loss | Spare part from VC inverter of nominal power rating | Framework dimensions W x H x D | For dimension drawing, see Section 7 | Weight, approx. | Cooling air requirement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_{rated}$ | $P_{max.}$ | $I_{n\,conv}$ | $I_G$ | $I_{max.}$ | | $P_v$ | $P_{type}$ | | | | |
| kW | kW | A | A | A | Order No. | kW | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V AC –20 % to 460 V +5 %** | | | | | | | | | | | |
| **Compact units** | | | | | | | | | | | |
| **6.8** | 11 | 10.2 | 9.2 | 16.3 | **6SE7021–0EA81** | 0.14 | 4 | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 5 | 8 (17.4) | 0.009 (0.318) |
| **9** | 14 | 13.2 | 11.9 | 21.1 | **6SE7021–3EB81** | 0.18 | 5.5 | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 5 | 12 (26.5) | 0.022 (0.777) |
| **12** | 19 | 17.5 | 15.8 | 28.0 | **6SE7021–8EB81** | 0.24 | 7.5 | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 5 | 12 (26.5) | 0.022 (0.777) |
| **17** | 27 | 25.5 | 23.0 | 40.8 | **6SE7022–6EC81** | 0.34 | 11 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 5 | 24 (52.9) | 0.028 (0.989) |
| **23** | 37 | 34 | 31 | 54 | **6SE7023–4EC81** | 0.46 | 15 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 5 | 24 (52.9) | 0.028 (0.989) |
| **32** | 51 | 47 | 42 | 75 | **6SE7024–7ED81** | 0.63 | 22 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 35 (77.2) | 0.054 (1.907) |
| **40** | 63 | 59 | 53 | 94 | **6SE7026–0ED81** | 0.79 | 30 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 35 (77.2) | 0.054 (1.907) |
| **49** | 78 | 72 | 65 | 115 | **6SE7027–2ED81** | 0.98 | 37 | 270 x 600 x 350 (10.6 x 23.6 x 13.8) | 5 | 35 (77.2) | 0.054 (1.907) |
| **Chassis units** | | | | | | | | | | | |
| **63** | 100 | 92 | 83 | 147 | **6SE7031–0EE80** | 1.06 | 45 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 7 | 55 (121.3) | 0.11 (3.885) |
| **85** | 135 | 124 | 112 | 198 | **6SE7031–2EF80** | 1.44 | 55 | 360 x 1050 x 365 (14.3 x 41.3 x 14.4) | 7 | 65 (143.3) | 0.15 (5.297) |
| **100** | 159 | 146 | 131 | 234 | **6SE7031–5EF80** | 1.69 | 75 | 360 x 1050 x 365 (14.3 x 41.3 x 14.4) | 7 | 65 (143.3) | 0.15 (5.297) |
| **125** | 200 | 186 | 167 | 298 | **6SE7031–8EF80** | 2.00 | 90 | 360 x 1050 x 365 (14.3 x 41.3 x 14.4) | 7 | 65 (143.3) | 0.15 (5.297) |
| **143** | 228 | 210 | 189 | 336 | **6SE7032–1EG80** | 2.42 | 110 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 155 (341.8) | 0.33 (11.654) |
| **177** | 282 | 260 | 234 | 416 | **6SE7032–6EG80** | 3.00 | 132 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 155 (341.8) | 0.33 (11.654) |
| **214** | 342 | 315 | 284 | 504 | **6SE7033–2EG80** | 3.64 | 160 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 165 (363.8) | 0.44 (15.539) |
| **250** | 400 | 370 | 333 | 592 | **6SE7033–7EG80** | 4.25 | 200 | 508 x 1450 x 465 (20 x 57.1 x 18.3) | 7 | 180 (396.9) | 0.44 (15.539) |

1) The quoted nominal power ratings serve only as a guide for the selection of other components. The exact drive output depends on the motor connected and this should be taken into account when planning.



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**Compact and chassis units**

**Self-commutating, pulsed rectifier/regenerative units Active Front End AFE**

| Sound pressure level with standard protection degree IP20/IP00 | Power connections – Terminals for sizes A to D – Lugs for sizes E to G – Location: at bottom for AFE reactor, at top for DC link connection | | | Auxiliary current requirement | | |
|---|---|---|---|---|---|---|
| | Finely stranded | Single- and multi-stranded | Retaining bolt | DC 24 V Standard version max. at 20 V | DC 24 V Max. version max. at 20 V | 2-ph. 230 V AC fan at AFE inverters 50 Hz/60 Hz[1]) |
| 50 Hz | | | | | | |
| dB (A) | $mm^2$ (AWG) | $mm^2$ (AWG) | | A | A | W |
| 60 | 2.5 to 10 (12 – 8) | 2.5 to 16 (12 – 6) | | 2 | 3 | none |
| 60 | 2.5 to 10 (12 – 8) | 2.5 to 16 (12 – 6) | | 2 | 3 | none |
| 60 | 2.5 to 10 (12 – 8) | 2.5 to 16 (12 – 6) | | 2 | 3 | none |
| 60 | 2.5 to 16 (12 – 6) | 10 to 25 (6 – 4) | | 2 | 3 | none |
| 60 | 2.5 to 16 (12 – 6) | 10 to 25 (6 – 4) | | 2 | 3 | none |
| 65 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 2 | 3 | 0.43/0.49 |
| 65 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 2 | 3 | 0.43/0.49 |
| 65 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 2 | 3 | 0.43/0.49 |
| 69 | | max. 2 x 70 (2 x 2/0) | M 10 | The AFE chassis units are supplied only with the line connection module (cf. system components) as standard. The 24 V DC and 230 V AC auxiliary power supply and its fusing is integrated in the related line connection module. | | |
| 70 | | max. 2 x 70 (2 x 2/0) | M 10 | | | |
| 70 | | max. 2 x 70 (2 x 2/0) | M 10 | | | |
| 70 | | max. 2 x 70 (2 x 2/0) | M 10 | | | |
| 81 | | max. 2 x 150 (2 x 300) | M 12 | | | |
| 81 | | max. 2 x 150 (2 x 300) | M 12 | | | |
| 83 | | max. 2 x 150 (2 x 300) | M 12 | | | |
| 83 | | max. 2 x 150 (2 x 300) | M 12 | | | |

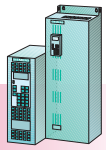




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# Selection and ordering data

## Rectifier/regenerative units[1])



**Compact and chassis units**

| Nominal power rating[2]) | Selection data: Rated DC link current | DC link base load current | DC link short-time current | Input current[3]) | **Rectifier/ regenerative unit** | Total power loss | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight, approx. | Cooling air requirement |
|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{DCrated}$ | $I_{DCG}$ | $I_{DCmax.}$ | | | | | | | |
| kW | A | A | A | A | Order No. | kW | mm x mm x mm (in x in x in) | No. | kg (lb) | $m^3/s$ ($ft^3/s$) |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | | |
| **Compact units** | | | | | | | | | | |
| **7.5** | 21 | 19 | 29 | 18 | **6SE7022–1EC85–1AA0** | 0.15 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 4 | 23 (50.7) | 0.028 (0.989) |
| **15** | 41 | 37 | 56 | 35 | **6SE7024–1EC85–1AA0** | 0.20 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 4 | 23 (50.7) | 0.028 (0.989) |
| **37** | 86 | 78 | 117 | 74 | **6SE7028–6EC85–1AA0** | 0.31 | 180 x 600 x 350 (7.1 x 23.6 x 13.8) | 4 | 23 (50.7) | 0.028 (0.989) |
| **Chassis units** | | | | | | | | | | |
| **75** | 173 | 157 | 235 | 149 | **6SE7031–7EE85–1AA0** | 0.69 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **90** | 222 | 202 | 302 | 192 | **6SE7032–2EE85–1AA0** | 0.97 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **132** | 310 | 282 | 422 | 269 | **6SE7033–1EE85–1AA0** | 1.07 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 45 (99.2) | 0.2 (7.1) |
| **160** | 375 | 341 | 510 | 326 | **6SE7033–8EE85–1AA0** | 1.16 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 52 (114.6) | 0.2 (7.1) |
| **200** | 463 | 421 | 630 | 403 | **6SE7034–6EE85–1AA0** | 1.43 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 52 (114.6) | 0.2 (7.1) |
| **250** | 605 | 551 | 823 | 526 | **6SE7036–1EE85–1AA0** | 1.77 | 270 x 1050 x 365 (10.6 x 41.3 x 14.4) | 6 | 65 (114.6) | 0.2 (7.1) |

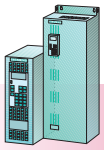
1) In the case of rapid changeover from supply to regenerative feedback, a dead time of 15 ms must be taken into account. For high dynamic response, AFE rectifier/regenerative units are to be used.

2) The quoted nominal power ratings serve only as a guide for the selection of other components. The exact drive output depends on the connected inverters and this should be taken into account when planning.

3) The currents are based on a line inductance of **3 %** in relation to the equipment impedance ***Z***, i.e. the ratio of the line short-circuit power to the converter power ***S*** is **33 : 1** or 100 : 1 if a 2 % line reactor is used as well.
Equipment impedance: $Z = \frac{V_{Line}}{\sqrt{3} \cdot I_{V_{Line}}}$



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Compact and chassis units

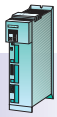
Rectifier/regenerative units

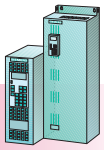
| Sound pressure level with standard protection degree IP20/IP00 | Power connections – Terminals for size C – Lugs for size E – Location: AC motorized top for frame size C, bottom for frame size E; DC top for frame sizes C and E; AC regenerative for frame sizes C and E | | | Auxiliary current requirement | | | |
|---|---|---|---|---|---|---|---|
| | Finely stranded | Single- and multi-stranded | Retaining bolt | DC 24 V Standard version max. at 20 V | DC 24 V Max. version max. at 20 V | 1-ph. or 2-ph. 230 V AC fan | |
| 50 Hz | | | | | | 50 Hz | 60 Hz |
| dB (A) | $mm^2$ (AWG) | $mm^2$ (AWG) | | A | A | A | A |
| 60 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 0.9 | 2.0 | none | none |
| 60 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 0.9 | 2.0 | none | none |
| 60 | 2.5 to 35 (12 – 2) | 10 to 50 (6 – 1/0) | | 0.9 | 2.0 | none | none |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.7 | 2.0 | 0.60 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.7 | 2.0 | 0.60 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.7 | 2.0 | 0.60 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.7 | 2.0 | 0.60 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 12 | 0.7 | 2.0 | 0.60 | 0.75 |
| 75 | | 2 x 300 (2 x 600) | M 16 | 0.7 | 2.0 | 0.60 | 0.75 |

3



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## Options

Compact PLUS units

Compact and chassis units



## Codes

| Code | Description | MC+ = Motion Control Compact PLUS. ■ Standard. ● Option available. – Not available. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Converter** | | | | **Inverter** | | | | **Rectifier unit** | | | **AFE** | **Rectifier/regenerative unit** | |
| Size | | MC+ | A–D | E–G | K | MC+ | A–D | E–G | J | MC+ | B–C | E | | C | E |
| **Line-side radio-interference suppression and protective devices** | | | | | | | | | | | | | | | |
| **L03** | Basic interference suppression when radio-interference suppression filters are used | ■ | ■ | ■ | ● | ■ | – | – | ● | – | – | – | – | – | – |
| **L20** | Operation of the converters with an IT supply system | ● | ● | ● | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | – | ■ | ■ |
| **L30** | Inverter fuses integrated, fuse type for DIN/IEC approval and UL | – | – | – | – | ■ | ■ | ● | ■ | – | – | – | – | – | – |
| **L33** | Compact inverters without fuses | – | – | – | – | – | ● | ■ | – | – | – | – | – | – | – |
| **Electrical options** | | | | | | | | | | | | | | | |
| **K80** | Safe Stop | ● | – | ● | ● | ● | ■ | ● | ● | – | – | – | – | – | – |
| **K91** | DC link current measuring unit | – | – | – | – | – | – | – | – | – | ● | ● | – | ■ | ■ |
| **Mechanical options** | | | | | | | | | | | | | | | |
| **M20** | Enclosure[1] for increasing the degree of protection to IP20 | ■ | ■ | ● | – | ■ | ■ | ● | – | ■ | ■ | ● | – | ■ | ● |
| **Documentation** | | | | | | | | | | | | | | | |
| **D72** | Documentation in Italian/English | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – | ● | ● |
| **D77** | Documentation in French/English | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – | ● | ● |
| **D78** | Documentation in Spanish/English | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – | ● | ● |
| **D99**[2] | Supplied without documentation | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – | ● | ● |

### Brief description of the options

**L03 Basic interference suppression when radio-interference suppression filters are used with TT and TN systems**
With the L03 option, unit sizes J to X are fitted with discharge capacitors in the DC link.

**L20 Operation with an IT system**
See description in Section 4.
With the L20 option, operation with non-earthed systems (IT systems), the basic interference capacitors built in as standard are removed.

**L30 Integrated inverter fuses, fuse type for DIN/IEC approval and UL**
Option L30 can only be used for inverter sizes E to G.
Inverter fuses are for protecting inverters connected to a DC bus. Inverter fuses must always be provided when at least 2 inverters are operated on this bus. The inverters do not have to be protected when a single inverter of a rectifier unit or a rectifier/regenerative unit is supplied with matched power. The same conditions apply to a converter.
For option L30, the inverter fuses indicated are integrated in the inverter.

**L33 Compact inverters without fuses**
For a description, see L30.
With the L33 option, which can be used for compact inverters sizes A to D, the inverter fuses are not built into the inverter and are not supplied with the drive unit. The inverter fuses must be ordered separately and mounted externally (for types, see page 3/23).

**K80 Safe Stop**
The function "Safe Stop" is a "device for the prevention of an unexpected start-up" to EN 60 204-1, section 5.4. It is realized in connection with an external circuit.
The "Safe Stop" function can be retrofitted by Siemens personnel only with converters and inverters of frame sizes E to K.

**K91 DC link current measurement**
In the rectifier unit sizes B, C and E, the DC link current is measured indirectly via the line-side current transformers.

**M20 IP20 panels**
With the M20 option, unit sizes E to G are provided with an IP20 enclosure (wall mounting possible). Control is via a PMU built into the front panel.

**D72 Documentation in Italian/English**
Operating instructions are supplied in Italian/English.

**D77 Documentation in French/English**
Operating instructions are supplied in French/English.

**D78 Documentation in Spanish/English**
Operating instructions are supplied in Spanish/English.

**D99[2] Supplied without operating instructions and without DriveMonitor**
If this option is chosen, no operating instructions or tools in the form of paper or software (no CD-ROM) are enclosed.

1) The enclosures can also be supplied separately. See "Selection and ordering data – Mechanical components".

2) In accordance with EU guidelines, the orderer of this option must ensure that the documentation is made available to the end user in the context of the machine and equipment documentation.



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## Isolation amplifier boards for the mounting of DIN rails

The isolation amplifier boards can be used for isolating the analog input and output signals from the supply.

Isolation amplifiers in modular housings from Knick are recommended.

For further information, please visit the Internet at:
*http://www.knick.de*

## SCI1 and SCI2 interface boards (for compact and chassis units only)

A serial I/O system using fiber-optic cables can be established with the SCI1 and SCI2 interface boards and the SCB1 interface board. This allows the binary and analog inputs and outputs to be considerably expanded. For a more detailed description of the SCI1 and SCI2, see Engineering Information, Section 6.

| Designation | | Order No. |
|---|---|---|
| **Interface boards for establishing an I/O system via fiber-optic cables** | | |
| **SCI1** | Interface board for binary and analog inputs/outputs. Supplied loose with 10 m/32.8 ft of fiber-optic cable | **6SE7090–0XX84–3EA0** |
| **SCI2** | Interface board for binary inputs/outputs. Supplied loose with 10 m/32.8 ft of fiber-optic cable. | **6SE7090–0XX84–3EF0** |

## Rectifier units for supplying 24 V DC

| Power supply A | Order No. | Dimensions W x H x D mm | (in) |
|---|---|---|---|
| **24 V DC rectifier units, single-phase 230 V AC and 400 V AC,** can be used with +6 % and –10 % line-voltage tolerance[1]) | | | |
| 1 (230 V) | **4AV21 02–2EB00–0A** | 45 x 135 x 111 | (1.8 x 5.3 x 4.4) |
| 1 (400 V) | **4AV21 06–2EB00–0A** | 45 x 135 x 111 | (1.8 x 5.3 x 4.4) |
| 3.5 (230 V) | **4AV23 02–2EB00–0A** | 72 x 135 x 111 | (2.8 x 5.3 x 4.4) |
| 2.5 (230/400 V) | **4AV20 00–2EB00–0A** | 85 x 137 x 98 | (3.3 x 5.4 x 3.9) |
| 5 (230/400 V) | **4AV22 00–2EB00–0A** | 106 x 160 x 113 | (4.2 x 6.3 x 4.5) |
| 10 (230/400 V) | **4AV24 00–2EB00–0A** | 121 x 170 x 128 | (4.8 x 6.7 x 5.0) |
| 15 (230/400 V) | **4AV26 00–2EB00–0A** | 151 x 200 x 145 | (5.9 x 7.9 x 5.7) |
| **24 V DC rectifier units, for 3-ph. 400 V DC,** can be used with +6 % and –10 % line-voltage tolerance[1]) | | | |
| 10 | **4AV30 00–2EB00–0A** | 164 x 190 x 115 | (6.4 x 7.5 x 4.5) |
| 15 | **4AV31 00–2EB00–0A** | 164 x 190 x 115 | (6.4 x 7.5 x 4.5) |
| 20 | **4AV32 00–2EB00–0A** | 216 x 220 x 115 | (8.5 x 8.7 x 4.5) |
| 30 | **4AV33 00–2EB00–0A** | 216 x 220 x 158 | (8.5 x 8.7 x 6.2) |
| 40 | **4AV34 00–2FB00–0A** | 266 x 260 x 165 | (10.4 x 10.2 x 6.5) |
| 50 | **4AV35 00–2FB00–0A** | 266 x 260 x 190 | (10.4 x 10.2 x 7.5) |
| **24 V DC power supply units,** can be used with ±15 % line-voltage tolerance[2]) | | | |
| 2.5 (230 V) | **6EP1 332–1SH41** | 126 x 90 x 55 | (5.0 x 3.5 x 2.2) |
| 5 (230 V) | **6EP1 333–3BA00** | 75 x 125 x 125 | (3.0 x 4.9 x 4.9) |
| 10 (230 V) | **6EP1 334–3BA00** | 100 x 125 x 135 | (3.9 x 4.9 x 5.3) |
| 20 (400 V) | **6EP1 336–3BA00** | 280 x 125 x 92 | (11.0 x 4.9 x 3.6) |

A Compact PLUS unit with 3 electronic components has a maximum current requirement of approximately 1.5 A (up to 4 kW) or of approximately 2 A (4 to 18.5 kW) from a 24 V DC power supply.

## Coupling relay

The coupling relay enables isolated energizing of a load. Additionally, it is possible to switch loads requiring increased power which cannot be supplied directly by the digital output.

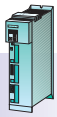
| Type | typ. power requirement for 24 V DC mA | Switching capacity, output | Supplier |
|---|---|---|---|
| **Coupling relay for connection to digital outputs of control board** | | | |
| **3TX70 02–3AB01** | < 7 | 60 V DC/1.5 A | Siemens |
| **3TX70 02–3AB00** | < 20 | 48 V AC to 264 V AC/1.8 A | Siemens |
| **PLC-RSC-24DC/21** | 9 | 250 V AC/6 A | Phoenix Contact |
| **PLC-RSP-24DC/21** | 9 | 250 V AC/6 A | Phoenix Contact |

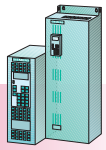
1) For technical data, see Catalog "Switchgear and Systems".

2) For technical data, see Catalog KT01.



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## Braking units and braking resistors

| Braking power | | | | Braking unit | | | | Braking resistor, external | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated braking power | Short-time braking power | Continuous braking power with external braking resistor | Continuous braking power with internal braking resistor | | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight, approx. | | Resistance[7] | Dimensions W x H x D | For dimension drawing, see Section 7 | Weight, approx. |
| $P_{20}$ | $P_3$ | $P_{DZ}$ | $P_{DB}$ | | | | | | | | | |
| kW | kW | kW | kW | Order No. | mm x mm x mm (in x in x in) | No. | kg (lb) | Order No. | Ω | mm x mm x mm (in x in x in) | No. | kg (lb) |
| **DC link voltage 510 V to 650 V DC** | | | | | | | | | | | | |
| **For Compact PLUS converter** | | | | | | | | | | | | |
| 2 | 3 | – | 0.15 | | | | | **6SE7013–2ES87–2DC0** | 200 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.4 (3.1) |
| 4 | 6 | – | 0.3[8] | | | | | **6SE7016–3ES87–2DC0** | 100 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.9 (4.2) |
| 5 | 7.5 | 1.25 | – | –[1] | | | | **6SE7018–0ES87–2DC0**[2] | 80 | 145 x 180 x 540 (5.7 x 7.1 x 21.3) | 11 | 6 (13.2) |
| 10 | 15 | 2.5 | – | –[1] | | | | **6SE7021–6ES87–2DC0**[2] | 40 | 145 x 360 x 540 (5.7 x 14.2 x 21.3) | 11 | 11.5 (25.4) |
| 12 | 18 | – | 0.9[9] | | | | | **6SE7022–0ES87–2DC0** | 33.3 | 134 x 350 x 203 (5.28 x 13.78 x 7.99) | 11a | 6.8 (15) |
| 20 | 30 | 5 | – | –[1] | | | | **6SE7023–2ES87–2DC0**[3] | 20 | 430 x 302 x 485 (16.9 x 11.9 x 19.1) | 12 | 17 (37.5) |
| **For Compact PLUS rectifier units** | | | | | | | | | | | | |
| 2 | 3 | – | 0.15 | | | | | **6SE7013–2ES87–2DC0** | 200 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.4 (3.1) |
| 4 | 6 | – | 0.3[8] | | | | | **6SE7016–3ES87–2DC0** | 100 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.9 (4.2) |
| 5 | 7.5 | 1.25 | – | –[1] | | | | **6SE7018–0ES87–2DC0**[4] | 80 | 145 x 180 x 540 (5.7 x 7.1 x 21.3) | 11 | 6 (13.2) |
| 10 | 15 | 2.5 | – | –[1] | | | | **6SE7021–6ES87–2DC0**[4] | 40 | 145 x 360 x 540 (5.7 x 14.2 x 21.3) | 11 | 11.5 (25.4) |
| 12 | 18 | – | 0.9[9] | | | | | **6SE7022–0ES87–2DC0** | 33.3 | 134 x 350 x 203 (5.28 x 13.78 x 7.99) | 11a | 6.8 (15) |
| 20 | 30 | 5 | – | –[1] | | | | **6SE7023–2ES87–2DC0**[4] | 20 | 435 x 305 x 485 (17.1 x 11.9 x 19.1) | 12 | 17 (37.5) |
| 50 | 75 | 12.5 | – | –[1] | | | | **6SE7028–0ES87–2DC0**[5] | 8 | 745 x 305 x 485 (29.3 x 11.9 x 19.1) | 12 | 27 (59.5) |
| 100 | 150 | 25 | – | –[1] | | | | **6SE7031–6ES87–2DC0**[6] | 4 | 745 x 605 x 485 (29.3 x 23.8 x 19.1) | 13 | 47 (103.6) |
| **For compact and chassis units** | | | | | | | | | | | | |
| 2 | 3 | – | 0.15 | | | | | **6SE7013–2ES87–2DC0** | 200 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.4 (3.1) |
| 4 | 6 | – | 0.3[8] | | | | | **6SE7016–3ES87–2DC0** | 100 | 44 x 250 x 120 (1.73 x 9.84 x 4.72) | 10a | 1.9 (4.2) |
| 5 | 7.5 | 1.25 | 0.16 | **6SE7018–0ES87–2DA0** | 45 x 425 x 350 (1.8 x 16.7 x 13.8) | 10 | 6 (13.2) | **6SE7018–0ES87–2DC0** | 80 | 145 x 180 x 540 (5.7 x 7.1 x 21.3) | 11 | 6 (13.2) |
| 10 | 15 | 2.5 | 0.32 | **6SE7021–6ES87–2DA0** | 45 x 425 x 350 (1.8 x 16.7 x 13.8) | 10 | 6 (13.2) | **6SE7021–6ES87–2DC0** | 40 | 145 x 360 x 540 (5.7 x 14.2 x 21.3) | 11 | 11.5 (25.4) |
| 12 | 18 | – | 0.9[9] | | | | | **6SE7022–0ES87–2DC0** | 33.3 | 134 x 350 x 203 (5.28 x 13.78 x 7.99) | 11a | 6.8 (15) |
| 20 | 30 | 5 | 0.63 | **6SE7023–2EA87–2DA0** | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 10 | 11 (24.3) | **6SE7023–2ES87–2DC0** | 20 | 430 x 302 x 485 (16.9 x 11.9 x 19.1) | 12 | 17 (37.5) |
| 50 | 75 | 12.5 | – | **6SE7028–0EA87–2DA0** | 90 x 425 x 350 (3.5 x 16.7 x 13.8) | 10 | 11 (24.3) | **6SE7028–0ES87–2DC0** | 8 | 740 x 302 x 485 (29.1 x 11.9 x 19.1) | 12 | 27 (59.5) |
| 100 | 150 | 25 | – | **6SE7031–6EB87–2DA0** | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 10 | 18 (39.7) | **6SE7031–6ES87–2DC0** | 4 | 740 x 605 x 485 (29.1 x 23.8 x 19.1) | 13 | 47 (103.6) |
| 170 | 255 | 42.5 | – | **6SE7032–7EB87–2DA0** | 135 x 425 x 350 (5.3 x 16.7 x 13.8) | 10 | 18 (39.7) | **6SE7032–7ES87–2DC0** | 2.35 | 740 x 1325 x 485 (29.1 x 52.0 x 19.1) | 14 | 103 (227.1) |

1) With Compact PLUS rectifier units and Compact PLUS converters, the brake choppers are included as standard features. The external braking resistor should be dimensioned accordingly.

2) Can be used for all Compact PLUS converters.

3) For Compact PLUS converters from 5.5 kW to 15 kW.

4) Can be used for all Compact PLUS rectifier units.

5) Can be used for Compact PLUS 50 kW and 100 kW rectifier units.

6) Can be used for Compact PLUS 100 kW rectifier units.

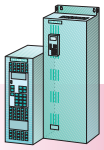
7) Allows the braking power at $V_d$ = 774 V.

8) CSA rating: 240 W.

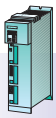
9) CSA rating: 720 W.



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Compact and chassis units



Compact PLUS units

Recommended DC link system components

## Capacitor module[1])

| Voltage range | Storage capacity at $V_{DC}$ constant/stable 510 V | 650 V | Order No. | Dimensions W x H x D | Weight, approx. |
|---|---|---|---|---|---|
| | $W_s$ | $W_s$ | | mm x mm x mm (in x in x in) | kg (lb) |
| 510 V DC (–15 %) to 650 V DC (+10 %) | 720 | 500 | **6SE7025–0TP87–2DD0** | 90 x 360 x 260 (3.54 x 14.1 x 10.2) | 6 (13.2) |

## DC link module

| Voltage range | Continuous current[2]) | Auxiliary current requirement | Order No. | Dimensions W x H x D | Weight, approx. |
|---|---|---|---|---|---|
| | A | A | | mm x mm x mm (in x in x in) | kg (lb) |
| 510 V DC (–15 %) to 650 V DC (+10 %) | 120 | – | **6SE7090–0XP87–3CR0** | 90 x 360 x 260 (3.54 x 14.1 x 10.2) | 2.7 (5.95) |

## DC link rail with Compact PLUS

If DC rails are required, tinned standard copper rails E-Cu 3 x 10 tinned and rounded acc. to DIN 46 433 must be used.

| Designation | Rated continous current | Order No. | Dimensions W x H x D |
|---|---|---|---|
| | A | | mm x mm x mm (in x in x in) |
| Standard busbar, tinned | 135 | **8WA2842** | 3 x 10 x 1000 (0.1 x 0.4 x 39.4) |

This rail can also be ordered by the meter from Phoenix Contact under the designation NSL-CU 3/10.

Phoenix Contact GmbH & Co,
Flachsmarktstr. 8 – 28,
32825 Blomberg

Tel.: 0 52 35 – 31 04 40,
Fax: 0 52 35 – 31 04 99,
Internet: www.phoenixcontact.com

1) Up to four capacitor modules can be connected to the Compact PLUS 15 kW rectifier unit and up to eight capacitor modules to the 50 kW and 100 kW units. Only one capacitor module can be connected to Compact PLUS converters.

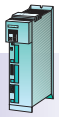
2) Short-time current for 250 ms: 360 A.

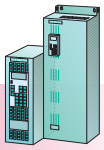


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# Selection and ordering data

## Recommended line-side power options

Compact PLUS units 

Compact and chassis units 

## Converters

| Nominal power rating | | Converter | Main circuit-breaker and EMERGENCY OFF switch | | Switch disconnector[2] | | Switch disconnector with fuse holder[2] | | | Fuse switch-disconnector[1][2] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Rated current | | Rated current | | Rated current | Max. fuse size | | Rated current | Size |
| kW | (HP) | Order No. | Order No. | A | Order No. | A | Order No. | A | | Order No. | A | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | | | | |
| **Compact PLUS units**[3] | | | | | | | | | | | | |
| **0.55** | **(0.75)** | **6SE7011–5EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **1.1** | **(1.5)** | **6SE7013–0EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **1.5** | **(2)** | **6SE7015–0EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **3** | **(4)** | **6SE7018–0EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **4** | **(5)** | **6SE7021–0EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **5.5** | **(7.5)** | **6SE7021–4EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **7.5** | **(10)** | **6SE7022–1EP□0** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **11** | **(15)** | **6SE7022–7EP□0** | 3LD12 | 32 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **15** | **(20)** | **6SE7023–4EP□0** | 3LD15 | 63 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **Compact units** | | | | | | | | | | | | |
| **2.2** | **(3)** | **6SE7016–1EA□1** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **3** | **(4)** | **6SE7018–0EA□1** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **4** | **(5)** | **6SE7021–0EA□1** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **5.5** | **(7.4)** | **6SE7021–3EB□1** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **7.5** | **(10)** | **6SE7021–8EB□1** | 3LD11 | 25 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **11** | **(15)** | **6SE7022–6EC□1** | 3LD12 | 32 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **15** | **(20)** | **6SE7023–4EC□1** | 3LD15 | 63 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **18.5** | **(25)** | **6SE7023–8ED□1** | 3LD15 | 63 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **22** | **(30)** | **6SE7024–7ED□1** | 3LD15 | 63 | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 160 | 000 |
| **30** | **(40)** | **6SE7026–0ED□1** | 3LD17 | 100 | 3KA51 30–1EE01 | 80 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 10–0CH01 | 160 | 000 |
| **37** | **(50)** | **6SE7027–2ED□1** | 3LD17 | 100 | 3KA51 30–1EE01 | 80 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 10–0CH01 | 160 | 000 |
| **Chassis units** | | | | | | | | | | | | |
| **45** | **(60)** | **6SE7031–0EE□0** | – | – | 3KA53 30–1EE01 | 160 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 70–0CA01 | 160 | 000 |
| **55** | **(75)** | **6SE7031–2EF□0** | – | – | 3KA53 30–1EE01 | 160 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **75** | **(100)** | **6SE7031–8EF□0** | – | – | 3KA53 30–1EE01 | 160 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **90** | **(120)** | **6SE7032–1EG□0** | – | – | 3KA55 30–1EE01 | 250 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **110** | **(150)** | **6SE7032–6EG□0** | – | – | 3KA55 30–1EE01 | 250 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **132** | **(175)** | **6SE7033–2EG□0** | – | – | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP43 70–0CA01 | 400 | 1; 2 |
| **160** | **(215)** | **6SE7033–7EG□0** | – | – | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP43 70–0CA01 | 400 | 1; 2 |
| **200** | **(270)** | **6SE7035–1EK□0** | – | – | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP43 70–0CA01 | 400 | 1; 2 |
| **250** | **(335)** | **6SE7036–0EK□0** | – | – | 3KA58 30–1EE01 | 630 | 3KL61 30–1AB0 | 630 | 3 | 3NP44 70–0CA01 | 630 | 2; 3 |

5 SIMOVERT MASTERDRIVES Motion Control
7 SIMOVERT MASTERDRIVES Motion Control Performance 2

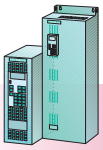
1) Fuse switch-disconnectors: Please take into account the size of the cable-protection fuses and semiconductor protection fuses.

2) Can be optionally used, depending on your requirements. For further information, refer to Catalog NS K.

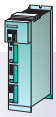
3) For single-axis applications. For multi-axis applications, see Section 6.



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Compact and chassis units



Compact PLUS units

Recommended line-side power options

| Nominal power rating | | Converter | Circuit-breaker for system and motor protection to IEC 60 947-4[1] | | Cable-protection fuses Duty class gL[2][3] | | | Semiconductor-protection fuses Duty class gR[3] (incl. cable protection) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Rated current | | Rated current | Size | | Rated current | Size |
| kW | (HP) | Order No. | Order No. | A | Order No. | A | | Order No. | A | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | | |
| **Compact PLUS units**[5] | | | | | | | | | | |
| **0.55** | **(0.75)** | **6SE7011–5EP□0**[4] | 3RV10 21–1CA10 | 1.8 – 2.5 | 3NA3 803 | 10 | 00 | 3NE1 813–0 | 16 | 000 |
| **1.1** | **(1.5)** | **6SE7013–0EP□0**[4] | 3RV10 21–1FA10 | 3.5 – 5.0 | 3NA3 803 | 10 | 00 | 3NE1 813–0 | 16 | 000 |
| **1.5** | **(2)** | **6SE7015–0EP□0**[4] | 3RV10 21–1HA10 | 5.5 – 8.0 | 3NA3 803 | 10 | 00 | 3NE1 813–0 | 16 | 000 |
| **3** | **(4)** | **6SE7018–0EP□0**[4] | 3RV10 21–1KA10 | 9.0 – 12.5 | 3NA3 805 | 16 | 00 | 3NE1 813–0 | 16 | 000 |
| **4** | **(5)** | **6SE7021–0EP□0** | 3RV10 21–1KA10 | 9.0 – 12.5 | 3NA3 805 | 16 | 00 | 3NE1 813–0 | 16 | 000 |
| **5.5** | **(7.5)** | **6SE7021–4EP□0** | 3RV10 21–4AA10 | 11 – 16 | 3NA3 810 | 25 | 00 | 3NE1 814–0 | 20 | 000 |
| **7.5** | **(10)** | **6SE7022–1EP□0** | 3RV10 21–4BA10 | 14 – 20 | 3NA3 810 | 25 | 00 | 3NE1 815–0 | 25 | 000 |
| **11** | **(15)** | **6SE7022–7EP□0** | 3RV10 31–4EA10 | 22 – 32 | 3NA3 814 | 35 | 00 | 3NE1 803–0 | 35 | 000 |
| **15** | **(20)** | **6SE7023–4EP□0** | 3RV10 31–4FA10 | 28 – 40 | 3NA3 817 | 40 | 00 | 3NE1 802–0 | 40 | 000 |
| **Compact units** | | | | | | | | | | |
| **2.2** | **(3)** | **6SE7016–1EA□1** | 3RV10 21–1HA10 | 5.5 – 8.0 | 3NA3 803 | 10 | 00 | 3NE1 813–0 | 16 | 000 |
| **3** | **(4)** | **6SE7018–0EA□1** | 3RV10 21–1KA10 | 9.0 – 12.5 | 3NA3 805 | 16 | 00 | 3NE1 813–0 | 16 | 000 |
| **4** | **(5)** | **6SE7021–0EA□1** | 3RV10 21–1KA10 | 9.0 – 12.5 | 3NA3 805 | 16 | 00 | 3NE1 813–0 | 16 | 000 |
| **5.5** | **(7.4)** | **6SE7021–3EB□1** | 3RV10 21–4AA10 | 11 – 16 | 3NA3 810 | 25 | 00 | 3NE1 814–0 | 20 | 000 |
| **7.5** | **(10)** | **6SE7021–8EB□1** | 3RV10 21–4BA10 | 14 – 20 | 3NA3 810 | 25 | 00 | 3NE1 815–0 | 25 | 000 |
| **11** | **(15)** | **6SE7022–6EC□1** | 3RV10 31–4EA10 | 22 – 32 | 3NA3 814 | 35 | 00 | 3NE1 803–0 | 35 | 000 |
| **15** | **(20)** | **6SE7023–4EC□1** | 3RV10 31–4FA10 | 28 – 40 | 3NA3 817 | 50 | 00 | 3NE1 802–0 | 40 | 000 |
| **18.5** | **(25)** | **6SE7023–8ED□1** | 3RV10 31–4HA10 | 40 – 50 | 3NA3 820 | 63 | 00 | 3NE1 817–0 | 50 | 000 |
| **22** | **(30)** | **6SE7024–7ED□1** | 3RV10 41–4JA10 | 45 – 63 | 3NA3 822 | 63 | 00 | 3NE1 818–0 | 63 | 000 |
| **30** | **(40)** | **6SE7026–0ED□1** | 3RV10 41–4KA10 | 57 – 75 | 3NA3 824 | 100 | 00 | 3NE1 820–0 | 80 | 000 |
| **37** | **(50)** | **6SE7027–2ED□1** | 3RV10 41–4LA10 | 70 – 90 | 3NA3 830 | 100 | 00 | 3NE1 021–0 | 100 | 00 |
| **Chassis units** | | | | | | | | | | |
| **45** | **(60)** | **6SE7031–0EE□0** | 3VF32 11–1BU41–0AA0 | 100 – 125 | 3NA3 032 | 125 | 0 | 3NE1 021–0 | 100 | 00 |
| **55** | **(75)** | **6SE7031–2EF□0** | 3VF33 11–1BX41–0AA0 | 160 – 200 | 3NA3 036 | 160 | 0 | 3NE1 224–0 | 160 | 1 |
| **75** | **(100)** | **6SE7031–8EF□0** | 3VF33 11–1BX41–0AA0 | 160 – 200 | 3NA3 140 | 200 | 1 | 3NE1 225–0 | 200 | 1 |
| **90** | **(120)** | **6SE7032–1EG□0** | 3VF42 11–1BM41–0AA0 | 200 – 250 | 3NA3 144 | 250 | 1 | 3NE1 227–0 | 250 | 1 |
| **110** | **(150)** | **6SE7032–6EG□0** | 3VF52 11–1BK41–0AA0 | 250 – 315 | 3NA3 144 | 315 | 2 | 3NE1 227–0 | 250 | 1 |
| **132** | **(175)** | **6SE7033–2EG□0** | 3VF52 11–1BK41–0AA0 | 250 – 315 | 3NA3 252 | 315 | 2 | 3NE1 230–0 | 315 | 1 |
| **160** | **(215)** | **6SE7033–7EG□0** | 3VF52 11–1BM41–0AA0 | 315 – 400 | 3NA3 260 | 400 | 2 | 3NE1 332–0 | 400 | 2 |
| **200** | **(270)** | **6SE7035–1EK□0** | 3VF62 11–1BK44–0AA0 | 400 – 500 | 3NA3 365 | 500 | 3 | 3NE1 333–0 | 450 | 2 |
| **250** | **(335)** | **6SE7036–0EK□0** | 3VF62 11–1BM44–0AA0 | 500 – 600 | 3NA3 372 | 630 | 3 | 3NE1 435–0 | 560 | 3 |

5 SIMOVERT MASTERDRIVES Motion Control
7 SIMOVERT MASTERDRIVES Motion Control Performance 2

1) Refer to catalog NS K.
Use together for drive converters with a line inductance of ≥ **3 %** referred to the drive converter impedance ***Z***, i.e. when the ratio of the line short-circuit power to the converter output is **33 : 1** or 100 : 1 and an additional 2 % line reactor is used. For the 100 kA short-circuit rating, it may be necessary to use a fuse as listed in the NS K Catalog.
Unit impedance: $Z = \frac{V_{Line}}{\sqrt{3} \cdot I_{V_{Line}}}$

2) Does not ensure total protection for the input rectifier of the unit.

3) The cable cross-sections must be dimensioned according to DIN VDE 0100, VDE 0298, Part 4, and as a function of the rated fuse currents.

4) Maximum possible protection permissible up to 25 A, i.e. gL 3NA3810 and gR 3NE 1815-0 with corresponding cable cross-section.

5) For single-axis applications. For multi-axis applications, see Section 6.



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# Selection and ordering data



## Converters (continued)

| Nominal power rating | | Converter | Main contactor/ AC contactor[1]) | | Commutating reactor[2]) $V_D$ = 2 % | | | Radio-interference suppression filter[2]) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | AC1 duty min. 40 °C (min. 104 °F) | Rated current | | $P_v$ 50/60 Hz | Rated current | | Class | Rated current |
| kW | (HP) | Order No. | Order No. | A | Order No. | W | A | Order No. | | A |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | | |
| **Compact PLUS units**[4]) | | | | | | | | | | |
| **0.55** | **(0.75)** | **6SE7011–5EP□0** | 3RT10 15 | 16 | 4EP32 00–4US00 | 8/10 | 1.5 | 6SE7012–0EP87–0FB1[3]) | B1 | 2 |
| **1.1** | **(1.5)** | **6SE7013–0EP□0** | 3RT10 15 | 16 | 4EP32 00–5US00 | 12/18 | 3.0 | 6SE7016–0EP87–0FB1[3]) | B1 | 6 |
| **1.5** | **(2)** | **6SE7015–0EP□0** | 3RT10 15 | 16 | 4EP32 00–2US00 | 23/35 | 5.0 | 6SE7016–0EP87–0FB1[3]) | B1 | 6 |
| **3** | **(4)** | **6SE7018–0EP□0** | 3RT10 15 | 16 | 4EP34 00–2US00 | 35/38 | 9.1 | 6SE7021–2EP87–0FB1[3]) | B1 | 12 |
| **4** | **(5)** | **6SE7021–0EP□0** | 3RT10 15 | 16 | 4EP34 00–1US00 | 35/38 | 11.2 | 6SE7021–2EP87–0FB1[3]) | B1 | 12 |
| **5.5** | **(7.5)** | **6SE7021–4EP□0** | 3RT10 16 | 20 | 4EP35 00–0US00 | 45/48 | 16 | 6SE7021–8EP87–0FB1[3]) | B1 | 18 |
| **7.5** | **(10)** | **6SE7022–1EP□0** | 3RT10 16 | 20 | 4EP36 00–4US00 | 52/57 | 18 | 6SE7021–8EP87–0FB1[3]) | B1 | 18 |
| **11** | **(15)** | **6SE7022–7EP□0** | 3RT10 25 | 35 | 4EP36 00–5US00 | 52/57 | 28 | 6SE7023–4ES87–0FB1 | B1 | 36 |
| **15** | **(20)** | **6SE7023–4EP□0** | 3RT10 34 | 45 | 4EP37 00–2US00 | 57/60 | 35.5 | 6SE7023–4ES87–0FB1 | B1 | 36 |
| **Compact units** | | | | | | | | | | |
| **2.2** | **(3)** | **6SE7016–1EA□1** | 3RT10 15 | 16 | 4EP32 00–1US00 | 23/35 | 6.3 | 6SE7021–0ES87–0FB1 | B1 | 12 |
| **3** | **(4)** | **6SE7018–0EA□1** | 3RT10 15 | 16 | 4EP34 00–2US00 | 35/38 | 9.1 | 6SE7021–0ES87–0FB1 | B1 | 12 |
| **4** | **(5)** | **6SE7021–0EA□1** | 3RT10 15 | 16 | 4EP34 00–1US00 | 35/38 | 11.2 | 6SE7021–0ES87–0FB1 | B1 | 12 |
| **5.5** | **(7.4)** | **6SE7021–3EB□1** | 3RT10 16 | 20 | 4EP35 00–0US00 | 45/48 | 16 | 6SE7021–8ES87–0FB1 | B1 | 18 |
| **7.5** | **(10)** | **6SE7021–8EB□1** | 3RT10 16 | 20 | 4EP36 00–4US00 | 52/57 | 18 | 6SE7021–8ES87–0FB1 | B1 | 18 |
| **11** | **(15)** | **6SE7022–6EC□1** | 3RT10 25 | 35 | 4EP36 00–5US00 | 52/57 | 28 | 6SE7023–4ES87–0FB1 | B1 | 36 |
| **15** | **(20)** | **6SE7023–4EC□1** | 3RT10 34 | 45 | 4EP37 00–2US00 | 57/60 | 35.5 | 6SE7023–4ES87–0FB1 | B1 | 36 |
| **18.5** | **(25)** | **6SE7023–8ED□1** | 3RT10 34 | 45 | 4EP37 00–5US00 | 57/60 | 40 | 6SE7027–2ES87–0FB1 | B1 | 80 |
| **22** | **(30)** | **6SE7024–7ED□1** | 3RT10 35 | 55 | 4EP38 00–2US00 | 67/71 | 50 | 6SE7027–2ES87–0FB1 | B1 | 80 |
| **30** | **(40)** | **6SE7026–0ED□1** | 3RT10 44 | 90 | 4EP38 00–7US00 | 67/71 | 63 | 6SE7027–2ES87–0FB1 | B1 | 80 |
| **37** | **(50)** | **6SE7027–2ED□1** | 3RT10 44 | 90 | 4EP39 00–2US00 | 82/87 | 80 | 6SE7027–2ES87–0FB1 | B1 | 80 |
| **Chassis units** | | | | | | | | | | |
| **45** | **(60)** | **6SE7031–0EE□0** | 3RT10 45 | 100 | 4EP40 00–2US00 | 96/103 | 100 | 6SE7031–2ES87–0FA1 | A1 | 120 |
| **55** | **(75)** | **6SE7031–2EF□0** | 3RT14 46 | 135 | 4EP40 00–6US00 | 96/103 | 125 | 6SE7031–8ES87–0FA1 | A1 | 190 |
| **75** | **(100)** | **6SE7031–8EF□0** | 3RT10 55 | 185 | 4EU25 52–4UA00–0AA0 | 187/201 | 200 | 6SE7031–8ES87–0FA1 | A1 | 190 |
| **90** | **(120)** | **6SE7032–1EG□0** | 3RT10 56 | 215 | 4EU25 52–4UA00–0AA0 | 187/201 | 200 | 6SE7031–8ES87–0FA1 | A1 | 190 |
| **110** | **(150)** | **6SE7032–6EG□0** | 3RT14 56 | 275 | 4EU25 52–8UA00–0AA0 | 187/201 | 224 | 6SE7033–6ES87–0FA1 | A1 | 320 |
| **132** | **(175)** | **6SE7033–2EG□0** | 3RT10 65 | 330 | 4EU27 52–0UB00–0AA0 | 253/275 | 280 | 6SE7033–2ES87–0FA1 | A1 | 320 |
| **160** | **(215)** | **6SE7033–7EG□0** | 3RT10 65 | 330 | 4EU27 52–7UA00–0AA0 | 253/275 | 315 | 6SE7033–2ES87–0FA1 | A1 | 320 |
| **200** | **(270)** | **6SE7035–1EK□0** | 3RT10 75 | 430 | 4EU30 52–5UA00–0AA0 | 334/367 | 560 | 6SE7036–0ES87–0FA1 | A1 | 600 |
| **250** | **(335)** | **6SE7036–0EK□0** | 3RT10 76 | 610 | 4EU30 52–5UA00–0AA0 | 334/367 | 560 | 6SE7036–0ES87–0FA1 | A1 | 600 |

5 SIMOVERT MASTERDRIVES Motion Control
7 SIMOVERT MASTERDRIVES Motion Control Performance 2

1) Refer to catalog NS K.

2) Compliance of radio-interference suppression with EN 55 011 is only ensured in combination with the line commutating reactor $V_D$ = 2 %. With Compact PLUS filters, the line commutating reactor $V_D$ = 2 % is integrated in the line filter.

3) Radio-interference suppression filters of type of construction Compact PLUS with commutating reactor $V_D$ = 2 % are integrated into the filter. No additional inverters for the converter have been taken into account.

4) For single-axis applications. For multi-axis applications, see Section 6.



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## Rectifier units

| Nominal power rating | Rectifier unit | Switch disconnector[2] | | Switch disconnector with fuse holders[1][2] | | | Fuse switch disconnectors[1][2] | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Rated current | | Rated current | Max. fuse size | | Rated current | Max. fuse size |
| kW | Order No. | Order No. | A | Order No. | A | | Order No. | A | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **Compact PLUS units** | | | | | | | | | |
| **15** | **6SE7024–1EP85–0AA0** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **50** | **6SE7031–2EP85–0AA0** | 3KA53 30–1EE01 | 160 | 3KL53 30–1EB01 | 160 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **100** | **6SE7032–3EP85–0AA0** | 3KA55 30–1EE01 | 250[8] | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **Compact and chassis units** | | | | | | | | | |
| **15** | **6SE7024–1EB85–0AA0** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **37** | **6SE7028–6EC85–0AA0** | 3KA51 30–1EE01 | 80 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 10–0CH01 | 100 | 000 |
| **75** | **6SE7031–7EE85–0AA0** | 3KA53 30–1EE01 | 160 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **110** | **6SE7032–7EE85–0AA0** | 3KA55 30–1EE01 | 250 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **160** | **6SE7033–8EE85–0AA0** | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP53 60–0CA00 | 400 | 1; 2 |
| **200** | **6SE7034–6EE85–0AA0** | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP53 60–0CA00 | 400 | 1; 2 |
| **250** | **6SE7036–1EE85–0AA0** | 3KA58 30–1EE00 | 630 | 3KL61 30–1AB0 | 630 | 3 | 3NP54 60–0CA00 | 630 | 2; 3 |

| Nominal power rating | Rectifier unit | Cable-protection fuses Duty class gL[3][4] | | | Semiconductor-protection fuses Duty class gR[3] (incl. cable protection) | | | Main contactor/ AC contactor[5] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Rated current | Size | | Rated current | Size | AC1 duty 55 °C | Rated current |
| kW | Order No. | Order No. | A | | Order No. | A | | Order No. | A |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **Compact PLUS units** | | | | | | | | | |
| **15** | **6SE7024–1EP85–0AA0** | 3NA3 817 | 40 | 00 | 3NE1 802-0 | 40 | 000 | 3RT10 34 | 45 |
| **50** | **6SE7031–2EP85–0AA0** | 3NA3 032 | 125 | 1 | 3NE1 022-0 | 125 | 1 | 3RT10 54 | 160 |
| **100** | **6SE7032–3EP85–0AA0** | 3NA3 142 | 224 | 2 | 3NE1 227-0 | 250 | 1 | 3RT10 64 | 275 |
| **Compact and chassis units** | | | | | | | | | |
| **15** | **6SE7024–1EB85–0AA0** | 3NA3 820 | 50 | 00 | 3NE1 802-0 | 40 | 000 | 3RT10 34 | 45 |
| **37** | **6SE7028–6EC85–0AA0** | 3NA3 830 | 100 | 00 | 3NE1 820-0 | 80 | 000 | 3RT10 44 | 90 |
| **75** | **6SE7031–7EE85–0AA0** | 3NA3 140 | 200 | 1 | 3NE1 224-0 | 160 | 1 | 3TK50 | 190 |
| **110** | **6SE7032–7EE85–0AA0** | 3NA3 252 | 315 | 2 | 3NE1 227-0 | 250 | 1 | 3TK52 | 315 |
| **160** | **6SE7033–8EE85–0AA0** | 3NA3 260 | 400 | 2 | 3NE1 331-0 | 350 | 2 | 3TK54 | 380 |
| **200** | **6SE7034–6EE85–0AA0** | 3NA3 365 | 500 | 3 | 3NE1 332-0 | 400 | 2 | 3TK56 | 500 |
| **250** | **6SE7036–1EE85–0AA0** | 3NA3 372 | 630 | 3 | 3NE1 435-0 | 560 | 3 | 2 x 3TK52 | 567 |

| Nominal power rating | Rectifier unit | Commutating reactor $V_D$ = 2 % | | | Commutating reactor $V_D$ = 4 % | | | Radio-interference suppression filter[6][7] | |
|---|---|---|---|---|---|---|---|---|---|
| | | 400/460 V 50/60 Hz | $P_v$ 50/60 Hz | Rated current | 400/460 V 50/60 Hz | $P_v$ 50/60 Hz | Rated current | | Class |
| kW | Order No. | Order No. | W | A | Order No. | W | A | Order No. | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **Compact PLUS units** | | | | | | | | | |
| **15** | **6SE7024–1EP85–0AA0** | 4EP37 00–2US00 | 57/60 | 35.5 | 4EP39 00–5US00 | 82/87 | 35.5 | 6SE7023–4ES87–0FB1 | B1 |
| **50** | **6SE7031–2EP85–0AA0** | 4EU24 52–2UA00–0AA0 | 154/163 | 160 | 4EU27 52–1UB00–0AA0 | 253/275 | 160 | 6SE7031–8ES87–0FA1 | A1 |
| **100** | **6SE7032–3EP85–0AA0** | 4EU25 52–5UA00–0AA0 | 187/201 | 250 | 4EU30 52–7UA00–0AA0 | 334/367 | 280 | 6SE7033–2ES87–0FA1 | A1 |
| **Compact and chassis units** | | | | | | | | | |
| **15** | **6SE7024–1EB85–0AA0** | 4EP37 00–2US00 | 57/60 | 35.5 | 4EP39 00–5US00 | 82/87 | 35.5 | 6SE7023–4ES87–0FB1 | B1 |
| **37** | **6SE7028–6EC85–0AA0** | 4EP39 00–2US00 | 82/87 | 80 | 4EU24 52–4UA00–0AA0 | 154/163 | 80 | 6SE7027–2ES87–0FB1 | B1 |
| **75** | **6SE7031–7EE85–0AA0** | 4EU24 52–2UA00–0AA0 | 154/163 | 160 | 4EU27 52–1UB00–0AA0 | 253/275 | 160 | 6SE7031–8ES87–0FA1 | A1 |
| **110** | **6SE7032–7EE85–0AA0** | 4EU25 52–5UA00–0AA0 | 187/201 | 250 | 4EU30 52–7UA00–0AA0 | 334/367 | 280 | 6SE7033–2ES87–0FA1 | A1 |
| **160** | **6SE7033–8EE85–0AA0** | 4EU27 52–7UA00–0AA0 | 253/275 | 315 | 4EU30 52–8UA00–0AA0 | 334/367 | 355 | 6SE7033–2ES87–0FA1 | A1 |
| **200** | **6SE7034–6EE85–0AA0** | 4EU27 52–8UA00–0AA0 | 253/275 | 400 | 4EU36 52–3UB00–0AA0 | 450/495 | 400 | 6SE7036–0ES87–0FA1 | A1 |
| **250** | **6SE7036–1EE85–0AA0** | 4EU30 52–5UA00–0AA0 | 334/367 | 560 | 4EU36 52–4UB00–0AA0 | 450/495 | 560 | 6SE7036–0ES87–0FA1 | A1 |

1) Switch disconnectors: Please take into account the size of the cable-protection and semiconductor-protection fuses!

2) Can be optionally used, depending on requirements. For further information refer to Catalog NS K.

3) The cable cross-sections must be dimensioned according to DIN VDE 0100, VDE 0298, Part 4 and as a function of the rated fuse currents.

4) Does not ensure total protection for the input rectifier of the unit.

5) Refer to Catalog NS K.

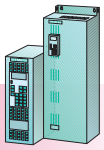
6) Line supply suppression according to EN 61 800-3 can only be ensured with the line commutating reactor $V_D$ = 2 %.

7) Can only be used with TT and TN systems (earthed systems).

8) Output current via a two-busbar connection with 120 A per outgoing circuit.




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## AFE rectifier/regenerative units

| Rated rectifier/ regen-erative output at cos φ = 1 and 400 V supply voltage $P_{rated}$ | AFE inverter with CUSA closed-loop control board 6SE7090-0XX84-0BJ0 | AFE reactor | Supply connection module | Rated current | Power loss | Weight, approx. | Dimensions supply connection module | Dimensions AFE reactor |
|---|---|---|---|---|---|---|---|---|
| | | | | | $P_v$ | | W x H x D | W x H x D |
| kW | Order No. | Order No. | Order No. | A | W | kg (lb) | mm x mm x mm (in x in x in) | mm x mm x mm (in x in x in) |
| **Supply voltage 3-ph. 380 V AC –20 % to 460 V +5 %** | | | | | | | | |
| **Compact units** | | | | | | | | |
| **6.8** | **6SE7021–0EA81** | 6SE7021–3ES87–1FG0[1)] | – | 13 | 17 | 8 (17.6) | – – | 270 x 250 x 196 (10.6 x 9.8 x 7.7) |
| **9** | **6SE7021–3EB81** | 6SE7021–3ES87–1FG0[1)] | – | 13 | 23 | 8 (17.6) | – – | 270 x 250 x 196 (10.6 x 9.8 x 7.7) |
| **12** | **6SE7021–8EB81** | 6SE7022–6ES87–1FG0[1)] | – | 26 | 30 | 12 (26.5) | – – | 300 x 250 x 185 (11.8 x 9.8 x 7.3) |
| **17** | **6SE7022–6EC81** | 6SE7022–6ES87–1FG0[1)] | – | 26 | 43 | 12 (26.5) | – – | 300 x 250 x 185 (11.8 x 9.8 x 7.3) |
| **23** | **6SE7023–4EC81** | 6SE7024–7ES87–1FG0[1)] | – | 47 | 58 | 20 (44.1) | – – | 360 x 300 x 185 (14.2 x 11.8 x 7.3) |
| **32** | **6SE7024–7ED81** | 6SE7024–7ES87–1FG0[1)] | – | 47 | 80 | 20 (44.1) | – – | 360 x 300 x 185 (14.2 x 11.8 x 7.3) |
| **40** | **6SE7026–0ED81** | 6SE7027–2ES87–1FG0[1)] | – | 72 | 100 | 32 (70.6) | – – | 380 x 300 x 196 (15.0 x 11.8 x 7.7) |
| **49** | **6SE7027–2ED81** | 6SE7027–2ES87–1FG0[1)] | – | 72 | 123 | 32 (70.6) | – – | 380 x 300 x 196 (15.0 x 11.8 x 7.7) |
| **Chassis units** | | | | | | | | |
| **63** | **6SE7031–0EE80** | – | 6SE7131–0EE83–2NA0 | 92 | 500 | 110 (242.6) | 274 x 1310 x 408 (10.8 x 51.6 x 16.1) | 300 x 267 x 212 (11.8 x 10.5 x 8.3) |
| **85** | **6SE7031–2EF80** | – | 6SE7131–2EF83–2NA0 | 124 | 630 | 160 (352.8) | 440 x 1310 x 470 (17.3 x 51.6 x 18.5) | 355 x 340 x 212 (14.0 x 13.4 x 8.3) |
| **100** | **6SE7031–5EF80** | – | 6SE7131–5EF83–2NA0 | 146 | 710 | 165 (363.8) | 440 x 1310 x 470 (17.3 x 51.6 x 18.5) | 355 x 340 x 272 (14.0 x 13.4 x 10.7) |
| **125** | **6SE7031–8EF80** | – | 6SE7131–8EF83–2NA0 | 186 | 860 | 170 (374.6) | 440 x 1310 x 470 (17.3 x 51.6 x 18.5) | 355 x 340 x 278 (14.0 x 13.4 x 10.9) |
| **143** | **6SE7032–1EG80** | – | 6SE7132–1EG83–2NA0 | 210 | 1100 | 235 (518.2) | 580 x 1339 x 459 (22.8 x 52.7 x 18.1) | 420 x 389 x 312 (16.5 x 15.3 x 12.3) |
| **177** | **6SE7032–6EG80** | – | 6SE7132–6EG83–2NA0 | 260 | 1300 | 240 (529.2) | 580 x 1339 x 459 (22.8 x 52.7 x 18.1) | 420 x 389 x 312 (16.5 x 15.3 x 12.3) |
| **214** | **6SE7033–2EG80** | – | 6SE7133–2EG83–2NA0 | 315 | 1500 | 295 (650.5) | 580 x 1339 x 459 (22.8 x 52.7 x 18.1) | 480 x 380 x 376 (18.9 x 15.0 x 14.8) |
| **250** | **6SE7033–7EG80** | – | 6SE7133–7EG83–2NA0 | 370 | 1820 | 305 (672.5) | 580 x 1339 x 459 (22.8 x 52.7 x 18.1) | 480 x 380 x 376 (18.9 x 15.0 x 14.8) |

Required components for compact units, description see Section 6.

1) Caution!
For compact units, the required system components must be ordered separately (see Section 6).



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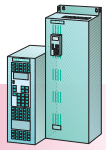
| Rated rectifier/ regenerative output at cos $\varphi$ = 1 and 400 V supply voltage $P_{rated}$ | **AFE inverter** with CUSA closed-loop control board 6SE7090-0XX84-0BJ0 | Main contactor/ AC contactor[1]) 230 V control | | Precharging | | Precharging | | Supply voltage detection VSB |
|---|---|---|---|---|---|---|---|---|
| | | | Rated current | Precharging contactor[1]) with Compact AFE 24 V | Rated current | Resistor 3 required | Rated value | For DIN rail mounting with enclosure |
| kW | Order No. | Order No. | A | Order No. | A | Order No. | Ω | Order No. |
| **Supply voltage 3-ph. 380 V AC –20 % to 460 V +5 %** | | | | | | | | |
| **Compact units** | | | | | | | | |
| **6.8** | **6SE7021–0EA81** | 3RT10 15 | 16 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC81 | 22 | 6SX7010–0EJ00 |
| **9** | **6SE7021–3EB81** | 3RT10 16 | 20 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC81 | 22 | 6SX7010–0EJ00 |
| **12** | **6SE7021–8EB81** | 3RT10 16 | 20 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC81 | 22 | 6SX7010–0EJ00 |
| **17** | **6SE7022–6EC81** | 3RT10 25 | 35 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC80 | 10 | 6SX7010–0EJ00 |
| **23** | **6SE7023–4EC81** | 3RT10 34 | 45 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC80 | 10 | 6SX7010–0EJ00 |
| **32** | **6SE7024–7ED81** | 3RT10 35 | 55 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC80 | 10 | 6SX7010–0EJ00 |
| **40** | **6SE7026–0ED81** | 3RT10 44 | 90 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC80 | 10 | 6SX7010–0EJ00 |
| **49** | **6SE7027–2ED81** | 3RT10 44 | 90 | 3RT10 16–.BB4. | 20 | 6SX7010–0AC80 | 10 | 6SX7010–0EJ00 |
| **Chassis units** | | | | | | | | |
| **63** | **6SE7031–0EE80** | Integrated into the supply connection module | | | | | | |
| **85** | **6SE7031–2EF80** | Integrated into the supply connection module | | | | | | |
| **100** | **6SE7031–5EF80** | Integrated into the supply connection module | | | | | | |
| **125** | **6SE7031–8EF80** | Integrated into the supply connection module | | | | | | |
| **143** | **6SE7032–1EG80** | Integrated into the supply connection module | | | | | | |
| **177** | **6SE7032–6EG80** | Integrated into the supply connection module | | | | | | |
| **214** | **6SE7033–2EG80** | Integrated into the supply connection module | | | | | | |
| **250** | **6SE7033–7EG80** | Integrated into the supply connection module | | | | | | |

Required components for compact units, description see Section 6.

1) Refer to Catalog NS K.




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## AFE rectifier/regenerative units (continued)

| Rated rectifier/ regenerative output at cos φ = 1 and 400 V supply voltage $P_{rated}$ | AFE inverter with CUSA closed-loop control board 6SE7090-0XX84-0BJ0 | Load switch disconnector[2] | | Load switch disconnector with fuse fittings[2] | | | Fuse load switch disconnector[1][2] | | | Semiconductor protection fuses opteration class gR[3] incl. cable protection | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rated current | | Rated current | Max. fuse size | | Rated current | Max. fuse size | | Rated current | Max. fuse size |
| kW | Order No. | Order No. | A | Order No. | A | Size | Order No. | A | Size | Order No. | A | Size |
| **Supply voltage 3-ph. 380 V AC –20 % to 460 V +5 %** | | | | | | | | | | | | |
| **Compact units** | | | | | | | | | | | | |
| **6.8** | **6SE7021–0EA81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 813–0 | 16 | 000 |
| **9** | **6SE7021–3EB81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 814–0 | 20 | 000 |
| **12** | **6SE7021–8EB81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 815–0 | 25 | 000 |
| **17** | **6SE7022–6EC81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 803–0 | 35 | 000 |
| **23** | **6SE7023–4EC81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 802–0 | 40 | 000 |
| **32** | **6SE7024–7ED81** | 3KA50 30–1EE01 | 63 | 3KL50 30–1EB01 | 63 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 818–0 | 63 | 000 |
| **40** | **6SE7026–0ED81** | 3KA51 30–1EE01 | 80 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 820–0 | 80 | 000 |
| **49** | **6SE7027–2ED81** | 3KA51 30–1EE01 | 80 | 3KL52 30–1EB01 | 125 | 00 | 3NP40 10–0CH01 | 100 | 000 | 3NE1 820–0 | 80 | 000 |
| **Chassis units** | | | | | | | | | | | | |
| **63** | **6SE7031–0EE80** | Integrated into the supply connection module | | | | | | | | | | |
| **85** | **6SE7031–2EF80** | Integrated into the supply connection module | | | | | | | | | | |
| **100** | **6SE7031–5EF80** | Integrated into the supply connection module | | | | | | | | | | |
| **125** | **6SE7031–8EF80** | Integrated into the supply connection module | | | | | | | | | | |
| **143** | **6SE7032–1EG80** | Integrated into the supply connection module | | | | | | | | | | |
| **177** | **6SE7032–6EG80** | Integrated into the supply connection module | | | | | | | | | | |
| **214** | **6SE7033–2EG80** | Integrated into the supply connection module | | | | | | | | | | |
| **250** | **6SE7033–7EG80** | Integrated into the supply connection module | | | | | | | | | | |

| **Rated rectifier/ regenerative output** at cos φ = 1 and 400 V supply voltage $P_{rated}$ | AFE inverter with CUSA closed-loop control board 6SE7090-0XX84-0BJ0 | Radio-interference suppression filter | | Clean Power Filter | | |
|---|---|---|---|---|---|---|
| | | | Class | | Power loss | Base radio-interference suppression |
| kW | Order No. | Order No. | | Order No. | W | Order No. |
| **Supply voltage 3-ph. 380 V AC –20 % to 460 V +5 %** | | | | | | |
| **Compact units** | | | | | | |
| **6.8** | **6SE7021–0EA81** | 6SE7021–0ES87–0FB1 | A1 | 6SE7021–0EB87–1FC0 | 200 | 6SX7010–0FB10 |
| **9** | **6SE7021–3EB81** | 6SE7021–8ES87–0FB1 | A1 | 6SE7021–8EB87–1FC0 | 250 | 6SX7010–0FB10 |
| **12** | **6SE7021–8EB81** | 6SE7021–8ES87–0FB1 | A1 | 6SE7021–8EB87–1FC0 | 250 | 6SX7010–0FB10 |
| **17** | **6SE7022–6EC81** | 6SE7023–4ES87–0FB1 | A1 | 6SE7022–6EC87–1FC0 | 300 | 6SX7010–0FB10 |
| **23** | **6SE7023–4EC81** | 6SE7023–4ES87–0FB1 | A1 | 6SE7023–4EC87–1FC0 | 400 | 6SX7010–0FB10 |
| **32** | **6SE7024–7ED81** | 6SE7027–2ES87–0FB1 | A1 | 6SE7024–7ED87–1FC0 | 500 | 6SX7010–0FB10 |
| **40** | **6SE7026–0ED81** | 6SE7027–2ES87–0FB1 | A1 | 6SE7027–2ED87–1FC0 | 600 | 6SX7010–0FB10 |
| **49** | **6SE7027–2ED81** | 6SE7027–2ES87–0FB1 | A1 | 6SE7027–2ED87–1FC0 | 600 | 6SX7010–0FB10 |
| **Chassis units** | | | | | | |
| **63** | **6SE7031–0EE80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **85** | **6SE7031–2EF80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **100** | **6SE7031–5EF80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **125** | **6SE7031–8EF80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **143** | **6SE7032–1EG80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **177** | **6SE7032–6EG80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **214** | **6SE7033–2EG80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |
| **250** | **6SE7033–7EG80** | Option L00 for supply connection module | A1 | Integrated into the supply connection module | | |

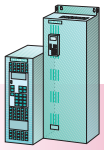
1) Fuse switch-disconnectors: Please take into account the size of the cable-protection fuses and semiconductor protection fuses.

2) Can be optionally used, depending on your requirements. For further information, refer to Catalog NS K.

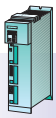
3) The cable cross-sections must be dimensioned acc. to DIN VDE 0100, VDE 0298, Part 4, and as a function of the rated fuse currents.



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Compact and chassis units



Compact PLUS units

Recommended line-side power options

## Rectifier/regenerative units, 25 % power-on duration in generating mode

| Nominal power rating | Rectifier/ regenerative unit | Switch disconnector[2] | | Switch disconnectors with fuse holders[1][2] | | | Fuse switch-disconnectors[1][2] | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Rated current | | Rated current | Max. fuse size | | Rated current | Max. fuse size |
| kW | Order No. | Order No. | A | Order No. | A | | Order No. | A | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **7.5** | **6SE7022–1EC85–1AA0** | 3KA50 30–1EE01 | 63 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **15** | **6SE7024–1EC85–1AA0** | 3KA50 30–1EE01 | 63 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **37** | **6SE7028–6EC85–1AA0** | 3KA51 30–1EE01 | 80 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **75** | **6SE7031–7EE85–1AA0** | 3KA53 30–1EE01 | 160 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **90** | **6SE7032–2EE85–1AA0** | 3KA55 30–1EE01 | 250 | 3KL55 30–1EB01 | 250 | 0; 1; 2 | 3NP42 70–0CA01 | 250 | 0; 1 |
| **132** | **6SE7033–1EE85–1AA0** | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP53 60–0CA00 | 400 | 1; 2 |
| **160** | **6SE7033–8EE85–1AA0** | 3KA57 30–1EE01 | 400 | 3KL57 30–1EB01 | 400 | 1; 2 | 3NP53 60–0CA00 | 400 | 1; 2 |
| **200** | **6SE7034–6EE85–1AA0** | 3KA57 30–1EE01 | 400 | 3KL61 30–1AB0 | 630 | 2; 3 | 3NP54 60–0CA00 | 630 | 2; 3 |
| **250** | **6SE7036–1EE85–1AA0** | 3KA58 30–1EE01 | 630 | 3KL61 30–1AB0 | 630 | 2; 3 | 3NP54 60–0CA00 | 630 | 2; 3 |

| Nominal power rating | Rectifier/ regenerative unit | Cable-protection fuses Duty class gL[3][4] | | Semiconductor-protection fuses Duty class aR[4] (incl. cable protection) | | | Main contactor/ AC contactor[5] | |
|---|---|---|---|---|---|---|---|---|
| | | | Rated current | Size | | Rated current | Size | AC1 duty 55 °C | Rated current |
| kW | Order No. | Order No. | A | | Order No. | A | | Order No. | A |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **7.5** | **6SE7022–1EC85–1AA0** | 3NA3 810 | 25 | 00 | 3NE4 101 | 32 | 0 | 3RT10 25 | 35 |
| **15** | **6SE7024–1EC85–1AA0** | 3NA3 820 | 50 | 00 | 3NE4 118 | 63 | 0 | 3RT10 34 | 45 |
| **37** | **6SE7028–6EC85–1AA0** | 3NA3 830 | 100 | 00 | 3NE4 122 | 125 | 0 | 3RT10 44 | 90 |
| **75** | **6SE7031–7EE85–1AA0** | 3NA3 140 | 200 | 1 | 3NE3 227 | 250 | 1 | 3TK50 | 190 |
| **90** | **6SE7032–2EE85–1AA0** | 3NA3 144 | 250 | 1 | 3NE3 230–0B | 315 | 1 | 3TK52 | 315 |
| **132** | **6SE7033–1EE85–1AA0** | 3NA3 252 | 315 | 2 | 3NE3 233 | 450 | 1 | 3TK52 | 315 |
| **160** | **6SE7033–8EE85–1AA0** | 3NA3 260 | 400 | 2 | 3NE3 333 | 450 | 2 | 3TK54 | 380 |
| **200** | **6SE7034–6EE85–1AA0** | 3NA3 365 | 500 | 3 | 3NE3 335 | 560 | 2 | 3TK56 | 500 |
| **250** | **6SE7036–1EE85–1AA0** | 3NA3 372 | 630 | 3 | 3NE3 338–8 | 800 | 2 | 2 x 3TK52 | 567 |

1) Switch disconnectors: Please take into account the size of the cable-protection and semiconductor-protection fuses!

2) Can be optionally used, depending on requirements. For further information refer to Catalog NS K.

3) Does not ensure total protection for the input rectifier of the unit.

4) The cable cross-sections must be dimensioned according to DIN VDE 0100, VDE 0298, Part 4 and as a function of the rated fuse currents.

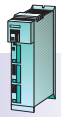
5) Refer to Catalog NS K.



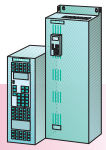
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# Selection and ordering data









## Rectifier/regenerative units, 25 % power-on duration in generating mode

| Nominal power rating | Rectifier/ regenerative unit | Commutating reactor $V_D$ = 2 % | | | Commutating reactor $V_D$ = 4 % | | | Radio-interference suppression filter[1)2)] | |
|---|---|---|---|---|---|---|---|---|---|
| | | **400/480 V 50/60 Hz** | $P_v$ 50/60 Hz | Rated current | **400/480 V 50/60 Hz** | $P_v$ 50/60 Hz | Rated current | | Class |
| kW | Order No. | Order No. | W | A | Order No. | W | A | Order No. | |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | | | |
| **7.5** | **6SE7022–1EC85–1AA0** | 4EP36 00–4US00 | 52/ 57 | 18 | 4EP37 00–7US00 | 57/ 60 | 18 | 6SE7023–4ES87–0FB1 | B1 |
| **15** | **6SE7024–1EC85–1AA0** | 4EP37 00–2US00 | 57/ 60 | 35.5 | 4EP39 00–5US00 | 82/ 87 | 35.5 | 6SE7023–4ES87–0FB1 | B1 |
| **37** | **6SE7028–6EC85–1AA0** | 4EP39 00–2US00 | 82/ 87 | 80 | 4EU24 52–4UA00–0AA0 | 154/163 | 80 | 6SE7027–2ES87–0FB1 | B1 |
| **75** | **6SE7031–7EE85–1AA0** | 4EU24 52–2UA00–0AA0 | 154/163 | 160 | 4EU27 52–1UB00–0AA0 | 253/275 | 160 | 6SE7031–8ES87–0FA1 | A1 |
| **90** | **6SE7032–2EE85–1AA0** | 4EU25 52–4UA00–0AA0 | 187/201 | 200 | 4EU27 52–2UB00–0AA0 | 253/275 | 200 | 6SE7031–8ES87–0FA1 | A1 |
| **132** | **6SE7033–1EE85–1AA0** | 4EU27 52–0UB00–0AA0 | 253/275 | 280 | 4EU30 52–7UA00–0AA0 | 334/367 | 280 | 6SE7033–2ES87–0FA1 | A1 |
| **160** | **6SE7033–8EE85–1AA0** | 4EU27 52–7UA00–0AA0 | 253/275 | 315 | 4EU30 52–8UA00–0AA0 | 334/367 | 355 | 6SE7033–2ES87–0FA1 | A1 |
| **200** | **6SE7034–6EE85–1AA0** | 4EU27 52–8UA00–0AA0 | 253/275 | 400 | 4EU36 52–3UB00–0AA0 | 450/495 | 400 | 6SE7036–0ES87–0FA1 | A1 |
| **250** | **6SE7036–1EE85–1AA0** | 4EU30 52–5UA00–0AA0 | 334/367 | 560 | 4EU36 52–4UB00–0AA0 | 450/495 | 560 | 6SE7036–0ES87–0FA1 | A1 |

| Nominal power rating | Rectifier/ regenerative unit | Regenerative autotransformer[3)] | | | | Free-wheeling diode on the DC bus[4)] | Clamping cap |
|---|---|---|---|---|---|---|---|
| | | 25 % power-on duration **380 V to 415 V 50/60 Hz** | $P_v$ 50/60 Hz | 25 % power-on duration **440 V to 480 V 60 Hz** | $P_v$ 50/60 Hz | Diode | |
| kW | Order No. | Order No. | kW | Order No. | kW | Order No. | Order No. |
| **Supply voltage 3-ph. 380 V to 480 V AC** | | | | | | | |
| **7.5** | **6SE7022–1EC85–1AA0** | 4AP25 95–0UA11–8AN2 | 0.35 | 4AP25 95–0UA21–8AN2 | 0.35 | SKR 3 F 20/12 | |
| **15** | **6SE7024–1EC85–1AA0** | 4AP27 95–0UA01–8AN2 | 0.45 | 4AP27 95–0UA51–8AN2 | 0.45 | SKR 3 F 20/12 | |
| **37** | **6SE7028–6EC85–1AA0** | 4AP30 95–0UA01–8AN2 | 0.65 | 4AP30 95–0UA71–8AN2 | 0.65 | SKR 60 F 12 | |
| **75** | **6SE7031–7EE85–1AA0** | 4AU39 95–0UA51–8AN2 | 2.20 | 4AU36 95–0UA21–8AN2 | 1.70 | SKR 60 F 12 | |
| **90** | **6SE7032–2EE85–1AA0** | 4AU39 95–0UA61–8AN2 | 2.20 | 4AU39 95–0UB01–8AN2 | 2.20 | SKR 60 F 12 | |
| **132** | **6SE7033–1EE85–1AA0** | 4BU43 95–0UA41–8A | 2.70 | 4BU43 95–0UA51–8A | 2.70 | 2 x SKR 141 F 15 | |
| **160** | **6SE7033–8EE85–1AA0** | 4BU45 95–0UA61–8A | 2.80 | 4BU45 95–0UA71–8A | 2.80 | 2 x SKR 141 F 15 | |
| **200** | **6SE7034–6EE85–1AA0** | 4BU47 95–0UA61–8A | 3.00 | 4BU47 95–0UA71–8A | 3.00 | 2 x SKR 141 F 15 | |
| **250** | **6SE7036–1EE85–1AA0** | 4BU51 95–0UA31–8A | 6.00 | 4BU51 95–0UA41–8A | 6.00 | D 689S 20[5)6)] | V 72–26.120M[5)6)] |

1) Compliance with radio-interference suppression to EN 61 800-3 can only be ensured in conjunction with a line commutating reactor of $V_D$ = 2 % .

2) Can only be used with TT and TN systems (earthed systems).

3) Transformer: Cycle duration of 22 min, i.e. with 25 % power-on duration, maximum 5.5 min in regenerating mode, 16.5 min in rectifying mode.

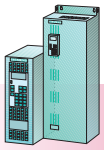
4) See Engineering Information, Section 6. The diodes referred to are from the range of products supplied by SEMIKRON GmbH u. Co. KG, Sigmundstr. 200, D-90431 Nuremberg, Germany. Internet: www.semikron.com

5) Diode supplied as a disc diode with a clamping cap for mounting on a copper plate or copper rail.

6) See Engineering Information, Section 6. The diodes referred to are from the product range supplied by EUPEC GmbH u. Co. KG, Max-Planck-Str. 5, D-59581 Warstein, Germany. Internet: www.eupec.com



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Compact and chassis units

Recommended DC link power options[5])

## Inverter

| Nominal power rating | | Inverter | Fuse switch-disconnector for DC coupling[1][2] | | | Inverter protection fuse Duty class gR[2] | | | Inverter protection fuse Duty class aR[2] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $I_{rated}$ | Max. fuse size | | $I_{rated}$ | Size | | $I_{rated}$ | Size |
| kW | (HP) | Order No. | Order No. | A | | Order No. | A | | Order No. | A | |
| **Compact units** | | | | | | | | | | | |
| **2.2** | **(3)** | **6SE7016–1TA51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 814–0[4] | 20 | 000 | 2 x 3NE8 015[4] | 25 | 00 |
| **3** | **(4)** | **6SE7018–0TA51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 815–0[4] | 25 | 000 | 2 x 3NE8 015[4] | 25 | 00 |
| **4** | **(5)** | **6SE7021–0TA51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 815–0[4] | 25 | 000 | 2 x 3NE8 015[4] | 25 | 00 |
| **5.5** | **(7.5)** | **6SE7021–3TB51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 803–0[4] | 35 | 000 | 2 x 3NE8 017[4] | 50 | 00 |
| **7.5** | **(10)** | **6SE7021–8TB51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 817–0[4] | 50 | 000 | 2 x 3NE8 017[4] | 50 | 00 |
| **11** | **(15)** | **6SE7022–6TC51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 818–0[4] | 63 | 000 | 2 x 3NE8 020[4] | 80 | 00 |
| **15** | **(20)** | **6SE7023–4TC51[3]** | 3NP40 10–0CH01 | 100 | 000 | 2 x 3NE1 820–0[4] | 80 | 000 | 2 x 3NE8 020[4] | 80 | 00 |
| **18.5** | **(25)** | **6SE7023–8TD51[3]** | 3NP40 70–0CA01 | 160 | 00 | 2 x 3NE1 021–0[4] | 100 | 00 | 2 x 3NE8 022[4] | 125 | 00 |
| **22** | **(30)** | **6SE7024–7TD51[3]** | 3NP40 70–0CA01 | 160 | 00 | 2 x 3NE1 022–0[4] | 125 | 00 | 2 x 3NE8 022[4] | 125 | 00 |
| **30** | **(40)** | **6SE7026–0TD51[3]** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE1 224–0[4] | 160 | 0 | 2 x 3NE8 024[4] | 160 | 00 |
| **37** | **(50)** | **6SE7027–2TD51[3]** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE1 224–0[4] | 160 | 0 | 2 x 3NE8 024[4] | 160 | 00 |
| **Chassis units** | | | | | | | | | | | |
| **45** | **(60)** | **6SE7031–0TE50** | 3NP42 70–0CA01 | 250 | 0; 1 | – | | | 2 x 3NE3 224 | 160 | 1 |
| **55** | **(75)** | **6SE7031–2TF50** | 3NP42 70–0CA01 | 250 | 0; 1 | – | | | 2 x 3NE3 227 | 250 | 1 |
| **75** | **(100)** | **6SE7031–8TF50** | 3NP42 70–0CA01 | 250 | 0; 1 | – | | | 2 x 3NE3 227 | 250 | 1 |
| **90** | **(120)** | **6SE7032–1TG50** | 3NP43 70–0CA01 | 400 | 1; 2 | – | | | 2 x 3NE3 230–0B | 315 | 1 |
| **110** | **(150)** | **6SE7032–6TG50** | 3NP44 70–0CA01 | 630 | 2; 3 | – | | | 2 x 3NE3 233 | 450 | 1 |
| **132** | **(175)** | **6SE7033–2TG50** | 3NP44 70–0CA01 | 630 | 2; 3 | – | | | 2 x 3NE3 233 | 450 | 1 |
| **160** | **(215)** | **6SE7033–7TG50** | 3NP44 70–0CA01 | 630 | 2; 3 | – | | | 2 x 3NE3 334–0B | 500 | 2 |
| **200** | **(270)** | **6SE7035–1TJ50** | 3NP44 70–0CA01 | 630 | 2; 3 | – | | | 2 x 3NE3 336 | 630 | 2 |
| **250** | **(335)** | **6SE7036–0TJ50** | 2 x 3NP53 60–0CA00 | 400 | 1; 2 | – | | | 2 x 2 x 3NE3 233[3] | 450 | 1 |

1) See Catalog "Low-Voltage Switchgear". The rated insulation voltage is valid for pollution degree 3 according to DIN VDE 0110, Part 1. The conditions of use, however, are according to pollution degree 2. The rated insulation voltage is therefore ≥ 1000 V.

2) Bear in mind the size of the fuses when selecting the fuse disconnector.

3) DC fuses contained in the inverter unit as standard features.

4) The fuses are necessary only if separate protection of the inverters is required. In that case, the inverters should be ordered with option L33.

5) The Compact PLUS inverters can be connected to the DC link via a coupling module. The power options for the DC link are to be dimensioned according to the total inverter output.

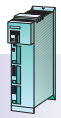


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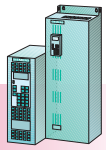
# Selection and ordering data

## Recommended DC link power options[1])

Compact PLUS units



Compact and chassis units



### Inverter

| Nominal power rating | | Inverter | Contactor for disconnecting the inverter from the DC bus[1]) | | Precharging resistors | | | Free-wheeling diode on the DC bus | Clamping cap |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $I_{rated}$ | | Quantity per inv. | $R_{rated}$ | Diode | |
| kW | (HP) | Order No. | Order No. | A | Order No. | | W | Order No. | Order No. |
| **Compact units** | | | | | | | | | |
| **2.2** | **(3)** | **6SE7016–1TA51** | 3RT13 25 | 1 x 30 | 6SX7010–0AC06 | 2 | 27 | SKR 3 F 20/12[2]) | |
| **3** | **(4)** | **6SE7018–0TA51** | 3RT13 25 | 1 x 30 | 6SX7010–0AC06 | 2 | 27 | SKR 3 F 20/12[2]) | |
| **4** | **(5)** | **6SE7021–0TA51** | 3RT13 25 | 1 x 30 | 6SX7010–0AC06 | 2 | 27 | SKR 3 F 20/12[2]) | |
| **5.5** | **(7.5)** | **6SE7021–3TB51** | 3RT13 25 | 1 x 30 | 6SX7010–0AC06 | 2 | 27 | SKR 3 F 20/12[2]) | |
| **7.5** | **(10)** | **6SE7021–8TB51** | 3RT13 25 | 2 x 27 | 6SX7010–0AC06 | 2 | 27 | SKR 3 F 20/12[2]) | |
| **11** | **(15)** | **6SE7022–6TC51** | 3RT13 25 | 2 x 27 | 6SX7010–0AC06 | 2 | 27 | SKR 60 F 12[2]) | |
| **15** | **(20)** | **6SE7023–4TC51** | 3RT13 25 | 2 x 27 | 6SX7010–0AC06 | 2 | 27 | SKR 60 F 12[2]) | |
| **18.5** | **(25)** | **6SE7023–8TD51** | 3RT13 25 | 2 x 27 | 6SX7010–0AC06 | 2 | 27 | SKR 60 F 12[2]) | |
| **22** | **(30)** | **6SE7024–7TD51** | 3RT13 36 | 2 x 50 | 6SX7010–0AC06 | 2 | 27 | SKR 60 F 12[2]) | |
| **30** | **(40)** | **6SE7026–0TD51** | 3RT13 44 | 2 x 81 | 6SX7010–0AC07 | 2 | 27 | SKR 141 F 15[2]) | |
| **37** | **(50)** | **6SE7027–2TD51** | 3RT13 44 | 2 x 81 | 6SX7010–0AC07 | 2 | 27 | SKR 141 F 15[2]) | |
| **Chassis units** | | | | | | | | | |
| **45** | **(60)** | **6SE7031–0TE50** | 3RT13 44 | 2 x 81 | 6SX7010–0AC08 | 2 | 15 | SKR 141 F 15[2]) | |
| **55** | **(75)** | **6SE7031–2TF50** | 3RT13 46 | 2 x 108 | 6SX7010–0AC08 | 2 | 15 | SKR 141 F 15[2]) | |
| **75** | **(100)** | **6SE7031–8TF50** | 3TK10 | 2 x 162 | 6SX7010–0AC08 | 2 | 15 | SKR 141 F 15[2]) | |
| **90** | **(120)** | **6SE7032–1TG50** | 3TK10 | 2 x 162 | 6SX7010–0AC10 | 2 | 10 | SKR 141 F 15[2]) | |
| **110** | **(150)** | **6SE7032–6TG50** | 3TK10 | 2 x 162 | 6SX7010–0AC10 | 2 | 10 | 2 x SKR 141 F 15[2]) | |
| **132** | **(175)** | **6SE7033–2TG50** | 3TK11 | 2 x 207 | 6SX7010–0AC10 | 2 | 10 | 2 x SKR 141 F 15[2]) | |
| **160** | **(215)** | **6SE7033–7TG50** | 3TK12 | 2 x 243 | 6SX7010–0AC10 | 2 | 10 | 2 x SKR 141 F 15[2]) | |
| **200** | **(270)** | **6SE7035–1TJ50** | 3TK13 | 2 x 279 | 6SX7010–0AC10 | 2 | 10 | 2 x SKR 141 F 15[2]) | |
| **250** | **(335)** | **6SE7036–0TJ50** | 3TK14 | 2 x 423 | 6SX7010–0AC10 | 2 | 10 | D 689S 20[3])[4]) | V 72–26.120M[3])[4]) |

## Recommended power options for braking units and braking resistors

### Components for braking units

| Nominal power rating $P_{20}$ | Components for braking units[5]) | Fuse switch-disconnector for DC coupling | | | Fuses for braking units | | |
|---|---|---|---|---|---|---|---|
| | | | Rated current | Max. fuse size | | Rated current | Size |
| kW | Order No. | Order No. | A | | Order No. | A | |
| **DC link voltage 510 V DC to 650 V DC** | | | | | | | |
| **5** | **6SE7018–0ES87–2DA0** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE4 101 | 32 | 0 |
| **10** | **6SE7021–6ES87–2DA0** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE4 101 | 32 | 0 |
| **20** | **6SE7023–2EA87–2DA0** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE4 102 | 40 | 0 |
| **50** | **6SE7028–0EA87–2DA0** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE4 121 | 100 | 0 |
| **100** | **6SE7031–6EB87–2DA0** | 3NP42 70–0CA01 | 250 | 0; 1 | 2 x 3NE3 225 | 200 | 1 |
| **170** | **6SE7032–7EB87–2DA0** | 3NP53 60–0CA00 | 400 | 0; 1 | 2 x 3NE3 230–0B | 315 | 1 |

1) Refer to Catalog "Switchgear and Systems". Rated insulation voltage with pollution degree 2 according to DIN VDE 0110, Part 1, 1000 V.

2) See Engineering Information, Section 6. The diodes referred to are from the range of products supplied by SEMIKRON GmbH u. Co. KG, Sigmundstr. 200, D-90431 Nuremberg, Germany. Internet: www.semikron.com

3) Diode supplied as a disc diode with a clamping cap for mounting on a copper plate or copper rail.

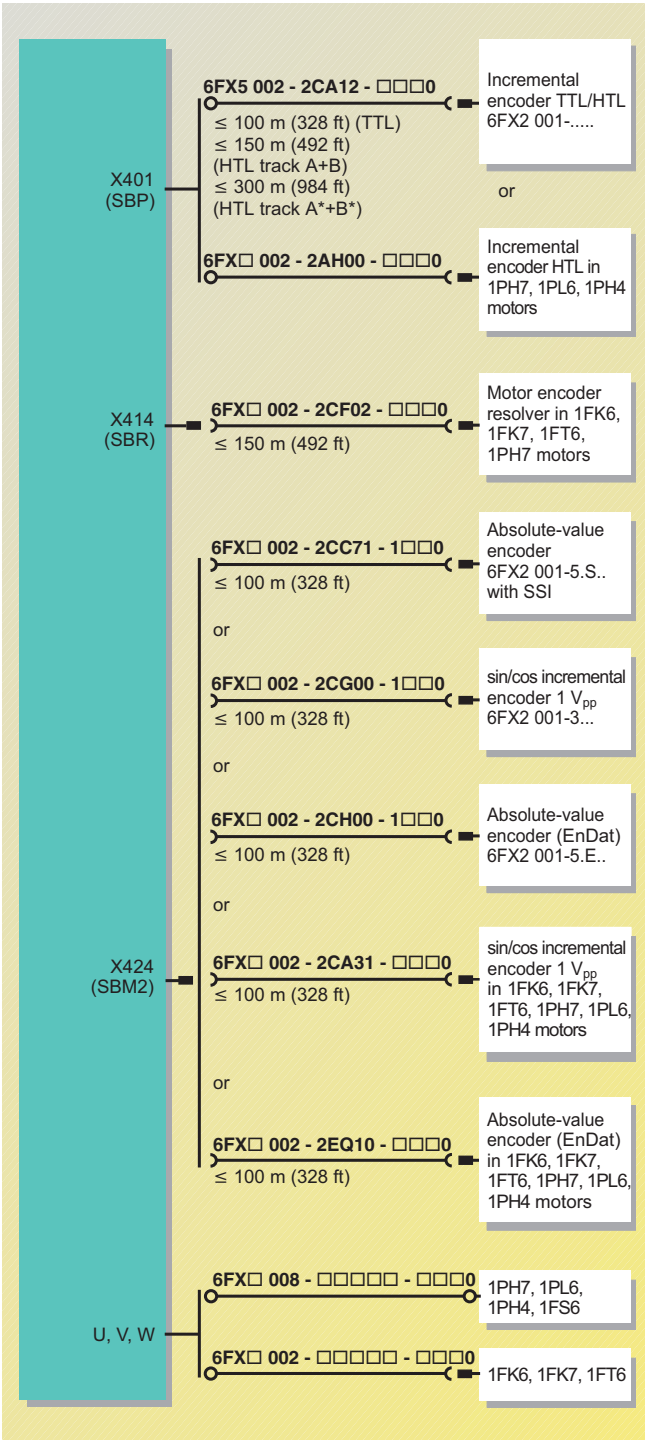
4) See Engineering Information, Section 6. The diodes referred to are from the product range supplied by EUPEC GmbH u. Co. KG, Max-Planck-Str. 5, D-59581 Warstein, Germany. Internet: www.eupec.com

5) The braking units connected in parallel to a DC voltage busbar or several converters are to be protected with the fuses indicated.



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## Connection overview




## Current carrying capacity ($I_z$) of PVC-insulated copper conductors acc. to IEC 60 204-1: 1997 ++ Corrigendum 1998

| Cross-section | Current carrying capacity $I_z$ (A) with installation types (see C 1.2) | | | |
|---|---|---|---|---|
| mm² | B1 | B2 | C | E |
| 0.75 | 7.6 | – | – | – |
| 1.0 | 10.4 | 9.6 | 11.7 | 11.5 |
| 1.5 | 13.5 | 12.2 | 15.2 | 16.1 |
| 2.5 | 18.3 | 16.5 | 21 | 22 |
| 4 | 25 | 23 | 28 | 30 |
| 6 | 32 | 29 | 36 | 37 |
| 10 | 44 | 40 | 50 | 52 |
| 16 | 60 | 53 | 66 | 70 |
| 25 | 77 | 67 | 84 | 88 |
| 35 | 97 | 83 | 104 | 114 |
| 50 | – | – | 123 | 123 |
| 70 | – | – | 155 | 155 |
| 95 | – | – | 192 | 192 |
| 120 | – | – | 221 | 221 |
| Electronics (pairs) | | | | |
| 0.2 | – | – | 4.0 | 4.0 |
| 0.3 | – | – | 5.0 | 5.0 |
| 0.5 | – | – | 7.1 | 7.1 |
| 0.75 | – | – | 9.1 | 9.1 |

## Correction factors

| Ambient air temperature | | Correction factor |
|---|---|---|
| °C | (°F) | |
| 30 | (86) | 1.15 |
| 35 | (95) | 1.08 |
| 40 | (104) | 1.00 |
| 45 | (113) | 0.91 |
| 50 | (122) | 0.82 |
| 55 | (131) | 0.71 |
| 60 | (140) | 0.58 |

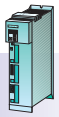
Note: The correction factors are taken from IEC 60 364-5-523, table 52-D1.

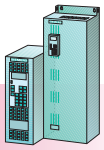
The current carrying capacity $I_z$ of PVC-insulated conductors is specified in the table above for an ambient air temperature of +40 °C (104 °F). For other ambient temperatures, the values must be corrected with the correction factors from the table above.

**This standard applies also to PUR cables.**



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## Power cables for 1FK., 1FT6, 1PH.

### *6FX□ 002–5CA . . without braking cable, with shield*

| mm² | Connector size | Prefabricated cables Order No. | $D_{max}$ 6FX8 mm (in) | $D_{max}$ 6FX5 mm (in) |
|---|---|---|---|---|
| 4 x 1.5 | 1<br>1.5 | **6FX□ 002–5CA01–□□□0**<br>**6FX□ 002–5CA21–□□□0** | 10.4 (0.41) | 10.1 (0.4) |
| 4 x 2.5 | 1<br>1.5 | **6FX□ 002–5CA11–□□□0**<br>**6FX□ 002–5CA31–□□□0** | 12.1 0.48) | 11.5 (0.45) |
| 4 x 4 | 1.5 | **6FX□ 002–5CA41–□□□0** | 13.2 (0.52) | 13.3 (0.52) |
| 4 x 6 | 1.5 | **6FX□ 002–5CA51–□□□0** | 16 (0.63) | 15.6 (0.61) |
| 4 x 10 | 3<br>1.5 | **6FX□ 002–5CA13–□□□0**<br>**6FX□ 002–5CA61–□□□0** | 19.4 (0.76) | 20.0 (0.79) |
| 4 x 16 | 3 | **6FX□ 002–5CA23–□□□0** | 23.6 (0.93) | 24.2 (0.96) |
| 4 x 25 | – | – | – | 28.0 (1.1) |
| 4 x 35 | – | – | – | 31.5 (1.24) |
| 4 x 50 | – | – | – | 38.0 (1.5) |
| 4 x 70 | – | – | – | 42.6 (1.68) |
| 4 x 95 | – | – | – | 51.7 (2.04) |
| 4 x 120 | – | – | – | 56.0 (2.2) |
| 4 x 150 | – | – | – | 63.0 (2.48) |
| 4 x 185 | – | – | – | 66.2 (2.61) |

### *6FX□ 008–1BB . . without braking cable, with shield*

| mm² | Cable by the meter Order No. | Weight[1] 6FX8 kg/m (lb/ft) | Weight[1] 6FX5 kg/m (lb/ft) | Smallest permissible bending radius 6FX8 mm (in) | Smallest permissible bending radius 6FX5 mm (in) |
|---|---|---|---|---|---|
| 4 x 1.5 | **6FX□ 008–1BB11–□□A0** | 0.16 (0.11) | 0.18 (0.12) | 100 (3.94) | 185 (7.28) |
| 4 x 2.5 | **6FX□ 008–1BB21–□□A0** | 0.24 (0.16) | 0.24 (0.16) | 120 (4.72) | 210 (8.27) |
| 4 x 4 | **6FX□ 008–1BB31–□□A0** | 0.31 (0.21) | 0.32 (0.22) | 130 (5.12) | 240 (9.45) |
| 4 x 6 | **6FX□ 008–1BB41–□□A0** | 0.43 (0.29) | 0.46 (0.31) | 170 (6.69) | 285 (11.22) |
| 4 x 10 | **6FX□ 008–1BB51–□□A0** | 0.63 (0.42) | 0.73 (0.49) | 210 (8.27) | 360 (14.17) |
| 4 x 16 | **6FX□ 008–1BB61–□□A0** | 0.95 (0.64) | 1.1 (0.74) | 260 (10.24) | 440 (17.32) |
| 4 x 25 | **6FX 5 008–1BB25–□□A0** | – | 1.42 (0.95) | – | 505 (19.88) |
| 4 x 35 | **6FX 5 008–1BB35–□□A0** | – | 1.87 (1.26) | – | 570 (22.44) |
| 4 x 50 | **6FX 5 008–1BB50–□□A0**[2] | – | 3.42 (2.3) | – | 685 (26.97) |
| 4 x 70 | **6FX 5 008–1BB70–□□A0**[2] | – | 4.12 (2.77) | – | 770 (30.31) |
| 4 x 95 | **6FX 5 008–1BB05–□□A0**[2] | – | 4.78 (3.21) | – | 935 (36.81) |
| 4 x 120 | **6FX 5 008–1BB12–□□A0**[2] | – | 6.11 (4.11) | – | 1010 (39.76) |
| 4 x 150 | **6FX 5 008–1BB15–□□A0**[2] | – | 7.75 (5.21) | – | 1135 (44.69) |
| 4 x 185 | **6FX 5 008–1BB18–□□A0**[2] | – | 9.45 (6.35) | – | 1195 (47.05) |

| | MOTION CONNECT 800 | MOTION CONNECT 500 |
|---|---|---|
| | 8 | 5 |
| 1 | 0 m (0 ft) | A 0 m (0 ft) |
| 2 | 100 m (328 ft) | B 10 m (33 ft) |
| 3 | 200 m (656 ft) | C 20 m (66 ft) |
| | | D 30 m (98 ft) |
| | | E 40 m (131 ft) |
| | | F 50 m (164 ft) |
| | | G 60 m (197 ft) |
| | | H 70 m (229 ft) |
| | | J 80 m (263 ft) |
| | | K 90 m (295 ft) |

**Length code**

| | MOTION CONNECT 800 | MOTION CONNECT 500 |
|---|---|---|
| | 8 | 5 |
| | A 0 m (0 ft) | A 0 m (0 ft) |
| | B 10 m (33 ft) | B 1 m (3.3 ft) |
| | C 20 m (66 ft) | C 2 m (6.6 ft) |
| | D 30 m (98 ft) | D 3 m (9.8 ft) |
| | E 40 m (131 ft) | E 4 m (13.1 ft) |
| | F 50 m (164 ft) | F 5 m (16.4 ft) |
| | G 60 m (197 ft) | G 6 m (19.7 ft) |
| | H 70 m (229 ft) | H 7 m (23 ft) |
| | J 80 m (263 ft) | J 8 m (26.2 ft) |
| | K 90 m (295 ft) | K 9 m (29.5 ft) |

| | | |
|---|---|---|
| 1 B | 10 m (33 ft) | Rings (25, 35, 50 mm²) |
| 1 F | 50 m (164 ft) | Rings (for deviations, see table) |
| 2 A | 100 m (328 ft) | Rings (for deviations, see table) |
| 3 A | 200 m (656 ft) | Disposable drum (not for cables > 10 mm²) |
| 6 A | 500 m (1640 ft) | Disposable drum (not for cables > 10 mm²) |

**Form of delivery**

**Example:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 m (3.3 ft): . . . | – | 1 | A | B | 0 |
| 8 m (26.2 ft): . . . | – | 1 | A | J | 0 |
| 17 m (55.8 ft): . . . | – | 1 | B | H | 0 |
| 59 m (193.5 ft): . . . | – | 1 | F | K | 0 |
| 111 m (364.2 ft): . . . | – | 2 | B | B | 0 |
| 262 m (859.8 ft): . . . | – | 3 | G | C | 0 |

### *Deviations from form of delivery*

| 6FX . 008– | 50 m (164 ft) (–1FA0) | 100 m (328 ft) (–2AA0) |
|---|---|---|
| **–1BA25** | Disposable drum | Disposable drum |
| **–1BA35** | Disposable drum | Disposable drum |
| **–1BA50** | Disposable drum | Disposable drum |
| **–1BA51 / –1BB51** | | Disposable drum |
| **–1BA61 / –1BB61** | | Disposable drum |

The cross-sections 25, 35 and 50 mm² can also be ordered and delivered by the meter from 10 m (33 ft) to 49 m (161 ft) (according to the length code of the prefabricated cables) and in 10 m (33 ft) rings.

1) Weight of cables sold by the meter excluding connector.

2) For a cable cross-section ≥ 50 mm² and a cable length of 50 m (164 ft), 100 m (328 ft) and 200 m (656 ft), the cables are supplied on drums.



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### 6FX□ 002–5DA . .
### with braking cable, with shield

| mm² | Connector size | Prefabricated cables Order No. | $D_{max}$ 6FX8 mm (in) | $D_{max}$ 6FX5 mm (in) |
|---|---|---|---|---|
| 4 x 1.5 + 2 x 1.5 | 1<br>1.5 | **6FX□ 002–5DA01–□□□0**<br>**6FX□ 002–5DA21–□□□0** | 12.9 (0.51) | 13.1 (0.52) |
| 4 x 2.5 + 2 x 1.5 | 1<br>1.5 | **6FX□ 002–5DA11–□□□0**<br>**6FX□ 002–5DA31–□□□0** | 14.2 (0.56) | 14.2 (0.56) |
| 4 x 4 + 2 x 1.5 | 1.5 | **6FX□ 002–5DA41–□□□0** | 15.3 (0.6) | 15.9 (0.63) |
| 4 x 6 + 2 x 1.5 | 1.5 | **6FX□ 002–5DA51–□□□0** | 17.8 (0.7) | 16.9 (0.67) |
| 4 x 10 + 2 x 1.5 | 3<br>1.5 | **6FX□ 002–5DA13–□□□0**<br>**6FX□ 002–5DA61–□□□0** | 20.8 (0.82) | 21.7 (0.85) |
| 4 x 16 + 2 x 1.5 | 3 | **6FX□ 002–5DA23–□□□0** | 24.7 (0.97) | 24.2 (0.95) |
| 4 x 25 + 2 x 1.5 | 3 | **6FX□ 002–5DA33–□□□0** | 27.9 (1.1) | 29.4 (1.16) |
| 4 x 35 + 2 x 1.5 | 3 | **6FX□ 002–5DA43–□□□0** | 32 (1.26) | 32.6 (1.28) |
| 4 x 50 + 2 x 1.5 | 3 | **6FX□ 002–5DA53–□□□0** | 35.8 (1.41) | 38.0 (1.5) |

### 6FX□ 008–1BA . .
### with braking cable, with shield

| Cable by the meter Order No. | Weight[1] 6FX8 kg/m (lb/ft) | Weight[1] 6FX5 kg/m (lb/ft) | Smallest permissible bending radius 6FX8 mm (in) | Smallest permissible bending radius 6FX5 mm (in) |
|---|---|---|---|---|
| **6FX□ 008–1BA11–□□A0** | 0.25 (0.17) | 0.22 (0.15) | 125 (4.92) | 240 (9.45) |
| **6FX□ 008–1BA21–□□A0** | 0.31 (0.21) | 0.28 (0.19) | 140 (5.51) | 260 (10.24) |
| **6FX□ 008–1BA31–□□A0** | 0.4 (0.27) | 0.36 (0.24) | 150 (5.91) | 290 (11.42) |
| **6FX□ 008–1BA41–□□A0** | 0.53 (0.36) | 0.54 (0.36) | 195 (7.68) | 305 (12.01) |
| **6FX□ 008–1BA51–□□A0** | 0.74 (0.5) | 0.75 (0.5) | 230 (9.06) | 395 15.55 |
| **6FX□ 008–1BA61–□□A0** | 1.10 (0.74) | 1.10 (0.74) | 275 (10.83) | 440 (17.32) |
| **6FX□ 008–1BA25–□□A0** | 1.46 (0.98) | 1.56 (1.05) | 325 (12.8) | 530 (20.87) |
| **6FX□ 008–1BA35–□□A0** | 2.10 (1.41) | 2.01 (1.35) | 380 (14.96) | 590 (23.23) |
| **6FX□ 008–1BA50–□□A0** | 2.75 (1.85) | 3.30 (2.22) | 420 (16.54) | 685 (26.97) |

MOTION CONNECT 800 **8**
MOTION CONNECT 500 **5**

**Length code**

| | | | | |
|---|---|---|---|---|
| **1** | 0 m (0 ft) | **A** | 0 m (0 ft) | **A** 0 m (0 ft) |
| **2** | 100 m (328 ft) | **B** | 10 m (33 ft) | **B** 1 m (3.3 ft) |
| **3** | 200 m (656 ft) | **C** | 20 m (66 ft) | **C** 2 m (6.6 ft) |
| | | **D** | 30 m (98 ft) | **D** 3 m (9.8 ft) |
| | | **E** | 40 m (131 ft) | **E** 4 m (13.1 ft) |
| | | **F** | 50 m (164 ft) | **F** 5 m (16.4 ft) |
| | | **G** | 60 m (197 ft) | **G** 6 m (19.7 ft) |
| | | **H** | 70 m (229 ft) | **H** 7 m (23 ft) |
| | | **J** | 80 m (263 ft) | **J** 8 m (26.2 ft) |
| | | **K** | 90 m (295 ft) | **K** 9 m (29.5 ft) |

MOTION CONNECT 800 **8**
MOTION CONNECT 500 **5**

**Form of delivery**

| | | |
|---|---|---|
| **1 B** | 10 m (33 ft) | Rings (25, 35, 50 mm²) |
| **1 F** | 50 m (164 ft) | Rings (for deviations, see table) |
| **2 A** | 100 m (328 ft) | Rings (for deviations, see table) |
| **3 A** | 200 m (656 ft) | Disposable drum (not for cables > 10 mm²) |
| **6 A** | 500 m (1640 ft) | Disposable drum (not for cables > 10 mm²) |

**Example:**

| | |
|---|---|
| 1 m (3.3 ft): ... | – 1 A B 0 |
| 8 m (26.2 ft): ... | – 1 A J 0 |
| 17 m (55.8 ft): ... | – 1 B H 0 |
| 59 m (193.5 ft): ... | – 1 F K 0 |
| 111 m (364.2 ft): ... | – 2 B B 0 |
| 262 m (859.8 ft): ... | – 3 G C 0 |

### Deviations from form of delivery

| 6FX . 008– | 50 m (164 ft)(–1FA0) | 100 m (328 ft) (–2AA0) |
|---|---|---|
| **–1BA25** | Disposable drum | Disposable drum |
| **–1BA35** | Disposable drum | Disposable drum |
| **–1BA50** | Disposable drum | Disposable drum |
| **–1BA51 / –1BB51** | | Disposable drum |
| **–1BA61 / –1BB61** | | Disposable drum |

The cross-sections 25, 35 and 50 mm² can also be ordered and delivered by the meter from 10 m (33 ft) to 49 m (161 ft) (according to the length code of the prefabricated cables) and in 10 m (33 ft) rings.

1) Weight of cables sold by the meter excluding connector.



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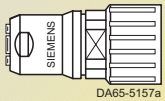
## Encoder cables for connecting to motors with HTL incremental encoder (1024 p/r and 2048 p/r)[1)]

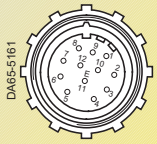
### *Cable design and pin assignment*

**Base cable type 6FX . 002–2AH00– . . . .**

| Converter side | Motion Control | Vector Cotrol | Cable by the meter 6FX . 008–1BD21 | | Measurement system side |
|---|---|---|---|---|---|
| | PIN | PIN | Signal name | Signal name | PIN |
| Cable end cut off | 71 | | * B | * B | 1 |
| | 63 | 30 | KTY84 + | KTY84 + | 2 |
| | 72 | 26 | ZERO TRACK | ZERO TRACK | 3 |
| | 73 | | * ZERO TRACK | * ZERO TRACK | 4 |
| | 68 | 24 | A | A | 5 |
| | 69 | | * A | * A | 6 |
| | 74 | 27 | CTRL TACHO | CTRL TACHO | 7 |
| | 70 | 25 | B | B | 8 |
| | 61 | 23 | 0 V | 0 V | 10 |
| | 62 | 29 | KTY84 – | KTY84 – | 11 |
| | 60 | 28 | 15 V | 15 V | 12 |
| | | | Outer shield on plug housing | | yes |

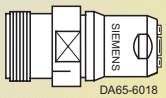
Plug type: 6FX2 003–0CE12

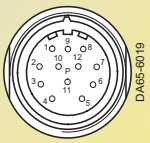



**Cable extension type 6FX . 002–2AH04– . . . 0**

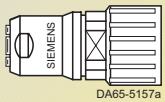
Plug type: 6FX2 003–1CF12

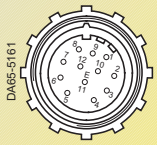



PIN assignment of the cable extension corresponding to the base cable

Plug type: 6FX2 003–0CE12




### *Selection and ordering data*

| Cable | Order No. |
|---|---|

**Prefabricated cables**

Encoder cables for connection to motors with HTL incremental encoder

**6FX□002–2AH00–□□□0**

MOTION CONNECT 800 **8**
MOTION CONNECT 500 **5**

| | | | | | |
|---|---|---|---|---|---|
| **1** | 0 m (0 ft) | **A** | 0 m (0 ft) | **A** | 0 m (0 ft) |
| **2** | 100 m (328 ft) | **B** | 10 m (33 ft) | **B** | 1 m (3.3 ft) |
| **3** | 200 m (656 ft) | **C** | 20 m (66 ft) | **C** | 2 m (6.6 ft) |
| **4** | 300 m (984 ft) | **D** | 30 m (98 ft) | **D** | 3 m (9.8 ft) |
| | | **E** | 40 m (131 ft) | **E** | 4 m (13.1 ft) |
| | | **F** | 50 m (164 ft) | **F** | 5 m (16.4 ft) |
| | | **G** | 60 m (197 ft) | **G** | 6 m (19.7 ft) |
| | | **H** | 70 m (229 ft) | **H** | 7 m (23 ft) |
| | | **J** | 80 m (263 ft) | **J** | 8 m (26.2 ft) |
| | | **K** | 90 m (295 ft) | **K** | 9 m (29.5 ft) |

**Length code**

**Example:**
1 m (3.3 ft): . . . – 1 A B 0
8 m (26.2 ft): . . . – 1 A J 0
17 m (55.8 ft): . . . – 1 B H 0
59 m (193.5 ft): . . . – 1 F K 0
111 m (364.2 ft): . . . – 2 B B 0
262 m (859.8 ft): . . . – 3 G C 0

| Cable | Length m (ft) | Order No. |
|---|---|---|

**Cable, sold by the meter**

Encoder cables for connection to motors with HTL incremental encoder
No. of cores x cross-section [mm²]
4 x 2 x 0.34 + 4 x 0.5

| | | |
|---|---|---|
| | 50 (164) | **6FX□008–1BD21–1FA0** |
| | 100 (328) | **6FX□008–1BD21–2AA0** |
| | 200 (656) | **6FX□008–1BD21–3AA0** |
| | 500 (1640) | **6FX□008–1BD21–6AA0** |

Outer diameter of cable for 6FX8: 9.3 mm (0.37 in) **8**
Outer diameter of cable for 6FX5: 9.3 mm (0.37 in) **5**

1) Cable length ≤ 150 m (492 ft) without transmission of the inverted signals and cable length 150 m (492 ft) to 300 m (984 ft) with transmission of the inverted signals and use of the DTI unit.



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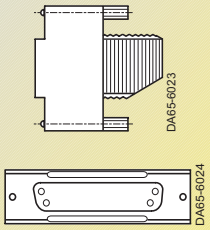
## Encoder cables for connection to motors with a 2-pole/multi-pole resolver

### *Cable design and pin assignment*

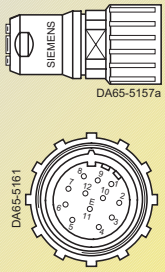
**Base cable type 6FX . 002–2CF02– . . . .**

| Converter side | | Cable by the meter 6FX . 008–1BD41 | | Measurement system side |
|---|---|---|---|---|
| **PIN** | **Signal name** | | **Signal name** | **PIN** |
| 3 | SIN | | SIN | 1 |
| 4 | * SIN | | * SIN | 2 |
| 5 | | Inner shield | | 3 |
| 6 | COS | | COS | 11 |
| 7 | * COS | | * COS | 12 |
| 8 | | Inner shield | | 5 |
| 13 | + TEMP | | + TEMP | 8 |
| 25 | – TEMP | | –TEMP | 9 |
| 24 | | Inner shield | | 4 |
| 9 | $+V_{pp}$ | | $+V_{pp}$ | 10 |
| 11 | $-V_{pp}$ | | $-V_{pp}$ | 7 |
| yes | | Outer shield on plug housing | | yes |

**Plug type: 6FC9 348–7HP00**



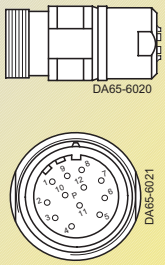

**Plug type: 6FX2 003–0CE12**



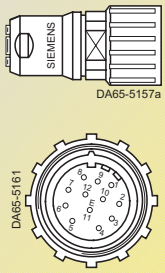

**Cable extension type 6FX . 002–2CF04– . . . .**

PIN assignment of the cable extension corresponding to the base cable

**Plug type: 6FX2 003–1CF12**




**Plug type: 6FX2 003–0CE12**




### *Selection and ordering data*

**Prefabricated cables (length < 150 m (492 ft))**

Encoder cables for connection to motors which are fitted with a resolver (detection of rotor position and speed build-up) prefabricated

**6FX□002–2CF02–□□□0**

| | | | |
|---|---|---|---|
| MOTION CONNECT 800 | **8** | | |
| MOTION CONNECT 500 | **5** | | |
| **1** 0 m (0 ft) | **A** 0 m (0 ft) | **A** 0 m (0 ft) | |
| **2** 100 m (328 ft) | **B** 10 m (33 ft) | **B** 1 m (3.3 ft) | |
| | **C** 20 m (66 ft) | **C** 2 m (6.6 ft) | |
| | **D** 30 m (98 ft) | **D** 3 m (9.8 ft) | |
| | **E** 40 m (131 ft) | **E** 4 m (13.1 ft) | |
| | **F** 50 m (164 ft) | **F** 5 m (16.4 ft) | |
| | **G** 60 m (197 ft) | **G** 6 m (19.7 ft) | |
| | **H** 70 m (229 ft) | **H** 7 m (23 ft) | |
| | **J** 80 m (263 ft) | **J** 8 m (26.2 ft) | |
| | **K** 90 m (295 ft) | **K** 9 m (29.5 ft) | |
| **Length code** | | | |

**Example:** 1 m (3.3 ft): . . . – 1 A B 0 — 59 m (193.5 ft): . . . – 1 F K 0
8 m (26.2 ft): . . . – 1 A J 0 — 111 m (364.2 ft): . . . – 2 B B 0
17 m (55.8 ft): . . . – 1 B H 0

**Cable, sold by the meter** [1]

| Cable | Length m (ft) | Order No. |
|---|---|---|
| Encoder cables for connection to motors which are fitted with a resolver (detection of rotor position and speed build-up) No. of cores x cross-section [mm²] 3 x 2 x 0.14 + 4 x 0.14 + 2 x 0.5 | 50 (164) | **6FX□008–1BD41–1FA0** |
| | 100 (328) | **6FX□008–1BD41–2AA0** |
| | 200 (656) | **6FX□008–1BD41–3AA0** |
| | 500 (1640) | **6FX□008–1BD41–6AA0** |

Outer diameter of cable for 6FX8: 9.2 mm (0.37 in) **8**
Outer diameter of cable for 6FX5: 9.3 mm (0.37 in) **5**

1) Maximum permissible length of the prefabricated cables for the resolvers: 150 m (492 ft).



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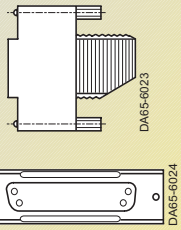
## Encoder cables for connection to motors with a sin/cos incremental encoder 1 $V_{pp}$

### *Cable design and pin assignment*

**Base cable type 6FX . 002–2CA31– . . . . / 6FX . 002–2YS01– . . . .**

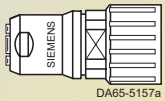
| Converter side | | Cable by the meter 6FX . 008–1BD51 | | Measurement system side |
|---|---|---|---|---|
| | PIN | Signal name | Signal name | PIN |
| Plug type: 6FC9 348–7HP00 | 3 | A | Ua1 | 1 |
| | 4 | * A | * Ua1 | 2 |
| | 5 | Inner shield | | 17 |
| | 6 | B | Ua2 | 11 |
| | 7 | * B | * Ua2 | 12 |
| | 8 | Inner shield | | 17 |
| | 17 | R | Ua0 | 3 |
| | 18 | * R | *Ua0 | 13 |
| | 24 | Inner shield | | 17 |
| | 19 | C | Ua3 | 5 |
| | 20 | * C | * Ua3 | 6 |
| | 21 | D | Ua4 | 14 |
| | 22 | * D | * Ua4 | 4 |
| | 13 | + Temp | + Temp | 8 |
| | 25 | – Temp | – Temp | 9 |
| | 1 | P encoder | P encoder | 10 |
| | 14 | 5 V sense | 5 V sense | 16 |
| | 2 | M encoder | M encoder | 7 |
| | 16 | 0 V sense | 0 V sense | 15 |
| | yes | Outer shield on plug housing | | yes |

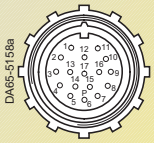
Plug type: 6FX2 003–0CE17




6FX . 002–2CA31– . . . .
Cable outlet at the bottom

6FX . 002–2YS01– . . . .
Cable outlet at the top



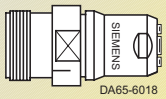



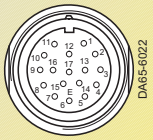

**Cable extension type 6FX . 002–2CA34– . . . .**

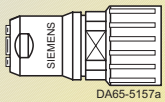
Plug type: 6FX2 003–1CF12

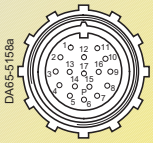
PIN assignment of the cable extension corresponding to the base cable

Plug type: 6FX2 003–0CE17




### *Selection and ordering data*

**Prefabricated cables (length < 100 m (328 ft))**

Encoder cables for connection to motors which are fitted with a sin/cos incremental encoder 1 $V_{pp}$ (detection of rotor position and speed build-up)

prefabricated **6FX□002–2CA31–□□□0**

| | | | | |
|---|---|---|---|---|
| MOTION CONNECT 800 | **8** | | | |
| MOTION CONNECT 500 | **5** | | | |
| **1** 0 m (0 ft) | **A** 0 m (0 ft) | **A** 0 m (0 ft) | | |
| **2** 100 m (328 ft) | **B** 10 m (33 ft) | **B** 1 m (3.3 ft) | | |
| | **C** 20 m (66 ft) | **C** 2 m (6.6 ft) | | |
| | **D** 30 m (98 ft) | **D** 3 m (9.8 ft) | | |
| | **E** 40 m (131 ft) | **E** 4 m (13.1 ft) | | |
| | **F** 50 m (164 ft) | **F** 5 m (16.4 ft) | | |
| | **G** 60 m (197 ft) | **G** 6 m (19.7 ft) | | |
| | **H** 70 m (229 ft) | **H** 7 m (23 ft) | | |
| | **J** 80 m (263 ft) | **J** 8 m (26.2 ft) | | |
| | **K** 90 m (295 ft) | **K** 9 m (29.5 ft) | | |
| **Length code** | | | | |

| Cable | Length m (ft) | Order No. |
|---|---|---|
| **Cable, sold by the meter** [1] | | |
| Encoder cables for connection to motors which are fitted with a sin/cos incremental encoder 1 $V_{pp}$ (detection of rotor position and speed build-up) No. of cores x cross-section [mm²] 3 x 2 x 0.14 + 4 x 0.14 + 2 x 0.5 + 4 x 0.23 | 50 (164) | **6FX□008–1BD51–1FA0** |
| | 100 (328) | **6FX□008–1BD51–2AA0** |
| | 200 (656) | **6FX□008–1BD51–3AA0** |
| | 500 (1640) | **6FX□008–1BD51–6AA0** |

Outer diameter of cable for 6FX8: 9.9 mm (0.39 in) **8**
Outer diameter of cable for 6FX5: 9.9 mm (0.39 in) **5**

**Example:** 1 m (3.3 ft): . . . – 1 A B 0 17 m (55.8 ft): . . . – 1 B H 0
8 m (26.2 ft): . . . – 1 A J 0 59 m (193.5 ft): . . . – 1 F K 0

1) Maximum permissible length of the prefabricated cables for the sin/cos incremental encoder 1 $V_{pp}$: 100 m (328 ft).



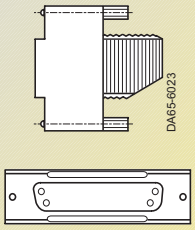
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## Encoder cables for connection to motors with an absolute-value encoder (EnDat)

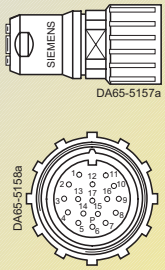
### *Cable design and pin assignment*

**Base cable type 6FX . 002–2EQ10– . . . .**

| Converter side | | Cable by the meter 6FX . 008–1BD51 | | Measurement system side |
|---|---|---|---|---|
| | PIN | Signal name | Signal name | PIN |
| Plug type: 6FC9 348–7HP00 | 3 | A | Ua1 | 1 |
| | 4 | * A | * Ua1 | 2 |
| | 5 | Inner shield | | 17 |
| | 6 | B | Ua2 | 11 |
| | 7 | * B | * Ua2 | 12 |
| | 8 | Inner shield | | 17 |
| | 15 | Data | Data | 3 |
| | 23 | * Data | *Data | 13 |
| | 24 | Inner shield | | 17 |
| | 10 | Clock | Clock | 5 |
| | 12 | * Clock | * Clock | 14 |
| | 13 | + Temp | + Temp | 8 |
| | 25 | – Temp | – Temp | 9 |
| | 1 | P encoder | P encoder | 10 |
| | 14 | 5 V sense | 5 V sense | 16 |
| | 2 | M encoder | M encoder | 7 |
| | 16 | 0 V sense | 0 V sense | 15 |
| | yes | Outer shield on plug housing | | yes |

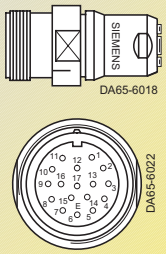



Plug type: 6FX2 003–0CE17



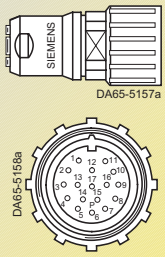

**Cable extension type 6FX . 002–2EQ14– . . . .**

Plug type: 6FX2 003–1CF17




PIN assignment of the cable extension corresponding to the base cable

Plug type: 6FX2 003–0CE17




### *Selection and ordering data*

**Prefabricated cables (length < 100 m (328 ft))**

Encoder cables for connection to motors which are fitted with an absolute-value encoder (EnDat) (detection of absolute position and speed build-up)

prefabricated **6FX□002–2EQ10–□□□0**

| | | | |
|---|---|---|---|
| MOTION CONNECT 800 | **8** | | |
| MOTION CONNECT 500 | **5** | | |
| **1** 0 m (0 ft) | **A** 0 m (0 ft) | **A** 0 m (0 ft) | |
| **2** 100 m (328 ft) | **B** 10 m (33 ft) | **B** 1 m (3.3 ft) | |
| | **C** 20 m (66 ft) | **C** 2 m (6.6 ft) | |
| | **D** 30 m (98 ft) | **D** 3 m (9.8 ft) | |
| | **E** 40 m (131 ft) | **E** 4 m (13.1 ft) | |
| | **F** 50 m (164 ft) | **F** 5 m (16.4 ft) | |
| | **G** 60 m (197 ft) | **G** 6 m (19.7 ft) | |
| | **H** 70 m (229 ft) | **H** 7 m (23 ft) | |
| | **J** 80 m (263 ft) | **J** 8 m (26.2 ft) | |
| | **K** 90 m (295 ft) | **K** 9 m (29.5 ft) | |
| **Length code** | | | |

| Cable | Length m (ft) | Order No. |
|---|---|---|
| **Cable, sold by the meter** [1] | | |
| Encoder cables for connection to motors which are fitted with an absolute-value encoder (EnDat) (detection of absolute position and speed build-up)<br>No. of cores x cross-section [mm²]<br>3 x 2 x 0.14 + 4 x 0.14 + 2 x 0.5 + 4 x 0.23 | 50 (164) | **6FX□008–1BD51–1FA0** |
| | 100 (328) | **6FX□008–1BD51–2AA0** |
| | 200 (656) | **6FX□008–1BD51–3AA0** |
| | 500 (1640) | **6FX□008–1BD51–6AA0** |

| | |
|---|---|
| Outer diameter of cable for 6FX8: 9.9 mm (0.39 in) | **8** |
| Outer diameter of cable for 6FX5: 9.9 mm (0.39 in) | **5** |

**Example:** 1 m (3.3 ft): . . . – 1 A B 0 17 m (55.8 ft): . . . – 1 B H 0
8 m (26.2 ft): . . . – 1 A J 0 59 m (193.5 ft): . . . – 1 F K 0

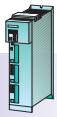
1) Maximum permissible length of the prefabricated cables for the absolute-value encoders (EnDat): 100 m (328 ft).

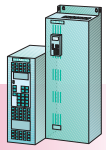


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# Selection and ordering data









## Enclosures for increasing the degree of protection of chassis units

The units can also be supplied with fitted enclosures.

See Section "Other options."

| Description | Size | Order No. | Dimensions W x H x D mm (in) | Weight kg (lb) |
|---|---|---|---|---|
| **IP20 enclosures (retrofit kit)** | | | | |
| For converters and inverters without PMU[1] | E | **6SE7090–0XE87–3AC0** | 270 x 1050 x 370 (10.6 x 41.3 x 14.6) | 15 (33.1) |
| | F | **6SE7090–0XF87–3AC0** | 360 x 1050 x 370 (14.2 x 41.3 x 14.6) | 17 (37.5) |
| | G | **6SE7090–0XG87–3AC0** | 508 x 1450 x 480 (20 x 57.1 x 18.9) | 25 (55.1) |
| For rectifier units | E | **6SE7090–0XE85–0TC0** | 270 x 1050 x 370 (10.6 x 41.3 x 14.6) | 15 (33.1) |
| For rectifier/regenerative units without PMU[1] | E | **6SE7090–0XE85–1TC0** | 270 x 1050 x 370 (10.6 x 41.3 x 14.6) | 15 (33.1) |

## G-rail for mounting the compact units

| Supplier[2] | Length | Order No. |
|---|---|---|
| **G-rail to EN 50 035, steel** | | |
| Phönix Contact, Blomberg | 2 m (6.6 ft) | **12 01 002** |
| Wieland, Bamberg | 2 m (6.6 ft) | **98.190.0000.0** |
| Weidmüller GmbH u. Co., Paderborn | 5 x 2 m (16.4 x 6.6 ft) | **05 1440** |
| Weidmüller GmbH u. Co., Paderborn | 10 x 1 m (32.8 x 3.3 ft) | **05 1441** |

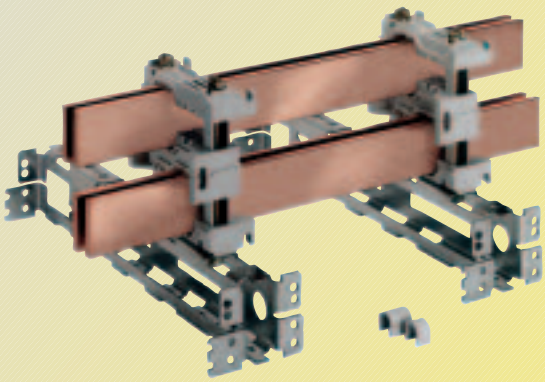
## DIN rail 35 mm for mounting the interface modules e.g.: ATI, DTI, SCI

| Supplier[2] | Length | Order No. |
|---|---|---|
| **DIN rail acc. to EN 50 022** | | |
| Siemens AG | 0.5 m (1.6 ft) | **8GR4 926** |
| Siemens AG | 1 m (3.3 ft) | **8GR4 928** |

## Bus retaining system

The following standard components are designed to provide a DC bus system up to 1800 A. The DC bus can either be mounted in or on top of the cabinet.

The bus bar retaining elements are designed to hold copper bus bars with dimensions from 10 mm x 30 mm (0.4 in x 1.2 in) up to 10 mm x 60 mm (0.4 in x 2.4 in).



| Cabinet width | Number of retaining elements |
|---|---|
| 600 mm (23.6 in) | 2 |
| 900 mm (35.4 in) | 3 |
| 1200 mm (47.2 in) | 4 |

| Designation | Order No. |
|---|---|
| **Bus retaining system** | |
| Bus retaining elements for 30 and 40 mm (1.2 and 1.6 in) buses | **6SE7090–0XX87–3CB0** |
| Bus retaining elements for 50 and 60 mm (2.0 and 2.4 in) buses | **6SE7090–0XX87–3CD0** |
| Bus retaining elements for 8MF and 8MC cabinets | **6SE7090–0XX87–3CC0** |

## Connecting adapter for cable shields – for compact units

The shield of the load-side cable and the shields of an additional 8 control cables can be connected here. Radio-interference suppression to EN 61 800-3 can thus be maintained with noise-suppression filter and line commutating reactor.

| Size | Order No. |
|---|---|
| **Connecting adapter for cable shields incl. shield clamp for power lines** | |
| 6SE70..–..A.. | **6SE7090–0XA87–3CA1** |
| 6SE70..–..B.. | **6SE7090–0XB87–3CA1** |
| 6SE70..–..C.. | **6SE7090–0XC87–3CA1** |
| 6SE70..–..D.. | **6SE7090–0XD87–3CA1** |

## Shield clamps to connect control-cable shields

| Designation | Order No. |
|---|---|
| **Shield clamps** | |
| Shield clamps, quantity = 15 | **6SY7000–0AD60** |

1) The retrofit kit contains all the mechanical components and cables. The PMU of the basic unit is to be built into the front door.

2) Located in Germany.



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## The OP1S comfort operator control panel

The OP1S operator control panel is an optional input/output unit which can be used for parameterizing the drive units. Plain text displays greatly facilitate parameterization.

For a more detailed description of the OP1S operator control panel, see Section 6 "Operator control and visualization".

| Designation | | Order No. |
|---|---|---|
| **OP1S control panel** | | **6SE7090–0XX84–2FK0** |
| **AOP1S adapter** for cabinet-door mounting incl. 5 m (16.4 ft) connecting cable | | **6SX7010–0AA00** |
| **Connecting cable** PMU-OP1S | 3 m (9.8 ft) | **6SX7010–0AB03** |
| **Connecting cable** PMU-OP1S | 5 m (16.4 ft) | **6SX7010–0AB05** |

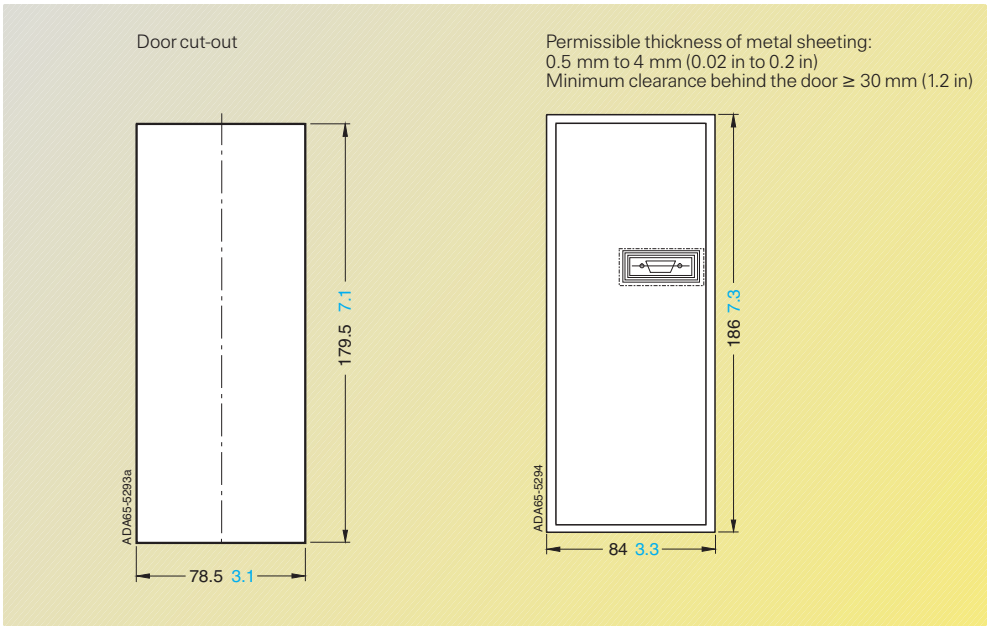
## APMU adapter for cabinet-door mounting

The PMU parameterizing unit included in the standard version of all drive units can also be built into a cabinet door using an APMU adapter.

For dimensions and door cut-out, see below.

Note:
The OP1S operator control panel can also be plugged onto the APMU.

| Designation | Order No. |
|---|---|
| **APMU adapter** for cabinet-door mounting incl. 2 m (6.6 ft) cable | **6SX7010–0AA10** |

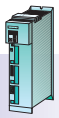


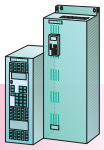

AOP1S/APMU adapter and door cut-out

Dimensions in mm
**Dimensions in inches**



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## Communication package for SIMATIC S5

The SIMATIC optional software package "DVA_S5" is available for integrating variable-speed drives such as SIMOREG and SIMOVERT into the higher-level control system STEP 5 (version ≥ 6.0) of SIMATIC S5.

This software supports communication between SIMATIC and Siemens drive units (SIMOVERT MASTERDRIVES) via PROFIBUS DP and the USS protocol. It enables the SIMATIC programmer to integrate communication with the drives into his control program without the need for detailed knowledge of the indicated communication systems, SIMATIC communication and the mechanisms of drive-related user data transfer. The user thus reduces programming time and costs.

Example programs are available for demonstrating the required configuration steps and can also be directly adopted by the user in his application.

For a detailed description, see Section 6 "SIMOVERT MASTERDRIVES in the world of automation."

Detailed documentation on every software component is included in the scope of supply.

| Scope of supply | Order No. | Supplied as | Documentation |
|---|---|---|---|
| **"DVA_S5" option software for SIMATIC S5 (STEP 5 > V 6.0)** | | | |
| • **"PROFIBUS DP" communication software** for S5-95U/DP-Master S5-115 ... 155U with IM308-B/C | **6DD1800–0SW0** | 3.5" floppy disk | German/English |
| • **"USS Protocol" communication software** for S5-95/S5-100 with CP 521Si S5-115 to S5-155U with CP 524 | | | |

### *Example of the user interface for a drive using PPO type 1 (SIMATIC S5, PROFIBUS DP communication)*

| | | | | |
|---|---|---|---|---|
| DBW n | Communication control word (KSTW) | | Communication control | |
| DBW n + 2 | Internal | | | |
| DBW n + 4 | Communication indicator word | | Communication tracking | |
| DBW n + 6 | Internal | | PKW attempt counter | |
| DBW n + 8 | Pafe 1-byte, Pafe 2-byte | | Parameter error | |
| DBW n + 10 | Parameter ID | PKE | | |
| DBW n + 12 | Index | IND | Intermediate memory for current PKW task | |
| DBW n + 14 | Parameter value 1 | PWE1 | | |
| DBW n + 16 | Parameter value 2 | PWE2 | | |
| DBW n + 18 | Parameter ID | PKE | | |
| DBW n + 20 | Index | IND | PKW area | |
| DBW n + 22 | Parameter value 1 | PWE1 | | |
| DBW n + 24 | Parameter value 2 | PWE2 | | transmit mailbox |
| DBW n + 26 | Control word (STW) | PZD1 | PZD area | |
| DBW n + 28 | Main setpoint (HSW) | PZD2 | | |
| DBW n + 30 | Parameter ID | PKE | | |
| DBW n + 32 | Index | IND | PKW area | |
| DBW n + 34 | Parameter value 1 | PWE1 | | |
| DBW n + 36 | Parameter value 2 | PWE2 | | receive mailbox |
| DBW n + 38 | Status word (ZSW) | PZD1 | PZD area | |
| DBW n + 40 | Main actual value (HIW) | PZD2 | | |
| (n = 2, 4, 6 ...) | | | | |

### *Software requirements*

- STEP 5 – from version 6.x (DVA_S5).

### *Software functions*

One or more data blocks form the user interface (see overview above) for the transfer of user data between the SIMATIC program and the drives.

Two function blocks are available for transmitting and receiving these user data.

A further function block supports generation and presetting of the data blocks necessary for communication.

The performance characteristics are as follows:

- Generation of data blocks for communication depending on the configured bus configuration
- Presetting of these data blocks
- Cyclic user data transfer
- Execution and monitoring of parameter tasks.



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## Start-up, parameterization and diagnostics with DriveMonitor

The DriveMonitor computer program can be used for control and visualization of SIMOVERT MASTERDRIVES by means of a graphic user interface.

For a more detailed description of DriveMonitor, see Section 6 "Operator control and visualization."

| Designation | Order No. | Supplied as |
|---|---|---|
| **DriveMonitor Version ≥ 5.1**<br>for SIMOVERT MASTERDRIVES<br>with documentation (operating instructions, Compendium, 5 languages) | | |
| Supplied separately | **6SX7010–0FA10** | CD-ROM |
| **Interface converter SU1 RS 232 C – RS 485,**<br>incl. mounting accessories;<br>Power supply: 115/230 V AC | **6SX7005–0AA00** | – |
| **Combination cable for the firmware boot function and DriveMonitor (RS 232 C).**<br>Pre-assembled signal cables with a boot switch integrated in the cable connector housing for boating firmware. In addition, the cable can be used for DriveMonitor (RS 232 C). Length 3 m (9.8 ft). | **9AK1012–1AA00** | – |





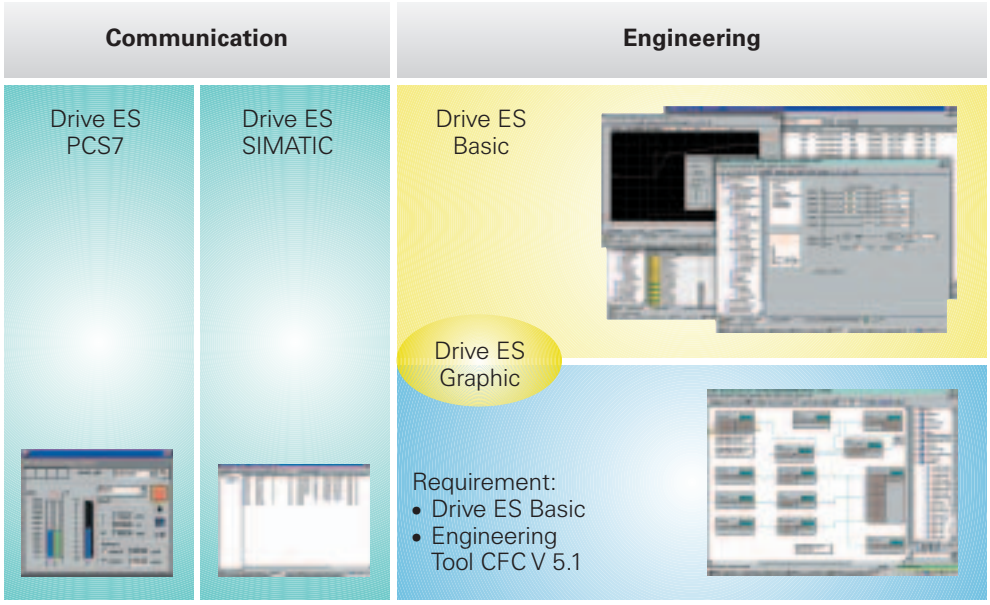
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## Engineering package Drive ES

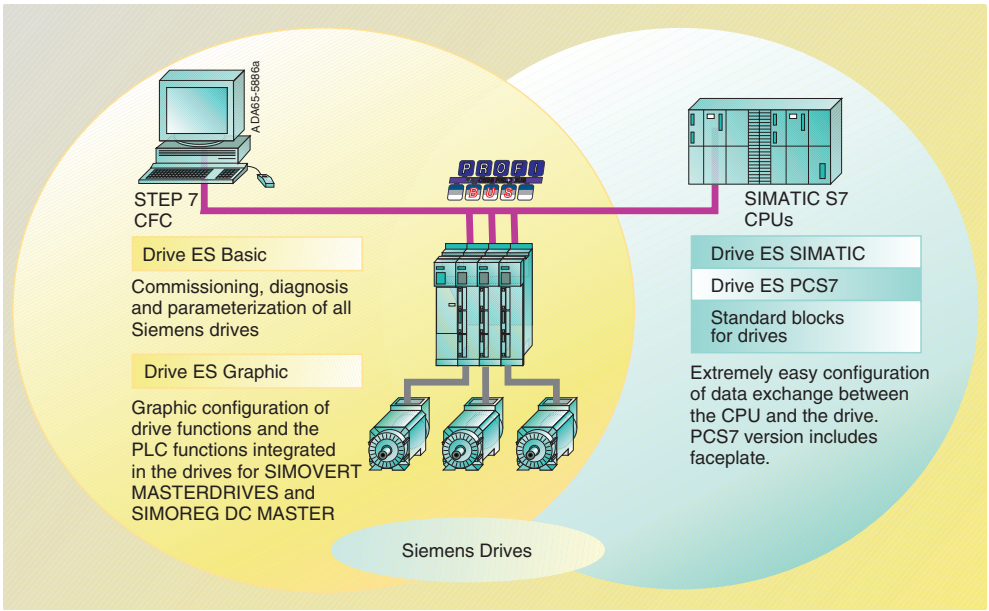
With Drive ES (*D*rive *E*ngineering *S*ystem) the SIMOVERT MASTERDRIVES series can be fully integrated into the SIMATIC automation world with regard to communication, configuring and data management.

Drive ES consists of four individually available software packages: Drive ES Basic, Drive ES Graphic, Drive ES SIMATIC and Drive ES PCS7.

- Drive ES Basic is the basic software for assigning parameters to all drives online and offline, and the basis for the Drive ES Graphic software.
- Drive ES Graphic is the software for the graphic online and offline configuring of BICO function blocks. Requirements are an installed Drive ES Basic and an installed SIMATIC CFC ≥ V 5.1 (graphic programming tool, see Catalog ST 70, Industrial software).
- Drive ES SIMATIC requires an installed STEP 7. It provides its own SIMATIC library, allowing simple and reliable programming of the PROFIBUS DP interface in the SIMATIC CPU for the drives.
- Drive ES PCS7 requires an installed SIMATIC PCS7, version 5.0 or greater. Drive ES PCS7 provides a library with function blocks for the drives and the associated faceplates for the operator station. It is therefore possible for an operator to control the drives from the PCS7 process control system.



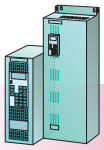

Product structure Drive ES



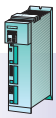

Distribution of tasks for the Drive ES packages



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Compact and chassis units



Compact PLUS units

Engineering system Drive ES

## Drive ES Basic

- Drive ES is based on the user interface of the STEP 7 manager.
- Parameters and charts of drives are available in the STEP 7 manager (system-wide data management).
- Drive ES ensures the unique assignment of parameters and charts to a drive.
- Archiving of a SIMATIC project including drive data
- Facility for using SIMATIC Teleservice (V5)
- Communication via PROFIBUS DP or USS with the drive

### *Functions*

- Trace evaluation for SIMOVERT MASTERDRIVES
- Reading out of the fault memory for SIMOVERT MASTERDRIVES
- Upread and download of parameter sets (as a complete file or as difference file from factory setting)
- Free assembly and editing of parameter sets
- Utilization of script files
- Controlled commissioning for SIMOVERT MASTERDRIVES

### *Installation with STEP 7*

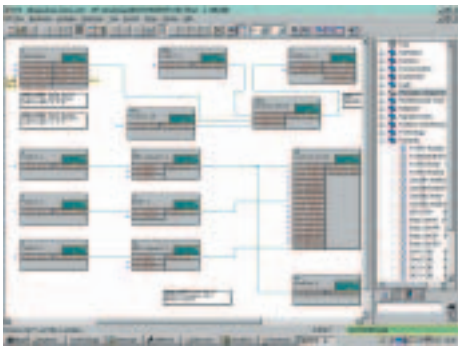
Drive ES Basic can be installed as an option for STEP 7 (≥ V 5.0), becoming homogeneously integrated in the SIMATIC environment.

### *Installation without STEP 7*

Drive ES Basic can also be installed without STEP 7, by providing its own drive manager (based on the SIMATIC manager).

## Drive ES Graphic

- Function charts are saved drive-specific in SIMATIC CFC format
- Configuring of drive functions in BICO technology with SIMATIC CFC
- Offline functionality
- Test mode (online functionality) with Change connection, Change value, Activate block
- Readback and reverse documentation
- For SIMOVERT MASTERDRIVES Vector Control software version ≥ 3.2 and Motion Control software version ≥ 1.3.



Graphic programming with Drive ES Graphic and CFC

## Drive ES SIMATIC

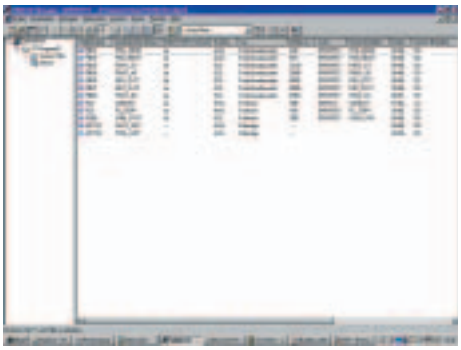
- Provides function blocks and examples of projects for the SIMATIC CPU which handle communication via PROFIBUS DP or USS with Siemens drives.
- Communication set-up via parameters as opposed to programming.

### *Features*

- Blocks in STEP 7 design; symbolic addressing; function blocks with entity data, online help
- Can be used in all SIMATIC programming and configuring environments such as LAD, FBD, STL, SCL, CFC.
- New block structure: modular individual functions for runtime-optimized programming

### *Block functions*

- Writing and reading of process data of freely configurable length and consistency
- Cyclic and acyclic exchange of parameters, monitoring of communication, reading out of fault memory from SIMOVERT MASTERDRIVES
- Parameter download via the CPU to the drive.



Integration of the drives into the STEP 7 manager

- Complete reparameterization after converter exchange at the push of a button from the CPU.

## Drive ES PCS7

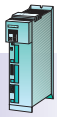
- Incorporates the drives with PROFIBUS DP-interface in PCS 7.
- For use with STEP 7 or PCS 7, ≥ V 5.

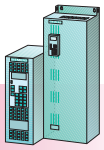
### *Block functions*

- Image and control blocks for incorporating drives in PCS 7 (SIMOVERT MASTERDRIVES with speed interface).



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## Integration of drives in SIMATIC S7 with Drive ES

Drive ES Basic is used for convenient start-up, servicing and diagnostics of Siemens drives. It can be integrated in STEP 7 or installed on a PC/PG as a stand-alone version.
For the stand-alone version, Drive ES Basic installs a drive manager instead of the SIMATIC manager but the drive manager has the same look and feel. For integrated installation as an option for STEP 7, the basic STEP 7 version as indicated in the ordering data must be used.

In conjunction with the SIMATIC tool CFC (Continuous Function Chart), Drive ES Graphic is an option for Drive ES Basic and used for the graphic configuring of functions provided in SIMOVERT MASTERDRIVES (base unit, free block and technology functions). Prerequisite: A Drive ES Basic V 5 and a CFC > V 5.1 must already have been installed on the computer.

Drive ES SIMATIC makes SIMATIC block libraries available, so that configuring the communication between SIMATIC S7 and Siemens drives (e.g. SIMOVERT MASTERDRIVES) only involves simple parameter assignment. Drive ES SIMATIC replaces the DVA_S7 software package for all STEP 7 versions ≥ V 5.0 and can also be installed and used independently, i.e. without Drive ES Basic.

Drive ES PCS7 provides a block library with image and control blocks with which Siemens drives (e.g. SIMOVERT MASTERDRIVES) can be integrated in the SIMATIC PCS7 process control system on the basics of a speed interface. The drives can then be controlled and visualized from the operator station (OS) via the drive faceplates. The PCS7 library can also be used independently, i.e. without Drive ES Basic, under PCS7 versions V 5.0 and V 5.1.

| Scope of supply | Order No. | Supplied as | Documentation |
|---|---|---|---|
| **Software packages Drive ES · Installation as integrated option for STEP 7 from version ≥ V 5.0** | | | |
| **Drive ES Basic V 5.0**[1] Single license | **6SW1700–0JA00–0AA0** | 1 CD-ROM | five standard languages |
| **Drive ES Graphic V 5.0** Single license | **6SW1700–0JB00–0AA0** | 1 CD-ROM | five standard languages |
| **Drive ES SIMATIC V 5.0** Single license | **6SW1700–0JC00–0AA0** | 1 CD-ROM | five standard languages |
| **Software packages Drive ES · Installation as integrated option for STEP 7 from version ≥ V 5.1** | | | |
| **Drive ES Basic V 5.1**[1] Single license | **6SW1700–5JA00–1AA0** | 1 CD-ROM | five standard languages |
| **Drive ES Basic V 5.1**[1] copy license (60 installations) | **6SW1700–5JA00–1AA1** | 1 CD-ROM | five standard languages |
| **Drive ES Graphic V 5.1** Single license | **6SW1700–5JB00–1AA0** | 1 CD-ROM | five standard languages |
| **Drive ES SIMATIC V 5.1** Single license | **6SW1700–5JC00–1AA0** | 1 CD-ROM | five standard languages |
| **Drive ES PCS7 V 5.1** Single license | **6SW1700–5JD00–1AA0** | 1 CD-ROM | five standard languages |
| **Software packages Drive ES · Installation as integrated option for STEP 7 from version ≥ V 5.2** | | | |
| **Drive ES Basic V 5.2**[1] Single license | **6SW1700–5JA00–2AA0** | 1 CD-ROM | five standard languages |
| **Drive ES Basic Upgrade**[1] **V 5.x → V 5.2** Single license | **6SW1700–5JA00–2AA4** | 1 CD-ROM | five standard languages |
| **Drive ES Basic V 5.2**[1] copy license (60 installations) | **6SW1700–5JA00–2AA1** | 1 CD-ROM + Copy license contract | five standard languages |
| **Drive ES Graphic V 5.2** Single license | **6SW1700–5JB00–2AA0** | 1 CD-ROM | five standard languages |
| **Drive ES Graphic Upgrade V 5.x → V 5.2** Single license | **6SW1700–5JB00–2AA4** | 1 CD-ROM | five standard languages |
| **Drive ES SIMATIC V 5.3** Single license | **6SW1700–5JC00–3AA0** | 1 CD-ROM | five standard languages |
| **Drive ES SIMATIC Upgrade V 5.x → V 5.3** Single license | **6SW1700–5JC00–3AA4** | 1 CD-ROM | five standard languages |
| **Drive ES SIMATIC V 5.x** Copy/runtime license | **6SW1700–5JC00–1AC0** | Product document only (w/o software and documentation) | five standard languages |
| **Drive ES PCS7 V 5.2** Single license | **6SW1700–5JD00–2AA0** | 1 CD-ROM | five standard languages |
| **Drive ES PCS7 Upgrade V 5.x → V 5.2** Single license | **6SW1700–5JD00–2AA4** | 1 CD-ROM | five standard languages |
| **Drive ES PCS7 V 5.x** Copy/runtime license | **6SW1700–5JD00–1AC0** | Product document only (w/o software and documentation) | five standard languages |

**Contents of the Drive ES SIMATIC package**

- **Communication software "PROFIBUS DP"** for
  S7-300 with CPUs with integrated DP interface (block libraries DRVDPS7, POSMO)
  S7-400 with CPUs with integrated DP interface or with CP443-5 (block libraries DRVDPS7, POSMO)
  S7-300 with CP342-5 (block library DRVDPS7C)
- **Communication software "USS-Protocoll"** for
  S7-200 with CPU 214/CPU 215/CPU 216 (driver program DRVUSS2 for programming tool STEP 7-micro)
  S7-300 with CP 340/341 and S7-400 with CP 411 (block library DRVUSSS7)
- **STEP 7 Slave object manager**
  for convenient configuration of drives as well as for acyclic PROFIBUS DP communication with the drives, support for conversion of DVA_S7 for Drive ES projects (only from V 5.1)
- **SET-UP program** for installation of the software in the STEP 7 environment

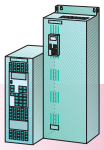
**Contents of the Drive ES PCS7 package** (the PCS7 package can be used with the PCS7 versions V 5.0 and V 5.1)

- **Block library for SIMATIC PCS7**
  Image and control blocks for SIMOVERT MASTERDRIVES VC and MC as well as MICRO-/MIDIMASTER 3rd and 4th generation
- **STEP 7 Slave object manager**
  for convenient configuration of drives as well as for acyclic PROFIBUS DP communication with the drives
- **SETUP program** for software installation in the PCS7 environment

1) Drive ES Basic can also be installed stand-alone without STEP 7 (for details see accompanying text).



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## Software update service Drive ES

A software update service can also be purchased for the Drive ES software. The user automatically receives the current software, service packs and complete versions for one year after the date of ordering.

Duration of the update service: 1 year.

6 weeks before expiry, the customer and his Siemens contact will be informed in writing that this period is about to expire. If the customer does not cancel the update service, it is automatically extended by another year.

The update service can only be ordered if the customer already has a complete version of the software.

| Scope of supply | Order No. |
|---|---|
| **Software update service** | |
| **Drive ES Basic** | **6SW1700–0JA00–0AB2** |
| **Drive ES Graphic** | **6SW1700–0JB00–0AB2** |
| **Drive ES SIMATIC** | **6SW1700–0JC00–0AB2** |
| **Drive ES PCS7** | **6SW1700–0JD00–0AB2** |





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# Motion Control
# Motor selection




4/2 **Motors with SIMOVERT MASTERDRIVES Motion Control**

**Selection**

Motors – Compact PLUS units

Compact and chassis units

Synchronous servomotors

4/4 • 1FK6

4/5 • 1FK7

4/7 • 1FT6 air-cooled

4/11 • 1FT6 water-cooled

Asynchronous servomotors

4/12 • 1PH7

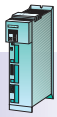

4



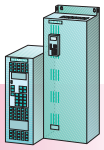

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# Motor selection

## Motors with SIMOVERT MASTERDRIVES Motion Control



Compact PLUS units



Compact and chassis units

SIMOVERT MASTER-DRIVES Motion Control converters are specially designed for driving various types of three-phase-motors.

They are optimally matched to the Siemens servo-motors, together with which they can be used to create high-performance drive systems.

## Siemens servomotors

A drive system consisting of a SIMOVERT MASTER-DRIVES Motion Control converter and a 1FT6/1FK. synchronous motor or 1PH7/1PL6 compact asyn-chronous motor is the optimal drive for servo applications.

1PH4 water-cooled asyn-chronous motors with the high IP65 degree of protec-tion can also be used for these applications.

A selection of 1FT6/1FK. and 1PH7 servomotors with ap-propriate converters can be found from page 4/4 on-wards.



Fig. 4/1 1FK6 synchronous servomotor

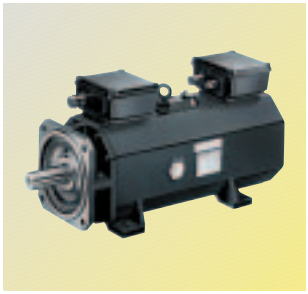


Fig. 4/3 Explosion-proof servomotor 1FS6

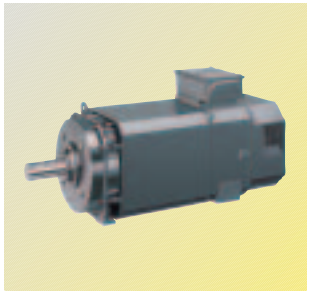


Fig. 4/5 1PH7 asynchronous servomotor



Fig. 4/2 1FK7 synchronous servomotor

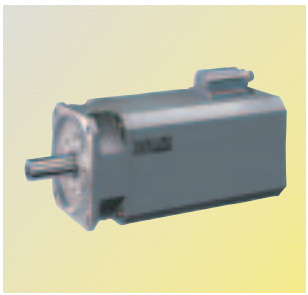


Fig. 4/4 1FT6 synchronous servomotor



Fig. 4/6 1PL6 asynchronous servomotor

## Siemens standard asynchronous motors

The SIMOVERT MASTER-DRIVES Motion Control con-verters can also be used with 1LA5/1LA6/1LA7 asyn-chronous motors. The drives can be operated in *V/f* control mode as well as in $n$ = speed control and $\tau$ = torque control modes. It should be remem-bered that the 1LA motors will go into the field-weakening mode at about 15 % below the rated speed.

For a detailed selection of motors, refer to Catalog M11.

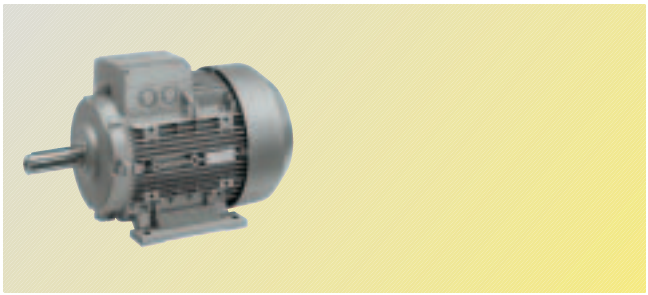


Fig. 4/7
1LA . standard asynchronous motor

## Synchronous motors for *V/f* operation

The "*V/f* control" mode is also possible with SIEMOSYN type 1FU mo-tors, which are designed as internal rotors or external ro-tor designs. These motors are especially suitable for ap-plications in the synthetic and natural-fiber industry as well as in the printing indus-try.

For a detailed selection of motors, refer to Catalog DA 48.

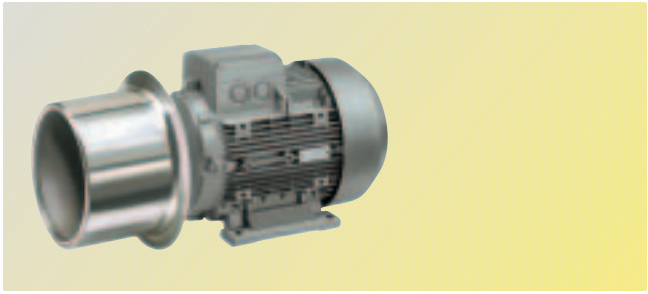
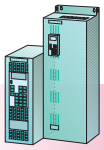


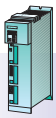
Fig. 4/8
SIEMOSYN motor



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Compact and chassis units



Compact PLUS units

Motors with SIMOVERT MASTERDRIVES Motion Control

## Motors from other manufacturers

SIMOVERT MASTERDRIVES Motion Control converters can be operated with motors from other manufacturers.

If motors from other manufacturers are used, the following applies:

- The insulation system must be designed for pulse-width modulation with 510 V to 650 V DC.
- The encoder system (e.g. incremental encoder, resolver) must be suitable for use with the SIMOVERT MASTERDRIVES Motion Control converters.
- Temperature evaluation is possible with KTY 84 and PTC.
- It is recommended that a trial with SIMOVERT MASTERDRIVES Motion Control converters is carried out with a demonstration case, or in our test laboratories.

## Overload capacity of the drives with 1FT6/1FK. motors

The overload capacity relates to the motor torque which is possible at 1.6 x or 3 x[1]) the rated current of the converter. Depending on the combination of converter and motor, this motor torque may be limited due to the maximum permissible motor current.
When higher speeds are approached, the overload capacity is limited by the voltage limit curve. The following relationship applies for the assignment of converter to 1FT6/1FK6/1FK7 motor:

$I_0 \leq I_{n\,conv}$
with $I_0$ = stall current of the motor
and $I_{n\,conv}$ = rated current of the converter.

## Overload capacity of the drives with 1PH7 motors

The overload capacity relates to the motor torque which is possible at 1.6 x the rated converter current.

This only applies to the constant-flux range.
The following relationship applies for the assignment of converter to 1PH7 motor:

$I_{rated} \leq I_{n\,conv}$
with $I_{rated}$ = rated current of the motor
and $I_{n\,conv}$ = rated current of the converter.

## Important supplementary information

**The maximum output voltage of the SIMOVERT MASTERDRIVES Motion Control converters is 0.86 x the line voltage.**

**The maximum field-weakening mode with asynchronous motors is 1 : 2.**

In this catalog, SIMOVERT MASTERDRIVES Motion Control converters are assigned to Siemens servomotors.

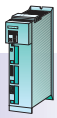
For the 1FT6 synchronous servomotors, so-called core types with appropriately short delivery times, have been suggested with the following features:

- IM B5 type of design (or IM V1, IM V3)
- Degree of protection IP65
- Sin/cos incremental encoder 1 $V_{pp}$ or absolute-value encoder (EnDat)
- Without/with holding brake
- Smooth shaft extension
- Radial eccentricity tolerance N
- Level of vibration N
- Power socket connector, transverse, to the right.

1) Only with Compact PLUS units



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## Inverters with 1FK6 synchronous servomotors

| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Inverter |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **3000** | 48 | **1FK6 042–6AF71–1...** | 2.6 (23) | 2.4 | 3 (26.6) | 2.6 | 0.82 (1.1) | 0.33 (0.0029) | 5 (11) | 1 | 4 | **6SE7 014–0TP□0** |
| | 63 | **1FK6 060–6AF71–1...** | 4 (35) | 3.1 | 6 (53) | 4.3 | 1.26 (1.69) | 0.86 (0.0076) | 9 (19.8) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FK6 063–6AF71–1...** | 6 (53) | 4.7 | 11 (97) | 7.9 | 1.88 (2.52) | 1.61 (0.0142) | 13.2 (29.1) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FK6 080–6AF71–1...** | 6.8 (60) | 5.2 | 8 (71) | 5.8 | 2.14 (2.87) | 1.5 (0.0133) | 12.5 (27.6) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 80 | **1FK6 083–6AF71–1...** | 10.5 (93) | 7.7 | 16 (142) | 10.4 | 3.3 (4.42) | 2.73 (0.0242) | 17 (37.5) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FK6 100–8AF71–1...** | 12 (106) | 8.4 | 18 (159) | 12.2 | 3.77 (5.05) | 5.53 (0.0489) | 21 (46.3) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FK6 101–8AF71–1...** | 15.5 (137) | 10.8 | 27 (239) | 17.5 | 4.87 (6.53) | 7.99 (0.0707) | 26 (57.3) | 1.5 | 17.5 | **6SE7 021–8TP□0** |
| | 100 | **1FK6 103–8AF71–1...** | 16.5 (146) | 11.8 | 36 (319) | 23.5 | 5.18 (6.94) | 10.5 (0.0929) | 30 (66.1) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| **6000** | 36 | **1FK6 032–6AK71–1...** | 0.8 (7) | 1.5 | 1.1 (10) | 1.7 | 0.5 (0.67) | 0.07 (0.0006) | 2.9 (6.4) | 1 | 2 | **6SE7 012–0TP□0** |
| | 48 | **1FK6 040–6AK71–1...** | 0.8 (7) | 1.75 | 1.6 (14) | 2.8 | 0.5 (0.67) | 0.18 (0.0016) | 3.7 (8.2) | 1 | 4 | **6SE7 014–0TP□0** |

For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7



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## Inverters with 1FK7 synchronous servomotors

| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Inverter |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | A | Order No. |
| **1FK7 CT (Compact) – Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **3000** | 48 | **1FK7 042–5AF71–1...** | 2.6 (23) | 1.95 | 3 (26.5) | 2.2 | 0.82 (1.1) | 0.301 (0.0027) | 4.8 (10.6) | 1 | 4 | **6SE7 014–0TP□0** |
| | 63 | **1FK7 060–5AF71–1...** | 4.7 (41.6) | 3.7 | 6 (53) | 4.5 | 1.48 (2) | 0.795 (0.007) | 8 (17.6) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FK7 063–5AF71–1...** | 7.3 (64.6) | 5.6 | 11 (97) | 8 | 2.29 (3.1) | 1.51 (0.0134) | 14 (30.9) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FK7 080–5AF71–1...** | 6.8 (60.2) | 4.4 | 8 (71) | 4.8 | 2.14 (2.9) | 1.5 (0.0132) | 11.3 (24.9) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 80 | **1FK7 083–5AF71–1...** | 10.5 (93) | 7.4 | 16 (142) | 10.4 | 3.3 (4.4) | 2.73 (0.0242) | 14 (30.9) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FK7 100–5AF71–1...** | 12 (106) | 8 | 18 (159) | 11.2 | 3.77 (5.1) | 5.53 (0.0489) | 18.9 (41.7) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FK7 101–5AF71–1...** | 15.5 (137) | 11.8 | 27 (239) | 19 | 4.87 (6.5) | 7.99 (0.0707) | 25 (55.1) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| | 100 | **1FK7 103–5AF71–1...** | 20.5[1] (181) | 16.5[1] | 36 (319) | 27.5 | 5.37[1] (7.2) | 10.5 (0.0929) | 29 (63.9) | 1.5 | 34 | **6SE7 023–4TP□0** |
| **4500** | 63 | **1FK7 060–5AH71–1...** | 3.7 (32.8) | 4.1 | 6 (53) | 6.2 | 1.74 (2.3) | 0.795 (0.0007) | 8 (17.6) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FK7 063–5AH71–1...** | 5[2] (44.2) | 6.1[2] | 11 (97) | 12 | 2.09[2] (2.8) | 1.51 (0.0134) | 12 (26.5) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 80 | **1FK7 080–5AH71–1...** | 4.5 (39.8) | 5.6 | 8 (71) | 7.4 | 2.38 (3.2) | 1.5 (0.0132) | 11,3 (24.9) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FK7 083–5AH71–1...** | 8.3[3] (73.5) | 9[3] | 16 (142) | 15 | 3.04[3] (4.1) | 2.73 (0.0242) | 14 (30.9) | 1 | 17.5 | **6SE7 021–8TP□0** |
| **6000** | 28 | **1FK7 022–5AK71–1...** | 0.6 (5.3) | 1.26 | 0.85 (7.5) | 1.8 | 0.4 (0.54) | 0.028 (0.0003) | 1.8 (3.97) | 1 | 2 | **6SE7 012–0TP□0** |
| | 36 | **1FK7 032–5AK71–1...** | 0.8 (7.1) | 1.2 | 1.1 (9.7) | 1.7 | 0.47 (0.63) | 0.061 (0.0005) | 2.7 (6) | 1 | 2 | **6SE7 012–0TP□0** |
| | 48 | **1FK7 040–5AK71–1...** | 1.1 (9.7) | 1.7 | 1.6 (14.2) | 2.25 | 0.69 (0.92) | 0.169 (0.0015) | 3.4 (7.5) | 1 | 4 | **6SE7 014–0TP□0** |
| | 48 | **1FK7 042–5AK71–1...** | 2[4] (17.7) | 3.1[4] | 3 (26.6) | 4.4 | 1.02[4] (1.37) | 0.301 (0.0027) | 4.8 (10.6) | 1 | 6.1 | **6SE7 016–0TP□0** |

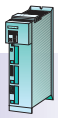
For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7

1) Rated data refer to $n$ = 2,500 rpm.
2) Rated data refer to $n$ = 4,000 rpm.
3) Rated data refer to $n$ = 3,500 rpm.
4) Rated data refer to $n$ = 5,000 rpm.



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## Inverters with 1FK7 synchronous servomotors (continued)

| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Inverter |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | A | Order No. |
| **1FK7 HD (High Dynamic) – Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **3000** | 48 | **1FK7 044–7AF71–1...** | 3.5 (31) | 4 | 4 (35.4) | 4.5 | 1.1 (1.47) | 0.128 (0.00113) | 7.7 (17) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FK7 061–7AF71–1...** | 5.4 (47.8) | 5.3 | 6.4 (56.6) | 6.1 | 1.7 (2.27) | 0.34 (0.00301) | 10 (22.1) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FK7 064–7AF71–1...** | 8 (70.8) | 7.5 | 12 (106.2) | 11 | 2.51 (3.36) | 0.65 (0.00575) | 17.2 (37.9) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 80 | **1FK7 082–7AF71–1...** | 8 (70.8) | 6.7 | 14 (124) | 10.6 | 2.51 (3.36) | 1.4 (0.0124) | 17.2 (38) | 1 | 13.2 | **6SE7 021–3TP□0** |
| | 80 | **1FK7 085–7AF71–1...** | 12[1] (106) | 12.5[1] | 22 (194.7) | 22.5 | 3.14[1] (4.21) | 2.3 (0.0204) | 23.5 (51.8) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| **4500** | 48 | **1FK7 043–7AH71–1...** | 2.6 (23) | 4 | 3.1 (27.4) | 4.5 | 1.23 (1.64) | 0.101 (0.00089) | 6.3 (13.9) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 48 | **1FK7 044–7AH71–1...** | 3 (26.6) | 4.9 | 4 (35.4) | 6.3 | 1.41 (1.89) | 0.128 (0.00113) | 7.7 (17) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 63 | **1FK7 061–7AH71–1...** | 4.3 (38.1) | 5.9 | 6.4 (56.6) | 8 | 2.03 (2.72) | 0.34 (0.00301) | 10 (22.1) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 63 | **1FK7 064–7AH71–1...** | 5 (44.3) | 7 | 12 (106.2) | 15 | 2.36 (3.16) | 0.65 (0.00575) | 17.2 (37.9) | 1 | 17.5 | **6SE7 021–8TP□0** |
| **6000** | 36 | **1FK7 033–7AK71–1...** | 0.9 (8) | 1.5 | 1.3 (11.5) | 2.2 | 0.57 (0.76) | 0.027 (0.00024) | 3.15 (6.9) | 1 | 4 | **6SE7 014–0TP□0** |
| | 48 | **1FK7 043–7AK71–1...** | 2 (17.7) | 4.4 | 3.1 (27.4) | 6.4 | 1.26 (1.68) | 0.101 (0.00089) | 6.3 (13.9) | 1 | 10.2 | **6SE7 021–0TP□0** |

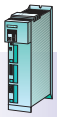
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SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7

1) Rated data refer to $n$ = 2,500 rpm.



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## Inverters with air-cooled 1FT6 synchronous servomotors, core types

| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Inverter |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | (lb$_f$-in) | A | (lb$_f$-in) | A | (HP) | (lb$_f$-in-s$^2$) | (lb) | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **2000** | 100 | **1FT6 102–1AC71–...1** | 23 (204) | 11 | 27 (239) | 12.4 | 4.8 (6.43) | 9.9 (0.09) | 27.5 (23.2) | 1.5 | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FT6 105–1AC71–...1** | 38 (336) | 17.6 | 50 (443) | 22.9 | 8 (10.72) | 16.8 (0.15) | 39.5 (87.1) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| **3000** | 48 | **1FT6 044–1AF71–...1** | 4.3 (38.1) | 2.9 | 5 (44.3) | 3 | 1.4 (1.87) | 0.51 (0.005) | 8.3 (18.3) | 1 | 4 | **6SE7 014–0TP□0** |
| | 63 | **1FT6 062–1AF71–...1** | 4.7 (41.6) | 3.4 | 6 (53.1) | 4 | 1.5 (2) | 0.85 (0.008) | 9.5 (21) | 1 | 4 | **6SE7 014–0TP□0** |
| | 63 | **1FT6 064–1AF71–...1** | 7 (62) | 4.9 | 9.5 (84.1) | 6.1 | 2.2 (2.95) | 1.3 (0.01) | 12.5 (27.6) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 80 | **1FT6 082–1AF71–...1** | 10.3 (91.2) | 8.7 | 13 (115.1) | 10.2 | 3.2 (4.3) | 3.0 (0.03) | 15 (33.1) | 1.5 | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FT6 084–1AF71–...1** | 14.7 (130) | 11 | 20 (177) | 14 | 4.6 (6.17) | 4.8 (0.04) | 20.5 (45.2) | 1.5 | 17.5 | **6SE7 021–8TP□0** |
| | 80 | **1FT6 086–1AF71–...1** | 18.5 (164) | 13 | 27 (239) | 17.5 | 5.8 (7.77) | 6.6 (0.06) | 25.5 (56) | 1.5 | 17.5 | **6SE7 021–8TP□0** |
| **4500** | 63 | **1FT6 062–1AH71–...1** | 3.6 (31.9) | 3.9 | 6 (53.1) | 5.6 | 1.7 (2.28) | 0.85 (0.008) | 9.5 (21) | 1 | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FT6 064–1AH71–...1** | 4.8 (42.5) | 5.5 | 9.5 (84.1) | 9.1 | 2.3 (3.08) | 1.3 (0.01) | 12.5 (27.6) | 1 | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FT6 084–1AH71–...1** | 10.5 (92.9) | 12.5 | 20 (177) | 21.6 | 4.9 (6.63) | 4.8 (0.04) | 20.5 (45.2) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| | 80 | **1FT6 086–1AH71–...1** | 12 (106) | 12.6 | 27 (239) | 25.3 | 5.7 (7.58) | 6.65 (0.06) | 25.5 (56.2) | 1.5 | 25.5 | **6SE7 022–6TP□0** |
| **6000** | 36 | **1FT6 034–1AK71–...1** | 1.4 (12.4) | 2.1 | 2 (17.7) | 2.6 | 0.88 (1.18) | 0.11 (0.001) | 4.4 (9.7) | 1 | 4 | **6SE7 014–0TP□0** |
| | 80 | **1FT6 084–1AK71–...1** | 6.5 (57.5) | 9.2 | 20 (177) | 25 | 4.1 (5.47) | 4.8 (0.04) | 20.5 (45.2) | 1.5 | 25.5 | **6SE7 022–6TP□0** |

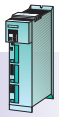
For detailed motor information, please refer to Catalog DA 65.3.

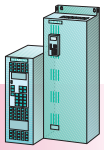
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## Inverters with air-cooled 1FT6 synchronous motors

| Motor data for a 100 K temperature increase | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | | Rated current | Converter E / Inverter T |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | | |
| **1500** Non-ventilated | 100 | **1FT6 102–8AB7.....** | 24.5 (217) | 8.4 | 27 (239) | 8.4 | 3.8 (5.09) | 9.9 (0.0876) | 27.5 (60.6) | 1.5 | | 10.2 | **6SE7 021–0TP□0** |
| | 100 | **1FT6 105–8AB7.....** | 41 (363) | 14.5 | 50 (442) | 17.2 | 6.4 (8.85) | 16.8 (0.1487) | 39.5 (87.1) | 1.5 | | 17.5 | **6SE7 021–8TP□0** |
| | 100 | **1FT6 108–8AB7.....** | 61 (540) | 20.5 | 70 (619) | 22.1 | 9.6 (12.87) | 26 (0.2301) | 55.5 (122.4) | 1.5 | | 25.5 | **6SE7 022–6TP□0** |
| | 132 | **1FT6 132–6AB7.....** | 62 (549) | 19 | 75 (664) | 23 | 9.7 (13) | 43 (0.3805) | 85 (187.4) | 1.5 | | 25.5 | **6SE7 022–6TP□0** |
| | 132 | **1FT6 134–6AB7.....** | 75 (664) | 24 | 95 (841) | 29 | 11.8 (15.82) | 54.7 (0.4841) | 100 (220.5) | 1.5 | | 34 | **6SE7 023–4TP□0** |
| | 132 | **1FT6 136–6AB7.....** | 88 (779) | 27 | 1018 (115) | 34 | 13.8 (18.5) | 66.4 (0.5876) | 117 (257.9) | 1.5 | | 34 | **6SE7 023–4TP□0** |
| **1500** Blower–ventilated | 100 | **1FT6 105–8SB7.....** | 59 (552) | 21.7 | 65 (575) | 23.5 | 9.3 (12.47) | 16.8 (0.1487) | 45.5 (100.3) | 1.5 | | 25.5 | **6SE7 022–6TP□0** |
| | 100 | **1FT6 108–8SB7.....** | 83 (735) | 31 | 90 (796) | 31 | 13 (17.43) | 26 (0.2301) | 61.5 (135.6) | 1.5 | | 34 | **6SE7 023–4TP□0** |
| | 132 | **1FT6 132–6SB7.....** | 102 (885) | 36 | 110 (973) | 39 | 16 (21.05) | 43 (0.3805) | 91 (200.6) | 3 | | 47 | **6SE7 024–7□D□1** |
| | 132 | **1FT6 134–6SB7.....** | 130 (1150) | 45 | 140 (1239) | 48 | 20.4 (27.35) | 54.7 (0.4841) | 106 (233.7) | 3 | | 47 | **6SE7 024–7□D□2** |
| | 132 | **1FT6 136–6SB7.....** | 160 (1416) | 55 | 175 (1549) | 55 | 25.1 (33.65) | 66.4 (0.5876) | 123 (271.2) | 3 | | 59 | **6SE7 026–0□D□1** |
| **2000** Non–ventilated | 63 | **1FT6 061–6AC7.....** | 3.7 (33) | 1.9 | 4 (35) | 2 | 0.8 (1.07) | 0.6 (0.0053) | 8 (17.6) | 1 | | 2 | **6SE7 012–0TP□0** |
| | 63 | **1FT6 062–6AC7.....** | 5.2 (46) | 2.6 | 6 (53) | 2.7 | 1.1 (1.47) | 0.85 (0.0075) | 9.5 (20.9) | 1 | | 4 | **6SE7 014–0TP□0** |
| | 80 | **1FT6 081–8AC7.....** | 7.5 (66) | 4.1 | 8 (71) | 4.1 | 1.6 (2.14) | 2.1 (0.0186) | 12.5 (27.6) | 1.5 | | 6.1 | **6SE7 016–0TP□0** |
| | 63 | **1FT6 064–6AC7.....** | 8 (71) | 3.8 | 9.5 (84) | 4.2 | 1.7 (2.28) | 1.3 (0.0115) | 12.5 (27.6) | 1 | | 6.1 | **6SE7 016–0TP□0** |
| | 80 | **1FT6 082–8AC7.....** | 11.4 (101) | 6.6 | 13 (115) | 6.9 | 2.4 (3.22) | 3 (0.0265) | 15 (33.1) | 1.5 | | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FT6 084–8AC7.....** | 16.9 (150) | 8.3 | 20 (177) | 9.5 | 3.5 (4.69) | 4.8 (0.0425) | 20.5 (45.2) | 1.5 | | 10.2 | **6SE7 021–0TP□0** |
| | 80 | **1FT6 086–8AC7.....** | 22.5 (204) | 10.9 | 27 (239) | 12 | 4.7 (6.43) | 6.65 (0.0588) | 25.5 (56.2) | 1.5 | | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FT6 102–8AC7.....** | 23 (204) | 11 | 27 (239) | 12.4 | 4.8 (6.43) | 9.9 (0.0876) | 27.5 (60.6) | 1.5 | | 13.2 | **6SE7 021–3TP□0** |
| | 100 | **1FT6 105–8AC7.....** | 38 (336) | 17.6 | 50 (442) | 22.9 | 8 (10.72) | 16.8 (0.1487) | 39.5 (87.1) | 1.5 | | 25.5 | **6SE7 022–6TP□0** |
| | 100 | **1FT6 108–8AC7.....** | 55 (487) | 24.5 | 70 (619) | 29 | 11.5 (15.42) | 26 (0.2558) | 55.5 (122.4) | 1.5 | | 34 | **6SE7 023–4TP□0** |
| | 132 | **1FT6 132–6AC7.....** | 55 (487) | 23 | 75 (664) | 31 | 11.5 (15.42) | 43 (0.3805) | 85 (187.4) | 1.5 | | 34 | **6SE7 023–4TP□0** |
| | 132 | **1FT6 134–6AC7.....** | 65 (575) | 27 | 95 (841) | 39 | 13.6 (18.23) | 54.7 (0.4841) | 100 (220.5) | 1.5 | | 47 | **6SE7 024–7□D□1** |
| | 132 | **1FT6 136–6AC7.....** | 665 (74) | 30 | 115 (1018) | 43 | 15.5 (20.78) | 66.4 (0.5876) | 117 (257.9) | 3 | | 47 | **6SE7 024–7□D□1** |

For detailed motor information, please refer to Catalog DA 65.3.

**P** for Compact PLUS units, **D** for compact units

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7



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| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Converter E / Inverter T |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **2000** Blower-ventilated | 100 | **1FT6 105–8SC7.....** | 56 (496) | 28 | 575 (65) | 32 | 11.7 (15.68) | 16.8 (0.1487) | 100.3 (45.5) | 1.5 | 34 | **6SE7 023–4T P□0** |
| | 100 | **1FT6 108–8SC7.....** | 80 (708) | 40 | 90 (796) | 41 | 16.8 (22.52) | 26 (0.2301) | 61.5 (135.6) | 3 | 47 | **6SE7 024–7□D□1** |
| | 132 | **1FT6 132–6SC7.....** | 98 (867) | 46 | 110 (973) | 51 | 20.5 (27.48) | 43 (0.3805) | 91 (200.6) | 3 | 59 | **6SE7 026–0□D□1** |
| | 132 | **1FT6 134–6SC7.....** | 125 (1106) | 57 | 140 (1239) | 62 | 26.2 (35.12) | 54.7 (0.4841) | 106 (233.7) | 3 | 72 | **6SE7 027–2□D□1** |
| | 132 | **1FT6 136–6SC7.....** | 155 (1372) | 72 | 175 (1549) | 78 | 32.5 (43.57) | 66.4 (0.5876) | 123 (271.2) | 3 | 92 | **6SE7 031–0□E□0** |
| **3000** Non–ventilated | 48 | **1FT6 041–4AF7.....** | 2.15 (19) | 1.7 | 2.6 (22) | 1.8 | 0.7 (0.94) | 0.29 (0.0026) | 6.6 (14.6) | 1 | 2 | **6SE7 012–0T P□0** |
| | 63 | **1FT6 061–6AF7.....** | 3.5 (31) | 2.6 | 4 (35) | 2.75 | 1.1 (1.47) | 0.6 (0.0053) | 8 (17.6) | 1 | 4 | **6SE7 014–0T P□0** |
| | 48 | **1FT6 044–4AF7.....** | 4.3 (38) | 2.9 | 5 (44) | 3 | 1.4 (1.88) | 0.51 (0.0045) | 8.3 (18.3) | 1 | 4 | **6SE7 014–0T P□0** |
| | 63 | **1FT6 062–6AF7.....** | 4.7 (42) | 3.4 | 6 (53) | 4 | 1.5 (2) | 0.85 (0.0075) | 9.5 (20.9) | 1 | 4 | **6SE7 014–0T P□0** |
| | 80 | **1FT6 081–8AF7.....** | 6.9 (61) | 5.6 | 8 (71) | 6 | 2.2 (2.95) | 2.1 (0.0186) | 12.5 (27.6) | 1.5 | 6.1 | **6SE7 016–0T P□0** |
| | 63 | **1FT6 064–6AF7.....** | 7 (62) | 4.9 | 9.5 (84) | 6.1 | 2.2 (2.95) | 1.3 (0.0115) | 12.5 (27.6) | 1 | 6.1 | **6SE7 016–0T P□0** |
| | 80 | **1FT6 082–8AF7.....** | 10.3 (91) | 8.7 | 13 (115) | 10.2 | 3.2 (4.29) | 3 (0.0265) | 15 (33.1) | 1.5 | 10.2 | **6SE7 021–0T P□0** |
| | 80 | **1FT6 084–8AF7.....** | 14.7 (130) | 11 | 20 (177) | 14 | 4.6 (6.17) | 4.8 (0.0425) | 20.5 (45.2) | 1.5 | 17.5 | **6SE7 021–8T P□0** |
| | 80 | **1FT6 086–8AF7.....** | 18.5 (164) | 13 | 27 (239) | 17.5 | 5.8 (7.77) | 6.65 (0.0588) | 25.5 (56.2) | 1.5 | 17.5 | **6SE7 021–8T P□0** |
| | 100 | **1FT6 102–8AF7.....** | 19.5 (173) | 13.2 | 27 (239) | 17.2 | 6.1 (8.18) | 9.9 (0.0878) | 27.5 (60.6) | 1.5 | 17.5 | **6SE7 021–8T P□0** |
| | 100 | **1FT6 105–8AF7.....** | 31 (274) | 22.5 | 50 (442) | 34 | 9.7 (13) | 16.8 (0.1478) | 39.5 (87.1) | 1.5 | 34 | **6SE7 023–4T P□0** |
| | 132 | **1FT6 132–6AF7.....** | 36 (319) | 23 | 75 (664) | 46 | 11.3 (15.15) | 43 (0.3805) | 85 (187.4) | 3 | 47 | **6SE7 024–7□D□1** |
| **3000** Blower–ventilated | 80 | **1FT6 084–8SF7.....** | 22 (195) | 17 | 26 (230) | 19.3 | 6.9 (9.25) | 4.8 (0.0425) | 25 (55.1) | 1.5 | 25.5 | **6SE7 022–6T P□0** |
| | 80 | **1FT6 086–8SF7.....** | 31 (274) | 24.5 | 35 (310) | 26 | 9.7 (13) | 6.65 (0.0588) | 30 (66.1) | 1.5 | 34 | **6SE7 023–4T P□0** |
| | 100 | **1FT6 105–8SF7.....** | 50 (443) | 35 | 65 (575) | 45 | 15.7 (21.05) | 16.8 (0.1487) | 45.5 (100.3) | 3 | 47 | **6SE7 024–7□D□1** |
| | 132 | **1FT6 132–6SF7.....** | 90 (796) | 62 | 110 (973) | 74 | 28.3 (37.94) | 43 (0.3805) | 91 (200.6) | 3 | 72 | **6SE7 027–2□D□1** |
| | 132 | **1FT6 134–6SF7.....** | 110 (973) | 72 | 140 (1239) | 90 | 34.6 (46.38) | 54.7 (0.4841) | 106 (233.7) | 3 | 92 | **6SE7 031–0□E□0** |
| | 132 | **1FT6 136–6SF7.....** | 145 (1283) | 104 | 175 (1549) | 111 | 45.5 (60.32) | 66.4 (0.5876) | 123 (271.2) | 3 | 124 | **6SE7 031–2□F□0** |

For detailed motor information, please refer to Catalog DA 65.3.

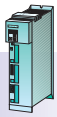
**P** for Compact PLUS units, **D** for compact units, **E** and **F** for chassis units

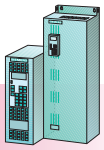
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## Inverters with air-cooled 1FT6 synchronous motors (continued)

| Motor data for a 100 K temperature increase | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | | Rated current | Converter E / Inverter T |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | | |
| **4500** Non-ventilated | 63 | **1FT6 061–6AH7.....** | 2.9 (26) | 3.4 | 4 (35) | 4.1 | 1.4 (1.88) | 0.6 (0.0053) | 8 (17.6) | 1 | | 6.1 | **6SE7 016–0T P□0** |
| | 63 | **1FT6 062–6AH7.....** | 3.6 (32) | 3.9 | 6 (53) | 5.6 | 1.7 (2.28) | 0.85 (0.0075) | 9.5 (20.9) | 1 | | 6.1 | **6SE7 016–0T P□0** |
| | 63 | **1FT6 064–6AH7.....** | 4.8 (42) | 5.5 | 9.5 (84) | 9.1 | 2.3 (3.08) | 1.3 (0.0115) | 12.5 (27.6) | 1 | | 10.2 | **6SE7 021–0T P□0** |
| | 80 | **1FT6 081–8AH7.....** | 5.8 (51) | 7.3 | 8 (71) | 9 | 2.7 (3.62) | 2.1 (0.0186) | 12.5 (27.6) | 1.5 | | 10.2 | **6SE7 021–0T P□0** |
| | 80 | **1FT6 082–8AH7.....** | 8.5 (75) | 11 | 13 (115) | 15 | 4 (5.36) | 3 (0.0265) | 15 (33.1) | 1.5 | | 17.5 | **6SE7 021–8T P□0** |
| | 80 | **1FT6 084–8AH7.....** | 10.5 (173) | 12.5 | 20 (177) | 21.6 | 4.9 (6.57) | 4.8 (0.0425) | 20.5 (45.2) | 1.5 | | 25.5 | **6SE7 022–6T P□0** |
| | 80 | **1FT6 086–8AH7.....** | 12 (106) | 12.6 | 27 (239) | 25.3 | 5.7 (7.64) | 6.65 (0.0588) | 25.5 (56.2) | 1.5 | | 25.5 | **6SE7 022–6T P□0** |
| | 100 | **1FT6 102–8AH7.....** | 12 (106) | 12 | 27 (239) | 24.8 | 5.7 (7.64) | 9.9 (0.0876) | 27.5 (60.6) | 1.5 | | 25.5 | **6SE7 022–6T P□0** |
| **4500** Blower-ventilated | 80 | **1FT6 084–8SH7.....** | 20 (177) | 24.5 | 26 (230) | 28 | 9.4 (12.6) | 4.8 (0.0425) | 25 (55.1) | 1.5 | | 34 | **6SE7 023–4T P□0** |
| | 80 | **1FT6 086–8SH7.....** | 27 (239) | 31.5 | 35 (310) | 39 | 12.7 (17) | 6.65 (0.0588) | 30 (66.1) | 3 | | 47 | **6SE7 024–7□D□1** |
| | 100 | **1FT6 105–8SH7.....** | 40 (354) | 41 | 65 (575) | 64 | 18.8 (25.2) | 16.8 (0.1486) | 45.5 (100) | 3 | | 72 | **6SE7 027–2□D□1** |
| **6000** Non-ventilated | 28 | **1FT6 021–6AK71....** | 0.3 (2.7) | 1.1 | 0.4 (3.5) | 1.25 | 0.19 (0.25) | 0.021 (0.00019) | 1.2 (2.6) | 1 | | 2 | **6SE7 012–0T P□0** |
| | 28 | **1FT6 024–6AK71....** | 0.5 (4.4) | 0.9 | 0.8 (7.1) | 1.25 | 0.31 (0.42) | 0.034 (0.0003) | 2.1 (4.6) | 1 | | 2 | **6SE7 012–0T P□0** |
| | 36 | **1FT6 031–4AK7.....** | 0.75 (6.63) | 1.2 | 1 (9) | 1.45 | 0.47 (0.63) | 0.065 (0.0006) | 3.1 (6.8) | 1 | | 2 | **6SE7 012–0T P□0** |
| | 36 | **1FT6 034–4AK7.....** | 1.4 (12) | 2.1 | 2 (18) | 2.6 | 0.88 (1.18) | 0.11 (0.001) | 4.4 (9.7) | 1 | | 4 | **6SE7 014–0T P□0** |
| | 48 | **1FT6 041–4AK7.....** | 1.7 (15) | 2.4 | 2.6 (22) | 3 | 1.1 (1.47) | 0.29 (0.0026) | 6.6 (14.6) | 1 | | 4 | **6SE7 014–0T P□0** |
| | 63 | **1FT6 061–6AK7.....** | 2.1 (19) | 3.1 | 4 (35) | 5 | 1.3 (1.74) | 0.6 (0.0053) | 8 (17.6) | 1 | | 6.1 | **6SE7 016–0T P□0** |
| | 63 | **1FT6 062–6AK7.....** | 2.1 (19) | 3.2 | 6 (53) | 7.5 | 1.3 (1.74) | 0.85 (0.0075) | 9.5 (20.9) | 1 | | 10.2 | **6SE7 021–0T P□0** |
| | 63 | **1FT6 064–6AK7.....** | 2.1 (19) | 3.5 | 9.5 (84) | 12.1 | 1.3 (1.74) | 1.3 (0.0115) | 12.5 (27.6) | 1 | | 13.2 | **6SE7 021–3T P□0** |
| | 48 | **1FT6 044–4AK7.....** | 3 (27) | 4.1 | 5 (44) | 5.9 | 1.9 (2.55) | 0.51 (0.0045) | 8.3 (18.3) | 1 | | 6.1 | **6SE7 016–0T P□0** |
| | 80 | **1FT6 081–8AK7.....** | 4.6 (41) | 7.7 | 8 (71) | 11.1 | 2.9 (3.89) | 2.1 (0.0186) | 12.5 (27.6) | 1.5 | | 13.2 | **6SE7 021–3T P□0** |
| | 80 | **1FT6 082–8AK7.....** | 5.5 (49) | 9.1 | 13 (115) | 18.2 | 3.5 (4.69) | 3 (0.0265) | 15 (33.1) | 1.5 | | 25.5 | **6SE7 022–6T P□0** |
| | 80 | **1FT6 084–8AK7.....** | 6.5 (57.5) | 9.2 | 20 (177) | 25 | 4.1 (5.5) | 4.8 (0.0425) | 20.5 (45.2) | 1.5 | | 25.5 | **6SE7 022–6T P□0** |
| **6000** Blower-Ventilated | 80 | **1FT6 084–8SK7.....** | 17 (150) | 25.5 | 26 (230) | 36 | 10.7 (14.34) | 4.8 (0.0425) | 25 (55.1) | 1.5 | | 37.5 | **6SE7 023–8T P□0** |
| | 80 | **1FT6 086–8SK7.....** | 22 (195) | 29 | 35 (310) | 45 | 13.8 (18.5) | 6.65 (0.0588) | 30 (66.1) | 3 | | 47 | **6SE7 024–7□D□1** |

For detailed motor information, please refer to Catalog DA 65.3.

**P** for Compact PLUS units, **D** for compact units

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## Converters/inverters with water-cooled 1FT6 synchronous servomotors

| Motor data for a 100 K temperature increase | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated torque | Rated current | Stall torque | Stall current | Rated power | Moment of inertia without brake | Weight without brake | Plug size for power cable | Rated current | Converter **E**<br>Inverter **T** |
| $n_{rated}$ | | | $\tau_{rated}$ Nm | $I_{rated}$ | $\tau_0$ Nm | $I_0$ | $P_{rated}$ kW | $J$ x $10^{-3}$ kgm$^2$ | kg | | $I_{n\,conv}$ | |
| rpm | | Order No. | ($lb_f$-in) | A | ($lb_f$-in) | A | (HP) | ($lb_f$-in-s$^2$) | (lb) | | A | Order No. |
| **Supply voltage 3-ph. 400 V to 480 V AC for SIMOVERT MASTERDRIVES Motion Control** | | | | | | | | | | | | |
| **1500** | 100 | **1FT6 108–8WB7.....** | 116 (1027) | 43 | 119 (1053) | 41 | 18.2 (24.4) | 26 (0.2301) | 61.5 (136) | 3 | 47 | **6SE7 024–7□D□1** |
| **2000** | 100 | **1FT6 105–8WC7.....** | 82 (726) | 60 | 85 (752) | 58 | 17.2 (23.06) | 16.8 (0.1487) | 45.5 (100) | 3 | 59 | **6SE7 026–0□D□1** |
| | 100 | **1FT6 108–8WC7.....** | 115 (1018) | 57 | 119 (1053) | 54 | 24.1 (32.3) | 26 (0.2301) | 61.5 (136) | 3 | 59 | **6SE7 026–0□D□1** |
| **3000** | 63 | **1FT6 062–6WF7.....** | 10.1 (89) | 6.7 | 10.2 (90) | 6.8 | 3.2 (4.3) | 0.85 (0.0075) | 9.5 (21) | 1 | 10.2 | **6SE7 021–0T P□0** |
| | 63 | **1FT6 064–6WF7.....** | 16.1 (143) | 10.2 | 16.2 (143) | 10.4 | 5.1 (6.8) | 1.3 (0.0115) | 12.5 (27.6) | 1 | 13.2 | **6SE7 021–3T P□0** |
| | 80 | **1FT6 084–8WF7.....** | 35 (310) | 27 | 35 (310) | 26 | 11 (14.7) | 4.8 (0.4248) | 21 (46) | 1.5 | 34 | **6SE7 023–4T P□0** |
| | 80 | **1FT6 086–8WF7.....** | 46 (407) | 37 | 47 (416) | 35 | 14.5 (19.4) | 6.65 (0.0589) | 26 (57) | 1.5 | 37.5 | **6SE7 023–8T P□0** |
| | 100 | **1FT6 105–8WF7.....** | 78 (690) | 82 | 85 (752) | 83 | 24.5 (32.8) | 16.8 (0.1487) | 45.5 (100) | 3 | 92 | **6SE7 031–0□E□0** |
| | 100 | **1FT6 108–8WF7.....**[1)] | 109 (965) | 81 | 119 (1053) | 81 | 34.2 (45.8) | 26 (0.2301) | 61.5 (136) | 3 | 92 | **6SE7 031–0□E□0** |
| **4500** | 63 | **1FT6 062–6WH7.....** | 10 (89) | 9.3 | 10.2 (90) | 9.5 | 4.7 (6.3) | 0.85 (0.0075) | 9.5 (21) | 1 | 13.2 | **6SE7 021–3T P□0** |
| | 63 | **1FT6 064–6WH7.....** | 16 (142) | 15.2 | 16.2 (143) | 15.5 | 7.5 (10) | 1.3 (0.0115) | 12.5 (27.6) | 1 | 25.5 | **6SE7 022–6T P□0** |
| | 80 | **1FT6 084–8WH7.....** | 35 (310) | 39 | 35 (310) | 38 | 16.5 (22.1) | 4.8 (0.4248) | 21 (46) | 1.5 | 47 | **6SE7 024–7□D□1** |
| | 80 | **1FT6 086–8WH7.....** | 45 (398) | 53 | 47 (416) | 53 | 21.2 (28.4) | 6.65 (0.0589) | 26 (57) | 3 | 59 | **6SE7 026–0□D□1** |
| **6000** | 63 | **1FT6 062–6WK7.....** | 9.8 (87) | 12.2 | 10.2 (90) | 12.8 | 6.2 (8.3) | 0.85 (0.0075) | 9.5 (21) | 1 | 17.5 | **6SE7 021–8T P□0** |
| | 63 | **1FT6 064–6WK7.....** | 15.8 (140) | 20 | 16.2 (143) | 20.6 | 9.9 (13.3) | 1.3 (0.0115) | 12.5 (27.6) | 1 | 34 | **6SE7 023–4T P□0** |
| | 80 | **1FT6 084–8WK7.....** | 34 (301) | 51 | 35 (310) | 49 | 21.4 (28.7) | 4.8 (0.4248) | 21 (46) | 3 | 59 | **6SE7 026–0□D□1** |
| | 80 | **1FT6 086–8WK7.....** | 44 (390) | 58 | 47 (416) | 61 | 27.7 (37.1) | 6.65 (0.0589) | 26 (57) | 3 | 59 | **6SE7 026–0□D□1** |

For detailed motor information, please refer to Catalog DA 65.3.

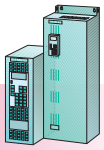
**P** for Compact PLUS units, **D** for compact units, **E** for chassis units

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7

1) Motor type 1FT6 108-8WF7 .– . . . . is only available with vibration severity grade N.



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## Converters/inverters with 1PH7[1] asynchronous servomotors

| Motor data (utilization to temperature rise class F) | | | | | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated power | Rated torque | Rated current | Rated voltage | Speed during field-weakening[2] | Max. operating speed[3] | Power factor | Magnetizing current | Efficiency | Rated frequency | Moment of inertia | Weight | Rated current | Converter E / Inverter T | |
| $n_{rated}$ | | | $P_{rated}$ kW | $\tau_{rated}$ Nm | $I_{rated}$ | $V_{rated}$ | $n_1$ | $n_{max}$ | | $I_\mu$ | $\eta_{rated}$ | $f_{rated}$ | $J$ kg/m² | $m$ kg | $I_{n\,conv}$ | | |
| rpm | | Order No. | (HP) | (lb$_f$-in) | A | V | rpm | rpm | cos $\varphi$ | A | | Hz | (lb$_f$-in-s²) | (lb) | A | Order No. | |
| **Supply voltage 3-ph. 400 V AC for SIMOVERT MASTERDRIVES Motion Control converters** | | | | | | | | | | | | | | | | | |
| **400** | 160 | **1PH7 163–..B..–....** | 9.5 (12.7) | 227 (167) | 30 | 274 | 800 | 6500 | 0.88 | 11.5 | 0.809 | 14.3 | 0.185 (1.637) | 175 (386) | 34 | **6SE7 023–4□C□1** | |
| | 160 | **1PH7 167–..B..–....** | 13 (17.4) | 310 (228) | 37 | 294 | 800 | 6500 | 0.88 | 14 | 0.814 | 14.3 | 0.228 (2.018) | 210 (463) | 37.5 | **6SE7 023–8□D□1** | |
| | 180 | **1PH7 184–..B..–....** | 16.3 (21.8) | 390 (287) | 51 | 271 | 800 | 5000 | 0.84 | 26 | 0.83 | 14.2 | 0.503 (4.451) | 370 (816) | 59 | **6SE7 026–0□D□1** | |
| | 180 | **1PH7 186–..B..–....** | 21.2 (28.4) | 505 (372) | 67 | 268 | 800 | 5000 | 0.81 | 38.5 | 0.845 | 14 | 0.666 (5.363) | 440 (970) | 72 | **6SE7 027–2□D□1** | |
| | 225 | **1PH7 224–..B..–....** | 30.4 (40.8) | 725 (533) | 88 | 268 | 800 | 4500 | 0.87 | 36.5 | 0.864 | 14 | 1.479 (13.088) | 630 (1389) | 92 | **6SE7 031–0□E□0** | |
| | 225 | **1PH7 226–..B..–....** | 39.2 (52.5) | 935 (688) | 114 | 264 | 800 | 4500 | 0.86 | 49 | 0.88 | 14 | 1.93 (17.08) | 750 (1653) | 124 | **6SE7 031–2□F□0** | |
| | 225 | **1PH7 228–..B..–....** | 48 (64.3) | 1145 (842) | 136 | 272 | 800 | 4500 | 0.85 | 60.5 | 0.888 | 13.9 | 2.326 (20.584) | 860 (1896) | 155 | **6SE7 031–8□F□0** | |
| **1000** | 100 | **1PH7 103–..D..–....** | 3.7 (5) | 35 (26) | 10 | 343 | 1800 | 9000 | 0.82 | 4.8 | 0.794 | 35.6 | 0.017 (0.150) | 40 (88) | 10.2 | **6SE7 021–0□A□1** | |
| | 100 | **1PH7 107–..D..–....** | 6.25 (8.4) | 60 (44) | 17.5 | 319 | 2000 | 9000 | 0.81 | 8.9 | 0.822 | 35.3 | 0.029 (0.257) | 65 (143) | 17.5 | **6SE7 021–8□B□1** | |
| | 132 | **1PH7 133–..D..–....** | 12 (16.1) | 115 (85) | 30 | 336 | 1800 | 8000 | 0.86 | 13 | 0.865 | 34.8 | 0.076 (0.673) | 90 (198) | 34 | **6SE7 023–4□C□1** | |
| | 132 | **1PH7 137–..D..–....** | 17 (22.8) | 162 (119) | 43 | 322 | 2000 | 8000 | 0.86 | 19 | 0.878 | 34.6 | 0.109 (0.965) | 150 (331) | 47 | **6SE7 024–7□D□1** | |
| | 160 | **1PH7 163–..D..–....** | 22 (29.5) | 210 (154) | 55 | 315 | 2000 | 6500 | 0.85 | 24 | 0.899 | 34.2 | 0.185 (1.637) | 175 (386) | 59 | **6SE7 026–0□D□1** | |
| | 160 | **1PH7 167–..D..–....** | 28 (37.5) | 267 (196) | 71 | 312 | 2000 | 6500 | 0.84 | 33 | 0.903 | 34.2 | 0.228 (2.018) | 210 (463) | 72 | **6SE7 027–2□D□1** | |
| | 180 | **1PH7 184–..D..–....** | 39 (52.3) | 372 (274) | 90 | 335 | 2000 | 5000 | 0.83 | 44 | 0.913 | 34.2 | 0.503 (4.451) | 370 (816) | 92 | **6SE7 031–0□E□0** | |
| | 180 | **1PH7 186–..D..–....** | 51 (68.4) | 485 (357) | 116 | 340 | 2000 | 5000 | 0.81 | 58 | 0.918 | 34.1 | 0.666 (5.894) | 440 (970) | 124 | **6SE7 031–2□F□0** | |
| | 225 | **1PH7 224–..D..–....** | 71 (95.2) | 678 (499) | 161 | 335 | 2000 | 4500 | 0.81 | 78.5 | 0.934 | 33.9 | 1.479 (13.088) | 630 (1389) | 175 | **6SE7 032–1□G□0** | |
| | 225 | **1PH7 226–..D..–....** | 92 (123.3) | 880 (647) | 198 | 340 | 2000 | 4500 | 0.84 | 87.5 | 0.935 | 33.9 | 1.93 (17.08) | 750 (1653) | 218 | **6SE7 032–6□G□0** | |
| | 225 | **1PH7 228–..D..–....** | 113 (151.5) | 1080 (794) | 240 | 340 | 2000 | 4500 | 0.85 | 98 | 0.938 | 33.9 | 2.326 (20.584) | 860 (1896) | 262 | **6SE7 033–2□G□0** | |

For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7

1) For rated currents below 37.5 A, Compact PLUS units can also be used.

2) $n_1$: motor speed at which, when $P = P_{rated}$, there is still a power reserve of 30 % before the stalling limit is reached or at which the mechanical speed limit is reached or at which the speed is limited by the SIMOVERT MASTERDRIVES Motion Control converter due to $f_{max.} \leq 2 \cdot f_{rated}$.

3) Warning! The maximum speed in field-weakening mode is sometimes limited to lower values due to $f_{max.} \leq 2 \cdot f_{rated}$.



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| Motor data (utilization to temperature rise class F) | | | | | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated power | Rated torque | Rated current | Rated voltage | Speed during field-weakening[1] | Max. operating speed[2] | Power factor | Magnetizing current | Efficiency | Rated frequency | Moment of inertia | Weight | Rated current | Converter E / Inverter T | |
| $n_{rated}$ | | | $P_{rated}$ kW | $\tau_{rated}$ Nm | $I_{rated}$ | $V_{rated}$ | $n_1$ | $n_{max}$ | | $I_\mu$ | $\eta_{rated}$ | $f_{rated}$ | $J$ kg/m² | $m$ kg | $I_{n\,conv}$ | | |
| rpm | | Order No. | (HP) | ($lb_f$-in) | A | V | rpm | rpm | cos φ | A | | Hz | ($lb_f$-in-s²) | (lb) | A | Order No. | |
| **Supply voltage 3-ph. 400 V AC for SIMOVERT MASTERDRIVES Motion Control converters** | | | | | | | | | | | | | | | | | |
| **1500** | 100 | **1PH7101–..F..–....** | 3.7 (5) | 24 (18) | 10 | 350 | 3000 | 9000 | 0.74 | 5.9 | 0.847 | 51.6 | 0.017 (0.15) | 40 (88) | 10.2 | **6SE7021–0□A□1** | |
| | 100 | **1PH7103–..F..–....** | 5.5 (7.4) | 35 (26) | 13 | 350 | 2100 | 9000 | 0.84 | 5.4 | 0.832 | 52.7 | 0.017 (0.15) | 40 (88) | 13.2 | **6SE7021–3□B□1** | |
| | 100 | **1PH7105–..F..–....** | 7 (9.4) | 45 (33) | 17.5 | 346 | 3000 | 9000 | 0.78 | 9.4 | 0.866 | 51.7 | 0.029 (0.257) | 65 (143) | 17.5 | **6SE7021–8□B□1** | |
| | 100 | **1PH7107–..F..–....** | 9 (12.1) | 57 (42) | 23.5 | 336 | 3000 | 9000 | 0.8 | 11 | 0.859 | 52 | 0.029 (0.257) | 65 (143) | 25.5 | **6SE7022–6□C□1** | |
| | 132 | **1PH7131–..F..–....** | 11 (14.7) | 70 (51) | 24 | 350 | 2900 | 8000 | 0.88 | 8.4 | 0.896 | 51.3 | 0.076 (0.673) | 90 (198) | 25.5 | **6SE7022–6□C□1** | |
| | 132 | **1PH7133–..F..–....** | 15 (20.1) | 96 (71) | 34 | 346 | 2500 | 8000 | 0.85 | 14 | 0.895 | 51.3 | 0.076 (0.673) | 90 (198) | 34 | **6SE7023–4□C□5** | |
| | 132 | **1PH7135–..F..–....** | 18.5 (24.8) | 118 (87) | 42 | 350 | 3000 | 8000 | 0.85 | 17 | 0.902 | 51.1 | 0.109 (0.965) | 150 (331) | 47 | **6SE7024–7□D□1** | |
| | 132 | **1PH7137–..F..–....** | 22 (29.5) | 140 (103) | 57 | 308 | 3000 | 8000 | 0.85 | 23 | 0.9 | 51.2 | 0.109 (0.965) | 150 (331) | 59 | **6SE7026–0□D□1** | |
| | 160 | **1PH7163–..F..–....** | 30 (40.2) | 191 (140) | 72 | 319 | 3000 | 6500 | 0.85 | 30 | 0.912 | 50.9 | 0.185 (1.637) | 175 (386) | 72 | **6SE7027–2□D□0** | |
| | 160 | **1PH7167–..F..–....** | 37 (49.6) | 236 (174) | 82 | 350 | 3000 | 6500 | 0.86 | 32 | 0.916 | 50.8 | 0.228 (2.018) | 210 (463) | 92 | **6SE7031–0□E□0** | |
| | 180 | **1PH7 184–..F..–....** | 51 (68.4) | 325 (239) | 120 | 335 | 3000 | 5000 | 0.78 | 64 | 0.93 | 50.7 | 0.503 (4.451) | 370 (816) | 124 | **6SE7 031–2□F□0** | |
| | 180 | **1PH7 186–..F..–....** | 74 (99.2) | 471 (346) | 170 | 330 | 3000 | 5000 | 0.81 | 84 | 0.937 | 50.7 | 0.666 (5.894) | 440 (970) | 175 | **6SE7 032–1□G□0** | |
| | 225 | **1PH7 224–..U..–....** | 95 (127.3) | 605 (445) | 204 | 340 | 3000 | 4500 | 0.84 | 88.5 | 0.944 | 50.6 | 1.479 (13.088) | 630 (1389) | 218 | **6SE7 032–6□G□0** | |
| | 225 | **1PH7 226–..F..–....** | 130 (174.3) | 828 (609) | 278 | 340 | 3000 | 4500 | 0.84 | 120 | 0.945 | 50.6 | 1.93 (17.08) | 750 (1653) | 308 | **6SE7 033–7□G□0** | |
| | 225 | **1PH7 228–..F..–....** | 160 (214.5) | 1019 (752) | 350 | 340 | 3000 | 4500 | 0.82 | 169 | 0.949 | 50.5 | 2.326 (20.585) | 860 (1896) | 423 | **6SE7 035–1E K□0** | |
| **2000** | 100 | **1PH7 103–..G..–....** | 7 (9.4) | 33 (24) | 17.5 | 343 | 4000 | 9000 | 0.8 | 8.3 | 0.857 | 68.9 | 0.017 (0.15) | 40 (88) | 17.5 | **6SE7 021–8□C□1** | |
| | 100 | **1PH7 107–..G..–....** | 10.5 (14.1) | 50 (37) | 26 | 350 | 4000 | 9000 | 0.8 | 12 | 0.869 | 68.6 | 0.029 (0.257) | 65 (143) | 25.5 | **6SE7 022–6□C□1** | |
| | 132 | **1PH7 133–..G..–....** | 20 (26.8) | 96 (71) | 45 | 350 | 3900 | 8000 | 0.86 | 18 | 0.898 | 68 | 0.076 (0.673) | 90 (198) | 47 | **6SE7 024–7□D□1** | |
| | 132 | **1PH7 137–..G..–....** | 28 (37.5) | 134 (99) | 60 | 350 | 4000 | 8000 | 0.88 | 21 | 0.903 | 68 | 0.109 (0.965) | 150 (331) | 59 | **6SE7 027–3□D□1** | |
| | 160 | **1PH7 163–..G..–....** | 36 (48.3) | 172 (126) | 85 | 333 | 4000 | 6500 | 0.84 | 37 | 0.906 | 67.5 | 0.185 (1.637) | 175 (386) | 92 | **6SE7 031–0□E□0** | |
| | 160 | **1PH7 167–..G..–....** | 41 (55) | 196 (145) | 89 | 350 | 4000 | 6500 | 0.84 | 40 | 0.907 | 67.4 | 0.228 (2.018) | 210 (463) | 92 | **6SE7 031–0□E□0** | |
| **2500** | 180 | **1PH7 184–..L..–....** | 78 (104.6) | 298 (219) | 171 | 340 | 5000 | 5000 | 0.82 | 77 | 0.937 | 84.1 | 0.503 (4.451) | 370 (816) | 175 | **6SE7 032–1□G□0** | |
| | 180 | **1PH7 186–..L..–....** | 106 (142.1) | 405 (298) | 235 | 335 | 5000 | 5000 | 0.82 | 108 | 0.942 | 84.1 | 0.666 (5.894) | 440 (970) | 262 | **6SE7 033–2□G□0** | |
| | 225 | **1PH7 224–..L..–....** | 142 (190.3) | 542 (399) | 298 | 340 | 4500 | 4500 | 0.84 | 115 | 0.948 | 84 | 1.479 (13.088) | 630 (1389) | 308 | **6SE7 033–7□G□0** | |
| | 225 | **1PH7 226–..L..–....** | 168 (225.2) | 642 (474) | 362 | 335 | 4500 | 4500 | 0.84 | 154 | 0.95 | 84 | 1.93 (17.08) | 750 (1653) | 423 | **6SE7 035–1E K□0** | |
| | 225 | **1PH7 228–..L..–....** | 205 (274.8) | 783 (578) | 433 | 340 | 4500 | 4500 | 0.84 | 185 | 0.95 | 83.9 | 2.326 (20.585) | 860 (1896) | 491 | **6SE7 036–0E K□0** | |


For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5

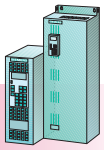
SIMOVERT MASTERDRIVES Motion Control Performance 2 7


1) $n_1$: motor speed at which, when $P = P_{rated}$, there is still a power reserve of 30 % before the stalling limit is reached or at which the mechanical speed limit is reached or at which the speed is limited by the SIMOVERT MASTERDRIVES Motion Control converter due to $f_{max.} \leq 2 \cdot f_{rated}$.

2) Warning! The maximum speed in field-weakening mode is sometimes limited to lower values due to $f_{max.} \leq 2 \cdot f_{rated}$.




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## Converters/inverters with 1PH7[1]) asynchronous servomotors (continued)

| Motor data (utilization to temperature rise class F) | | | | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated power | Rated torque | Rated current | Rated voltage | Speed during field-weakening[2]) | Max. operating speed[3]) | Power factor | Magnetizing current | Efficiency | Rated frequency | Moment of inertia | Weight | Rated current | Converter E / Inverter T |
| $n_{rated}$ rpm | | Order No. | $P_{rated}$ kW (HP) | $\tau_{rated}$ Nm ($lb_f$-in) | $I_{rated}$ A | $V_{rated}$ V | $n_1$ rpm | $n_{max}$ rpm | cos φ | $I_\mu$ A | $\eta_{rated}$ | $f_{rated}$ Hz | $J$ kg/m² ($lb_f$-in-s²) | $m$ kg (lb) | $I_{n\,conv}$ A | Order No. |
| **Supply voltage 3-ph. 480 V AC for SIMOVERT MASTERDRIVES Motion Control converters** | | | | | | | | | | | | | | | | |
| **400** | 160 | **1PH7 163–..B..–....** | 9.5 (12.7) | 227 (167) | 30 | 274 | 800 | 6500 | 0.88 | 11.5 | 0.809 | 14.3 | 0.185 (1.637) | 175 (386) | 34 | **6SE7 023–4□C□1** |
| | 160 | **1PH7 167–..B..–....** | 13 (17.4) | 310 (228) | 37 | 294 | 800 | 6500 | 0.88 | 14 | 0.814 | 14.3 | 0.228 (2.018) | 210 (463) | 37.5 | **6SE7 023–8□D□1** |
| | 180 | **1PH7 184–..B..–....** | 16.3 (21.8) | 390 (287) | 51 | 271 | 800 | 5000 | 0.84 | 26 | 0.83 | 14.2 | 0.503 (4.451) | 370 (816) | 59 | **6SE7 026–0□D□1** |
| | 180 | **1PH7 186–..B..–....** | 21.2 (28.4) | 505 (372) | 67 | 268 | 800 | 5000 | 0.81 | 38.5 | 0.845 | 14 | 0.666 (5.363) | 440 (970) | 72 | **6SE7 027–2□D□1** |
| | 225 | **1PH7 224–..B..–....** | 30.4 (40.8) | 725 (533) | 88 | 268 | 800 | 4500 | 0.87 | 36.5 | 0.864 | 14 | 1.479 (13.088) | 630 (1389) | 92 | **6SE7 031–0□E□0** |
| | 225 | **1PH7 226–..B..–....** | 39.2 (52.5) | 935 (688) | 114 | 264 | 800 | 4500 | 0.86 | 49 | 0.88 | 14 | 1.93 (17.08) | 750 (1653) | 124 | **6SE7 031–2□F□0** |
| | 225 | **1PH7 228–..B..–....** | 48 (64.3) | 1145 (842) | 136 | 272 | 800 | 4500 | 0.85 | 60.5 | 0.888 | 13.9 | 2.326 (20.584) | 860 (1896) | 155 | **6SE7 031–8□F□0** |
| **1150** | 100 | **1PH7 103–..D..–....** | 4.3 (5.8) | 36 (26) | 10 | 391 | 2200 | 9000 | 0.81 | 5 | 0.813 | 40.6 | 0.017 (0.15) | 40 (88) | 10.2 | **6SE7 021–0□A□1** |
| | 100 | **1PH7 107–..D..–....** | 7.2 (9.7) | 60 (44) | 17.5 | 360 | 2300 | 9000 | 0.81 | 8.8 | 0.838 | 40.3 | 0.029 (0.257) | 65 (143) | 17.5 | **6SE7 021–8□B□1** |
| | 132 | **1PH7 133–..D..–....** | 13.5 (18.1) | 112 (82) | 29 | 381 | 2300 | 8000 | 0.85 | 13 | 0.877 | 39.7 | 0.076 (0.673) | 90 (198) | 34 | **6SE7 023–4□C□1** |
| | 132 | **1PH7 137–..D..–....** | 19.5 (26.1) | 162 (119) | 43 | 367 | 2300 | 8000 | 0.86 | 19 | 0.887 | 39.6 | 0.109 (0.965) | 150 (331) | 47 | **6SE7 024–7□D□1** |
| | 160 | **1PH7 163–..D..–....** | 25 (33.5) | 208 (153) | 55 | 364 | 2300 | 6500 | 0.84 | 25 | 0.904 | 39.2 | 0.185 (1.637) | 175 (386) | 59 | **6SE7 026–0□D□1** |
| | 160 | **1PH7 167–..D..–....** | 31 (41.6) | 257 (189) | 70 | 357 | 2300 | 6500 | 0.83 | 34 | 0.909 | 39.1 | 0.228 (2.018) | 210 (436) | 72 | **6SE7 027–2□D□1** |
| | 180 | **1PH7 184–..D..–....** | 44 (59) | 366 (269) | 89 | 383 | 2300 | 5000 | 0.83 | 42 | 0.92 | 39.2 | 0.503 (4.451) | 370 (816) | 92 | **6SE7 031–0□E□0** |
| | 180 | **1PH7 186–..D..–....** | 58 (77.7) | 482 (354) | 116 | 390 | 2300 | 5000 | 0.81 | 58 | 0.925 | 39.1 | 0.666 (5.894) | 440 (970) | 124 | **6SE7 031–2□F□0** |
| | 225 | **1PH7 224–..D..–....** | 81 (108.6) | 670 (346) | 160 | 385 | 2300 | 4500 | 0.81 | 79 | 0.938 | 38.9 | 1.479 (13.088) | 630 (1389) | 175 | **6SE7 032–1□G□0** |
| | 225 | **1PH7 226–..D..–....** | 105 (140.8) | 870 (640) | 197 | 390 | 2300 | 4500 | 0.84 | 87.5 | 0.941 | 38.9 | 1.93 (17.08) | 750 (1653) | 218 | **6SE7 032–6□G□0** |
| | 225 | **1PH7 228–..D..–....** | 129 (172.9) | 1070 (787) | 238 | 390 | 2300 | 4500 | 0.85 | 98 | 0.943 | 38.9 | 2.326 (20.584) | 860 (1896) | 262 | **6SE7 033–2□G□0** |

For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5
SIMOVERT MASTERDRIVES Motion Control Performance 2 7

1) For rated currents below 37.5 A, Compact PLUS units can also be used.

2) $n_1$: motor speed at which, when $P = P_{rated}$, there is still a power reserve of 30 % before the stalling limit is reached or at which the mechanical speed limit is reached or at which the speed is limited by the SIMOVERT MASTERDRIVES Motion Control converter due to $f_{max.} \leq 2 \cdot f_{rated}$.

3) Warning! The maximum speed in field-weakening mode is sometimes limited to lower values due to $f_{max.} \leq 2 \cdot f_{rated}$.



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| Motor data (utilization to temperature rise class F) | | | | | | | | | | | | | | | | Converter data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated speed | Size | Motor | Rated power | Rated torque | Rated current | Rated voltage | Speed during field-weakening[1] | Max. operating speed[2] | Power factor | Magnetizing current | Efficiency | Rated frequency | Moment of inertia | Weight | Rated current | Converter E / Inverter T | |
| $n_{rated}$ | | | $P_{rated}$ kW | $\tau_{rated}$ Nm | $I_{rated}$ | $V_{rated}$ | $n_1$ | $n_{max}$ | | $I_\mu$ | $\eta_{rated}$ | $f_{rated}$ | $J$ kg/m² | $m$ kg | $I_{n\,conv}$ | | |
| rpm | | Order No. | (HP) | (lb$_f$-in) | A | V | rpm | rpm | cos $\varphi$ | A | | Hz | (lb$_f$-in-s²) | (lb) | A | Order No. | |
| **Supply voltage 3-ph. 480 V AC for SIMOVERT MASTERDRIVES Motion Control converters** | | | | | | | | | | | | | | | | | |
| **1750** | 100 | **1PH7 101–..F..–....** | 4.3 (5.8) | 24 (18) | 10 | 398 | 3500 | 9000 | 0.75 | 5.7 | 0.855 | 60 | 0.017 (0.15) | 40 (88) | 10.2 | **6SE7 021–0□A□1** | |
| | 100 | **1PH7 103–..F..–....** | 6.25 (8.4) | 34 (25) | 13 | 398 | 2600 | 9000 | 0.84 | 5.3 | 0.849 | 61 | 0.017 (0.15) | 40 (88) | 13.2 | **6SE7 021–3□B□1** | |
| | 100 | **1PH7 105–..F..–....** | 8 (10.7) | 44 (32) | 17.5 | 398 | 3500 | 9000 | 0.77 | 9.3 | 0.875 | 60 | 0.029 (0.257) | 65 (143) | 17.5 | **6SE7 022–8□C□1** | |
| | 100 | **1PH7 107–..F..–....** | 10 (13.4) | 55 (40) | 23 | 381 | 3500 | 9000 | 0.80 | 10.6 | 0.87 | 60.3 | 0.029 (0.257) | 65 (143) | 25.5 | **6SE7 022–6□C□1** | |
| | 132 | **1PH7 131–..F..–....** | 13 (17.4) | 71 (52) | 24 | 398 | 3300 | 8000 | 0.88 | 8.1 | 0.902 | 59.7 | 0.076 (0.673) | 90 (198) | 25.5 | **6SE7 022–6□C□1** | |
| | 132 | **1PH7 133–..F..–....** | 17.5 (23.5) | 96 (71) | 34 | 398 | 3400 | 8000 | 0.85 | 14 | 0.9 | 59.7 | 0.076 (0.673) | 90 (198) | 34 | **6SE7 023–4□C□1** | |
| | 132 | **1PH7 135–..F..–....** | 21.5 (28.8) | 117 (86) | 42 | 398 | 3500 | 8000 | 0.86 | 16 | 0.906 | 59.5 | 0.109 (0.965) | 150 (331) | 47 | **6SE7 024–7□D□1** | |
| | 132 | **1PH7 137–..F..–....** | 25 (33.5) | 136 (100) | 56 | 357 | 3500 | 8000 | 0.85 | 23 | 0.902 | 59.5 | 0.109 (0.965) | 150 (331) | 59 | **6SE7 026–0□D□1** | |
| | 160 | **1PH7 163–..F..–....** | 34 (45.6) | 186 (136) | 72 | 364 | 3500 | 6500 | 0.86 | 28 | 0.915 | 59.2 | 0.185 (1.637) | 175 (386) | 72 | **6SE7 027–2□D□1** | |
| | 160 | **1PH7 167–..F..–....** | 41 (55) | 224 (165) | 79 | 398 | 3500 | 6500 | 0.86 | 30 | 0.92 | 59.2 | 0.228 (2.018) | 210 (463) | 92 | **6SE7 031–0□E□0** | |
| | 180 | **1PH7 184–..F..–....** | 60 (80.4) | 327 (240) | 120 | 388 | 3500 | 5000 | 0.78 | 64 | 0.934 | 59 | 0.503 (4.451) | 370 (816) | 124 | **6SE7 031–2□F□0** | |
| | 180 | **1PH7 186–..F..–....** | 85 (113.9) | 465 (342) | 169 | 385 | 3500 | 5000 | 0.8 | 84 | 0.94 | 59 | 0.666 (5.894) | 440 (970) | 186 | **6SE7 032–1□G□0** | |
| | 225 | **1PH7 224–..U..–....** | 110 (147.5) | 600 (441) | 203 | 395 | 3500 | 4500 | 0.84 | 88 | 0.944 | 58.9 | 1.479 (13.088) | 630 (1389) | 210 | **6SE7 032–6□G□0** | |
| | 225 | **1PH7 226–..F..–....** | 135 (181) | 737 (542) | 254 | 395 | 3500 | 4500 | 0.82 | 120 | 0.947 | 58.9 | 1.93 (17.08) | 750 (1653) | 262 | **6SE7 033–2□G□0** | |
| | 225 | **1PH7 228–..F..–....** | 179 (240) | 975 (719) | 342 | 395 | 3500 | 4500 | 0.81 | 169 | 0.948 | 58.8 | 2.326 (20.585) | 860 (1896) | 423 | **6SE7 035–1E K□0** | |
| **2300** | 100 | **1PH7 103–..G..–....** | 7.5 (10.1) | 31 (23) | 17 | 388 | 4600 | 9000 | 0.79 | 8.2 | 0.866 | 78.8 | 0.017 (0.15) | 40 (88) | 17.5 | **6SE7 021–8□C□1** | |
| | 100 | **1PH7 107–..G..–....** | 12 (16.1) | 50 (37) | 26 | 400 | 4600 | 9000 | 0.8 | 12 | 0.878 | 78.7 | 0.029 (0.257) | 65 (143) | 25.5 | **6SE7 022–6□C□1** | |
| | 132 | **1PH7 133–..G..–....** | 22.5 (30.2) | 93 (68) | 45 | 398 | 4600 | 8000 | 0.86 | 17 | 0.9 | 78 | 0.076 (0.673) | 90 (198) | 47 | **6SE7 024–7□D□1** | |
| | 132 | **1PH7 137–..G..–....** | 29 (38.9) | 120 (88) | 56 | 398 | 4600 | 8000 | 0.87 | 21 | 0.903 | 77.8 | 0.109 (0.965) | 150 (331) | 59 | **6SE7 026–0□D□1** | |
| | 160 | **1PH7 163–..G..–....** | 38 (50.9) | 158 (116) | 82 | 398 | 4600 | 6500 | 0.78 | 43 | 0.9 | 77.3 | 0.185 (1.637) | 175 (386) | 92 | **6SE7 031–0□E□0** | |
| | 160 | **1PH7 167–..G..–....** | 44 (60) | 183 (135) | 85 | 398 | 4600 | 6500 | 0.84 | 40 | 0.911 | 77.4 | 0.228 (2.018) | 210 (463) | 92 | **6SE7 031–0□E□0** | |
| **2900** | 180 | **1PH7 184–..L..–....** | 81 (108.6) | 265 (195) | 158 | 395 | 5000 | 5000 | 0.8 | 77 | 0.934 | 97.4 | 0.503 (4.451) | 370 (816) | 175 | **6SE7 032–1□G□0** | |
| | 180 | **1PH7 186–..L..–....** | 101 (135.4) | 333 (245) | 206 | 385 | 5000 | 5000 | 0.78 | 107 | 0.936 | 97.3 | 0.666 (5.894) | 440 (970) | 218 | **6SE7 032–6□G□0** | |
| | 225 | **1PH7 224–..L..–....** | 149 (199.7) | 490 (360) | 274 | 395 | 4500 | 4500 | 0.84 | 115 | 0.946 | 97.3 | 1.479 (13.088) | 630 (1389) | 308 | **6SE7 033–7□G□0** | |
| | 225 | **1PH7 226–..L..–....** | 185 (248) | 610 (450) | 348 | 390 | 4500 | 4500 | 0.83 | 154 | 0.947 | 97.2 | 1.93 (17.081) | 750 (1654) | 423 | **6SE7 035–1E K□0** | |
| | 225 | **1PH7 228–..L..–....** | 215 (288) | 708 (522) | 402 | 395 | 4500 | 4500 | 0.82 | 186 | 0.946 | 97.2 | 2.326 (20.585) | 860 (1896) | 491 | **6SE7 036–0E K□0** | |


For detailed motor information, please refer to Catalog DA 65.3.

SIMOVERT MASTERDRIVES Motion Control 5

SIMOVERT MASTERDRIVES Motion Control Performance 2 7


1) $n_1$: motor speed at which, when $P = P_{rated}$, there is still a power reserve of 30 % before the stalling limit is reached or at which the mechanical speed limit is reached or at which the speed is limited by the SIMOVERT MASTERDRIVES Motion Control converter due to $f_{max.} \leq 2 \cdot f_{rated}$.

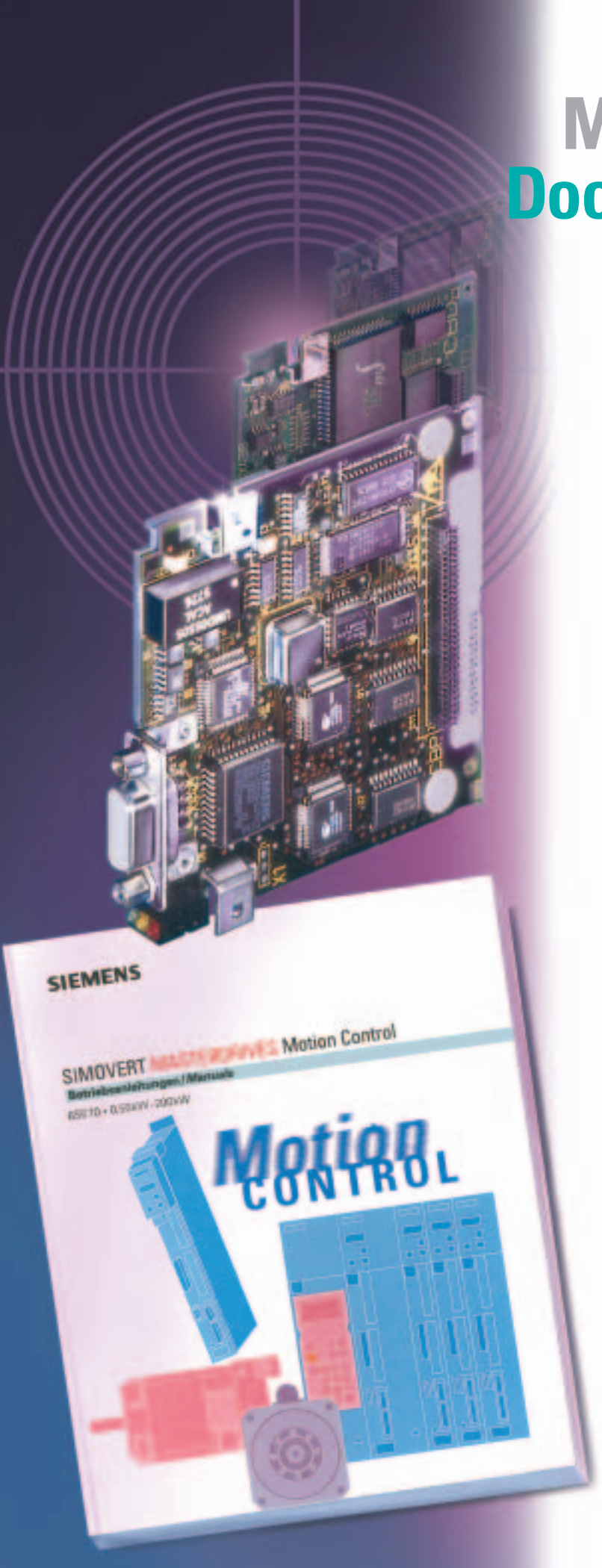
2) Warning! The maximum speed in field-weakening mode is sometimes limited to lower values due to $f_{max.} \leq 2 \cdot f_{rated}$.




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# Motion Control
# Documentation and training





5/2 **Overview**

5/2 **Operating instructions**

5/3 **Technology documentation**

5/4 **Reference works**
- Compendium
5/4
- Operating instructions

5/4 **Siemens safety engineering**

5/5 **Demonstration case**

5/8 **Training Center**

5/9 **Training courses**


5



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# Documentation and training

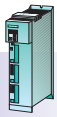
## Overview

The documentation for the units (converters, inverters, rectifier units, rectifier/regenerative units), system components and options is provided in English and German for the products ordered. When ordering MASTERDRIVES products, you can also order operating instructions in other languages as follows:

| Language | Code |
|---|---|
| French/English | **D77** |
| Spanish/English | **D78** |
| Italian/English | **D72** |

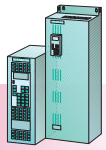
The documentation with its detailed description of the parameter lists and control concepts is very extensive. The additionally available free function blocks, which can be combined and connected as required with the help of the BICO system, require additional instructions. Therefore, the documentation is split up into three parts:

- The operating instructions are supplied with the units and contain the information necessary for standard drives, without the parameter lists and without the binector/connector lists.



**Compact PLUS units**

- The Compendium contains the detailed documentation for the software, including parameter lists and binector/connector lists as well as block circuit diagrams for the various types of open-loop and closed-loop control and function blocks. The Compendium must be ordered separately and is valid for all types of units. The Compendium is necessary when
  - the technology software is used (centrally or distributed)
  - additional signals, above and beyond those of the factory settings, are to be processed, i.e. if access to the parameter list is required.



**Compact and chassis units**

  - the full range of functions of the converter software, including communication by means of field-bus systems, is to be used
  - additional inputs/outputs are envisaged via the EB1 and EB2 expansion boards
  - the free function blocks are to be used.
- The CD-ROM is included in the scope of supply (exception: Option D99). This contains:
  - DriveMonitor V 5.x (see page 6/101)
  - all operating instructions and the Compendium in the form of PDF files in German and English and other available languages.

## Operating instructions

### Converter and inverter units

| Operating instructions for | Size | Order No. |
|---|---|---|
| AC/AC Compact PLUS unit | | **6SE708☐–☐JP50** |
| AC/AC compact unit | A to D | **6SE708☐–☐JD50** |
| AC/AC chassis unit | E to K | **6SE708☐–☐JK50** |
| DC/AC Compact PLUS unit | | **6SE708☐–☐KP50** |
| DC/AC compact unit | A to D | **6SE708☐–☐KD50** |
| DC/AC chassis unit | E to J | **6SE708☐–☐KN50** |

| | |
|---|---|
| German/English | **7 6** |
| Italian/English | **7 2** |
| French/English | **7 7** |
| Spanish/English | **7 8** |

### Rectifier/regenerative units

| Operating instructions for | Size | Order No. |
|---|---|---|
| Compact and chassis units | C to K | **6SE708☐–☐AK85–1AA0** |

| | |
|---|---|
| English | **7 6** |
| Italian | **7 2** |
| French | **7 7** |
| Spanish | **7 8** |
| German | **0 0** |

### Rectifier units

| Operating instructions for | Size | Order No. |
|---|---|---|
| Compact PLUS unit[1] | | **6SE708☐–☐NP85–0AA0** |
| Compact unit | B and C | **6SE708☐–☐AC85–0AA0** |
| Chassis unit | E | **6SE708☐–☐AE85–0AA0** |
| Chassis unit | H and K | **6SE708☐–☐AK85–0AA0** |

| | |
|---|---|
| German/English | **7 6** |
| Italian | **7 2** |
| French | **7 7** |
| Spanish | **7 8** |

### Self-commutated, pulsed rectifier/regenerative units Active Front End (AFE)

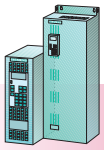
| Unit type | Frame size | Order No. | Order No. |
|---|---|---|---|
| Compact unit | A to D | **6SE708☐–☐KD80** | – |
| Chassis unit | E to G | – | **6SE708☐–☐CX86–2AA0** |

| | | |
|---|---|---|
| German/English | **7 6** | |
| German | | **0 0** |
| English | | **7 6** |
| Italian | **7 2** | **7 2** |
| French | **7 7** | **7 7** |
| Spanish | **7 8** | **7 8** |

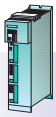
1) English is included in all the language combinations.



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Compact and chassis units



Compact PLUS units

Operating instructions

## System components

| Operating instructions for | Order No. |
|---|---|
| Capacitor module[1]) | **6SE708☐–☐NP87–2DD0** |
| DC link module[1]) | **6SE708☐–☐NP87–3CR0** |
| Braking units | **6SE708☐–☐CX87–2DA0** |
| Radio-interference suppression filter for Compact PLUS units[1]) | **6SE708☐–☐NP87–0FB0** |
| Radio-interference suppression filter for compact and chassis units | **6SE708☐–☐CX87–0FB0** |

| | | |
|---|---|---|
| German/English | 7 | 6 |
| Italian | 7 | 2 |
| French | 7 | 7 |
| Spanish | 7 | 8 |

## Electronics options

| Electronics options | Order No. |
|---|---|
| OP1S operator control panel | **6SE708☐–☐NX84–2FK0** |
| SBR1/2 resolver board | **6SE708☐–☐NX84–0FC0** |
| SBP incremental encoder board | **6SE708☐–☐NX84–0FA0** |
| SBM/SBM2 incremental encoder/multiturn encoder evaluation board | **6SE708☐–☐NX84–0FD0** |
| EB1 expansion board | **6SE708☐–☐NX84–0KB0** |
| EB2 expansion board | **6SE708☐–☐NX84–0KC0** |
| CBP/CBP2 communication board for PROFIBUS DP | **6SE708☐–☐NX84–0FF0** |
| CBC communication board for CAN bus | **6SE708☐–☐NX84–0FG0** |
| SLB communication board for SIMOLINK | **6SE708☐–☐NX84–0FJ0** |

| | | |
|---|---|---|
| German/English | 7 | 6 |
| Italian/English | 7 | 2 |
| French/English | 7 | 7 |
| Spanish/English | 7 | 8 |

## T100 and T300 technology boards

| Technology boards | Language | Order No. |
|---|---|---|
| T100 technology board – Hardware description | G/En/Fr/S/It | **6SE7080–0CX87–0BB0** |
| T300 technology board – Hardware description | German/English | **6SE7087–6CX84–0AH0** |
| | French | **6SE7087–7CX84–0AH0** |
| MS320 software module axial winder, for T300 | German | **6SE7080–0CX84–2AH1** |
| | English | **6SE7080–6CX84–2AH1** |
| MS340 software module angular synchronism control, for T300 | German | **6SE7080–0CX84–4AH1** |
| | English | **6SE7087–6CX84–4AH1** |
| | French | **6SE7087–7CX84–4AH1** |
| MS360 software module multi-motor drive, for T300 | German | **6SE7080–0CX84–6AH1** |
| | English | **6SE7087–6CX84–6AH1** |
| MS380 software module positioning control, for T300 | German | **6SE7080–0CX84–8AH1** |
| | English | **6SE7087–6CX84–8AH1** |
| MS100 software module universal drive, for T100 | German | **6SE7080–0CX84–0BB1** |
| | English | **6SE7087–6CX84–0BB1** |
| SCB1 interface board with SCI1 and SCI2 | | **6SE708☐–☐CX84–0BC0** |
| SCB2 interface board | | **6SE708☐–☐CX84–0BD0** |

| | | |
|---|---|---|
| German/English | 7 | 6 |
| Italian | 7 | 2 |
| French | 7 | 7 |
| Spanish | 7 | 8 |

5

## Technology documentation

The Compendium and the Motion Control project-planning package are necessary for using the technology

- distributed in the SIMOVERT MASTERDRIVES Motion Control

### *Compendium*

The SIMOVERT MASTERDRIVES Motion Control Compendium, as described on Page 5/2, is essential for technology applications.

| Language | Order No. |
|---|---|
| Compendium | **6SE708☐–☐QX☐0** |

| | | | |
|---|---|---|---|
| German | 0 | 0 | |
| English | 7 | 6 | |
| Italian | 7 | 2 | |
| French | 7 | 7 | |
| Spanish | 7 | 8 | |
| Motion Control Standard | | | 5 |
| Motion Control Performance 2 | | | 7 |

### *Motion Control project-planning package*

Motion Control project-planning package for MASTERDRIVES MC and SIMATIC S7

- Technology manual Detailed description of Motion Control
- Communication boards GMC Basic for SIMATIC S7.

Supplied as a manual with CD-ROM.

| Language | Order No. |
|---|---|
| Project-planning package Motion Control | **6AT1880–0AA00–1☐C0** |

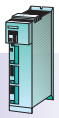
| | |
|---|---|
| German | A |
| English | B |

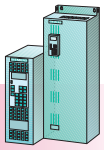
1) English is included in all the language combinations.



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## Reference works

Compact PLUS units 

Compact and chassis units 

### Compendium

***Contents***

- System description
- Configuration and connection examples
- Technology functions
- EMC guidelines
- Function blocks and parameters
- Parameterization
- Parameterizing steps
- Functions
- Process data
- Communication
  SST1/2 interfaces
  USS protocol
  PROFIBUS DP
  CAN
  SIMOLINK
- Annex
  Function diagrams
  Binector list
  Connector list
  Parameter list
  Faults and alarms list
  Motor list

| Language | Order No. |
|---|---|
| Compendium | **6SE708□–□QX□0** |
| German | 0 0 |
| English | 7 6 |
| Italian | 7 2 |
| French | 7 7 |
| Spanish | 7 8 |
| Motion Control Standard | 5 |
| Motion Control Performance 2 | 7 |

### Operating instructions

The reference work is to be regarded as reference documentation and includes operating instructions for the following components:

- Converters
- Inverters
- Rectifier units
- Rectifier/regenerative units
- Capacitor module
- DC link module
- Braking units
- Radio-interference suppression filters
- EB1/EB2 expansion boards
- Communication boards
  CBP/CBP2
  (PROFIBUS DP), CBC
  (CAN) and SLB (SIMOLINK)
- Encoder boards
  SBP, SBR1/2, SBM/SBM2
- OP1S operator control panel

The operating instructions contain a description of the basic functions and instructions for installation and start-up.

| Language | Order No. |
|---|---|
| Reference works<br>Operating instructions | **6SE708□–□NX50** |
| German/English | 7 6 |
| Italian/English | 7 2 |
| French/English | 7 7 |
| Spanish/English | 7 8 |

## Siemens safety engineering

***"Safety Integrated" application manual***

The "Safety Integrated" application manual uses technical explanations and application examples to show how to prevent or eliminate the hazards of electric and electronic devices.

***The complete CD-ROM about the safety system***

The "Safety Integrated" CD-ROM offers a comprehensive overview of safety technology and the widest range of safety components, while still embedded in the standard world of automation.

| Language | Order No. |
|---|---|
| Application manual | **6ZB5 000–0AA0□–0BA0** |
| German | 1 |
| English | 2 |

| Language | Order No. |
|---|---|
| "Safety Integrated" CD-ROM<br>German/English | **E20001–D10–M103–X–7400** |



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## SIMOVERT MASTERDRIVES Motion Control demonstration case

***1-axis system***

Stand-alone case equipped with

- Converter
- CBP/CBP2 communications board (for communicating with the PROFIBUS DP demonstration case)
- Control panel
- Pulse resistor
- Radio-interference suppression filter
- Motor, including resolver
- CEE plug for power supply connection, 3-ph. 400 V AC
- DriveMonitor visualization program for PCs.

Dimensions (W x H x D):
360 mm x 500 mm x 235 mm
(14.2 in x 19.7 in x 9.3 in)
Weight: approx. 20 kg (41.1 lb)

Order No.:
**6SX7000–0AF00**

***Transport trolley see page 5/7.***



Fig. 5/1
1-axis demonstration case

## Technology for MASTERDRIVES Motion Control demonstration case

***2-axis system***

Stand-alone case equipped with

- Converter/inverter
- CPB/CBP2 communication board (for communication with the "PROFIBUS DP demonstration case and the "SIMATIC S7 Motion Control" demonstration case)
- Control panel
- Pulse resistor
- Radio-interference suppression filter
- 1FT6 and 1FK6 servomotors with actual-value encoders
- CEE plug for power supply connection, 3-ph. 400 V AC
- DriveMonitor visualization program for PCs.

Dimensions (W x H x D):
510 mm x 610 mm x 300 mm
(20.1 in x 24 in x 11.8 in)
Weight: approx. 47 kg
(103.6 lb)

Order No.:
**6SX7000–0AF20**

On request, the SIMOVERT MASTERDRIVES Motion Control 2-axis demonstration case is also available for supply voltage 120 V AC.

***Transport trolley see page 5/7.***

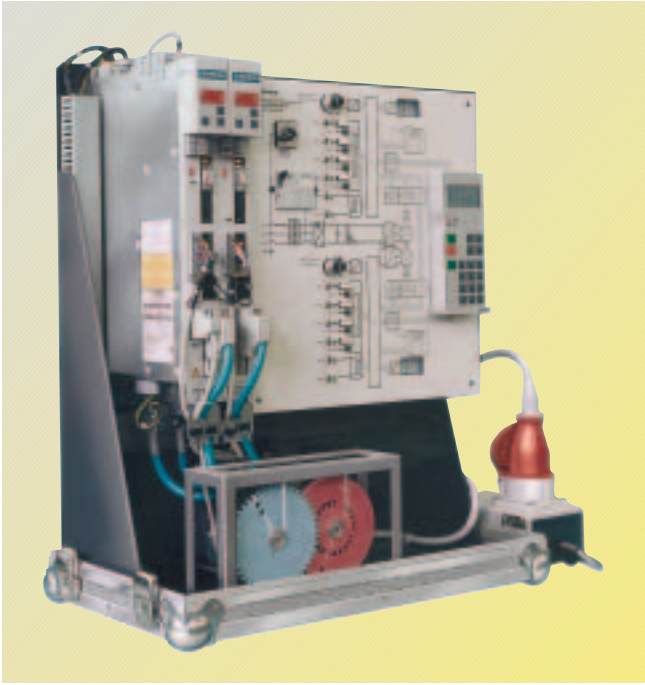


Fig. 5/2
2-axis demonstration case with adapter box

## Adapter box for SIMOVERT MASTERDRIVES Motion Control demonstration case for 1-axis and 2-axis system

Contains

- Power supply plug, 1-ph. 230 V AC
- CEE socket for demonstration case
- 24 V power supply unit with terminal for the MC converter/inverter.

Dimensions (W x H x D):
230 mm x 170 mm x 170 mm
(9.1 in x 6.7 in x 6.7 in)
Weight: approx. 3 kg (6.6 lb)

Order No.:
**9AK1013–1AA00**



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## Demonstration case for MASTERDRIVES Motion Control with Drive ES and touch panel

This demonstration case enables the functions of MASTERDRIVES Motion Control units to be demonstrated with a synchronous PROFIBUS DP. The operator uses the TP27 touch panel. A user interface for the TP27 is also supplied to provide the drives of a connected 1-axis or 2-axis demonstration case with setpoints and parameters or to read out faults. A PC/PG with STEP7/ Drive ES can be connected to the demonstration case in order to demonstrate the functions of Drive ES.

Hardware structure:

- SIMATIC CPU 316-2DP (direct slave-to-slave traffic, clock synchronicity, routing)
- Power supply
- SIMATIC simulator module
- TP27 touch panel
- TS adapter
- Connecting leads for 1-axis or 2-axis Motion Control demonstration case, and PG/PC with Drive ES.
- Operating instructions for the software supplied for the TP27 for operating a connected 1-axis or 2-axis case.
- Documentation in German/ English

Dimensions (W x H x D):
500 mm x 300 mm x 150 mm
(19.7 in x 11.8 in x 5.9 in)
Weight: approx. 8.5 kg (18.7 lb)

Order No.:
**6SX7000–0AJ00**

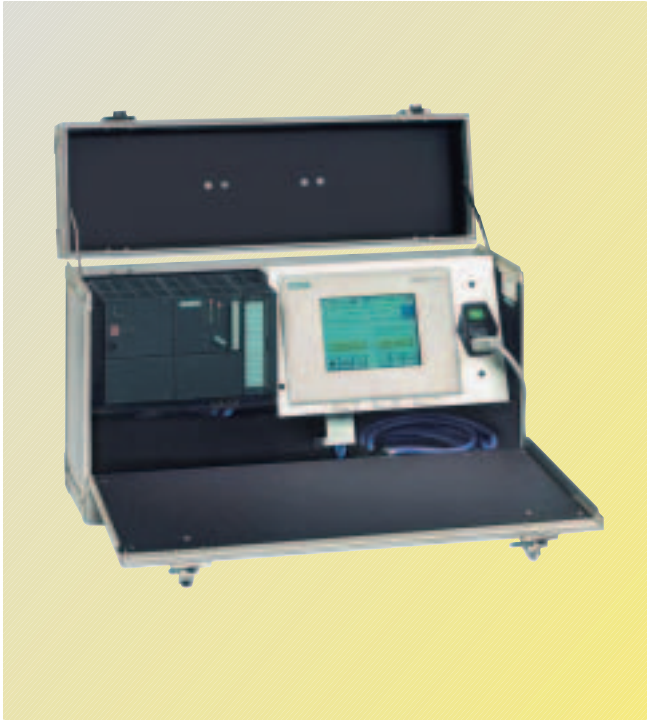


Fig. 5/3
Demonstration case with Drive ES and touch panel

## PROFIBUS DP/SIMATIC S7 demonstration case

Enables demonstration of the drives within an automation system.

The PROFIBUS DP demonstration case consists of

- SIMATIC S7-300 (CPU 315-2DP, CP 340 with RS485 interface and 5 A power-supply unit)
- CP340 with RS485 interface for USS protocol (in preparation)
- OP7 operator-control unit
- EPROM with operator-control and control program for PROFIBUS DP
- 3 m PROFIBUS DP cable for two bus stations
- 3 m power-supply cable for connecting 3-ph. 400 V AC
- Two 3-ph. AC CEE sockets (16 A) for connecting SIMOVERT MASTERDRIVES or SIMOREG K 6RA24 demonstration cases
- Two 1-ph. 230 V AC sockets

The documentation describes the hardware, the STEP 7 program and how to use the demonstration case.

Dimensions (W x H x D):
550 mm x 410 mm x 350 mm
(21.7 in x 16.1 in x 13.8 in)
Weight: approx. 20 kg
(41.1 lb)

Order No.:
**6SX7000–0AG00**

***Transport trolley see page 5/7.***



Fig. 5/4
PROFIBUS DP/SIMATIC S7 demonstration case



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## Start-up box for SIMOVERT MASTERDRIVES Motion Control

The start-up box is a support device for starting up and servicing SIMOVERT MC converters and inverters.

The start-up box can be connected to the control terminal strip (-X101) of the converter by means of a prefabricated, highly flexible signal cable (included in the scope of supply). An electronic circuit within the device is used for converting the 24 V DC auxiliary power supply value of the converter to an analog setpoint. The analog setpoint can be adjusted and is displayed via a 5-digit LCD.

### *Performance characteristics of the start-up box*

- Analog setting of setpoints:
  - coarse and fine setting by means of two potentiometers in the ratio 1 : 10
  - polarity selector switch between normal and inverse setpoint polarity
  - potentiometer for analog offset value with autonomous ON/OFF switch
  - ON/OFF switch for setting analog setpoints
- The analog setpoint is decoupled and largely protected against pole-switching within the operating voltage range.
- The analog output signal of the control terminal strip is wired to 2 mm (0.08 in) measuring sockets in the start-up box.
- Six OFF switches for digital enabling signals, with green LED indicator lamps.
- Four red LEDs for displaying digital output signals.



Fig. 5/5
Start-up box

**Technical data**

| Designation | Value |
|---|---|
| Size (L x W x H) | 175 mm x 90 mm x 45 mm (6.9 in x 3.5 in x 1.8 in) |
| Voltage supply | 24 V DC (via terminal – X101) |
| Voltage range, analog setpoint | 0 V to 12.5 V/10 mA |
| Length of signal cable | 1.3 m (4.3 ft) |

**Ordering data**

| Designation | Order No. |
|---|---|
| Start-up box for SIMOVERT MASTERDRIVES Motion Control | **9AK1011–1AA00** |

## Transport trolley for demonstration units, suitable for 1-axis and 2-axis demonstration case

Sturdy transport trolley for demonstration case consisting of an aluminium frame with a telescopic handle and wheels with roller bearings. The transport trolley is fitted with an elastic strap for holding the demonstration case in place during transport. The trolley can be folded up for storage.

Dimensions when folded up:

Height folded/open:
approx. 662/1020 mm
(26.1/40.2 in)
Width: approx. 480 mm
(18.9 in)
Weight: approx. 5 kg (11 lb)

Order No.:
**6SX7000–0AE01**

5



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## Training Center

A&D Training Centers are located all over the world and provide a range of training courses for SIMOVERT MASTERDRIVES. The contents of the courses can be customized and the courses can also be conducted on the customer's premises.

Contact:

Any regional A&D Information & Training Center and regional companies in Germany:
Tel.: +49 18 05-23 56 11

Head Office:

Siemens AG
Automation and Drives
Training Office
P. O.Box 48 48
90327 Nuremberg,
Germany

E-mail:
A&D.Kursbuero@nbgm.siemens.de
Phone:
+49 9 11-8 95-32 00
Fax:
+49 9 11-8 95-32 75



Fig. 5/6
Training Center

5



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## Overview of training courses

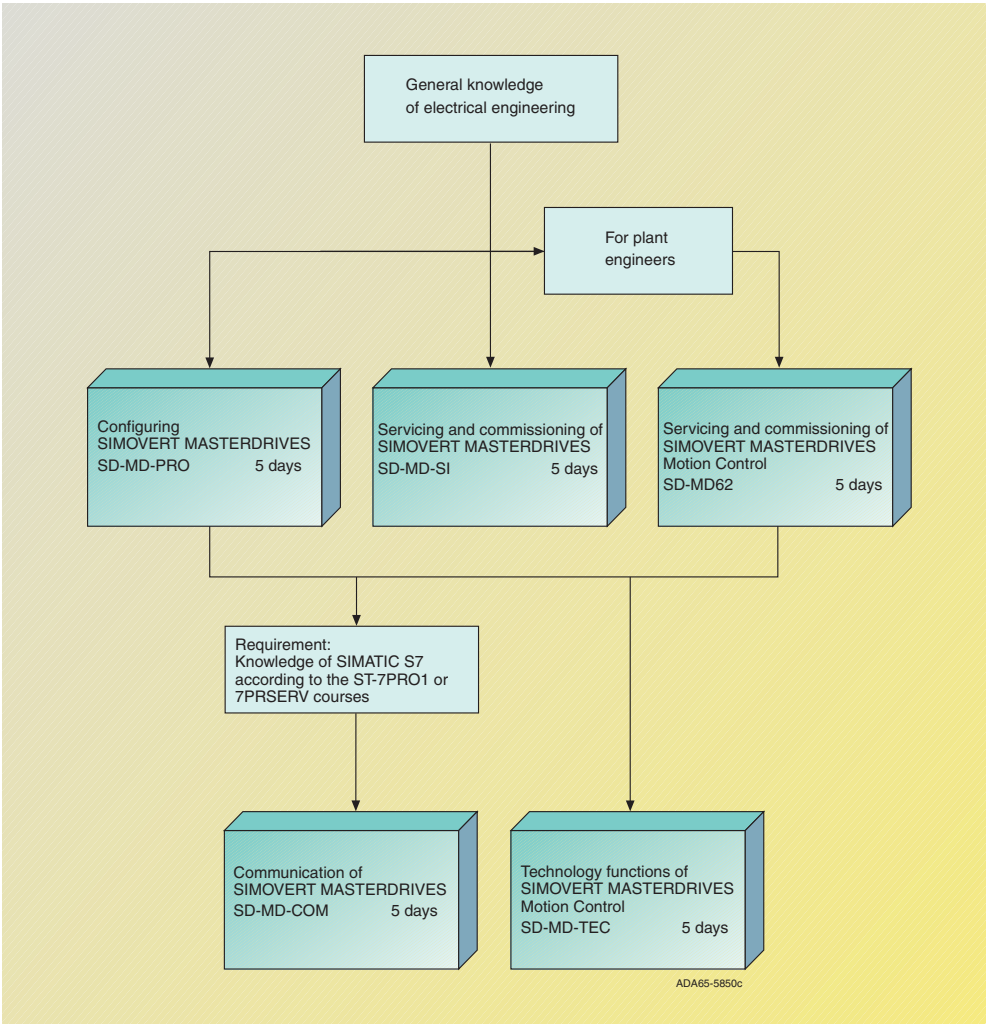



Fig. 5/7
Overview of training courses

### *Configurations of SIMOVERT MASTERDRIVES SD-MD-PRO*

Participants are provided with the technical knowledge they require to configure the SIMOVERT MASTERDRIVES series of converters with the help of the catalog and PC tools. The course is aimed at planning engineers, technicians and other engineers with responsibility for the "selection and calculation of variable-speed drives."

Note:

Parameterization is dealt with in detail in the SD-MD-SI course.

### *Servicing and commissioning of SIMOVERT MASTERDRIVES SD-MD-SI Compact course for MC and VC*

This course is intended for commissioning and service personnel. Participants are taught the technical knowledge they require for parameterizing, commissioning and servicing SIMOVERT MASTERDRIVES Motion Control and Vector Control converters.

### *Communication SIMOVERT MASTERDRIVES SD-MD-COM*

The course is intended for commissioning and service personnel, as well as for planning engineers for SIMOVERT MASTERDRIVES.

It provides participants with the knowledge they require for commissioning, configuring and programming the communication interfaces.

### *Technology functions of SIMOVERT MASTERDRIVES Motion Control SD-MD-TEC*

The course is intended for commissioning and service personnel, as well as for plant engineers responsible for commissioning SIMOVERT MASTERDRIVES Motion Control converters. The decentralized technology functions are commissioned and their numerous features are explained in detail and applied.

Further information can be found in the ITC catalog October 2002, or can be obtained under http://www.sitrain.com.

### *Servicing and commissioning of SIMOVERT MASTERDRIVES Motion Control SD-MD62*

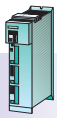
This course is intended for plant engineers responsible for commissioning SIMOVERT MASTERDRIVES Vector Control converters. The three-phase drives with these converters are commissioned. The extensive functions are explained in detail and applied.

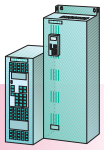
The course SD-MD62 takes place at Siemens AG, I&S IS INA Training Center in Erlangen, Germany.
Telephone:
+49 91 31-72 92 62
E-mail:
info@sitrain.com

5



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# Motion Control
# Engineering information




6/2 **Dimensioning of the power section and drive**

6/20 **Applications for single-axis and multi-axis drives with Compact PLUS**

**Motion Control open-loop and closed-loop control functions**
- 6/24 MASTERDRIVES Motion Control P2
- 6/24 Free function blocks with BICO system
- 6/24 Safe Stop

**Unit design, power and control terminals**
- 6/26 Compact PLUS units
- 6/36 Compact and chassis units with CUMC control board
- 6/45 Rectifier units and rectifier/regenerative units
- 6/47 Control terminal strip on the CUSA control board (AFE)
- 6/48 Braking units

6/49 **Electromagnetic compatibility (EMC)**

**System components**
- 6/50 Line-side components
- 6/51 Rectifier units and rectifier/regenerative units
- 6/52 AFE rectifier/regenerative units (Active Front End)
- 6/56 Braking units and braking resistors
- 6/57 DC bus
- 6/59 Free-wheeling diode on the DC bus
- 6/59 Dimensioning of the system components for multi-axis drives

6/60 **Integration of the electronics options**

**Electronics options**
- 6/62 SBR option board for resolvers
- 6/64 SBP option board for incremental encoders
- 6/66 SBM/SBM2 option board for incremental encoder/ absolute-value encoder
- 6/68 Expansion boards
- 6/72 Interface boards

6/76 **SIMOVERT MASTERDRIVES in the world of automation**

**Communication**
- 6/78 Overview
- 6/78 USS protocol
- 6/79 SIMOLINK
- 6/82 PROFIBUS DP
- 6/84 CAN
- 6/86 CBD

**Technology**
- 6/87 Overview
- 6/89 Technology functions of the basic software
- 6/90 Technology software
- 6/95 Encoders for position detection
- 6/96 T100, T300 and T400 Technology boards
- 6/97 Central control boards

**Operator control and visualization**
- 6/98 OP1S user-friendly operator control panel
- 6/100 Control terminal strip
- 6/100 Main contactor control
- 6/101 Start-up, parameterization and diagnostics with DriveMonitor

6/102 **Power and encoder cables**






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## Engineering instructions

### *Motion Control*

Servo drives are mostly cycle-type drives, i.e. drives which perform particular sequences of movement within a fixed cycle of motion. These movements can be linear or rotational. In addition, the motion sequence usually involves approaching a predefined position, and all movements must be carried out in the shortest possible time. As a consequence, servo drives have to meet the following specific requirements:

- Dynamic, i.e. have short rise-times and move to the desired position without overshoot
- High overload capability, i.e. have a high acceleration reserve
- Broad control range, i.e. high resolution for exact positioning.

The engineering notes below refer to servo drives with 1FK./1FT6 synchronous servomotors or with 1PH7/ 1PH4/1PL6 asynchronous servomotors.

Synchronous servomotors are preferred where a compact motor volume, low rotor inertia and fast response levels are important. With asynchronous servomotors, high maximum speeds are reached in the field-weakening speed range. They have a somewhat larger motor volume.

The drives can be operated individually as single-axis drives or together as multi-axis drives. For connecting the drives to a PLC, via PROFIBUS DP for example, supplementary boards may be necessary. Decentralized provision of technology functions within the Motion Control system is possible with special software or the functions can be provided centrally using a PLC.

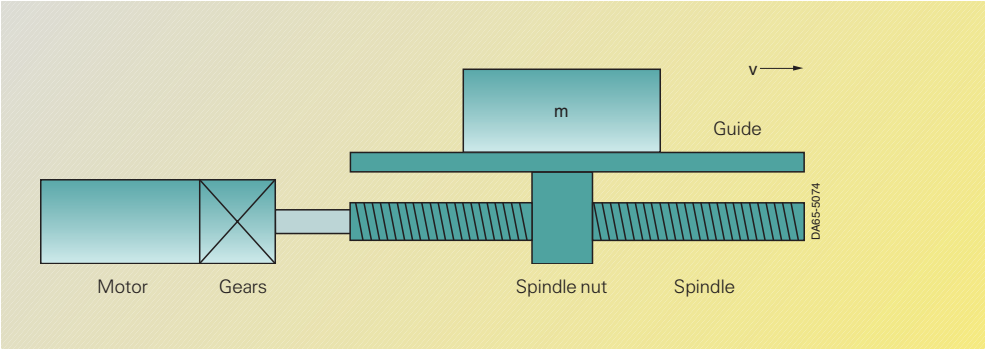



Fig. 6/1
Typical spindle drive

### *A typical engineering sequence*

The basis for engineering is a sketch and a description of how the machine functions. The PATH project-planning tool is of considerable help in further designing the system.




1. Clarification of the type of drive, technical data and other boundary conditions such as technological functions and integration into an automation system
2. Specification of the motion curve
3. Calculation of the maximum load torque and selection of the gearbox
4. Selection of the motor
5. Selection of the converter or inverter
6. Multi-axis drives
   - in the case of Compact PLUS units, selection of a rectifier unit or a converter
   - in the case of compact and chassis units, selection of the rectifier unit
7. Selection of the braking unit and braking resistor
8. Selection of other components.

1. Clarification of the type of drive, technical data and other boundary conditions

The procedure for calculating the load torque depends on the type of drive. For example, it may be a traction drive, a hoisting drive or a turntable drive. In the case of linear motion, for example, power can be transmitted via a toothed belt, a gear rack or a spindle. Normally, a gearbox is also needed for adapting the motor speed and the motor torque to the load conditions.

For this calculation, the following technical data must be available such as:

- Masses to be moved
- Diameter of the drive wheel or the diameter and pitch of the spindle
- Details of the frictional losses
- Mechanical efficiency
- Distances to be travelled
- Maximum speed
- Maximum acceleration and deceleration
- Cycle time
- Accuracy levels for positioning.

Further conditions are the integration into a system (PLC), the technology to be used (centralized or distributed) and the coupling between the drives (e.g. with SIMOLINK).

2. Specification of the motion curve

The motion curve – namely the *v,t* diagram when a linear drive is being used – is determined from the information relating to travel distances, speed, acceleration, deceleration and the cycle time. If multi-axis drives are used, the interdependence of the individual motion curves must be taken into account. The motion curve is also required for thermally dimensioning the motor and selecting the braking resistor. It should therefore represent the "worst-case scenario" for the task.



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### 3. Calculation of the load speed and the maximum load torque, selection of the gearbox

Information on the mechanical factors involved is used to calculate the load speed and the maximum load torque. If the deceleration is equal to the acceleration, the load torque is at a maximum during the acceleration phase. In addition to the maximum load torque, various other variables are involved in gear selection. These are:

- Size
- Efficiency
- Torsional play
- Torsional rigidity
- Moment of inertia
- Noise.

Planetary gears are especially suitable for positioning tasks due to their low torsional play and high torsional rigidity. These gears also have a high power density, are highly efficient and quiet. When the gear transmission ratio is being selected, it should be borne in mind that higher motor speeds generally entail smaller motors. This must, however, be checked for each individual case. A higher gear transmission ratio has a favorable effect on positioning accuracy in relation to the encoder resolution. The angle of rotation $\alpha_G$ of the gear, the number of pulses $z$ per revolution of the encoder, the drive-wheel diameter $D$ or the spindle pitch $h$ and the gear transmission ratio $i$ give the positioning accuracy as follows:

$$\Delta s_{Gear} = \frac{D \cdot \pi}{360°} \cdot \alpha_G$$

$$\Delta s_{Encoder} = \frac{D \cdot \pi}{i \cdot z}$$

or

$$\Delta s_{Encoder} = \frac{h}{i \cdot z} \text{ with spindle drives}$$

$$\Delta s_{tot} = \Delta s_{Gear} + \Delta s_{Encoder} + \Delta s_{mech} \text{ (steady – state)}$$

$\Delta S_{mech}$ is the imprecision of the mechanical system e.g. due to expansion of a toothed belt.

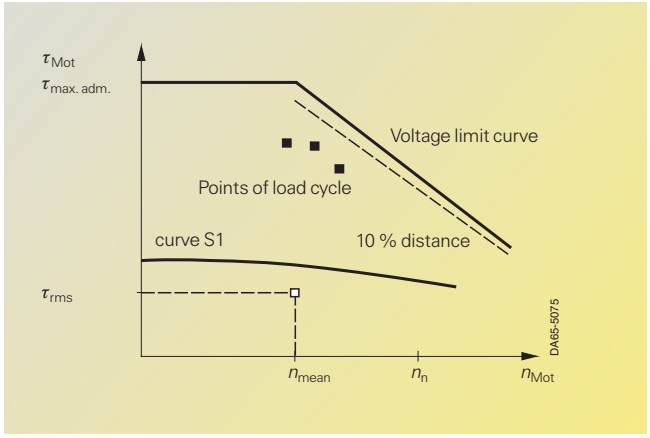



Fig. 6/2
Torque limit curves for 1FK./1FT6 motors (synchronous servomotors)

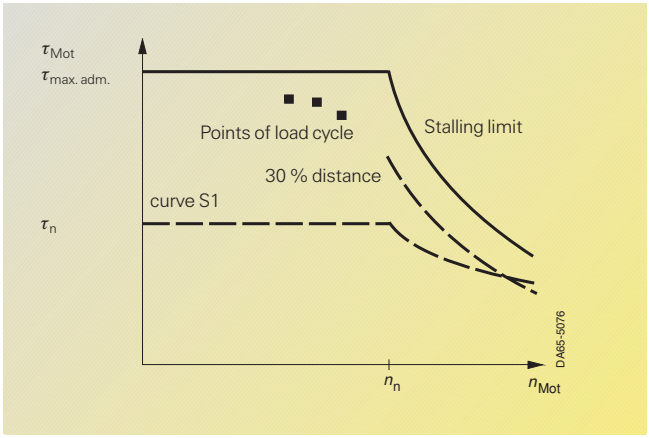



Fig. 6/3
Torque limit curves for 1PH7 motors (asynchronous servomotors)

### 4. Selection of the motor

The motor is selected according to the following criteria:

- Adherence to dynamiclimits, i.e. all $\tau_n$ points of the load cycle must be below the limit curve.
- Motor speed must be smaller than $n_{max\ perm.}$. With synchronous servomotors, the maximum motor speed must not be greater than the rated speed.
- Observing the thermal limits, i.e. with synchronous servomotors, the motor rms torque at the mean motor speed resulting from the load cycle must be below the S1 curve. With asynchronous servomotors, the rms value of the motor current within a load cycle must be smaller than the rated current of the motor.

When synchronous servomotors are used, it must be borne in mind that the maximum permissible motor torque at high speeds is reduced by the voltage limit curve. In addition, a margin of about 10 % should be kept from the voltage limit curve as a protection against voltage fluctuations.

If asynchronous servomotors are used, the permissible motor torque in the field-weakening range is reduced by the stalling limit. Here, a clearance of approximately 30 % should be maintained.





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## Engineering instructions (continued)

In order to keep a check on the dynamic limits, the maximum motor torques must be calculated. In general, the maximum motor torque occurs during the acceleration phase. During acceleration, in addition to the maximum torque determined by the load, there is also the torque $\tau_{a\,Mot}$ needed for accelerating the rotor's moment of inertia. The following formula is therefore used to calculate the maximum motor torque:

$\tau_{Mot\,max} = \tau_{a\,Mot} + \tau_{*Load\,max}$

$\tau_{a\,Mot}$ Accelerating torque for the motor rotor

$\tau_{*Load\,max}$ The maximum load torque referred to the motor speed during the acceleration phase, including the component gearbox

with

$\tau_{a\,Mot} = J_{Mot} \cdot \alpha_{a\,Mot}$

$\alpha_{a\,Mot}$ Angular acceleration of the motor

By experimentation, a motor that fulfils the condition for the maximum motor torque over the required speed range can now be found. The proportion of the acceleration torque for the motor rotor in relation to the maximum motor torque depends not only on the motor's moment of inertia and the angular acceleration, but also on the moment of inertia of the load, the gear transmission ratio and the static load torque.

A second point to be checked is whether the thermal limits are adhered to.

Synchronous servomotors

In order to calculate the rms torque, the motor torque must be determined at all parts of the motion curve. The following formula is used to calculate the rms torque and the mean motor speed:

$$\tau_{rms} = \sqrt{\frac{\sum \tau^2_{Mot\,i} \cdot \Delta t_i}{T}}$$

$$n_{mean} = \frac{\sum \frac{|n_{Mot\,B} + n_{Mot\,E}|}{2} \cdot \Delta t_i}{T}$$

$T$ Cycle period

$\tau_{Mot\,i}$ Motor torque in time segment $\Delta t_i$

$\frac{|n_{Mot\,B} + n_{Mot\,E}|}{2}$ Mean motor speed in time segment $\Delta t_i$ (B: beginning value, E: ending value)

If the rms torque at the mean motor speed is below the S1 curve and the dynamic limits are being adhered to, the selected synchronous servomotor can be used.

Asynchronous servomotors

In order to calculate the motor's rms current, the motor torque at all parts of the motion curve must first be determined. The motor current is thus calculated as follows:

$$I_{Mot} = I_n \cdot \sqrt{\left(\frac{\tau_{Mot}}{\tau_n}\right)^2 \cdot \left[1 - \left(\frac{I_{\mu n}}{I_n}\right)^2\right] \cdot k_n^{\,2} + \left(\frac{I_{\mu n}}{I_n}\right)^2 \cdot \frac{1}{k_n^{\,2}}}$$

$I_{\mu n}$ Rated magnetizing current

$k_n = 1$ in the constant flux range

$k_n = \frac{n}{n_n}$ in the field-weakening range

The following formula is used to calculate the rms value of the motor current:

$$I_{rms} = \sqrt{\frac{\sum \left(\frac{I_{Mot\,B} + I_{Mot\,E}}{2}\right)^2 \cdot \Delta t_i}{T}}$$

$\frac{I_{Mot\,B} + I_{Mot\,E}}{2}$ Mean motor current in time segment $\Delta t_i$ (B: beginning value, E: ending value)

If the dynamic limits are adhered to and the rms value of the motor current is smaller than the motor's rated current, the selected asynchronous motor can be used.

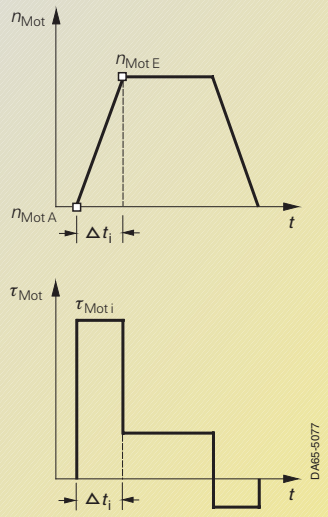



Fig. 6/4
Example of motor speed and motor torque in a time segment $\Delta t_i$

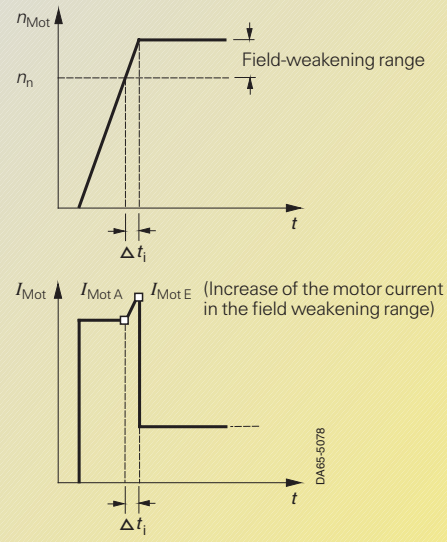



Fig. 6/5
Example of motor speed and motor torque in a time segment $\Delta t_i$

The encoder to be selected depends on the requirements in each individual case. Incremental encoders provide high resolution and extremely true running at the lowest speeds. They are thus especially suitable for highly accurate positioning tasks. Resolvers are robust, cost-effective and provide good resolution.



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5. Selection of converters or inverters

For single-axis drives, a converter now has to be selected and, for multi-axis drives, an inverter is necessary. The selection criteria are the same for both:

- The maximum motor current must be smaller than the maximum permissible output current of the converter/inverter. For Compact PLUS units, the × 3 overload current capability must not be used for more than 250 ms (see technical data).
- The arithmetic mean value of the motor current must be smaller than the rated current of the converter/inverter with a maximum cycle period of 300 s.

The second condition arises from the fact that the switching losses and forward losses in the inverter are approximately proportional to the output current.

In order to determine the motor current at a given motor torque, the following formula is used:

– with synchronous servomotors

$$I_{Mot} = \frac{\tau_{Mot}}{k_{Tn}}$$

$k_{Tn}$ Torque constant

In general, the maximum motor current occurs during the acceleration phase. At high motor torques, the motor current may be greater than calculated with $k_{Tn}$ due to saturation effects. This must to be taken into account when dimensioning/selecting the motor.

– with asynchronous servomotors

Calculation of the motor current is as described under 4. Accelerating into the field-weakening range with a constant motor torque results in the maximum motor current in the field-weakening range at maximum speed.

The following formula is used to calculate the arithmetic mean of the motor current:

– with synchronous servomotors

$$I_{Mot\ mean} = \frac{\sum |\tau_{Mot\,i}| \cdot \Delta t_i}{k_{Tn} \cdot T}$$

$\tau_{Mot\,i}$ Motor torque in time segment $\Delta t_i$

$T$ Cycle period

– with asynchronous servomotors

$$I_{Mot\ mean} = \frac{\sum \frac{I_{Mot\,B} + I_{Mot\,E}}{2} \cdot \Delta t_i}{T}$$

$\frac{I_{Mot\,B} + I_{Mot\,E}}{2}$ Mean motor current in time segment $\Delta t_i$ (B: beginning value, E: ending value)

6. Permissible and non-permissible motor-converter combinations

Rated motor current greater than rated converter current

If a motor is to be used with a rated current greater than that of the rated converter current, the following relationship is to be ensured (even if the motor is only operated under partial load):

$I_{n\,motor} \leq I_{max\,conv} = 1.50 \times I_{n\,conv}$

The maximum rated converter current must be greater than or at least equal to the rated current of the connected motor.

If this is not complied with, the lower leakage inductance causes greater motor peak currents which can lead to shutdown.

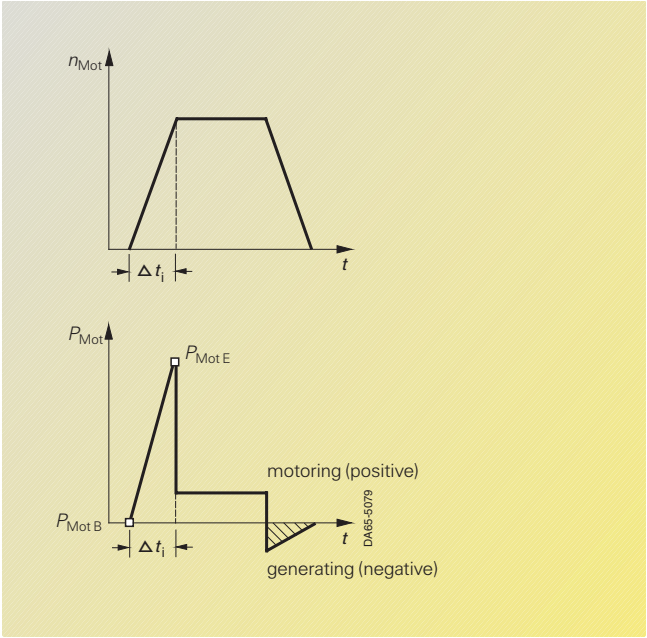



Fig. 6/6
Example of motor speed and motor output in a time segment $\Delta t_i$

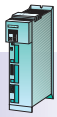
Smallest permissible rated motor current at the converter

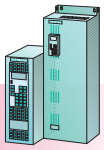
If the Vector Control modes are used, the rated motor current in the case of compact and chassis units must be at least $^1/_8$ of the rated converter current and, in the case of the Compact PLUS units, at least $^1/_4$ of the rated converter current.
If the rated motor current is < $^1/_4$ resp. $^1/_2$ of the rated converter current (in the case of compact units and Compact PLUS units), torque precision during torque-control mode is somewhat less accurate than when the current level is optimally adapted.

If the $V/f$ characteristic curves are used, this restriction does not apply. If power is fed to a much smaller motor in comparison to the converter power output, however, the quality of control suffers because the $I^2t$ calculation for the motor can no longer be carried out correctly.



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## Engineering instructions (continued)

7. Selection of the rectifier unit for multi-axis drives

When multi-axis drives are used, several inverters are supplied with power via a rectifier unit. When the rectifier unit is selected, it must be determined whether all the drives can work at the same time. The criteria for making the selection are as follows:

- The maximum DC link current must be less than the maximum permissible output current of the rectifier unit. In the case of a Compact PLUS rectifier unit, if three times the rated current is utilized, this current must not flow for longer than 250 ms (see technical data). If a Compact PLUS rectifier is not used, the maximum output current must not exceed 1.36 times the rated current for a period of 60 s (see technical data).
- The arithmetic mean value of the DC link current must be smaller than the rated value of the DC link current of the rectifier unit when the maximum cycle period is 300 s.

The second condition arises from the fact that the rectifier losses are approximately proportional to the DC link current.

The DC link current is calculated as follows:

$$I_{DC\ rect} = \sum I_{DC\ inv}$$

$$I_{DC\ inv} = \frac{P_{Mot}}{\eta_{Mot} \cdot \eta_{inv} \cdot V_{DC}}$$

DC link current of an inverter during motor operation

$V_{DC} = 1.35 \cdot V_{Line}$ DC link voltage

$P_{Mot} = \frac{\tau_{Mot} \cdot n_{Mot}}{9550}$ Motor output in kW

When the rectifier is selected, only motor operation needs to be considered. The maximum DC link current occurs when all the motors connected to the inverters have to simultaneously produce the maximum motor output. If this is not the case, a smaller rectifier may be selected. The total number of inverters connected, however, must not be too large or, otherwise, the precharging unit of the rectifier may be overloaded (see technical data).

In order to determine the arithmetic mean value of the DC link current, the mean values of the individual inverters are added together. For one inverter, the calculation is as follows:

$$I_{DC\ inv\ mean} = \frac{P_{Mot\ mean}}{\eta_{Mot} \cdot \eta_{inv} \cdot V_{DC}}$$

$$P_{Mot\ mean} = \frac{\sum \frac{P_{Mot\ B} \cdot P_{Mot\ E}}{2} \cdot \Delta t_i}{T}$$

$\frac{P_{Mot\ B} \cdot P_{Mot\ E}}{2}$ Mean motor output in time segment $\Delta t_i$ (B: beginning value, E: ending value)

$T$ Cycle period

Only positive motor outputs need to be evaluated.

Adding the mean values for the individual inverters ($I_{DC\ inv\ mean}$) gives the mean value for the rectifier ($I_{DC\ rect\ mean}$) as follows:

$$I_{DC\ rect\ mean} = \sum I_{DC\ inv\ mean}$$

For further information on planning multi-axis drives, see chapter "Engineering Information – System components".

Selection of the rectifier unit or converter if multi-axis drives are used with Compact PLUS converters and inverters

- The total nominal outputs of the inverters connected to a converter must not exceed the nominal output of the converter with a coincidence factor of 0.8!

  Example:
  5.5 kW (7.5 HP) converter with 1 x 4 kW (5.5 HP) and 1 x 1.5 kW (2 HP) inverters on a common DC bus. The installed motor output is 11 kW (15 HP). The coincidence factor of 0.8 means that the maximum continuous output of the simultaneously operated motors must not exceed 8.8 kW (12 HP).
- The line-side components are determined in accordance with the total output of the converter and all inverters.

  Example:
  Total 11 kW (5.5 kW + 4 kW + 1.5 kW) [15 HP (7.5 HP + 5.5 HP + 2 HP)].
  The line-side components are selected for an 11 kW (15 HP) converter. If the output is not exactly the same as that of the converter, the components for the next lower converter size are selected.
- If more than 2 inverters are planned (in the case of the 6SE7011-5EP50 Compact PLUS converter, the 6SE7012-0TP50 inverter can only be connected once), an external 24 V power supply must be provided. For "Selection and ordering data", see page 3/17. If 1 or 2 inverters are used, the internal 24 V power supply of the converter can be used.
- If braking power occurs when the drives are shut down, a braking resistor to match the braking power is needed. For "Selection and ordering data", see page 3/18.
- If dynamic load changes occur during operation which have to be stored intermediately for a buffered period, a capacitor module may be used. For "Selection and ordering data", see page 3/18.





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8. Selection of the braking resistors

a) Compact PLUS

With Compact PLUS, the choppers for the braking resistors are integrated in the converters, on the one hand, and in the rectifier units, on the other (when multi-axis drives are used with several inverters). The following criteria apply to the braking resistors:

- The maximum braking power which occurs must be less than 1.5 times $P_{20}$. This power must not occur for longer than 3 s (see technical data).
- The mean braking power must be less than $P_{20}/4.5$ with a maximum cycle period of 90 s.

b) Compact units and chassis units

The braking units for compact and chassis units are autonomous components. The braking units, up to a power rating of $P_{20}$ = 20 kW, have an internal braking resistor. In addition to the internal braking resistor, an external braking resistor can be used to increase the continuous power rating. The following criteria apply to the selection process:

- The maximum braking power which occurs must be less than 1.5 times $P_{20}$. This power must not occur for longer than 0.4 s when an internal braking resistor is used or 3 s when an external braking resistor (see technical data is used).
- The mean braking power must be less than $P_{20}/36$ when an internal braking resistor is used or less than $P_{20}/4.5$ when an external braking resistor is used. The maximum cycle time is 90 s.

The maximum braking power with a single-axis drive is calculated as follows:

$$P_{br\,max} = P_{Mot\,br\,max} \cdot \eta_{Mot} \cdot \eta_{inv}$$

The maximum braking power $P_{Mot\,\nu\,max}$ generally occurs at the beginning of deceleration when the motor is running at maximum speed. If several inverters are operated from one rectifier unit, a check must be made to see whether several drives must brake simultaneously. In the event of an emergency stop, all drives may have to be shut down at the same time.

The mean braking power is calculated with the following formula:

$$P_{br\,mean} = \frac{\sum \frac{P_{Mot\,br\,B} + P_{Mot\,br\,E}}{2} \cdot \Delta t_i}{T} \cdot \eta_{Mot} \cdot \eta_{inv}$$

| | |
|---|---|
| $\frac{P_{Mot\,br\,A} + P_{Mot\,br\,E}}{2}$ | Mean braking power in time segment $\Delta t_i$ (B: beginning value, E: ending value) |
| $T$ | Cycle period |

Only negative motor outputs need to be evaluated.

If several inverters are connected to one rectifier unit, the mean value is calculated by adding together the individual mean values for the inverters.

9. Selection of other components

Selection tables are used to make a list of the other components needed on the rectifier side:

- line switch
- line contactor
- line fuses
- line filter
- line reactor.

For further information, see chapter "Engineering Information – System components".

Depending on the drive configuration, additional components may be necessary such as

- 24 V DC power supply unit
- communication boards
- encoder-evaluation boards
- power back-up.

Notes on the use of a capacitor module

The power buffering module is for increasing the capacity of the DC link. This can bridge a short-time power-system failure and also enables intermediate buffering of braking energy.

The buffering capacity in the event of a power-system failure is calculated as follows:

$$W = \frac{1}{2} \cdot C \cdot (V^2_{DC\,n} - V^2_{DC\,min})$$

With a 400 V supply voltage and with
C = 5.1 mF and
$V_{DC\,min}$ = 400 V,
for example, the buffering capacity is:

$$W = \frac{1}{2} \cdot 5.1 \cdot 10^{-3} \cdot \left((1.35 \cdot 400)^2 - 400^2\right) = 336\ \text{Ws}$$

With a 460 V supply voltage, the buffering capacity increases to 444 Ws. The possible ride-through time $t_{rt}$ is calculated with the output power $P$ as follows:

$$t_{rt} = \frac{W}{P}$$

The buffering capacity during regenerative operation is calculated as follows:

$$W = \frac{1}{2} \cdot C \cdot (V^2_{DC\,max} - V^2_{DC\,n})$$

With a 400 V supply voltage and when
$V_{DC\,max}$ = 750 V:

$$W = \frac{1}{2} \cdot 5.1 \cdot 10^{-3} \cdot \left(750^2 - (1.35 \cdot 400)^2\right) = 691\ \text{Ws}$$

During braking, for example, from maximum speed to 0 within time $t_{br}$, the braking energy is calculated as follows:

$$W_{br} = \frac{1}{2} \cdot P_{br\,max} \cdot t_{br}$$

with

$$P_{br\,max} = \frac{\tau_{Mot\,br\,max} \cdot n_{Mot\,max}}{9550} \cdot \eta_{Mot} \cdot \eta_{inv}$$

maximum braking power of the motor in kW

| | |
|---|---|
| $\tau_{Mot\,br\,max}$ | Maximum motor torque during braking |

Notes on pulse frequency

Compact units and chassis units require derating above 6 kHz or 5 kHz depending on the power output (see technical data, page 2/3). A reduction in the permissible rated current entails a reduction in the permissible maximum current by the same factor. In addition, the maximum pulse frequency of the chassis units > 90 kW (120 HP) is less than 8 kHz (see technical data, page 2/3).





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## Calculating example

A three-axis conveyor vehicle is to be designed. The x-axis is the main propelling drive, the y-axis is the fork drive and the z-axis is the lifting drive. The propelling drive and the lifting drive can be operated simultaneously whereas the fork drive only operates alone. The x-axis and the y-axis are driven via toothed belts. The z-axis is driven via a gear rack. Three inverters are to be used on one rectifier unit. Positioning is to be carried out non-centrally in the inverter. The Profibus is to be used for connection to a PLC.

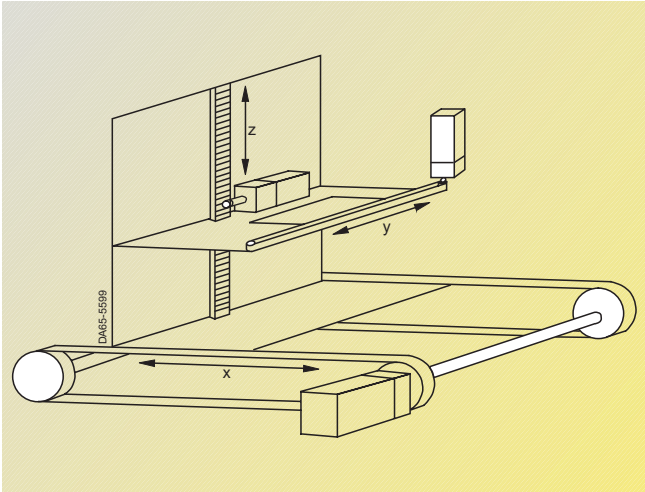



Fig. 6/7
Line drawing of a three-axis conveyor vehicle

### *Calculation of the x-axis as the travel gear*

1. Data of the drive

- Mass to be transported $m = 400$ kg
- Diameter of drive wheel $D = 0.14$ m
- Max. speed $v_{max} = 1.6$ m/s
- Max. acceleration and deceleration $a_{max} = 6.4$ m/s2
- Distance travelled $s = 2$ m
- Cycle time $T = 7$ s
- Mechanical efficiency $\eta_{mech} = 0.9$
- Specific travelling resistance $w_f = 0.1$
- Mechanical accuracy $\Delta s_{mech} = \pm 0.1$ mm
- Overall accuracy required $\Delta s_{tot} = \pm 0.2$ mm

2. Travel curve

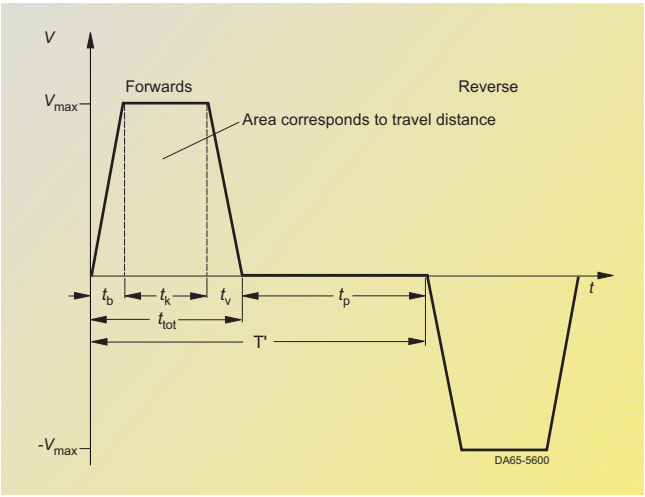



Fig. 6/8
Travel curve for forwards and reverse travel

It is sufficient to only consider forwards travel because the conditions are the same for forwards and reverse travel.

- The new cycle time is therefore:

$$T' = \frac{T}{2}$$

- For the remaining values of the travel curve, the following is obtained:

$$t_b = t_v = \frac{v_{max}}{a_{max}} = \frac{1.6}{6.4} = 0.25 \text{ s}$$

$$t_k = \frac{s - v_{max} \cdot \frac{t_b}{2} - v_{max} \cdot \frac{t_v}{2}}{v_{max}} = \frac{2 - 1.6 \cdot \frac{0.25}{2} - 1.6 \cdot \frac{0.25}{2}}{1.6} = 1 \text{ s}$$

$$t_{tot} = t_b + t_k + t_v = 0.25 + 1 + 0.25 = 1.5 \text{ s}$$

$$t_p = T' - t_{tot} = 3.5 - 1.5 = 2 \text{ s}$$



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3. Max. speed under load, max. load torque, selection of the gear unit

- Max. speed under load at the drive wheel

$$n_{load\,max} = \frac{v_{max} \cdot 60}{\pi \cdot D} = \frac{1.6 \cdot 60}{\pi \cdot 0.14} = 218.27 \text{ rpm}$$

A gear transmission ratio of $i = 10$ is selected here.
A synchronous servomotor can thus be used with a rated speed of 3000 rpm.

$n_{Mot\,max} = i \cdot n_{load\,max} = 10 \cdot 218.27 = 2182.7$ rpm

- Resistance torque

$$\tau_W = m \cdot g \cdot w_f \cdot \frac{D}{2} = 400 \cdot 9.81 \cdot 0.1 \cdot \frac{0.14}{2} = 27.47 \text{ Nm}$$

- Acceleration and deceleration torque for the load

$$\alpha_{load} = a_{max} \cdot \frac{2}{D} = 6.4 \cdot \frac{2}{0.14} = 91.4 \text{ s}^{-2}$$

$$J_{load} = m \cdot \left(\frac{D}{2}\right)^2 = 400 \cdot \left(\frac{0.14}{2}\right)^2 = 1.96 \text{ kgm}^2$$

$$\tau_{a\,br\,load} = J_{load} \cdot \alpha_{load} = 1.96 \cdot 91.4 = 179.2 \text{ Nm}$$

- Max. torque on the output side of the gear unit

$$\tau_{load\,max} = (\tau_{a\,load} + \tau_W) \cdot \frac{1}{\eta_{mech}} = (179.2 + 27.47) \cdot \frac{1}{0.9} = 229.6 \text{ Nm}$$

A planetary gear unit for mounting on 1FT6 motors is therefore used where

$\tau_{max} = 400$ Nm at $i = 10$

$J_G^* = 0.001$ kgm$^2$ moment of inertia referred to motor
$\eta_G = 0.95$ gear unit efficiency
$\alpha_G = 3'$ torsional play

- Acceleration and deceleration torque for the gear unit

$\tau_{a\,br\,G} = J_G^* \cdot \alpha_{load} \cdot i = 0.001 \cdot 91.4 \cdot 10 = 0.914$ Nm

- Positioning accuracy

$$\Delta s_{gear} = \frac{D \cdot \pi}{360°} \cdot \frac{\alpha_G}{60} = \frac{0.14 \cdot \pi}{360} \cdot \frac{3}{60} = 0.061 \text{ mm}$$

i.e. ± 0.0305 mm

$$\Delta s_{encoder} = \frac{D \cdot \pi}{i \cdot z} = \frac{0.14 \cdot \pi}{10 \cdot 1024} = \pm 0.04 \text{ mm}$$

with a 2-pole resolver[1])

$\Delta s_{tot} = \Delta s_{mech} + \Delta s_{gear} + \Delta s_{encoder}$
$= 0.1 + 0.0305 + 0.04 = 0.1705 < 0.2$ mm

The required accuracy is thus complied with.

4. Selection of the motor

Selection with regard to the dynamic limit curve

- The maximum motor torque occurs here because the deceleration is equal to the acceleration.

$$\tau_{Mot\,max} = \tau_{a\,Mot} + \tau_{a\,br\,G} + (\tau_{a\,load} + \tau_W) \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G}$$

$$= \tau_{a\,Mot} + 0.914 + (179.2 + 27.47) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95}$$

$$= \tau_{a\,Mot} + 25.08 \text{ Nm}$$

where $\tau_{a\,Mot} = J_{Mot} \cdot \alpha_{load} \cdot i = J_{Mot} \cdot 91.4 \cdot 10 = J_{Mot} \cdot 914$ s$^{-2}$

The first 1FT6 motor with $n_n = 3000$ rpm, which satisfies the condition or the dynamic limit curve, is the 1FT6084–8AF7 with $P_n = 4.6$ kW, $\tau_n = 14.7$ Nm, $\tau_{max\,perm} = 65$ Nm, $J_{Mot} = 0.0065$ kgm$^2$ (with brake), $k_{Tn100} = 1.34$ Nm/A, $\eta_{Mot} = 0.92$; $\tau_0 = 20$ Nm

- The acceleration and deceleration torque for the motor rotor is thus:

$\tau_{a\,br\,Mot} = 0.0065 \cdot 914 = 5.94$ Nm

- The maximum motor torque is equal to the motor torque during acceleration:

$\tau_{Mot\,max} = \tau_{Mot\,a} = 5.94 + 25.08 = 31.03$ Nm

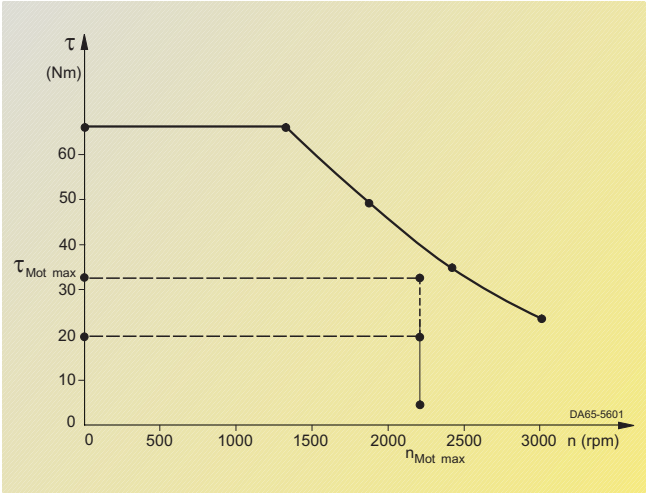



Fig. 6/9
Dynamic limit curve for the 1FT6084–8AF7 with the points of the load cycle

1) Other approximate encoder accuracies
Pulse Encoder ~ Number of pulses
Sin/Cos Encoder (ERN 1387) ~ $10^5$ to $10^6$
Absolute-value Encoder (EQN 1325) ~ $10^5$ to $10^6$



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**Calculating example** (continued)

As a check on the thermal limits, the effective motor torque is calculated. This is done by determining all the motor torques within the travel curve in addition to the motor torque during acceleration.

- Motor torque during constant travel:

$$\tau_{Mot\,k} = \tau_W \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G} = 27.47 \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 3.21 \text{ Nm}$$

- Motor torque during deceleration:

$$\tau_{Mot\,br} = -\tau_{br\,Mot} - \tau_{a\,G} + (-\tau_{br\,load} + \tau_W) \cdot \frac{1}{i \cdot (\eta_{mech} \cdot \eta_G)^{sign(-\tau_{br\,load} + \tau_W)}}$$

$$= -5.94 - 0.914 + (-179.2 + 27.47) \cdot \frac{0.9 \cdot 0.95}{10} = -19.83 \text{ Nm}$$

Here, the proportion of deceleration torque outweighs the resistance torque. Regenerative operation occurs. In this case, the efficiency levels are above the line (the sign before the bracketed term "$-\tau_{br\,load} + \tau_W$" is negative).

The torque characteristic can be determined using the values calculated for the motor torque.

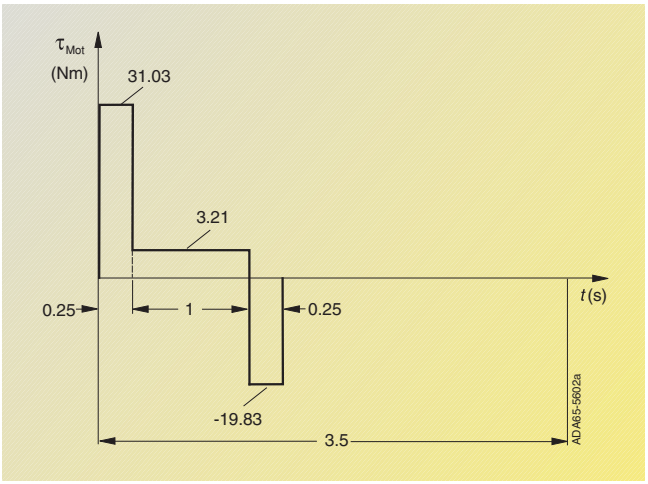



Fig. 6/10
Torque characteristic for forwards travel

- The effective motor torque is obtained from the torque characteristic as follows:

$$\tau_{eff} = \sqrt{\frac{\sum \tau_{Mot\,i}^2 \cdot \Delta t_i}{T'}}$$

$$= \sqrt{\frac{31.03^2 \cdot 0.25 + 3.21^2 \cdot 1 + 19.83^2 \cdot 0.25}{3.5}} = 10 \text{ Nm}$$

- By using the travel curve, which is proportional to the speed, the mean motor speed is obtained:

$$n_{mean} = \frac{\sum \frac{|n_B + n_E|}{2} \cdot \Delta t_i}{T'}$$

$$= \frac{\frac{2182.7}{2} \cdot 0.25 + 2182.7 \cdot 1 + \frac{2182.7}{2} \cdot 0.25}{3.5} = 779.5 \text{ rpm}$$

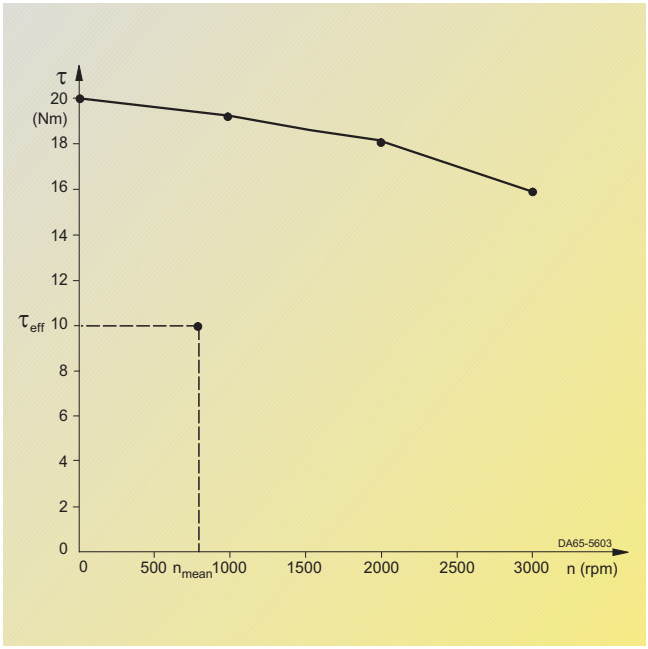



Fig. 6/11
S1 curve for the 1FT6084–8AF

The effective motor torque calculated is $n_{mean}$ below the S1 curve. The motor is therefore suitable.

5. Selection of the inverter

The inverter is selected according to the maximum motor current and the mean value of the motor current.

- Maximum motor current (the saturation influence can be neglected here)

$$I_{Mot\,max} \approx \frac{\tau_{Mot\,max}}{k_{Tn100}} = \frac{31.03}{1.34} = 23.16 \text{ A}$$

- Mean value of the motor current obtained from the magnitude of the torque characteristic

$$I_{Mot\,mean} \approx \frac{\sum |\tau_{Mot\,i}| \cdot \Delta t_i}{k_{Tn100} \cdot T'}$$

$$= \frac{31.03 \cdot 0.25 + 3.21 \cdot 1 + 19.83 \cdot 0.25}{1.34 \cdot 3.5} = 3.4 \text{ A}$$

Because the accelerating and decelerating times are ≤ 0.25 s and the time between is ≥ 0.75 s, a check is now made to see if 3 times the rated current of a Compact PLUS inverter can be utilized when $I_{Vn}$ = 10.2 A.

- The following applies to the motor current during constant travel:

$$I_{Mot\,k} = \frac{\tau_{Mot\,k}}{k_{Tn100}} = \frac{3.21}{1.34} = 2.4 \text{ A}$$



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• Thus:

$I_{Mot\,max} = 23.16\ A < 3 \cdot I_{Vn} = 30\ A$

$I_{Mot\,mean} = 3.4\ A < I_{Vn} = 10.2\ A$

$I_{Mot\,k} = 2.4\ A < 0.91 \cdot I_{Vn} = 9.3\ A$

The 6SE7021–0TP50 Compact PLUS inverter can therefore be used when $I_{Vn} = 10.2$ A.

## 6. Determination of the DC link currents

The maximum DC link current and the mean value of the DC link current for the inverter which occur during motor operation must be determined for later rating of the rectifier unit. To do this, all motor power output levels within the travel curve first have to be calculated.

• Max. power output of motor during acceleration:

$$P_{Mot\,a\,max} = \frac{\tau_{Mot\,a} \cdot n_{Mot\,max}}{9550} = \frac{31.03 \cdot 2182.7}{9550} = 7.09\ kW$$

• Power output of motor during constant travel:

$$P_{Mot\,k} = \frac{\tau_{Mot\,k} \cdot n_{Mot\,max}}{9550} = \frac{3.21 \cdot 2182.7}{9550} = 0.734\ kW$$

• Max. power output of motor during deceleration:

$$P_{Mot\,br\,max} = \frac{\tau_{Mot\,br} \cdot n_{Mot\,max}}{9550} = \frac{-19.83 \cdot 2182.7}{9550} = -4.53\ kW$$

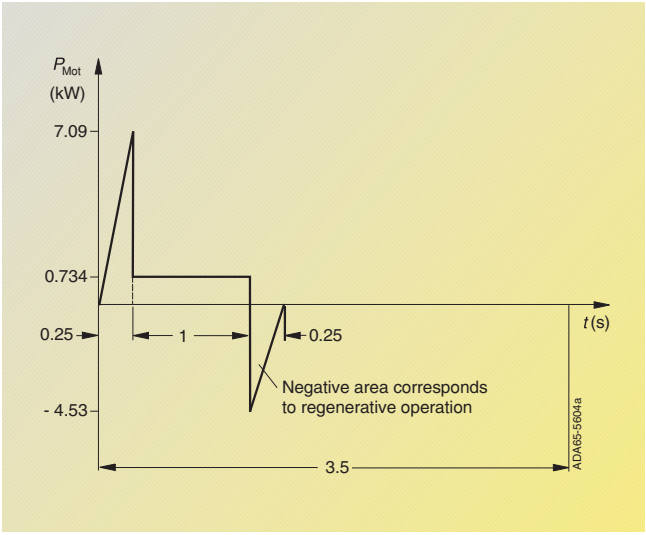



Fig. 6/12
Characteristic of the motor output for forwards travel

• The maximum DC link current during operation of the motor during acceleration is

$$I_{Link\,inv\,max} = \frac{P_{Mot\,max}}{\eta_{Mot} \cdot \eta_{inv} \cdot 1.35 \cdot V_{line}}$$

$$= \frac{7090}{0.92 \cdot 0.98 \cdot 1.35 \cdot 460} = 12.66\ A$$

• The mean motor power output during operation of the motor is calculated from the positive characteristic of the motor power output as follows:

$$P_{Mot\,mean} = \frac{\sum \frac{P_{Mot\,B} + P_{Mot\,E}}{2} \cdot \Delta t_i}{T'}$$

$$= \frac{\frac{1}{2} \cdot 7.09 \cdot 0.25 + 0.734 \cdot 1}{3.5} = 0.463\ A$$

• The mean value of the DC link current is therefore:

$$I_{Link\,mean} = \frac{P_{Mot\,mean}}{\eta_{Mot} \cdot \eta_{inv} \cdot 1.35 \cdot V_{line}}$$

$$= \frac{463}{0.92 \cdot 0.98 \cdot 1.35 \cdot 460} = 0.83\ A$$

## 7. Determination of braking power

The maximum braking power and the mean braking power have to be calculated for later rating of the braking resistors. The maximum power output of the motor during braking has already been calculated (see 6.).

• The maximum braking power is therefore:

$P_{br\,max} = P_{Mot\,br\,max} \cdot \eta_{Mot} \cdot \eta_{inv} = -4.53 \cdot 0.92 \cdot 0.98 = -4.08\ kW$

• The mean braking power is obtained from the negative characteristic of the motor power output as follows:

$$P_{br\,mean} = \frac{\sum \frac{P_{Mot\,br\,B} + P_{Mot\,br\,E}}{2} \cdot \Delta t_i}{T'} \cdot \eta_{Mot} \cdot \eta_{inv}$$

$$= \frac{\frac{1}{2} \cdot (-4.53) \cdot 0.25}{3.5} \cdot 0.92 \cdot 0.98 = -0.146\ kW$$

6



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**Calculating example** (continued)

### *Calculating the y-axis as the travel gear*

1. Data of the drive

- Mass to be transported $m = 100$ kg
- Diameter of drive wheel $D = 0.1$ m
- Max. speed $v_{max} = 1$ m/s
- Max. acceleration and deceleration $a_{max} = 2.5$ m/s$^2$
- Distance travelled $s = 0.5$ m
- Cycle time $T = 7$ s
- Mechanical efficiency $\eta_{mech} = 0.9$
- Specific travelling resistance $w_f = 0.1$
- Mechanical accuracy $\Delta s_{mech} = \pm 0.1$ mm
- Overall accuracy required $\Delta s_{tot} = \pm 0.2$ mm

Note

The same calculating procedures apply to the y-axis as the propelling drive as to the x-axis. This calculation is therefore dispensed with.

With $i = 10$, the motor selected is a 1FT6041–4AF7 motor with a gear unit and the smallest 6SE7012–0TP50 Compact PLUS inverter with $I_{Vn} = 2$ A. Because the drive of the y-axis always runs alone and, with regard to its power, is small in comparison to the drives of the x-axis and the z-axis, it is not taken into account in the rating of the rectifier unit and the braking resistor.

### *Calculating the z-axis as the lifting drive*

1. Drive data

- Mass to be transported $m = 200$ kg
- Pinion diameter $D = 0.1$ m
- Max. speed $v_{max} = 1.5$ m/s
- Max. acceleration and deceleration $a_{max} = 2.5$ m/s$^2$
- Lifting height $h = 1.35$ m
- Cycle time $T = 7$ s
- Mechanical efficiency $\eta_{mech} = 0.9$
- Mechanical accuracy $\Delta s_{mech} = \pm 0.1$ mm
- Overall accuracy required $\Delta s_{tot} = \pm 0.2$ mm

2. Travel curve

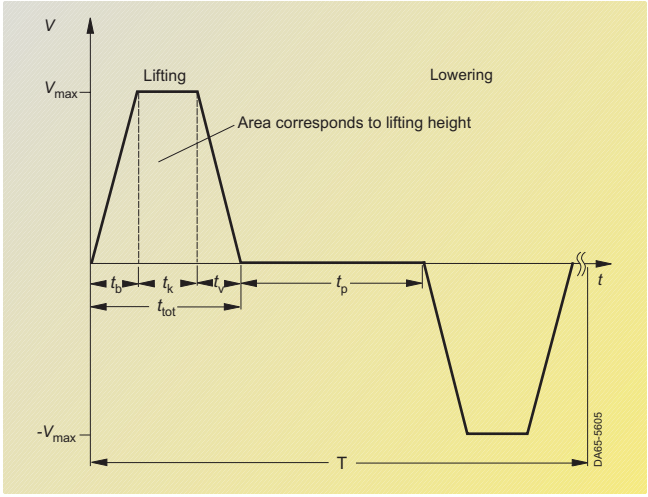



Fig. 6/13
Travel curve for lifting and lowering

The travel curve for lifting and lowering is symmetrical. Since the lifting torque and the lowering torque are different, however, the whole travel curve has to be considered.

- The following is obtained for the missing values of the travel curve:

$$t_b = t_v = \frac{v_{max}}{a_{max}} = \frac{1.5}{2.5} = 0.6 \text{ s}$$

$$t_k = \frac{h - v_{max} \cdot \frac{t_b}{2} - v_{max} \cdot \frac{t_v}{2}}{v_{max}} = \frac{1.35 - 1.5 \cdot \frac{0.6}{2} - 1.5 \cdot \frac{0.6}{2}}{1.5} = 0.3 \text{ s}$$

$$t_{tot} = t_b + t_k + t_v = 0.6 + 0.3 + 0.6 = 1.5 \text{ s}$$

$$t_p = \frac{T}{2} - t_{tot} = 3.5 - 1.5 = 2 \text{ s}$$



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3. Max. speed under load, max. torque under load, selection of gear unit

• Max. speed under load at the pinion:

$$n_{load\ max} = \frac{v_{max} \cdot 60}{\pi \cdot D} = \frac{1.5 \cdot 60}{\pi \cdot 0.1} = 286.5\ rpm$$

Here, a gear transmission ratio of $i = 10$ is selected.
A synchronous servomotor with a rated speed of 3000 rpm can therefore be used.

$n_{Mot\ max} = i \cdot n_{load\ max} = 10 \cdot 286.5 = 2865$ rpm

• Lifting torque:

$$\tau_H = m \cdot g \cdot \frac{D}{2} = 200 \cdot 9.81 \cdot \frac{0.1}{2} = 98.1\ Nm$$

• Acceleration and deceleration torque for the load:

$$\alpha_{load} = a_{max} \cdot \frac{2}{D} = 2.5 \cdot \frac{2}{0.1} = 50\ s^{-2}$$

$$J_{load} = m \cdot \left(\frac{D}{2}\right)^2 = 200 \cdot \left(\frac{0.1}{2}\right)^2 = 0.5\ kgm^2$$

$$\tau_{a\ br\ load} = J_{load} \cdot \alpha_{load} = 0.5 \cdot 50 = 25\ Nm$$

• Max. torque on the output side of the gear unit:

$$\tau_{load\ max} = (\tau_{b\ load} + \tau_H) \cdot \frac{1}{\eta_{mech}} = (25 + 98.1) \cdot \frac{1}{0.9} = 136.8\ Nm$$

A planetary gear unit for mounting on 1FT6 motors is selected with

$\tau_{max} = 400$ Nm when $i = 10$

$J_G^* = 0.001\ kgm^2$ moment of inertia referred to the motor
$\eta_G = 0.95$ gear unit efficiency
$\alpha_G = 3'$ torsional play

• Acceleration and deceleration torque for the gear unit:

$\tau_{a\ br\ G} = J_G^* \cdot \alpha_{load} \cdot i = 0.001 \cdot 50 \cdot 10 = 0.5$ Nm

• Positioning accuracy:

$$\Delta s_{gear} = \frac{D \cdot \pi}{360°} \cdot \frac{\alpha_G}{60} = \frac{0.1 \cdot \pi}{360} \cdot \frac{3}{60} = 0.0436\ mm$$

i.e. ± 0.0218 mm

$$\Delta s_{encoder} = \frac{D \cdot \pi}{i \cdot z} = \frac{0.1 \cdot \pi}{10 \cdot 1024} = \pm 0.0306\ mm$$

with a 2-pole resolver

$\Delta s_{tot} = \Delta s_{mech} + \Delta s_{gear} + \Delta s_{encoder}$
$= 0.1 + 0.0218 + 0.0306 = 0.1518 < 0.2$ mm

The accuracy requirement is thus satisfied.

4. Selection of motor

Selection in relation to the dynamic limit curve

• The max. motor torque here occurs during acceleration upwards since the deceleration is equal to the acceleration and the drive, during lifting, also has to overcome the levels of efficiency.

$$\tau_{Mot\ max} = \tau_{a\ Mot} + \tau_{a\ G} + (\tau_{a\ load} + \tau_H) \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G}$$

$$= \tau_{a\ Mot} + 0.5 + (25 + 98.1) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95}$$

$$= \tau_{a\ Mot} + 14.9\ Nm$$

with $\tau_{a\ Mot} = J_{Mot} \cdot \alpha_{load} \cdot i = J_{Mot} \cdot 50 \cdot 10 = J_{Mot} \cdot 500\ s^{-2}$

The first 1FT6 motor with $n_n = 3000$ rpm, which satisfies the condition or matches the dynamic limit curve, is the 1FT6082–8AF7 with $P_n = 3.2$ kW, $\tau_n = 10.3$ Nm, $\tau_{max\ perm} = 42$ Nm, $J_{Mot} = 0.00335\ kgm^2$ (with brake), $k_{Tn100} = 1.18$ Nm/A, $\eta_{Mot} = 0.89$, $\tau_0 = 13$ Nm

• The acceleration and deceleration torque for the motor rotor is thus

$\tau_{a\ br\ Mot} = 0.00335 \cdot 500 = 1.68$ Nm

• The max. motor torque is equal to the motor torque during acceleration:

$\tau_{Mot\ max} = \tau_{Mot\ b\ up} = 1.68 + 14.9 = 16.58$ Nm

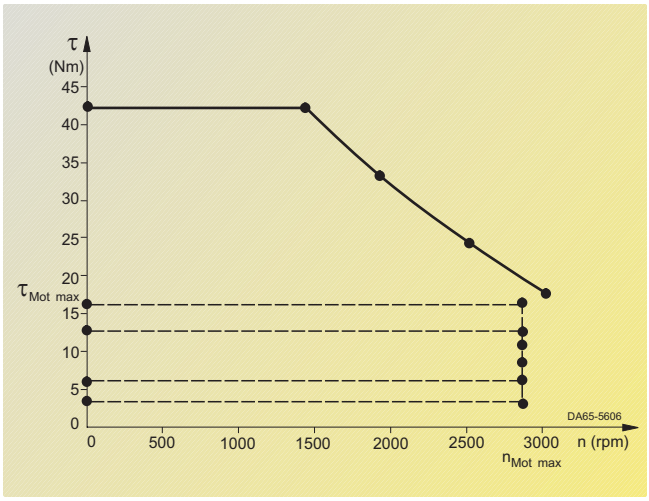



Fig. 6/14
Dynamic limit curve for the 1FT6082–8AF7 with the points of the load cycle

In order to check the thermal limits, the effective motor torque is calculated. For this purpose all other motor torques within the travel curve have to be calculated in addition to the motor torque during acceleration.



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**Calculating example** (continued)

- Lifting of the load, motor torque during constant travel:

$$\tau_{Mot\ k\ up} = \tau_H \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G} = 98.1 \cdot \frac{1}{01 \cdot 0.9 \cdot 0.95} = 11.47\ Nm$$

- Lowering of the load, motor torque during constant travel:

$$\tau_{Mot\ k\ down} = \tau_H \cdot \frac{\eta_{mech} \cdot \eta_G}{i} = 98.1 \cdot \frac{0.9 \cdot 0.95}{10} = 8.39\ Nm$$

- Lifting of the load, motor torque during deceleration:

$$\tau_{Mot\ up} = -\tau_{br\ Mot} - \tau_{br\ G} + \left(-\tau_{br\ load} + \tau_H\right) \cdot \frac{1}{i \cdot \left(\eta_{mech} \cdot \eta_G\right)^{sign(-\tau_{br\ load} + \tau_H)}}$$

$$= -1.68 - 0.5 + \left(-25 + 98.1\right) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 6.37\ Nm$$

Lowering of the load, motor torque during acceleration:

$$\tau_{Mot\ a\ down} = -\tau_{a\ Mot} - \tau_{a\ G} + \left(-\tau_{a\ load} + \tau_H\right) \cdot \frac{\left(\eta_{mech} \cdot \eta_G\right)^{sign(-\tau_{a\ load} + \tau_H)}}{i}$$

$$= -1.68 - 0.5 + \left(-25 + 98.1\right) \cdot \frac{0.9 \cdot 0.95}{10} = 4.08\ Nm$$

- Lowering of the load, motor torque during deceleration:

$$\tau_{Mot\ br\ down} = \tau_{br\ Mot} + \tau_{br\ G} + \tau_{br\ load} + \tau_H \cdot \frac{\left(\eta_{mech} \cdot \eta_G\right)}{i}$$

$$= 1.68 + 0.5 + \left(25 + 98.1\right) \cdot \frac{0.9 \cdot 0.95}{10} = 12.7\ Nm$$

The motor curve can be determined with the help of the values calculated for the motor torque.

- The effective motor torque is obtained from the torque characteristic as follows:

$$\tau_{eff} = \sqrt{\frac{\sum \tau_{Mot\,i}^2 \cdot \Delta t_i}{T}}$$

$$= \sqrt{\frac{16.58^2 \cdot 0.6 + 11.47^2 \cdot 0.3 + 6.37^2 \cdot 0.6 + 4.08^2 \cdot 0.6 + 8.39^2 \cdot 0.3 + 12.7^2 \cdot 0.6}{7}}$$

$$= 7.14\ Nm$$

- The speed-proportional travel curve is used to obtain the mean motor speed as follows:

$$n_{mean} = \frac{\sum \frac{|n_B + n_E|}{2} \cdot \Delta t_i}{T}$$

$$= \frac{\frac{2865}{2} \cdot 0.6 + 2865 \cdot 0.3 + \frac{2865}{2} \cdot 0.6 \cdot 2}{7} = 736.7\ rpm$$

(due to the symmetry of the travel curve, the component for lifting is multiplied by 2)

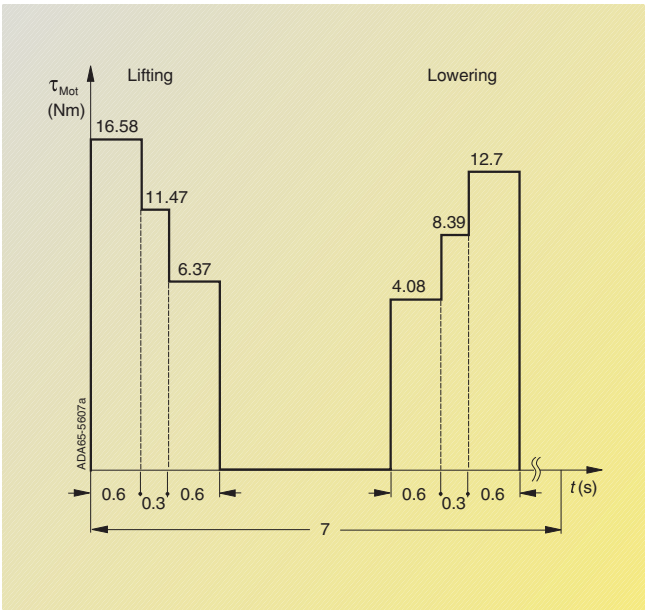



Fig. 6/15
Torque characteristic for lifting and lowering

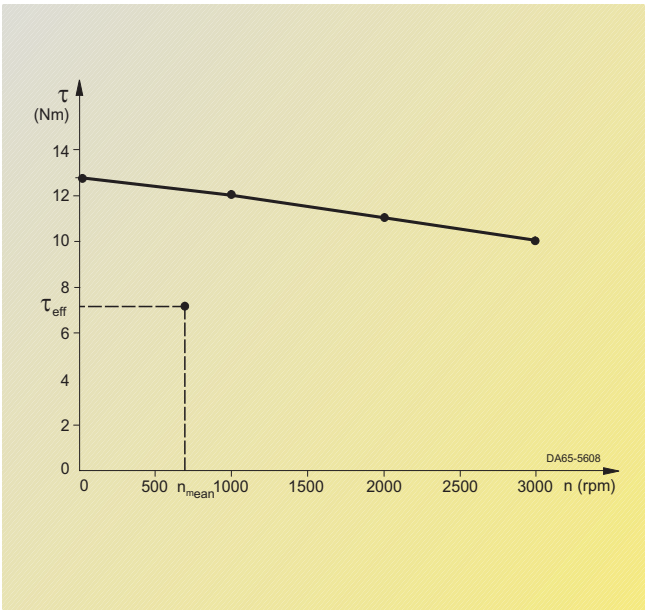



Fig. 6/16
S1 curve for the 1FT6082–8AF7

The calculated effective motor torque at $n_{mean}$ is below the S1 curve. The motor is therefore suitable.



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5. Selection of the inverter

The inverter is selected according to the maximum motor current and the mean motor current.

- Maximum motor current (the saturation influence here can be ignored):

$$I_{\text{Mot max}} \approx \frac{\tau_{\text{Mot max}}}{k_{\text{Tn100}}} = \frac{16.57}{1.18} = 14\ \text{A}$$

- Mean motor current, obtained from the magnitude of the torque characteristic:

$$I_{\text{Mot mean}} \approx \frac{\sum |\tau_{\text{Mot i}}| \cdot \Delta t_i}{k_{\text{Tn100}} \cdot T}$$

$$= \frac{16.58 \cdot 0.6 + 11.47 \cdot 0.3 + 6.37 \cdot 0.6 + 4.08 \cdot 0.6 + 8.39 \cdot 0.3 + 12.7 \cdot 0.6}{1.18 \cdot 7}$$

$$= 3.6\ \text{A}$$

- A 6SE7021–0TP50 Compact PLUS inverter is necessary with $I_{\text{Vn}} = 10.2$ A. Since the acceleration and deceleration times are > 0.25 s, only 1.6 times the rated current can be utilized. Thus

$I_{\text{Mot max}} = 14\ \text{A} < 1.6 \cdot I_{\text{Vn}} = 16\ \text{A}$

$I_{\text{Mot mean}} = 3.6\ \text{A} < I_{\text{Vn}} = 10.2\ \text{A}$

6. Determination of the DC link currents

The maximum DC link current occurring during motor operation and the mean DC link current for the inverter have to be determined for later rating of the rectifier unit. To do this, all power outputs of the motor within the travel curve first have to be calculated.

- Lifting of the load, max. power output of motor during acceleration:

$$P_{\text{Mot a up max}} \approx \frac{\tau_{\text{Mot a up}} \cdot n_{\text{Mot max}}}{9550} = \frac{16.58 \cdot 2865}{9550} = 4.97\ \text{kW}$$

- Lifting of the load, power output of motor during constant travel:

$$P_{\text{Mot k up}} = \frac{\tau_{\text{Mot k up}} \cdot n_{\text{Mot max}}}{9550} = \frac{11.47 \cdot 2865}{9550} = 3.44\ \text{kW}$$

- Lifting of the load, max. power output of motor during deceleration:

$$P_{\text{Mot br up max}} = \frac{\tau_{\text{Mot v br up}} \cdot n_{\text{Mot max}}}{9550} = \frac{6.37 \cdot 2865}{9550} = 1.91\ \text{kW}$$

- Lowering of the load, max. power output of motor during acceleration:

$$P_{\text{Mot a down max}} = \frac{\tau_{\text{Mot a down}} \cdot n_{\text{Mot max}}}{9550} = \frac{4.08 \cdot (-2865)}{9550} = -1.22\ \text{kW}$$

- Lowering of the load, power output of motor during constant travel:

$$P_{\text{Mot k down}} = \frac{\tau_{\text{Mot k down}} \cdot n_{\text{Mot max}}}{9550} = \frac{8.39 \cdot (-2865)}{9550} = -2.52\ \text{kW}$$

- Lowering of the load, max. power output of motor during deceleration:

$$P_{\text{Mot v br down max}} = \frac{\tau_{\text{Mot br down}} \cdot n_{\text{Mot max}}}{9550} = \frac{12.7 \cdot (-2865)}{9550} = -3.81\ \text{kW}$$

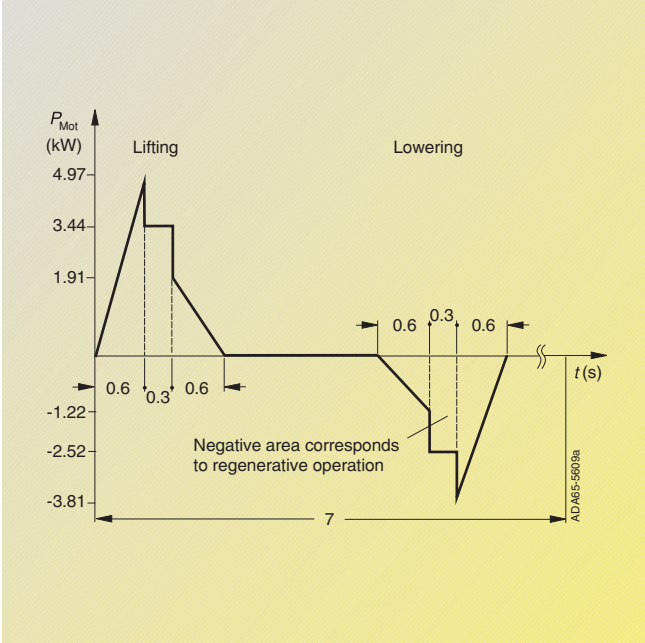



Fig. 6/17
Curve of motor power output for lifting and lowering

- The maximum DC link current during motor operation during acceleration upwards is as follows:

$$I_{\text{Link inv max}} = \frac{P_{\text{Mot max}}}{\eta_{\text{Mot}} \cdot \eta_{\text{inv}} \cdot 1.35 \cdot V_{\text{line}}}$$

$$= \frac{4970}{0.89 \cdot 0.98 \cdot 1.35 \cdot 460} = 9.18\ \text{A}$$

- The mean power output of the motor during motor operation is calculated from the positive characteristic of the motor power output as follows:

$$P_{\text{Mot mean}} = \frac{\sum \frac{P_{\text{Mot B}} + P_{\text{Mot E}}}{2} \cdot \Delta t_i}{T}$$

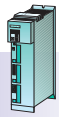
$$= \frac{\frac{1}{2} \cdot 4.97 \cdot 0.6 + 3.44 \cdot 0.3 + \frac{1}{2} \cdot 1.91 \cdot 0.6}{7} = 0.442\ \text{A}$$

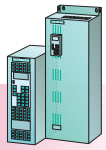
- The mean DC link current is therefore:

$$I_{\text{Link mean}} = \frac{P_{\text{Mot mean}}}{\eta_{\text{Mot}} \cdot \eta_{\text{inv}} \cdot 1.35 \cdot V_{\text{line}}} = \frac{442}{0.89 \cdot 0.98 \cdot 1.35 \cdot 460} = 0.82\ \text{A}$$



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**Calculating example** (continued)

7. Determination of braking power

The maximum braking power and the mean braking power have to be determined for later rating of the braking resistors. The maximum motor power output during braking has already been calculated in 6.

- The maximum braking power is thus:

$P_{br\,max} = P_{Mot\,br\,down\,max} \cdot \eta_{Mot} \cdot \eta_{inv} = -3.81 \cdot 0.89 = -3.32\ kW$

- The mean braking power is obtained from the negative characteristic of the motor power output as follows:

$$P_{br\,mean} = \frac{\sum \frac{P_{Mot\,B} + P_{Mot\,v\,E}}{2} \cdot \Delta t_i}{T} \cdot \eta_{Mot} \cdot \eta_{inv}$$

$$= \frac{\frac{1}{2} \cdot (-1.22) \cdot 0.6 + (-2.52) \cdot 0.3 + \frac{1}{2} \cdot (-3.81) \cdot 0.6}{7} \cdot 0.89 \cdot 0.98$$

$$= -0.28\ kW$$

### *Selection of the rectifier unit*

Now that the drives of the x, y and z axes have been calculated, the rectifier unit can be selected. Here, it is assumed that the drives of the x and z axes can operate simultaneously.

- The maximum DC link currents of the two inverters during motor operation are therefore added together.

$I_{Link\,rect\,max} = \Sigma\, I_{Link\,inv\,max} = 12.66\ A + 9.18\ A = 21.84\ A$

- In order to determine the mean value of the DC link current, the mean values of the two inverters are added together.

$I_{Link\,rect\,mean} = \Sigma\, I_{Link\,inv\,mean} = 0.83\ A + 0.82\ A = 1.65\ A$

- The 15 kW rectifier unit, 6SE7024–1EP85-0AA0, with $I_{DC\,n} = 41\ A$ is sufficient.

$I_{Link\,rect\,max} = 21.84\ A < 1.6 \cdot I_{Link\,n} = 65.6\ A$

$I_{Link\,rect\,mean} = 1.65\ A < I_{Link\,n} = 41\ A$

### *Selection of the braking resistor*

The braking resistor is connected to the chopper of the rectifier unit. During rating, it is assumed that the drives of the x and z axes can brake simultaneously.

- The maximum braking power levels of the two inverters are therefore added together.

$P_{br\,max}\ \Sigma\, P_{br\,inv} = -4.08\ kW - 3.32\ kW = -7.4\ kW$

- For the mean braking power, the individual mean values are also added together.

$P_{br\,mean}\ \Sigma\, P_{br\,inv\,mean} = -0.146\ kW - 0.28\ kW = -0.426\ kW$

- A 6SE7018-0ES87–2DC0 braking resistor of 80 Ω with $P_{20} = 5\ kW$ is necessary.

$P_{br\,max} = 7.4\ kW < 1.5 \cdot P_{20} = 7.5\ kW$

$P_{br\,mean} = 0.426\ kW < P_{20}/4.5 = 1.11\ kW$



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## Legend

| Math Symbol | Definition |
|---|---|
| $\Delta s_{Gear}$ | Positioning accuracy of gear box |
| $\Delta s_{Encoder}$ | Positioning accuracy of encoder |
| $\Delta s_{mech}$ | Imprecision of the mechanical system |
| $\Delta s_{tot}$ | Positioning accuracy of the total system |
| $\alpha_G$ | Angular rotation of gear box |
| $D$ | Diameter (in length) |
| $\pi$ | Pi |
| $Z$ | Pulses per revolution of encoder |
| $i$ | Gear ration |
| $n_n$ | Rated speed in rmp |
| $\tau_{a\,Mot}$ | Accelerating torque needed for accelerating the motor rotor moment of inertia |
| $\tau_{*\,load\,max}$ | Maximum load torque converted to the motor speed during the acceleration phase, including the contribution of the gearbox |
| $\tau_{Mot\,max}$ | Maximum motor torque |
| $\alpha_{a\,Mot}$ | Angular acceleration of the motor |
| $\tau_{rms}$ | Total rms torque |
| $\tau_{Mot\,i}$ | Motor torque in the time segment "$i$" |
| $\Delta T_i$ | Time segment "$i$" in seconds |
| $T$ | Total cycle time |
| $n_{mean}$ | Total mean speed in rpm |
| $n_{Mot\,B}$ | Beginning value of motor speed in rpm |
| $n_{Mot\,E}$ | Ending value of motor speed in rpm |
| $J_{Mot}$ | Inertia of motor rotor |
| $I_{rms}$ | Motor rms current |
| $I_n$ | Rated motor current |
| $I_{Mot}$ | Motor current at a given part of the motion curve |
| $\tau_{\mu n}$ | Rated magnetizing current |
| $I_{Mot\,B}$ | Beginning value of motor current |
| $I_{Mot\,E}$ | Ending value of motor current |
| $k_{Tn}$ | Motor torque constant |
| $P_{Mot}$ | Motor power in kW |
| $I_{DC\,rect}$ | DC bus current required by rectifier |
| $I_{DC\,inv}$ | DC bus current required from inverter |
| $V_{DC}$ | DC bus voltage |
| $\eta_{Inv}$ | Efficiency of inverter |
| $\eta_{Mot}$ | Efficiency of motor |
| $V_{line}$ | AC line voltage |
| $W_s$ | Storage capacity of capacitor in Watt∗Seconds |
| $V_{DC\,n}$ | Rated DC bus voltage |
| $V_{DC\,min}$ | Minimum allowable DC bus voltage |
| $\tau_{Mot\,br\,max}$ | Maximum motor torque during braking |
| $t_{rt}$ | Power dip ride-through time |
| $P_{br\,max}$ | Maximum braking power |
| $t_{br}$ | Braking time |
| $W_{br}$ | Braking energy |





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## Overload capability of the converter

The inverters and converters can be overloaded for a short time by up to 1.6 times the rated current (200 kW (270 HP) and 250 kW (335 HP) up to 1.36 times).

The permissible overload time is dependent on the overload factor. If this time is exceeded, then the converter output current is limited to 91 % of the rated converter current. The current-time ratios which are just insufficient for activating the fault memory are shown in the overload diagrams. Possible overcurrents, necessary recovery times and load cycles can be obtained from the overload diagrams.

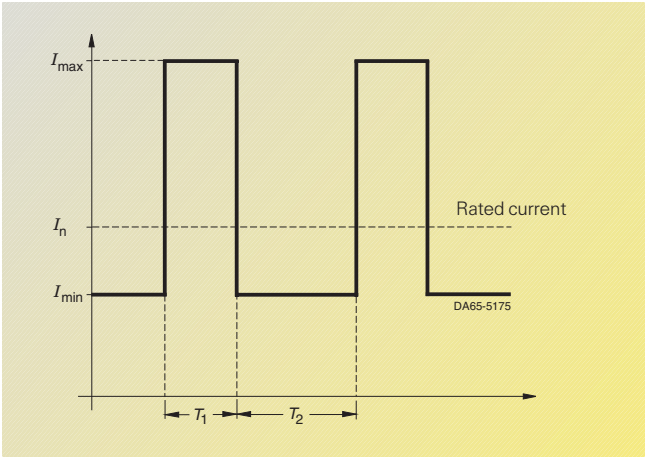



Fig. 6/18
Example of an overload curve

For overloads as shown in Fig. 6/18 with $I_{max} > I_n$ and $I_{min} < I_n$, the necessary base-load time $T_2$ can be obtained using the nomogram in Fig. 6/19, given the values of the overload current $I_{max}$, the overload time $T_1$ and the base load current $I_{min}$. For example, for $I_{max} = 1.6 \times I_n$, $T_1 = 30$ s and $I_{min} = 0.4 \times I_n$, the necessary base-load time is $T_2 = 30$ s.

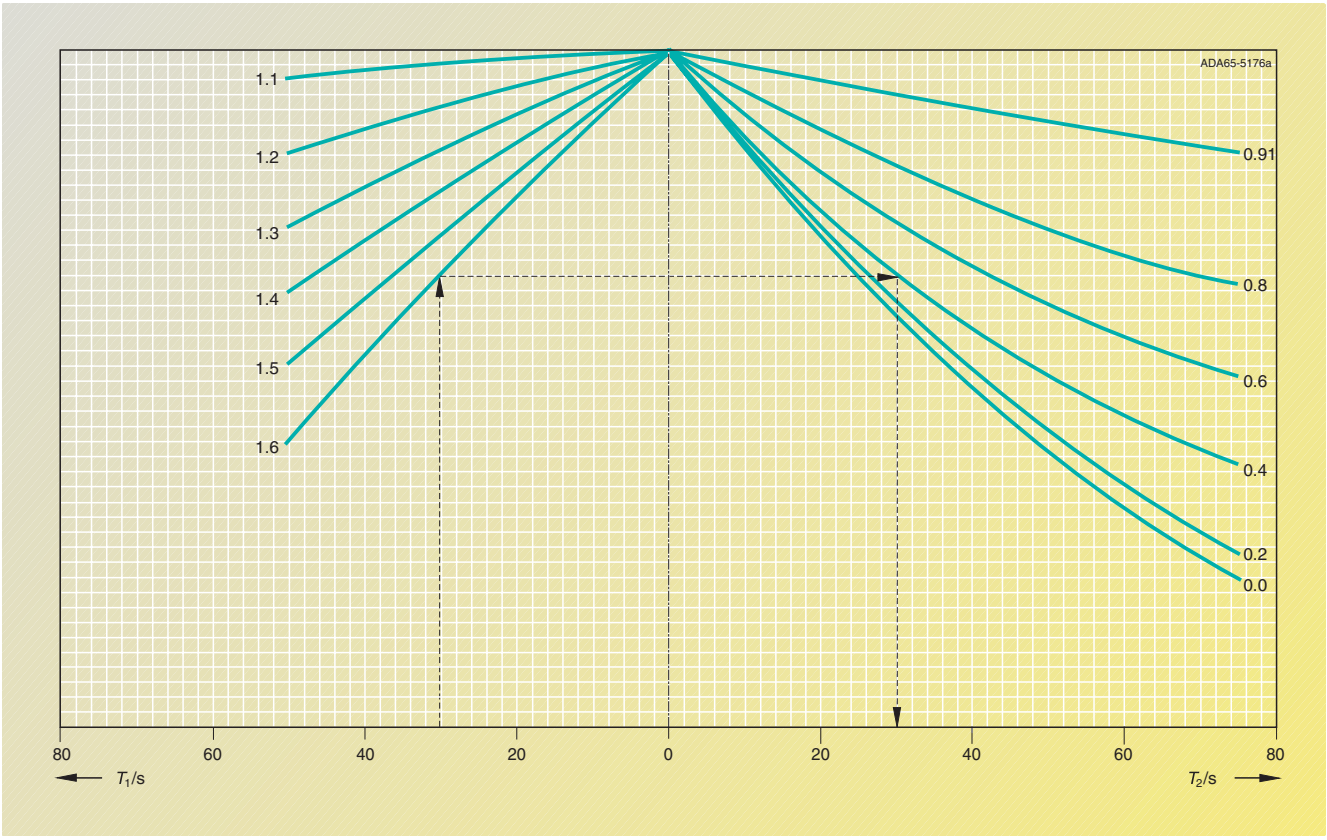



Fig. 6/19
Nomogram for determining the overload and pause times



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## Installation conditions and correction factors

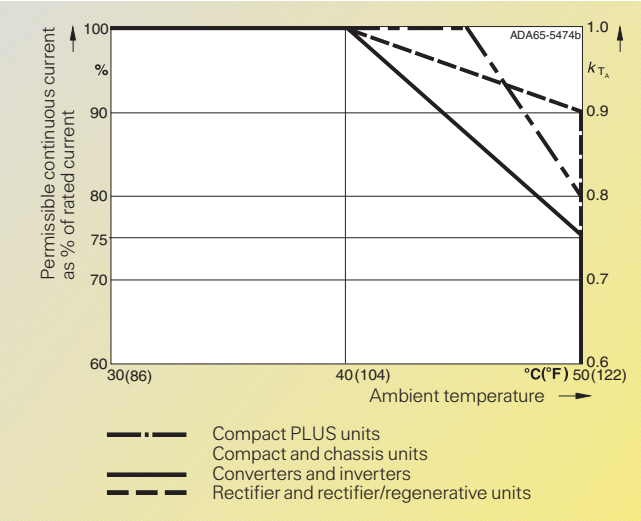



Fig. 6/20
Reduction factor $k_{TA}$ for installation altitudes up to 1000 m (3282 ft) above sea level and different ambient temperatures

If the MASTERDRIVES units are operated at installation altitudes up to 1000 m (3282 ft) above sea level and at ambient temperatures > 40 °C (104 °F), the **current reduction factors** from Fig. 6/20 are to be applied to the rated current.

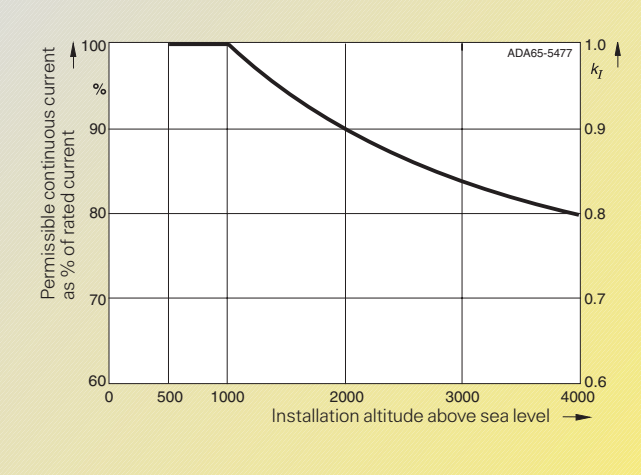



Fig. 6/21
Reduction factor $k_I$ for installation altitudes from 1000 m (3282 ft) to 4000 m (13 126 ft) above sea level

Current reduction (correction factor $k_I$ in accordance with Fig. 6/21) is also necessary if the units are used at installation altitudes between 1000 m (3282 ft) and 4000 m (13126 ft) above sea level.

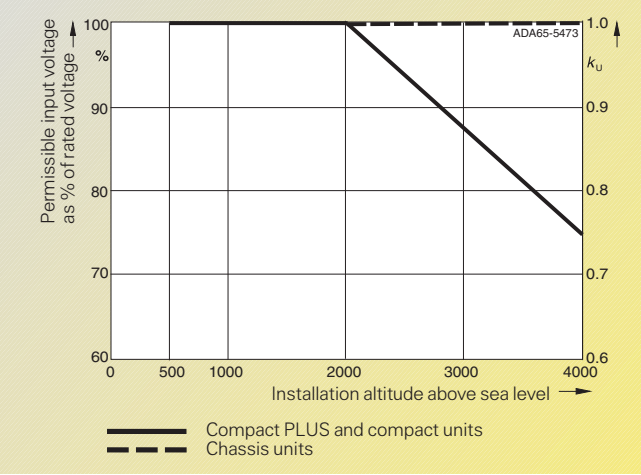



Fig. 6/22
Reduction factor $k_V$ for installation altitudes from 1000 m (3282 ft) to 4000 m (13126 ft) above sea level

In the case of installation altitudes > 2000 m (6563 ft), in addition to current derating, **voltage reduction $k_U$** is necessary in accordance with DIN VDE 0110. If CSA or NEMA regulations apply, voltage reduction is not necessary. The reference voltage for voltage reduction is 480 V. The result is that, at an installation altitude of approx. 3000 m (9845 ft), a maximum line voltage of 400 V is permissible (Compact PLUS and compact units).



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## Single-axis drive for single-drive tasks

Single drives are always used whenever only single-drive tasks have to be performed or when energy equalization over several axes is not desired or is not possible. Converters are then used which, if necessary, are directly connected to the 3-phase power supply via external main contactors, filters and line commutating reactors.

For regenerative operation, the converters are combined with braking choppers and braking resistors. For Compact PLUS converters, the braking choppers are integrated. Braking operation with compact and chassis units requires external braking units. The braking units up to a rated braking power of 20 kW contain an internal braking resistor.

As an option, a capacitor module can be used to buffer short-time energy peaks.

Figure 6/23 shows an example of a single-axis drive, Compact PLUS design.

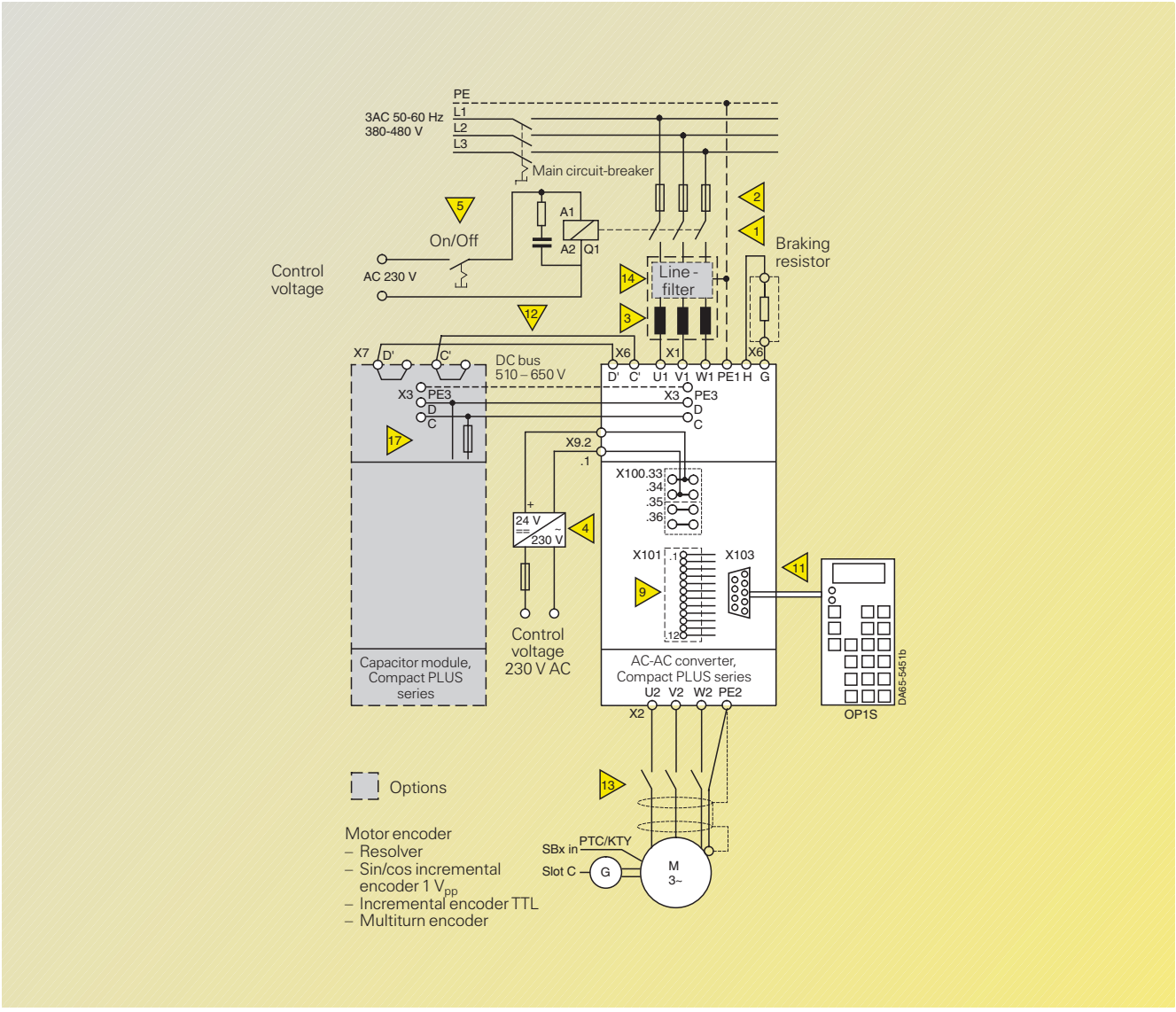



Fig. 6/23
Example of a single-axis drive, Compact PLUS series



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## Multi-axis drives with a converter as the rectifier unit

### *Converter with connected inverters*

For applications in the lower output range, a Compact PLUS converter can be combined with inverters of the same series.

The converter rectifier rectifies the line voltage and feeds the inverters via the DC bus system arranged on the top of the units. If 1 or 2 inverters are used, the internal 24 V power supply of the converter can be used. If more than 2 inverters are planned (with the smallest Compact PLUS converter, 6SE7011-5EP50, only the 6SE7012-0TP50 inverter can be connected once), an external 24 V power supply must be provided. See "Selection and ordering data", page 3/17.

This enables multi-axis systems to be implemented with inverters in a very compact manner and without the use of a separate rectifier unit. See also "Engineering instructions", item 7, page 6/6.

If one axis is braked, the braking energy is fed back into the DC link and made available to the other connected motors. Excess energy is reduced by means of an external braking resistor.

As an option, a capacitor module can be used, which buffers energy peaks for a short time.

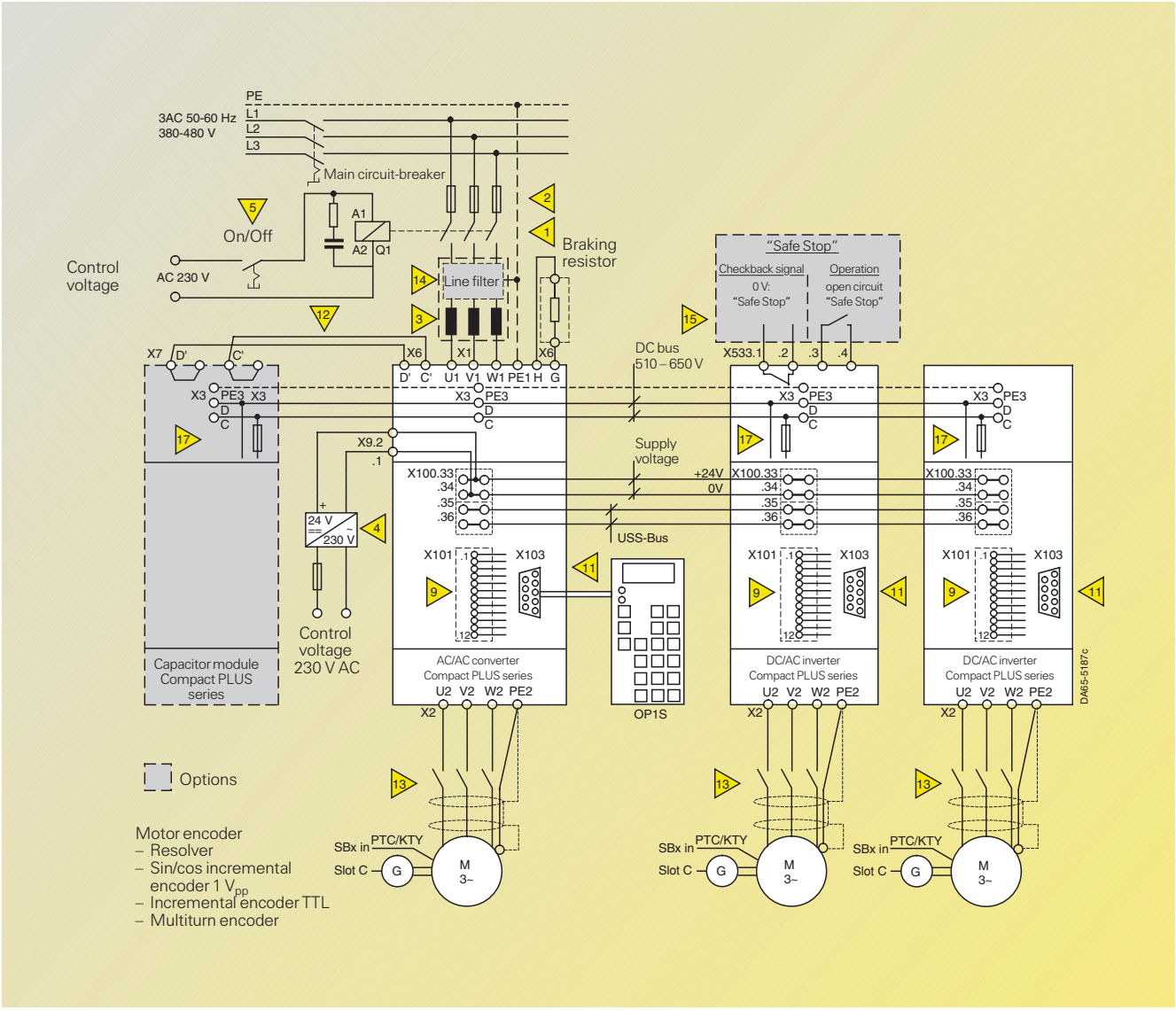



Fig. 6/24
Example of multi-axis drive with 3 axes, Compact PLUS series



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## Multi-axis drive with a rectifier unit

### *Multi-axis drive with a rectifier unit and inverters*

Multi-axis drives can also be created with inverters and a common rectifier unit.

The rectifer unit rectifies the line voltage and supplies the inverters via the DC bus.

The DC bus is simultaneously used for energy equalization between the individual axes.

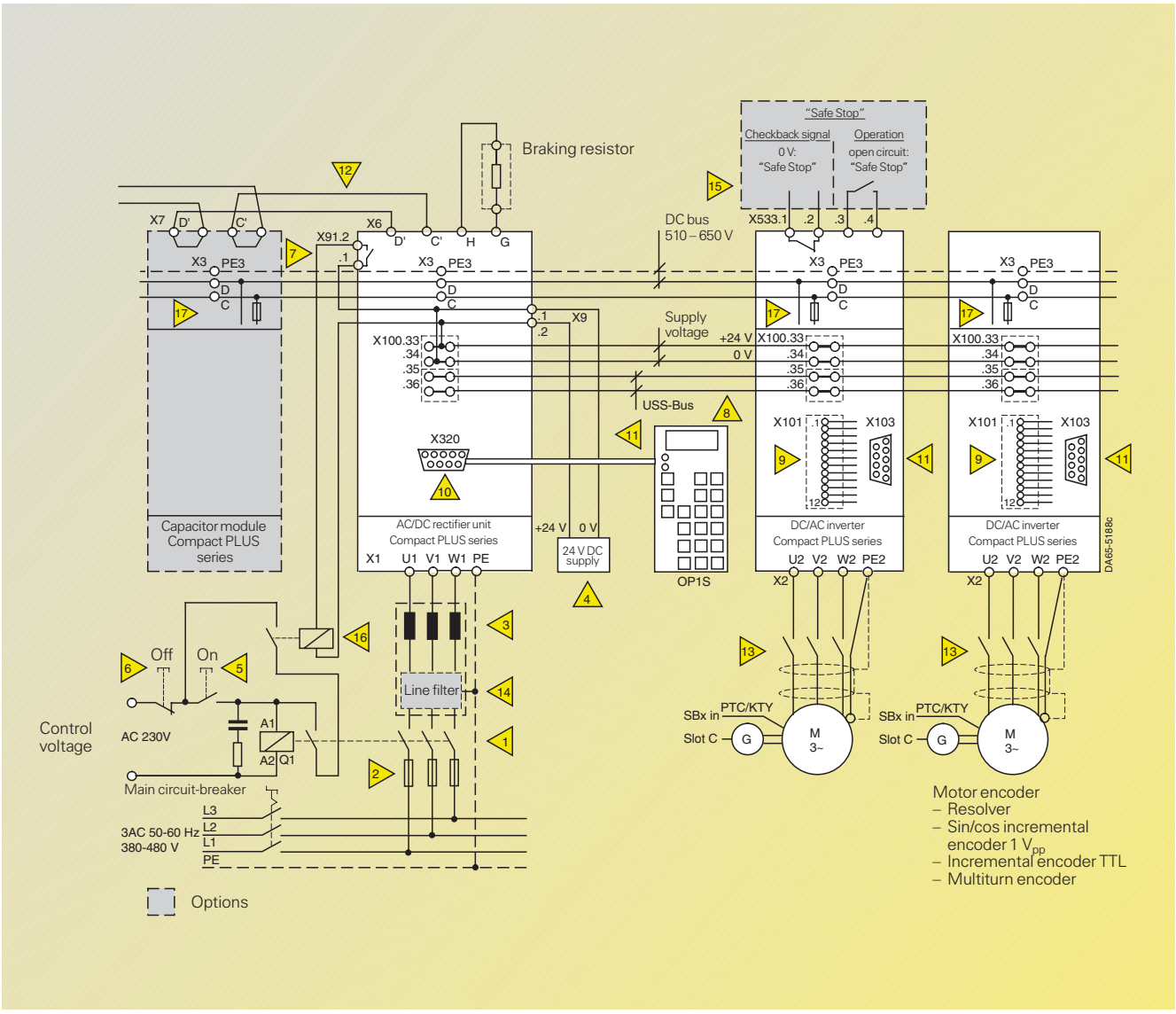



Fig. 6/25
Example of a multi-axis drive with rectifier unit, Compact PLUS series

### *Multi-axis drive with Compact PLUS series*

In Fig. 6/25, several inverters of the Compact PLUS type are combined. A Compact PLUS rectifier unit feeds all of the connected inverters. As an option, capacitor modules can be used to buffer short-time energy peaks. Excessive braking energy is dissipated using an external braking resistor.

The OP1S operator control panel enables parameterization, parameter backup and visualization of all inverters.

An external 24 V power supply unit ensures that the electronics of the rectifier unit and the inverters are supplied with power at all times.



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## Legend for the examples given

General

The examples given show typical ways of expanding the drives. The necessity of the individual components must be clarified when the drive tasks to be performed are being defined.

You can find the information necessary for dimensioning the individual components together with their order numbers in the catalog.

1 Q1 line contactor

The line contactor is used to connect the whole system to the power supply and to disconnect it when necessary or in the event of a fault.

The line contactor must be dimensioned according to the rated output of the converters or inverters connected.

2 Line fuses

The line fuses, depending on their response characteristics and the requirements, protect the connected cables and the input rectifier of the units.

3 Line commutating reactor[1])

With the line commutating reactor, any current peaks occurring are limited and harmonics reduced. It is required to reduce the line reaction to the levels specified in DIN VDE 0160.

4 24 V power supply

The external 24 V power supply unit is required for maintaining communication and diagnostics of the connected units even when the supply voltage has been switched off.

The following criteria apply to dimensioning of the unit:

- When the 24 V power supply unit is switched on, an increased switch-on current occurs. The 24 V power supply must be dimensioned to take this into account.
- A regulated power unit must not be used. The voltage must be between 20 V and 30 V.

In order to determine the 24 V current requirement, see "Unit design power and control terminals".

5 On/Off

In the case of single-axis drive and multi-axis drives without a rectifier unit, a switch is used to open and close the line contactor. If the switch is turned off during operation, the drives are not shut down in a controlled manner but are simply braked by the connected load.

In the case of a multi-axis drive with a rectifier unit, a pushbutton for closing the line contactor is used. By means of a lock-type contact which is connected to the fault signalling relay of the rectifier unit, the line contactor remains closed as long as no fault is detected in the rectifier unit.

6 Off switch

The line contactor is opened immediately when the Off switch is operated.

The drives are not shut down in a controlled manner but are simply braked by the connected load.

7 Fault signaling relay

If a fault occurs in the rectifier unit, a fault signal is generated at the connecting contacts of the signalling relay.

When the 24 V power supply is switched on, the relay is closed as long as there is no fault.

In the event of a fault, the lock of the line contactor is opened, the contact falls out and the drives coast to a standstill.

8 USS bus

The USS bus is for communication and need only be connected when required.

9 X101

The digital inputs and outputs as well as the analog input and output must be assigned according to the requirements placed on the drives.

10 X320 of the rectifier unit

The X320 terminal on the rectifier unit is only for permanently attaching the user-friendly OP1S operator control panel and for linking up to the connected inverters.

For the measures to be taken and the information necessary for correct operation, please refer to the corresponding operating instructions.

11 X103 serial interface

The serial interface is for connecting the OP1S operator control panel or a PC. It can be operated in accordance with the RS232 or RS485 protocols.

For the measures to be taken and the information necessary for correct operation, please refer to the corresponding operating instructions.

12 Precharging – Capacitor module

If a capacitor module is used, the terminals for precharging of the capacitors must be connected. This is not necessary when using the Compact PLUS 50 kW and 100 kW rectifier units.

If one or more capacitor modules are operated at the 15 kW Compact PLUS rectifier unit, then precharging may be done only once every 3 minutes.

13 Output contactor

The use of an output contactor is necessary when a motor with a charged DC link is to be isolated from the converter/inverters.

14 Radio-interference suppression filter[1])

The use of a radio-interference suppression filter is only necessary if the radio-interference voltages of the converters or rectifier units have to be reduced.

15 Safe Stop (option)

With the "Safe Stop" option, the power supply for the power section pulse transmission can be interrupted by means of a safety relay. This ensures that the unit does not create a rotating field in the connected motor.

16 Auxiliary contactor

With the auxiliary contactor, the lock of the main contactor is opened in the event of a fault signal. It must be used if the control voltage for the Q1 line contactor is 230 V AC.

The auxiliary contactor can be dispensed with if a line contactor with a 24 V DC control voltage is used.

17 DC link fuse

A DC link fuse is integrated in the inverters and in the capacitor module.

1) In the case of radio-interference suppression filters for the Compact PLUS series (6SE70..–. EP87–....), a commutating reactor is built in.



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## MASTERDRIVES Motion Control P2

P2 stands for Performance 2. Performance increase by a factor of 2. Computing power is doubled, and consequently, computing times are reduced by half for all functions.

- Significant improvement in the dynamic response of the movement (for example, calculation of current and speed controller in T0 in 100 $\mu$s)
- Faster calculation of the technological setpoint functions such as cam discs and other components (now in 1.6 ms instead of 3.2 ms)
- High-performance connection to the new SIMOTION Motion Control system.

The use of new hardware components has resulted in new firmware (V 2.x) that optimizes utilization of all resources. The firmware (V 1.x) no longer runs on the new hardware. Functionally, the new V 2.0 is identical to V 1.6.

The new Motion Control P2 is download-compatible. All DNL and Script files will execute, thereby offering the best-possible investment security for the engineering services provided.

The mechanical and electrical connections are compatible, so conversion to P2 does not negatively impact plant design.

## Free function blocks with BICO system

In the software of the basic unit, there are function blocks which can be "softwired" as required with the help of the "BICO system". The user is therefore able to tailor the MASTERDRIVES exactly to the problem to be solved.

Data between the function blocks as well as with the available control variables such as actual values and setpoints are exchanged via "plug-in connectors" referred to as either binectors (for binary signals) or connectors (for analog signals as a 16 or 32 bit word), depending on the type of signal to be transmitted. BICO system = Binector-Connector system.

The following freely usable function blocks are available (with exceptions), however, use of these blocks may affect the computing time:

- General function blocks

  Fixed setpoints
  Indicator blocks
  Converter blocks
  Diagnostic blocks

- Arithmetic and control blocks

  Adders, subtracters, multipliers, dividers, absolute-value generators with filtering, sign inverters, limiters, limit-value monitors, minimum maximum selection, timers, polygon curve characteristics, flip-flop

- Complex blocks

  Ramp generator, software counter
  PID controller
  Wobble generator
  Brake control

- Logic blocks

  AND elements
  OR elements
  EXCLUSIVE OR elements
  Inverters
  NAND elements
  RS storage elements
  D storage elements
  Timers, Pulse generator

Note

See the Compendium for the exact list and description of the blocks.

## Safe Stop

The "Safe Stop" function for SIMOVERT MASTERDRIVES is a "device for avoiding unexpected starting" according to EN 60 204-1, Section 5.4. In combination with an external circuit, the "Safe Stop" function for SIMOVERT MASTERDRIVES has been certified by the German Berufsgenossenschaft (institution for statutory accident insurance and prevention) in accordance with EN 954-1 Safety Category 3. Due to the "Safe Stop" function, motor-side contactors as a second switch-off path are not required.

The "Safe Stop" function prevents unexpected starting of the connected motor from a standstill. The "Safe Stop" is to be activated only when the drive is at a standstill; otherwise, it loses its ability to brake the motor.

The "Safe Stop" function is integrated in Compact inverters and is available for Compact PLUS units (all converters and inverters from 5.5 kW (7.5 HP)) as option K80.

### *Operating principle*

The safety relay with positively driven contacts uses the NO contact to interrupt the power supply to the optocoupler or fiber-optic cable and thus prevents the transmission of firing pulses into the power section, so that the unit cannot generate a rotating field.

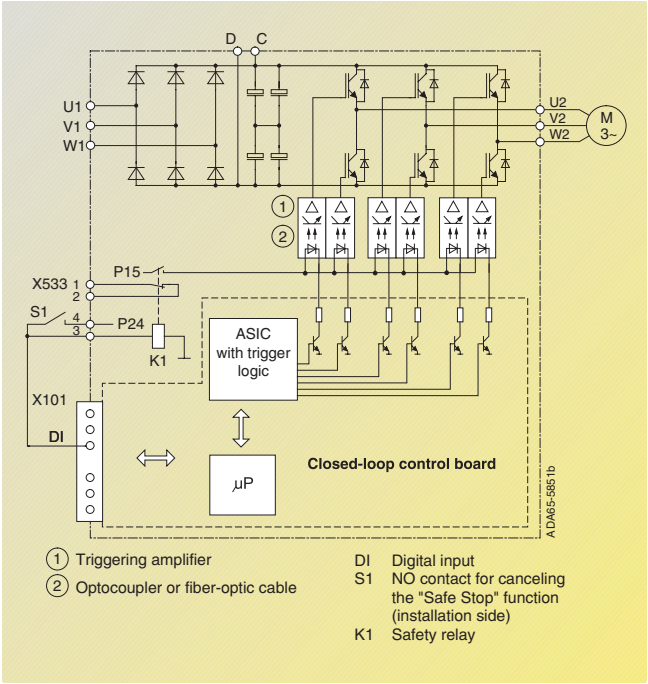



Fig. 6/26
Block diagram of "Safe Stop" function
(Terminal designation applies to chassis unit with option K80)



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## Safe Stop (continued)

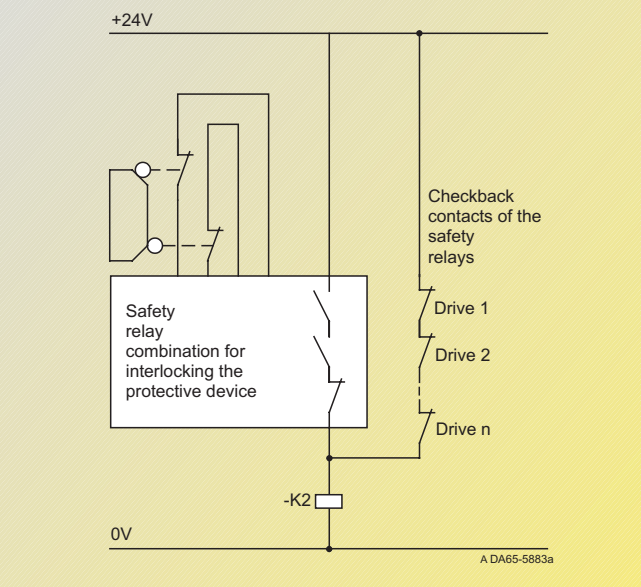



Fig. 6/27
Direct triggering of the K2 main contactor via the checkback contact of the safety relay

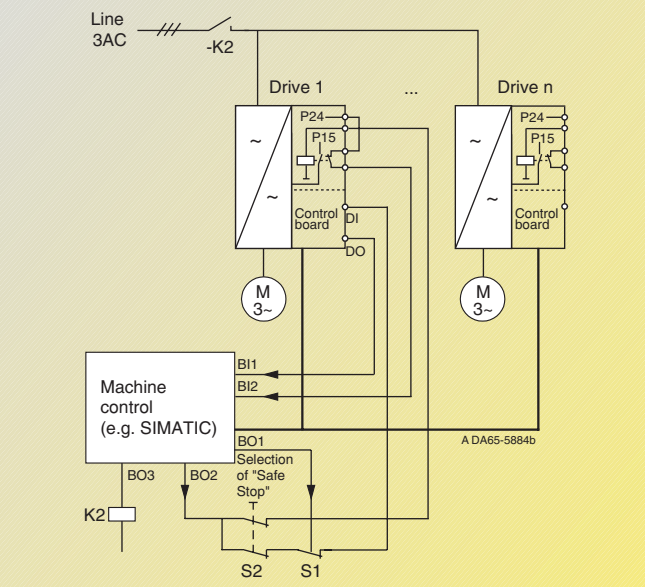



Fig. 6/28
Test of the switch-off method via the machine control unit

The NC contact (= checkback contact) is used to report the switching status of the safety relay to the external control unit. The checkback contact of the safety relay always has to be evaluated and can be used for directly triggering a second switch-off path as shown in Fig. 6/27. The "Safe Stop" function is to be selected before the protective device is opened. If the NO contact of the safety relay is stuck, the checkback contact of the K2 main contactor switches off. The circuit in Fig. 6/27 assumes that the operator triggers the protective device at regular intervals. This checks the effectiveness of the switch-off paths.

In conjunction with the machine control unit, the switch-off paths in the converter or inverter can be tested and the higher-level K2 contactor is opened if a fault is detected. The machine control unit selects "Safe Stop" via binary output BO2 and tests the reaction of the safety relay via binary input BI2. BO2 then changes to operating mode and the reaction of the control board can be tested via BO1 and S1 by means of BI1. When "Safe Stop" is selected in the status word, the control board must signal back the "Stop2" command. If a reaction does not match expectations according to the programmed reaction, the control unit generates a fault message and opens the K2 main contactor. The switch-off paths can also be tested via a communications link, e.g. PROFIBUS DP.

The circuit shown in Fig. 6/28 assumes that the machine control unit tests the effectiveness of the switch-off paths at regular intervals and before each start (e.g. every 8 hours).

When the "Safe Stop" function is activated, electrical isolation from the supply does not take place. The function is therefore not designed for protection against electrical shock!

### *Functional safety and applications*

The entire machine must be fully isolated from the supply by means of the main switch for operational interruptions, maintenance, repair and cleaning work **on the electrical equipment** such as SIMOVERT MASTERDRIVES and motors (EN 60 204/5.3).

The "Safe Stop" function supports the requirements according to EN 954-1 Category 3 and EN 1037 relating to the safety of machines. The function is based on switching off/interrupting the power supply for firing the IGBT modules so that a "hazardous movement" is prevented.

In the case of asynchronous motors, no rotational movement is possible even if several faults occur in very specific constellations.

In applications with synchronous motors, e.g. 1FT6, 1FK6, it must be pointed out that, due to the physics involved when 2 faults occur, a residual movement can occur in very specific constellations.

Fault example:
Simultaneous breakdown of an IGBT in one phase in the positive branch and an IGBT of another phase in the negative branch.

Residual movement:

$$\alpha_{max} = \frac{360°}{\text{Pole number of the motor}}$$

e.g. 1FT6, 6-pole motor
$\alpha = 60°$

In order to estimate the hazard potential of this critical residual movement, a safety evaluation must be carried out by the engineer.

Advantage:
Motor contactors are no longer needed to meet these requirements.

**Caution!**
**When "Safe Stop" has been activated, hazardous voltages are still present at the motor terminals due to the inverter circuit.**

For further information on the Siemens safety engineering, please visit the Internet at:
http://www.siemens.com/safety

The application manual "Safety Integrated: The safety program for protecting man, machine, environment and process for the world's industries" with technical explanations and application examples can be ordered or downloaded at the above-mentioned Internet address.

6



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## Compact PLUS converters up to 4 kW (5 HP)

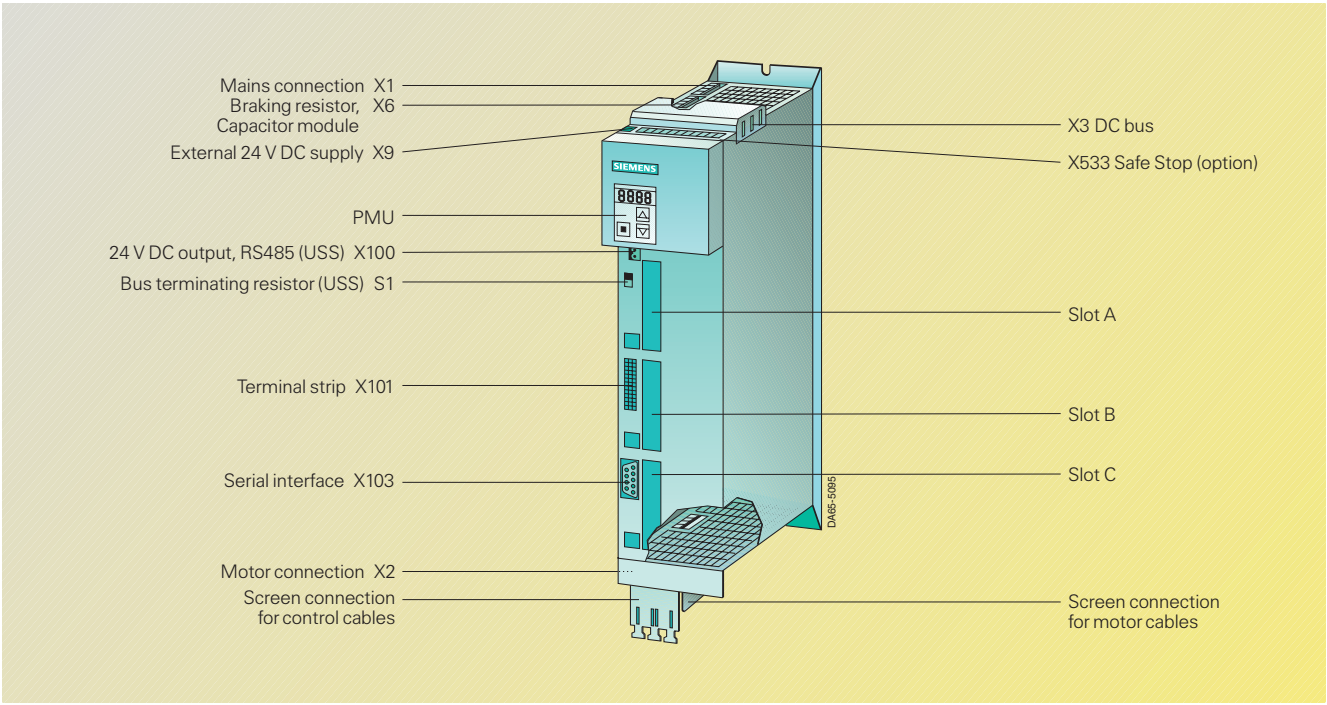



Fig. 6/29
Connection overview for Compact PLUS converters up to 4 kW (5 HP)

### *Power connections*

| X1 – Mains connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| | PE1 | Connection of equipment grounding conductor | – | 4 mm² (AWG 10) |
| | U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC | 4 mm² (AWG 10) |
| | V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC | 4 mm² (AWG 10) |
| | W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC | 4 mm² (AWG 10) |

| X3 – DC link bus module | Conductor | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|---|
| Electrical connection of individual units via the DC link. | 3 | PE3 | Connection of equipment grounding conductor | – | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 2 | D/L– | DC link voltage – | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 1 | C/L+ | DC link voltage + | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |

| X2 – Motor connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| Dimensioning of the motor cables in accordance with DIN VDE 298. | PE2 | Connection of equipment grounding conductor | – | 4 mm² (AWG 10) |
| | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage | 4 mm² (AWG 10) |
| | V2/T2 | Phase V2/T2 | | 4 mm² (AWG 10) |
| | W2/T3 | Phase W2/T3 | | 4 mm² (AWG 10) |

| X6 – Braking resistor and precharging of capacitor module | Designation | Description | Max. cross-section |
|---|---|---|---|
| During braking, the full braking current flows via the external braking resistor terminals. For this reason, the maximum cross-section must always be used for the wiring of these terminals. | C′ | Precharging of capacitor module | 4 mm² (AWG 10) |
| | G | Braking resistor | 4 mm² (AWG 10) |
| | H | Braking resistor | 4 mm² (AWG 10) |
| | D′ | Precharging of capacitor module | 4 mm² (AWG 10) |



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## Compact PLUS converters 5.5 kW (7 HP) and 7.5 kW (10 HP)

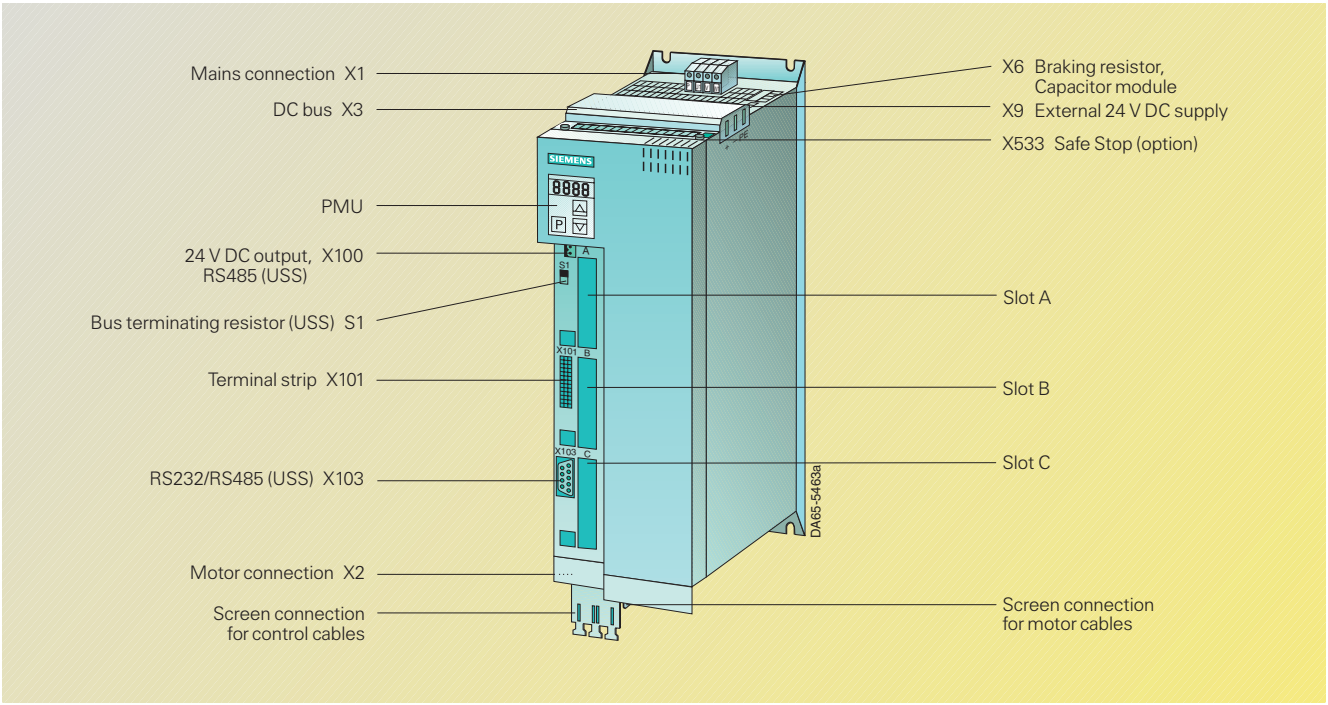



Fig. 6/30
Connection overview for Compact PLUS converters 5.5 kW (7 HP) and 7.5 kW (10 HP)

### *Power connections*

| X1 – Mains connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| | PE1 | Connection of equipment grounding conductor | | 10 mm² (AWG 8) |
| | U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC | 10 mm² (AWG 8) |
| | V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC | 10 mm² (AWG 8) |
| | W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC | 10 mm² (AWG 8) |

| X3 – DC link bus module | Cond. | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|---|
| Electrical connection of individual units on the DC link side. | 3 | PE3 | Connection of equipment grounding conductor | | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 2 | D/L– | DC link voltage – | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 1 | C/L+ | DC link voltage + | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |

| X2 – Motor connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| Dimensioning of the motor cables in accordance with DIN VDE 298. | PE2 | Connection of equipment grounding conductor | | 10 mm² (AWG 8) |
| | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage | 10 mm² (AWG 8) |
| | V2/T2 | Phase V2/T2 | | 10 mm² (AWG 8) |
| | W2/T3 | Phase W2/T3 | | 10 mm² (AWG 8) |

| X6 – Braking resistor and precharging of capacitor module for 5.5 kW and 7.5 kW | Designation | Description | Max. cross-section |
|---|---|---|---|
| During braking, the full braking current flows via the external braking resistor terminals. For this reason, the maximum cross-section must always be used for the wiring of these terminals. | C' | Precharging of capacitor module | 4 mm² (AWG 10) |
| | G | Braking resistor | 4 mm² (AWG 10) |
| | H | Braking resistor | 4 mm² (AWG 10) |
| | D' | Precharging of capacitor module | 4 mm² (AWG 10) |



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## Compact PLUS converters 11 kW (15 HP) and 15 kW (20 HP)

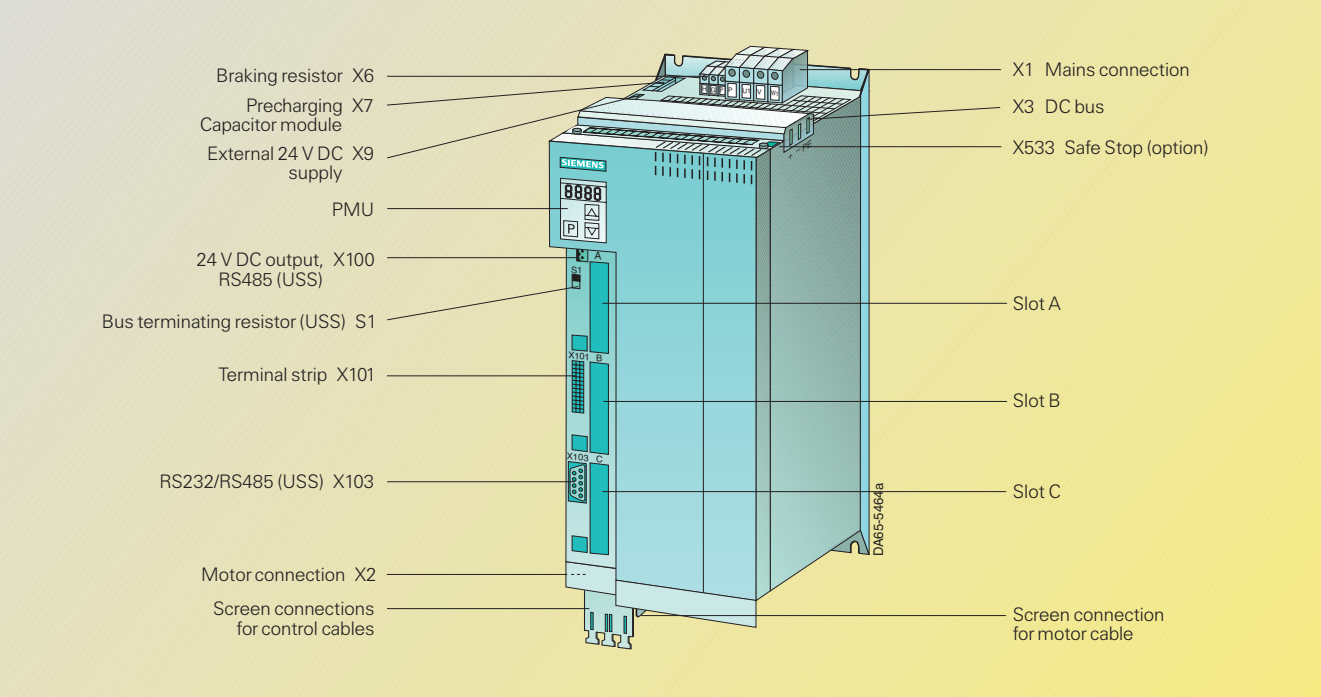



Fig. 6/31
Connection overview for Compact PLUS converters 11 kW (15 HP) and 15 kW (20 HP)

### *Power connections*

| X1 – Mains connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| | PE1 | Connection of equipment grounding conductor | | 25 mm² (AWG 4) |
| | U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC | 25 mm² (AWG 4) |
| | V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC | 25 mm² (AWG 4) |
| | W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC | 25 mm² (AWG 4) |

| X3 – DC link bus module | Cond. | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|---|
| Electrical connection of individual units on the DC link side. | 3 | PE3 | Connection of equipment grounding conductor | | Copper rail 3 x 10 mm (0.12 x 0.39 in) |
| | 2 | D/L– | DC link voltage – | 510 V to 650 V DC | Copper rail 3 x 10 mm (0.12 x 0.39 in) |
| | 1 | C/L+ | DC link voltage + | 510 V to 650 V DC | Copper rail 3 x 10 mm (0.12 x 0.39 in) |

| X2 – Motor connection | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| Dimensioning of the motor cables in accordance with DIN VDE 298 Part 4 and Part 100. | PE2 | Connection of equipment grounding conductor | | 16 mm² (AWG 6) |
| | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage | 16 mm² (AWG 6) |
| | V2/T2 | Phase V2/T2 | | 16 mm² (AWG 6) |
| | W2/T3 | Phase W2/T3 | | 16 mm² (AWG 6) |

| X6 – Braking resistor | Designation | Description | Max. cross-section |
|---|---|---|---|
| During braking, the full braking current flows via the terminals for the external braking resistor. For this reason, the maximum cross-section must always be used for the wiring of these terminals. | PE | Connection of equipment grounding conductor | 10 mm² (AWG 4) |
| | G | Braking resistor | 10 mm² (AWG 4) |
| | H | Braking resistor | 10 mm² (AWG 4) |

| X7 – Precharging of capacitor module | Designation | Description | Max. cross-section |
|---|---|---|---|
| The terminals are for precharging the back-up capacitors. For connecting a capacitor module (max. one capacitor module to a converter), connection to a terminal C′ and D′ is sufficient. | C′ | Precharging of capacitor module | 4 mm² (AWG 10) |
| | C | Precharging of capacitor module | 4 mm² (AWG 10) |
| | D′ | Precharging of capacitor module | 4 mm² (AWG 10) |
| | D | Precharging of capacitor module | 4 mm² (AWG 10) |



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## Compact PLUS converters

### *Control terminals*

Standard connections

Control terminals in the basic version:

- External 24 V power supply
- USS bus connection
- Serial interface for PC or OP1S
- Control terminal strip

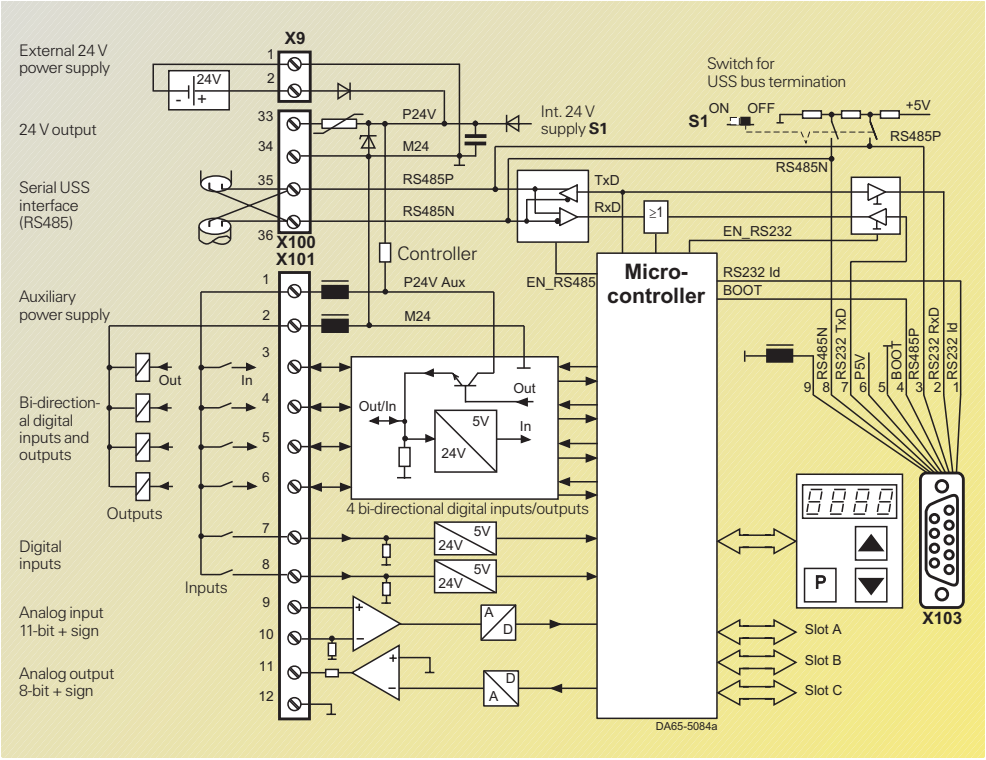



Fig. 6/32
Control terminals of Compact PLUS converters

**X9 – External 24 V power supply**

To enable parameterization and monitoring of the unit even when the DC link has been discharged (e.g. supply cut-off), an external 24 V voltage supply is required.

With the DC link charged, the voltage is supplied by an internal switch-mode power supply.

In stand-by mode, the unit has a current drain of 700 mA. This is increased if optional cards are inserted to a maximum of 1.5 A (units up to 4 kW (5 HP)) or up to a maximum of 2 A (units from 5.5 kW (7.5 HP) to 15 kW (20 HP)).

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 1 | 0 V | Reference potential | 18 V to 30 V DC | 2.5 mm² (AWG 12) |
| 2 | +24 V | External 24 V supply | 18 V to 30 V DC | 2.5 mm² (AWG 12) |

**X533 – "Safe Stop" option for Compact PLUS converters of 0.55 kW (0.75 HP) to 15 kW (20 HP)**

With this option, the power supply for pulse transmission to the power section can be interrupted by a safety relay. This ensures that the unit does not generate a rotating field in the connected motor. Even if the control electronics generate appropriate signals, the power section cannot move the motor.

In this way, mechanical work can be carried out on the drive when the supply voltage is switched on and without electrical isolation of the motor from the unit.

The option consists of the safety relay and the connecting terminals for relay activation and a checkback-signal contact.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 4 | P 24 | 24 V voltage | 24 V DC | 1.5 mm² (AWG 16) |
| 3 | Cl. a | Control terminal | $I_{max.}$ = 20 mA | 1.5 mm² (AWG 16) |
| 2 | Cl. 12 | NC contact | $I_{max.}$ = 1 A/24 V | 1.5 mm² (AWG 16) |
| 1 | Cl. 11 | NC contact | | 1.5 mm² (AWG 16) |

Note

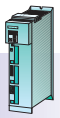
When activated, the "Safe Stop" option prevents accidental rotation of the connected motor.

However, there are still hazardous voltages across the motor terminals even in the "Safe Stop" state!

The option is not suitable for stopping a rotating motor as fast as possible, since switching off the control signals causes braking of the motor only by means of the connected load.



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## Compact PLUS converters (continued)

### X100 – 24 V output, USS bus

The unit has a 24 V output to which a maximum of two additional converters can be connected (in the case of the 6SE7011–5EP50 Compact PLUS converter, only the 6SE7012– 0TP50 inverter can be connected once).

The USS bus terminal is connected to the control electronics and the 9-pin Sub-D socket of the serial interface.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 33 | +24 V (out) | 24 V output | 24 V – 28 V DC | 2.5 mm² (AWG 12) |
| 34 | 0 V | Reference potential | 0 V | 2.5 mm² (AWG 12) |
| 35 | RS485P (USS) | USS bus connection | RS485 | 2.5 mm² (AWG 12) |
| 36 | RS485N (USS) | USS bus connection | RS485 | 2.5 mm² (AWG 12) |

### X103 – Serial interface

An OP1S or a PC can be connected via the 9-pin Sub-D socket.

The 9-pin Sub-D socket is internally linked to the USS bus so that data exchange with other nodes which are linked via the USS bus is possible.

This interface is also used for downloading software.

| Pin | Designation | Description | Range |
|---|---|---|---|
| 1 | RS232 ID | Changeover to RS232 interface | Digital signal, low active |
| 2 | RS232 R x D | Data received via the RS232 interface | RS232 |
| 3 | RS485 P | Data via RS485 interface | RS485 |
| 4 | Boot | Control signal for software update | Digital signal, low active |
| 5 | M5 AUX | Reference potential to P5V | 0 V |
| 6 | P5V | 5 V auxiliary power supply | +5 V, max. 200 mA |
| 7 | RS232 T x D | Data transmitted via the RS232 interface | RS232 |
| 8 | RS485 N | Data via RS485 interface | RS485 |
| 9 | M_RS232/485 | Digital ground (choked) | |

### X101 – Control terminal strip

Terminals on the control terminal strip

- 4 combined digital inputs and outputs
- 2 additional digital inputs
- 1 analog input
- 1 analog output
- 24 V auxiliary power supply (Compact PLUS, max. 60 mA; compact and chassis units, max. 150 mA) for the inputs and outputs.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 1 | P24 AUX | Auxiliary power supply | DC 24 V/ 60 mA | 1.5 mm² (AWG 16) |
| 2 | M24 AUX | Reference potential | 0 V | 1.5 mm² (AWG 16) |
| 3 | DIO 1 | Digital input/output 1 | 24 V, 10/20 mA | 1.5 mm² (AWG 16) |
| 4 | DIO 2 | Digital input/output 2 | 24 V, 10/20 mA | 1.5 mm² (AWG 16) |
| 5 | DIO 3 | Digital input/output 3 | 24 V, 10/20 mA | 1.5 mm² (AWG 16) |
| 6 | DIO 4 | Digital input/output 4 | 24 V, 10/20 mA | 1.5 mm² (AWG 16) |
| 7 | DI5 | Digital input 5 | 24 V, 10 mA | 1.5 mm² (AWG 16) |
| 8 | DI6 | Digital input 6 | 24 V, 10 mA | 1.5 mm² (AWG 16) |
| 9 | AI– | Analog input – | Differential input | 1.5 mm² (AWG 16) |
| 10 | AI+ | Analog input + 11-bit + sign | ± 10 V/ $R_i$ = 40 kΩ | 1.5 mm² (AWG 16) |
| 11 | AO | Analog output 8-bit + sign | ± 10 V/ 5 mA | 1.5 mm² (AWG 16) |
| 12 | M AO | Ground analog output | | 1.5 mm² (AWG 16) |

### Terminals on option boards

Each option board has additional terminals such as encoder terminals, bus terminals or supplementary terminals which are needed for the functioning of the option board.

For more detailed information on the terminals of the option boards, please refer to the associated documentation.



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## Compact PLUS inverters

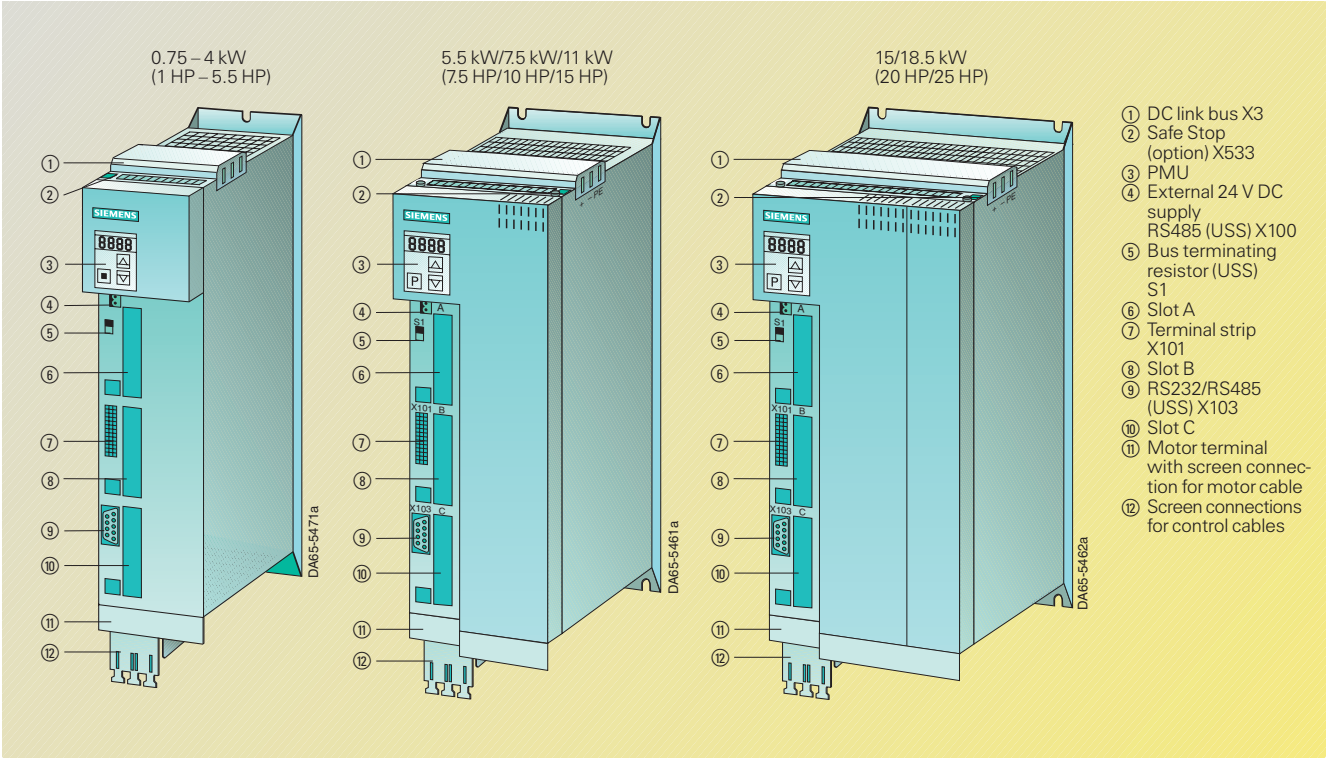



Fig. 6/33
Overview of terminals, Compact PLUS inverters (0.75 – 4 kW (1 HP – 5.5 HP), 5.5/7.5/11 kW (7.5 HP/10 HP/15 HP), 15/18.5 kW (20 HP/25 HP))

### *Power terminals*

| **X3 – DC bus** | Cond. | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|---|
| Electrical connection of individual units via the DC link. | 3 | PE3 | Connection of equipment grounding conductor | | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 2 | D/L– | DC link voltage – | 510 to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| | 1 | C/L+ | DC link voltage + | 510 to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |

| **X2 – Motor terminal** | Des-igna-tion | Description | Range | Max. cross-section 0.55 – 4 kW (0.75 – 5.5 HP) | 5.5/7.5/11 kW (7.5/10/15 HP) | 15/18.5 kW (20/25 HP) |
|---|---|---|---|---|---|---|
| Dimensioning of the motor cables in accordance with DIN VDE 298. | PE2 | Connection of equipment grounding conductor | | 4 mm² (AWG 10) | 10 mm² (AWG 8) | 16 mm² (AWG 6) |
| | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage | 4 mm² (AWG 10) | 10 mm² (AWG 8) | 16 mm² (AWG 6) |
| | V2/T2 | Phase V2/T2 | | 4 mm² (AWG 10) | 10 mm² (AWG 8) | 16 mm² (AWG 6) |
| | W2/T3 | Phase W2/T3 | | 4 mm² (AWG 10) | 10 mm² (AWG 8) | 16 mm² (AWG 6) |



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## Compact PLUS inverters (continued)

### *Control terminals*

Standard connections

Control terminals in the basic version:

- 24 V power supply
- USS bus terminal
- Serial interface for PC or OP1S
- Control terminal strip

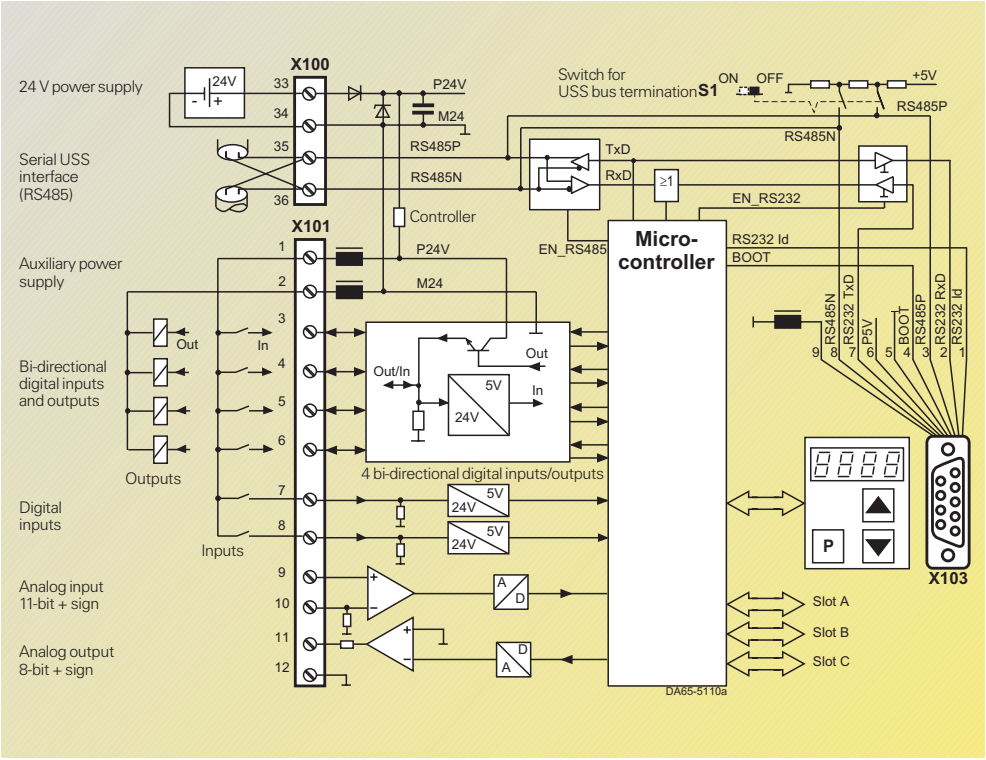



Fig. 6/34
Control terminals of the Compact PLUS inverters

### X100 – 24 V power supply, USS bus

For operation, the unit needs a 24 V power supply.

The USS bus terminal is connected to the control electronics and the 9-pin Sub-D socket of the serial interface.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 33 | +24 V (in) | 24 V voltage input | 18 to 30 V DC | 2.5 mm² (AWG 12) |
| 34 | 0 V | Reference potential | 0 V | 2.5 mm² (AWG 12) |
| 35 | RS485P (USS) | USS bus termination | RS485 | 2.5 mm² (AWG 12) |
| 36 | RS485N (USS) | USS bus termination | RS485 | 2.5 mm² (AWG 12) |

The inverters have a max. current requirement of 1.5 A (for units up to 4 kW (5 HP)) and 2 A (for units 5.5 kW (7.5 HP) to 18.5 kW (25 HP)) from the 24 V power supply.

### X103 – Serial interface, X101 – Control terminal strip

Same as for Compact PLUS converters (see page 6/30).

### X533 – "Safe Stop" option

With this option, the power supply required for pulse transmission to the power section can be interrupted by a safety relay. This ensures that the unit does not generate a rotating field in the connected motor. Even if the control electronics generate appropriate signals, the power section cannot move the motor.

In this way, mechanical work can be carried out on the drive when the supply voltage is switched on and without electrical isolation of the motor from the unit.

This option consists of the safety relay and the connecting terminals for relay activation and a checkback-signal contact.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 4 | P 24 | 24 V voltage | 24 V DC | 1.5 mm² (AWG 16) |
| 3 | Cl. a | Control terminal | $I_{max.}$ = 20 mA | 1.5 mm² (AWG 16) |
| 2 | Cl. 12 | NC contact | $I_{max.}$ = 1 A | 1.5 mm² (AWG 16) |
| 1 | Cl. 11 | NC contact | – | 1.5 mm² (AWG 16) |

Note

When activated, the "Safe Stop" option prevents accidental rotation of the connected motor.

However, there are still hazardous voltages across the motor terminals, even in the "Safe Stop" state!

The option is not suitable for stopping a rotating motor as fast as possible, since switching off the control signals causes braking of the motor only by means of the connected load.



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## Terminals of the Compact PLUS rectifier unit

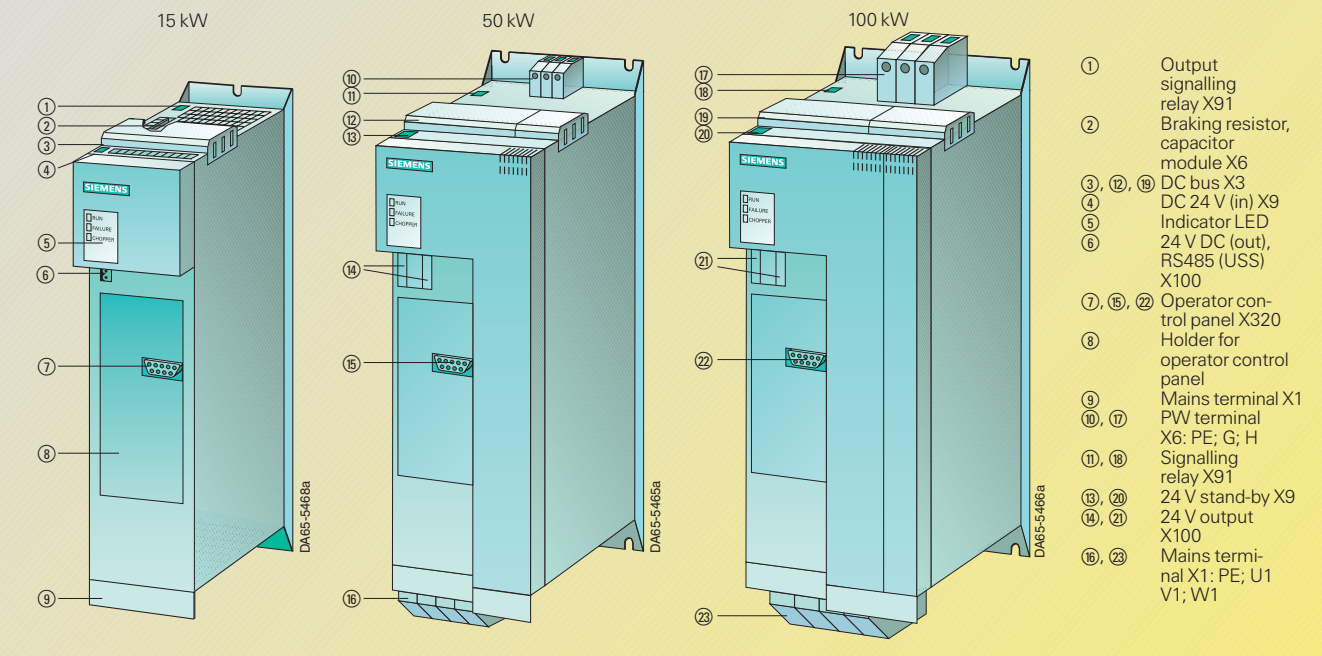



Fig. 6/35
Overview of terminals on the Compact PLUS rectifier units

### *Power terminals*

**X1 – Mains connection**

| Designation | Description | Range | Max. cross-section 15 kW | 50 kW | 100 kW |
|---|---|---|---|---|---|
| PE1 | Connection of equipment grounding conductor | | 10 mm² (AWG 6) | 50 mm² (AWG 1/0) | 95 mm² (AWG 4/0) |
| U1/L1 | Phase U1/L1 | 3-ph 380 V to 480 V AC | 10 mm² (AWG 6) | 50 mm² (AWG 1/0) | 95 mm² (AWG 4/0) |
| V1/L2 | Phase V1/L2 | 3-ph 380 V to 480 V AC | 10 mm² (AWG 6) | 50 mm² (AWG 1/0) | 95 mm² (AWG 4/0) |
| W1/L3 | Phase W1/L3 | 3-ph 380 V to 480 V AC | 10 mm² (AWG 6) | 50 mm² (AWG 1/0) | 95 mm² (AWG 4/0) |

**X3 – DC bus**

The DC bus is for supplying the connected inverters with DC power.

| Conductor | Designation | Description | Range | Max. cross-section 15 kW | 50 kW | 100 kW[1] |
|---|---|---|---|---|---|---|
| 3 | PE | Connection of equipment grounding conductor | | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 2 | D/L– | DC link voltage | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 1 | C/L+ | DC link voltage | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |

**X6 – Braking resistor and precharging of capacitor module**

During braking, the full braking current flows via the external braking resistor terminals. The maximum cable cross-section must therefore always be used for wiring these terminals.

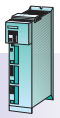
If capacitor modules are operated at the 15 kW rectifier unit, the DC link may be precharged only once every 3 minutes.

| Designation | Description | Max. cross-section 15 kW |
|---|---|---|
| C' | Precharging of capacitor module | 4 mm² (AWG 10) |
| G | Braking resistor | 4 mm² (AWG 10) |
| H | Braking resistor | 4 mm² (AWG 10) |
| D' | Precharging of capacitor module | 4 mm² (AWG 10) |

1) The 100 kW rectifier unit supplies 230 A and therefore has two 120 A busbar terminals. Each of these supplies a busbar system, one to the right and one to the left of the rectifier unit. The distribution of current is not monitored. By appropriate installation, it must be ensured that 120 A per outgoing section is not exceeded.



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## Terminals of the Compact PLUS rectifier unit (continued)

### *Power terminals (continued)*

**X6 – Braking resistor**[1]

During braking, the full braking current flows via the external braking resistor terminals. The maximum cable cross-section must therefore always be used for wiring these terminals.

| Designation | Description | Max. cross-section 50 kW | Max. cross-section 100 kW |
|---|---|---|---|
| PE | Connection of equipment grounding conductor | 25 mm² (AWG 2) | 50 mm² (AWG 1/0) |
| G | Braking resistor | 25 mm² (AWG 2) | 50 mm² (AWG 1/0) |
| H | Braking resistor | 25 mm² (AWG 2) | 50 mm² (AWG 1/0) |

### *Control terminals*

**X9 – 24 V power supply**

For operating purposes, the unit needs a 24 V power supply.

During operation, the unit has a current requirement of approx. 0.5 A at 15 kW and 0.7 A at 50 kW and 100 kW.

When selecting a 24 V power supply, bear in mind that all inverters connected to the rectifier unit must also be supplied.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 2 | +24 V | 24 V power supply max. 30 A | 18 V to 30 V DC | 2.5 mm² for 15 kW (AWG 12); 4 mm² for 50/ 100 kW (AWG 10) |
| 1 | 0 V | Reference potential | 0 V | |

**X100 – 24 V voltage output, USS bus**

The unit has a 24 V voltage output to supply the connected inverters.

The USS bus terminal is connected to the 9-pin Sub-D socket of the serial interface.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 33 | +24 V (out) | 24 V output | 18 V to 30 V | 2.5 mm² (AWG 12) |
| 34 | 0 V | Reference potential | 0 V | 2.5 mm² (AWG 12) |
| 35 | RS485P (USS) | USS bus terminal | RS485 | 2.5 mm² (AWG 12) |
| 36 | RS485N (USS) | USS bus terminal | RS485 | 2.5 mm² (AWG 12) |

**X3**

An OP1S or PC can be connected via the 9-pole Sub-D socket.

The 9-pole Sub-D socket is connected internally with the USS bus, thus enabling data exchange with other USS bus nodes.

This interface also serves for downloading software.

| Pin | Designation | Description | Range |
|---|---|---|---|
| 1 | not connected | Not used | |
| 2 | not connected | Not used | |
| 3 | RS485P (USS) | Data via RS485 interface | RS485 |
| 4 | not connected | Not used | |
| 5 | Ground | Reference potential to P5V | 0 V |
| 6 | P5V | 5 V auxiliary power supply | +5 V, max. 200 mA |
| 7 | not connected | Not used | |
| 8 | RS485N (USS) | Data via RS485 interface | RS485 |
| 9 | not connected | Not used | |

**X91 – Output, signalling relay**

If a fault occurs in the rectifier unit, the fault is signalled via the connecting contact of the signalling relay. In the event of a fault, the contact is opened.

| Pin | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 2 | T. 13 | Fault-signalling relay | $I_{max.}$ = 1 A/24 V | 2.5 mm² (AWG 12) |
| 1 | T. 14 | Fault-signalling relay | $I_{max.}$ = 1 A/24 V | 2.5 mm² (AWG 12) |

1) Precharging the capacitor module is carried out via the controlled input rectifier. The connections for the capacitor module are not necessary.



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## Compact PLUS capacitor module and DC link module

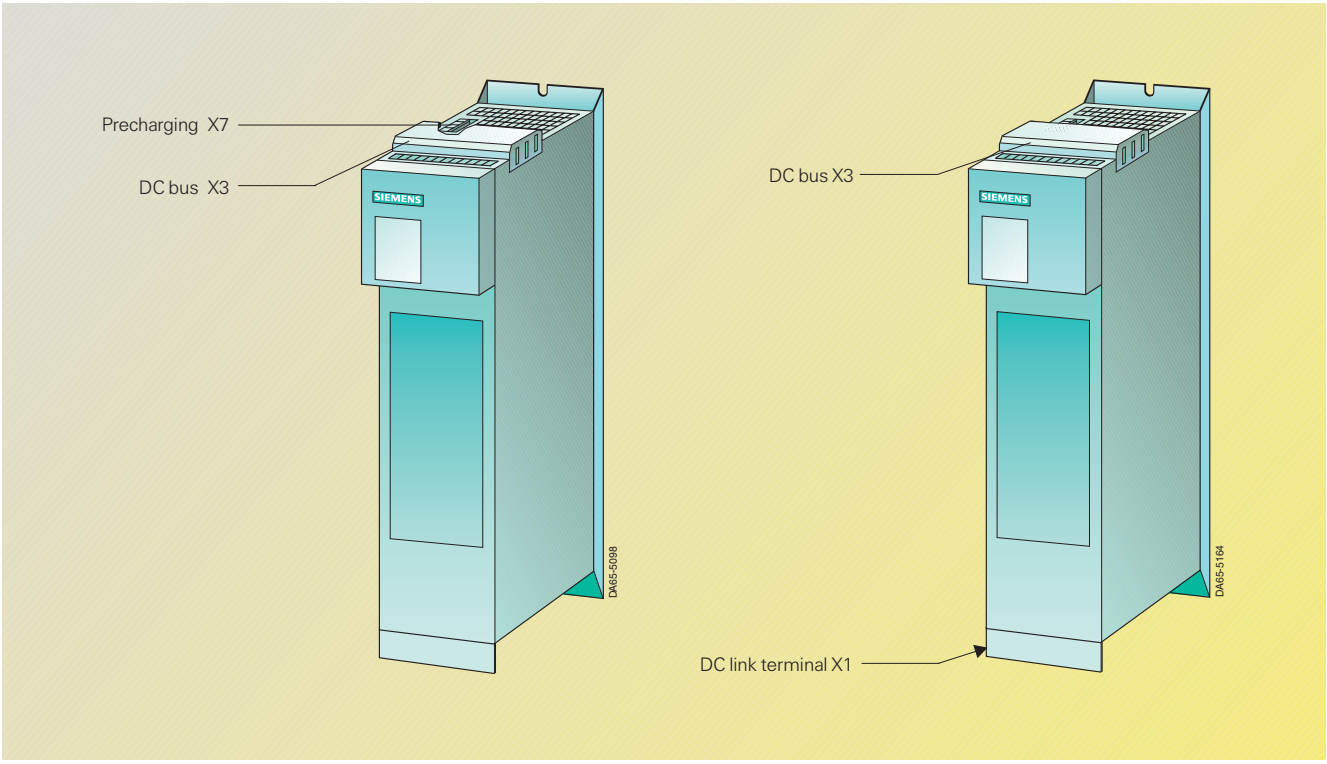



Fig. 6/36
Overview of terminals on Compact PLUS capacitor module (left) and DC link module (right)

### *Power terminals on the Compact PLUS capacitor module*

**X3 – DC bus**

The DC link bus is for exchanging energy between the capacitor module and the connected inverters.

The capacitor module has a capacitance of 5.1 mF (corresponding to a 45 kW (60 HP) inverter). A DC link fuse (made by SIBA; 63 A, 660 V gR) is fitted internally.

| Conductor | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 3 | PE/GND | Connection of equipment grounding conductor | | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 2 | D/L– | DC link voltage – | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 1 | C/L+ | DC link voltage + | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |

**X7 – Precharging**

The terminals are for precharging the stand-by capacitors from the converters and the 15 kW Compact PLUS rectifier unit.

If connected to a Compact PLUS 15 kW rectifier unit, the remaining two free contacts are used for looping the precharging cable to additional capacitor modules.

| Pin | Designation | Description | Max. cross-section |
|---|---|---|---|
| 4 | C' (Terminal+) | Precharging | 4 mm² (AWG 10) |
| 3 | C' (Terminal+) | Precharging | 4 mm² (AWG 10) |
| 2 | D' (Terminal–) | Precharging | 4 mm² (AWG 10) |
| 1 | D' (Terminal–) | Precharging | 4 mm² (AWG 10) |

### *Power terminals on the Compact PLUS DC link module*

**X1 – DC terminal**

Note

Short-circuit-proof installation of the supply cable (max. 5 m (16.4 ft)/ 2 x 50 mm² (AWG 1/0), twisted with 5 twists per meter) if there are no DC link fuses provided.

| Terminal | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| | PE/GND | Connection of equipment grounding conductor | – | |
| 1 | C | DC link voltage + | 510 V to 650 V DC | 50 mm² (AWG 1/0) |
| 2 | D | DC link voltage – | 510 V to 650 V DC | 50 mm² (AWG 1/0) |

**X3 – DC bus**

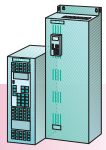
The DC link bus is for exchanging power between the DC link module and the connected inverters.

The rated input and output current of the DC link module is 120 A in each case.

| Conductor | Designation | Description | Range | Max. cross-section |
|---|---|---|---|---|
| 3 | PE/GND | Connection of equipment grounding conductor | – | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 2 | D/L– | DC link voltage – | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |
| 1 | C/L+ | DC link voltage + | 510 V to 650 V DC | Copper bus bar 3 x 10 mm (0.12 x 0.39 in) |



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## Compact units and chassis units with the CUMC control board

### *Control terminals*

Standard connections

The control terminals are the same for all compact and chassis type units. The reason for this is that they are located on the CUMC board. The board is located in the electronics box of the compact and chassis units.

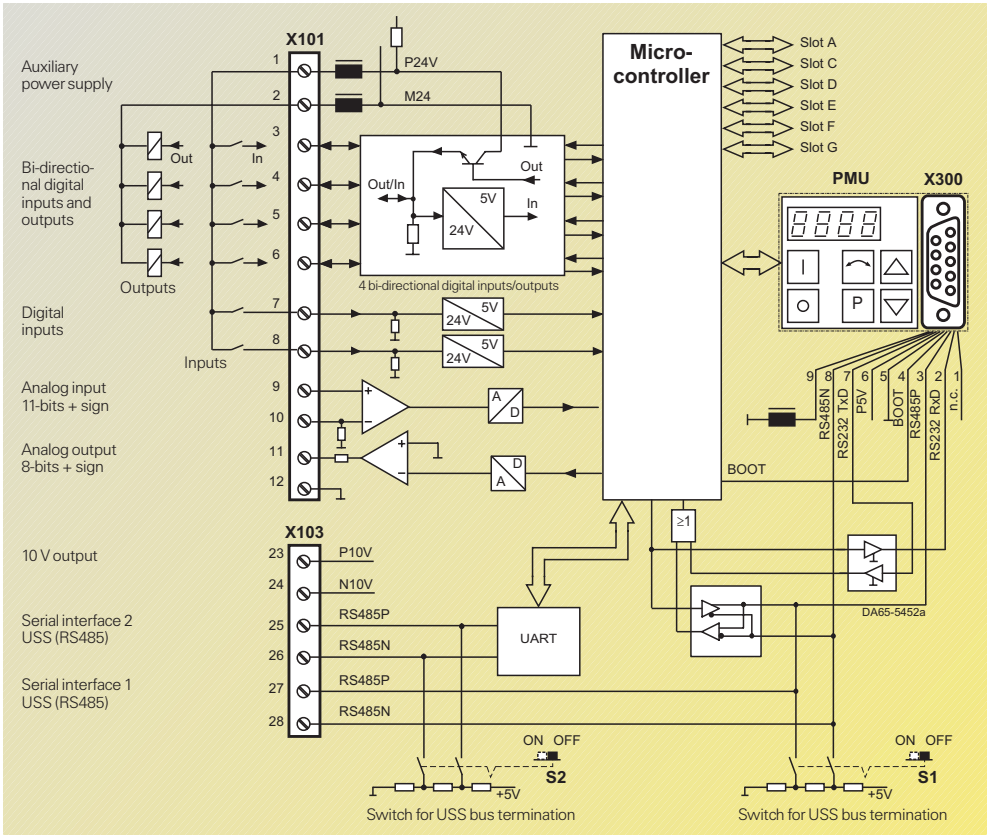



Fig. 6/37
Control terminals of the CUMC control board

### X101 – Control terminal strip

Same as for Compact PLUS converter (see page 6/30).

### X103 – Serial interface

In addition to terminal strip X101, terminal strip X103 is available on the CUMC board.

Connectable cross-section: 1.5 mm² (AWG 16)

Terminals 23 and 24 are short-circuit-proof.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 23 | P10V | +10 V supply for external potentiometer | +10 V ± 1.3 %, $I_{max.}$ = 5 mA |
| 24 | N10V | –10 V supply for external potentiometer | –10 V ± 1.3 %, $I_{max.}$ = 5 mA |
| 25 | RS485 P (SST2) | USS bus terminal SST2 | RS485 |
| 26 | RS485 N (SST2) | USS bus terminal SST2 | RS485 |
| 27 | RS485 P (SST1) | USS bus terminal SST1 | RS485 |
| 28 | RS485 N (SST1) | USS bus terminal SST1 | RS485 |

### X300 – Serial interface

An OP1S or PC can be connected via the 9-pin Sub-D socket.

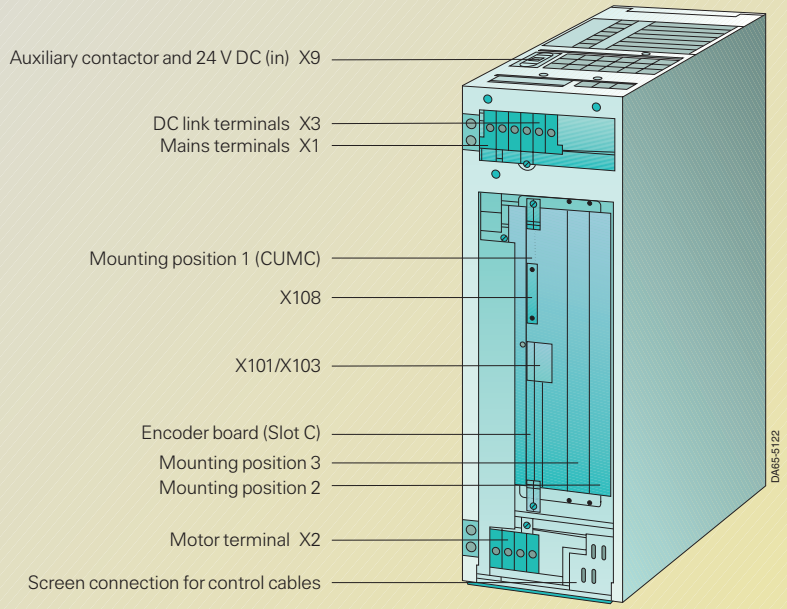
The 9-pin Sub-D socket is internally linked to the USS bus, enabling data exchange with other converters and inverters that are connected by means of the USS bus.

| Pin | Designation | Description | Range |
|---|---|---|---|
| 1 | n.c. | Not used | |
| 2 | RS232 R x D | Data received via RS232 | RS232 |
| 3 | RS485 P | Data via RS485 | RS485 |
| 4 | Boot | Control signal for firmware | Digital signal, low active |
| 5 | M5V | Reference potential to P5V | 0 V |
| 6 | P5V | 5 V auxiliary power supply | +5 V, $I_{max}$ = 200 mA |
| 7 | RS232 T x D | Data transmitted via RS232 | RS232 |
| 8 | RS485 N | Data via RS485 | RS485 |
| 9 | M RS232/485 | Digital ground (choked) | |

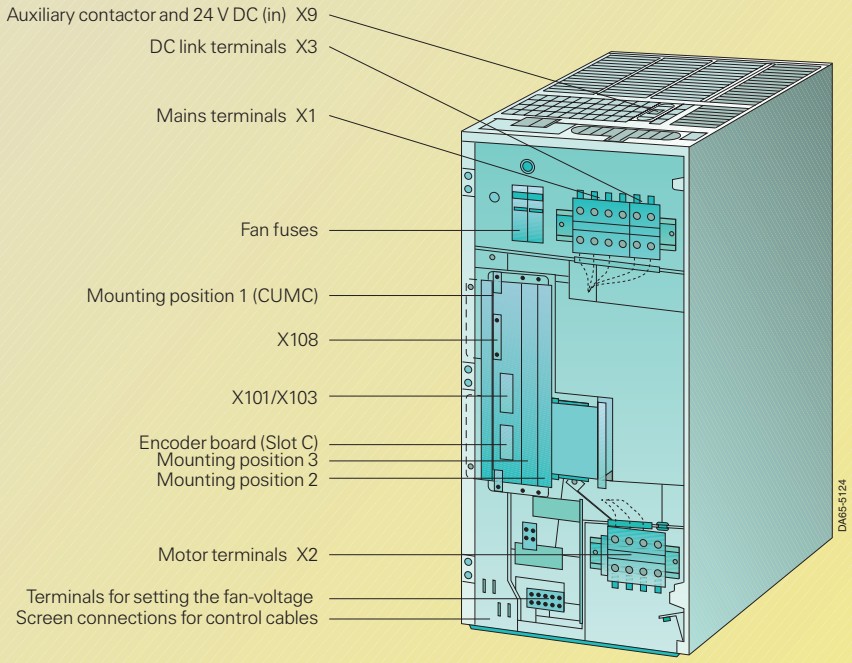


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## Compact-type converters




Enclosure sizes A, B, C

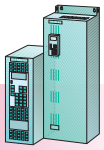



Enclosure size D

Fig. 6/38
Overview of terminals on the Compact-type converters



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## Compact-type converters (continued)

### Power terminals

**X1 – Mains terminal, X3 – DC link terminals**

The mains and DC link terminals are located on top of the unit on a common terminal block.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 1 | U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC |
| 2 | V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC |
| 3 | W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC |
| 4 | PE1/GND | Connection of equipment grounding conductor | |
| 5 | C/L+ | DC link voltage + | 510 V to 650 V DC |
| 6 | D/L– | DC link voltage – | 510 V to 650 V DC |

**X2 – Motor terminals**

The motor terminals are located at the bottom of the unit.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 1 | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage |
| 2 | V2/T2 | Phase V2/T2 | |
| 3 | W2/T3 | Phase W2/T3 | |
| 4 | PE2/GND | Connection of equipment grounding conductor | |

**Wire cross-sections**

| Enclosure size | Order No. | Flexible | | Stranded/single core | |
|---|---|---|---|---|---|
| | | mm² | AWG | mm² | AWG |
| A | **6SE70..–..A51** | 2.5 - 10 | 12 - 6 | 2.5 - 16 | 12 - 4 |
| B | **6SE70..–..B51** | 2.5 - 10 | 12 - 6 | 2.5 - 16 | 12 - 4 |
| C | **6SE70..–..C51** | 4 - 16 | 6 - 4 | 10 - 25 | 6 - 2 |
| D | **6SE70..–..D51** | 10 - 35 | 6 - 2 | 10 - 50 | 6 - 0 |

Note

The wire cross-sections are determined for copper cable at 40 °C (104 °F) ambient temperature (in acc. with DIN VDE 0298, Part 4 and Part 100/02.88, Group 5).

| Order No. | Line terminal | | | | | | | | | | Motor terminal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-section to VDE | AWG | Recommendend fuse, type gR (SITOR) | | gL (NH) | | for North America | | | Line reactor | Cross-section to VDE | AWG |
| | mm² | | A | 3NE | A | 3NA | Type | V | A | 4EP | mm² | |
| **6SE7016–1EA51** | 1.5 | 16 | 16 | – | 10 | 3803 | AJT, LPJ | 600 | 8 | 3200–1US | 1.5 | 16 |
| **6SE7018–0EA51** | 1.5 | 16 | 16 | 1813–0 | 16 | 3805 | AJT, LPJ | 600 | 12 | 3400–2US | 1.5 | 16 |
| **6SE7021–0EA51** | 2.5 | 14 | 16 | 1813–0 | 16 | 3805 | AJT, LPJ | 600 | 15 | 3400–1US | 1.5 | 16 |
| **6SE7021–3EB51** | 2.5 | 14 | 20 | 1814–0 | 25 | 3810 | AJT, LPJ | 600 | 17.5 | 3500–0US | 2.5 | 14 |
| **6SE7021–8EB51** | 4 | 10 | 25 | 1815–0 | 25 | 3810 | AJT, LPJ | 600 | 25 | 3600–4US | 2.5 | 14 |
| **6SE7022–6EC51** | 10 | 6 | 35 | 1803–0 | 35 | 3814 | AJT, LPJ | 600 | 35 | 3600–5US | 10 | 6 |
| **6SE7023–4EC51** | 16 | 4 | 40 | 1802–0 | 50 | 3820 | AJT, LPJ | 600 | 45 | 3700–2US | 10 | 6 |
| **6SE7023–8ED51** | 16 | 4 | 50 | 1817–0 | 63 | 3822 | AJT, LPJ | 600 | 50 | 3700–5US | 16 | 4 |
| **6SE7024–7ED51** | 25 | 2 | 63 | 1818–0 | 63 | 3822 | AJT, LPJ | 600 | 60 | 3800–2US | 16 | 4 |
| **6SE7026–0ED51** | 25 | 2 | 80 | 1820–0 | 100 | 3830 | AJT, LPJ | 600 | 80 | 3800–7US | 16 | 4 |
| **6SE7027–2ED51** | 50 | 00 | 80 | 1820–0 | 100 | 3830 | AJT, LPJ | 600 | 90 | 3900–2US | 25 | 2 |

### Control terminals

**Standard connections on the CUMC board**

See page 6/36.

**X9 – 24 V DC power supply, operation of main contactor (MC)**

The 9-pin terminal strip is for connecting a 24 V power supply and for connecting a main contactor or bypass contactor.

The power supply is needed if the converter is connected via a main contactor or bypass contactor.

The terminals for operating the contactors are floating.

Connectable cross-section: 1.5 mm² (AWG 16).

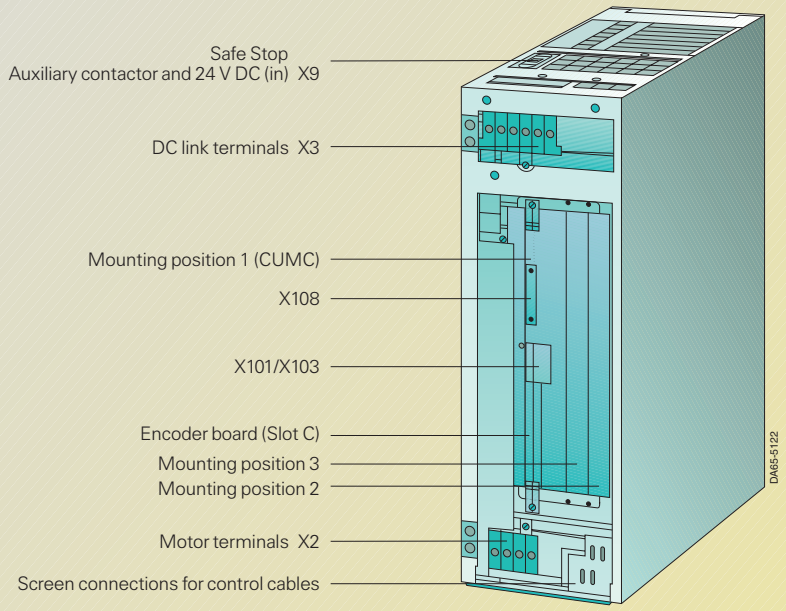
The unit has a current requirement of 1.5 A from the 24 V power supply. This increases to a maximum of 2.5 A if option cards are plugged in.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 9 | Operation of MC | Operation of main contactor | 230 V AC, 1 kVA |
| 8 | Not assigned | Not used | – |
| 7 | Operation of MC | Operation of main contactor | 230 V AC, 1 kVA |
| 6 | Not assigned | Not used | – |
| 5 | Not assigned | Not used | – |
| 4 | Not assigned | Not used | – |
| 3 | Not assigned | Not used | – |
| 2 | 0 V | Reference potential | 0 V |
| 1 | + 24 V (in) | 24 V power supply | 24 V DC, ≤ 2.5 A |

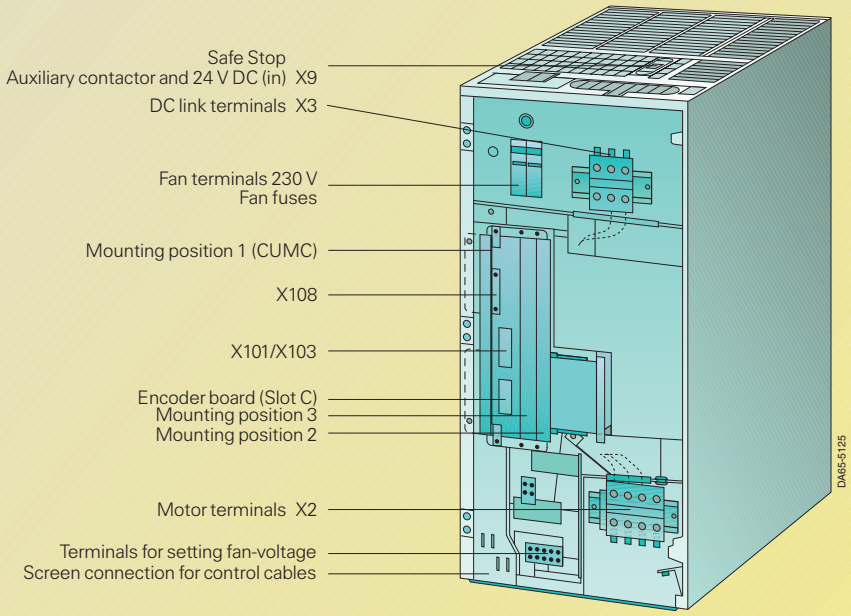


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## Compact-type inverters




Enclosure sizes A, B and C

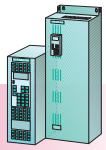



Enclosure size D

Fig. 6/39
Overview of terminals on the compact-type inverters



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## Compact-type inverters (continued)

### Power terminals

**X3 – DC link terminals**

The terminals for the DC link are on the top of the unit on a terminal block.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 1 | U1/L1 | These terminals are not connected internally | |
| 2 | V1/L2 | | |
| 3 | W1/L3 | | |
| 4 | PE1/GND | Connection of equipment grounding conductor | |
| 5 | C/L+ | DC link voltage + | 510 V to 650 V DC |
| 6 | D/L– | DC link voltage – | 510 V to 650 V DC |

**Wire cross-sections · Fuses**

| Enclosure size | Order No. | Flexible | | Stranded/single core | |
|---|---|---|---|---|---|
| | | mm² | AWG | mm² | AWG |
| A | **6SE70..–..A51** | 2.5 - 10 | 12 - 6 | 2.5 - 16 | 12 - 4 |
| B | **6SE70..–..B51** | 2.5 - 10 | 12 - 6 | 2.5 - 16 | 12 - 4 |
| C | **6SE70..–..C51** | 4 - 16 | 6 - 4 | 10 - 25 | 6 - 2 |
| D | **6SE70..–..D51** | 10 - 35 | 6 - 2 | 10 - 50 | 6 - 0 |

Note

The wire cross-sections are determined for copper cable at 40 °C (104 °F) ambient temperature (in acc. with DIN VDE 0298, Part 4 and Part 100/02.88, Group 5).

| Order No. | Supply side | | | | | | | | Motor side | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rated DC current | Cross-section to DIN VDE | AWG | Recommended fuse, type | | for North America | | | Rated output voltage | current | Cross-section to DIN VDE | AWG |
| | A | mm² | | A | 3NE | 170M | V | A | V | A | mm² | |
| **6SE7016–1TA51** | 7.3 | 1.5 | 16 | 25 | 8 015 | 1561 | 600 | 25 | 0 - 480 | 6.1 | 1.5 | 16 |
| **6SE7018–0TA51** | 9.5 | 1.5 | 16 | 25 | 8 015 | 1561 | 660 | 25 | 0 - 480 | 8.0 | 1.5 | 16 |
| **6SE7021–0TA51** | 12.1 | 1.5 | 16 | 25 | 8 015 | 1564 | 660 | 50 | 0 - 480 | 10.2 | 1.5 | 16 |
| **6SE7021–3TB51** | 15.7 | 4 | 10 | 50 | 8 017 | 1564 | 660 | 50 | 0 - 480 | 13.2 | 2.5 | 14 |
| **6SE7021–8TB51** | 20.8 | 4 | 10 | 50 | 8 017 | 1564 | 660 | 50 | 0 - 480 | 17.5 | 2.5 | 14 |
| **6SE7022–6TC51** | 30.4 | 10 | 6 | 80 | 8 020 | 1568 | 660 | 125 | 0 - 480 | 25.5 | 6 | 8 |
| **6SE7023–4TC51** | 40.5 | 10 | 6 | 80 | 8 020 | 1568 | 660 | 125 | 0 - 480 | 34 | 10 | 6 |
| **6SE7023–8TD51** | 44.6 | 16 | 4 | 125 | 8 022 | 1568 | 660 | 125 | 0 - 480 | 37.5 | 16 | 4 |
| **6SE7024–7TD51** | 55.9 | 25 | 2 | 125 | 8 022 | 1568 | 660 | 125 | 0 - 480 | 47 | 16 | 4 |
| **6SE7026–0TD51** | 70.2 | 35 | 0 | 160 | 8 024 | 1570 | 660 | 200 | 0 - 480 | 59 | 25 | 2 |
| **6SE7027–2TD51** | 85.7 | 35 | 0 | 160 | 8 024 | 1570 | 660 | 200 | 0 - 480 | 72 | 25 | 2 |

AWG: American Wire Gauge

**X2 – Motor terminals**

The motor terminals are located at the bottom of the unit

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 1 | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage |
| 2 | V2/T2 | Phase V2/T2 | |
| 3 | W2/T3 | Phase W2/T3 | |
| 4 | PE2/GND | Connection of equipment grounding conductor | |

### Control terminals

**Standard connections on the CUMC board**

See page 6/36.

**X9 – 24 V DC power supply, "Safe Stop", operation of main contactor**

The 9-pin terminal strip is for connecting a 24 V power supply, a main contactor or bypass contactor and also the "Safe Stop" function.

A power supply is required if the inverter is connected via a main or bypass contactor.

The terminals for operation of the contactors are floating.

The "Safe Stop" function ensures that a rotating field cannot occur at the motor terminals, i.e. the motor cannot turn. When the bridge between terminals X9.5 and X9.6 is opened (by an external contact), the "Safe Stop" function is activated. The inverter is supplied with terminals X9.5 and X9.6 bridged.

The unit has a current requirement of 1.5 A from the 24 V power supply. This increases to a max. of 2.5 A if option cards are plugged in.

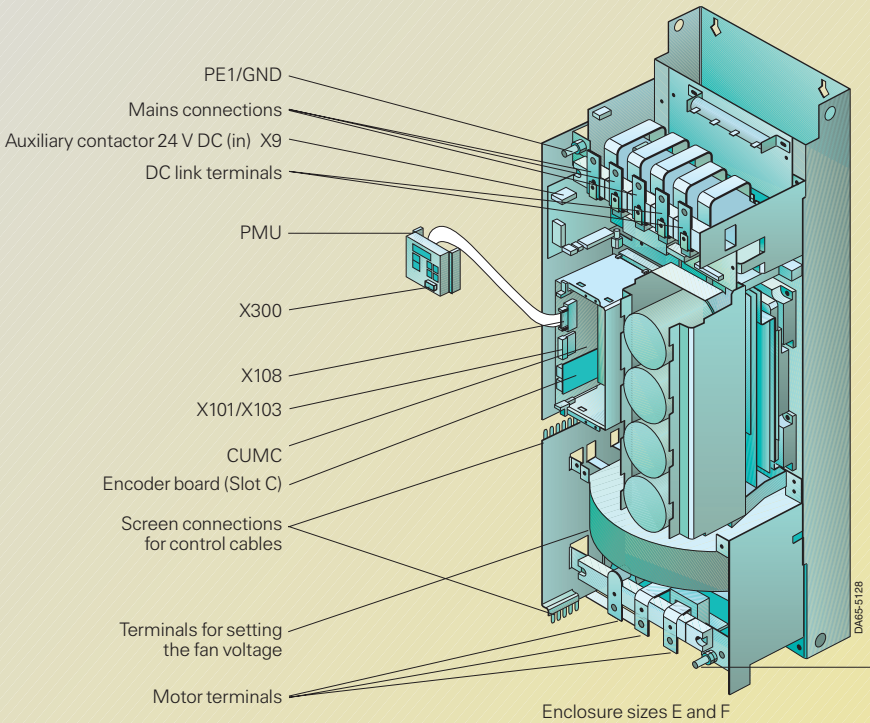
| Terminal | Designation | Description | Range |
|---|---|---|---|
| 9 | Operation of MC | Operation of main contactor | 30 V DC, 0.5 A |
| 8 | Not assigned | Not used | |
| 7 | Operation of MC | Operation of main contactor | |
| 6 | Safe Stop | Operation of "Safe Stop" | 30 V DC |
| 5 | Safe Stop | Operation of "Safe Stop" | 10 mA to 30 mA |
| 4 | Safe Stop | Checkback signal "Safe Stop" | 30 V DC |
| 3 | Safe Stop | Checkback signal "Safe Stop" | 2 A |
| 2 | 0 V | Reference potential | 0 V |
| 1 | + 24 V (in) | 24 V voltage supply | 24 V DC, ≤ 2.5 A |

Connectable cross-section: 1.5 mm² (AWG 16)

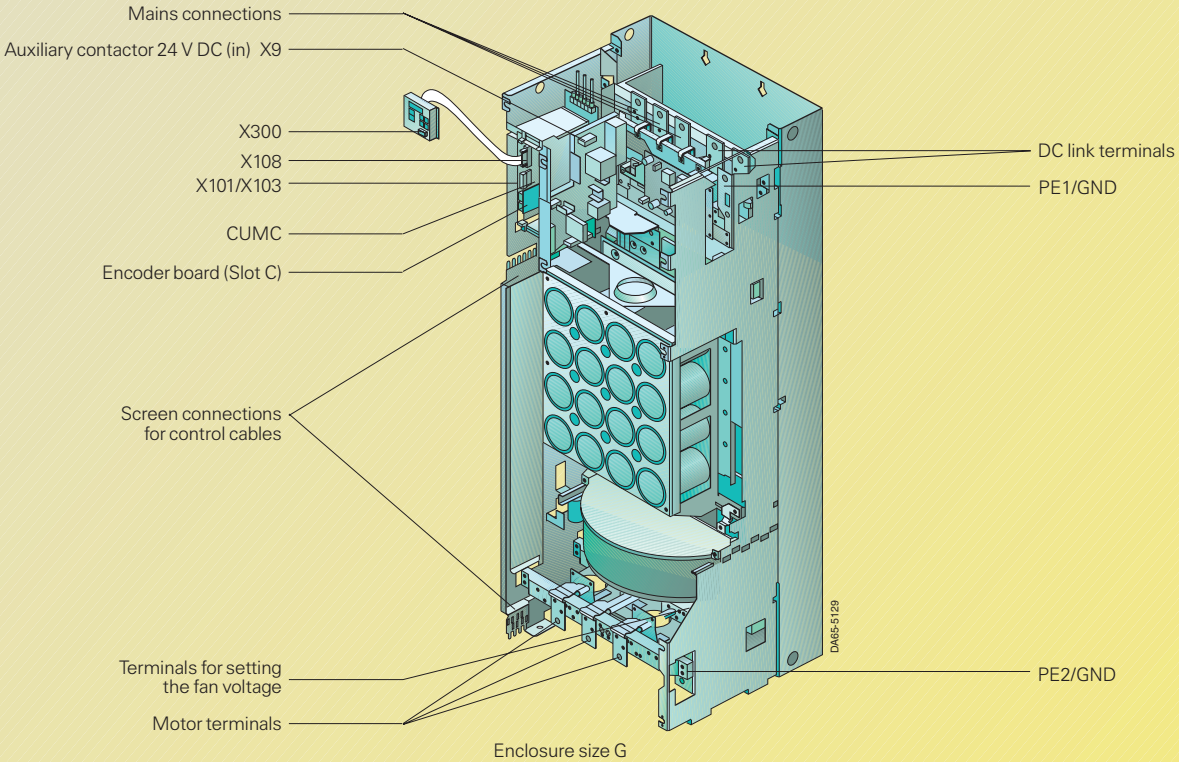


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## Chassis-type converters




Enclosure sizes E and F

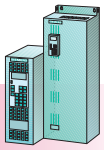



Enclosure size G

Fig. 6/40
Overview of terminals on the chassis-type converters



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## Chassis-type converters (continued)

### Power terminals

**Mains terminal and DC link terminal**

The mains and DC link terminal are located at the bottom of the unit.

| Designation | Description | Range |
|---|---|---|
| PE1/GND | Connection of equipment grounding conductor | – |
| U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC |
| V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC |
| W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC |
| C/L+ | DC link voltage + | 510 V to 650 V DC |
| D/L– | DC link voltage – | 510 V to 650 V DC |

**Wire ranges · Fuses**

Possible wire cross-sections, screw connection.

| Enclosure size | Order No. | Max. wire cross-section mm² to DIN VDE | AWG | Screw connection |
|---|---|---|---|---|
| E | **6SE703 . – . . E50** | 2 x 70 | 2 x 00 | M10 |
| F | **6SE703 . – . . F50** | 2 x 70 | 2 x 00 | M10 |
| G | **6SE703 . – . . G50** | 2 x 150 | 2 x 300 | M12 |
| K | **6SE703 . – . . K50** | 4 x 300 | 4 x 800 | M 12/M16 |

Note

The wire cross-sections are determined for copper cable at 40 °C (104 °F) ambient temperature in accordance with DIN VDE 0298, Part 4/02.88, Group 5).

| Order No. | Line side | | | | | | | | | | Motor side | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rated input current A | Cross-section to DIN VDE mm² | AWG | Recommended fuse, type gR (SITOR) A | 3NE | gL NH A | 3NA | for North America V | A | | Cross-section to DIN VDE mm² | AWG |
| **6SE7031–0EE50** | 101 | 1 x 70 | 1 x 000 | 100 | 1021–0 | 125 | 3032 | AJT, LPJ | 600 | 125 | 1 x 35 | 1 x 0 |
| **6SE7031–2EF50** | 136 | 2 x 35 | 2 x 0 | 125 | 1022–0 | 160 | 3036 | AJT, LPJ | 600 | 175 | 2 x 25 | 2 x 2 |
| **6SE7031–8EF50** | 171 | 2 x 35 | 2 x 0 | 160 | 1224–0 | 200 | 3140 | AJT, LPJ | 600 | 200 | 2 x 35 | 2 x 0 |
| **6SE7032–1EG50** | 192 | 2 x 50 | 2 x 00 | 200 | 1225–0 | 250 | 3144 | AJT, LPJ | 600 | 300 | 2 x 35 | 2 x 0 |
| **6SE7032–6EG50** | 238 | 2 x 70 | 2 x 000 | 250 | 1227–0 | 315 | 3252 | AJT, LPJ | 600 | 350 | 2 x 50 | 2 x 00 |
| **6SE7033–2EG50** | 288 | 2 x 95 | 2 x 4/0 | 315 | 1230–0 | 315 | 3252 | AJT, LPJ | 600 | 400 | 2 x 70 | 2 x 000 |
| **6SE7033–7EG50** | 339 | 2 x 120 | 2 x 300 | 350 | 1331–0 | 400 | 3260 | AJT, LPJ | 660 | 500 | 2 x 95 | 2 x 4/0 |
| **6SE7035–1EK50** | 465 | 3 x 300 | 2 x 800 | 560 | 1434–0 | 630 | 3372 | – | – | – | 2 x 300 | 2 x 800 |
| **6SE7036–0EK50** | 539 | 3 x 300 | 2 x 800 | 560 | 1434–0 | 630 | 3372 | – | – | – | 2 x 300 | 2 x 800 |

AWG: American Wire Gauge

**Motor terminals**

The motor terminals are located at the bottom of the unit.

| Designation | Description | Range |
|---|---|---|
| U2/T1 | Phase U2/T1 | 3-ph. 0 V to 480 V AC |
| V2/T2 | Phase V2/T2 | 3-ph. 0 V to 480 V AC |
| W2/T3 | Phase W2/T3 | 3-ph. 0 V to 480 V AC |
| PE2/GND | Connection of equipment grounding conductor | |

### Control terminals

**Standard connections on the CUMC board**

See page 6/36.

**X9 – 24 V DC power supply, operation of main contactor**

The 5-pin terminal strip is for connecting a 24 V power supply and a bypass contactor.

The power supply is needed if the inverter is connected via a main contactor (MC) or bypass contactor.

The terminals for operation of the contactor are floating.

The unit has a current requirement of 3 A from the 24 V power supply. This increases to a maximum of 4.3 A when option cards are plugged in.

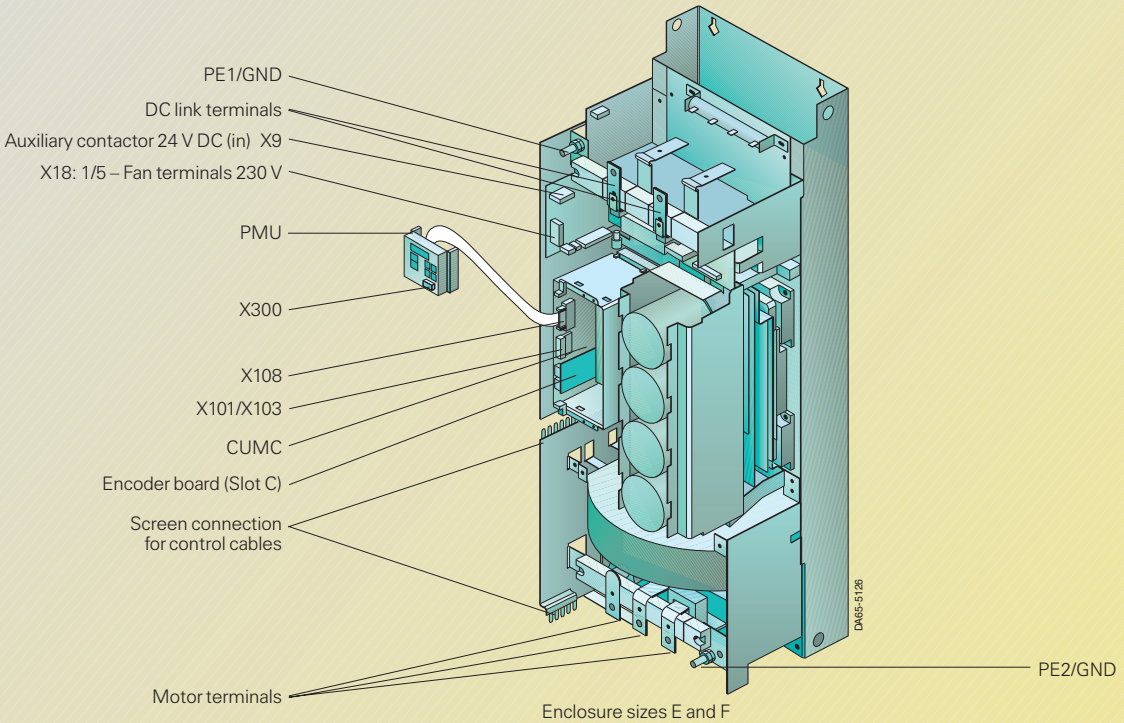
| Terminal | Designation | Description | Range |
|---|---|---|---|
| 5 | Operation of MC | Operation of main contactor | 230 V AC |
| 4 | Operation of MC | Operation of main contactor | 1 kVA |
| 3 | Not assigned | Not used | |
| 2 | 0 V | Reference potential | 0 V |
| 1 | +24 V (in) | 24 V power supply | Enclosure sizes E, F, G<br>24 V DC, ≤ 3.5 A<br>Enclosure size K<br>24 V DC, ≤ 4.3 A |

Connectable cross-section: 2.5 mm² (AWG 12)

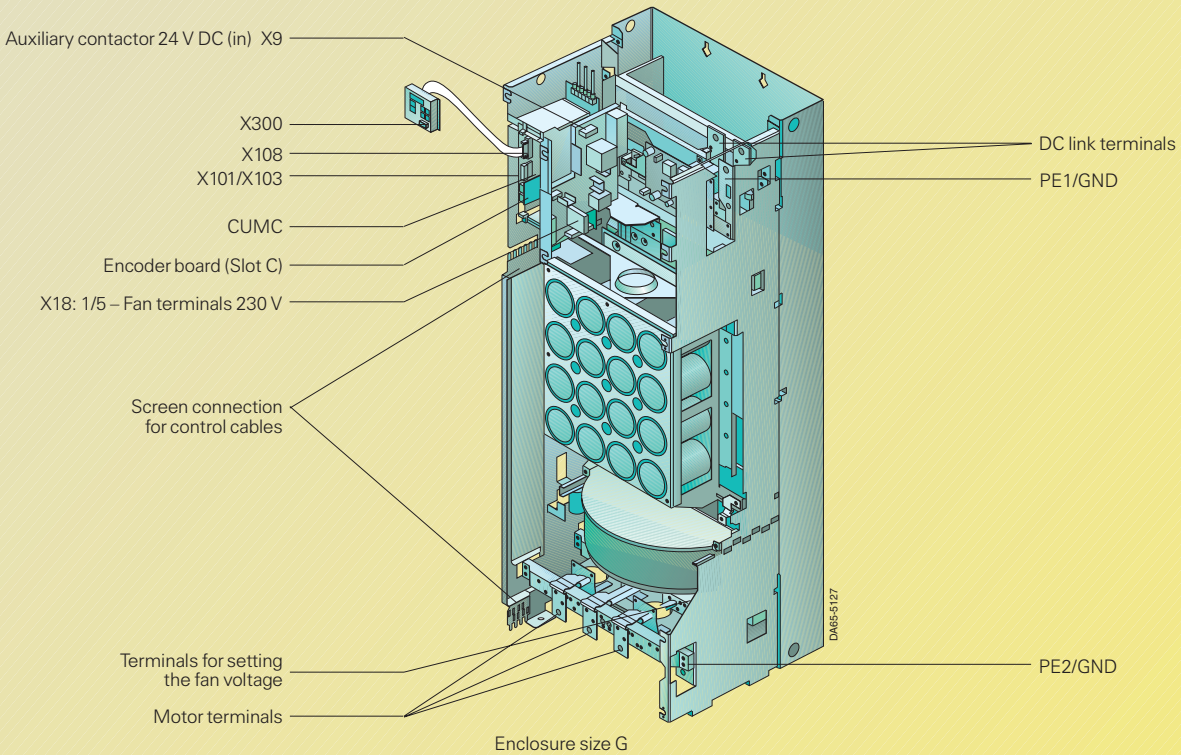


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## Chassis-type inverters




Enclosure sizes E and F

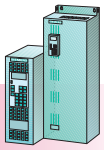



Enclosure size G

Fig. 6/41
Overview of terminals on the chassis-type inverters



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## Chassis-type inverters (continued)

### Power terminals

| DC link terminals | Designation | Description | Range |
|---|---|---|---|
| The DC link terminals are located on the top of the unit. | C/L+ | DC link voltage + | 510 V to 650 V DC |
| | D/L– | DC link voltage – | 510 V to 650 V DC |
| | PE1/GND | Connection of equipment grounding conductor | – |

| Wire cross-sections · Fuses | Enclosure size | Order No. | Max. wire cross-section mm² to DIN VDE | Max. wire cross-section AWG | Screw connection |
|---|---|---|---|---|---|
| Possible wire ranges, screw type connection. | E | **6SE703.–..E50** | 2 x 70 | 2 x 00 | M10 |
| | F | **6SE703.–..F50** | 2 x 70 | 2 x 00 | M10 |
| | G | **6SE703.–..G50** | 2 x 150 | 2 x 300 | M12 |
| | J | **6SE703.–..J50** | 2 x 300 | 2 x 800 | M12/M16 |

Notes

- The cross-sections ranges are determined for copper cable at 40 °C (104 °F) ambient temperature (in acc. with DIN VDE 0298, Part 4/02.88, Group 5).
- If DC fuses have been integrated, additional fuses on the rectifier unit are not necessary as long as the connecting cables to the DC bus are short-circuit-proof and overloading by other loads is not possible. For J-type units, the fuses are an integral part of the unit. In the case of unit types E, F, and G, the fuses are an option (L30).
- The connections to the rectifier unit are to be kept as short as possible and, in the case of large systems, between the inverters as well. Ideally, they should be low-inductance busbars.

| Order No. | Supply side: Rated DC current | Cross-section to DIN VDE | Cross-section to AWG | Recommended fuse type: for North America | | | | | Motor side: Rated output voltage | Rated output current | Cross-section to DIN VDE | Cross-section to AWG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | mm² | | A | 3NE | 170M | V | A | V | A | mm² | |
| **6SE7031–0TE50** | 110 | 1 x 70 | 1 x 000 | 160 | 3224 | 3718 | 600 | 350 | 0 - 480 | 92 | 1 x 35 | 1 x 0 |
| **6SE7031–2TF50** | 148 | 2 x 35 | 2 x 0 | 250 | 3227 | 3718 | 660 | 350 | 0 - 480 | 124 | 2 x 25 | 2 x 2 |
| **6SE7031–8TF50** | 184 | 2 x 35 | 2 x 0 | 250 | 3227 | 3718 | 660 | 350 | 0 - 480 | 155 | 2 x 35 | 2 x 0 |
| **6SE7032–1TG50** | 208 | 2 x 50 | 2 x 00 | 315 | 3230-0B | 3720 | 660 | 450 | 0 - 480 | 175 | 2 x 35 | 2 x 0 |
| **6SE7032–6TG50** | 254 | 2 x 70 | 2 x 000 | 450 | 3233 | 6709 | 660 | 550 | 0 - 480 | 218 | 2 x 50 | 2 x 00 |
| **6SE7033–2TG50** | 312 | 2 x 95 | 2 x 4/0 | 450 | 3233 | 6709 | 660 | 550 | 0 - 480 | 262 | 2 x 70 | 2 x 000 |
| **6SE7033–7TG50** | 367 | 2 x 120 | 2 x 300 | 500 | 3334-0B | 6710 | 660 | 630 | 0 - 480 | 308 | 2 x 95 | 2 x 4/0 |
| **6SE7035–1TJ50** | 503 | 4 x 300 | 4 x 800 | 450 | 2 x 3233 | 2 x 6709 | 660 | 550 | 0 - 480 | 423 | 2 x 300 | 2 x 800 |
| **6SE7036–0TJ50** | 584 | 4 x 300 | 4 x 800 | 450 | 2 x 3233 | 2 x 6709 | 660 | 550 | 0 - 480 | 491 | 2 x 300 | 2 x 800 |

AWG: American Wire Gauge

| Motor terminal | Designation | Description | Range |
|---|---|---|---|
| The motor terminals are at the bottom of the unit. | U2/T1 | Phase U2/T1 | 3-ph. 0 V AC to 0.86 x line voltage |
| | V2/T2 | Phase V2/T2 | |
| | W2/T3 | Phase W2/T3 | |
| | PE2/GND | Connection of equipment grounding conductor | – |

### Control terminals

**Standard connections on the CUMC module**

See page 6/36.

**X9 – 24 V DC power supply and operation of the bypass contactor (BC)**

The 5-pin terminal strip is for connecting a 24 V power supply and a bypass contactor (BC).

The power supply is needed if the inverter is connected via a bypass contactor.

The auxiliary power supply simultaneously secures communication to the automation system even when the supply voltage of the power section has been switched off.

The terminals for operation of the contactor are floating.

The position of the terminal strip can be seen from the overview of the terminals.

The field coil of the main contactor is to be connected up with overvoltage limiters, e.g. RC elements.

The unit has a current intake of 3 A from the 24 V voltage supply. This increases to a maximum of 4.2 A if option cards are plugged in.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 5 | Operation of BC | Operation of bypass contactor | 230 V AC |
| 4 | Operation of BC | Operation of bypass contactor | 1 kVA |
| 3 | Not assigned | Not used | |
| 2 | 0 V | Reference potential | 0 V |
| 1 | +24 V (in) | 24 V power supply | Enclosure sizes E, F, G 24 V DC, ≤ 3.5 A Enclosure size J 24 V DC, ≤ 4.2 A |

Connectable cross-section: 2.5 mm² (AWG 12)



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## Rectifier units and rectifier/regenerative units

### *Power terminals*

**X1 – Mains connection, DC link terminals**

The mains and DC link terminals are located on the top of the unit.

| Designation | Description | Range |
|---|---|---|
| U1/L1 | Phase U1/L1 | 3-ph. 380 V to 480 V AC |
| V1/L2 | Phase V1/L2 | 3-ph. 380 V to 480 V AC |
| W1/L3 | Phase W1/L3 | 3-ph. 380 V to 480 V AC |
| PE/GND | Equipment grounding conductor | – |
| C/L+ | DC link voltage + | 510 V to 650 V DC |
| D/L– | DC link voltage – | 510 V to 650 V DC |

**X4 – Regenerating terminal, autotransformer/mains**

For rectifier/regenerative units only.

| Designation |
|---|
| 1U2/1T1 |
| 1V2/1T2 |
| 1W2/1T3 |

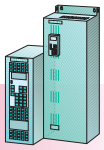
**Wire cross-sections**

| Order No. | Input current | Wire cross-section | | | | | |
|---|---|---|---|---|---|---|---|
| | | U1/L1, V1/L2, W1/L3, 1U2/1T1*, 1V2/1T2*, 1W2/1T3* | | C/L+, D/L– | | PE | |
| | A | to DIN VDE mm² | AWG | to DIN VDE mm² | AWG | to DIN VDE mm² | AWG |
| **6SE7024–1EB85–0AA0** | 36 | 16 | 6 | 16 | 6 | 16 | 6 |
| **6SE7028–6EC85–0AA0** | 75 | 50 | 1/0 | 50 | 1/0 | 25 | 4 |
| **6SE7022–1EC85–1AA0** | 18 | 50 | 1/0 | 50 | 1/0 | 10 | 10 |
| **6SE7024–1EC85–1AA0** | 35 | 50 | 1/0 | 50 | 1/0 | 16 | 6 |
| **6SE7028–6EC85–1AA0** | 74 | 50 | 1/0 | 50 | 1/0 | 25 | 4 |
| **6SE7031–7EE85–0AA0** | 151 | 120 | 4/0 | 2 x 70 | 2 x 2/0 | 70 | 2/0 |
| **6SE7032–7EE85–0AA0** | 235 | 2 x 95 | 2 x 3/0 | 2 x 120 | 2 x 4/0 | 120 | 4/0 |
| **6SE7033–8EE85–0AA0** | 327 | 2 x 150 | 2 x 300 | 2 x 185 | 2 x 350 | 185 | 350 |
| **6SE7034–6EE85–0AA0** | 404 | 2 x 185 | 2 x 350 | 2 x 240 | 2 x 500 | 240 | 500 |
| **6SE7036–1EE85–0AA0** | 528 | 2 x 240 | 2 x 500 | 2 x 300 | 2 x 600 | 300 | 600 |
| **6SE7031–7EE85–1AA0** | 149 | 2 x 120 | 2 x 4/0 | 2 x 150 | 2 x 300 | 70 | 2/0 |
| **6SE7032–2EE85–1AA0** | 191 | 2 x 120 | 2 x 4/0 | 2 x 150 | 2 x 300 | 95 | 3/0 |
| **6SE7033–1EE85–1AA0** | 267 | 2 x 120 | 2 x 4/0 | 2 x 150 | 2 x 300 | 150 | 300 |
| **6SE7033–8EE85–1AA0** | 323 | 2 x 240 | 2 x 500 | 2 x 300 | 2 x 600 | 185 | 350 |
| **6SE7034–6EE85–1AA0** | 398 | 2 x 240 | 2 x 500 | 2 x 300 | 2 x 600 | 240 | 500 |
| **6SE7036–1EE85–1AA0** | 520 | 2 x 240 | 2 x 500 | 2 x 300 | 2 x 600 | 300 | 600 |

AWG: American Wire Gauge
*For rectifier/regenerative units only.



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## Rectifier units and rectifier/regenerative units (continued)

### *Control terminals*

**X9 – Electronics power supply/operation of main contactor**

The external power supply required for the electronics is not included in the scope of supply of the rectifier units.

The unit has a power requirement of 1 A from the 24 V power supply. This increases to a maximum of 2 A if option cards are plugged in.

Load capability of the contact for operating the main contactor: 230 V AC: 7.5 A at cos φ = 0.4; L/R = 7 ms; 30 V DC: 5 A; 60 V DC: 1 A

| Designation | Description | Range |
|---|---|---|
| 1 | 24 V DC | 20 V to 30 V |
| 2 | Reference potential | |
| 3 | Not assigned | |
| 4 | Operation of main contactor | |
| 5 | | |

**X36 – Signalling relay**

"Overtemperature", "Precharging fault"

Load capability: 48 V AC, 60 VA (cos φ = 0.8); 48 V DC, 24 W

| Designation | |
|---|---|
| 1 | Signalling contact for switching low voltage |
| 2 | |

**Control terminals on the CUR control board**

Application of the CUR control board: SIMOVERT MASTERDRIVES rectifier/ regenerative units.
Order No. of the CUR: 6SE7090–0XX85–1DA0

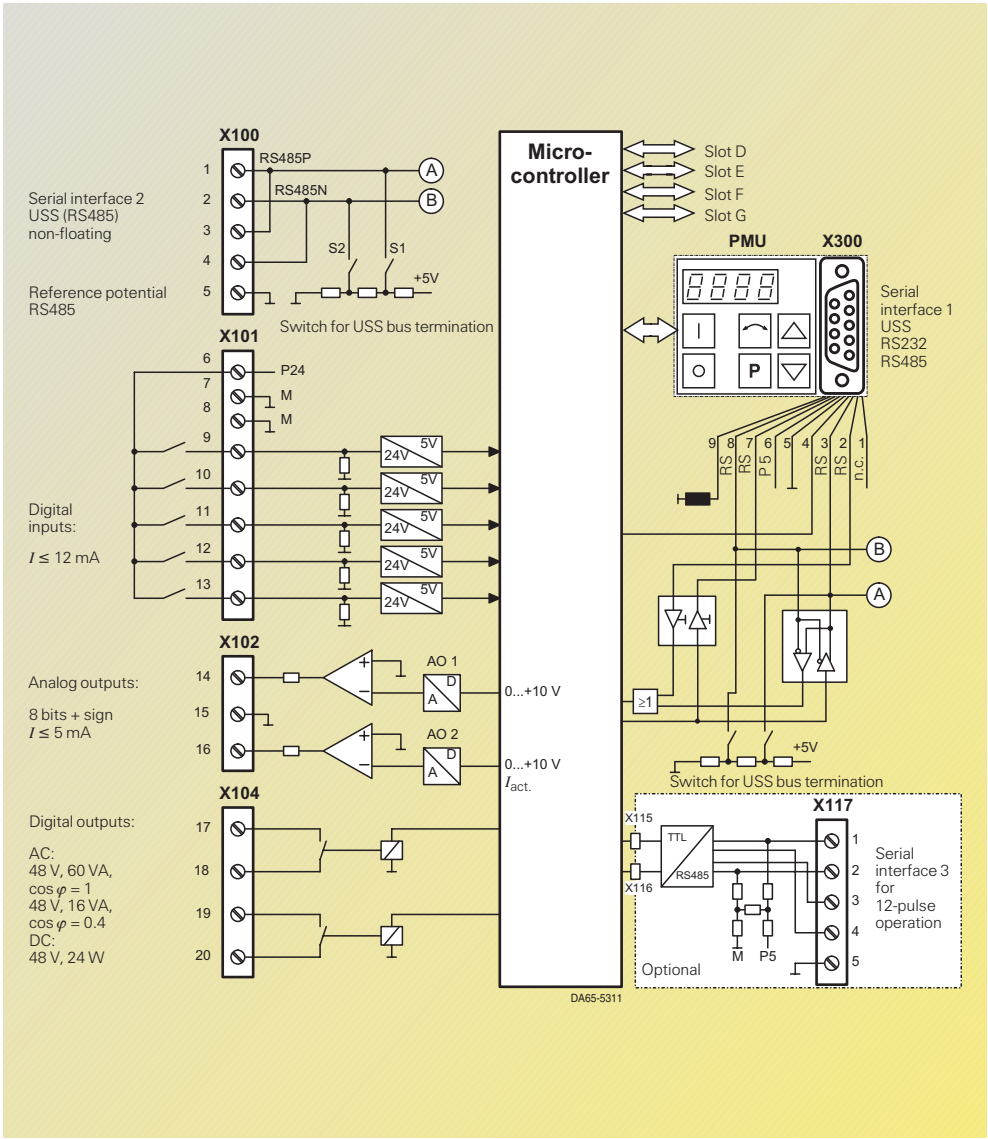



Fig. 6/42
Control terminals on the CUR control board

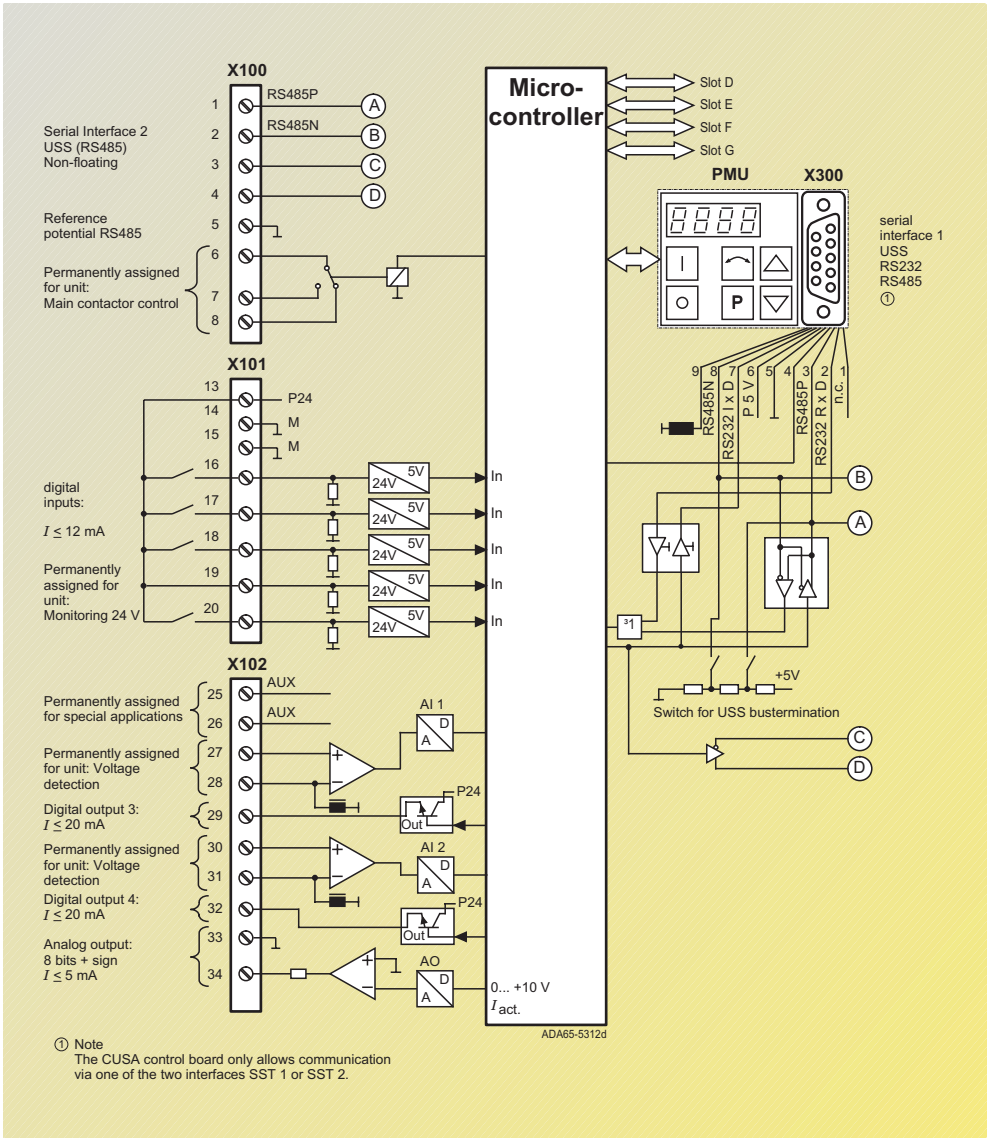


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## Control terminal strip on the CUSA control board (AFE rectifier/regenerative unit)

Application:
SIMOVERT MASTER-DRIVES cabinet units, as control electronics for the self-commutated, pulsed AFE rectifier/regenerative unit
Order No. of the CUSA:
6SE7090–0XXB4–0BJ0

Connector for the terminal strip:
Order No.: 6SY7000–0AD30
(connectors X100 to X102)

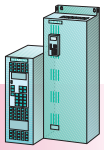



① Note
The CUSA control board only allows communication via one of the two interfaces SST 1 or SST 2.

Fig. 6/43
Control terminals of the CUSA control board



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## Braking units

### *Power terminals*

**Block diagram of the braking unit**

See pages 6/56 and 6/57.

**DC link terminals**

Terminal strip X3 for sizes S and A
Busbars for size B

| Designation | Description |
|---|---|
| C/+ | DC link voltage + |
| D/– | DC link voltage – |
| ⊥ | Screen connection |
| PE1/GND | Connection of equipment grounding conductor |

**Terminals for internal[1])/external braking resistor**

Terminal strip X6 for sizes S and A
Busbars for size B

| Designation | Description |
|---|---|
| G | External braking resistor |
| H1 | Internal braking resistor |
| H2 | External braking resistor |
| ⊥ | Screen connection |
| PE2/GND | Connection of equipment grounding conductor |

**Wire cross-sections · Type of connection**

| Type | Order No. | Wire cross-section mm² to DIN VDE | AWG | Type of connection |
|---|---|---|---|---|
| S | **6SE70 . . – . ES87–2DA0** | 1.5 - 4 | 16 - 10 | Terminal strip |
| A | **6SE70 . . – . EA87–2DA0** | 2.5 - 10 | 14 - 6 | Terminal strip |
| B | **6SE70 . . – . EB87–2DA0** | max. 1 x 95 | max. 1 x 000 | Cable lug to DIN 46 235 (M8 screws) |

AWG: American Wire Gauge

### *Control terminals*

**X38 – Control terminal strip**

Input "inhibit" (pins 1 and 2):
Application of 24 V:
Braking unit inhibit reset
"OVERAMP" and "OVERTEMP" faults.

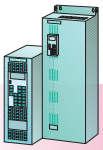
Fault output (pins 4 and 5)
Relay closed: no fault
Relay open: fault
or
Braking unit inhibited
or
DC voltage is not connected

| Pin | Designation | Description |
|---|---|---|
| 1 | + | Inhibit |
| 2 | – | Inhibit |
| 4 | | Fault output |
| 5 | | Fault output |

1) Only for sizes S and A ≤ 20 kW.



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Compact and chassis units



Compact PLUS units

## Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC) is defined in the EMC directive as the "ability of a device to function satisfactorily in an electromagnetic environment without itself causing electromagnetic interference which is unacceptable for other devices in this environment." In order to ensure that the relevant EMC standards are complied with, the devices must demonstrate a sufficiently high immunity, on the one hand, and interference emission must be limited to compatible values, on the other.

### *Immunity*

The units satisfy the requirements of the EMC product standard, EN 61 800-3, for the industrial sector and thus the lower values regarding immunity required by the residential sector as well.

### *Interference emission and radio-interference suppression*

If converters are used in a residential application, conducted interference or electromagnetically emitted interference must not exceed the limit values according to "B1"[1]).

| Type of interference | Level of interference | Comments |
|---|---|---|
| Discharging of static electricity | up to 12 kV | |
| Rapid transient interference (burst) | up to 4 kV | for power section |
| | up to 2 kV | for signal cables |

A residential application in this sense is a connection, i.e. an outgoing section of a transformer, to which private households are also connected.

The EMC directive requires that an industrial system as a whole be electromagnetically compatible with its environment.

In the case of units for use in industry, limit values are prescribed for emitted interference.

If the MASTERDRIVES units are to comply with limit values, the following must be provided:

- Radio-interference suppression filters, including line commutating reactors for reducing the conducted interference
- Screened cables for motor supply cables and signal cables for reducing electromagnetically emitted interference
- Compliance with the installation guidelines.

In systems with MASTERDRIVES units and other components, e.g. contactors, switches, monitoring units, automation units, etc., it must be ensured that no interference is emitted to the outside and also that the individual units do not cause interference among themselves. In this respect, the measures described in the brochure, "Design of Drives in Conformance with EMC Regulations", Order No. 6SE7087-6CX87-8CE0 are to be implemented (contained in the Compendium, see documentation description in Section 5).

The most important of these measures are as follows:

- The components of a system must be housed in a cabinet which acts like a Faraday cage.
- Signal cables and motor supply cables must be screened. The screen must be grounded at both ends.
- Signal cables should be spatially separated (at least 20 cm (8 in)) from the power cables. If necessary, screening plates are to be provided.

For further measures and details, see the installation notes referred to.

1) See section 2, general technical data.



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## Line-side components

### *Line fuses*

The 3NE1 SITOR® double protection fuse provides both cable protection and semiconductor protection in one fuse. This results in significant cost savings and reduced installation times.

For Order No. and assignment, see Section 3.

For the description and technical data of the fuses, see Configuration Manual "SITOR Halbleiterschutzsicherungen"
Order No.:
E20001–A700–P302 (available only in German).

### *Line commutating reactor*

The line commutating reactor reduces the harmonics of the converter, the rectifier unit and the rectifier/regenerative unit. The effect of the reactor depends on the ratio of the line short-circuit output to the apparent drive output. Recommended ratio of line short-circuit outputs to apparent drive output
> 33 : 1:

- Use a 2 % line commutating reactor for converters and rectifier units.
- Use a 4 % line commutating reactor for rectifier/regenerative units.

A line commutating reactor also limits current spikes caused by line-supply voltage disturbances (e.g. due to compensation equipment or grounding faults) or switching operations on the power system.

Reactors for supply voltages of 380 to 480 V and 50 Hz can be used with 60 Hz without any restrictions.

For rated currents up to 40 A, connecting terminals are fitted. In the case of reactors with rated currents ≥ 41 A, flat connections are provided. The conductor cross-sections that can be connected are indicated in the dimension drawings (see Section 7).

The commutating reactors are designed with degree of protection IP00.

For further technical data regarding the mechanical design, see Catalog PD 30,
Order No.:
E86060–K2803–A101–A1
(only available in German).

### *Autotransformers for rectifier/regenerative units*

Rectifier/regenerative units require a 20 % higher supply voltage at the anti-parallel inverter bridge for regenerative operation. An autotransformer can be used to adapt the voltage accordingly. Two types of autotransformer are available, one with 25 % and another with 100 % power-on duration. They correspond to the required technical specifications and cannot be replaced by any other types.

For Order No. and assignment, see Section 3;
for dimension drawings, see Section 7.

### *Radio-interference suppression filters*

When integrated in the installation in accordance with EMC guidelines, SIMOVERT MASTERDRIVES applications comply with the EMC product standard for electrical drives, EN 61 800-3.

The radio-interference suppression filters, in conjunction with the line commutating reactor, reduce the radio interference voltages of the converters, the rectifier units and the rectifier/regenerative units - up to an output of 37 kW (50 HP). The specified limits acc. to EN 61 8003 Class B1 (residential sector) for 3-ph. 200 V AC to 230 V AC and 3-ph. 380 V to 480 V AC in TT (Delta) or TN (Wye) systems are adhered to with the suggested filters.

For Order No. and assignment, see Section 3;
for dimension drawings, see Section 7.

For limit values, see "Electromagnetic compatibility (EMC)" on page 6/49.

Note

- The radio-interference suppression filters of the Compact PLUS series have an integrated commutating reactor.
- If several converters are built into a drive cabinet or control room, a common shared filter with the total current of the installed converters is to be used in order to avoid exceeding the limit values. The individual converters are to be decoupled with the appropriate line commutating reactor.



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## Compact PLUS, compact and chassis series rectifier units up to 250 kW (335 HP)

Rectifier units are used to supply the DC bus for motoring inverters with motoring energy and enable operation of a combined multi-motor system.

These units do not have a processor board and charge the connected DC links of the inverters immediately after the supply voltage has been switched on. They are switched on and off by means of the main contactor.

A main contactor enables a unit to be switched on and off at the power supply and, in the event of a fault, also protects the connected rectifier units against overload.

The rectifier units are to be dimensioned for the total DC link current of the inverter units in motoring mode. The rectifier units are only thermally protected against overload. The overload limits must not be exceeded.

## Compact and chassis series rectifier/regenerative units up to 250 kW (335 HP)

Rectifier/regenerative units supply DC buses for inverters with motoring energy from a three-phase supply and also return regenerative energy from the DC bus to the power supply. This is achieved using two independent thyristor bridges, with the regenerative bridge connected to the supply via an autotransformer (for selection and ordering data, see Section 3).

Using an autotransformer for the regenerative bridge has the following advantage:

- Maximum motor torque at full motor speed even in regenerative mode.

For rapid changeovers from infeed to regeneration, a dead time of 15 ms has to be taken into account.

Rectifier/regenerative units can be ordered for mounting in control cabinets as chassis units only.

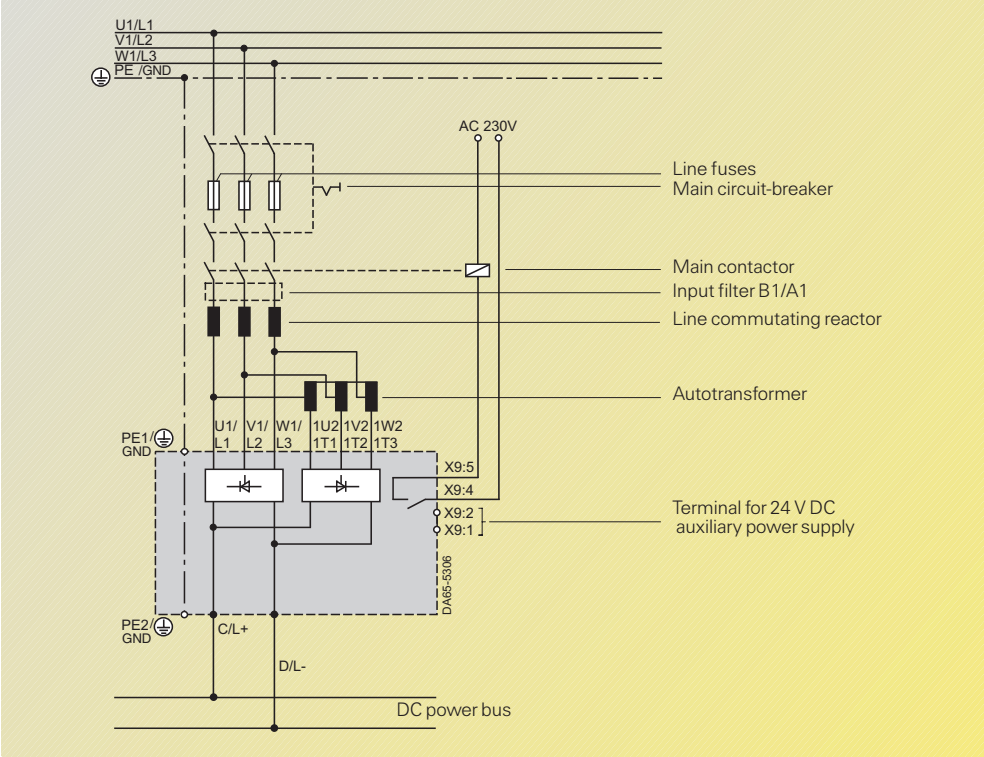



Fig. 6/44
Block diagram of the rectifier/regenerative unit

The main contactor can be controlled by means of the electronics in the standard unit.

The electronics box of the rectifier/regenerative unit contains the CUR control board. It can also accommodate two additional boards (a communication and/or a technology board). The rectifier/regenerative unit can thus be automated via PROFIBUS DP and, with the technology boards, can perform distributed technology tasks.

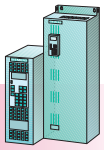
Functions of the CUR board

- Sequence control and operator-control via PMU
- Gating unit and command stage
- Voltage and current controller
- Monitoring function and actual values processing
- Terminal strip
- Communication via dual-port RAM and the serial SST1 interface of the basic unit.

6



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## AFE rectifier/regenerative unit (Active Front End) compact and chassis units up to 250 kW (335 HP)

### *Function*

The main components of the AFE rectifier/regenerative unit are a voltage source inverter with a CUSA control board. From a three-phase power supply, it generates a regulated DC voltage, the so-called DC link voltage. This DC link voltage is kept almost constant irrespective of the supply voltage, even during regenerative operation.

On the three-phase side, a supply-angle-oriented high-speed vector controller is subordinate to the DC link voltage controller. This vector controller impresses an almost sinusoidal current towards the supply and, with the help of the Clean Power filter, minimizes network perturbations.

The vector controller also enables the power factor cos $\varphi$ and thus reactive power compensation to be set, whereby the drive power requirement has priority.

The VSB board (Voltage Sensing Board) functions as a supply-angle encoder and works according to a principle similar to that of an incremental encoder.

### *Note:*

AFE inverters are aligned inversely to the supply and are not capable of functioning autonomously. In order to function, they need at least the following system components:

- For the compact units
  - Precharger
  - Main contactor
  - AFE reactor
  - VSB voltage sensing board

For safety reasons, an AFE rectifier/regenerative unit must be connected to the supply via a line contactor. An external 24 V power supply is therefore always necessary for supplying the VSB board and the AFE inverter.

- For the chassis units
  - AFE supply connecting module

This module contains a Clean Power filter, a main circuit-breaker with fuses, the 230 V AC and 24 V DC power supplies, as well as the VSB, precharger and the main contactor.

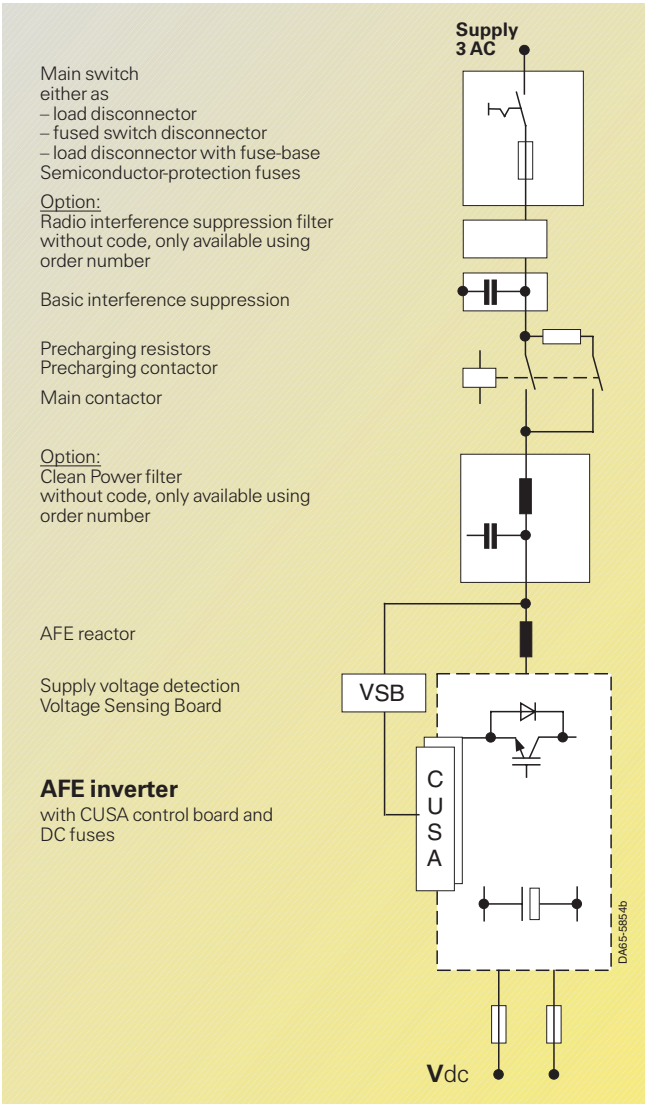



Fig. 6/45
AFE compact units

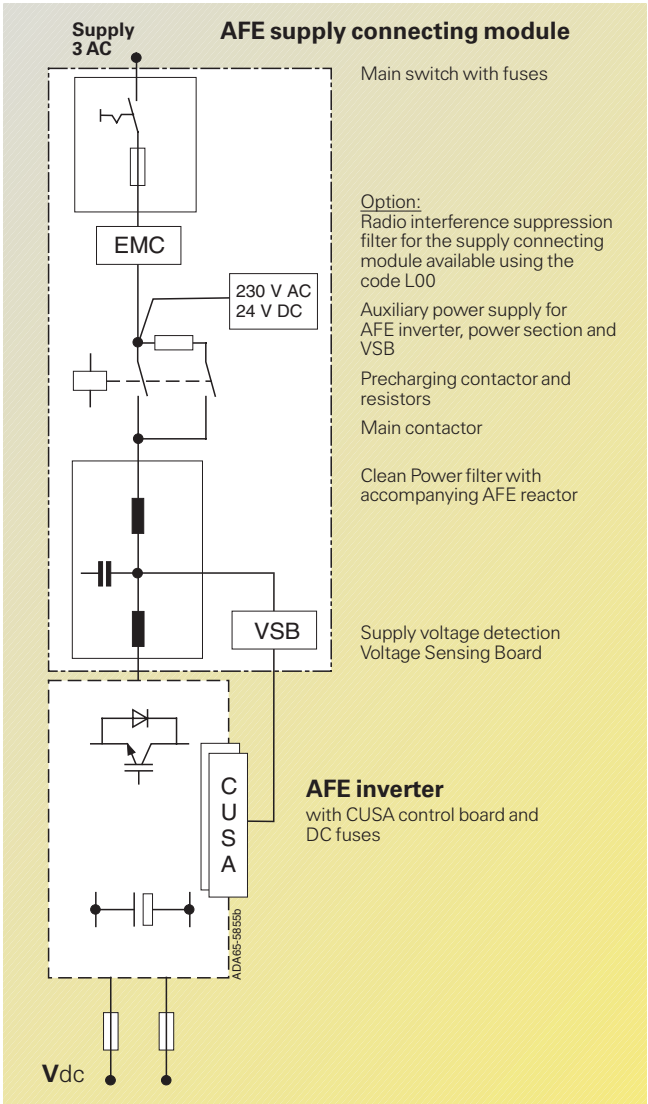



Fig. 6/46
AFE chassis units



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### *Technical characteristics*

Output range

- Compact units
  Rectifier output
  6.8 to 49 kW at 400 V
  Design: Compact A to D
- Chassis units
  Rectifier output
  63 to 250 kW (335 HP) at 400 V
  Design: Chassis E to G

Optimum infeed and regenerative operation

SIMOVERT MASTERDRIVES AFEs are 100 % capable of regenerative power feedback without the need for a regenerative transformer. Even during regenerative mode, power losses do not occur as is the case of the pulsed-resistor method. The transition from motoring to regenerative mode is stepless, with pulse-frequency response. The exactly regulated DC link voltage ensures optimum supply of the drive inverter, making it almost independent of the supply voltage.

Minimal network perturbations thanks to AFE with Clean Power technology

With SIMOVERT MASTERDRIVES AFE, harmonics and commutating dips are avoided, except for a very small residue. Optimum agreement between the electronically controlled active section (AFE inverter) and the passive section (Clean Power filter) ensures that almost sinusoidal voltages and currents are impressed in the direction of the supply. Network perturbations are practically non-existent.

Maximum availability even if the supply system is instable

With SIMOVERT MASTERDRIVES AFE, it is possible to operate a drive system with reliability and precision, irrespective of the properties displayed by the power supply, i.e. active protection against power outages, overvoltages, frequency and voltage fluctuations by means of AFE vector control and high-speed electronic monitoring. The downstream Clean Power filter provides optimum passive protection against transient voltage peaks.

If the supply exceeds the permissible range or if it fails completely, the electronics reports the problem immediately, and the AFE disconnects the drive from the supply by actively switching it off. As a consequence, inverter stalling with fuse tripping can no longer occur even during regenerative mode. The back voltage of the AFE inverter to the supply is impressed with a highly dynamic pulse frequency and tolerates even very short power interruptions in the millisecond range. In the case of single-phase power dips, the controller distributes the power over the other two phases and can continue to work for several seconds.

### *Optimum power conversion*

Because the AFE method does not place stress on the power supply systems by producing harmonics, the supply currents are lower. Supply components can thus be rated lower than with conventional methods. This applies to the line transformer and the supply leads, as well as to the fuses and switches.

### *Optimum drive utilization due to the step-up controllability of the AFE technology*

Because the DC link voltage is kept constant irrespective of the supply voltage, lower rating of the drive inverters and motor currents is also possible.

### *Uniform configuration*

Because the AFE system is free of system perturbations and very robust to line-voltage and frequency fluctuations, uniform, reliable and simple configuration is possible with regard to the power-supply properties and system perturbations.

### *Supply voltage range*

SIMOVERT MASTERDRIVES AFE can be operated from a 3-phase power supply system with or without a grounded neutral point. Supply voltage ranges: 3-ph. 380 V AC -20 % to 460 V AC +5 %

### *Power system tolerances*

A high-performance vector controller with high-speed encoder (VSB) enables operation from power systems with fluctuating and hard-to-define properties.

The following therefore applies to power system undervoltages:

a) In the case of short voltage dips, i.e. < 1 min, and up to 30 % of rated voltage, unrestricted operation is possible. If a long-term deviation from the rated value occurs, the power configuration must be redimensioned.
b) In the case of short voltage dips lasting from approx. 20 ms to 1 min and up to 50 % of the rated voltage, a special auxiliary power supply must be provided and the power correspondingly redimensioned.
c) Transient supply undervoltages in the range < 20 ms are tolerated up to 50 % of the rated voltage.
d) In the case of supply dips of > 50 %, the AFE actively switches off with the fault "Supply undervoltage" and the line contactor is opened.

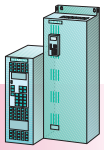
The following therefore applies to supply overvoltages:

a) Transient supply overvoltages in the range of 10 ms are tolerated up to 50 % of the rated voltage.
b) The continuously tolerated maximum supply voltage is 485 V.
c) Short-time overvoltages of 20 % to 30 % in the range of 1 s to 1 min can be tolerated, depending on the load level.





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## AFE rectifier/regenerative unit (Active Front End) compact and chassis units up to 250 kW (335 HP)

### *Clean Power filter*

Whereas the Clean Power filter is generally necessary for the chassis units (sizes E to G), it is optional in the case of compact units.

For very small line transformers, i.e. for a power ratio of $P_{AFE}$ to $P_{Trans}$ = 1:5, use of this filter is recommended (e.g. if $P_{AFE}$ = 6.8 kW, a Clean Power filter should be used for line transformer outputs < 34 kVA).

### *Basic interference-suppression board*

The basic interference-suppression board must be used if an EMC filter has not been configured to ensure basic EMC interference-suppression. It is only permissible to use this board together with grounded supply systems.

### *Nominal power rating and rectifier/regenerative power rating*

The rectifier/regenerative power rating describes the actual power of the AFE inverter when cos $\varphi$ = 1 and at the rated voltage. There is also the term "nominal power rating". This term is used purely for cross-referencing the AFE inverter to its corresponding motor-side inverter for stocking spare parts (the AFE inverters and standard SIMOVERT MASTERDRIVES inverters with identical nominal power ratings have identical power sections). It is therefore possible to use the same spare parts in the power section for both units.

Example:

An AFE inverter with 6.8 kW infeed/regenerative power rating has the order number 6SE7021-0EA81. Which spare parts and how many are kept can then be derived from the basic inverter with a nominal power rating of 4 kW (5 HP), i.e. with an inverter of the type 6SE7021-0TA61.

Ordering examples

1st example:
AFE rectifier/regenerative unit with 63 kW, 400 V (chassis unit) with operating instructions
Position 1
AFE supply connecting module
6SE7131-0EE83-2NA0
Position 2
AFE inverter
6SE7031-0EE80
Position 3
Operating instructions
6SE7080-0CX86-2AA0

2nd example:
AFE rectifier/regenerative unit with 6.8 kW, 400 V (compact unit with minimum configuration)
with EMC filter
Position 1
AFE inverter
6SE7021-0EA81
Position 2
VSB with housing
6SX7010-0EJ00
Position 3
AFE reactor
6SE7021-3ES87-1FG0
Position 4
Precharging resistors
6SX7010-0AC81 (3 pieces)
Position 5
EMC filter
6SE7021-0ES87-0FB1
Precharging contactor:
3RT1016 with 24 V control voltage.

Note

A 24 V power supply must be provided from the plant side.

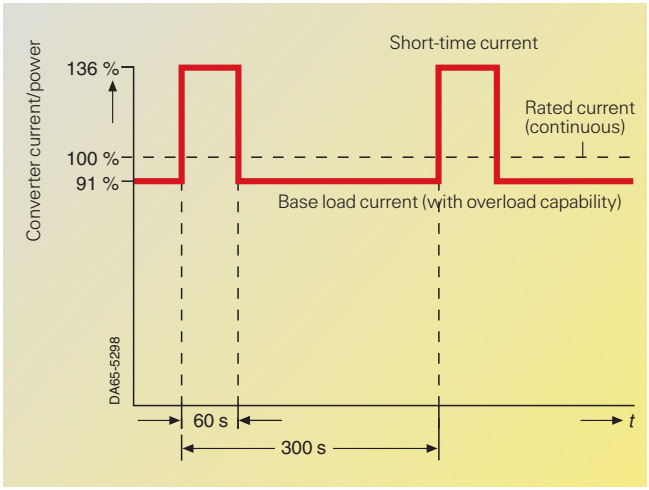



Fig. 6/47
Definition of the rated value and also the overload and base load current

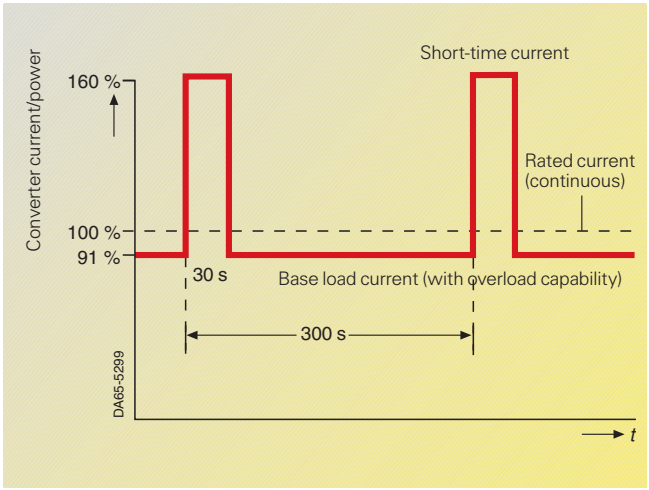



Fig. 6/48
Additional definition of the rated value and the overload and base load values

### *Rated data and continuous operation of the AFE inverters*

The line voltage used as a basis is 400 V. The power section is protected against overload using $I^2t$ monitoring.

The units are designed for continuous operation with an AFE input current $I_{VN}$. If this current is used over a long period of time (> 60 s), corresponding to 100 % of the value of Fig. 6/47 or 6/48, the unit reaches its maximum permissible operating temperature and the $I^2t$ monitoring does not allow any overload above this.



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### *Overload capability of the AFE inverters*

For more information, see "Overload capability of the converter", page 6/18.

### *Installation conditions and correction factors*

For more information, see page 6/19.

### *Notes on dimensioning of the AFE rectifier/ regenerative power*

Appropriate selection of the AFE inverters is supported by the PATH engineering tool.

Due to the sinusoidal, precisely controlled voltages and currents, SIMOVERT MASTERDRIVES AFEs can be engineered very simply and reliably.

The following applies:
$P_{AFE} = 1.73 \cdot V_{supply} \cdot I_{AFE} = P_{mech} + P_{losses}$

The power loss is determined by the efficiency of the inverters and the motor, typically 10 % of the drive power in total. The mechanical power, i.e. the product of the motor torque and the motor speed, is defined by the application. What is decisive for dimensioning, therefore, is the power and not the torque, as is the case with drive inverters. One or several inverters can be connected to the output of the AFE. The maximum connected inverter power can exceed the rated power of the AFE by a factor of 4. The continuous power drawn from the supply may not exceed the rated power of the AFE inverter.

### *Operation and control*

The unit can be controlled by means of the following elements:

- PMU parameterizing unit
- Optional OP1S operator panel
- Terminal strip
- Serial interface.

In combination with automation systems, the unit is controlled via optional interfaces (e.g. PROFIBUS DP) or via technology boards (T100, T300).



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## Braking units and braking resistors

In the Compact PLUS series, the brake chopper is already contained as a standard component in the converter and rectifier units. Only the braking resistor has to be configured and connected up.

For the compact and chassis units, braking units must be used. In the range $P_{20}$ = 5 kW to 20 kW, they consist of a chopper power section and an internal load resistor.

An external load resistor can be connected to increase the available braking power or to increase the continuous braking power. The internal load resistor must be disabled by removing the connecting jumper when an external load resistor is used (see Fig. 6/50).



Fig. 6/49
Braking unit and external braking resistor

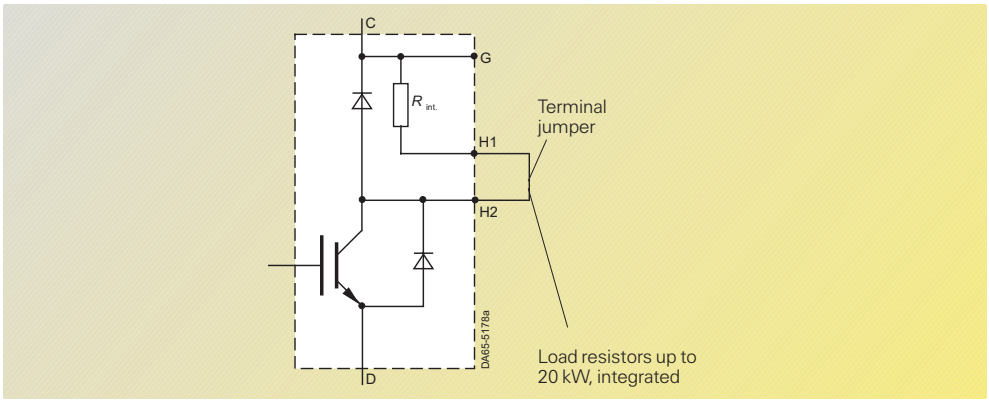



Fig. 6/50
Block diagram of a braking unit with **internal** braking resistor

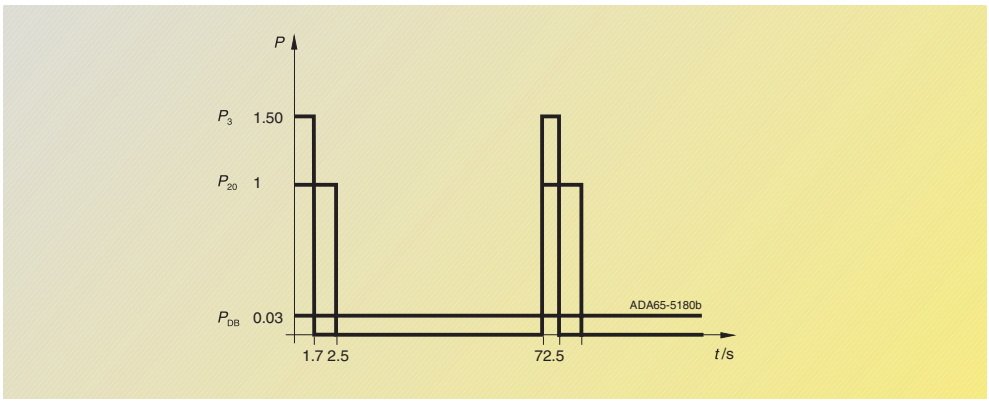



Fig. 6/51
Load diagram with **internal** braking resistor

**Protective functions indicated via the LEDs mounted in the braking unit**

| | | |
|---|---|---|
| Overcurrent | | Overcurrent has occurred.<br>Reset necessary |
| Overload | | The braking unit is powered down after the permissible $I^2t$-value has been exceeded. The unit is ready for operation again after elapse of the defined pause intervals. |
| Overtemp | | Temperature of the heat sink too high; self-resetting once the temperature falls below preset threshold. |
| Ready | Ready for operation, operating | DC voltage is connected (LED is on).<br>Braking unit is operating (LED flashes) |



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## Braking units and braking resistors (continued)

Units with 50 kW to 170 kW braking power require an external load resistor, which is to be connected to the braking units (see fig. 6/52).

The braking units can be connected in parallel to increase the power. Each braking unit requires its own load resistor. The maximum permissible continuous braking power (with an external resistor) connected to a converter or inverter is
$P_{DBMAX} \leq 0.6\ P_{INV}$
$P_{20MAX} \leq 2.4\ P_{INV}$.

Note

When the internal load resistor is used, $P_{20}$ can be used for a braking time of 2.5 s and $P_3$ for a braking time of 1.4 s with a cycle period of 72.5 s (see Fig. 6/51).

Where a braking unit is connected directly to the DC link, a fuse as described in Section 3 "Selection and ordering data" must be used.

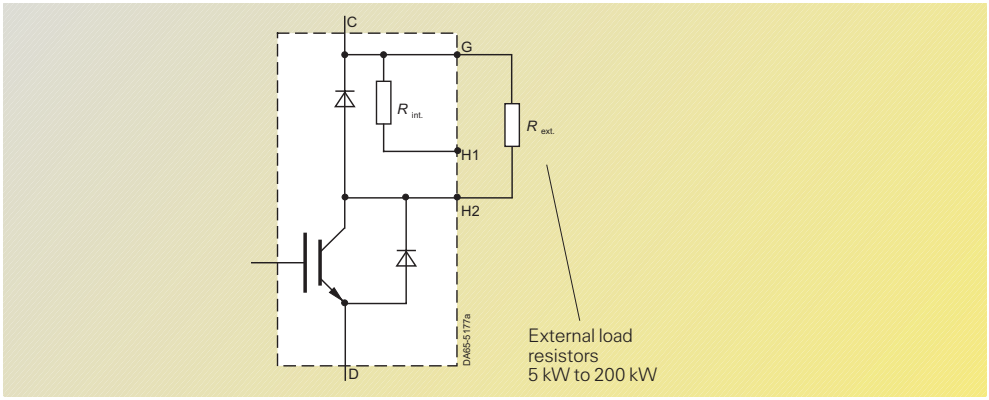



Fig. 6/52
Block diagram of a braking unit with **external** braking resistor

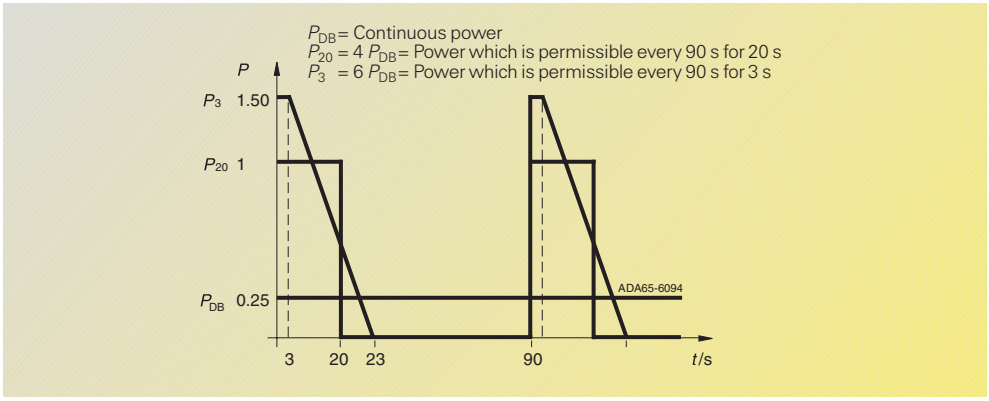



Fig. 6/53
Load diagram with **external** braking resistor

## DC power bus

The DC link voltage is supplied by rectifier units, rectifier/regenerative units or AFE rectifier units from the three-phase supply.

If this solution is used with inverters connected to a DC bus, the following advantages can be exploited in comparison to single converters.

- If individual drives work in the regenerative mode, energy is exchanged via the DC link. If overall regenerative power occasionally occurs, e.g. simultaneous shutdown of all drives, a central braking unit can be utilized.

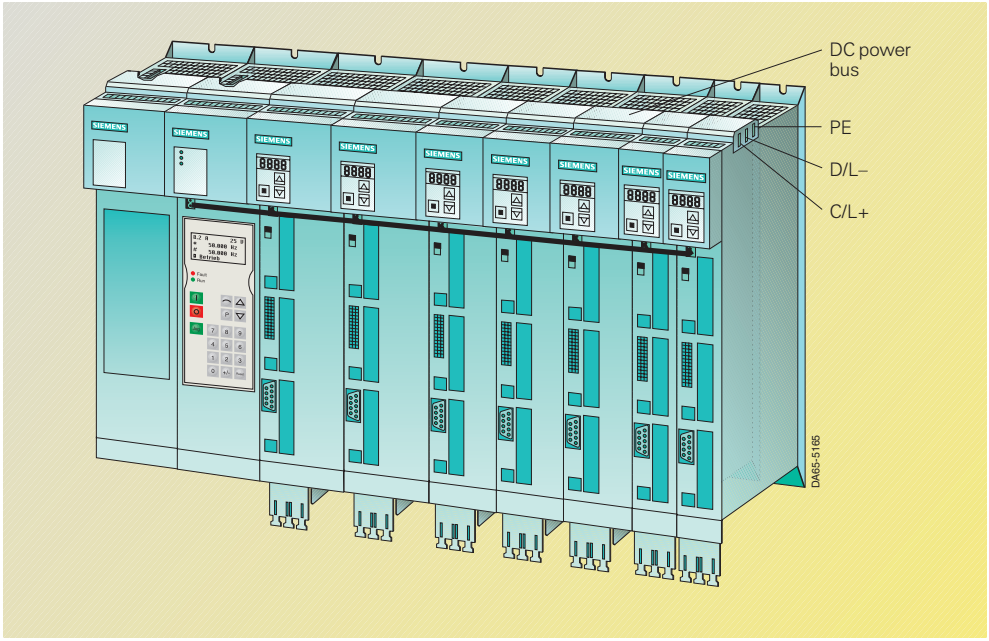



Fig. 6/54
DC voltage bus for Compact PLUS units



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## DC power bus (continued)

- In comparison to single converters, the required mounting space can be reduced, as supply-side components such as fuses, contactors and switchgear as well as line commutating reactors only have to be provided once at a central location.

The DC bus is a DC voltage system which supplies the individual inverters. In the case of the Compact PLUS units, the DC bus system is integrated and, for the compact and chassis units, it should be planned and ordered separately.

Compact PLUS units

DC voltage is distributed to all the components of the Compact PLUS by means of a 3-phase bus system (C/L+; D/L- and PE) using standard copper rails (cross-section 3 mm x 10 mm (0.12 in x 0.39 in)). The current-carrying capacity is 120 A.
A DC system can also be connected using the DC link module (see page 6/35) or busbar-mounting terminals (e.g. from Phoenix, AKG35/AZK35 up to wire cross-section 25/35 $mm^2$). The insulation and appropriate protection of this supply is the responsibility of the user.

The DC link module may be used for connecting the DC bus system of the Compact PLUS units to the DC bus system of the compact units and vice versa.

Compact and chassis units

The DC bus is supplied via a rectifier unit or a rectifier/regenerative unit whose line-side fuses also protect the DC bus against short-circuits and overload.

The inverters and braking units can be connected to the DC bus in three ways:

- Direct connection with the fuses integrated in the unit. Option: **L30** for sizes E to G
- Electromechanical connection (Fig. 6/55). A load-switch disconnector (2-pole connection) with two SITOR fuses (which protect the inverter) connects the inverters and braking units to the DC bus. The DC bus must be de-energized when inverters or braking units are switched on- or off-line. For ordering data, see Section 3.
- Electrical connection (Fig. 6/56). A load-switch disconnector (2-pole connection) with SITOR fuses, precharging resistors and a contactor connects inverters to the DC bus. In the standard version, the contactor can be operated by the electronics of the inverter. The inverters can thus be switched on-/off-line while the DC bus is charged. For ordering data, see Section 3.

The suggested components have rated insulation voltages of ≥ 1000 V when used under conditions according to DIN VDE 0110 and with pollution degree 2.

| DC voltage range | Precharging contactor type |
|---|---|
| 280 V to 780 V | 3TC44 |

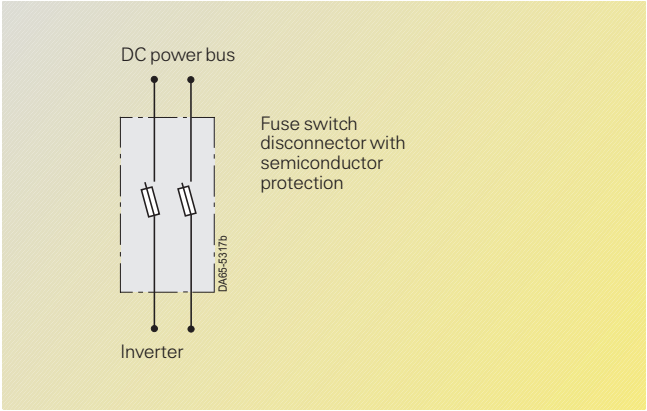



Fig. 6/55
Electromechanical connection

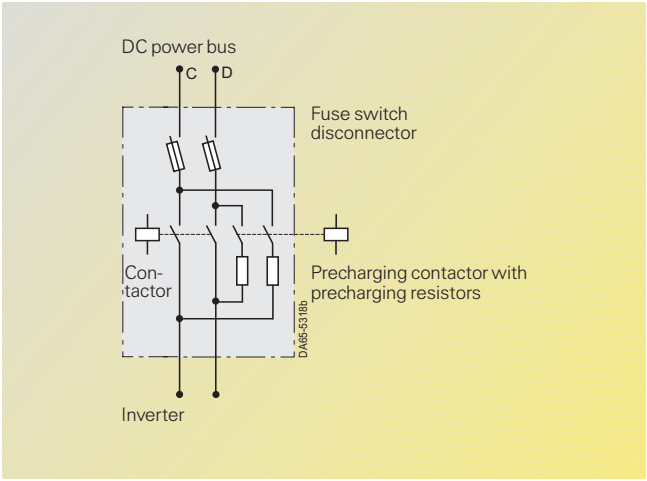



Fig. 6/56
Electrical connection



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## Free-wheeling diode on the DC bus

When using Compact PLUS units, a free-wheeling diode is not necessary.

If Compact PLUS units are used with compact/chassis units, free-wheeling diodes are to be used if the nominal power ratings exceed the specified range (see table).

With multi-axis drives (inverters connected to a common DC bus) the free-wheeling diodes must be used for the following applications:

1. When a braking unit is connected
2. When the output range (incl. rectifier/regenerative units) exceeds the levels in the following table.

| DC voltage range | Nominal power rating or rated current of the inverters |
|---|---|
| 510 V to 650 V | 2.2 kW to 15 kW (6.1 A to 34 A) (3 HP to 20 HP)<br>5.5 kW to 45 kW (13.2 A to 92 A) (7.5 HP to 60 HP)<br>18.5 kW to 90 kW (47 A to 186 A) (25 HP to 120 HP)<br>37 kW to 160 kW (72 A to 315 A) (50 HP to 215 HP)<br>45 kW to 250 kW (92 A to 510 A) (60 HP to 335 HP)<br>110 kW to 1300 kW (210 A to 2740 A) (150 HP to 1740 HP) |

## Dimensioning of the system components for multi-axis drives

### *Dimensioning of the rectifier units*

Rectifier units, Compact PLUS 15 kW

- Inverters:
  The maximum total inverter output (total of all nominal power ratings) which may be connected is limited to double the nominal power rating of the rectifier unit.
- Capacitor modules:
  4 capacitor modules can be connected. The capacitor modules do not have to be taken into account because they have their own internal precharging resistors. The envisaged connections for precharging from the rectifier unit to the capacitor module, however, must be taken into account.

Rectifier units, Compact PLUS, 50 kW and 100 kW

- Inverters:
  The maximum connectable total inverter output (total of all nominal power ratings) that can be connected is limited to three times the nominal power rating of the rectifier unit.
- Capacitor modules:
  8 capacitor modules can be connected. Due to current controlled precharging, capacitor module precharging via resistors is not necessary. The precharging terminals on the capacitor module remain unused.

Rectifier units, Compact, 15 kW and 37 kW

- Inverters:
  The maximum DC link inverter current of 45 A must not be exceeded in the case of the 15 kW rectifier unit and 95 A in the case of the 37 kW unit.
- Capacitor modules:
  The Compact PLUS capacitor modules cannot be connected.

Rectifier units, 75 kW to 250 kW and rectifier/regenerative units, 7.5 kW to 250 kW

- Inverters:
  The maximum total inverter output (total of all nominal power ratings) that can be connected is limited to three times the nominal power rating of the rectifier unit or the rectifier/regenerative unit.
- Capacitor modules:
  Compact PLUS capacitor modules can be connected as an option. The DC link module is used for connecting the Compact PLUS busbar system.

  For planning purposes, a capacitor module corresponds to an inverter output of 45 kW (60 HP).

### *Dimensioning of the line-side components for compact and chassis units*

The assignments given in the tables in Section 3 apply.

### *Dimensioning of the line-side components for Compact PLUS rectifier units*

- The line-side contactors, circuit-breakers, fuses, commutating reactors or radio-interference suppression filters are determined in accordance with the rectifier unit.
- If the sum of the connected inverter ratings is higher than that of the rectifier unit, the line-side components must be dimensioned in accordance with the rectifier unit.
- If the sum of the connected inverter ratings is smaller than that of the rectifier unit, the line-side components can be dimensioned with lower ratings if an overload of the components on the incoming side can be ruled out. Values should not fall below the following levels.
  15 kW rectifier unit:
  The line-side components for a 7.5 kW unit are to be selected as a minimum.
  50 kW rectifier unit:
  The line-side components for a 30 kW unit are to be selected as a minimum.
  100 kW rectifier unit:
  The line-side components for a 55 kW unit are to be selected as a minimum.

  If, for example, four inverters, each with an output of 1.5 kW, are connected to a 15 kW rectifier unit, the line-side components of the nearest unit can be selected, in this case the line-side components for a 7.5 kW unit.

### *Dimensioning of the line-side components for Compact PLUS converters with inverters*

The line-side contactors, circuit-breakers, fuses, commutating reactors or radio-interference suppression filters are selected in accordance with the total output of the converter and all the inverters connected to the DC bus (see Page 6/6).



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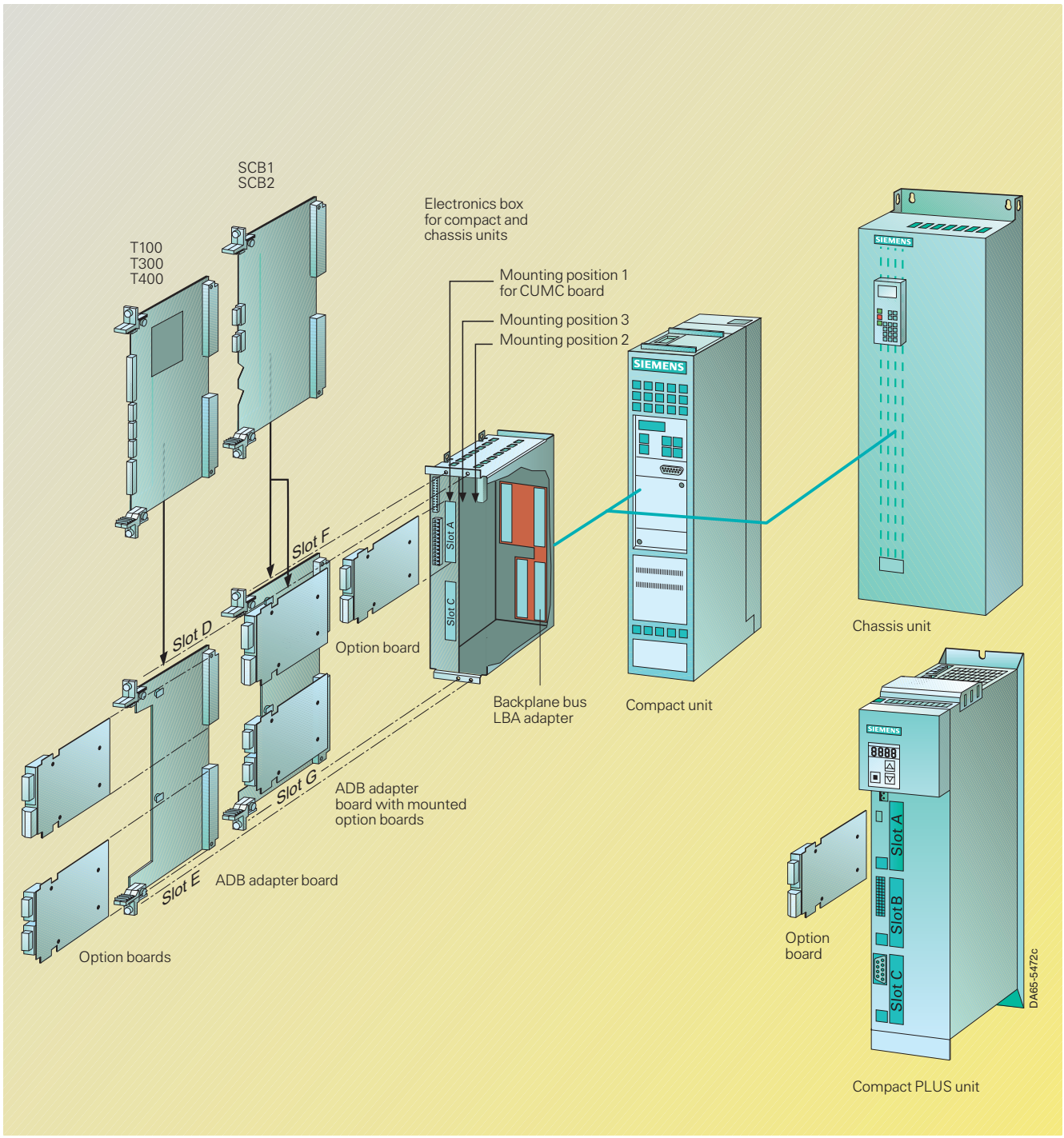



Fig. 6/57
Integrating/mounting option boards in Compact PLUS, compact and chassis units.

There are up to six slots available for mounting option boards in the electronics box of converters and inverters. The slots are designated with the letters A to G. Slot B does not exist in the compact/chassis design. It is only used in the Compact PLUS series.

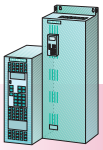
If slots D to G are needed, the LBA (Local Bus Adapter) must first be installed.

An adapter board is necessary for slots D and E and additionally for F and G respectively.

See also page 3/8, "Accessories for compact and chassis units".



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**Compact and chassis units**



**Compact PLUS units**

## Integration of the electronics options

Components which can be fitted in Compact PLUS converters and inverters

**The encoder board for closed-loop motor control must be plugged into slot C.**

An additional encoder board for the machine encoder can be plugged into one of the other slots.

A maximum of 2 expansion boards, 2 communication boards, 2 encoder boards and 2 SIMOLINK boards can be used.

| Option boards | Slot A | B | C |
|---|---|---|---|
| Encoder boards | | | |
| SBP | ● | ● | ● |
| SBR1, SBR2 | – | – | ● |
| SBM2 | ● | ● | ● |
| Communication boards | | | |
| CBP2 | ● | ● | ● |
| CBC | ● | ● | ● |
| SIMOLINK board | | | |
| SLB | ● | ● | ● |
| Expansion boards | | | |
| EB1 | ● | ● | ● |
| EB2 | ● | ● | ● |

● Possible
– Not possible

Components which can be fitted in the electronics box of compact and chassis units

**The encoder board for closed-loop motor control must be plugged into slot C.**

An additional encoder board for the machine encoder can be plugged into one of the other slots.

Mounting position 3 is to be used only if mounting position 2 is occupied.

A maximum of 2 terminal expansion boards, 2 communication boards, 2 SIMOLINK boards and 2 encoder boards may be used.

| Option boards | Mounting position 1 | | 3 | | 2 | | Maximum number of components in the electronics box |
|---|---|---|---|---|---|---|---|
| | CUMC | | | | | | |
| | Slots A | C | F | G | D | E | |
| | Board plugged in<br>• in mounting position 2 (slot D or E): Code K11 + K01 necessary<br>• in mounting position 3 (slot F or G): Code K11 + K02 necessary | | | | | | |
| Encoder boards | | | | | | | |
| SBP | ● | ● | ● | ● | ● | ● | |
| SBR1, SBR2 | – | ● | – | – | – | – | |
| SBM2 | ● | ● | ● | ● | ● | ● | |
| Communication boards | | | | | | | |
| CBP2 | ●[2] | ● | – | ●[1] | – | ● | Max. two communication boards can be inserted |
| CBC | ● | ● | – | ●[1] | – | ● | |
| SIMOLINK board | | | | | | | |
| SLB | ● | ● | ● | ● | ● | ● | Max. two SLB can be inserted |
| Expansion boards | | | | | | | |
| EB1 | ●[1] | ●[1] | ● | ● | ● | ● | Max. two EB1 boards can be inserted |
| EB2 | ●[1] | ●[1] | ● | ● | ● | ● | Max. two EB2 boards can be inserted |

● Possible
– Not possible

1) Slot/slots for T100, T300 and T400.
2) Not permissible in the case of A-type compact units.

Special factors when a T100, T300 or T400 technology board is used

The technology boards can only be used in compact and chassis units, not in Compact PLUS units.

- The technology board must be plugged into mounting position 2 in the electronics box.
- Only one communication board (CBP2, CBC, etc.) can be plugged in, and mounting position 3 must be used. The communication board is then mounted on an ADB adapter board in slot G.
  The communication board communicates directly with the technology board.
- If the SIMOLINK SLB board is used, it must be plugged into a slot on the base CUMC electronics board, preferably slot A. The SLB board communicates directly with the base unit. Signal connections to the T300 can be established using the logical binector/connector links.
- The EB1 and EB2 expansion boards can be fitted in slots A or C only.

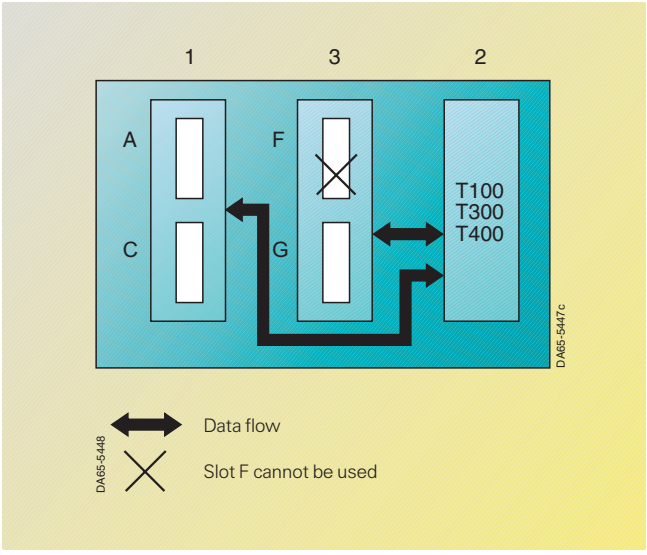



Fig. 6/58
Integration of technology boards in the electronics box



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## SBR option board for resolvers

The SBR option board (Sensor Board Resolver) enables a resolver to be connected to the converter/inverter modules.

The SBR option board is available in two versions:

- SBR1 Option board for connecting a resolver
- SBR2 Option board for connecting a resolver with additional incremental-encoder simulation.

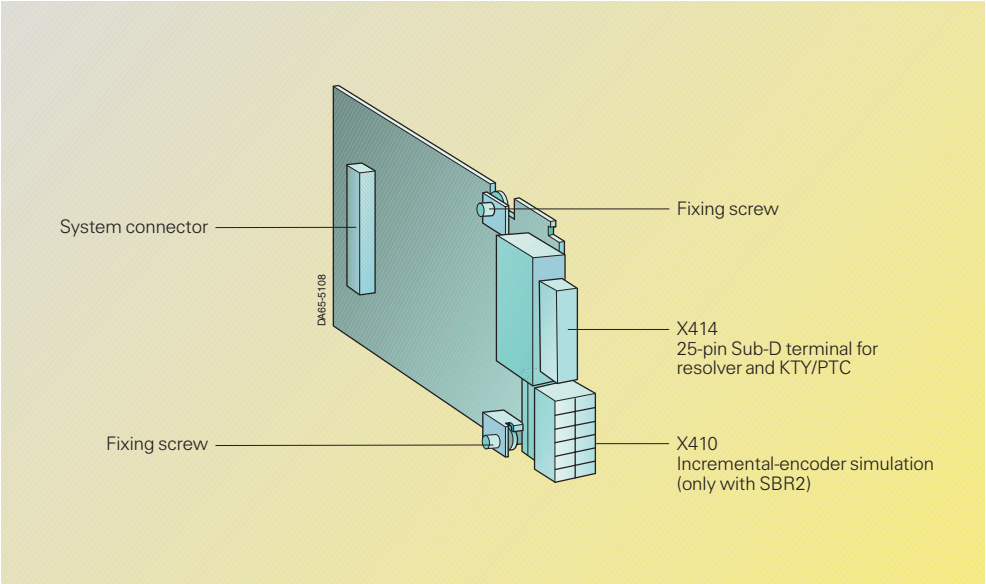



Fig. 6/59
View of the SBR option board

### *Connectable resolvers*

All standard available 2-pole resolvers and resolvers with the same number of pole pairs as the motor can be connected to the option board. Adaptation to the different types takes place on the option board by means of automatic adaptation of the signal amplitude and of the sampling time.

### *Temperature sensor*

In addition to a resolver, a temperature sensor (KTY or PTC sensor) for monitoring the motor temperature can be connected to the option board.

### *Incremental-encoder simulation*

The SBR2 option board is equipped with an incremental-encoder simulator. It provides the signals, A+, A-, B+, B-, Zero+ and Zero- with TTL level which are available via an additional connector on the front of the board.

### *Terminals*

The option board has the following terminals for signal cables:

- X414: Encoder connection via a 25-pole Sub-D male connector
- X410: Incremental-encoder simulator via 6-pin terminal strip (SBR2 only)



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## X414 – Encoder terminal

The resolver is connected via a 25-pin Sub-D socket on the front of the option board.

For prefabricated cables, see page 3/31.

Maximum connectable encoder-cable length with compliant screening[1]): 150 m (492 ft)

| Pin | Description | Range |
|---|---|---|
| 3 | Resolver output voltage sin + | – |
| 4 | Resolver output voltage sin – | – |
| 5 | Internal screen for 3 and 4 | – |
| 6 | Resolver output voltage cos + | – |
| 7 | Resolver output voltage cos – | – |
| 8 | Internal screen for 6 and 7 | – |
| 9 | Resolver excitation $V_{SS}$ | 0 V to 7 V Automatic adaptation, 5 kHz to 10 kHz sine |
| 11 | Ground for resolver excitation | |
| 13 | Motor-temperature monitoring, PTC/KTY | – |
| 24 | Internal screen for 13 and 25 | – |
| 25 | Motor-temperature monitoring PTC/KTY | – |
| Housing | Equipment grounding conductor | – |

## X410 – Incremental-encoder simulation (SBR2 board)

The incremental-encoder simulation signals generated on the option board can be detected at terminal X410.

The option board generates 1024 pulses per resolver pole-pair. Correspondingly, with a two-pole resolver, 512 or 1024 pulses are generated. With a four-pole resolver, 1024 or 2048 pulses are generated and, with a six-pole resolver, 1536 or 3072 pulses.

The simulation signals are available as differential signals with a 5 V TTL level.

Maximum encoder-cable length that can be connected with compliant screening[1]): 25 m (82 ft)

| Pin | Designation | Description | Range |
|---|---|---|---|
| 90 | A+ | Incremental-encoder simulation, A+ track | 5 V TTL level RS422 (standard) |
| 91 | A– | Incremental-encoder simulation, A– track | |
| 92 | B+ | Incremental-encoder simulation, B+ track | 5V TTL level RS422 (standard) |
| 93 | B– | Incremental-encoder simulation, B– track | |
| 94 | N+ | Incremental-encoder simulation, Zero+ track | 5V TTL level RS422 (standard) |
| 95 | N– | Incremental-encoder simulation, Zero– track | |

Max. connectable cross-section: 0.14 – 0.5 mm² (AWG 20)

1) See page 6/49, "Electromagnetic compatibility".



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## SBP option board for incremental encoders

The SBP option board (Sensor Board Pulse) enables connection of an incremental encoder or a frequency generator to the converter and inverter for setting the frequency or speed setpoint for SIMOVERT MASTERDRIVES.

### *Connectable incremental encoders and frequency generators*

The SBP option board can also be used to evaluate an external encoder or frequency generator.

All standard available incremental encoders can be connected to the option board.

The pulses can be processed in a bipolar or in a unipolar manner as a TTL or HTL level.

The following maximum pulse frequencies apply:

- 410 kHz for evaluation of encoder signals
- 1 MHz for frequency generators

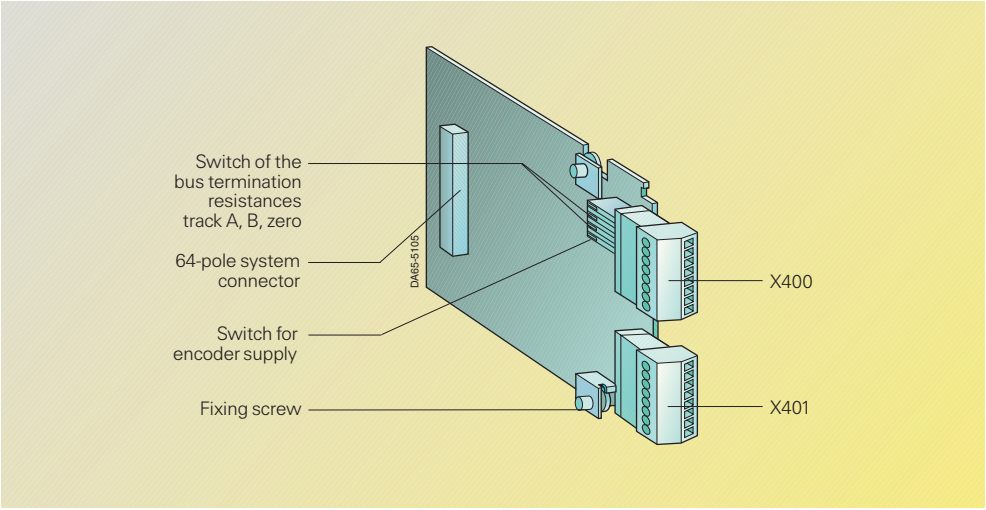



Fig. 6/60
View of the SBP option board

Monitoring by evaluation of the control track is also possible.

The supply voltage of the connected encoder or frequency generator can be set to 5 V or 15 V.

### *Temperature monitoring*

In addition to an incremental encoder, a temperature sensor (KTY or PTC sensor) can be connected to the option board to monitor the motor temperature.

### *Terminals*

The option board has two terminal strips for the signal wires.

For information on customized encoder cables for motor fitting encoder and external encoders, refer to Catalog NC Z.

| X400 | Terminal | Designation | Description | Range |
|---|---|---|---|---|
| | 60 | $+V_{SS}$ | Power supply for incremental encoder | 5 V/15 V<br>$I_{max.}$ = 250 mA |
| | 61 | $-V_{SS}$ | Ground for power supply | – |
| | 62 | –temp | Minus(-) terminal KTY84/PTC100 | – |
| | 63 | +temp | Plus(+) terminal KTY84/PTC 100 | 3 mA<br>Accuracy ±1 % |
| | 64 | Ground coarse/fine | Ground | – |
| | 65 | Coarse pulse 1 | Digital input for coarse pulse 1 | – |
| | 66 | Coarse pulse 2 | Digital input for coarse pulse 2 | – |
| | 67 | Fine pulse 2 | Digital input for fine pulse 2 | – |

Max. connectable cross-section: 0.14 – 1.5 mm² (AWG 16)
Terminal 60 is at the top when installed.



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**X401**

Maximum encoder cable length which can be connected with compliant screening[1]):
– 100 m (328 ft) (TTL signals)
– 150 m (492 ft) with A and B track (HTL signals)
– 300 m (984 ft) with A+/A– and B+/B– track (HTL signals).

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 68 | A+ track | Plus(+) terminal Track A | TTL/HTL/HTL, unipolar |
| 69 | A– track | Minus(–) terminal Track A | TTL/HTL/HTL, unipolar |
| 70 | B+ track | Plus(+) terminal Track B | TTL/HTL/HTL, unipolar |
| 71 | B– track | Minus(–) terminal Track B | TTL/HTL/HTL, unipolar |
| 72 | Zero pulse + | Plus(+) terminal Zero track | TTL/HTL/HTL, unipolar |
| 73 | Zero pulse – | Minus(–) terminal Zero track | TTL/HTL/HTL, unipolar |
| 74 | CTRL + | Plus(+) terminal Control track | TTL/HTL/HTL, unipolar |
| 75 | CTRL – = M | Minus(–) terminal Control track = Ground | TTL/HTL/HTL, unipolar |

Max. connectable cross-section: 0.14 – 1.5 mm² (AWG 16)
Terminal 68 is at the top when installed.

**Voltage range of the encoder inputs**

| | RS422 (TTL) | HTL bipolar | HTL unipolar |
|---|---|---|---|
| Voltage range – Input | Max. 33 V; min. –33 V | | |
| Voltage range + Input | Max. 33 V; min. –33 V | | |
| Switching level of differential voltage – LOW | Min. –150 mV | Min. –2 V | Min. 4 V |
| Switching level of differential voltage – HIGH | Max. 150 mV | Max. 2 V | Max. 8 V |

Note

If unipolar signals are connected, one ground terminal for all signals at the CTRL– terminal is sufficient. Due to possible interference emission, it is recommended for cable lengths over 50 m (164 ft) that the four terminals A–, B–, zero pulse – and CTRL– be bypassed and connected to the encoder ground.

**Voltage range of the digital inputs**

| | Rated value | Min. | Max. |
|---|---|---|---|
| Voltage range LOW | 0 V | –0.6 V | 3 V |
| Voltage range HIGH | 24 V | 13 V | 33 V |
| Input current LOW | ≤ 2 mA | | |
| Input current HIGH | 10 mA | 8 mA | 12 mA |

Note

The inputs are non-floating. The rough pulse is smoothed with 0.7 ms, the fine pulse with approx. 200 ns.

1) See page 6/49, "Electromagnetic compatibility".



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## SBM/SBM2 option board for incremental encoder/absolute-value encoder

The SBM/SBM2 board (Sensor Board Multiturn/sin/cos incremental encoder 1 $V_{pp}$) enables connection and evaluation of sin/cos incremental and multiturn encoders.

Incremental encoders with 4 to 16384 lines per revolution are supported.

For the multiturn phase-angle encoder, the usual communication protocols are supported (EnDat and SSI) with baud rates from 100 kHz to 2 MHz.

The supply voltage for the encoders can be set to 5 V, 7.5 V or 15 V. By connecting the sense cable, the voltage of long encoder cables can be monitored and corrected at the encoder input (4-wire principle).

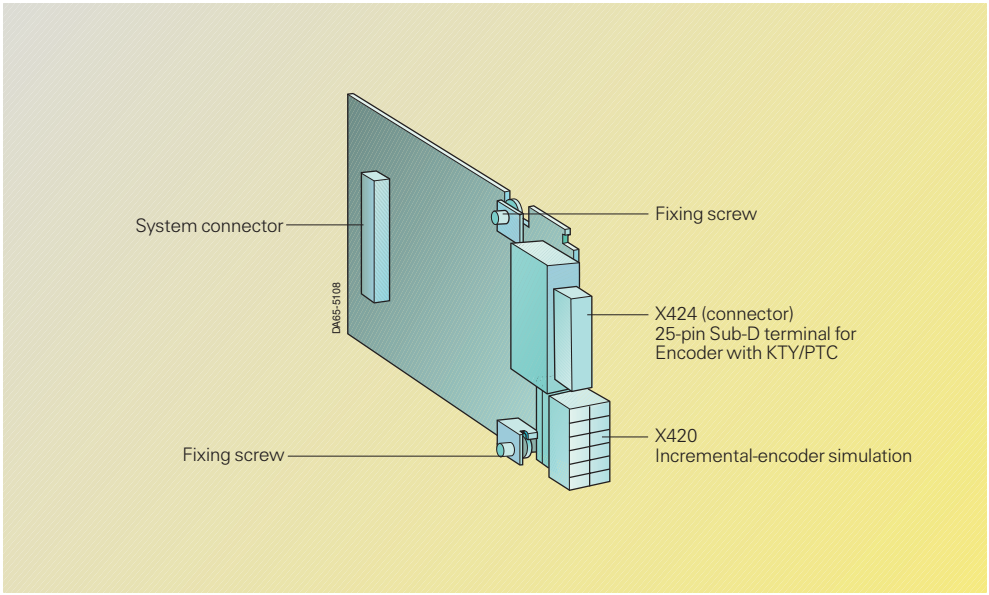



Fig. 6/61
View of the SBM2 option board

### *Extended functionality of the SBM2*

- Adjustment of the encoder voltage supply by means of software parameter P145
- High resolution (approx. $17 \cdot 10^6$ increments per revolution) possible also for external encoders.

In addition to the processing of encoder signals, the motor temperature is also detected (either KTY or PTC sensors).

The A+, A–, B+, B–, zero+ and zero– signals are provided by the incremental-encoder simulator via an additional connector on the front of the board using the RS422 standard. The number of pulses/revolutions corresponds to the number of lines of the incremental encoder or multiturn encoder.

Note

The SBM2 is supported from Version 1.3 of the Motion Control firmware upwards!

For information on customized encoder cables for motor fitting encoder and external encoders, see Catalog NC Z.

| X424 – Incremental encoder terminal | Pin | Designation | Description |
|---|---|---|---|
| Maximum connectable encoder-cable length with compliant screening[1]): 100 m (328 ft) | 1 | P incremental encoder | 5 V/7.5 V/15 V switchable, $I_{max}$ = 390 mA |
| | 2 | M incremental encoder | Ground |
| | 3 | A+ | $V_{SS}$ = 1 V (0.8 V to 1.2 V) |
| | 4 | A– | |
| | 5 | Internal screen | |
| | 6 | B+ | $V_{SS}$ = 1 V (0.8 V to 1.2 V) |
| | 7 | B– | |
| | 8 | Internal screen | |
| | 13 | +temp | Motor-temperature monitoring PTC/KTY |
| | 14 | 5 V sense | Sensor input for 5 V voltage control |
| | 16 | 0 V sense | Reference for Pin 14 |
| | 17 | R+ | Zero track $V_{SS}$ = 0.5 V (0.2 V – 0.8 V) |
| | 18 | R– | |
| | 19 | C+ | 1 sine/revolution $V_{SS}$ = 1 V (0.8 V – 1.2 V) |
| | 20 | C– | |
| | 21 | D+ | 1 cosine/revolution $V_{SS}$ = 1 V (0.8 V – 1.2 V) |
| | 22 | D– | |
| | 24 | Internal screen | |
| | 25 | –temp | Motor-temperature monitoring PTC/KTY |
| | Housing | External screen | |

1) See page 6/49, "Electromagnetic compatibility".



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| **X424 – Terminal for absolute-value multiturn encoder** | Pin | Designation | Description |
|---|---|---|---|
| Maximum connectable encoder-cable length with compliant screening[1]): 100 m (328 ft) | 1 | P incremental encoder | 5 V/7.5 V/15 V switchable, $I_{max}$ = 390 mA |
| | 2 | M incremental encoder | Ground |
| | 3 | A+ | $V_{SS}$ = 1 V (0.8 V – 1.2 V) |
| | 4 | A– | |
| | 5 | Internal screen | – |
| | 6 | B+ | $V_{SS}$ = 1 V (0.8 V – 1.2 V) |
| | 7 | B– | |
| | 8 | Internal screen | – |
| | 10 | Pulse + | Baud rate 100 kHz to 2 MHz RS422 |
| | 12 | Pulse– | |
| | 13 | +temp | Motor-temperature monitoring PTC/KTY |
| | 14 | 5 V sense | Sensor input for 5 V voltage control |
| | 15 | Data + | RS485 |
| | 16 | 0 V Sense | Ground, sensor input |
| | 23 | Data– | RS485 |
| | 24 | Internal screen | – |
| | 25 | –temp | Motor-temperature monitoring PTC/KTY |
| | Housing | External screen | – |

| **X420 – Incremental-encoder simulation** | Terminal | Designation | Description | Range |
|---|---|---|---|---|
| Maximum connectable encoder-cable length with compliant screening[1]): 25 m (82 ft) | 80 | A+ | Incremental-encoder simulation, track A+ | RS422 standard |
| | 81 | A– | Incremental-encoder simulation, track A– | |
| | 82 | B+ | Incremental-encoder simulation, track B+ | RS422 standard |
| | 83 | B– | Incremental-encoder simulation, track B– | |
| | 84 | N+ | Incremental-encoder simulation, track zero+ | RS422 standard |
| | 85 | N– | Incremental-encoder simulation, track zero– | |

Max. connectable cross-section: 0.14 – 0.5 mm² (AWG 20)

At terminal X420, the signals of the incremental-encoder simulator, which are generated on the option board, can be picked up.

A non-existing zero pulse (if a multiturn encoder is connected) is simulated by the board.

The simulation signals are available as differential signals in accordance with the RS422 standard.

1) See page 6/49, "Electromagnetic compatibility".



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## EB1 expansion board

With the EB1 (Expansion Board 1), it is possible to expand the number of digital and analog inputs and outputs.

The EB1 expansion board has

- 3 digital inputs
- 4 bidirectional digital inputs/outputs
- 1 differential analog input signal which can be used as a current/voltage input
- 2 analog inputs (single-ended) which can also be used as digital inputs
- 2 analog outputs
- 1 input for the external 24 V power supply for the digital outputs

The EB1 expansion board can be integrated into the electronics box. The slot for this board is indicated in the description on page 6/60.

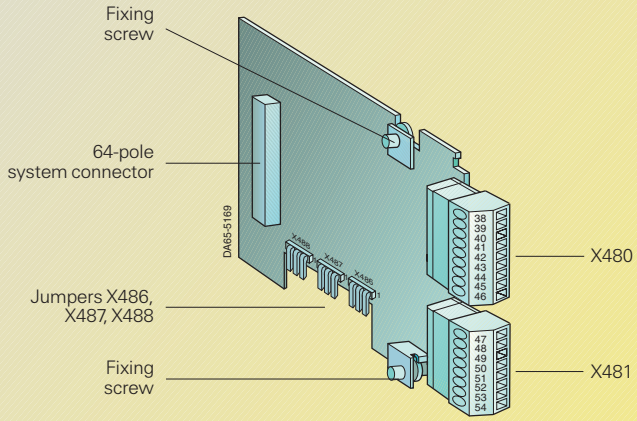



Fig. 6/62
EB1 expansion board

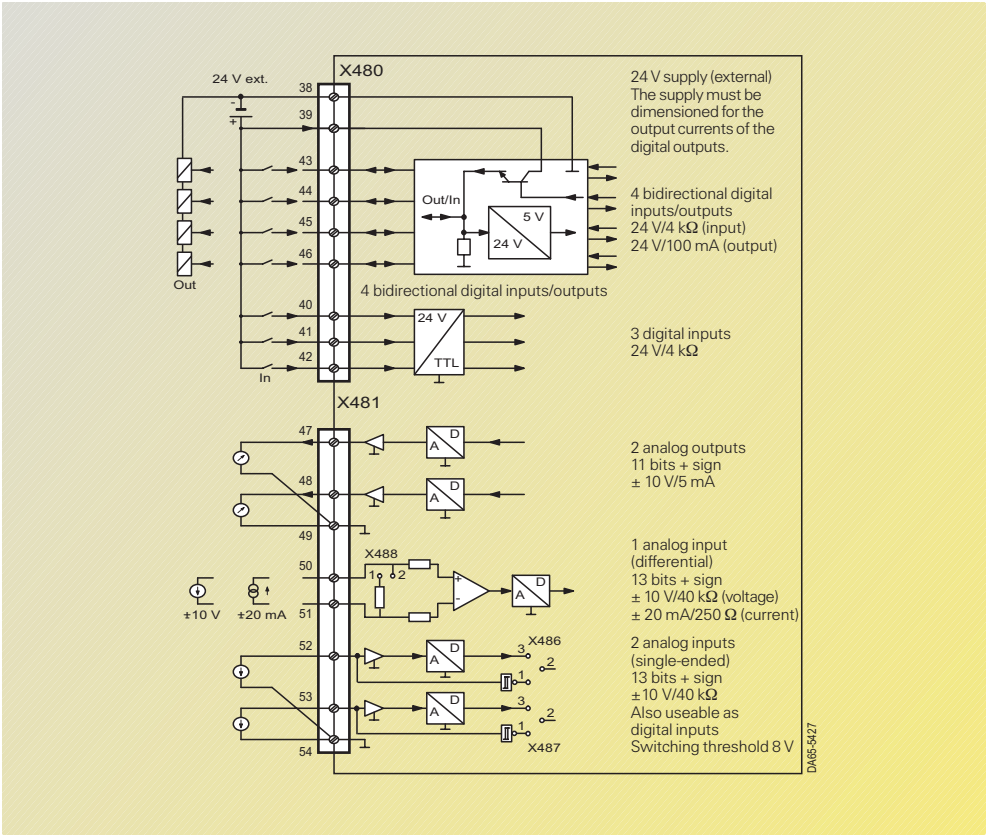



Fig. 6/63
Circuit diagram of the EB1 expansion board



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## Connection X480

The following connections are provided on the terminal strip:

- 3 digital inputs
- 4 bidirectional digital inputs/outputs

The ground cables are protected by a reactor. Terminal 46 is at the top when fitted.

Note

An external 24 V supply is necessary and must be dimensioned for the currents of the digital outputs.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 38 | M | Ground digital | 0 V |
| 39 | P24 ext. | Ext. 24 V supply | 20 V to 33 V |
| 40 | DI1 | Digital input 1 | 24 V, $R_i$ = 4 kΩ |
| 41 | DI2 | Digital input 2 | 24 V, $R_i$ = 4 kΩ |
| 42 | DI3 | Digital input 3 | 24 V, $R_i$ = 4 kΩ |
| 43 | DIO1 | Digital input/output 1 | As input: 24 V, 4 kΩ |
| 44 | DIO2 | Digital input/output 2 | |
| 45 | DIO3 | Digital input/output 3 | As output: Output voltage P24 ext. 100 mA |
| 46 | DIO4 | Digital input/output 4 | |

Max. connectable cross-section: 0.14 – 1.5 mm² (AWG 16)

## Connection X481

The following connections are provided on the terminal strip:

- 1 differential analog input, which can be used as a current and voltage input
- 2 analog inputs (single-ended) which can also be used as digital inputs
- 2 analog inputs

The ground cables are protected by a reactor. Terminal 47 is at the top when fitted.

| Terminal | Designation | Description | Range |
|---|---|---|---|
| 47 | AO1 | Analog output 1 | ±10 V, 5 mA |
| 48 | AO2 | Analog output 2 | ±10 V, 5 mA |
| 49 | AOM | Ground analog output | 0 V |
| 50 | AI1P | Analog input 1 + | Voltage: ± 10 V, 40 kΩ |
| 51 | AI1N | Analog input 1 – | Current: ± 20 mA, 250 Ω |
| 52 | AI2 | Analog input 2 | ±10 V, 40 kΩ |
| 53 | AI3 | Analog input 3 | ±10 V, 40 kΩ |
| 54 | AIM | Ground analog input | 0 V |

Max. connectable cross-section: 0.14 – 1.5 mm² (AWG 16)

## Technical Data

| Designation | Value |
|---|---|
| Digital inputs | DI1, DI2, DI3 |
| • Voltage range LOW | 0 V (–33 V to +5 V) |
| • Voltage range HIGH | +24 V ( 13 V to 33 V) |
| • Input resistance | 4 kΩ |
| • Smoothing | 250 µs |
| • Electrical isolation | None |
| Bidirectional digital inputs/outputs | DIO1, DIO2, DIO3, DIO4 |
| As input | |
| • Voltage range LOW | 0 V (–33 V to +5 V) |
| • Voltage range HIGH | +24 V ( 13 V to 33 V) |
| • Input resistance | 4 kΩ |
| As output | |
| • Voltage range LOW | < 2 V |
| • Voltage range HIGH | > P24 ext. –2.5 V |
| Analog input (differential input) | AI1P, AI1N |
| • Input range | |
| Voltage | ±11 V |
| Current | ±20 mA |
| • Input resistance | |
| Voltage | 40 kΩ to ground |
| Current | 250 Ω to ground |
| • Hardware smoothing | 220 µs |
| • Resolution | 13 bits + sign |
| Analog input (single-ended) | AI2, AI3, AIM |
| • Input range | ±11 V |
| • Input resistance | 40 kΩ to ground |
| • Hardware smoothing | 220 µs |
| • Resolution | 13 bits + sign |
| Analog output | AO1, AO2, AOM |
| • Voltage range | ±10 V |
| • Input resistance | 40 kΩ to ground |
| • Hardware smoothing | 10 µs |
| • Resolution | 11 bits + sign |





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## EB2 expansion board

With the EB2 expansion board (Expansion Board 2), the number of digital and analog inputs and outputs can be expanded.

The EB2 expansion board has

- 2 digital inputs
- 1 relay output with changeover contacts
- 3 relay outputs with make contact
- 1 differential analog input signal which can be used as current input or voltage input
- 1 analog output
- 24 V power supply for the digital inputs

The EB2 expansion board can be integrated into the electronics box. The slot for this board is indicated in the description on page 6/60.

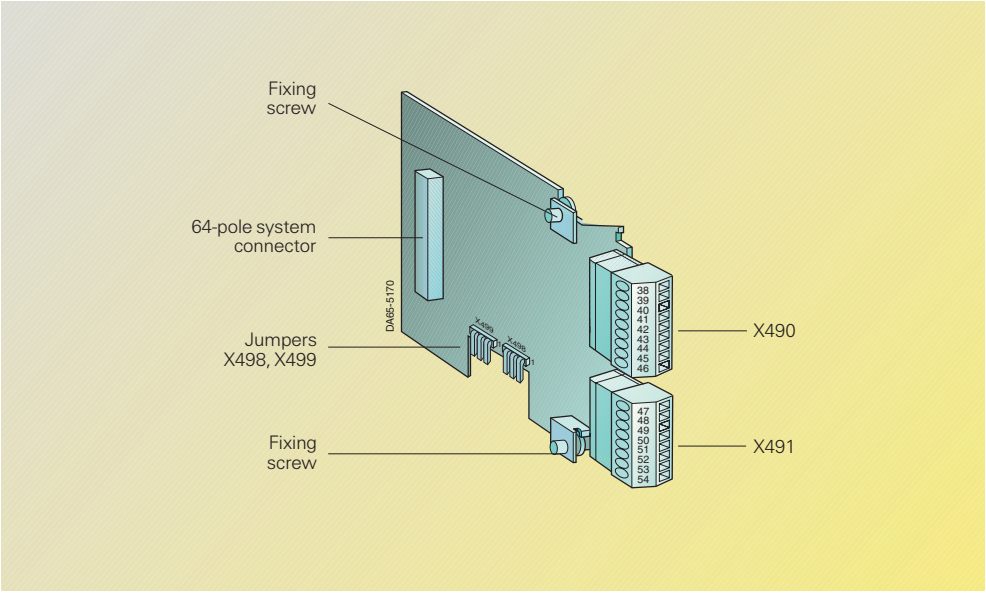



Fig. 6/64
EB2 expansion board

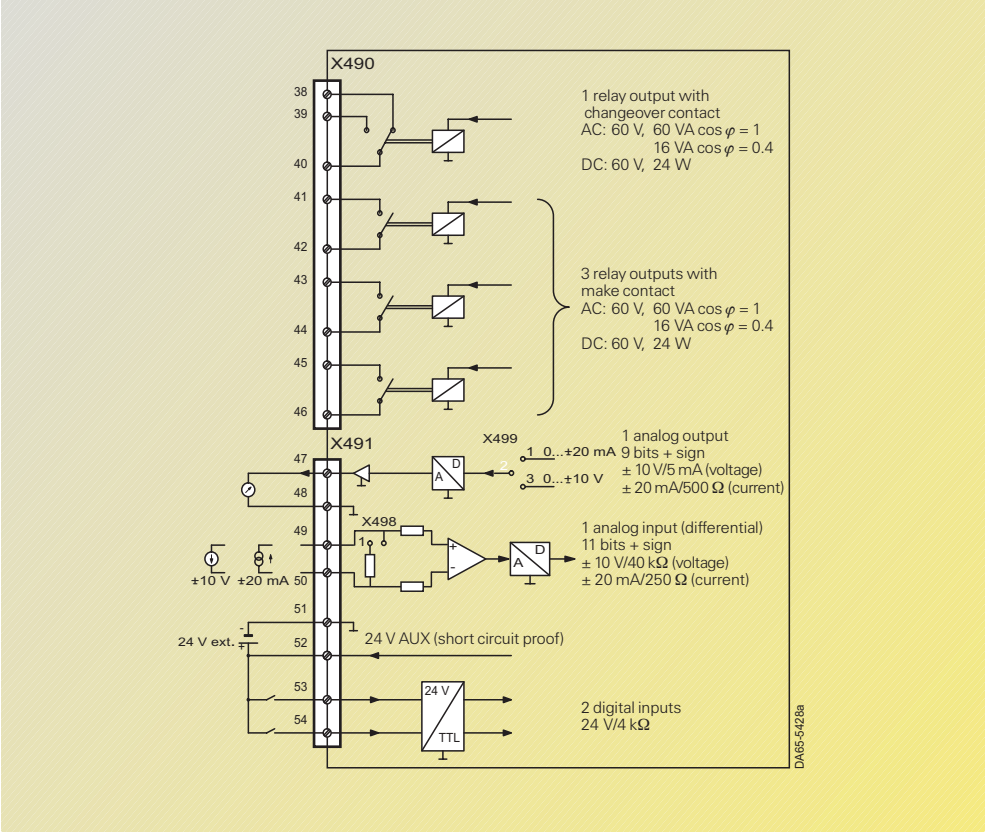



Fig. 6/65
Circuit diagram of the EB2 expansion board



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**Connection X490**

| Terminal | Designation | Significance |
|---|---|---|
| 38 | DO13 | Relay output 1, break contact |
| 39 | DO12 | Relay output 1, make contact |
| 40 | DO11 | Relay output 1, reference contact |
| 41 | DO22 | Relay output 2, make contact |
| 42 | DO21 | Relay output 2, reference contact |
| 43 | DO32 | Relay output 3, make contact |
| 44 | DO31 | Relay output 3, reference contact |
| 45 | DO42 | Relay output 4, make contact |
| 46 | DO41 | Relay output 4, reference contact |

Connectable cross-section: 0.14 – 1.5 mm² (AWG 16)

**Load capability of the relay contacts**

| Type of contact | Changeover contact |
|---|---|
| Maximum switching voltage | 60 V AC, 60 V DC |
| Maximum switching output | 16 VA at 60 V AC ($\cos\varphi = 0.4$)<br>60 VA at 60 V AC ($\cos\varphi = 1.0$)<br>3 W at 60 V DC<br>24 W at 60 V DC |

**Connection X491**

| Terminal | Designation | Significance | Range |
|---|---|---|---|
| 47 | AO | Analog output | ±10 V, 5 mA<br>±20 mA, 500 Ω |
| 48 | AOM | Ground analog output | |
| 49 | AI1P | Analog input + | ±10 V, 40 kΩ<br>±20 mA, 250 Ω |
| 50 | AI1N | Analog input – | |
| 51 | DIM | Ground digital input | 0 V |
| 52 | P24AUX | 24 V supply | 24 V |
| 53 | DI1 | Digital input 1 | 24 V, $R_i$ = 4 kΩ |
| 54 | DI2 | Digital input 2 | 24 V, $R_i$ = 4 kΩ |

Connectable cross-section: 0.14 – 1.5 mm² (AWG 16)

The ground cables are protected by a reactor.

Note

The analog input can be used as a voltage or current input. A jumper is used for switching over.

**Technical Data**

| Designation | Value |
|---|---|
| Digital inputs | DI1, DI2, DIM |
| • Voltage range LOW | 0 V (–33 V to +5 V) |
| • Voltage range HIGH | +24 V ( 13 V to 33 V) |
| • Input resistance | 4 kΩ |
| • Smoothing | 250 µs |
| • Electrical isolation | None |
| Digital outputs (relays) | DO1., DO2., DO3., DO4. |
| • Type of contact | Changeover contact |
| • Max. switching voltage | 60 V AC, 60 V DC |
| • Max. switching capacity | |
| – at 60 V AC: | 16 VA ($\cos\varphi = 0.4$)<br>60 VA ($\cos\varphi = 1.0$) |
| – at 60 V DC: | 3 W<br>24 W |
| • Min. permissible load | 1 mA, 1 V |
| Analog input (differential input) | AI1P, AI1N |
| • Input range | |
| Voltage | ±11 V |
| Current | ±20 mA |
| • Input resistance | |
| Voltage | 40 kΩ to ground |
| Current | 250 Ω to ground |
| • Hardware smoothing | 220 µs |
| • Resolution | 11 bits + sign |
| Analog output | AO, AOM |
| • Voltage range | ±10 V, ±0 – 20 mA |
| • Input resistance | 40 kΩ to ground |
| • Hardware smoothing | 10 µs |
| • Resolution | 9 bits + sign |





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## SCB1 and SCB2 interface boards for compact and chassis units (not available for Compact PLUS)

### *SCB1 interface board*

The SCB1 interface board (Serial Communication Board 1) has a fiber-optic cable connection and enables the creation of a:

- peer-to-peer connection between several units with a max. data transfer rate of 38.4 kbit/s
- serial I/O system (see Fig. 6/66) in conjunction with the SCI1 and SCI2 serial interface boards (see page 6/74)

The following is thus made possible:

1. Expansion of the number of binary and analog inputs and outputs of the basic units
2. Customized assignment of the terminals for the inputs and outputs (e.g. NAMUR).

The following board combinations are possible:

SCB1 with one SCI1 or SCI2

SCB1with two SCI1 or SCI2 boards

SCB 1 with one SCI1 and one SCI2

The SCB1 interface board can be integrated into the electronics box in mounting position 2 or 3 (description, see page 6/60).

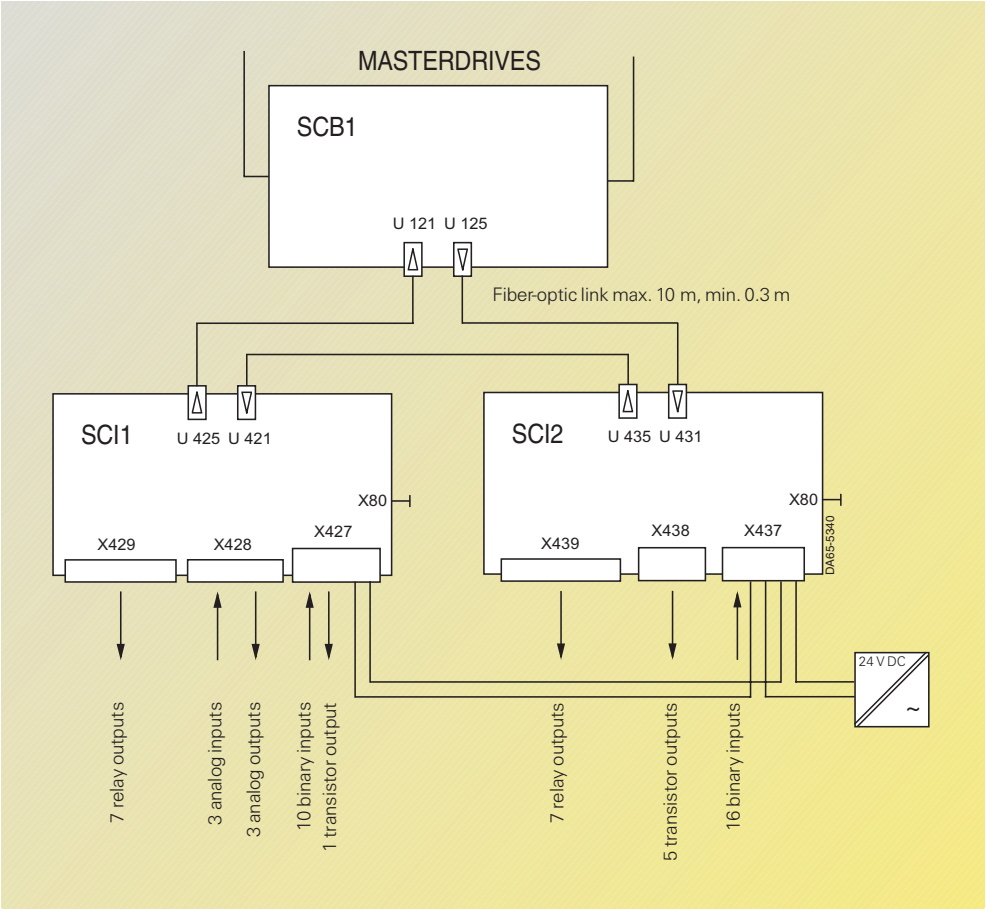



Fig. 6/66
Example of connecting a serial I/O system with SCB1, SCI1 and SCI2

### *SCB2 interface board*

The SCB2 interface board (Serial Communication Board 2) has a floating RS485 interface and enables the following alternatives:

- Peer-to-peer connection between several converters via the RS485 interface (see Figs. 6/67 and 6/68)
- Bus connection with a maximum of 31 slaves connected to a master (e.g. SIMATIC) via the RS485 interface, using the USS protocol (see Fig. 6/69). The maximum data transfer rate is 187.5 kbit/s.

The SCB2 interface board can be integrated into the electronics box in mounting position 2 or 3 (description, see page 6/60).

Note

The SCB2 interface board always operates as a slave.



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### *Peer-to-peer connection*

The serial peer-to-peer connection operates via a 4-wire connection (see Fig. 6/67).

A peer-to-peer connection can also be created in parallel with the SCB2, i.e. the corresponding slave drives are controlled by the master drive via a parallel cable (see Fig. 6/68).

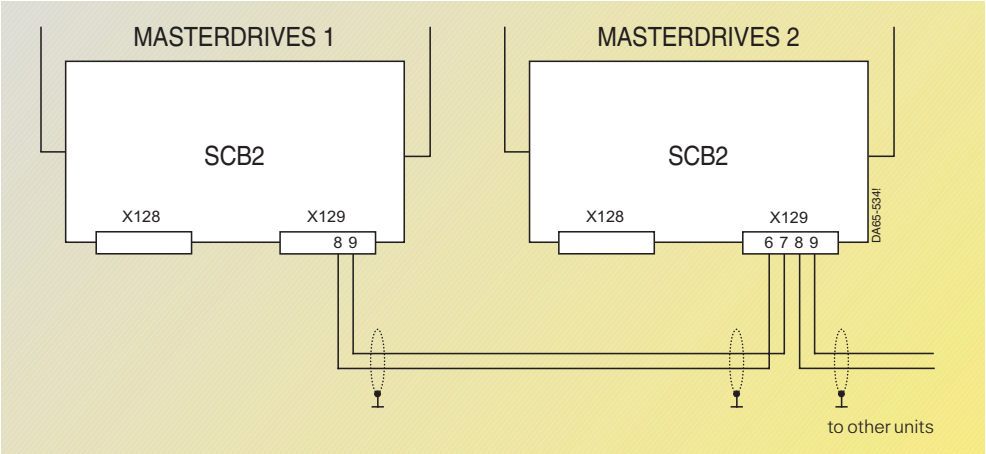



Fig. 6/67
Example of a serial peer-to-peer connection via RS485

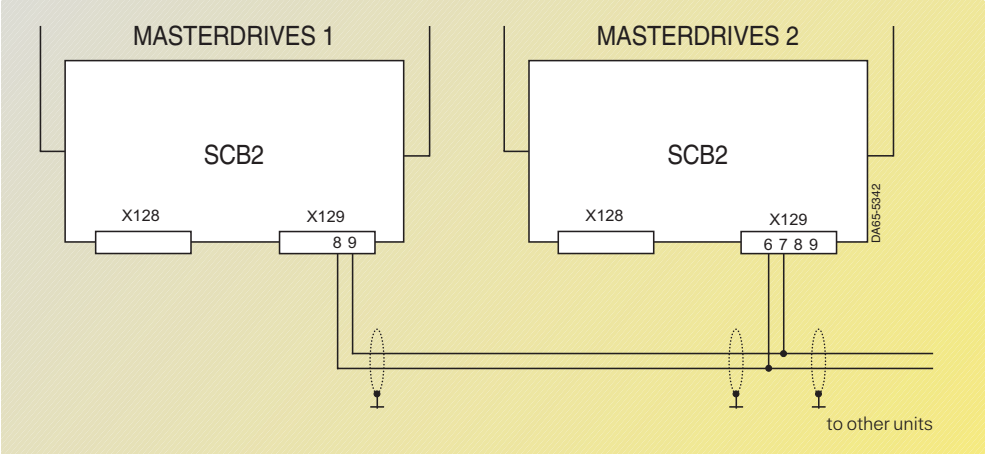



Fig. 6/68
Example of a parallel peer-to-peer connection via RS485

### *Bus connection with USS protocol*

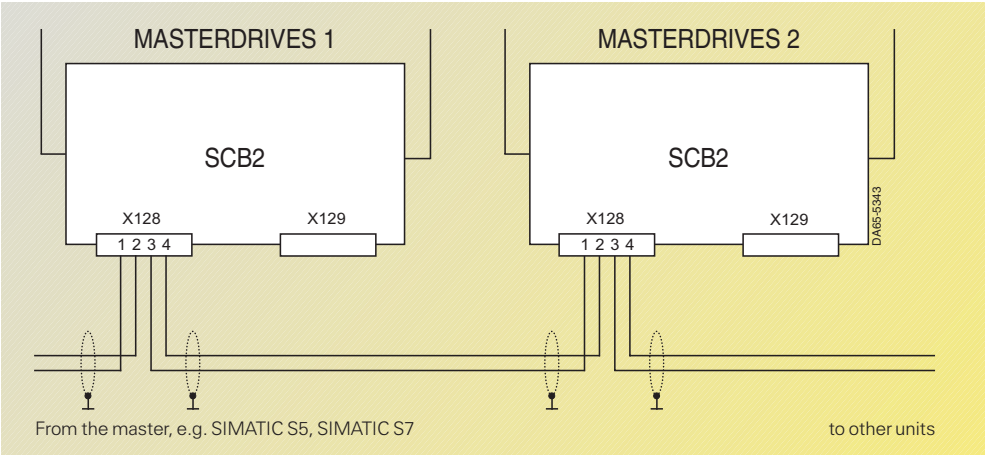



Fig. 6/69
Example of a bus connection with USS protocol via RS485.



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## SCI1 and SCI2 interface boards

A serial I/O system using fiber-optic cables can be established with the SCI1 and SCI2 (Serial Communication Interface 1 or 2) interface boards and the SCB1 interface board. This allows the number of binary and analog inputs and outputs to be considerably expanded. In addition, the fiber-optic cables safely decouple the units in accordance with DIN VDE 0100 and DIN VDE 0160 (PELV function, e.g. for NAMUR).

The fiber-optic cables, which can have a maximum length of 10 m (33 ft) and a minimum length of 0.3 m (1 ft), connect the boards in a ring structure. Both the SCI1 and the SCI2 require an external 24 V power supply (1 A each).

All the inputs and outputs of the interface boards can be parameterized.

The SCI1 and SCI2 interface boards can be snapped onto a DIN rail at a suitable place in the control cabinet.

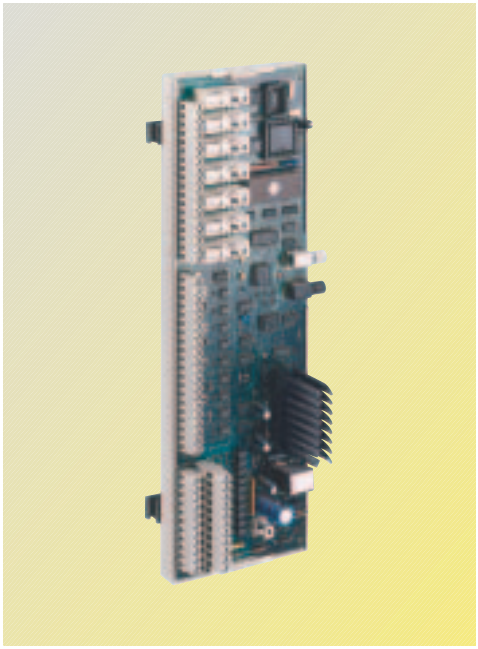


Fig. 6/70
SCI1 interface board

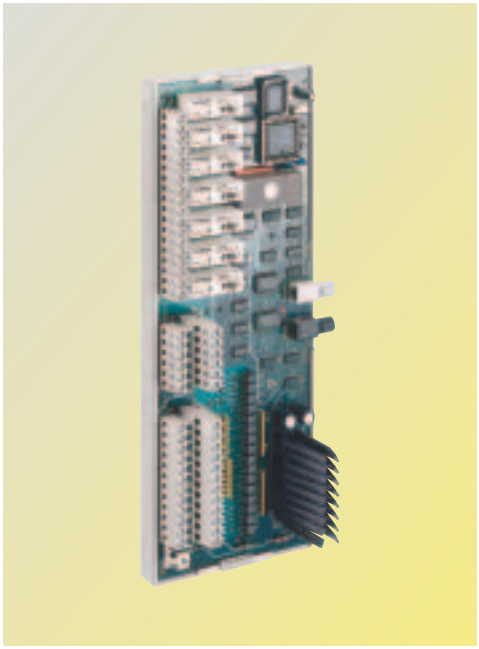


Fig. 6/71
SCI2 interface board

| Inputs and outputs<br>Functions | SCI1 | SCI2 | Description |
|---|---|---|---|
| Binary inputs | 10 | 16 | Floating optocoupler inputs in 2 circuits<br>24 V DC, 10 mA |
| Binary outputs<br>including:<br>Relay changeover contacts<br>Relay make contacts<br>Transistor outputs | 8<br><br>4<br>3<br>1 | 12<br><br>4<br>3<br>5 | <br>Load capability<br>250 V AC, 2000 VA ($\cos\varphi = 1$)<br>100 V DC, 240 W<br>240 V DC, max. 100 mA, short-circuit-proof,<br>open-emitter for driving the optocouplers or relays |
| Analog inputs | 3 | – | Voltage signals: 0 to ±10 V<br>Current signals: 0 to ±20 mA;<br>4 mA to 20 mA, 250 Ω burden<br>Non-floating inputs |
| Analog outputs | 3 | – | Output signals<br>0 V to ±10 V, 0 mA to ±20 mA, 4 mA to 20 mA,<br>non-floating<br>Max. cable length with shielded cables is 100 m (33 ft)<br>Max. load 500 Ω |
| Supply voltage:<br>Reference voltage<br>+10 V<br>–10 V<br>24 V DC | <br><br>1<br>1<br>2 | <br><br>–<br>–<br>2 | <br><br>5 mA load capability, short-circuit-proof<br>5 mA load capability, short-circuit-proof<br>Short-circuit-proof output for binary inputs or outputs,<br>load capability 280 mA |

| Technical data | |
|---|---|
| Mounting | DIN mounting rail (see Section 3) |
| Rated external input voltage | 24 V DC (–17 %, +25 %), 1 A |
| Degree of protection | IP00 |
| Dimensions H x W x D | SCI1: 95 mm x 300 mm x 80 mm (3.7 in x 11.8 in x 3.15 in)<br>SCI2: 95 mm x 250 mm x 80 mm (3.7 in x 9.8 in x 3.15 in) |



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**Control terminal strip on the SCI1 interface board** for cabinet units with PMU or OP1S and the option "NAMUR terminal strip"

| Terminal | No. | Type | Preassignment | Notes |
|---|---|---|---|---|
| **X427** | A1 | P24 | | |
| | A2 | M | | |
| | A3 | BE6 | Setpoint lower | |
| | A4 | BE7 | Acknowledge | |
| | A5 | BE8 | Off 2 | |
| | A6 | BE9 | Select counter-clockwise rotating field | |
| | A7 | BE10 | None | |
| | A8 | M | | |
| | A9 | M | | |
| | A10 | M | | |
| | A11 | M | | |
| **X427** | B1 | P24 | | |
| | B2 | BA8 | None | Transistor output |
| | B3 | BE1 | On/Off 1 | |
| | B4 | BE2 | Select BICO data set 2 | Local/remote operation |
| | B5 | BE3 | None | |
| | B6 | BE4 | None | |
| | B7 | BE5 | Setpoint higher | |
| | B8 | M | | |
| | B9 | P24 | | |
| | B10 | P24 | | |
| | B11 | P24 | | |
| **X428** | 1 | +10 V stab | | |
| | 2 | –10 V stab | | |
| | 3 | AE1 ±10 V | Main setpoint | Analog input 1 |
| | 4 | M | | |
| | 5 | AE1 ±20 mA | | Load 250 Ω |
| | 6 | AE2 ±10 V | None | Analog input 2 |
| | 7 | M | | |
| | 8 | AE2 ±20 mA | | Load 250 Ω |
| | 9 | AE3 ±10 V | None | Analog input 3 |
| | 10 | M | | |
| | 11 | AE3 ±20 mA | | Load 250 Ω |
| | 12 | AA1 ±10 V | Speed | Analog output 1 |
| | 13 | M | | |
| | 14 | AA1 ±20 mA | | Load, max. 500 Ω |
| | 15 | AA2 ±10 V | Output current | Analog output 2 |
| | 16 | M | | |
| | 17 | AA2 ±20 mA | | Load, max. 500 Ω |
| | 18 | AA3 ±10 V | Torque | Analog output 3 |
| | 19 | M | | |
| | 20 | AA3 ±20 mA | | Load, max. 500 Ω |
| **X429** | 1 | BA1 | Ready for power-on | Relay contact |
| | 2 | | | |
| | 3 | BA2 | Setpoint reached | Relay contact |
| | 4 | | | |
| | 5 | BA3 | Off 2 signal | Relay contact |
| | 6 | | | |
| | 7 | BA4 | Fault | Changeover contact: common |
| | 8 | | | break contact NC |
| | 9 | | | make contact NO |
| | 10 | BA5 | None | Changeover contact: common |
| | 11 | | | break contact NC |
| | 12 | | | make contact NO |
| | 13 | BA6 | None | Changeover contact: common |
| | 14 | | | break contact NC |
| | 15 | | | make contact NO |
| | 16 | BA7 | None | Changeover contact: common |
| | 17 | | | break contact NC |
| | 18 | | | make contact NO |

Relay contacts, maximum loading 100 V DC, 2.4 A or with 250 V AC, 8 A.



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## Link-up to automation systems

SIMOVERT MASTERDRIVES can easily be linked up to any automation system, such as a PLC or an industrial PC (Fig. 6/72). The automation system controls the drives according to the requirements of the process. To this end, control data and setpoints are cyclically transmitted to the drives. The latter transmit status data and actual values back to the automation system. Even process-related parameter adaption of the drives is possible (e.g. in the case of a change in recipe).

The fieldbus system is responsible for transporting the information. This is preferably PROFIBUS DP, an open fieldbus standard standardized in EN 50 170, and supported by many automation systems.

An alternative, which is especially cost-effective and easy to install in any automation system, is the USS protocol.

Finally, links to other fieldbus systems (e.g. CAN) round off the communication possibilities of SIMOVERT MASTERDRIVES.

In order to ensure that the drive can perform its process-specific task, its parameters must be individually adapted in the start-up phase. The DriveMonitor and Drive ES Basic engineering tools running under Windows 98/ME/NT 4.0/2000 and XP Professional are available for this purpose. DriveMonitor is delivered free of charge with every drive.

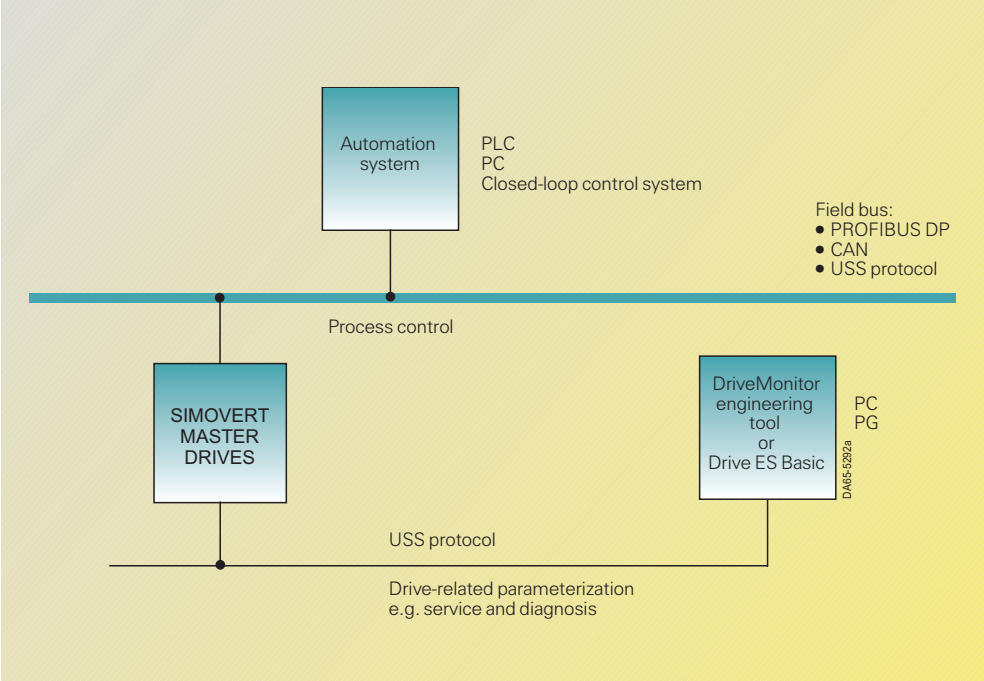



Fig. 6/72
Link between SIMOVERT MASTERDRIVES and a higher-level automation system

Both tools guide the commissioning engineer in a structured manner through the unit parameters and are service and diagnostic tools during operation.

While only the bus-capable USS protocol is used for communication with the DriveMonitor units, Drive ES Basic also works directly via PROFIBUS DP.

## Link to a SIMATIC PLC

If the automation system involved is a SIMATIC PLC, the link-up to SIMOVERT MASTERDRIVES is particularly simple. With the DVA_S5 (for SIMATIC S5 and STEP 5 ≥ V 6.0) or Drive ES SIMATIC (for SIMATIC S7 and STEP 7 > V 5.0) option software, communication between the PLC and the drive can be established simply by assigning appropriate parameters.

When this option software is used, there is no need to incorporate detailed knowledge of the communication mechanisms in the control program; programming time and costs are thus reduced. Both PROFIBUS DP and the USS protocol can be used as the fieldbus system.



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## Integrating drives in SIMATIC S7 with Drive ES

The engineering and process control of SIMOVERT MASTERDRIVES in combination with a SIMATIC S7 and STEP 7 ≥ V 5.0 is particularly user-friendly and convenient.

If the option Software Drive ES (Drive Engineering System) is installed on the same software platform (PC or PG) then the engineering of the complete system can take place via the STEP 7 Manager. Data transportation is handled by the S7 system bus PROFIBUS DP (see Fig. 6/73).

The Drive ES option software combines the previously separate steps of configuring (hardware configuring, parameter assignment, technology functions) and the control functions between SIMATIC S7 and SIMOVERT MASTERDRIVES in one software tool.

Fully integrated in the STEP 7 Manager, Drive ES consists of four packages with different functions.

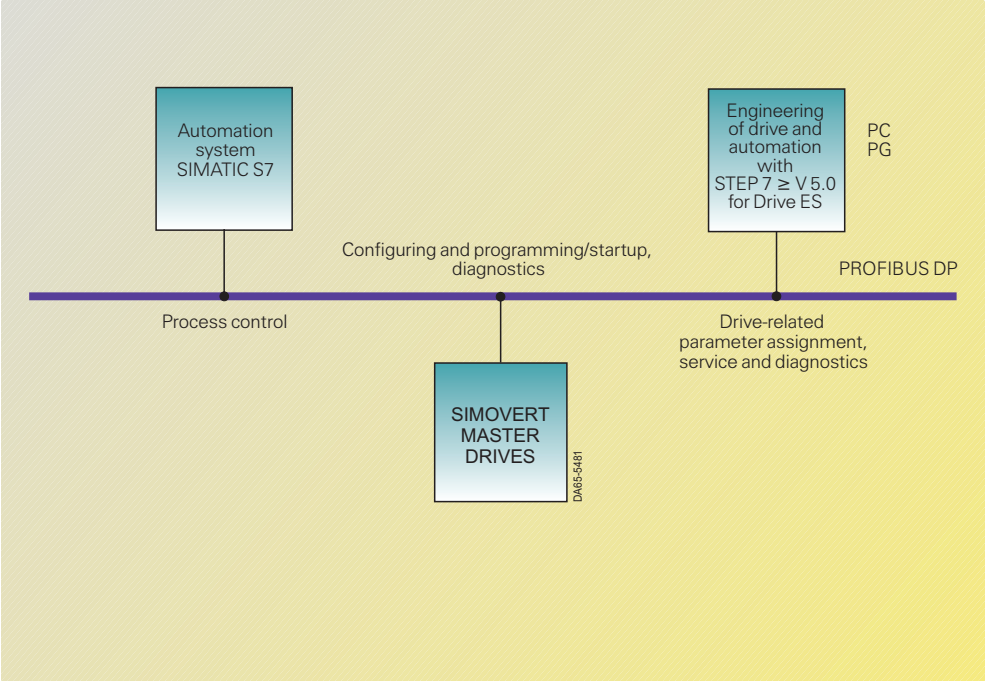



Fig. 6/73
Integration of SIMOVERT MASTERDRIVES in the SIMATIC S7 automation system

Drive ES Basic is used for convenient startup and for servicing and diagnostics during operation of the plant. The great advantage compared to DriveMonitor is in the system-wide data management of drive and automation data of a project in the STEP 7 Manager as well as the utilization of the complete communication environment of the SIMATIC S7. This also includes, for example, communication via different bus systems by means of ROUTING as well as the use of the SIMATIC teleservice.

The functions provided in MASTERDRIVES (basic unit, free block and technology functions) can be graphically configured using Drive ES Graphic together with the SIMATIC tool CFC (Continuous Function Chart).

Drive ES SIMATIC provides a whole library of function blocks. The communication between SIMATIC S7 and Siemens drives (e.g. MASTERDRIVES) can then be configured using preconfigured CPU function blocks and simple parameter assignment. Furthermore, drives with PROFIBUS DP interface can be incorporated in SIMATIC PCS 7 using Drive ES PCS 7.

In joint operation with the PROFIBUS DP communication board CBP2, Drive ES supports additional functionalities such as clock synchronization of drives, slave-to-slave communication between drives and flexible configuration of the cyclic messages (see page 6/82).





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## Overview

The SIMOVERT MASTERDRIVES Motion Control units have several serial interfaces for communication with higher-level PLC systems, industrial PCs, etc.

The interfaces can be classified as follows:

- Basic drive units:
  - Compact PLUS units: A serial interface with USS protocol (RS485)
  - Compact and chassis units: Two serial interfaces with USS protocol (RS485)

Options: Communication and interface boards for different transmission protocols or bus systems.

## USS protocol

The user data that can be transmitted with the USS protocol have the structure shown in Fig. 6/74.

The PKW area allows reading and writing of parameter values and reading of parameter descriptions and texts. This mechanism is mainly used for exchanging data for operator control and visualization as well as start-up and diagnostics.

The PZD area contains the signals necessary for process control – such as control words and setpoints – from the automation system to the drive, and status words and actual values from the drive to the automation system.

USS interfaces available in MASTERDRIVES Motion Control:

- Compact PLUS units: one serial interface (SCom1)
- compact and chassis units, on the basic module CUMC (SCom1, SCom2)
- the T100 technology board
- SCB2 interface board.

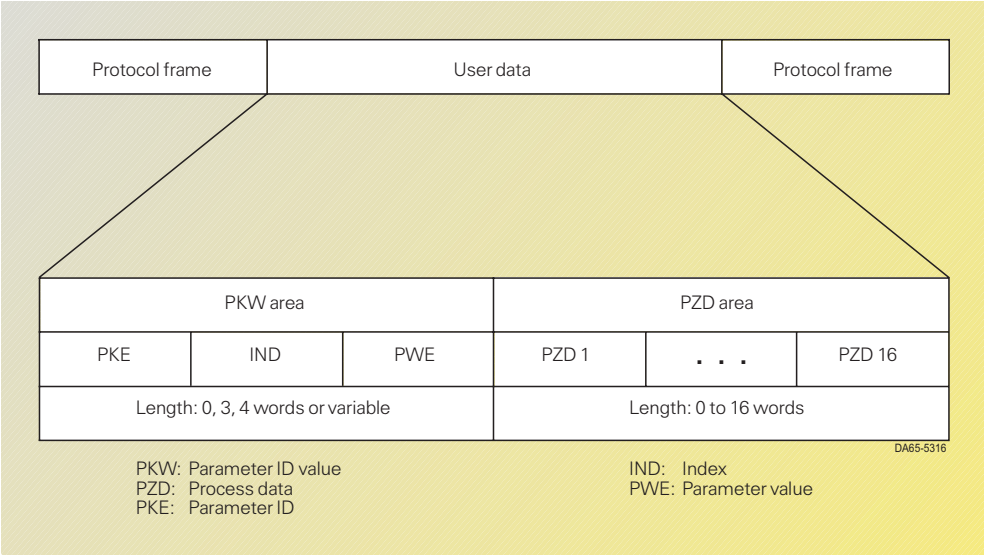



Fig. 6/74
Message frame structure with the USS protocol

| USS Master | | Additional hardware/software[1]) |
|---|---|---|
| SIMATIC S5 | AG95/AG100U with CP521 Si communications processor | RS232/RS485 interface converter<br>DVA_S5 option package for SIMATIC S5 (see page 3/40) |
| | AG115 to AG155U with CP524 communications processor | RS485 interface module for CP524<br>373 memory module for CP524<br>COM525 parameterization software for CP524<br>S5R00T special driver for CP524 (6ES5897-2MB11)<br>DVA_S5 option package for SIMATIC S5 (see page 3/40) |
| SIMATIC S7 | S7-200 (CPU 214, 215 or 216) | STEP 7-Micro/DOS or STEP 7-Micro/WIN configuration tool for S7-200 |
| | S7-300 with CP340-1C | Configuration package for CP340, point-to-point coupling<br>Drive ES SIMATIC (STEP 7 ≥ V 5.0) option software (see page 3/44) |
| | S7-400 with CP441 | X27 RS422/RS485 interface module<br>Configuration package for CP441, point-to-point coupling<br>Drive ES SIMATIC (STEP 7 ≥ V 5.0) option software (see page 3/44) |
| SIMATIC TI | FIM505 field interface module | |
| SIMADYN D | CS7 adaption board with SS4 interface module | |
| PC | RS485 interface card or RS232/RS485 converter, USS driver | |

### *Bus topology*

The USS bus is to be established as a line without spur lines.

### *Bus cable*

The SINEC L2 bus cable (Order No. 6XV1830-0EH10) can be used as the bus cable. The maximum permissible cable length is 1200 m (3937 ft).

### *Installing the bus cable*

The USS bus cable is usually connected with screw or plug-in terminals. The SCom1 on the basic board is accessible via a 9-pole SUB-D socket. The pin or terminal assignment of the SCom1 is given in Section 2 and that of the SCom2 in the section "System components".

The assignment of the interface on the supplementary boards can be found in the respective operating instructions.

1) For order numbers for supplementary items, refer to Catalogs ST 50 and ST 70.



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## USS protocol (continued)

### *Bus termination*

The bus cable is to be terminated at both ends (first and last node). In the case of Compact PLUS, termination is established by means of switch S1 (SCom1, X103). In the case of the CUMC it is terminated with the S1 switches (SCom1, X300) or S2 (SCom2, X103) on the base electronics board.

Possible USS masters are

- a user-friendly operator control panel, OP1S (local operator control)
- a Drive ES or a DriveMonitor PC (central parameterization and diagnosis) or
- an automation system (see table).

Possible USS automation masters and the necessary hardware/software additions are shown in the table.

### *Configuration of USS communication*

Configuration of USS communication in an automation system consists of the following steps:

- parameterization of the USS master
- creation of the communication program in the master
- parameterization of the drives.

Parameterization of the master and the communication program is system-specific.

Parameterization of the drives consists of two steps (example of SCom1/SCom2):

- parameterization of the interface (parameters P700, P701, P702, P703, P704)
- parameterization of the process data interconnection and parameterizing enable (control words P554 to P591, setpoints P443, P433 etc., status words and actual values P707, P708, parameterizing enable P053).

## SIMOLINK

SIMOLINK (Siemens Motion Link) is a Siemens-specific development for Siemens drive technology.

The SIMOLINK is mainly used for the extremely fast and strictly cyclical transmission of process data (control information, setpoints, actual values and additional information) between the MASTERDRIVES units or between the MASTERDRIVES units and a higher-level control system with synchronization of all connected nodes to a common system clock.

Due to its extremely high data transmission rate and the transmission of strictly time-equidistant and jitter-free SYNC message frames in each bus cycle, SIMOLINK enables highly dynamic and accurate synchronous operation of all connected MASTERDRIVES units. The transmission rate is 11 Mbit/s.

Typical uses are all applications which require a high degree of angular synchronism of the individual MASTERDRIVES units in relation to each other.

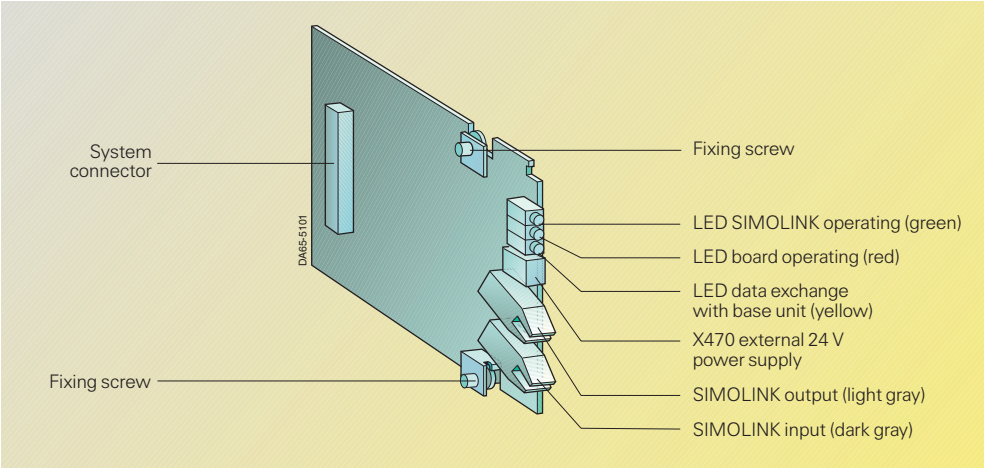



Fig. 6/75
SLB communication board

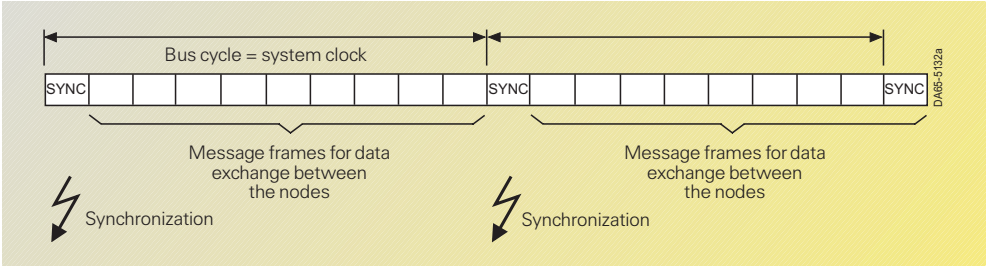



Fig. 6/76
SIMOLINK message frame communication

The SLB communication board (SIMOLINK board) is used for linking up drives to the SIMOLINK. Each SLB communication board is a node connected to the SIMOLINK. The maximum number of nodes is limited to 201.

Data is transmitted between the individual nodes via fiber-optic cables. Plastic fiber or glass fiber cables may be used.

The SLB option board has a 24 V power input for external power supply to the board.

This ensures that data exchange in the SIMOLINK is maintained even if the converter/inverter is switched off.



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## SIMOLINK (continued)

The module has three LEDs for indicating the current operating status.

### Characteristics

- The transmission medium is the fiber-optic cable. This can be either glass or plastic.
- The structure of the SIMOLINK is a fiber-optic-cable ring. Each node in the ring acts as a signal amplifier.
- The following distances are possible, depending on the selected transmission medium:
  - up to 40 m (131 ft) between each node if plastic cables are used or
  - up to 300 m (984 ft) between each node if glass cables are used.
- Theoretically, a maximum of 201 nodes can be connected together using SIMOLINK.
- The nodes are synchronized by means of a SYNC message frame, which is generated by a node with a special function, namely the dispatcher function, and simultaneously received by all other nodes. The SYNC message frame is generated with absolute time-equidistance and is jitter-free. The time between two SYNC message frames is the bus cycle time of the SIMOLINK and, at the same time, corresponds to the common system clock for synchronization of all connected nodes.
- Data transfer between the nodes is strictly cyclical and takes place in the clock of the bus cycle. This means that all data read or written by the nodes are transferred between two SYNC message frames. When the SYNC message frame is received, the data received in each MASTERDRIVES Motion Control unit are passed on synchronously as currently valid data to the closed-loop control system of the inverter. This ensures that the latest data are available to all nodes on the bus simultaneously.

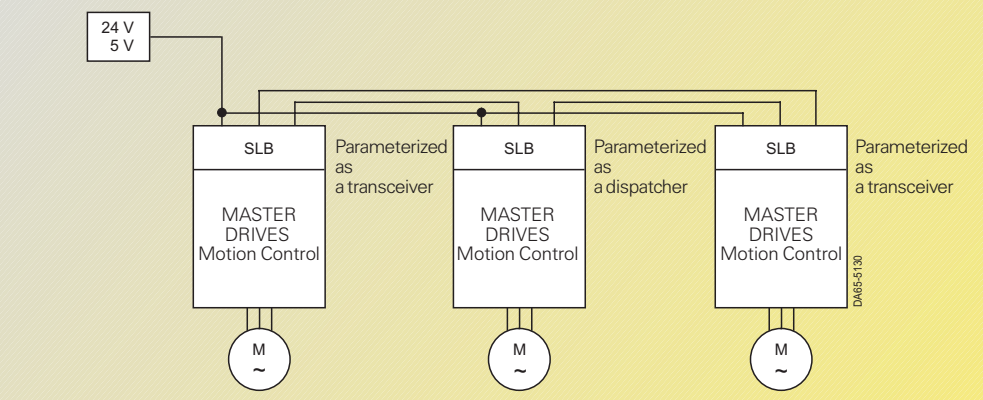



Fig. 6/77
Peer-to-peer functions with SIMOLINK

### Method of operation

The SLB board is the link between the converter/inverter and SIMOLINK. It can be used as a SIMOLINK dispatcher or as a SIMOLINK transceiver. The switchover between the two functions is determined by parameterization.

### Peer-to-peer functionality

The peer-to-peer functionality with the SIMOLINK is, in principle, the same as the familiar peer-to-peer functionality of the MASTERDRIVES and SIMOREG systems. With SIMOLINK, the exchange of process data between the MASTERDRIVES Motion Control units has the following advantages:

- Very high speed (11 Mbit/s: 100 items of 32-bit data in 0.63 ms)
- Free choice, i.e. each MASTERDRIVES Motion Control unit can send or receive process data from any other MASTERDRIVES Motion Control unit.
- Up to 16 items of 32-bit process data per MASTERDRIVES Motion Control unit is possible via the SIMOLINK, i.e. each MASTERDRIVES Motion Control unit can receive up to 8 process data elements (32-bit values) or send up to 8 process data elements to other MASTERDRIVES Motion Control units.

### Parameterization

Data traffic is parameterized solely by means of the parameters of the basic MASTERDRIVES Motion Control unit. An additional configuration tool is not needed. For configuration of the SLB, the following parameter settings are necessary:

- Specification of the bus address:
  0 to 200, whereby the following applies:
  - 0 = dispatcher function
  - 1 to 200 = transceiver function
- Transmission power
- Bus cycle time
- Number of nodes and telegrams per node
- Monitoring time for fault messages in the event of communication failure.

The BICO system is used for configuring which process data are to be sent by a MASTERDRIVES Motion Control unit. The BICO system is also used to determine at what position in the control system the process data are to act. The SLB can be parameterized with the PMU, the OP1S or the PC-based tools Drive ES or DriveMonitor.

### Power Supply

The power supply to the option board can be supplied either internally by the converter/inverter or externally. Priority is given to external power supply. The changeover takes place automatically on the option board.

### Note

The external power supply must not be changed over during bus operation. If the power supply is automatically changed over, a reset signal is generated on the board, thus causing several message frames to be lost.



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### *Application: angular synchronous operation*

A typical application of the SIMOLINK is for digital set-point cascades where one or more setpoints are passed on to the slave drive by a MASTERDRIVES Motion Control unit acting as the master drive.

Fig. 6/78 shows how SIMOLINK functions with MASTERDRIVES Motion control units and how it is parameterized.

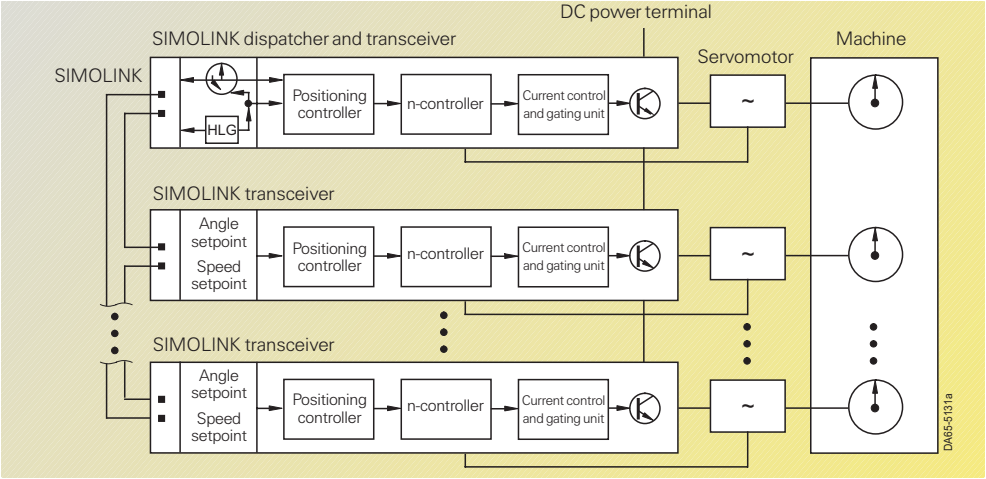
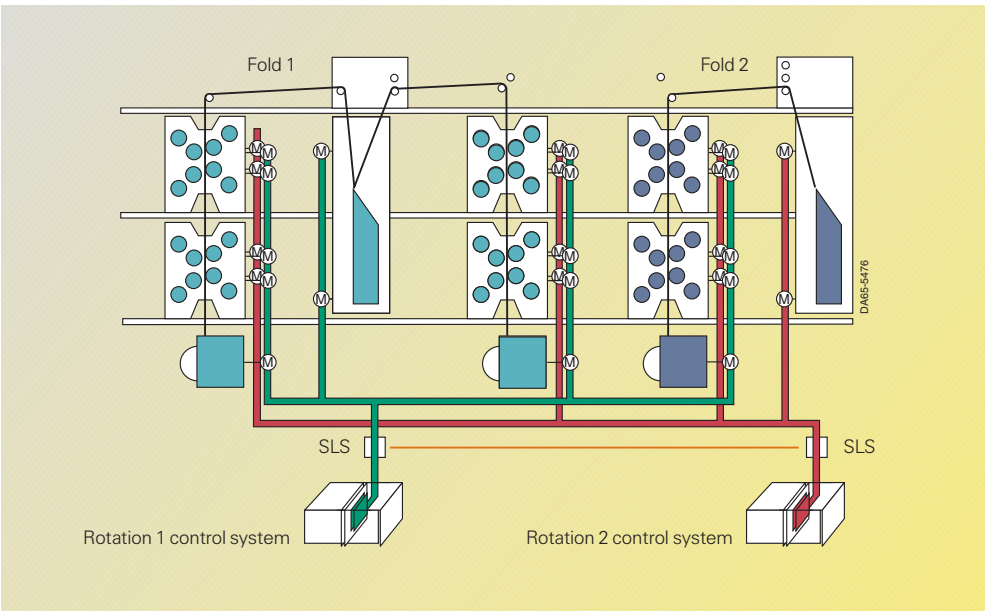



Fig. 6/78
Angular synchronism with SIMOLINK

| Technical data of the SLB | Designation | Value |
|---|---|---|
| | Size (length x width) | 90 mm x 83 mm (3.5 in x 3.2 in) |
| | External voltage supply | 24 V DC |
| | Current input from the external voltage supply | Max. 200 mA |
| | Voltage supply from the basic unit | 5 V DC |
| | Current input from the voltage supply of the basic unit | Max. 600 mA |
| | Changeover of the voltage source | Automatic; external supply has priority |
| | Node address | Can be set in the appropriate parameters |
| | Data transfer rate | 11 Mbit/s |
| | Run time delay | Max. 3 clock cycles |
| | Fiber optic cable | Plastic (preferable); glass fiber |
| | Cable length at 0 to 70 °C (32 to 158 °F) | Max. 40 m (131 ft) (plastic) between 2 nodes<br>300 m (984 ft) (glass fiber) between 2 nodes |
| | Display | 3 LEDs: yellow: data exchange with the basic unit<br>green: SIMOLINK in operation<br>red: board in operation |




SIMOLINK slave module
SIMOLINK master module
SLS SIMOLINK switch
FOC ring for rotation 1
FOC ring for rotation 2
Redundant connection between guide 1 and guide 2

Fig. 6/79
Shaftless printing machine with SIMOLINK



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## PROFIBUS DP

If the PROFIBUS DP is used, the CBP or CBP2 communication board is necessary for interfacing drives to higher-level automation systems.

With extended functionality, CBP2 is fully compatible with CBP and will replace it in the future. In the following, therefore, "CBP" always signifies both boards; individual special features of CBP2 are indicated.

### *Functionality of the CBP*

- Cyclical user data exchange with the master according to the "PROFIBUS DP Profile for PROFIDRIVE Variable-Speed Drives " (Order No. 3.071, PROFIBUS DP Nutzerorganisation e.V., Karlsruhe).
- Acyclical communication channel for exchanging parameter values up to a length of 118 words with a SIMATIC S7 CPU.
- Acyclical communication channel for connecting the Drive ES Basic start-up, parameterization and diagnostics tools.
- Support of the PROFIBUS DP control commands, SYNC and FREEZE, for synchronized data transfer from the master to several slaves and vice versa.

### *Extended functionality of CBP2*

(to PROFIBUS DP profile, drive systems V3 PROFIDRIVE)

- Flexible configuration of cyclic messages at up to 16 process data words
- Slave-to-slave communication for direct exchange of data between slaves
- Clock synchronization of drives for implementing Motion Control functions via PROFIBUS DP
- Acyclic communication channel for direct access of a SIMATIC OP to a drive.

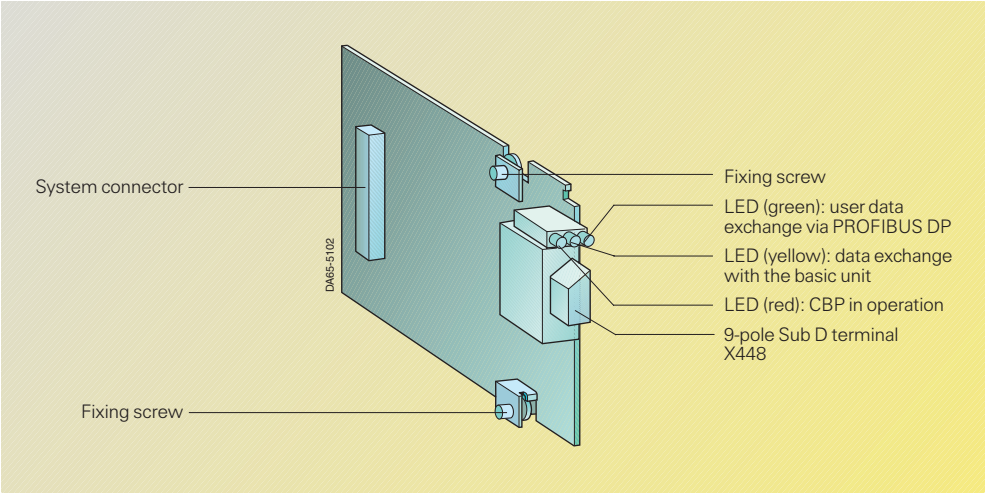



Fig. 6/79
CBP/CBP 2 communication board

Possible user data structure with CBP and CBP2

| PPO-Type | PKW area | | | PZD area | | | Functionality | |
|---|---|---|---|---|---|---|---|---|
| | PKW | IND | PWE | PZD1 | • • • | PZD16 | CBP | CBP2 |
| PPO1 | fixed length: 4 words | | | fixed length: 2 words | | | ✔ | ✔ |
| PPO2 | fixed length: 4 words | | | fixed length: 6 words | | | ✔ | ✔ |
| PPO3 | fixed length: 0 words | | | fixed length: 2 words | | | ✔ | ✔ |
| PPO4 | fixed length: 0 words | | | fixed length: 6 words | | | ✔ | ✔ |
| PPO5 | fixed length: 4 words | | | fixed length: 10 words | | | ✔ | ✔ |
| none | 0 or 4 words | | | flexible configurable from 1 to 16 words | | | | ✔ |

PKW: Parameter ID value
PZD: Process data
PKE: Parameter ID
IND: Index
PWE: Parameter value

### *Cyclic exchange of user data*

In the PROFIBUS DP profile on which the CBP functionality is based, the structure of the user data, amongst other items, with which a DP master can access the drives is defined. There are five permanently defined PPO (parameter process-data objects); these are subdivided into a PKW area (parameter identifier value area, up to 4 words) and the PZD area (process data area, up to 10 words).

The PKW area enables reading and writing of parameter values and the reading of parameter descriptions. This mechanism is used to visualize or change any of the slaves' parameters.

The PZD area contains the data – such as control words and setpoints needed for process control – from the automation system to the drive or status words and actual values from the drive to the automation system.

When a CBP2 is used, local user data structures with up to 16 process data words can now also be utilized in addition to the five PPO types.

### *Technical data of the CBP*

- RS485 interface acc. to EN 50 170, short-circuit-proof and floating
- Baud rates from 9.6 kbit/s to 12 Mbit/s.

### *Mounting of the CBP*

For Compact PLUS units, slots A, B and C are available. For compact units, slots A, C, E and G in the electronics box are available. For slots G and E, the local bus adapter (6SE7090–0XX84–4HA0) and the adapter board (6SE7090–0XX84–0KA0) are necessary.

### *Bus cable*

A bus cable to the PROFIBUS DP specifications is to be used for data transmission.



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### Bus connection

The bus is connected to the PROFIBUS DP via the 9-pole Sub-D socket (X448) in accordance with the PROFIBUS DP standard. For the pin assignment at terminal X448, see the table, top right.

On the bus side, a 9-pole Sub-D connector plug is necessary (e.g. Order No. 6SE7972–0BA41–0XA0).

The CBP2 communication board can alternatively be connected to the optical PROFIBUS DP (e.g. Order No. 6GK1502–1AA00) via an optical bus terminal or an optical link module.

### Bus termination

Each RS485 bus segment must be provided at both ends with a bus termination. The bus is not terminated at the CBP. If the plug-in connector referred to is used, the termination can be opened or closed by means of a switch integrated in the plug-in connector.

Pin assignment at terminal X448

| Pin | Designation | Description | Area |
|---|---|---|---|
| 1 | SHIELD | Ground connection | |
| 2 | – | Not assigned | |
| 3 | RxD/TxD-P | Receive/transmit data P (B/B') | RS485 |
| 4 | CNTR-P | Control signal | TTL |
| 5 | DGND | PROFIBUS DP data reference potential (C/C') | |
| 6 | VP | Supply voltage plus | 5 V ± 10 % |
| 7 | – | Not assigned | |
| 8 | RxD/TxD-N | Receive/transmit data N (A/A') | RS485 |
| 9 | – | Not assigned | |

| PROFIBUS DP master systems | | Additional software[1] |
|---|---|---|
| SIMATIC S5 | AG95U/DP master<br>AG115 to 155U with IM308-C (or CP5431) communication board | COM PROFIBUS DP parameterization software<br>DVA_S5 option package for SIMATIC S5<br>(see page 3/40) |
| SIMATIC S7 | S7-300 with CPU315-2DP, 318-2<br>S7-300 with CP342-5<br>S7-400 with CPU413-/414-/416-2DP, 417-4<br>S7-400 with CP443-5 Ext.<br>S7-400 with IM467 | Drives ES SIMATIC (STEP 7 ≥ V 5.0)<br>(see page 3/44) |
| SIMATIC M7 | IF 964 interface module | |
| SIMATIC TI | TI545/TI555 with integrated DP interface<br>FIM505 field interface module | |
| SIMADYN D | CS7 adaption board with SS52 interface module | |
| PC | CP5613/5614 (PCI) communication board | COM PROFIBUS DP parameterization software |
| | CP55511 (PCMCIA) communication board | SOFTNET-DP/Windows 95/98/NT for PROFIBUS DP |
| | CP5611 (PCI) communication board | |
| | CP5412 (A2) communication board | software package DP-5412/Windows 95/98/NT |

1) For the ordering data of the additional items, see Catalogs ST 50 and ST 70.

### PROFIBUS DP master systems

Drives can generally be coupled to any DP2 master in accordance with EN 50 170.

The lower table on this page contains a list of the automation masters most frequently used in drive technology.

## Configuration of PROFIBUS DP communication

Configuration of DP communication consists of the following steps:

### Configuring the DP master

With SIMATIC S7, the bus system is configured together with the hardware in STEP 7. The CBP/CBP2 is already integrated here so that the cyclic exchange of user data can be configured (STEP 7 versions < 4.02: the CBP/CBP2 can be introduced by loading file SI8045AX.200 supplied). A CBP2 is in this case configured as CBP.

To configure the extended functionality of CBP2, the Drive ES Basic or Drive ES SIMATIC software package is needed in addition to STEP 7 version ≥ 5.0. (Additional hardware requirement for implementation of slave-to-slave communication and pulse synchronization: S7-CPU with integrated DP interface more recent than 04/99).

With SIMATIC S5, the bus system can be configured via the COM PROFIBUS DP software. The CBP board is already integrated in COM PROFIBUS DP as of version 3.2; for older versions, the procedure is the same as for STEP 7. The extended CBP2 functionality is not supported by SIMATIC S5. A CBP2 is configured as CBP in this case.

In principle, the CBP2 can be introduced to other configuration tools by installing file "SIEM8045.GSD".

### Creating the communication program in the master

The communication program is application-specific. For convenient programming the software Drive ES SIMATIC (for STEP 7 ≥ V 5.0) is available for SIMATIC S7. The DVA_S5 option software is available for programming communication on a SIMATIC S5.

### Parameterization of the drives

Parameterization of the drives consists of two steps:

- parameterization of the interface (parameter P918)
- parameterization of the process-data interconnection and parameterization enabling (control words P554 to P591), setpoints P443, P433 etc., status words and actual values P734, process-data monitoring P722, parameter access P053).



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## CAN

The CBC board (Communication Board CAN) enables SIMOVERT MASTERDRIVES units to communicate with a higher-level automation system, with each other and with field devices by means of the CAN protocol. Power is supplied from the base unit.

The CAN protocol (**C**ontroller **A**rea **N**etwork) is specified in the international standard recommendation ISO DIS 11 898; however, only the electrical components of the physical layer and the data-link layer (layers 1 and 2 in the ISO and OSI layers reference model) are specified in this standard recommendation. The CiA (**C**AN **i**n **A**utomation, an international association of users and manufacturers) has defined the use of the CAN protocol as an industrial field bus with the DS 102-1 recommendations for bus interfacing and the bus medium.

- The specifications in ISO-DIS 11 898 and in DS 102-1 are complied with by the CBC board.
- The CBC board only supports CAN layers 1 and 2. At present, additional higher-level communication specifications of the different user organizations, such as CAN open of the CiA, are *not* supported (CAN open is available on request).

The CBC board is limited to the specifications of CAN and is therefore not tied to the dependent specifications of the user organizations. Data exchange with SIMOVERT MASTERDRIVES takes place according to the user-data specification for drive systems with PROFIBUS: PROFIBUS DP Profile for PROFIDRIVE Variable-Speed Drives, PNO, Order No. 3.071.

The user-data structure is divided into two areas:

- Process data (control words, setpoints, status words and actual values)
- Parameter area (mechanism for reading and writing parameter values, e.g. settings, alarms, fault numbers or values).

These areas are transmitted as communication objects (identifiers).

**Functionality**

| | | |
|---|---|---|
| Process data | max. 16 words | |
| Data transfer rate: | 10, 20, 50 kbit/s | up to 1000 m (3280 ft) cable length |
| | 100 kbit/s | up to 750 m (2460 ft) cable length |
| | 125 kbit/s | 530 m (1738 ft) cable length |
| | 250 kbit/s | 270 m (885 ft) cable length |
| | 500 kbit/s | 100 m (328 ft) cable length |
| | 1 Mbit/s | 9 m (29 ft) cable length |
| Max. bus nodes: | ≤ 124 | |

Individual communication objects for the process data from and to the drive are defined, as well as for the parameter tasks of "reading" and "writing".

A defined description can be found in the Compendium for SIMOVERT MASTERDRIVES (for Order No., see Section 5).

Data exchange via CAN

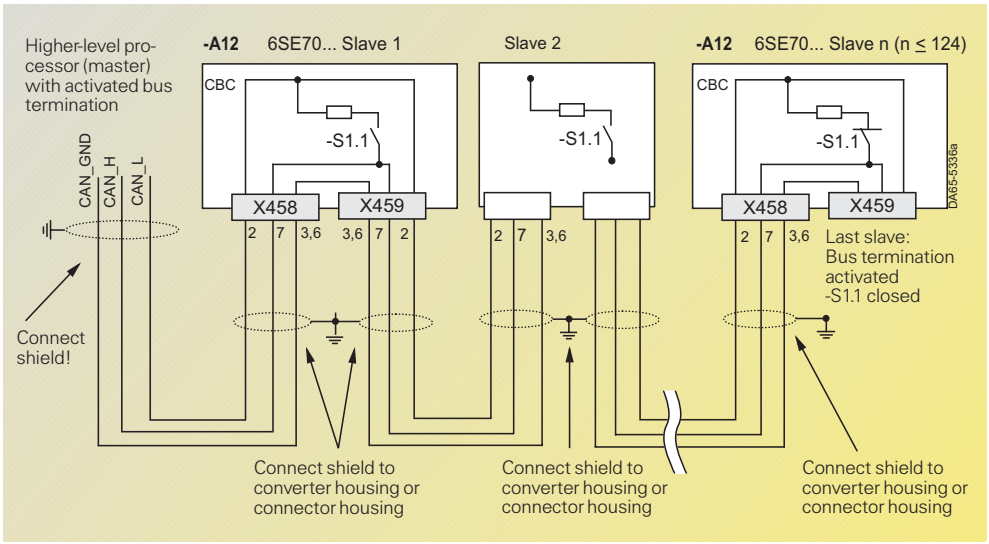



Fig. 6/80
Data exchange between CBC boards, with bus interruption

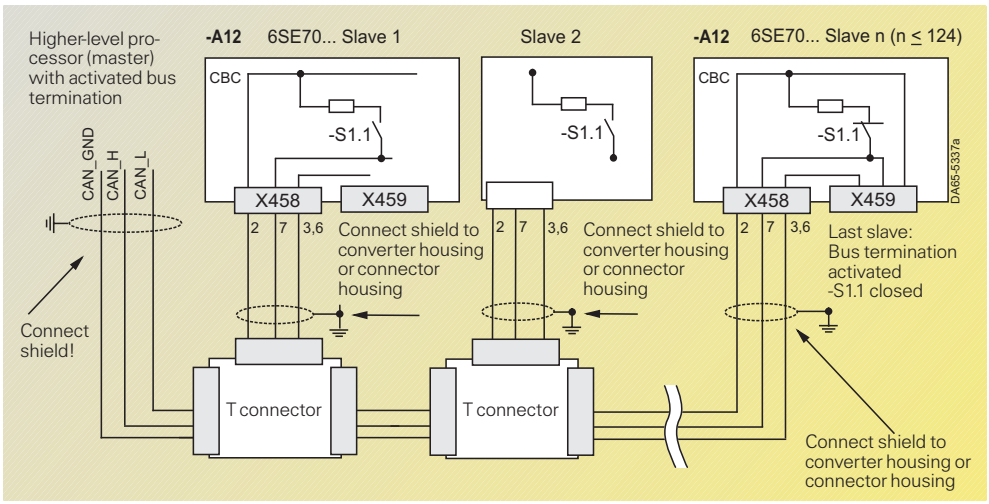



Fig. 6/81
Data exchange between CBC boards, without bus interruption



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The CAN protocol enables rapid data exchange between the bus nodes. With regard to user data, a distinction is made between parameter values (PKW) and process data (PZD).

A CAN data message frame consists of a protocol header, the CAN identifier (up to 8 bytes of user data) and the protocol trailer. The CAN identifier serves to uniquely identify the data message frame. A total of 2048 different CAN identifiers are possible in the standard message format. In the extended message format, $2^{29}$ CAN identifiers are possible.

The extended message format is tolerated by the CBC board but not evaluated. The CAN identifier specifies the priority of the data message frame. The smaller the number of the CAN identifier, the higher is its priority.

A maximum of 8 bytes can be transmitted in a CAN data message frame. The PKW area always consists of 4 words or 8 bytes, i.e. the data can be transferred in a single data message frame. In the case of SIMOVERT MASTERDRIVES, the process-data area, for example, consists of 16 words. A total of 4 data message frames is therefore needed in order to transfer all process data.

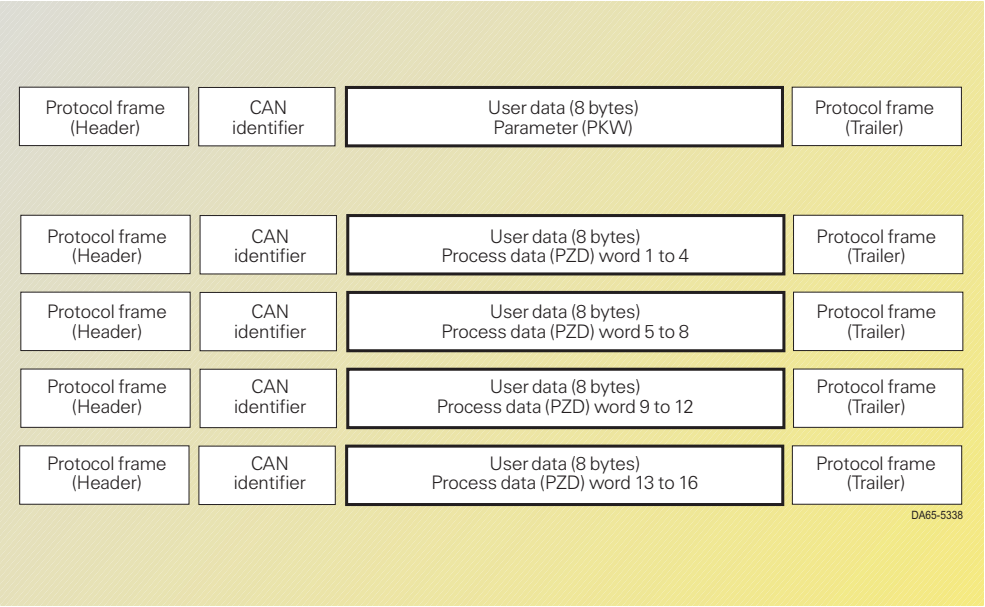



Fig. 6/82
Structure of the user data in the message frame

### *X458 and X459 terminals on the CBC board*

The CBC communication board has a 9-pole Sub-D connector (X458) and a 9-pole Sub-D socket (X459) for connection to the CAN.

Both terminals are assigned identically and are connected internally. The connecting interface is short-circuit-proof and floating.

### *Mounting the CBC board*

For Compact PLUS units, slots A, B and C are available. For compact and chassis units, slots A, C, E and G are available in the electronics box. If slots E and G are to be used, the LBA backplane adapter (Order No. 6SE7090–0XX84–4HA0) and the ADB adapter board (Order No. 6SE7090–0XX84–0KA0) are necessary.

| Pin | Designation | Description |
|---|---|---|
| 1 | – | Not assigned |
| 2 | CAN_L | CAN_L bus line |
| 3 | CAN_GND | CAN ground (frame M5) |
| 4 | – | Not assigned |
| 5 | – | Not assigned |
| 6 | CAN_GND | CAN ground (frame M5) |
| 7 | CAN_H | CAN_H bus line |
| 8 | – | Not assigned |
| 9 | – | Not assigned |

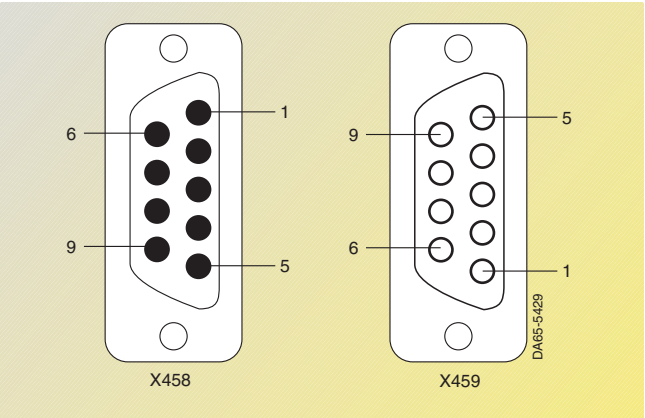


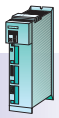

Fig. 6/83
Connectors X458 (plug) and X459 (socket) on the CBC board



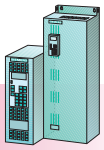
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Communication

Compact PLUS units



Compact and chassis units



## CBD

The CBD **C**ommunications **B**oard **D**eviceNet permits MASTERDRIVES to be coupled to automation units, or other field devices via the DeviceNet™ protocol. The CBD board can be inserted in the MASTERDRIVES electronics box, and operates with all of the software and hardware versions of the MASTERDRIVES.

The CBD supports both DeviceNet Explicit Messages and I/O Messages to implement the equivalent of the process data and parameter portions of drive communication.

DeviceNet Explicit Message Connections provide generic, multipurpose communication paths between two devices. They provide the means by which non time critical functions are performed (for example module configuration and drive parameterization).

By contrast, DeviceNet I/O Message Connections provide time critical special-purpose communication paths between a transmitting device and one or more receiving devices. Process data moves across this I/O Connection. The meaning of the data within an I/O Message is implied by the associated Connection ID.

The CBD supports the Predefined Master/Slave Connection Set as defined in the DeviceNet specification. Both poll and bit strobe I/O messages are supported.

The CBD follows the DeviceNet Device Profile for the Communication Adapter (Device Type 12). The Communication Adapter Profile was chosen so that all the flexibility and advanced features of the MASTERDRIVES could be used by the DeviceNet master. For the same reason, CBD did not implement the DeviceNet AC Drives profile.

| | | Drop length | |
|---|---|---|---|
| Data rate | Trunk distance | Maximum drop | Cumulative |
| 125 Kb | 500 m (1640 ft) | 6 m (20 ft) | 156 m (512 ft) |
| 250 Kb | 250 m (820 ft) | 6 m (20 ft) | 78 m (256 ft) |
| 500 Kb | 100 m (328 ft) | 6 m (20 ft) | 39 m (128 ft) |

| Description | Order No. |
|---|---|
| CBD DeviceNet Board | 6SX7010–0FK00 |
| Instruction manual | Included in above |

6



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## Overview

The basic software for SIMOVERT MASTERDRIVES Motion Control converters and inverters contains many technology functions.

For more extensive applications, each SIMOVERT MASTERDRIVES Motion Control unit can be supplied with the technology software with functions that can be divided up into the following main categories:

- General technology functions (linear axis, rotary axis, roll feed)
- Positioning (point-to-point, automatic)
- Synchronous operation (angular synchronism, electronic gears, start/stop operation, print-mark synchronization, electronic cam).

The technology software is an option and can be ordered with the code F01. Even in a converter/inverter not supplied with this option, the technology software can be enabled later on by means of a PIN number (e.g. when units are replaced).

### *500-hour PIN*

For testing and demonstration purposes or for using replacement units ordered without option F01, the technology software can be enabled free-of-charge for a one-off period of 500 hours with a special PIN number.

The 500-hour PIN is entered in parameter 2977:
U977.1 = 0727
U977.2 = 0101

When the PIN is enabled, this is indicated in parameter n 978 = 2.

The table on page 6/88 provides an overview of the technology functions incorporated in MASTERDRIVES Motion Control.

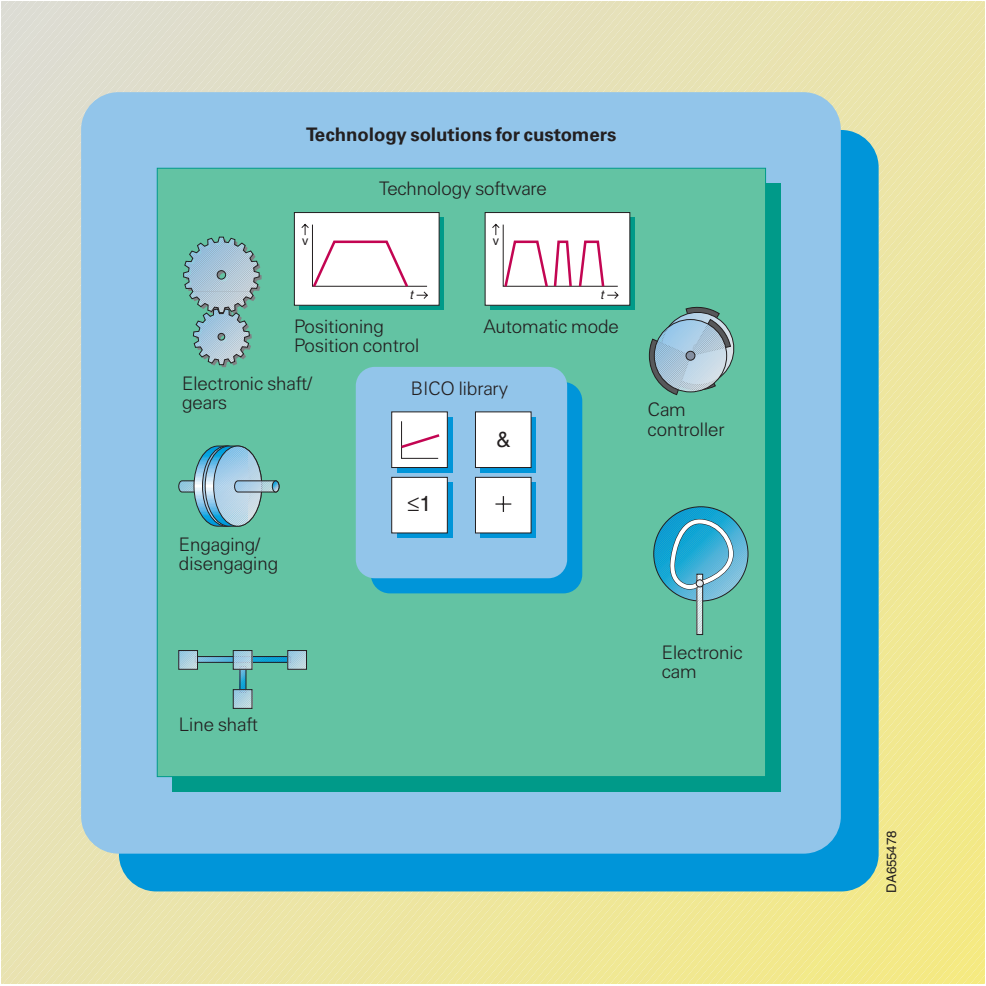
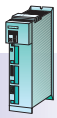
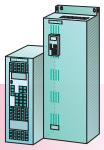



Fig. 6/84



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## Overview

Technology functions of SIMOVERT MASTERDRIVES Motion Control units

| | |
|---|---|
| Number of axes | Any<br>axis-modular structure |
| **Technology functions basic software** | |
| Simple and comfort ramp-function generator | |
| PID controller | |
| Brake control | |
| Encoder evaluation for position detection | |
| Position control with pre-control | |
| Cam controller | Position cams, 2 x 2 cams, minimum reaction time 800 $\mu$s |
| Wobble generator | |
| Motor potentiometer | |
| Basic positioner | |
| Logic and arithmetic functions<br>(AND, OR, NOR, +, –, x, /, comparator)<br>as free-function blocks which can be connected with<br>Drive ES or DriveMonitor via parameters. | |
| **Functions technology software (option F01)** | |
| **General functions** | |
| Linear axis | |
| Rotary axis | |
| Roll feed | |
| Homing procedure | |
| Homing on the fly | |
| **Positioning** | |
| Traversing range | +/– 1000 m (3281 ft) |
| Traversing speed | 0.01 mm/min up to 500 m/min |
| Acceleration/deceleration | 1.0 mm/s$^2$ to 99.999 mm/s$^2$ |
| Jerk limitation | 1.0 mm/s$^3$ to 99.999 mm/s$^3$ |
| Number of program blocks | 50 |
| Number of programs | 20 |
| Roll feed | |
| Zero shift | |
| Acceleration can be influenced by means of the G-function | |
| Software limit switch | |
| Actual-value evaluation factor | |
| Tool corrections | |
| Override for feeding and acceleration | |
| Backlash compensation | |
| Position-feedback setting/measuring on the fly | |
| External start | |
| External record change | |
| External read-in enable | |
| Switching functions (M functions) | |
| Rotary axis | |
| Teach-in | |
| Simulation | |
| **Synchronous operation** | |
| Master-setpoint sources:<br>– virtual<br>– actual-value based master axis<br>– setpoint driven master axis | Drive coupling via SIMOLINK or clock-synchronous PROFIBUS DP (CBP2) |
| Free allocation of master and slave axes<br>(cascading of the slave axes) | Via parameter connection |
| Electronic gears<br>– transmission ratio | 1 : 5 to 32 000 : 1, can be modified during operation |
| Electronic cam<br>– number of tables<br>– number of interpolation points<br>– table change on the fly | max. 8<br>max. 400 |
| Engaging/disengaging | |
| Synchronization<br>– via fast input (print-mark synchronization)<br>– catch-up | |





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## Technology functions of the basic software

The functions described below are included in the basic software, as are the "free function blocks". Thus, they can always be implemented, irrespective of whether or not the converter was ordered with technology option F01.

### *Cam controller*

A cam controller switches digital outputs on and off when pre-defined positions have been reached. This enables, external switching elements, such as pneumatic valves, to be be operated at defined points during a movement (positioning cams).

The basic software for MASTERDRIVES Motion Control contains two cam controllers as free function blocks, each with two positioning cams that can be supplied by separate input signals, e.g. position setpoint slave and position setpoint master. There are therefore four cams with switch-on and switch-off positions which can be set independently of each other.

These cams an adjustable hysteresis for the switching point and a time resolution of at least 800 $\mu$s. The outputs of the cam controllers are binectors which can be connected as required, e.g. to digital outputs of the MASTERDRIVES units for operating magnetic valves etc.

A speed-dependent compensation for switching time function and time cams are not provided. These functions, however, can often be implemented using the timers in the free function blocks.

If an extremely fast cam controller with switching-instant compensation and additional time cams are needed, an external hardware cam controller such as the SIMATIC S7 module FM352 ("FM Cams") or the T400 technology board should be used.

### *Brake control*

The integrated brake control function prevents inconvenient waiting times when brakes are applied or released.

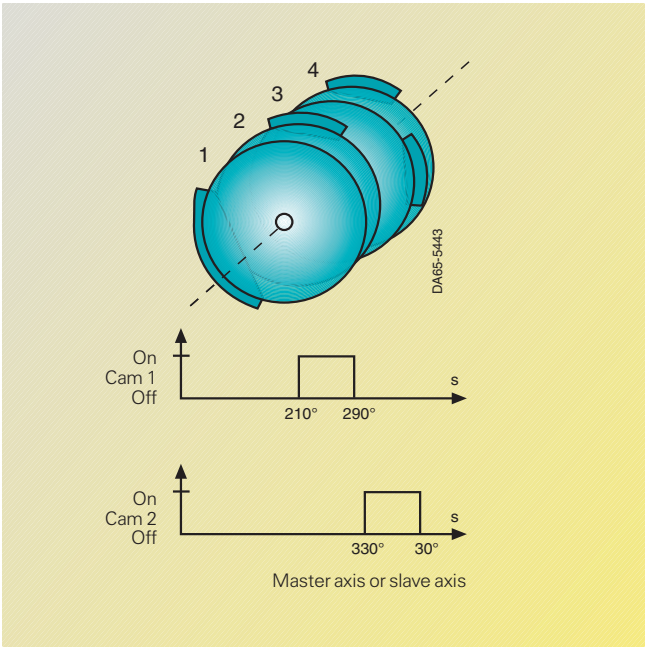



Fig. 6/85
Cam controller for MASTERDRIVES Motion Control

Hoisting gear can also be positioned quickly and reliably – with little effort in the external machine control unit and during start-up. Checkback contacts of the brake can be evaluated in the brake control function. Output signals of the brake control function are the binectors "Release brake" and "Close brake". Relays for operating the brake are not built into the MASTERDRIVES unit.

The following methods are available for brake operation:

- Use of a relay output on the EB1 expansion board
- Use of an external relay which is operated by a digital output of the MASTERDRIVES
- The relay (in compact and chassis units) for operating the main contactor can be used for operating the brake if there is no main contactor.

Releasing and closing the brake can be effected by means of external commands but, normally, the brake control function works fully automatically without any intervention by the external machine control unit.

Release brake

If the drive changes to the "On" state after power-on, the inverter enabling signal is given and the brake is released. After the set brake-release time and when the checkback signal "Brake released" is received, setpoint enabling takes place. An adjustable limit-value monitor can be used in special cases in order to make releasing of the brake dependent on a particular criterion.

Close brake

If the drive is shut down, i.e. if its speed has fallen below the set threshold and is switched off by means of OFF1 or OFF3, the brake closes. The inverter enable signal is removed after the set brake-closing time has elapsed and the "Brake closed" signal has been sent (possibly by a checkback contact). OFF2 should not be used, if possible, because, an OFF2 command causes the pulses to be blocked immediately and the motor to be deenergized during the brake-closing time.

### *Basic positioner*

The basic positioner is included in all MASTERDRIVES Motion Control units from firmware version 1.5 upwards as a "free function block". The basic positioner can be used to perform "simple positioning tasks" without activating the F01 technology option.
The basic positioner performs the following functions:

- Absolute and relative positioning
- Linear and rotary axes
- With motor encoder or machine encoder
- Set up (position-controlled method using the speed setpoint)
- Referencing ("flying" and with homing procedure)
- Software limit switch (only in the case of linear axes)
- Play compensation
- Adoption of setpoints, continuous or edge-triggered
- Jerk-free changeover from set-up to positioning and vice versa, without standstill of the axis
- Setpoint changes for position, speed and acceleration during movement along the axis possible.

Standard applications are available, including parameterization and documentation. These can be obtained from your regional Siemens AG office and from the Applications Center for Production Machines.



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## Technology software – General functions

The Motion Control technology software (F01) has the following general functions.

### *Linear axis*

(with fixed stops and a max. traversing range of 1000 m (3281 ft) with a resolution of 1$\mu$) software limit switches are evaluated. A traversing car is an example of a linear axis.

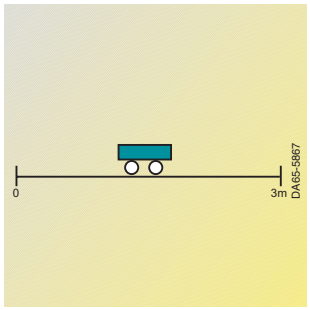



Fig. 6/86
Linear axis

- Either the motor encoder (resolver, optical sin/cos incremental encoder, absolute-value encoder, incremental encoder) or an external machine encoder (e.g. incremental encoder or SSI absolute-value encoder) built on to the driven machine can act as a **position encoder**.

### *Rotary axis*

(permanently rotating, without fixed stops with definition of direction or direction "shortest distance"). A turntable is an example of a rotary axis.

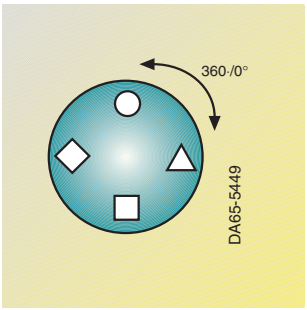



Fig. 6/87
Rotary axis

- The Motion Control software contains a sophisticated precontrol strategy. At any given moment, the position ramp-function generator appropriately controls the speed and accelerating torque by bypassing the position controller so that an optimum dynamic response is achieved and no significant following errors occur.

### *Roll feed*

(permanently rotating rotary axis with "cut-to-length function") The illustration shows a roll feed used in a cutting machine.

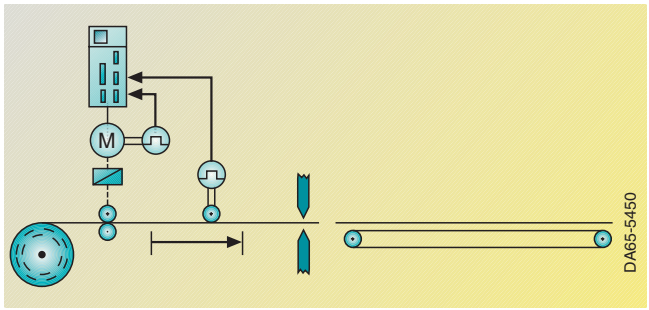



Fig. 6/88
Roll feed

- Even if the high dynamic response is fully utilized, the mechanical components are subjected to very little stress. This is ensured by the position ramp-function generator with its flexibly adjustable jerk-limiter and accelerator.



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## Technology software – Positioning

The MASTERDRIVES Motion Control unit has an easy-to-use integrated position control system with the following functions:

- Setup:
  Position-controlled traversing of the axis in jog mode
- Homing procedure:
  Variable function for establishing a relationship between an incremental measuring system and the mechanical equipment.
- MDI:
  Point-to-point positioning (**M**anual **D**ata **I**nput)
  - Relative or absolute positioning (absolute or incremental dimension)
  - Stipulation of an MDI positioning record with position, speed and acceleration.

  The MDI positioning record can be directly specified by the machine control unit, e.g. via PROFIBUS DP, or called using control commands from a table (stored in the MASTERDRIVES Motion Control unit) of 10 fixed position setpoints. Together with the MDI positioning record, the starting command can be transmitted in one and the same PROFIBUS DP telegram. This enables comfortable and time-saving operation of the positioning process even when using a small PLC.
  - Changeover on the fly to another MDI record during travel is possible.
  - Start command (a read-in enable in the case of roll feed) is possible via digital inputs of the MASTERDRIVES Motion Control or via the fieldbus.
- Automatic function
  - Execution of complete positioning programs in the automatic mode
  - Single-step mode possible
  - Creation of traversing programs using a powerful programming language in accordance with DIN 66 025 (industrial standard)
  - Input of traversing programs via SIMATIC S7-CPU or via the DriveMonitor service program with special editor
  - Up to 20 programs with a total of 50 records (traversing commands) can be programmed
  - Program-controlled output of switching functions (M functions)
  - Flying record change via digital input
  - Start and read-in enabling also possible via digital input
  - Zero shifting, tool correction and backlash compensation can be programmed
  - Acceleration can be influenced by means of the G-function
  - Actual-value setting on the fly
  - Starting command, record change and read-in enabling can be stipulated via fieldbus or digital inputs
  - Teach-in: adoption of the current position in a traversing record is possible by means of set-up mode
  - Speed override, acceleration override and time override
  - Collision monitoring via external input
  - Simulation mode for testing automation programs without motor, e.g. for recording the position-setpoint curve with simulation of the M-functions.
- Roll feed:
  - Automatic cut-to-length function for presses, stamping machines and cross-cutting machines in start/stop mode
  - Speed/acceleration profile of the traversing curve can be stipulated. In this way, optimum through-put times are achieved and material wear and slippage is avoided.
  - Changeover between an external machine encoder and motor encoder is possible (at standstill)
  - The number of loops (number of cutting processes) can be programmed.

### *Applications for the positioning function*

Typical applications for the MASTERDRIVES Motion Control are positioning drives in the following areas:

- Wood-working machinery
- Roll feeders for presses
- Packaging machines
- Printing machines
- Drive tasks in the glass, tile and tire industries as well as in general machine building.

### *Operator control*

DriveMonitor guides the user through operator screen forms where functions can be entered with a mouse click. Fig. 6/89 shows an example of a start-up screen form for axis configuration.

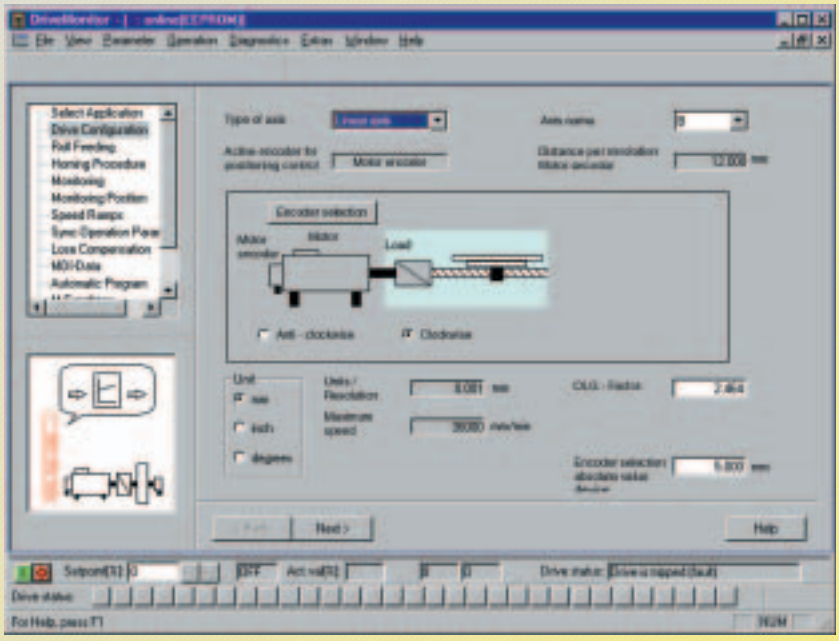


Fig. 6/89
Start-up screen form for axis configuration



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## Technology software – Positioning

### *Positioning in automatic mode*

Fig. 6/90 shows a typical application for an automatic traversing program which is automatically executed by MASTERDRIVES Motion Control. A chipboard laminated on both sides is being drilled through. The traversing program goes through the following steps:

- Travel A → B:
  The drill bit travels rapidly until it reaches the material and then begins to reduce the feeding speed. At point B precisely, the drill has reached the reduced feeding speed for drilling through the plastic coating.
- Travel B → C:
  The coating is drilled through at reduced speed
- Travel C → D:
  The chipboard itself is drilled through at normal feeding speed.
- Travel D → E:
  The reduced feeding speed again applies for the lower coating.
- Travel E → A:
  Drill returns at increased speed.

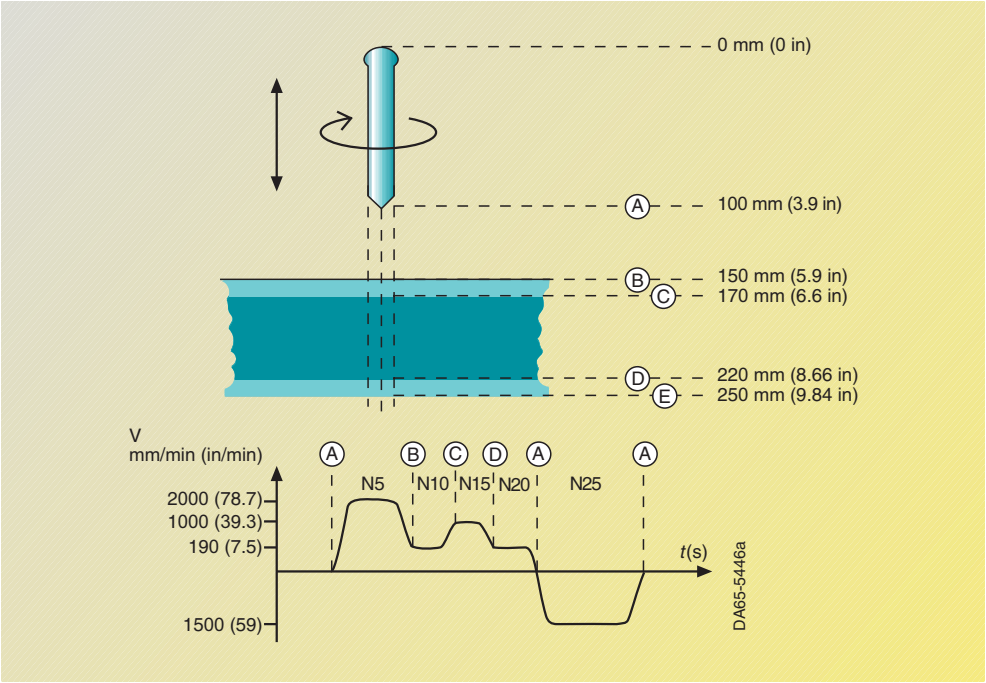



Fig. 6/90
Automatic drill function

The table shows the traversing program entered for this application in the MASTERDRIVES Motion Control (example).

| NC program | |
|---|---|
| N5 X 150 F2000 G44 D1: | Record No. 5: travel to position 150 mm (5.9 in) at speed of 2000 mm/min (78.7 in/min), tool correction (G44) stored in D1 (100 mm (3.9 in)) |
| N10 X 170 F190: | Record No. 10: Travel to position 170 mm (6.6 in) at speed of 190 mm/min (7.5 in/min) |
| N15 X 220 F1000: | Record No. 15: Travel to position 220 mm (8.66 in) at speed of 1000 mm/min (39.3 in/min) |
| N20 X 250 F190: | Record No. 20: Travel to position 250 mm (9.84 in) at speed of 190 mm/min (7.5 in/min) |
| N25 X 0 F1500 D0: | Record No. 25: Travel to standard position 0 and deselect tool correction (D0) |



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## Technology software – Synchronous operation

### *General synchronous-operation functions*

The following synchronous-operation functions are contained:

- Electronic shaft (exact synchronism of several axes with long-time stability)
- Electronic gears (with a transmission ratio that can be precisely tuned via numerator and denominator settings; the value range for numerators and denominators, respectively, is –32767 to +32767)
- Transmission ratio can be changed even during operation. If necessary, the stipulated transmission ratio can be adjusted using a free ramp-function generator in order to avoid sudden changes.
- Electronic cam
  - With up to 400 interpolation points. The 400 interpolation points can be divided into upto 8 tables. A table can be reloaded in the background and edited while the first table is running on-line. There is linear interpolation between the interpolation points.
  - The interpolation points do not have to be equidistant but can be set closer together in critical zones and farther apart from each other in linear areas.
  - Changing tables on the fly is possible during operation.
  - The table is scalable in both the X and Y directions and has integrated gears.
- The distance/angle setpoint can be stipulated by a real "master axis" (internal or external) or by a "virtual master" created using the software.
- 2 digital inputs with interrupt capability for detecting synchronization signals, e.g. print marks.

### *SIMOLINK as the backbone of synchronous speed control*

The drives participating in angular synchronism are linked via the serial setpoint link, SIMOLINK. SIMOLINK is a high-speed ring of fiber-optic cables that operates at 11 Mbd and is used to transmit the angle setpoints from drive to drive or from a control system to the drives. To transmit one hundred 32-bit values, for example, SIMOLINK takes only 630 $\mu$s. Special SYNC telegrams are used to achieve exact, jitter-free transmission synchronization of the sampling times of up to 200 connected converters. This enables highly dynamic and precise synchronous operation of the drives. The master incremental encoder is normally not needed, as its function is performed by the software and transmitted via SIMOLINK (principle of the "virtual master axis"). Conventional operation with master incremental encoders is, of course, possible as well.

Thanks to SIMOLINK, the master-drive function can be assigned to any drive or even to a higher-level control system. This is especially necessary in the case of machines where drives are taken out of the combined drive system, e.g. in the case of shaftless printing machines.

The master-drive function can also be performed by a drive which is temporarily taken out of the combined drive system. SIMADYN D, SIMATIC M7 or SICOMP® SMP can act as the higher-level control system; SIMOLINK interfaces are also available for these systems.

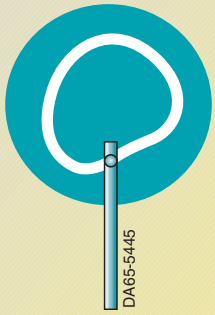
### *Electronic gears*

Electronic gears can easily be used to substitute all kinds of variable gear-ratio gearboxes and shafts. The transmission ratio is precisely defined as the numerator and denominator of a fraction (16 bits each). Operation with encoders built onto Siemens motors, including absolute-value encoders (e.g. encoders with protocol according to SSI standard) and SIMOLINK.

### *Electronic cam for simulating mechanical contours*

The electronic cam enables accurate relative movement between a master drive and a slave drive. It replaces mechanical eccentric cams, gear-change gearboxes or cranks as the following picture is intended to symbolize.

A maximum of 400 coordinate pairs of variables describe the relative movement by means of table interpolation. These 400 interpolation points can be divided up into upto 8 curves. x and y coordinates can be entered separately. The x values do not have to be equidistant, i.e. many points are placed at the tight sections of the curve and fewer in the straight sections. Linear interpolation takes place between the points. A very smooth torque curve can thus be achieved with relatively few points. These values, of course, can be parameterized via PROFIBUS DP. Therefore, where necessary, the cam may be changed within seconds (can be input by means of the DriveMonitor service program). A very high dynamic performance and a high degree of accuracy are achieved due to precontrol of the speed and torque.




| Master | Slave |
|---|---|
| 0° | 20 mm (0.78 in) |
| 5° | 100 mm (3.9 in) |
| 10° | 300 mm (11.8 in) |
| . | . |
| . | . |
| 360° | 20 mm (0.78 in) |

Fig. 6/91
Electronic cam disc



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## Technology software – Synchronous operation

### *Start/stop function for product collation and product decollation*

The start/stop function allows targeted shutdown and starting of the angular synchronism mode, including the cam function, at a precisely defined engaging position for one or several machine cycles. The ramp for the start/stop function can be stipulated as the distance. The engaging/disengaging action can also be started via a digital input.

The disengaging function is used, for example, for collating products if a product is missing in the continuous flow of goods.

The disengaging function stops the drive (slave drive) according to a corresponding request at a parking position and, after one or several machine cycles (product lengths), starts it again in angular synchronism with the master drive.
The engaging function can be used for removing defective products. This function is similar to the disengaging function but, here, the drive starts for one or more machine cycles with angular synchronism, starting from a parking position relative to the master drive. After this, it again moves precisely to its parking position.

The start/stop function can also be used in combination with the gears and the cam.

Fig. 6/92 shows an example of using the start/stop function for ejecting defective products of a packing machine.

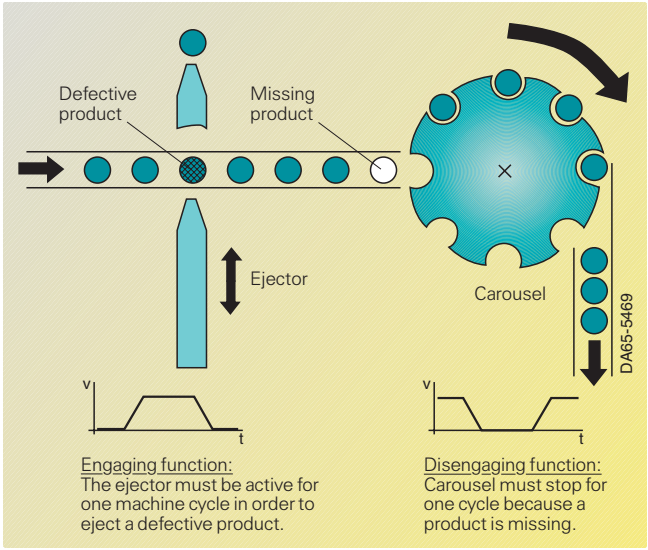



Fig. 6/92
Application example of the start/stop function for removing defective products in a packing machine

### Print-mark control

The print-mark control system, in conjunction with suitable reading devices, is for matching the master drive to the slave drive. The synchronization signal is evaluated by a high-speed digital input with interrupt capability and a time resolution of a few $\mu$s. The speed at which matching or the correction movement is carried out can be set.

An example of print-mark evaluation is a packing machine in which the continuous flow of goods must be packed in foil with the requirement that the printed image of the packing foil is always at the same position on the product. By detection of the print-mark on the foil, expansion (or shrinkage) of the foil – both of which always occur – can be detected and automatically compensated.

Drifting phenomena, which would be noticeable during operation without print-mark control, are thus reliably avoided.

Fig. 6/93 illustrates the method of functioning of print-mark synchronization.

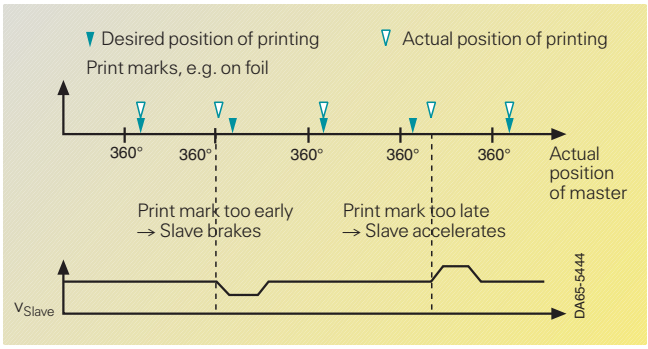



Fig. 6/93
Example of print-mark synchronization

### *Applications of the synchronous-operation function*

With the angular synchronism control system, mechanical shafts, gears and cams can be replaced, e.g. in

- shaftless printing machines
- packing and filling machines
- looms and other textile machines
- gantry traversing units
- conveyor systems.



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## Encoders for position detection

For the technology functions, information about the position is required in addition to speed. MASTERDRIVES Motion Control allows position detection directly via the motor encoder, thus eliminating the need for an additional built on encoder for position control. Only when it is necessary from a technological point of view can position detection take place by means of an additional external encoder. The types of encoder can be classified as incremental encoders and absolute-value encoders.

### *Incremental encoders*

Incremental encoders only provide the relative change in position. In order to enable absolute positioning, encoder detection must be referenced. This can be done by means of a proximity switch (BERO®) with a known mechanical position and/or with the zero mark of the encoder.

### *Absolute-value encoders*

can be divided up into two groups:

Single-turn encoders (two-pole resolver, optical sin/cos incremental encoder) supply the absolute position within a revolution. If absolute positions have to be detected over several revolutions with a single-turn encoder (normal occurrence), referencing is necessary as with the incremental encoder.

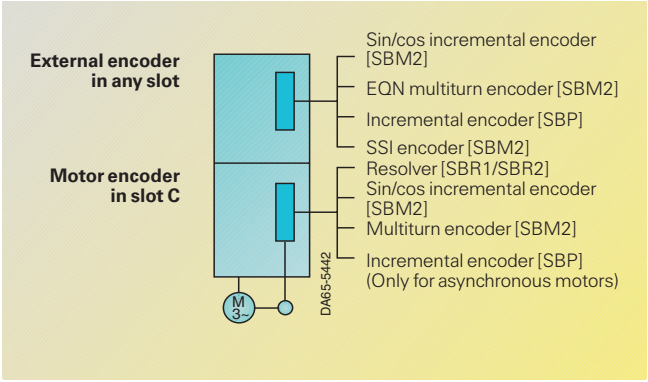



Fig. 6/94
Overview of the useable encoder-evaluation boards

Multiturn encoders detect the position within a revolution and over a defined range (e.g. 4096 revolutions) and supply this value when the system is restarted after a power failure. Referencing is thus not necessary.

Encoder-evaluation boards ("sensor boards") that can be used with MASTERDRIVES Motion Control units are shown in Fig. 6/94.
A maximum of two encoders can be evaluated at the same time.

Overview of the characteristics of the different encoders:

| Encoder type | Evaluation board in MASTERDRIVES Motion Control | Resolution (increments/revolution) | Achievable positioning accuracy (1) (pulses/revolution) | Useable as Motor encoder (slot C) | External encoder |
|---|---|---|---|---|---|
| Resolver (2) | SBR1/SBR2 (without/with incremental encoder simulation) | 4096 pulses/rev. with 2-pole resolver | 1024 pulses/rev. with 2-pole resolver | Yes | No |
| Sin/cos incremental encoder 1 $V_{pp}$ (5) | SBM/SBM2 | 16.8 x $10^6$ pulses/rev. | $10^5$ to $10^6$ pulses/rev. | Yes | Yes (SBM2) |
| Absolute-value encoder (EnDat) | SBM/SBM2 | 16.8 x $10^6$ pulses/rev. 4096 revolutions can be simulated | $10^5$ to $10^6$ pulses/rev. | Yes | Yes (SBM2) |
| Incremental encoder TTL (3) | SBP | Number of lines x 4, i.e. 4096 pulses/rev. for standard motor encoder | Number of lines x 1, i.e. 1024 incs./rev. with standard motor encoder | Yes, with asynchronous motors | Yes |
| Absolute-value encoder SSI (4) | SBM/SBM2 | Typically 4096 pulses/rev. Typically 4096 revolutions can be simulated | typically 1024 pulses/rev. | No | Yes |

**Notes**

(1) In practice, the resolution of the encoder must be higher than the requested positioning accuracy by a factor of 4 to 10. The levels of accuracy given in the table are only rough guidelines.

(2) Resolver:

- In the case of multiple-pole resolvers, the resolution and accuracy are correspondingly higher.
- In the following cases, a sin/cos incremental encoder should be used instead of a resolver:
  – for stringent requirements regarding positioning accuracy
  – for stringent requirements regarding the dynamic response
  – when print marks are to be detected with a high degree of accuracy
  – when smooth running characteristics are required at extremely low speeds under approx. 5 rpm.
- In the case of the SBR2, incremental encoder simulation is performed at terminals equipped with 2 tracks, each with 512 or 1024 pulses per revolution (can be set) and zero pulse, RS422 level (TTL differential signal).
  Applies to 2-pole resolvers; with multiple-pole resolvers, the number of pulses per revolution is correspondingly higher.

(3) Incremental encoder:

- On the SBP, the pulses are quadrupled internally (flank evaluation).
- Number of lines can be parameterized between 4 and 32768 lines per revolution.
- Max. pulse frequency that can be evaluated: 410 kHz
- HTL and RS422 level can be evaluated

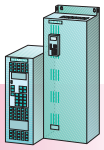
(4) SSI encoder

- Many types of SSI encoder with various resolutions (single-turn and multiturn, linear scales, etc.) are available on the market.
- All encoders can be evaluated with the standard SSI protocol (e.g. SIEMENS, Stegmann, TR, Fraba, Heidenhain, Infrarot-Abstandsmeßsystem, etc.).

(5) SBM/SBM2: Incremental encoder simulation is performed at the output terminals equipped with 2 tracks, each with 2048 pulses per revolution and zero pulse; RS422 level.



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## T100, T300 and T400 technology boards for compact and chassis units

The T100, T300 and T400 technology boards can be integrated in all compact and chassis units but **not in the Compact PLUS units**. With these boards, additional technological functions can be implemented. They are mainly used for SIMOVERT MASTERDRIVES Vector Control (VC), as these units do not have any integrated technology functions (positioning, synchronous operation). For a detailed description of the functionality of these boards, refer to the catalog for MASTERDRIVES Vector Control (DA 65.10 or the North American version).

The following is a short overview of the functions provided:

### *T100 technology board*

- 8 binary inputs and 5 binary outputs
- 5 analog inputs and 2 analog outputs
- 2 serial interfaces
- Many control, arithmetic and logic software modules.

Implementation of the T100 together with SIMOVERT MASTERDRIVES is only useful if many software blocks must be calculated in a very short period of time and the available processing time on the MASTERDRIVES Motion Control units is not sufficient (e.g. if the pulse frequency has to be set to 10 kHz for dynamic reasons).

### *T300 technology board*

- 16 binary inputs and 8 binary outputs
- 7 analog inputs and 4 analog outputs
- 2 serial interfaces
- Standard software for positioning, synchronous operation, center winders, multi-axis drives
- Compatible with SIMADYN D
- Customized planning with STRUC®

### *T400 technology board*

- 8 binary inputs and 4 bidirectional binary inputs or outputs
- 5 analog inputs and 2 analog outputs
- 2 serial interfaces
- Compatible with SIMADYN D
- Customized planning with SIMATIC STEP 7/CFC V 4.0

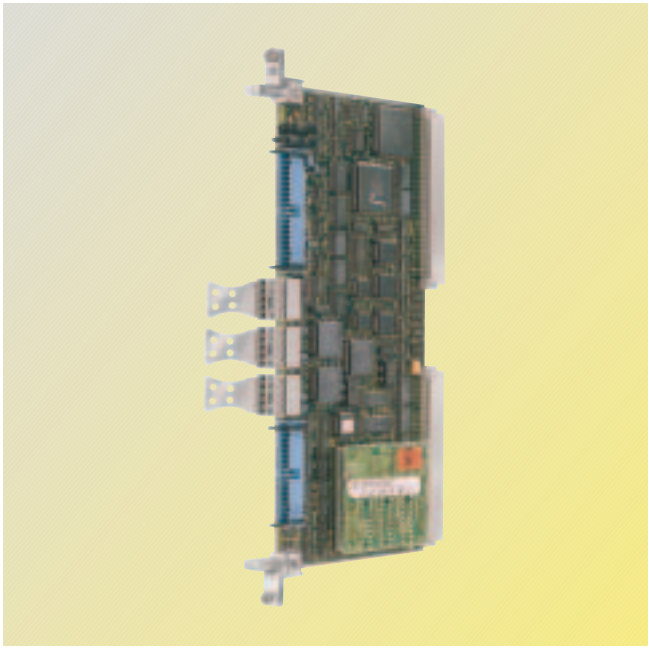


Fig. 6/95
T300 board with memory module



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## Central control boards

Siemens supplies "scalable technology functions" for Motion Control.

The MASTERDRIVE Motion Control converters already have a wide range of functions "on board". In order to extend these functions, the MASTERDRIVES Motion Control units can be flexibly linked up to central systems. Some central solutions can be configured graphically with CFC. This enables simple and rapid customized planning and adaptation.

The link can be established in any of the following ways:

- Fieldbus systems (PROFIBUS DP)
  - Transmission of setpoints, actual values, control words and parameters
  - Additional synchronization of the drives and direct communication between drives with clock-synchronous PROFIBUS DP
- SIMOLINK:
  - Transmission of setpoints, actual values and control words
  - Synchronization of the drives
  - Direct communication between the drives
  - Transmission of parameters not possible
- Analog input on MASTERDRIVES Motion Control +/– 10 V
  - The standard resolution of the analog input is 12 bits
  - 14 bits resolution possible with the EB1 expansion board
- Encoder signals from the MASTERDRIVES Motion Control to the control center using
  - TTL signals (5 V) with the SBR2, SBP, SBM2 encoder boards
  - HTL signals (15 V) with the SBP encoder board
  - SIMOLINK.
  - Clock-synchronous PROFIBUS DP

The following table provides an overview of the centralized control boards and their functionality.

| Central boards | | Software | | Link to MASTERDRIVES Motion Control | | | Functionality | | | | | Setpoint stipulation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Family | Hardware | Standard | customer-specific | Digital PROFIBUS DP | SIMOLINK | Analog +/– 10 V | Positioning | Synchronous operation | Cam | Lin. interpolation | Path curves | Speed | Position |
| SIMADYN D | PM 5/6 | no | yes, with CFC | yes | yes | yes | Customer-specific using CFC | | yes | yes | no | yes | yes |
| | T400[1] | no | yes, with CFC | Built into SIMOVERT MASTERDRIVES[1] | | | Customer-specific using CFC | | yes | no | no | yes | yes |
| For SIMATIC S7-300 | FM 354 | yes | no | no | no | yes | yes | no | no | yes | no | yes | no |
| | FM 357-2 | yes | yes | no | no | yes | yes | yes | yes | yes | yes | yes | no |
| For SIMATIC S7-400 | FM 453 | yes | no | no | no | yes | yes | no | no | yes | no | yes | no |
| | FM 458 | no | yes, with CFC | yes | yes | yes | Customer-specific using CFC | | yes | yes | no | yes | yes |
| SIMATIC TDC | CPU 551 | no | yes, with CFC | yes | no | yes | Customer-specific using CFC | | yes | yes | no | yes | yes |
| Open software kit (OSB) | SICOMP SMP | no | yes | no | yes | yes | yes | yes | yes | yes | no | yes | yes |
| | SIMATIC PC | yes | yes | yes[2] | no | no | yes | yes | yes | yes | no | yes | no |

1) Cannot be combined with Compact PLUS design (6SE70 . . - . .P. .).

2) Clock-synchronous.



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## OP1S user-friendly operator control panel

The OP1S operator control panel is an optional input/output device which can be used for parameterizing the units. Parameterization is menu-guided and is performed by selecting the parameter number and then entering the parameter value. Plain-text displays greatly facilitate parameterization.

Parameter and parameter value descriptions, as well as text displays in English, German, Spanish, French and Italian, are included in the standard version.

The OP1S has a non-volatile memory and is capable of permanently storing complete parameter sets. It can therefore be used for archiving parameter settings and for transferring parameter sets from one unit to another.
Its storage capacity is sufficient to store 5 CUMC board data sets. It is not possible to store data sets of the technology boards (e.g. T100, T300).

On the rear of the OP1S is a 9-pin SUB-D connector via which power is supplied and communication with the connected units takes place.

The OP1S operator control panel may be plugged directly onto the SUB-D socket of the PMU operator control and parameterizing unit and screwed into the front panel.

The OP1S operator panel can also be used as a remote-control device. The cable between the PMU and the OP1S must not exceed 200 m (656 ft). If longer than 5 m (16 ft), a standard 5 V power supply with a current capability of at least 400 mA must be included on the OP1S end, as shown in Fig. 6/97.

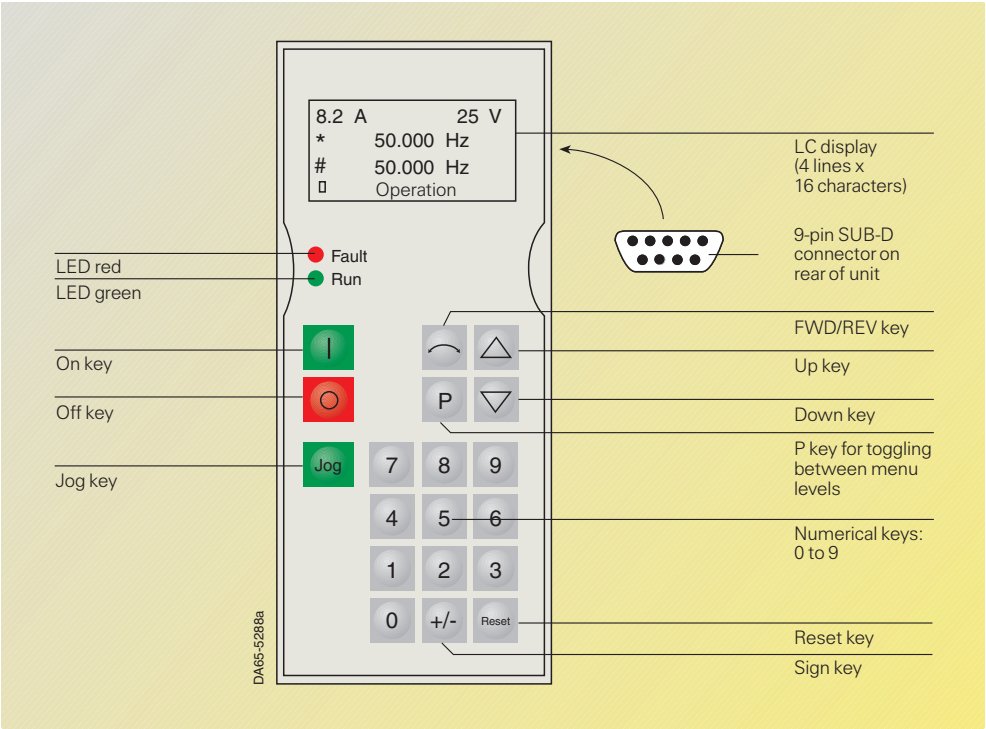



Fig. 6/96
View of the OP1S

| OP1S connections via RS485 | Pin | Designation | Description |
|---|---|---|---|
| | 1 | – | – |
| | 2 | – | – |
| | 3 | RS485 P | Data via RS485 interface |
| | 4 | – | – |
| | 5 | N5V | Ground |
| | 6 | P5V | 5 V auxiliary voltage supply |
| | 7 | – | – |
| | 8 | PS485 N | Data via RS485 interface |
| | 9 | – | Reference potential |

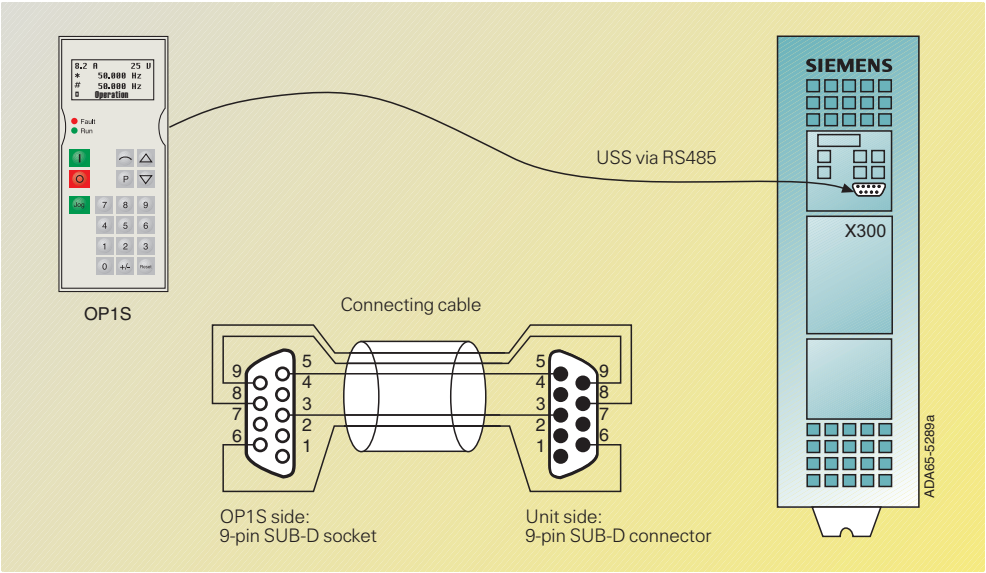



Fig. 6/97
OP1S in a point-to-point link



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## OP1S user-friendly operator control panel (continued)

The OP1S and the unit to be operated communicate with each other via the serial interface (RS485) using the USS protocol (see Fig. 6/97). During communication, the OP1S assumes the function of a master whereas the connected units function as slaves (see Fig. 6/99). The OP1S can be operated at transfer rates of 9.6 kbit/s and 19.2 kbit/s and is capable of communicating with up to 31 slaves (address 1 to 31). It can therefore be used in a point-to-point link (operator control of one unit) or with a bus configuration (operator control of several units).

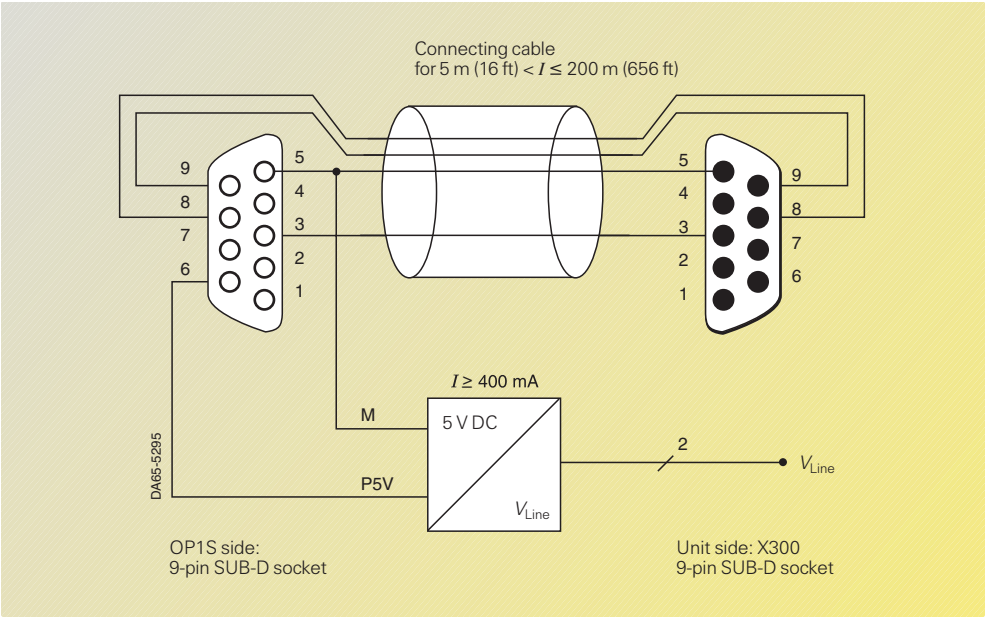



Fig. 6/98
OP1S in a point-to-point link with up to 200 m (656 ft) of cable

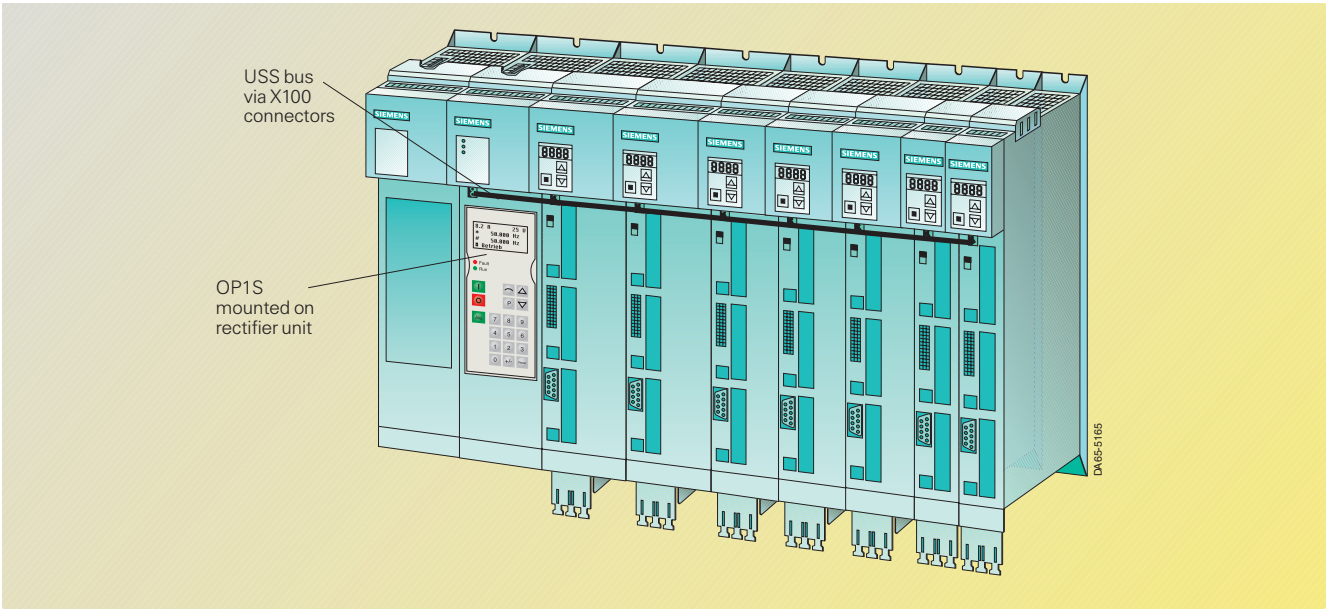
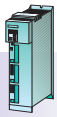


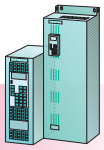

Fig. 6/99
OP1S, bus operation with Compact PLUS units



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Operator control and visualization | Compact PLUS units | Compact and chassis units





## Control terminal strip

The control terminal strip is located on the front of the Compact PLUS units or on the CUMC control board for the compact and chassis units.
All the necessary functions for operating and monitoring SIMOVERT MASTERDRIVES are accessible via the control terminal strip.

- Control commands, e.g. ON/OFF, inverter enable, ramp-function generator enable, setpoint enable, fixed setpoint selection, acknowledgement, etc.
- Analog setpoint inputs, e.g. speed setpoint, torque setpoint
- Analog outputs of internally calculated quantities, e.g. motor current, speed, motor voltage, frequency
- Status messages, e.g. ready to switch on, run, fault.

For the assignment of the control terminal strip, please refer to pages 6/29, 6/30, 6/32, 6/34 and 6/36.

## Main contactor control

SIMOVERT MASTERDRIVES have a digital output which can be parameterized and is pre-assigned to control an external main contactor via the ON command of the SIMOVERT MASTERDRIVES. In this case, an external 24 V DC auxiliary power supply is required.

The connections for this purpose are provided on the X9 terminal (see pages 6/29 and 6/38).





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## Start-up, parameterization and diagnostics with DriveMonitor

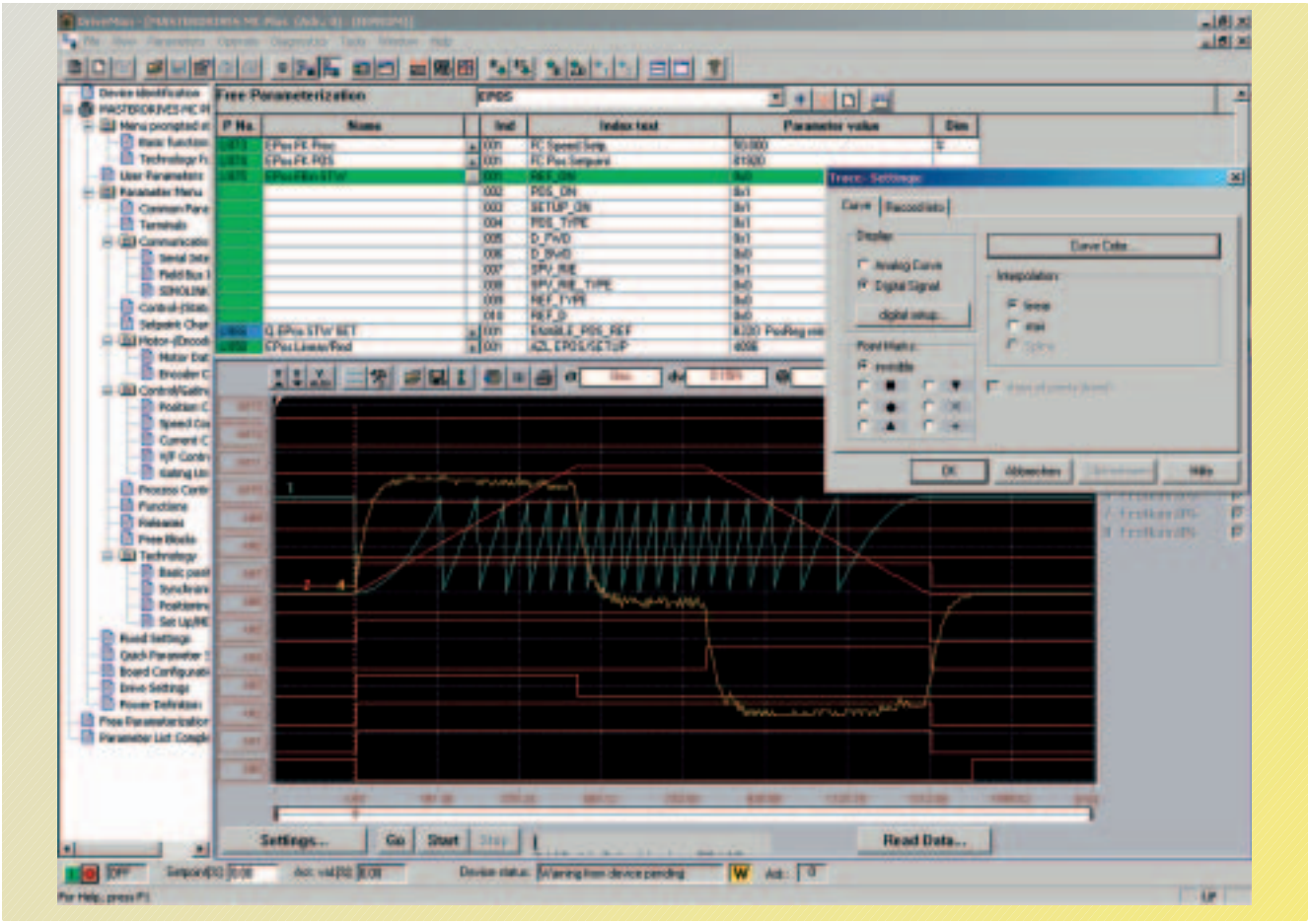


Fig. 6/100
Trace function with DriveMonitor

DriveMonitor performance characteristics

- Setting and monitoring of all basic-unit parameters in tables, which can be individually created
- Reading, writing, managing, printing and comparison of parameter sets
- Handling of process data (control commands, setpoints)
- Diagnostics (faults, alarms, fault memory)
- Off-line and on-line operation
- Parameterization of the T100, T300 and T400 technology boards
- Graphic display of the trace-memory function for analysis purposes
- Menu-assisted parameterization during commissioning.

Hardware and software requirements

- PC with Pentium II or comparable processor
- Operating systems
  - Windows 98/ME or
  - Windows NT/2000/ XP Professional
- Main memory of at least 32 MB RAM with Windows 98/ME, 64 MB RAM with Windows NT/2000/ XP Professional
- CD-ROM drive (24 x)
- Screen resolution 800 x 600 or higher
- Free hard-disk memory of 200 MB for minimum requirements
- Recommended system requirements
  - Pentium II/500 MHz or higher
  - Main memory of 256 MB RAM

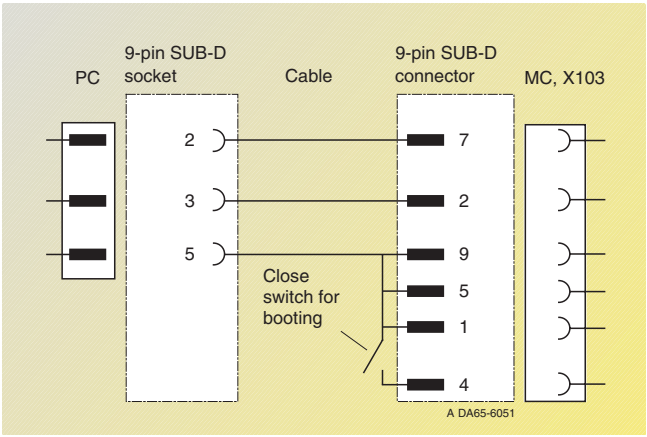



Fig. 6/101
Combination cable for boot function and DriveMonitor

- Windows 98/ME/NT/ 2000/XP Professional
- CD-ROM drive (24 x)
- Screen resolution 800 x 600 or higher
- Free hard-disk memory of 500 MB

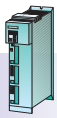
For stand-alone operation (USS)

- RS232 serial interface (for one unit, point-to-point)
- RS485 serial interface (for several units, bus operation), e.g. with the RS232/RS485 interface converter, SU1).

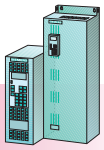


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## Power and encoder cables



Compact PLUS units



Compact and chassis units

For safe and reliable operation, it is essential for the power and encoder cables to be laid in accordance with EMC considerations, such as shielding, physical separation of encoder and power cables, etc. (see Electromagnetic compatibility, page 6/49).

If the power cables are unshielded, continuous sheet-metal barriers between signal and power cables are absolutely essential.

### Maximum lengths of encoder cables

| Encoder | Max. cable length |
|---|---|
| Sin/cos encoders (incremental encoders, singleturn generators, multiturn encoders) | 100 m (328 ft) |
| Resolvers | 150 m (492 ft) |
| Incremental encoders<br>– TTL<br>– HTL without signal inversion<br>– HTL with signal inversion | <br>100 m (328 ft)<br>150 m (492 ft)<br>300 m (984 ft) |

Note

Correct shielding of the signal cable is absolutely essential.

### Maximum lengths of power cables

The lengths given below apply only to power cables with PE insulation.

Cables with PVC insulation have a considerably higher capacitance per unit length.

If cables with PVC insulation are used, the lengths indicated must be reduced by one third.

Overdimensioning the converter or inverter allows the use of slightly longer cables.

#### *Compact PLUS units*

| Unit (power rating) | Pulse frequency of 5 kHz | | Pulse frequency of 10 kHz | |
|---|---|---|---|---|
| | Unshielded cable | Shielded cable | Unshielded cable | Shielded cable |
| 0.55 kW (0.75 HP) and 0.75 kW (1 HP) | 100 m (328 ft) | 70 m (230 ft) | 50 m (164 ft) | 35 m (115 ft) |
| 1.1 kW (1.5 HP) to 18.5 kW (24.8 HP) | 130 m (427 ft) | 100 m (328 ft) | 65 m (213 ft) | 50 m (164 ft) |

#### *Compact and chassis units*

| Unit (power rating) | Pulse frequency of 5 kHz | | Pulse frequency of 10 kHz | |
|---|---|---|---|---|
| | Unshielded cable | Shielded cable | Unshielded cable | Shielded cable |
| 2.2 kW (3 HP) to 4 kW (5 HP) | 100 m (328 ft) | 70 m (230 ft) | 50 m (164 ft) | 35 m (115 ft) |
| 5.5 kW (7.5 HP) to 250 kW (335 HP) | 130 m (427 ft) | 100 m (328 ft) | 65 m (213 ft) | 50 m (164 ft) |





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# Motion Control
# Dimension drawings



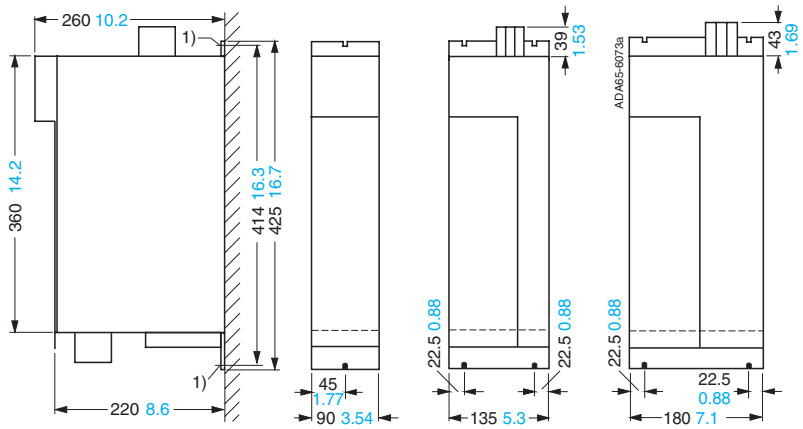

| | |
|---|---|
| 7/2 | Compact PLUS units |
| 7/3 | Compact units |
| 7/4 | Chassis units |
| 7/6 | Braking units and braking resistors |
| 7/8 | Line-side components |
| 7/15 | DC link components |
| 7/16 | 1FK6 synchronous servomotors |
| 7/17 | 1FK7 synchronous servomotors |
| 7/20 | 1FT6 synchronous servomotors |
| 7/28 | 1PH7 asynchronous servomotors |






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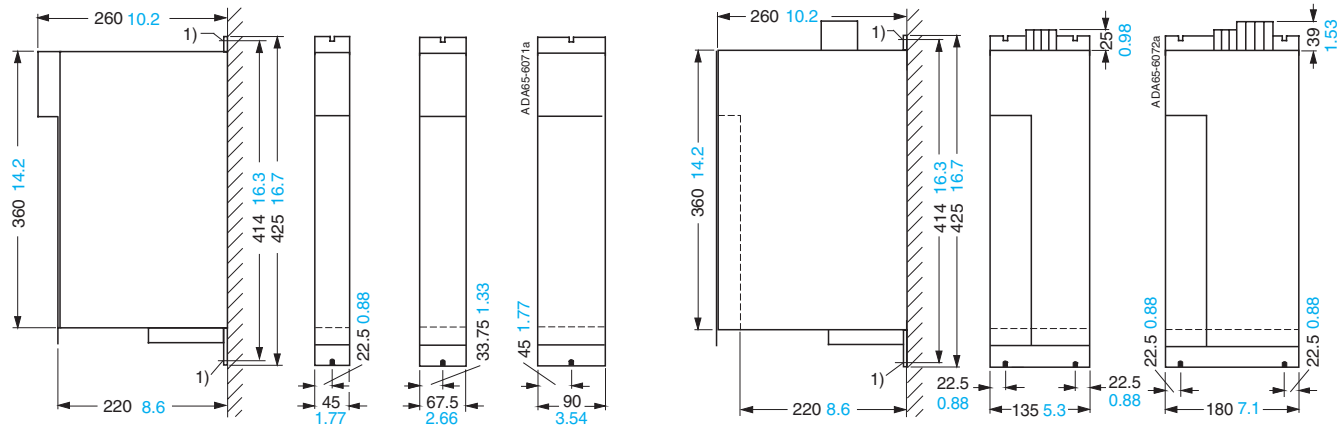
## Rectifier units



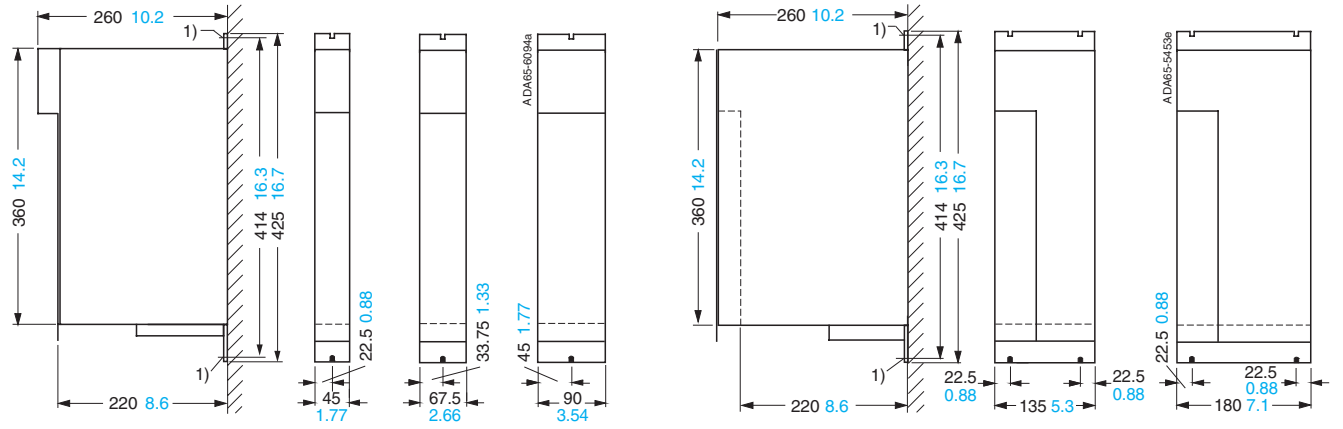

Front views without front cover | 15 kW | 50 kW | 100 kW

**Fig. 7/1**

## Converters and inverters




**Converter** | 0.55 kW (0.75 HP) | 1.1/1.5 kW (1.5/2 HP) | 3 kW and 4 kW (4 HP and 5 HP) | 5.5/7.5 kW (7/10 HP) | 11/15 kW (15/20 HP)




**Inverter** | 0.75 kW (1 HP) | 1.5/2.2 kW (2/3 HP) | 4 kW (5 HP) | 5.5/7.5/11 kW (7/10/15 HP) | 15/18.5 kW (20/25 HP)

Front views without front cover

**Fig. 7/2**

Dimension in mm
**Dimension in inches**

1) Retaining bolts: M5.



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## DC link module and capacitor module

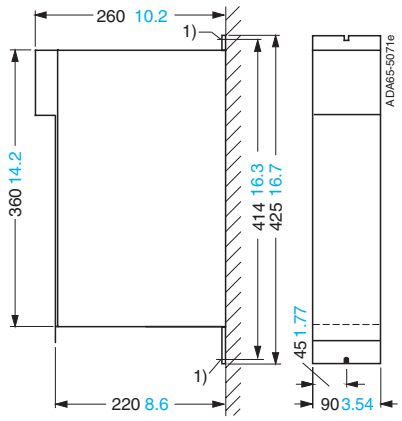



**Fig. 7/3**

## Rectifier units and rectifier/regenerative units

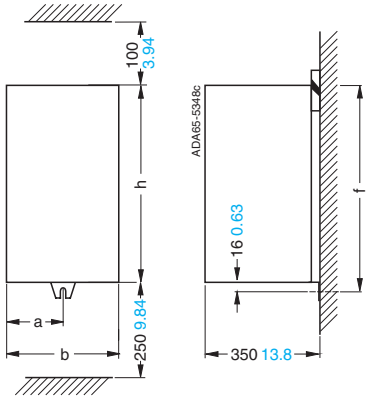



**Fig. 7/4**

**6SE7024–1EB85**
**6SE70 . . –. EC85**

| Type | a mm (in) | b | f | h |
|---|---|---|---|---|
| 6SE7024–1EB85 | 67.5 (2.66) | 135 (5.31) | 425 (16.73) | 425 (16.73) |
| 6SE70 . . –. EC85 | 90 (3.54) | 180 (7.07) | 600 (23.62) | 600 (23.62) |

## Converters and inverters, AFE inverters

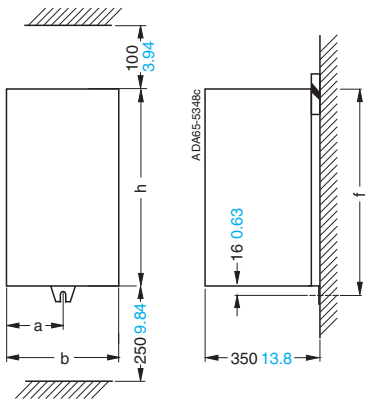



**Fig. 7/5**

**6SE70 . . –. . A51**
**6SE70 . . –. . B51**
**6SE70 . . –. . C51**
**6SE70 . . –. . D51**

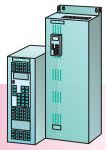
| Type | a mm (in) | b | f | h |
|---|---|---|---|---|
| 6SE70 . . –. . A51 | 45 (1.77) | 90 (3.54) | 425 (16.73) | 425 (16.73) |
| 6SE70 . . –. . B51 | 67.5 (2.66) | 135 (5.31) | 425 (16.73) | 425 (16.73) |
| 6SE70 . . –. . C51 | 90 (3.54) | 180 (7.07) | 600 (23.62) | 600 (23.62) |
| 6SE70 . . –. . D51 | 45[1]) (1.77[1])) | 270 (10.63) | 600 (23.62) | 600 (23.62) |

Dimension in mm
**Dimension in inches**

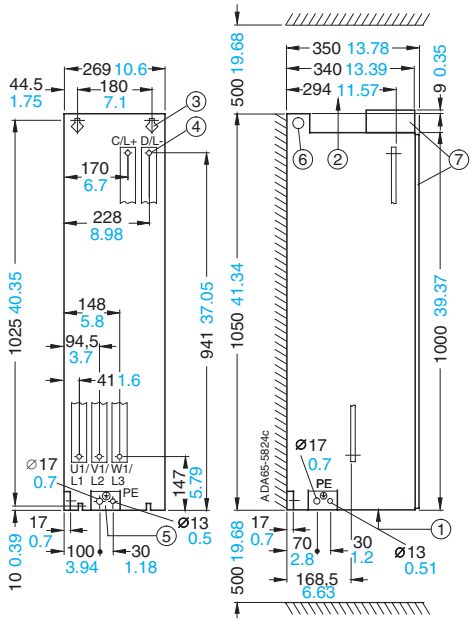
1) For size D, two lugs left and right.



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## Rectifier units and rectifier/regenerative units




① Air inlet, e.g. up to the closed cabinet base or cable duct

② Air outlet up to a reflecting surface, e.g. ceiling or closed roof

③ Through-hole for M8 bolt

④ Through-hole for power connections:
M16 for 6SE7036–1EE85–0AA0, 6SE7034–2FE85–0AA0, 6SE7035–4FE85–0AA0, 6SE7034–2HE85–0AA0 and 6SE7035–4HE85–0AA0
M12 for all other units

⑤ Pre-fitted terminal for PE:
M16 for 6SE7036–1EE85–0AA0, 6SE7034–2FE85–0AA0, 6SE7035–4FE85–0AA0, 6SE7034–2HE85–0AA0 and 6SE7035–4HE85–0AA0
M12 for all other units

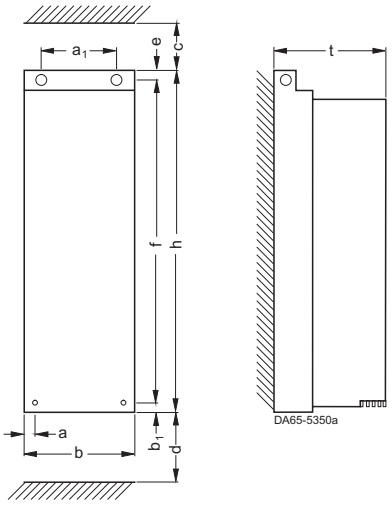
⑥ Lifting eye Ø 30 mm

⑦ Front cover (doors) and terminal cover, only with version IP20

**Fig. 7/6**

**6SE70 . . – . EE85**

## Converters and inverters, sizes E, F and G, AFE inverters




| Type | a mm (in) | $a_1$ | b | $b_1$ | c | d | e | f | h | t |
|---|---|---|---|---|---|---|---|---|---|---|
| 6SE70 . . – . . E | 45 (1.77) | 180 (7.07) | 270 (10.63) | 10 (0.39) | 350 (13.78) | 400 (15.75) | 15 (0.59) | 1025 (40.35) | 1050 (41.34) | 365 (14.37) |
| 6SE70 . . – . . F | 45 (1.77) | 270 (10.63) | 360 (14.17) | 10 (0.39) | 350 (13.78) | 400 (15.75) | 15 (0.59) | 1025 (40.35) | 1050 (41.34) | 365 (14.37) |
| 6SE70 . . – . . G | 119 (4.69) | 270 (10.63) | 508 (20.0) | 25 (0.98) | 350 (13.78) | 320 (12.6) | 50 (1.97) | 1375 (54.13) | 1450 (57.09) | 465 (18.3) |

**Fig. 7/7**

7

Dimension in mm
**Dimension in inches**



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## Inverters, size J

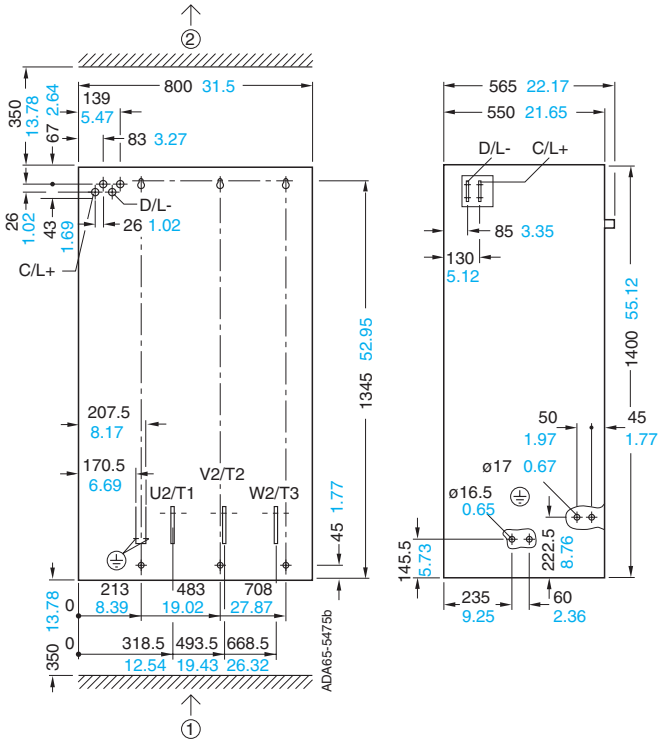



Fig. 7/8

## Converters, size K

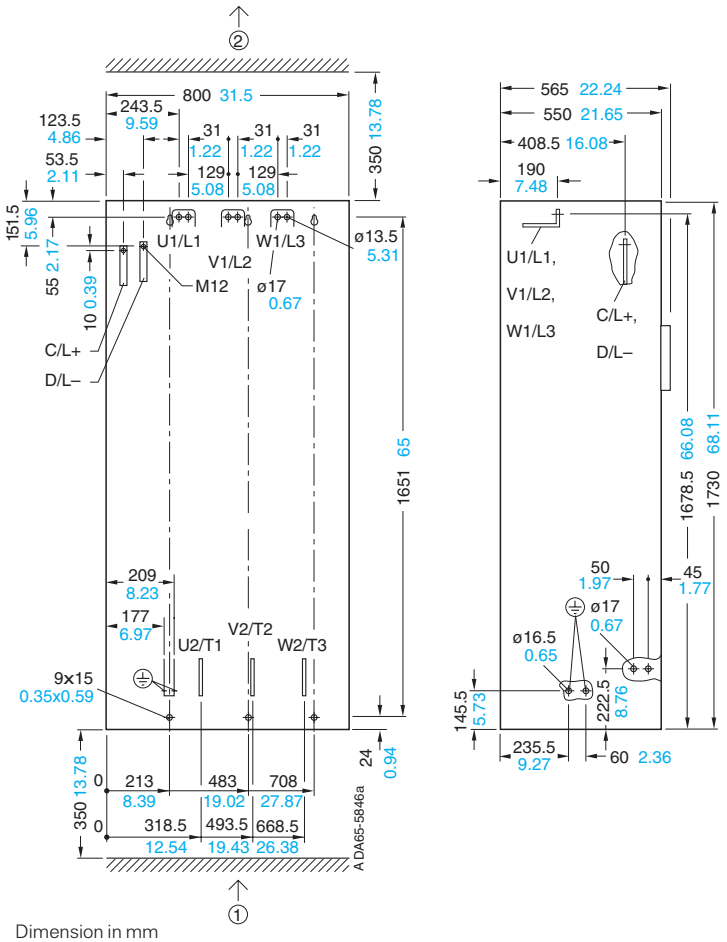



Fig. 7/9

Dimension in mm
**Dimension in inches**



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# Dimension drawings

## Braking units and braking resistors

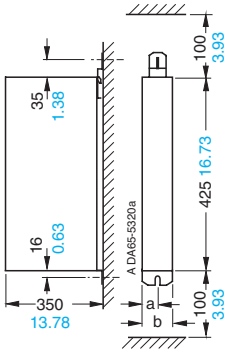



**Fig. 7/10**

**Sizes S, A and B**

| Type | a<br>mm<br>(in) | b |
|---|---|---|
| 6SE70 . . – . . S | 22.5<br>(0.88) | 45<br>(1.77) |
| 6SE70 . . – . . A | 45<br>(1.77) | 90<br>(3.54) |
| 6SE70 . . – . . B | 67.5<br>(2.66) | 135<br>(5.31) |

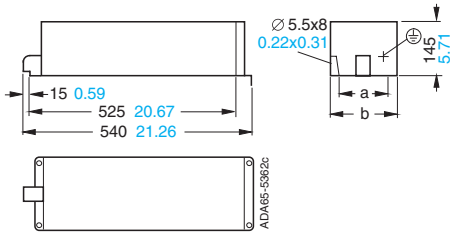
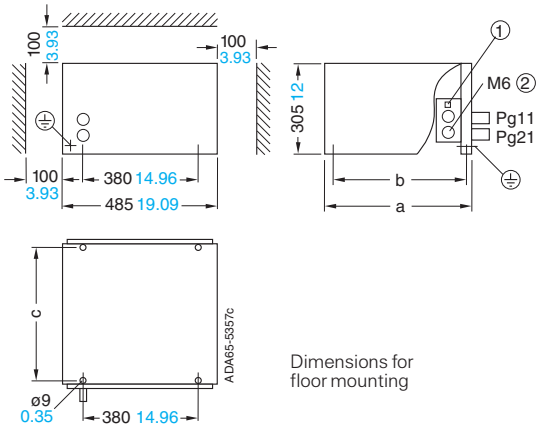



**Fig. 7/11**

**Braking resistors, 5 kW and 10 kW**

| Type | a<br>mm<br>(in) | b |
|---|---|---|
| 6SE70 18–0ES87–2DC0 | 150<br>(5.9) | 180<br>(7.07) |
| 6SE70 21–6ES87–2DC0 | 330<br>(13) | 360<br>(14.2) |

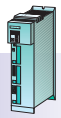



Dimensions for floor mounting

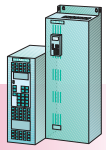
**Fig. 7/12**

**Braking resistors, 20 kW and 50 kW**

## Compact PLUS units



## Compact and chassis units



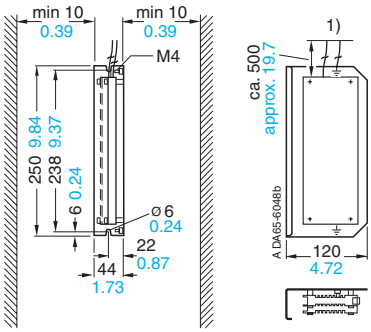



**Fig. 7/10a**

**Braking resistors, 2 kW and 4 kW**

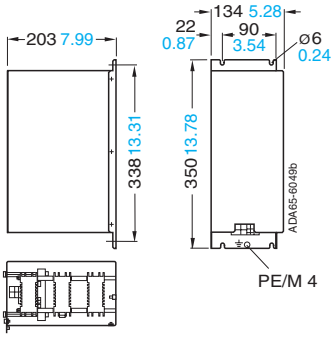
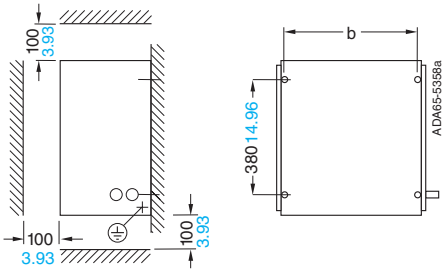



**Fig. 7/11a**

**Braking resistor, 12 kW**




Wall mounting possible

| Type | a<br>mm<br>(in) | b | c |
|---|---|---|---|
| 6SE70 23–2ES87–2DC0 | 430<br>(16.93) | 400<br>(15.75) | 400<br>(15.75) |
| 6SE70 28–0ES87–2DC0 | 740<br>(29.13) | 710<br>(27.95) | 710<br>(27.95) |

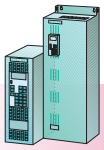
Dimension in mm
**Dimension in inches**

① T1/T2 socket terminal
② Stud terminal

1) 6SE7013–2ES87–2DC0: 1.3 mm² (AWG 16)
6SE7016–3ES87–2DC0: 2.1 mm² (AWG 14)



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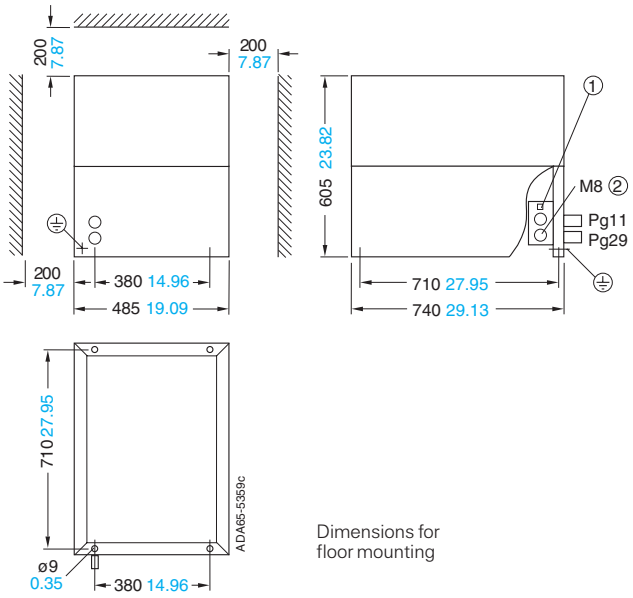


Compact and chassis units



Compact PLUS units

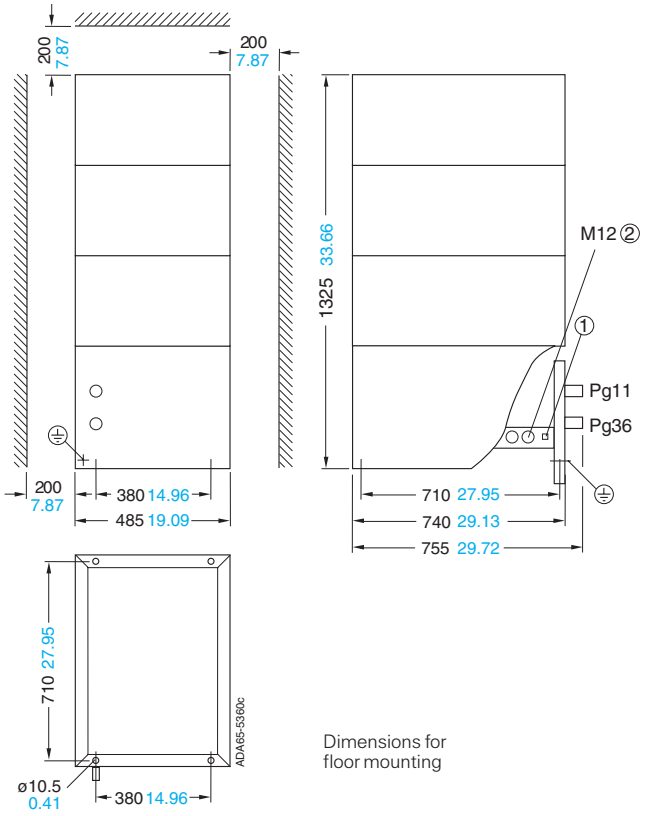
Braking units and braking resistors




Dimensions for floor mounting

**Fig. 7/13**

**Braking resistor, 100 kW**
**6SE7031–6ES87–2DC0**




Dimensions for floor mounting

**Fig. 7/14**

**Braking resistor, 170 kW**
**6SE7032–7ES87–2CD0**

Dimension in mm
**Dimension in inches**

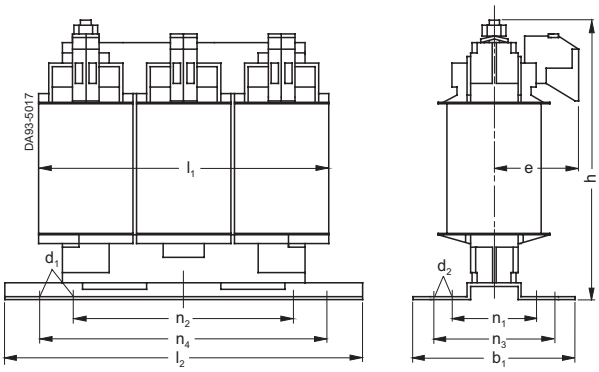
① T1/T2 socket terminal

② Stud terminal



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## 4EP commutating reactors




$n_3$ and $n_4$ mounting hole acc. to EN 60 852-4
$n_1$ and $n_2$ mounting hole acc. to DIN 41 308

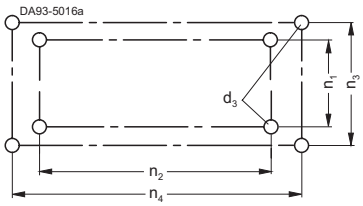



**Fig. 7/15**

**4EP commutating reactors, $I_{LN} \leq 35.5$ A**
with terminal connections, suitable for all mounting positions

| Type | $b_1$ mm (in) | $d_1$ | $d_2$ | $d_3$ | e | h | $l_1$ | $l_2$ | $n_1$ | $n_2$ | $n_3$ | $n_4$ | Weight, approx. kg (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EP32 | 57.5 (2.26) | 4.8 (0.19) | 9 (0.35) | M4 | 56 (2.20) | 108 (4.25) | 78 (3.07) | 88.5 (3.48) | 34 (1.34) | 1) | 42.5 (1.67) | 79.5 (3.13) | 0.7 (1.54) |
| 4EP33 | 64 (2.52) | 4.8 (0.19) | 9 (0.35) | M4 | 55 (2.16) | 122 (4.80) | 96 (3.78) | 124 (4.88) | 33 (1.30) | 1) | 44 (1.73) | 112 (4.41) | 0.9 (1.98) |
| 4EP34 | 73 (2.87) | 4.8 (0.19) | 9 (0.35) | M4 | 59 (2.32) | 122 (4.80) | 96 (3.78) | 124 (4.88) | 42 (1.65) | 1) | 53 (2.09) | 112 (4.41) | 1.4 (3.09) |
| 4EP35 | 68 (2.68) | 4.8 (0.19) | 9 (0.35) | M4 | 57 (2.24) | 139 (5.47) | 120 (4.72) | 148 (5.83) | 39 (1.54) | 90 (3.54) | 48 (1.89) | 136 (5.35) | 1.9 (4.19) |
| 4EP36 | 78 (3.07) | 4.8 (0.19) | 9 (0.35) | M4 | 62 (2.44) | 139 (5.47) | 120 (4.72) | 148 (5.83) | 49 (1.93) | 90 (3.54) | 58 (2.28) | 136 (5.35) | 2.8 (6.17) |
| 4EP37 | 73 (2.87) | 5.8 (0.23) | 11 (0.43) | M5 | 60 (2.36) | 159 (6.26) | 150 (5.91) | 178 (7.01) | 49 (1.93) | 113 (4.45) | 53 (2.09) | 166 (6.54) | 3.7 (8.16) |
| 4EP38 | 88 (3.46) | 5.8 (0.23) | 11 (0.43) | M5 | 67 (2.64) | 159 (6.26) | 150 (5.91) | 178 (7.01) | 64 (2.52) | 113 (4.45) | 68 (2.68) | 166 (6.54) | 5 (11.03) |
| 4EP39 | 99 (3.90) | 7 (0.28) | 13 (0.51) | M6 | 62 (2.44) | 181 (7.13) | 182 (7.17) | 219 (8.62) | 56 (2.20) | 136 (5.35) | 69 (2.72) | 201 (7.91) | 6.1 (13.45) |
| 4EP40 | 119 (4.69) | 7 (0.28) | 13 (0.51) | M6 | 72 (2.83) | 181 (7.13) | 182 (7.17) | 219 (8.62) | 76 (2.99) | 136 (5.35) | 89 (3.50) | 201 (7.91) | 8.8 (19.40) |

Terminal 8WA9 200
(for $I_{LN} \leq 15$ A)

| | |
|---|---|
| Solid | 0.5 mm² to 6.0 mm² |
| Finely stranded | 1.5 mm² to 4.0 mm² |

Terminal RKW 110 or
TRKSD 10 (for $I_{LN}$ 16 A to 35.5 A)

| | |
|---|---|
| Solid | 1.0 mm² to 16.0 mm² |
| Finely stranded | 1.0 mm² to 10.0 mm² |

Grounding stud M6 x 12

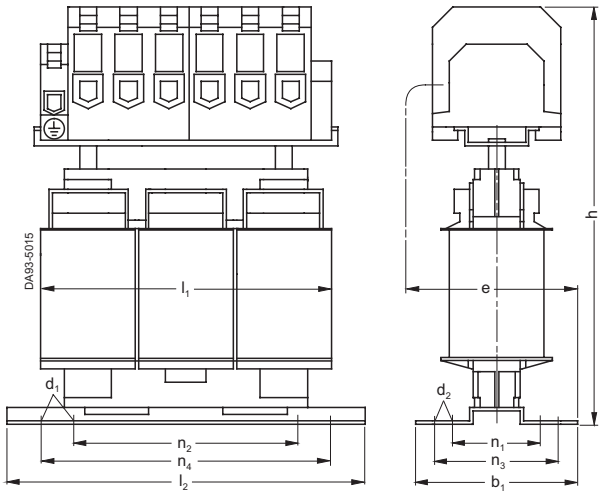
| | |
|---|---|
| Solid | 2.5 mm² to 10.0 mm² |
| Finely stranded | 4.0 mm² to 10.0 mm² |

1) Fixing hole in the center of the foot.

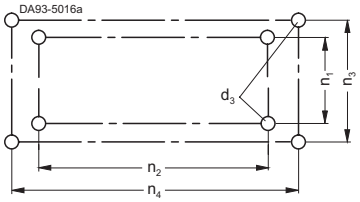


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## 4EP commutating reactors




$n_3$ and $n_4$ mounting hole acc. to EN 60 852-4
$n_1$ and $n_2$ mounting hole acc. to DIN 41 308




Terminal RKW 110
or TRKSD 10 (for $I_{LN} \leq 40$ A)

| | |
|---|---|
| Solid | 1.0 mm² to 16.0 mm² |
| Finely stranded | 1.0 mm² to 10.0 mm² |

Grounding stud M6 x 12

| | |
|---|---|
| Solid | 2.5 mm² to 10.0 mm² |
| Finely stranded | 4.0 mm² to 10.0 mm² |

Terminal 8WA1 304
(for $I_{LN}$ 40 A to 50 A)

| | |
|---|---|
| Solid | 1.0 mm² to 16.0 mm² |
| Stranded | 10.0 mm² to 25.0 mm² |
| Finely stranded | 2.5 mm² to 16.0 mm² |

Grounding terminal
EK 16/35

| | |
|---|---|
| Solid | 2.5 mm² to 16.0 mm² |
| Finely stranded | 4.0 mm² to 16.0 mm² |

**Fig. 7/16**

**4EP commutating reactors, $I_{LN}$ 36 A to 50 A**
with terminal connections, suitable for all mounting positions

| Type | $b_1$ mm (in) | $d_1$ | $d_2$ | $d_3$ | e | h | $l_1$ | $l_2$ | $n_1$ | $n_2$ | $n_3$ | $n_4$ | Weight, approx. kg (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EP38 | 88 (3.46) | 5.8 (0.23) | 11 (0.43) | M5 | 86 (3.39) | 193 (7.60) | 150 (5.91) | 178 (7.01) | 64 (2.52) | 113 (4.45) | 68 (2.68) | 166 (6.54) | 5 (11.03) |
| 4EP39 | 99 (3.90) | 7 (0.28) | 13 (0.51) | M6 | 91.5 (3.60) | 220 (8.66) | 182 (7.17) | 219 (8.62) | 56 (2.20) | 136 (5.35) | 69 (2.72) | 201 (7.91) | 6.1 (13.45) |
| 4EP40 | 119 (4.69) | 7 (0.28) | 13 (0.51) | M6 | 101.5 (3.97) | 220 (8.66) | 182 (7.17) | 219 (8.62) | 76 (2.99) | 136 (5.35) | 89 (3.50) | 201 (7.91) | 8.8 (19.40) |



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## 4EP and 4EU commutating reactors

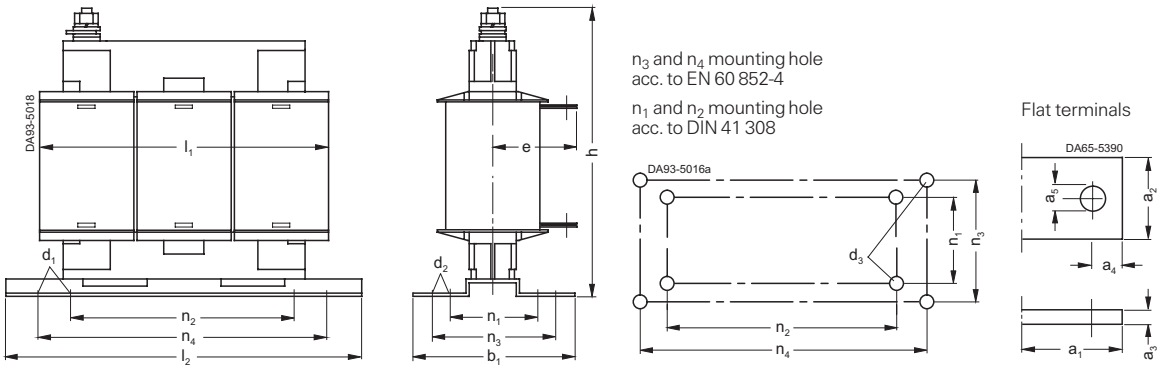



**Fig. 7/17**

**4EP commutating reactors, $I_{LN} \geq 51$ A**
with flat terminals, suitable for all mounting positions

| Type | $b_1$ | $d_1$ | $d_2$ | $d_3$ | e | h | $l_1$ | $l_2$ | $n_1$ | $n_2$ | $n_3$ | $n_4$ | Weight, approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm (in) | | | | | | | | | | | | kg (lb) |
| 4EP38 | 88 (3.46) | 5.8 (0.23) | 11 (0.43) | M5 | 76 (2.99) | 153 (6.02) | 150 (5.91) | 178 (7.01) | 64 (2.52) | 113 (4.45) | 68 (2.68) | 166 (6.54) | 5 (11.03) |
| 4EP39 | 99 (3.90) | 7 (0.28) | 13 (0.51) | M6 | 73 (2.87) | 179 (7.05) | 182 (7.17) | 219 (8.62) | 56 (2.20) | 136 (5.35) | 69 (2.72) | 201 (7.91) | 6.5 (14.33) |
| 4EP40 | 119 (4.69) | 7 (0.28) | 13 (0.51) | M6 | 83 (3.27) | 179 (7.05) | 182 (7.17) | 219 (8.62) | 76 (2.99) | 136 (5.35) | 89 (3.50) | 201 (7.91) | 10 (22.05) |

| Rated current $I_{LN}$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ |
|---|---|---|---|---|---|
| A | | | | | |
| 51 to 80 | 30 (1.18) | 20 (0.79) | 3 (0.12) | 10 (0.39) | 9 (0.35) |
| 81 to 200 | 35 (1.38) | 25 (0.98) | 5 (0.20) | 12.5 (0.49) | 11 (0.43) |

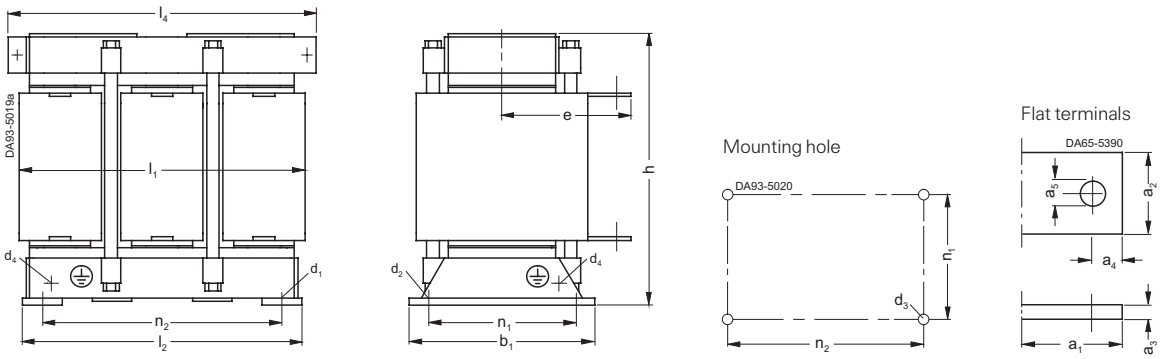



**Fig. 7/18**

**4EU commutating reactors, $I_{LN} \geq 45$ A**
with flat terminals, for mounting on horizontal surfaces

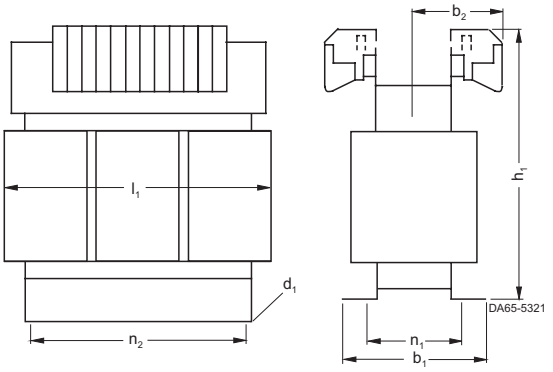
| Type | $b_1$ | $d_1$ | $d_2$ | $d_3$ | $d_4$ | e | h | $l_1$ | $l_2$ | $l_4$ | $n_1$ | $n_2$ | Weight, approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm (in) | | | | | | | | | | | | kg (lb) |
| 4EU24 | 104 (4.09) | 7 (0.28) | 13 (0.51) | M6 | M6 | 80 (3.15) | 220 (8.66) | 219 (8.62) | 206 (8.11) | 196 (7.72) | 70 (2.76) | 176 (6.93) | 11.9 (26.24) |
| 4EU25 | 128 (5.04) | 7 (0.28) | 13 (0.51) | M6 | M6 | 97 (3.82) | 220 (8.66) | 219 (8.62) | 206 (8.11) | 196 (7.72) | 94 (3.70) | 176 (6.93) | 18 (39.69) |
| 4EU27 | 146 (5.75) | 10 (0.39) | 18 (0.71) | M8 | M6 | 114 (4.49) | 250 (9.84) | 255 (10.04) | 235 (9.25) | 280 (11.02) | 101 (3.98) | 200 (7.87) | 28.2 (62.18) |
| 4EU30 | 155 (6.10) | 10 (0.39) | 18 (0.71) | M8 | M6 | 116 (4.57) | 280 (11.02) | 285 (11.22) | 264 (10.39) | 310 (12.20) | 118 (4.65) | 224 (8.82) | 40.3 (88.86) |
| 4EU36 | 169 (6.65) | 10 (0.39) | 18 (0.71) | M8 | M6 | 180 (7.09) | 335 (13.19) | 345 (13.58) | 314 (12.36) | 360 (14.17) | 138 (5.43) | 264 (10.39) | 61 (134.51) |

| Rated current $I_{LN}$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ |
|---|---|---|---|---|---|
| A | | | | | |
| 45 to 80 | 30 (1.18) | 20 (0.79) | 3 (0.12) | 10 (0.39) | 9 (0.35) |
| 81 to 200 | 35 (1.38) | 25 (0.98) | 5 (0.20) | 12.5 (0.49) | 11 (0.43) |
| 201 to 315 | 40 (1.57) | 30 (1.38) | 6 (0.24) | 15 (0.59) | 14 (0.55) |
| 316 to 800 | 50 (1.97) | 40 (1.57) | 6 (0.24) | 20 (0.79) | 14 (0.55) |



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## Autotransformers for regenerative feedback, with 25 % power-on duration




Mounting hole acc. to DIN 41 308

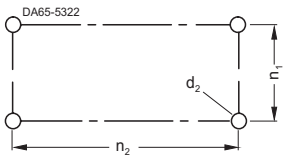


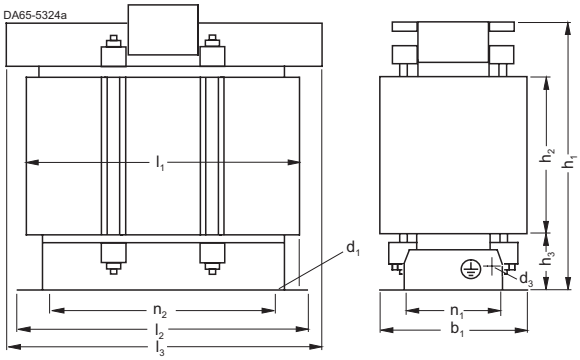

**Fig. 7/19**

**4AP25 to 4AP30 autotransformers**
suitable for all mounting positions

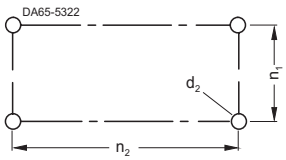
| Type | Designation acc. to DIN 41 302 | $b_1$ mm (in) | $b_2$ | $d_1$ | $d_2$ | $h_1$ | $l_1$ | $n_1$ | $n_2$ | Weight, approx. kg (lb) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4AP25 | 3UI 114/62 | 115 (4.53) | 85 (3.35) | 7.4 (0.29) | M6 | 214 (8.43) | 229 (9.02) | 94 (3.70) | 176 (6.93) | 19 (41.89) |
| 4AP27 | 3UI 132/70 | 133 (5.24) | 89 (3.50) | 10 (0.39) | M8 | 241 (9.49) | 264 (10.39) | 101 (3.98) | 200 (7.87) | 26 (57.33) |
| 4AP30 | 3UI 150/75 | 148 (5.83) | 92 (3.62) | 10 (0.39) | M8 | 270 (10.63) | 300 (11.81) | 118 (4.65) | 224 (8.82) | 37 (1.46) |

Screw terminals

| | | |
|---|---|---|
| 24 A: | Solid | 0.5 to 6 mm² |
| | Finely stranded | 0.5 to 4 mm² |
| 58 A: | Solid or stranded | 1 to 25 mm² |
| | Finely stranded | 2.5 to 16 mm² |
| 94 A: | Solid or stranded | 4 to 50 mm² |




Mounting hole acc. to DIN 41 308




Flat terminals

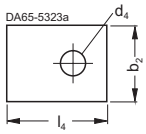



**Fig. 7/20**

**4AU36, 4AU39 autotransformers**
with flat terminals, suitable for all mounting positions

Permissible constant load for mounting on vertical surfaces:
0.95 · $P_s$ at $t_a$ = 55 °C (131° F)
$P_s$ at $t_a$ = 45 °C (113 °F)

| Form | Nominal current A | $b_2$ mm (in) | $d_4$ | $l_4$ |
|---|---|---|---|---|
| A | 100 | 16 (0.63) | 7 (0.28) | 25 (0.98) |
| A | 200 | 20 (0.79) | 9 (0.35) | 35 (1.38) |
| A | 400 | 25 (0.98) | 11 (0.43) | 35 (1.38) |

| Type | Designation acc. to DIN 41 302 | $b_1$ mm (in) | $d_1$ | $d_2$ | $d_3$ | $h_1$ | $h_2$ | $h_3$ | $l_1$ | $l_2$ | $l_3$ | $n_1$ | $n_2$ | Weight, approx. kg (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4AU36 | 3UI 180/75 | 169 (6.65) | 10 (0.39) | M8 | M6 | 320 (12.60) | 150 (5.91) | 60 (2.36) | 360 (14.17) | 314 (12.36) | 360 (14.17) | 138 (5.43) | 264 (10.39) | 59 (130.01) |
| 4AU39 | 3UI 210/70 | 174 (6.85) | 12 (0.47) | M10 | M6 | 370 (14.57) | 180 (7.09) | 66 (2.60) | 420 (16.54) | 366 (14.41) | 410 (16.14) | 141 (5.55) | 316 (12.44) | 81 (178.61) |



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## Autotransformers for regenerative feedback, with 25 % power-on duration (continued)

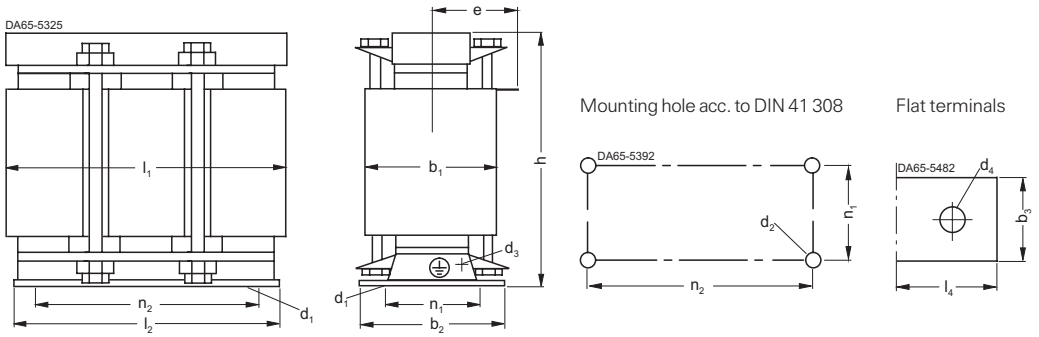



**Fig. 7/21**

**4BU autotransformer**
with flat terminals, for mounting on horizontal surfaces

| Type | Type size acc. to DIN 41 302 | $b_1$ mm (in) | $b_2$ | $d_1$ | $d_2$ | $d_3$ | h | $l_1$ | $l_2$ | $n_1$ | $n_2$ | Weight, approx. kg (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4BU43 | 3UI 240/ 80 | 194 (7.64) | 194 (7.64) | 15 x 22 (0.59 x 0.87) | M12 | M6 | 420 (16.54) | 480 (18.90) | 416 (16.38) | 155 (6.10) | 356 (14.02) | 108 (238.14) |
| 4BU45 | 3UI 240/107 | 221 (8.70) | 221 (8.70) | 15 x 22 (0.59 x 0.87) | M12 | M6 | 420 (16.54) | 480 (18.90) | 416 (16.38) | 182 (7.17) | 356 (14.02) | 135 (297.68) |
| 4BU47 | 3UI 240/137 | 251 (9.88) | 251 (9.88) | 15 x 22 (0.59 x 0.87) | M12 | M6 | 420 (16.54) | 480 (18.90) | 416 (16.38) | 212 (8.35) | 356 (14.02) | 170 (374.85) |
| 4BU51 | 3UIS 265/107 | 267 (10.51) | 207 (8.15) | 12.5 (0.49) | M10 | M12 | 515 (20.28) | 555 (21.85) | 470 (18.50) | 170 (6.69) | 410 (16.14) | 180 (396.90) |

| Form | Nominal current A | $b_3$ mm (in) | $d_4$ | $l_4$ |
|---|---|---|---|---|
| A | 200 | 20 (0.79) | 9 (0.35) | 35 (1.38) |
| A | 400 | 25 (0.98) | 11 (0.43) | 35 (1.38) |
| A | 630 | 30 (1.18) | 11 (0.43) | 40 (1.57) |



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## Radio-interference suppression filters for Compact PLUS units

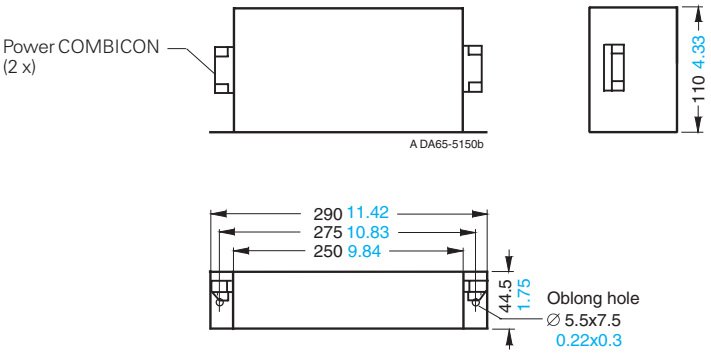



**Fig. 7/22**

**Radio-interference suppression filter 6SE7012–0EP87–0FB0**

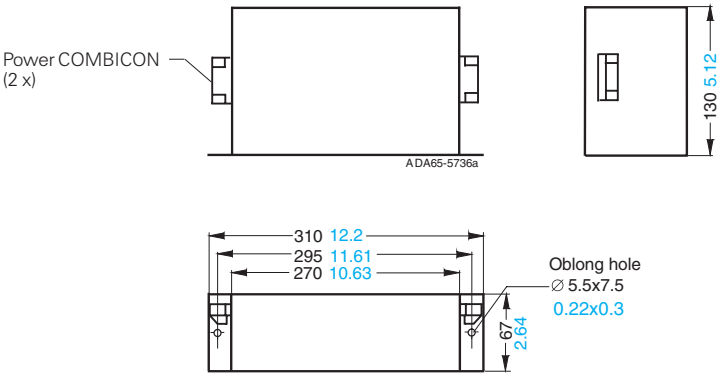



**Fig. 7/23**

**Radio-interference suppression filter 6SE7016–0EP87–0FB0**

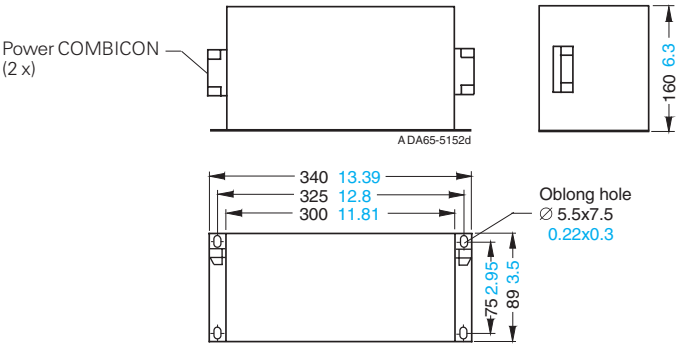


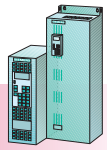

**Fig. 7/24**

**Radio-interference suppression filter 6SE7021–2EP87–0FB0, 6SE7021–8EP87–0FB0**

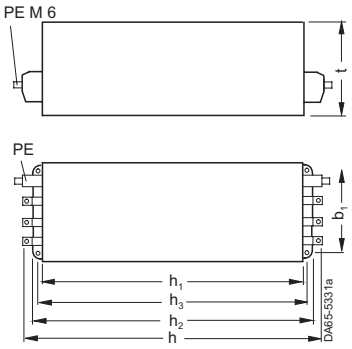
Dimension in mm
**Dimension in inches**



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## Radio-interference suppression filters for compact and chassis units



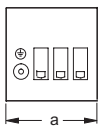




Fig. 7/25

**Radio-interference suppression filter 6SE7021, 6SE7023, 6SE7027**

| Type | a<br>mm<br>(in) | $b_1$ | h | $h_1$ | $h_2$ | $h_3$ | t | Terminals | Grounding stud | Weight, approx.<br>kg<br>(lb) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6SE7021–0ES87–0FB1 | 90<br>(3.54) | 75<br>(2.95) | 215<br>(8.46) | 166<br>(6.54) | 196<br>(7.72) | 182<br>(7.17) | 81<br>(3.19) | 4 mm²<br>(AWG 10) | M6 | 2.5<br>(5.51) |
| 6SE7021–8ES87–0FB1 | 90<br>(3.54) | 75<br>(2.95) | 215<br>(8.46) | 166<br>(6.54) | 196<br>(7.72) | 182<br>(7.17) | 81<br>(3.19) | 4 mm²<br>(AWG 10) | M6 | 2.5<br>(5.51) |
| 6SE7023–4ES87–0FB1 | 101<br>(3.98) | 85<br>(3.35) | 231<br>(9.09) | 166<br>(6.54) | 196<br>(7.72) | 182<br>(7.17) | 86<br>(3.39) | 16 mm²<br>(AWG 4) | M6 | 4<br>(8.82) |
| 6SE7027–2ES87–0FB1 | 141<br>(5.55) | 120<br>(4.73) | 308<br>(12.13) | 221<br>(8.7) | 256<br>(10.08) | 240<br>(9.45) | 141<br>(5.55) | 50 mm²<br>(AWG 6 – 1/0) | M10 | 9<br>(19.85) |

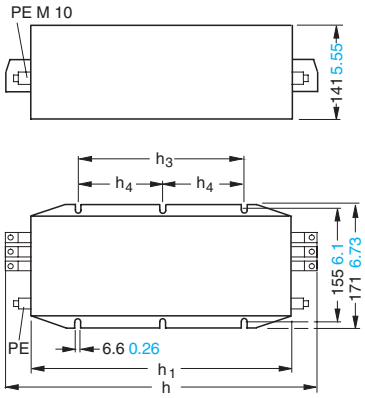






Fig. 7/26

**Radio-interference suppression filter 6SE7031**

| Type | h<br>mm<br>(in) | $h_1$ | $h_3$ | $h_4$ | Terminals | Weight, approx.<br>kg<br>(lb) |
|---|---|---|---|---|---|---|
| 6SE7031–0ES87–0FA0 | 348<br>(13.70) | 261<br>(10.28) | 115<br>(4.53) | – | 50 mm²<br>(AWG 6 – 1/0) | 10<br>(22.05) |
| 6SE7031–8ES87–0FA0 | 404<br>(15.91) | 301<br>(11.85) | 165<br>(6.50) | 82.5<br>(3.25) | 95 mm²<br>(AWG 4 – 4/0) | 10<br>(22.05) |

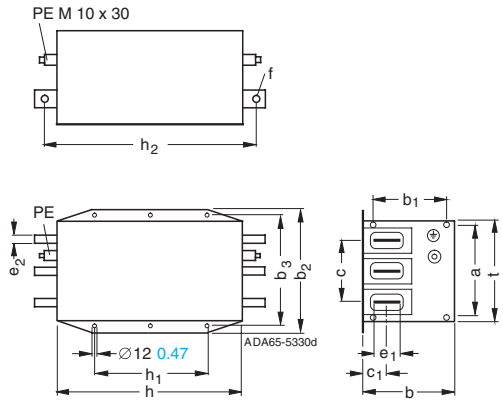



Fig. 7/27

**Radio-interference suppression filter 6SE7033, 6SE7036**

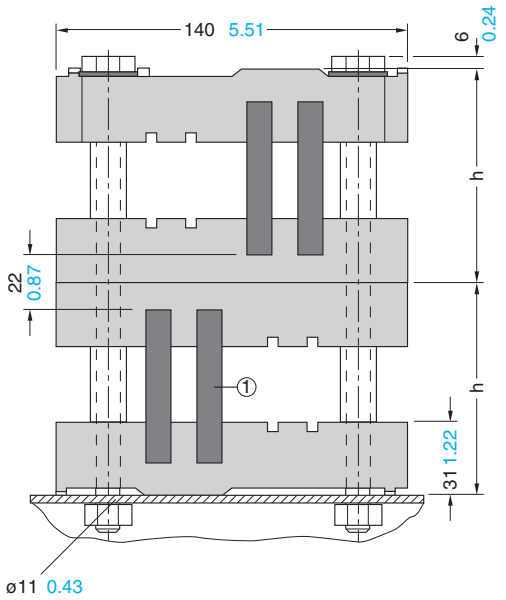
| Type | a<br>mm<br>(in) | b | $b_1$ | $b_2$ | $b_3$ | c | $c_1$ | e | $e_1$ | $e_2$ | f | h | $h_1$ | $h_2$ | t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6SE7033–2ES87–0FA1 | 180<br>(7.09) | 116<br>(4.57) | 85<br>(3.35) | 260<br>(10.24) | 235<br>(9.25) | 120<br>(4.72) | 36<br>(1.42) | 15<br>(0.59) | 25<br>(0.98) | 5<br>(0.20) | Ø 11<br>(0.43) | 300<br>(11.81) | 240<br>(9.45) | 360<br>(14.17) | 210<br>(8.27) |
| 6SE7036–0ES87–0FA1 | 180<br>(7.09) | 116<br>(4.57) | 85<br>(3.35) | 260<br>(10.24) | 235<br>(9.25) | 120<br>(4.72) | 36<br>(1.42) | 15<br>(0.59) | 30<br>(1.18) | 5<br>(0.20) | Ø 11<br>(0.43) | 350<br>(13.78) | 290<br>(11.42) | 410<br>(16.14) | 210<br>(8.27) |

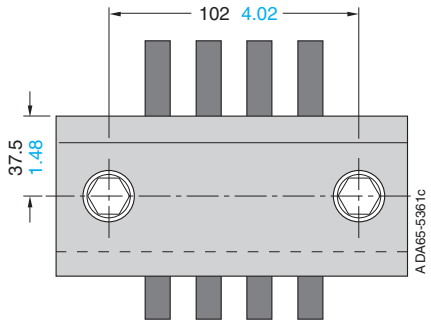
Dimension in mm
**Dimension in inches**



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## Busbar support for DC busbar system




| Rail height mm (in) | h |
|---|---|
| 30 (1.18) | 57 (2.24) |
| 40 (1.57) | 67 (2.64) |
| 50 (1.97) | 77 (3.03) |
| 60 (2.36) | 87 (3.44) |

① Copper busbar 2 x 60 x 10 mm (0.08 x 2.36 x 0.39 in)

**Fig. 7/28**

**Busbar support**

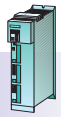
Dimension in mm
**Dimension in inches**



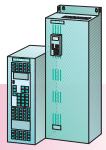
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# Dimension drawings

## 1FK6 synchronous servomotors



**Compact PLUS units**



**Compact and chassis units**

| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | | Re-solver | sin/cos incr. encod. 1 $V_{pp}$ | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | **DIN** **IEC** | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | h H | $i_2$ – | $o_1$ – | $o_2$ – | p HD | $s_2$ S | k LB | k LB | **d** **D** | $d_6$ – | l E | t GA | u F |
| **Type of construction IM B5, non-ventilated, with angled plug, with/without brake** | | | | | | | | | | | | | | | | | | | | | | |
| 36 | **1FK6032** | | 92 (3.6) | 60 (2.3) | 8 (0.31) | 75 (2.9) | 72 (2.8) | 3 (0.11) | 79 (3.11) | 36 (1.41) | 30 (1.18) | 95.5 (3.7) | 154 (6.1) | 78 (3.1) | 6.5 (0.26) | 179 (7.05) | – | **14** **(0.55)** | M5 | 30 (1.18) | 16 (0.62) | 5 (0.19) |
| 48 | **1FK6040** | | 120 (4.7) | 80 (3.1) | 10 (0.39) | 100 (3.9) | 96 (3.7) | 3 (0.11) | 85 (3.34) | 48 (1.88) | 40 (1.57) | 83 (3.2) | 134 (5.2) | – | 7 (0.27) | 160 (6.3) | 203.5 (8.01) | **19** **(0.74)** | M6 | 40 (1.57) | 21.5 (0.84) | 6 (0.23) |
| | **1FK6042** | | | | | | | | | | | 115 (4.5) | 166 (6.5) | | | 192 (7.6) | 235.5 (9.3) | | | | | |
| 63 | **1FK6060** | | 155 (6.1) | 110 (4.3) | 10 (0.39) | 130 (5.1) | 126 (4.9) | 3.5 (0.13) | 100 (3.93) | 63 (2.48) | 50 (1.96) | 104 (4.1) | 170 (6.6) | – | 9 (0.35) | 200 (7.9) | 238 (9.4) | **24** **(0.94)** | M8 | 50 (1.96) | 27 (1.06) | 8 (0.31) |
| | **1FK6063** | | | | | | | | | | | 154 (6.1) | 220 (8.6) | | | 250 (9.8) | 288 (11.3) | | | | | |
| 80 | **1FK6080** | | 186 (7.3) | 130 (5.1) | 13 (0.51) | 165 (6.4) | 155 (6.1) | 3.5 (0.13) | 114.5 (4.5) | 77.5 (3.05) | 58 (2.28) | 97 (3.8) | 165 (6.4) | – | 11 (0.43) | 195 (7.7) | 242 (9.5) | **32** **(1.25)** | M12 | 58 (2.28) | 35 (1.37) | 10 (0.39) |
| | **1FK6083** | | | | | | | | | | | 135 (5.3) | 203 (7.9) | | | 233 (9.17) | 280 (11) | | | | | |
| 100 | **1FK6100** | | 240 (9.4) | 180 (7) | 13 (0.51) | 215 (8.4) | 192 (7.5) | 4 (0.15) | 132 (5.19) | 96 (3.77) | 80 (3.14) | 113 (4.4) | 188 (7.4) | 155 (6.1) | 14 (0.5) | 218 (8.6) | 265 (10.4) | **38** **(1.49)** | M12 | 80 (3.14) | 41 (1.61) | 10 (0.39) |
| | **1FK6101** | | | | | | | | 150 (5.90) | | | 148 (5.8) | 214 (8.4) | | | 244 (9.6) | 291 (11.5) | | | | | |
| | **1FK6103** | | | | | | | | | | | 174 (6.8) | 240 (9.4) | | | 270 (10.6) | 317 (12.5) | | | | | |

**Fig. 7/29**

**1FK6032**

Shaft with featherkey

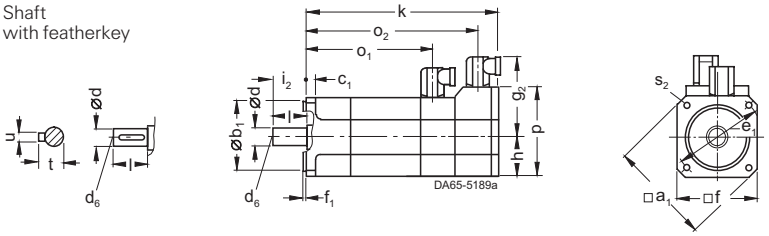



**Fig. 7/30**

**1FK604.**
**1FK606.**
**1FK608.**

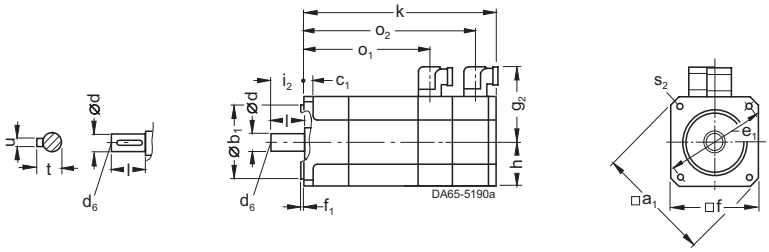



**Fig. 7/31**

**1FK6100**

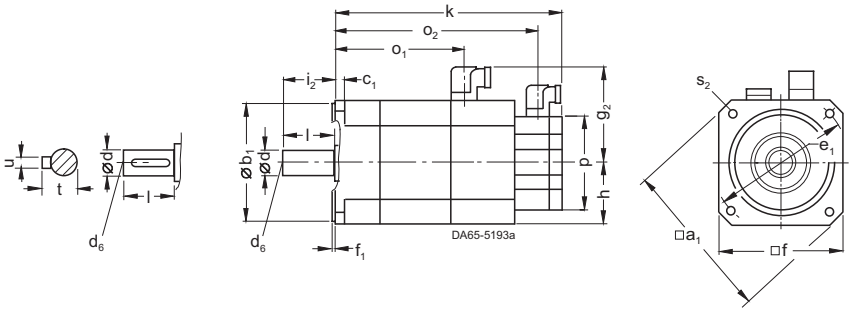
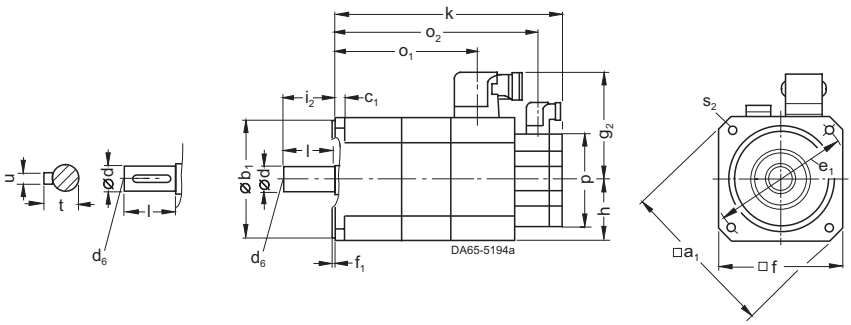



**Fig. 7/32**

**1FK6101**
**1FK6103**




7



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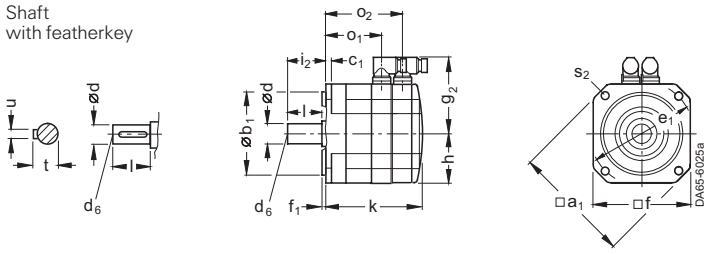
| For motor | | Dimension in mm (inches) | | | | | | | | | | | Resolver | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | without brake | | | with brake | | |
| Size | Type | **DIN**<br>**IEC** | $a_1$<br>P | $b_1$<br>N | $c_1$<br>LA | $e_1$<br>M | f<br>AB | $f_1$<br>T | $g_2$<br>– | h<br>H | $i_2$<br>– | $s_2$<br>S | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– |
| **1FK7 CT (compact), type of construction IM B5, non-ventilated, with angled plug, with/without brake** | | | | | | | | | | | | | | | | | | |
| 28 | **1FK7022-5** | | – | 40<br>(1.57) | 7<br>(0.28) | 63<br>(2.48) | 55<br>(2.17) | 2.5<br>(0.1) | 69.5<br>(2.74) | 27.5<br>(1.08) | 20<br>(0.79) | 5.8<br>(0.23) | 150<br>(5.91) | 75.5<br>(2.97) | 125<br>(4.92) | 178<br>(7.01) | 104.5<br>(4.11) | 154<br>(6.06) |
| 36 | **1FK7032-5** | | 93<br>(3.66) | 60<br>(2.36) | 8<br>(0.31) | 75<br>(2.95) | 72<br>(2.83) | 3<br>(0.12) | 78<br>(3.07) | 36<br>(1.42) | 30<br>(1.18) | 6.5<br>(0.26) | 150<br>(5.91) | 75.5<br>(2.97) | 125<br>(4.92) | 179<br>(7.05) | 104.5<br>(4.11) | 154<br>(6.06) |
| 48 | **1FK7040-5** | | 120<br>(4.72) | 80<br>(3.15) | 10<br>(0.39) | 100<br>(3.94) | 96<br>(3.78) | 3<br>(0.12) | 90<br>(3.54) | 48<br>(1.89) | 40<br>(1.57) | 7<br>(0.28) | 135<br>(5.31) | 74<br>(2.91) | 107<br>(4.21) | 164<br>(6.46) | 74<br>(2.91) | 136<br>(5.35) |
| | **1FK7042-5** | | 120<br>(4.72) | 80<br>(3.15) | 10<br>(0.39) | 100<br>(3.94) | 96<br>(3.78) | 3<br>(0.12) | 90<br>(3.54) | 48<br>(1.89) | 40<br>(1.57) | 7<br>(0.28) | 162<br>(6.38) | 101<br>(3.98) | 134<br>(5.28) | 191<br>(7.52) | 101<br>(3.98) | 163<br>(6.42) |
| 63 | **1FK7060-5** | | 155<br>(6.1) | 110<br>(4.33) | 10<br>(0.39) | 130<br>(5.12) | 126<br>(4.96) | 3.5<br>(0.14) | 105<br>(4.13) | 63<br>(2.48) | 50<br>(1.97) | 9<br>(0.35) | 157<br>(6.18) | 93<br>(3.66) | 125<br>(4.92) | 200<br>(7.87) | 93<br>(3.66) | 168<br>(6.61) |
| | **1FK7063-5** | | 155<br>(6.1) | 110<br>(4.33) | 10<br>(0.39) | 130<br>(5.12) | 126<br>(4.96) | 3.5<br>(0.14) | 105<br>(4.13) | 63<br>(2.48) | 50<br>(1.97) | 9<br>(0.35) | 202<br>(7.95) | 138<br>(5.43) | 170<br>(6.69) | 245<br>(9.65) | 138<br>(5.43) | 213<br>(8.39) |

| (continued) | | Basic absolute-value encoder (EnDat) (from size 48 on) sin/cos incremental encoder 1 $V_{pp}$ | | | | | | Absolute-value encoder (EnDat) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | | with brake | | | without brake | | | with brake | | | | | | | |
| | | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | **d**<br>**D** | $d_6$<br>– | l<br>E | t<br>GA | u<br>F |
| 28 | **1FK7022-5** | 182<br>(7.17) | 85<br>(3.35) | 134.5<br>(5.3) | 210<br>(8.27) | 113<br>(4.45) | 162.5<br>(6.4) | 182<br>(7.17) | 85<br>(3.35) | 134.5<br>(5.3) | 210<br>(8.27) | 113<br>(4.45) | 162.5<br>(6.4) | **9**<br>**(0.35)** | M3 | 20<br>(0.79) | 10.2<br>(0.4) | 3<br>(0.12) |
| 36 | **1FK7032-5** | 182<br>(7.17) | 85<br>(3.35) | 134.5<br>(5.3) | 211<br>(8.31) | 114<br>(4.49) | 163.5<br>(6.44) | 182<br>(7.17) | 85<br>(3.35) | 134.5<br>(5.3) | 211<br>(8.31) | 114<br>(4.49) | 163.5<br>(6.44) | **14**<br>**(0.55)** | M5 | 30<br>(1.18) | 16<br>(0.63) | 5<br>(0.2) |
| 48 | **1FK7040-5** | 155<br>(6.1) | 64<br>(2.52) | 106<br>(4.17) | 184<br>(7.24) | 73<br>(2.87) | 135<br>(5.31) | 164<br>(6.46) | 65<br>(2.56) | 107<br>(4.21) | 193<br>(7.6) | 74<br>(2.91) | 136<br>(5.35) | **19**<br>**(0.75)** | M6 | 40<br>(1.57) | 21.5<br>(0.85) | 6<br>(0.24) |
| | **1FK7042-5** | 183<br>(7.2) | 92<br>(3.62) | 134<br>(5.28) | 212<br>(8.35) | 101<br>(3.98) | 163<br>(6.42) | 191<br>(7.52) | 92<br>(3.62) | 134<br>(5.28) | 220<br>(8.66) | 101<br>(3.98) | 163<br>(6.42) | **19**<br>**(0.75)** | M6 | 40<br>(1.57) | 21.5<br>(0.85) | 6<br>(0.24) |
| 63 | **1FK7060-5** | 180<br>(7.09) | 93<br>(3.66) | 125<br>(4.92) | 223<br>(8.78) | 93<br>(3.66) | 168<br>(6.61) | 188<br>(7.4) | 93<br>(3.66) | 125<br>(4.92) | 231<br>(9.09) | 93<br>(3.66) | 168<br>(6.61) | **24**<br>**(0.94)** | M8 | 50<br>(1.97) | 27<br>(1.06) | 8<br>(0.31) |
| | **1FK7063-5** | 225<br>(8.86) | 138<br>(5.43) | 140<br>(5.51) | 268<br>(10.55) | 138<br>(5.43) | 213<br>(8.39) | 233<br>(9.17) | 138<br>(5.43) | 170<br>(6.69) | 276<br>(10.87) | 138<br>(5.43) | 213<br>(8.39) | **24**<br>**(0.94)** | M8 | 50<br>(1.97) | 27<br>(1.06) | 8<br>(0.31) |

**Fig. 7/33**

**1FK702 . –5**
**1FK703 . –5**
**1FK704 . –5**
**1FK706 . –5**

Shaft
with featherkey

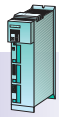




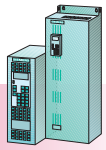

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# Dimension drawings

## 1FK7 CT synchronous servomotors



Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | | | | | | Resolver | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | without brake | | | with brake | | |
| Size | Type | **DIN**<br>**IEC** | $a_1$<br>P | $b_1$<br>N | $c_1$<br>LA | $e_1$<br>M | f<br>AB | $f_1$<br>T | $g_2$<br>– | h<br>H | $i_2$<br>– | $s_2$<br>S | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– |
| **1FK7 CT (compact), type of construction IM B5, non-ventilated, with angled plug, with/without brake** | | | | | | | | | | | | | | | | | | |
| 80 | **1FK7080-5** | | 186<br>(7.32) | 130<br>(5.12) | 13<br>(0.51) | 165<br>(6.5) | 155<br>(6.1) | 3.5<br>(0.14) | 119.5<br>(4.7) | 77.5<br>(3.05) | 58<br>(2.28) | 11<br>(0.43) | 156<br>(6.14) | 91<br>(3.58) | 124<br>(4.88) | 184<br>(7.24) | 91<br>(3.58) | 152<br>(5.98) |
| | **1FK7083-5** | | 186<br>(7.32) | 130<br>(5.12) | 13<br>(0.51) | 165<br>(6.5) | 155<br>(6.1) | 3.5<br>(0.14) | 119.5<br>(4.7) | 77.5<br>(3.05) | 58<br>(2.28) | 11<br>(0.43) | 194<br>(7.64) | 129<br>(5.08) | 162<br>(6.38) | 245<br>(9.65) | 152<br>(5.98) | 213<br>(8.39) |
| 100 | **1FK7100-5** | | 240<br>(9.45) | 180<br>(7.09) | 13<br>(0.51) | 215<br>(8.46) | 192<br>(7.56) | 4<br>(0.16) | 138<br>(5.43) | 96<br>(3.78) | 80<br>(3.15) | 14<br>(0.55) | 185<br>(7.28) | 113<br>(4.45) | 153<br>(6.02) | 204<br>(8.03) | 113<br>(4.45) | 172<br>(6.77) |
| | **1FK7101-5** | | 240<br>(9.45) | 180<br>(7.09) | 13<br>(0.51) | 215<br>(8.46) | 192<br>(7.56) | 4<br>(0.16) | 160<br>(6.3) | 96<br>(3.78) | 80<br>(3.15) | 14<br>(0.55) | 211<br>(8.31) | 139<br>(5.47) | 179<br>(7.05) | 240<br>(9.45) | 139<br>(5.47) | 208<br>(8.19) |
| | **1FK7103-5** | | 240<br>(9.45) | 180<br>(7.09) | 13<br>(0.51) | 215<br>(8.46) | 192<br>(7.56) | 4<br>(0.16) | 160<br>(6.3) | 96<br>(3.78) | 80<br>(3.15) | 14<br>(0.55) | 237<br>(9.33) | 165<br>(6.5) | 205<br>(8.07) | 266<br>(10.47) | 165<br>(6.5) | 234<br>(9.21) |

| (continued) | | Basic absolute-value encoder (EnDat) (from size 48 on) sin/cos incremental encoder 1 $V_{pp}$ | | | | | | Absolute-value encoder (EnDat) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | | with brake | | | without brake | | | with brake | | | | | | | |
| | | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | k<br>LB | $o_1$<br>– | $o_2$<br>– | **d**<br>**D** | $d_6$<br>– | l<br>E | t<br>GA | u<br>F |
| 80 | **1FK7080-5** | 179<br>(7.05) | 91<br>(3.58) | 124<br>(4.88) | 206<br>(8.11) | 91<br>(3.58) | 151<br>(5.94) | 187<br>(7.36) | 91<br>(3.58) | 124<br>(4.88) | 215<br>(8.46) | 91<br>(3.58) | 152<br>(5.98) | **32**<br>**(1.26)** | M12 | 58<br>(2.28) | 35<br>(1.38) | 10<br>(0.39) |
| | **1FK7083-5** | 217<br>(8.54) | 129<br>(5.08) | 162<br>(6.38) | 268<br>(10.55) | 153<br>(6.02) | 213<br>(8.39) | 225<br>(8.86) | 129<br>(5.08) | 162<br>(6.38) | 276<br>(10.87) | 152<br>(5.98) | 213<br>(8.39) | **32**<br>**(1.26)** | M12 | 58<br>(2.28) | 35<br>(1.38) | 10<br>(0.39) |
| 100 | **1FK7100-5** | 208<br>(8.19) | 113<br>(4.45) | 153<br>(6.02) | 227<br>(8.94) | 113<br>(4.45) | 172<br>(6.77) | 216<br>(8.5) | 113<br>(4.45) | 153<br>(6.02) | 235<br>(9.25) | 113<br>(4.45) | 172<br>(6.77) | **38**<br>**(1.5)** | M12 | 80<br>(3.15) | 41<br>(1.61) | 10<br>(0.39) |
| | **1FK7101-5** | 234<br>(9.21) | 139<br>(5.47) | 179<br>(7.05) | 263<br>(10.35) | 139<br>(5.47) | 208<br>(8.19) | 242<br>(9.53) | 139<br>(5.47) | 179<br>(7.05) | 271<br>(10.67) | 139<br>(5.47) | 208<br>(8.19) | **38**<br>**(1.5)** | M12 | 80<br>(3.15) | 41<br>(1.61) | 10<br>(0.39) |
| | **1FK7103-5** | 260<br>(10.24) | 165<br>(6.5) | 205<br>(8.07) | 289<br>(11.38) | 165<br>(6.5) | 234<br>(9.21) | 268<br>(10.55) | 165<br>(6.5) | 205<br>(8.07) | 297<br>(11.69) | 165<br>(6.5) | 234<br>(9.21) | **38**<br>**(1.5)** | M12 | 80<br>(3.15) | 41<br>(1.61) | 10<br>(0.39) |

**Fig. 7/34**

**1FK708 . –5**

Shaft
with featherkey

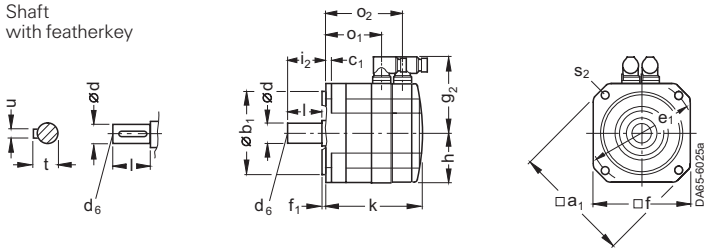
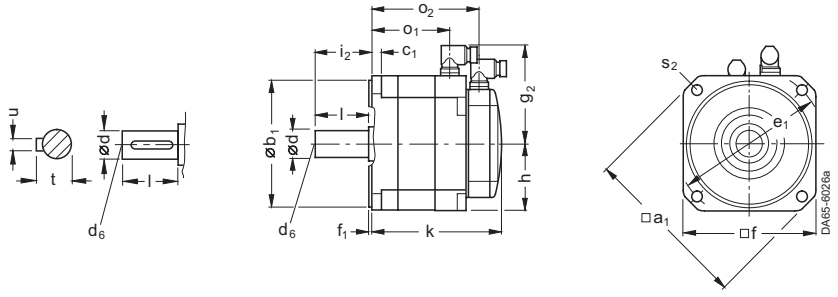



**Fig. 7/35**

**1FK7100–5**
**1FK7101–5**
**1FK7103–5**




7



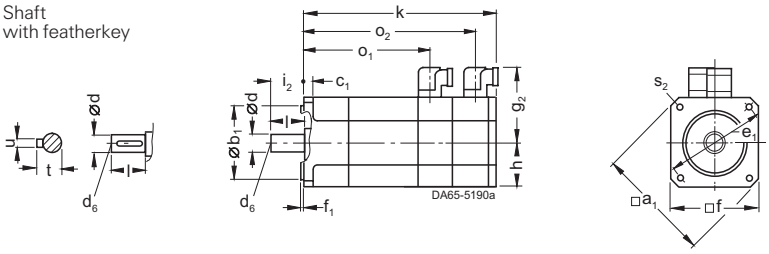
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| For motor | | Dimension in mm (inches) | | | | | | | | | | | | Resolver |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | without brake/with brake | | |
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | h H | $i_2$ – | $o_1$ – | $o_2$ – | $s_2$ S | k LB |
| **1FK7 HD (High Dynamic), type of construction IM B5, non-ventilated, with angled plug, with/without brake** | | | | | | | | | | | | | | |
| 36 | **1FK7033-7** | | 92 (3.62) | 60 (2.36) | 8 (0.31) | 75 (2.95) | 72 (2.83) | 3 (0.12) | 78 (3.07) | 36 (1.42) | 30 (1.18) | 114.5 (4.51) | 164/164 (6.46/6.46) | 6.5 (0.26) | 171.5/192.5 (6.75/7.58) |
| 48 | **1FK7043-7** | | 120 (4.72) | 80 (3.15) | 10 (0.39) | 100 (3.94) | 96 (3.78) | 3 (0.12) | 90 (3.54) | 48 (1.89) | 40 (1.57) | 135 (5.31) | 177/200 (6.97/7.87) | 7 (0.28) | 191.5/220.5 (7.54/8.68) |
| | **1FK7044-7** | | | | | | | | | | | 161 (6.34) | 202/225 (7.95/8.86) | | 216.5/245.5 (8.52/9.67) |
| 63 | **1FK7061-7** | | 155 (6.10) | 110 (4.33) | 10 (0.39) | 130 (5.12) | 126 (4.96) | 3.5 (0.14) | 105 (4.13) | 63 (2.48) | 50 (1.97) | 123 (4.84) | 166/184 (6.54/7.24) | 9 (0.35) | 186.5/228.5 (7.34/9) |
| | **1FK7064-7** | | | | | | | | | | | 187 (7.36) | 230/248 (9.06/9.76) | | 250.5/292.5 (9.86/11.52) |
| 80 | **1FK7082-7** | | 186 (7.32) | 130 (5.12) | 13 (0.51) | 165 (6.5) | 155 (6.1) | 3.5 (0.14) | 119.5 (4.7) | 77.5 (3.05) | 58 (2.28) | 142.5 (5.61) | 186/228 (7.32/8.98) | 11 (0.43) | 210.5/253 (8.29/10) |
| | **1FK7085-7** | | | | | | | | 132.5 (5.22) | | | 192.5 (7.58) | 236/278 (9.29/10.94) | | 260.5/303 (10.26/11.93) |

| (continued) | | sin/cos incremental encoder 1 $V_{pp}$ | Absolute-value encoder (EnDat) | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|
| | | DIN / IEC k LB | k LB | **d** **D** | $d_6$ – | l E | t GA | u F |
| 36 | **1FK7033-7** | 196.5/217 (7.74/8.54) | –/– | **14 (0.55)** | M5 | 30 (1.18) | 16 (0.63) | 5 (0.2) |
| 48 | **1FK7043-7** | 212/241 (8.35/9.49) | 220.5/249.5 (8.68/9.82) | **19 (0.75)** | M6 | 40 (1.57) | 21.5 (0.85) | 6 (0.24) |
| | **1FK7044-7** | 237/266 (9.33/10.47) | 245.5/274.5 (9.67/10.81) | | | | | |
| 63 | **1FK7061-7** | 209.5/251.5 (8.25/9.9) | 218/260 (8.58/10.24) | **24 (0.94)** | M8 | 50 (1.97) | 27 (1.06) | 8 (0.31) |
| | **1FK7064-7** | 273.5/315.5 (10.77/12.42) | 282/324 (11.1/12.76) | | | | | |
| 80 | **1FK7082-7** | 233.5/276 (9.19/10.87) | 242/284.5 (9.53/11.2) | **32 (1.26)** | M12 | 58 (2.28) | 35 (1.38) | 10 (0.39) |
| | **1FK7085-7** | 283.5/326 (11.16/12.83) | 292/334.5 (11.5/13.17) | | | | | |

**Fig. 7/36**

Shaft with featherkey

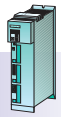




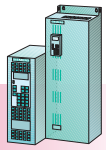

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# Dimension drawings

## 1FT6 synchronous servomotors



Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | Resolver | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | without brake | | with brake | |
| Size | Type | DIN IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | $o_1$ – | k LB | o – | k LB | o – |
| **Type of construction IM B5, non-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | | | |
| 28 | **1FT6021** | | – | 40 (1.57) | 10 (0.39) | 63 (2.48) | 55 (2.17) | 2.5 (0.1) | 63 (2.48) | 28 (1.1) | 20 (0.79) | – | 5.8 (0.23) | – | 34.5 (1.36) | 193 (7.6) | 122 (4.8) | 218 (8.58) | 147 (5.79) |
| | **1FT6024** | | – | | | | | | | | | | | | | 233 (9.17) | 162 (6.38) | 258 (10.16) | 187 (7.36) |
| 36 | **1FT6031** | | 92 (3.62) | 60 (2.36) | 8 (0.31) | 75 (2.95) | 72 (2.83) | 3 (0.12) | 77 (3.03) | 36 (1.42) | 30 (1.18) | – | 6 (0.24) | – | – | 180 (7.09) | 151 (5.94) | 200 (7.87) | 171 (6.73) |
| | **1FT6034** | | | | | | | | | | | | | | | 220 (8.66) | 191 (7.52) | 240 (9.45) | 211 (8.31) |

| (continued) | | sin/cos incremental encoder 1 $V_{pp}$ | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | | | | | |
| | DIN IEC | k LB | o – | k LB | o – | **d** D | $d_6$ – | l E | t GA | u F |
| 28 | **1FT6021** | 193 (7.6) | 122 (4.8) | 218 (8.58) | 147 (5.79) | **9 (0.35)** | M3 | 20 (0.79) | 10.2 (0.4) | 3 (0.12) |
| | **1FT6024** | 233 (9.17) | 162 (6.38) | 258 (10.16) | 187 (7.36) | | | | | |
| 36 | **1FT6031** | 220 (8.66) | 151 (5.94) | 240 (9.45) | 171 (6.73) | **14 (0.55)** | M5 | 30 (1.18) | 16 (0.63) | 5 (0.2) |
| | **1FT6034** | 260 (10.24) | 191 (7.52) | 280 (11.02) | 211 (8.31) | | | | | |

**Fig. 7/37**

**1FT602 .**

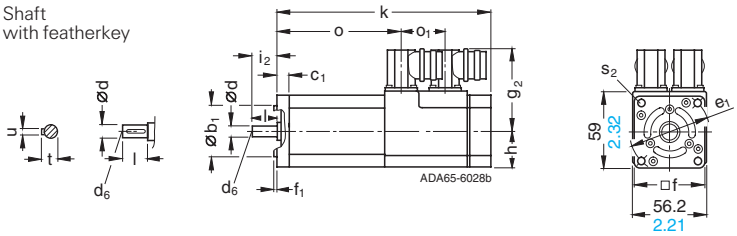
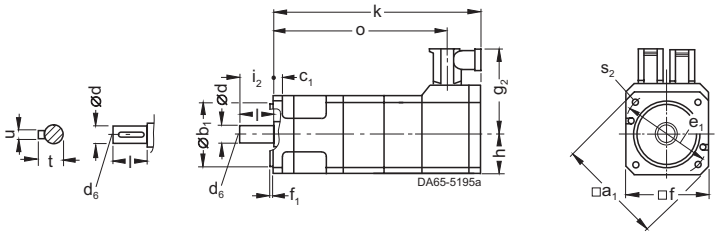



**Fig. 7/38**

**1FT603 .**




Dimension in mm
**Dimension in inches**

1) IM B5.

2) IM B14.



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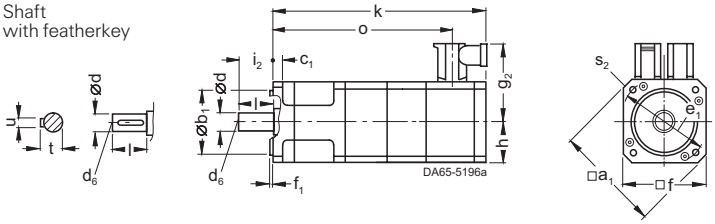
| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | Resolver without brake | | with brake | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | $o_1$ | k LB | o – | k LB | o – |
| **Type of construction IM B5, non-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | | | | |
| 48 | **1FT6041** | | 120 (4.72) | 80 (3.15) | 10 (0.39) | 100 (3.94) | 96 (3.78) | 3 (0.12) | 81 (3.19) | 48 (1.89) | 40 (1.57) | – | 7 (0.28) | – | – | 187 (7.36) | 157 (6.18) | 222 (8.74) | 192 (7.56) |
| | **1FT6044** | | | | | | | | | | | | | | | 237 (9.33) | 207 (8.15) | 272 (10.71) | 242 (9.53) |
| 63 | **1FT6061** | | 146 (5.75) | 110 (4.33) | 10 (0.39) | 130 (5.12) | 116 (4.57) | 3.5 (0.14) | 91 (3.58) | 58 (2.28) | 50 (1.97) | – | 9 (0.35) | M8 | – | 198 (7.8) | 172 (6.77) | 228 (8.98) | 202 (7.95) |
| | **1FT6062** | | | | | | | | | | | | | | | 223 (8.78) | 197 (7.76) | 253 (9.96) | 227 (8.94) |
| | **1FT6064** | | | | | | | | | | | | | | | 273 (10.75) | 247 (9.72) | 303 (11.93) | 277 (10.91) |

| (continued) | | sin/cos incremental encoder 1 $V_{pp}$ | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | | | | | |
| | DIN / IEC | k LB | o – | k LB | o – | **d** **D** | $d_6$ – | l E | t GA | u F |
| 48 | **1FT6041** | 228 (8.98) | 157 (6.18) | 263 (10.35) | 192 (7.56) | **19 (0.75)** | M6 | 40 (1.57) | 21.5 (0.85) | 6 (0.24) |
| | **1FT6044** | 278 (10.94) | 207 (8.15) | 313 (12.32) | 242 (9.53) | | | | | |
| 63 | **1FT6061** | 228 (8.98) | 172 (6.77) | 258 (10.16) | 202 (7.95) | **24 (0.94)** | M8 | 50 (1.97) | 27 (1.06) | 8 (0.31) |
| | **1FT6062** | 253 (9.96) | 197 (7.76) | 283 (11.14) | 227 (8.94) | | | | | |
| | **1FT6064** | 303 (11.93) | 247 (9.72) | 333 (13.11) | 277 (10.91) | | | | | |

**Fig. 7/39**

**1FT604 .**
**1FT606 .**

Shaft with featherkey



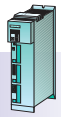

1) IM B5.
2) IM B14.



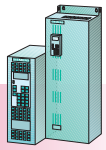
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# Dimension drawings

## 1FT6 synchronous servomotors



Compact PLUS units



Compact and chassis units

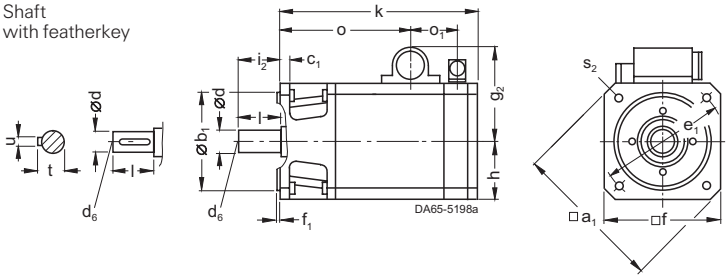
| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | Resolver without brake | | with brake | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | **DIN**<br>**IEC** | $a_1$<br>P | $b_1$<br>N | $c_1$<br>LA | $e_1$<br>M | f<br>AB | $f_1$<br>T | $g_2$<br>– | h<br>H | $i_2$<br>– | p<br>HD | $s_2$[1]<br>S | $s_2$[2]<br>S | $o_1$ | k<br>LB | o<br>– | k<br>LB | o<br>– |
| **Type of construction IM B5, non-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | | | | |
| 80 | **1FT6081** | | 194<br>(7.64) | 130<br>(5.12) | 12<br>(0.47) | 165<br>(6.5) | 155<br>(6.1) | 3.5<br>(0.14) | 127.5<br>(5.02) | 77.5<br>(3.05) | 58<br>(2.28) | – | 11<br>(0.43) | M10 | 76<br>(2.99) | 221<br>(8.7) | 113<br>(4.45) | 248<br>(9.76) | 140<br>(5.51) |
| | **1FT6082** | | | | | | | | | | | | | | | 246<br>(9.69) | 138<br>(5.43) | 273<br>(10.75) | 165<br>(6.5) |
| | **1FT6084** | | | | | | | | | | | | | | | 296<br>(11.65) | 188<br>(7.4) | 342<br>(13.46) | 234<br>(9.21) |
| | **1FT6086** | | | | | | | | | | | | | | | 346<br>(13.62) | 238<br>(9.37) | 392<br>(15.43) | 284<br>(11.18) |

| (continued) | | sin/cos incremental encoder 1 $V_{pp}$ | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | | | | | |
| | | **DIN**<br>**IEC** | k<br>LB | o<br>– | k<br>LB | o<br>– | **d**<br>**D** | $d_6$<br>– | l<br>E | t<br>GA | u<br>F |
| 80 | **1FT6081** | | 221<br>(8.7) | 113<br>(4.45) | 248<br>(9.76) | 140<br>(5.51) | **32**<br>**(1.26)** | M12 | 58<br>(2.28) | 35<br>(1.38) | 10<br>(0.39) |
| | **1FT6082** | | 246<br>(9.69) | 138<br>(5.43) | 273<br>(10.75) | 165<br>(6.5) | | | | | |
| | **1FT6084** | | 296<br>(11.65) | 188<br>(7.4) | 342<br>(13.46) | 234<br>(9.21) | | | | | |
| | **1FT6086** | | 346<br>(13.62) | 238<br>(9.37) | 392<br>(15.43) | 284<br>(11.18) | | | | | |

**Fig. 7/40**

**1FT608 .**

Shaft with featherkey




1) IM B5.

2) IM B14.



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| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | Resolver without brake | | with brake | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | $o_1$ | k LB | o – | k LB | o – |
| **Type of construction IM B5, non-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | | | | |
| 100 | **1FT6102** | | 240 (9.45) | 180 (7.09) | 13 (0.51) | 215 (8.46) | 192 (7.56) | 4 (0.16) | 146 (5.75) | 96 (3.78) | 80 (3.15) | 155 (6.1) | 14 (0.55) | M12 | 76 (2.99) | 295 (11.61) | 186 (7.32) | 341 (13.43) | 232 (9.13) |
| | **1FT6105** | | | | | | | | | | | | | | | 370 (14.57) | 261 (10.28) | 416 (16.38) | 307 (12.09) |
| | **1FT6108** | | | | | | | | | | | | | | | 470 (18.5) | 361 (14.21) | 516 (20.31) | 407 (16.02) |
| 132 | **1FT6132** | | – | 250 (9.84) | 18 (0.71) | 300 (11.81) | 260 (10.24) | 5 (0.2) | 172.5 (6.79) | 132 (5.2) | 82 (3.23) | 245 (9.65) | 18 (0.71) | – | 66 (2.6) | 423 (16.65) | 288 (11.34) | 473 (18.62) | 338 (13.31) |
| | **1FT6134** | | | | | | | | | | | | | | | 473 (18.62) | 338 (13.31) | 523 (20.59) | 388 (15.28) |
| | **1FT6136** | | | | | | | | | | | | | | | 523 (20.59) | 388 (15.28) | 573 (22.56) | 438 (17.24) |

| (continued) | | sin/cos incremental encoder 1 $V_{pp}$ | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | | | | | |
| | | DIN / IEC | k LB | o – | k LB | o – | **d** D | $d_6$ – | l E | t GA | u F |
| 100 | **1FT6102** | | 295 (11.61) | 186 (7.32) | 341 (13.43) | 232 (9.13) | **38 (1.5)** | M12 | 80 (3.15) | 41 (1.61) | 10 (0.39) |
| | **1FT6105** | | 370 (14.57) | 261 (10.28) | 416 (16.38) | 307 (12.09) | | | | | |
| | **1FT6108** | | 470 (18.5) | 361 (14.21) | 516 (20.31) | 407 (16.02) | | | | | |
| 132 | **1FT6132** | | 423 (16.65) | 288 (11.34) | 473 (18.62) | 338 (13.31) | **48 (1.89)** | M16 | 82 (3.23) | 51.5 (2.03) | 14 (0.55) |
| | **1FT6134** | | 473 (18.62) | 338 (13.31) | 523 (20.59) | 388 (15.28) | | | | | |
| | **1FT6136** | | 523 (20.59) | 388 (15.28) | 573 (22.56) | 438 (17.24) | | | | | |

**Fig. 7/41**

**1FT610 .**

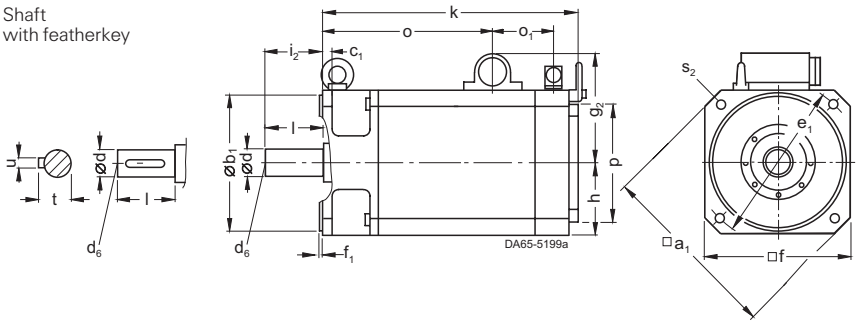
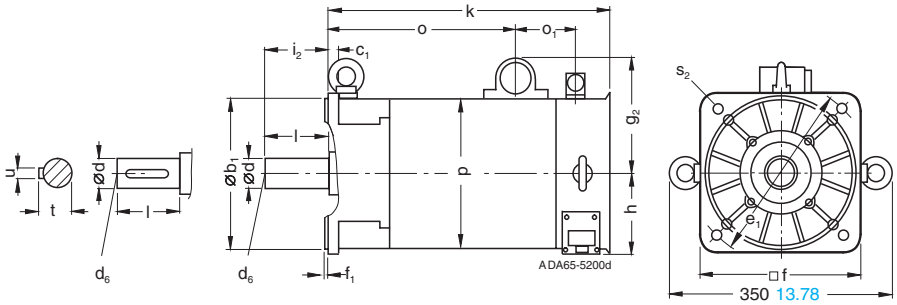



**Fig. 7/42**

**1FT613 .**




Dimension in mm
**Dimension in inches**

1) IM B5.

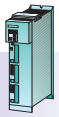
2) IM B14.



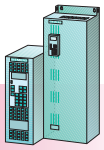
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# Dimension drawings

## 1FT6 synchronous servomotors



Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | Plug Size 1.5 | Plug Size 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | DIN IEC $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | $g_2$ – | h H | $i_2$ – | p HD | $s_2$[1] S | $s_2$[2] S | $o_1$ – | $o_2$ – |
| **Type of construction IM B5, blower-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | |
| 80 | **1FT6084** | 194 (7.64) | 130 (5.12) | 12 (0.47) | 165 (6.5) | 185 (7.28) | 3.5 (0.14) | 139.5 (5.49) | 153.5 (6.04) | 92.5 (3.64) | 58 (2.28) | 175 (6.89) | 11 (0.43) | M10 | 76 (2.99) | 169 (6.65) |
| | **1FT6086** | | | | | | | | | | | | | | | |
| 100 | **1FT6105** | 240 (9.45) | 180 (7.09) | 13 (0.51) | 215 (8.46) | 221 (8.7) | 4 (0.16) | 158 (6.22) | 172 (6.77) | 110.5 (4.35) | 80 (3.15) | 212 (8.35) | 14 (0.55) | M12 | 76.5 (3.01) | 170 (6.69) |
| | **1FT6108** | | | | | | | | | | | | | | | |

| (continued) | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ without brake | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ with brake | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | DIN IEC k LB | o – | k LB | o – | **d D** | $d_6$ – | l E | t GA | u F |
| 80 | **1FT6084** | 399 (15.71) | 188 (7.4) | 445 (17.52) | 234 (9.21) | **32 (1.26)** | M12 | 58 (2.28) | 35 (1.38) | 10 (0.39) |
| | **1FT6086** | 449 (17.68) | 238 (9.37) | 495 (19.49) | 284 (11.18) | | | | | |
| 100 | **1FT6105** | 473 (18.62) | 261 (10.28) | 519 (20.43) | 307 (12.09) | **38 (1.5)** | M12 | 80 (3.15) | 41 (1.61) | 10 (0.39) |
| | **1FT6108** | 573 (22.56) | 361 (14.21) | 619 (24.37) | 407 (16.02) | | | | | |

**Fig. 7/43**

**1FT608 .**

Shaft with featherkey

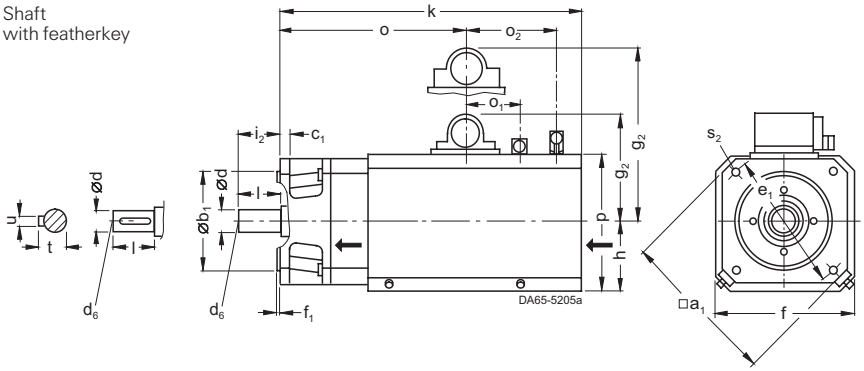
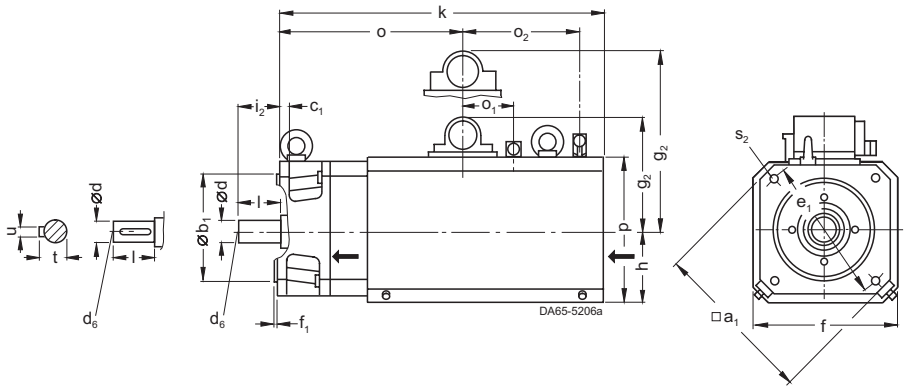



**Fig. 7/44**

**1FT610 .**




1) IM B5.

2) IM B14.



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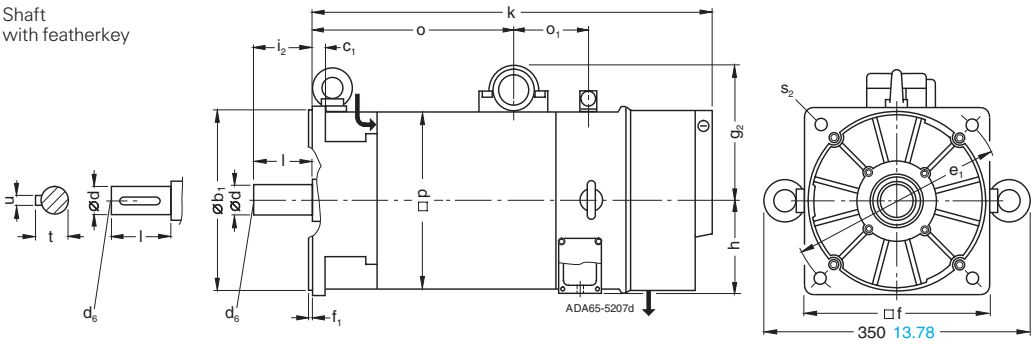
| For motor | | Dimension in mm (inches) | | | | | | | Plug Size 1.5 | Plug Size 3 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | $o_1$ – | $o_2$ – |
| **Type of construction IM B5, blower-ventilated, with plug, with/without brake** | | | | | | | | | | | | | | | | | |
| 132 | **1FT6132** | | 250 (9.84) | 18 (0.71) | 300 (11.81) | 260 (10.24) | 5 (0.2) | – | 186.5 (7.34) | 132 (5.2) | 82 (3.23) | 245 (9.65) | 18 (0.71) | – | 66 (2.6) | – |
| | **1FT6134** | | | | | | | | | | | | | | | |
| | **1FT6136** | | | | | | | | | | | | | | | |

| (continued) | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ without brake | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ with brake | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | DIN / IEC | k LB | o – | k LB | o – | **d** **D** | $d_6$ – | l E | t GA | u F |
| 132 | **1FT6132** | | 541 (21.3) | 288 (11.34) | 591 (23.27) | 338 (13.31) | **48** **(1.89)** | M16 | 82 (3.23) | 51.5 (2.03) | 14 (0.55) |
| | **1FT6134** | | 591 (23.27) | 338 (13.31) | 641 (25.24) | 388 (15.28) | | | | | |
| | **1FT6136** | | 641 (25.24) | 388 (15.28) | 691 (27.2) | 438 (17.24) | | | | | |

**Fig. 7/45**

**1FT613 .**

Shaft with featherkey




Dimension in mm
**Dimension in inches**

1) IM B5.

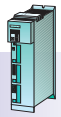
2) IM B14.



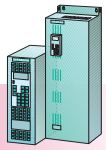
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# Dimension drawings

## 1FT6 synchronous servomotors



Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | Plug Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1 | 1.5 | 3 | | | | | | |
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | $g_2$ – | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | o – |
| **Type of construction IM B5, water-cooled, with plug, with/without brake** | | | | | | | | | | | | | | | | |
| 63 | **1FT6062** | | 146 (5.75) | 110 (4.33) | 10 (0.39) | 130 (5.12) | 116 (4.57) | 3.5 (0.14) | 99 (10.8) | – | – | 58 (2.28) | 50 (1.97) | – | 9 (0.35) | M8 | – |
| | **1FT6064** | | | | | | | | | | | | | | | | |
| 80 | **1FT6084** | | 194 (7.64) | 130 (5.12) | 12 (0.47) | 165 (6.5) | 155 (6.1) | 3.5 (0.14) | – | 139.5 (5.49) | 153.5 (6.04) | 77.5 (3.05) | 58 (2.28) | – | 11 (0.43) | M10 | 76 (2.99) |
| | **1FT6086** | | | | | | | | | | | | | | | | |

| (continued) | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ | | | | Re-solver | sin/cos incremental encoder 1 $V_{pp}$ | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | with/without brake | | | | | | | |
| | DIN / IEC | k LB | $o_1$ – | k LB | $o_1$ – | k LB | k LB | $o_1$ – | **d** D | $d_6$ – | l E | t GA | u F |
| 63 | **1FT6062** | – | – | – | – | 253 (9.96) | 283 (11.14) | 227 (8.94) | **24 (0.94)** | M8 | 50 (1.97) | 27 (1.06) | 8 (0.31) |
| | **1FT6064** | | | | | 303 (11.93) | 333 (13.11) | 277 (10.91) | | | | | |
| 80 | **1FT6084** | 296 (11.65) | 188 (7.4) | 342 (13.46) | 234 (9.21) | – | – | – | **32 (1.26)** | M12 | 58 (2.28) | 35 (1.38) | 10 (0.39) |
| | **1FT6086** | 346 (13.62) | 238 (9.37) | 392 (15.43) | 284 (11.18) | – | – | – | | | | | |

**Fig. 7/46**

**1FT606 .**

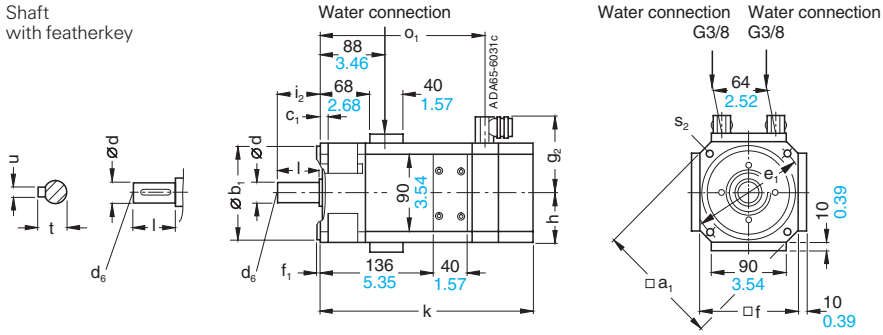
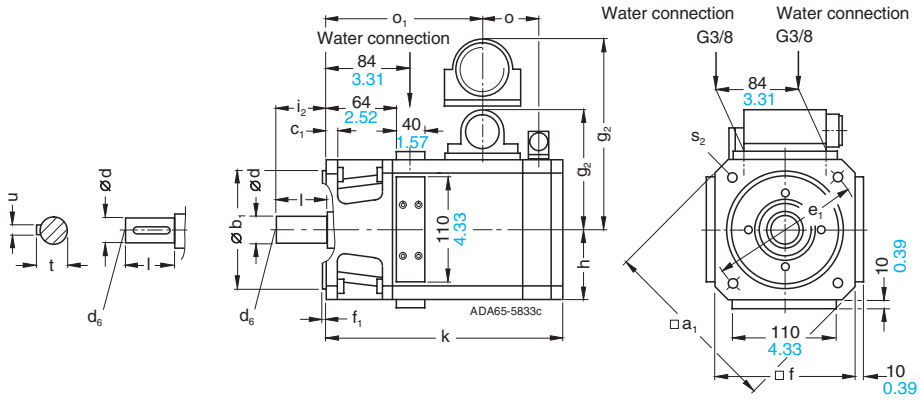



**Fig. 7/47**

**1FT608 .**




Dimension in mm
**Dimension in inches**

1) IM B5.

2) IM B14.



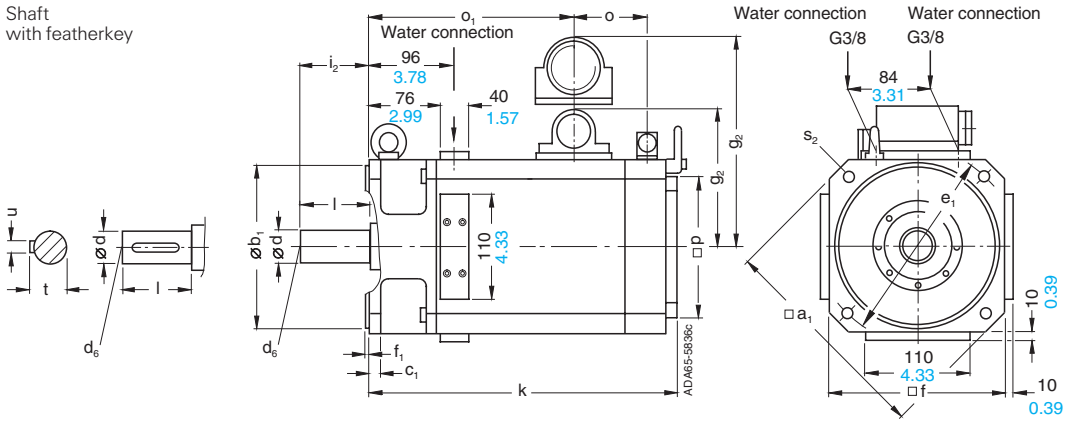
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| For motor | | Dimension in mm (inches) | | | | | | Plug Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1 | 1.5 | 3 | | | | | | |
| Size | Type | DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $g_2$ – | $g_2$ – | $g_2$ – | h H | $i_2$ – | p HD | $s_2$ [1] S | $s_2$ [2] S | o – |
| **Type of construction IM B5, water-cooled, with plug, with/without brake** | | | | | | | | | | | | | | | | |
| 100 | **1FT6105** | | 240 (9.45) | 180 (7.09) | 13 (0.51) | 215 (8.46) | 192 (7.56) | 4 (0.16) | – | 158 (6.22) | 172 (6.77) | 96 (3.78) | 80 (3.15) | 155 (6.1) | 14 (0.55) | M12 | 76 (2.99) |
| | **1FT6108** | | | | | | | | | | | | | | | |

| (continued) | | Resolver/sin/cos incremental encoder 1 $V_{pp}$ | | | | Re-solver | sin/cos incremental encoder 1 $V_{pp}$ | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | without brake | | with brake | | with/without brake | | | | | | | |
| | DIN / IEC | k LB | $o_1$ – | k LB | $o_1$ – | k LB | k LB | $o_1$ – | **d** **D** | $d_6$ – | l E | t GA | u F |
| 100 | **1FT6105** | 370 (14.57) | 261 (10.28) | 416 (16.38) | 307 (12.09) | – | – | – | **38 (1.5)** | M12 | 80 (3.15) | 41 (1.61) | 10 (0.39) |
| | **1FT6108** | 470 (18.5) | 361 (14.21) | 516 (20.31) | 407 (16.02) | – | – | – | | | | | |

**Fig. 7/48**

**1FT610 .**




Dimension in mm
**Dimension in inches**

1) IM B5.

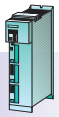
2) IM B14.



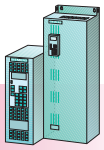
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# Dimension drawings

## 1PH7 asynchronous servomotors



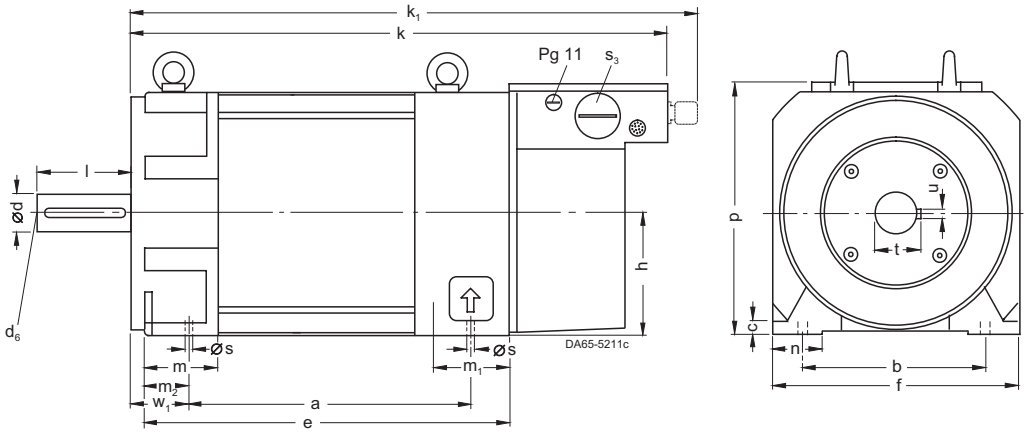
Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | **DIN** a<br>**IEC** B | b<br>A | c<br>LA | e<br>M | f<br>AB | h<br>H | k<br>LB | $k_1$<br>– | m<br>BA | $m_1$<br>– | $m_2$<br>– | n<br>AA | p<br>HD | s<br>K | $s_3$<br>– | $w_1$<br>C | **d**<br>**D** | $d_6$<br>– | l<br>E | t<br>GA | u<br>F |
| **Type of construction IM B3** | | | | | | | | | | | | | | | | | | | | | | |
| 100 | **1PH7101** | 202.5<br>(7.97) | 160<br>(6.2) | 11<br>(0.43) | 263<br>(10.35) | 196<br>(7.7) | 100<br>(3.9) | 411<br>(16.18) | 434<br>(17.09) | 52<br>(2.04) | 64<br>(2.51) | 27<br>(1.06) | 39<br>(1.53) | 220<br>(8.6) | 12<br>(0.47) | Pg 29 | 40<br>(1.57) | **38**<br>**(1.49)** | M12 | 80<br>(3.14) | 41<br>(1.61) | 10<br>(0.39) |
| | **1PH7103** | | | | | | | | | | | | | | | | | | | | | |
| | **1PH7105** | 297.5<br>(11.71) | | | 358<br>(14.09) | | | 506<br>(19.92) | 529<br>(20.83) | | | | | | | | | | | | | |
| | **1PH7107** | | | | | | | | | | | | | | | | | | | | | |
| 132 | **1PH7131** | 265.5<br>(10.45) | 216<br>(8.5) | 14<br>(0.55) | 341<br>(13.42) | 260<br>(10.2) | 132<br>(5.1) | 538<br>(21.18) | 561<br>(22.09) | 63<br>(2.48) | 75<br>(2.95) | 33<br>(1.29) | 52<br>(2.04) | 275<br>(10.8) | 12<br>(0.47) | Pg 36 | 50<br>(1.96) | **42**<br>**(1.65)** | M16 | 110<br>(4.33) | 45<br>(1.77) | 12<br>(0.47) |
| | **1PH7133** | | | | | | | | | | | | | | | | | | | | | |
| | **1PH7135** | 350.5<br>(13.79) | | | 426<br>(16.77) | | | 623<br>(24.53) | 646<br>(25.43) | | | | | | | | | | | | | |
| | **1PH7137** | | | | | | | | | | | | | | | | | | | | | |
| 160 | **1PH7163** | 346.5<br>(13.64) | 254<br>(10) | 17<br>(0.66) | 438<br>(17.24) | 314<br>(12.3) | 160<br>(6.2) | 640<br>(25.2) | 663<br>(26.1) | 78<br>(3.07) | 81<br>(3.18) | 42<br>(1.65) | 62<br>(2.44) | 330<br>(12.9) | 14<br>(0.47) | Pg 42 | 64<br>(2.51) | **55**<br>**(2.16)** | M20 | 110<br>(4.33) | 59<br>(2.32) | 16<br>(0.62) |
| | **1PH7167** | 406.5<br>(16) | | | 498<br>(19.6) | | | 700<br>(27.56) | 723<br>(28.46) | | | | | | | | | | | | | |

**Fig. 7/49**



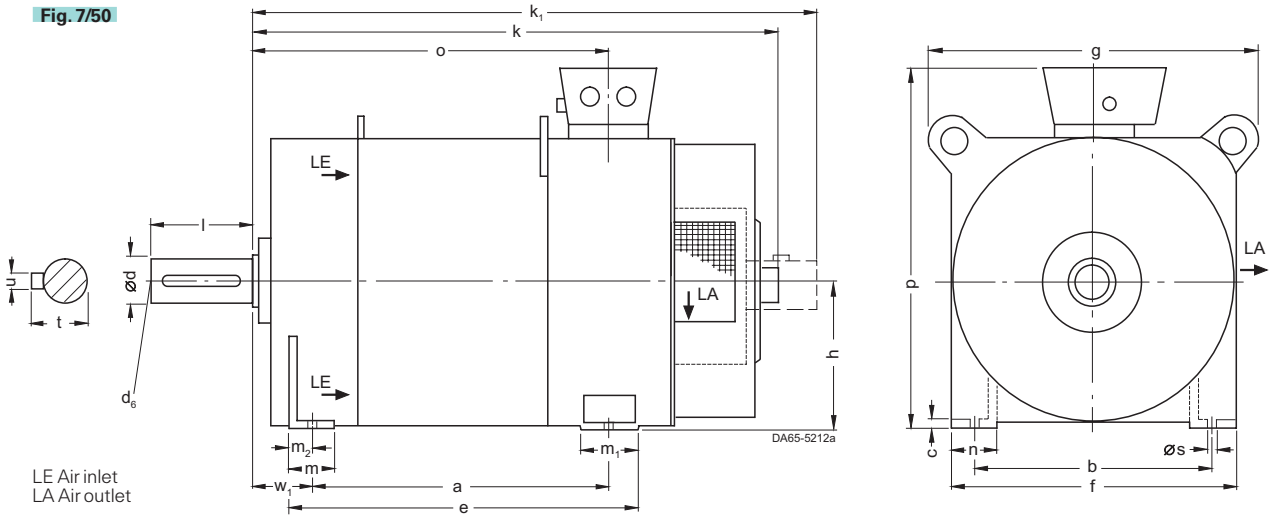



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| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | **DIN** **IEC** a B | b A | c LA | e M | f AB | g AC | h H | k LB | $k_1$ – | m BA | $m_1$ – | $m_2$ – | n AA | o – | p[1] HD | s K | $w_1$ C |
| **Type of construction IM B3, air-flow from D-end to ND-end** | | | | | | | | | | | | | | | | | | | |
| 180 | **1PH7184** | 430 (16.9) | 279 (10.9) | 14 (0.55) | 510 (20) | 360 (14.1) | 395 (15.5) | 180 (7) | 820 (32.28) | – | 52 (2.04) | 110 (4.3) | 35 (1.37) | 65 (2.55) | 541 (21.2) | 500 (19.6) | 14.5 (0.57) | 121 (4.7) |
| | **1PH7186** | 520 (20.4) | | | 600 (23.6) | | | | 910 (35.83) | | | | | | 631 (24.8) | 560 (22.1) | | |
| 225 | **1PH7224** | 445 (17.5) | 356 (14) | 18 (0.7) | 540 (21.2) | 450 (17.7) | 495 (19.4) | 225 (8.8) | – | 1100 (43.31) | 60 (2.36) | 110 (4.3) | 40 (1.57) | 85 (3.34) | 629 (24.7) | 680 (26.8) | 18.5 (0.72) | 149 (5.8) |
| | **1PH7226** | 545 (21.4) | | | 640 (25.1) | | | | | 1200 (47.24) | | | | | 729 (28.7) | | | |
| | **1PH7228** | 635 (25) | | | 730 (28.7) | | | | | 1290 (50.79) | | | | | 819 (32.2) | | | |

| (continued) | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|
| | | **DIN** **IEC** **d** **D** | $d_6$ – | l E | t GA | u F |
| 180 | **1PH7184** | **60 (2.36)** | M20 | 140 (5.5) | 64 (2.5) | 18 (0.7) |
| | **1PH7186** | **65 (2.55)** | | | 69 (2.7) | |
| 225 | **1PH7224** | **75 (2.95)** | M20 | 140 (5.5) | 79.5 (3.1) | 20 (0.8) |
| | **1PH7226** | | | | | |
| | **1PH7228** | | | | | |

**Fig. 7/50**




LE Air inlet
LA Air outlet

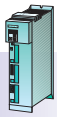
1) Maximum dimensions. Depending on the electrical design (terminal box type), smaller dimensions are also possible.



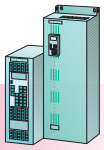
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# Dimension drawings

## 1PH7 asynchronous servomotors



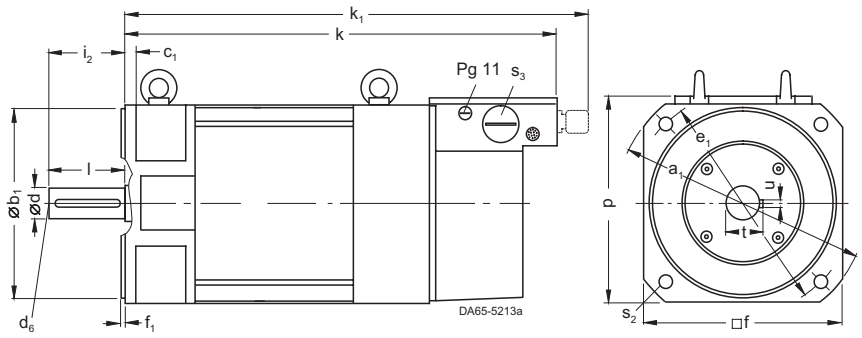
Compact PLUS units



Compact and chassis units

| For motor | | Dimension in mm (inches) | | | | | | | | | | | | D-end of shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | **DIN**<br>**IEC** | $a_1$<br>P | $b_1$<br>N | $c_1$<br>LA | $e_1$<br>M | f<br>AB | $f_1$<br>T | $i_2$<br>– | k<br>LB | $k_1$<br>– | p<br>HD | $s_2$<br>S | $s_3$<br>– | **d**<br>**D** | $d_6$<br>– | l<br>E | t<br>GA | u<br>F |
| **Type of construction IM B5** | | | | | | | | | | | | | | | | | | | |
| 100 | **1PH7101** | | 250<br>(9.84) | 180<br>(7.08) | 10<br>(0.39) | 215<br>(8.46) | 196<br>(7.71) | 4<br>(0.15) | 80<br>(3.14) | 411<br>(16.18) | 434<br>(17.13) | 218<br>(8.58) | 14<br>(0.55) | Pg 29 | **38**<br>**(1.49)** | M12 | 80<br>(3.14) | 41<br>(1.61) | 10<br>(0.38) |
| | **1PH7103** | | | | | | | | | | | | | | | | | | |
| | **1PH7105** | | | | | | | | | 506<br>(19.92) | 529<br>(20.83) | | | | | | | | |
| | **1PH7107** | | | | | | | | | | | | | | | | | | |
| 132 | **1PH7131** | | 350<br>(13.77) | 250<br>(9.84) | 16<br>(0.62) | 300<br>(11.81) | 260<br>(10.23) | 5<br>(0.19) | 110<br>(4.33) | 538<br>(21.18) | 561<br>(20.09) | 273<br>(10.74) | 18<br>(0.7) | Pg 36 | **42**<br>**(1.65)** | M16 | 110<br>(4.33) | 45<br>(1.77) | 12<br>(0.47) |
| | **1PH7133** | | | | | | | | | | | | | | | | | | |
| | **1PH7135** | | | | | | | | | 623<br>(24.53) | 646<br>(25.43) | | | | | | | | |
| | **1PH7137** | | | | | | | | | | | | | | | | | | |

**Fig. 7/51**



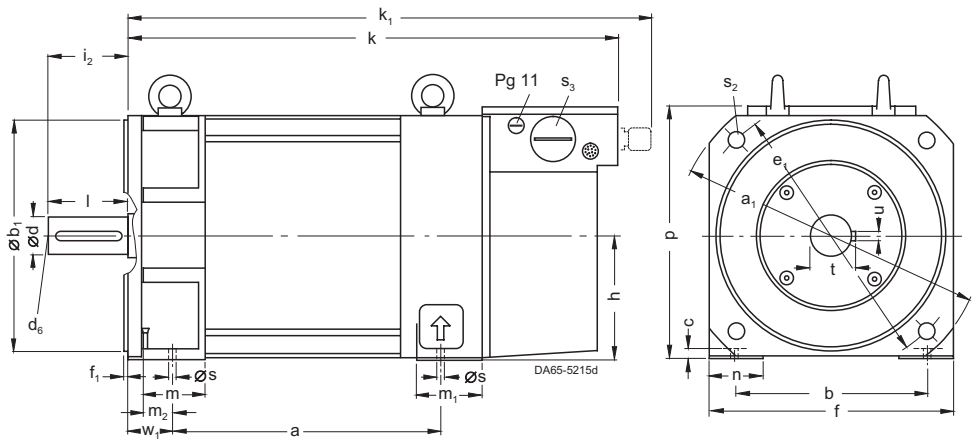



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| For motor | | Dimension in mm (inches) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Type | DIN / IEC a / B | $a_1$ / P | b / A | $b_1$ / N | c / LA | $e_1$ / M | f / AB | $f_1$ / T | h / H | $i_2$ / – | k / LB | $k_1$ / – | m / BA | $m_1$ / – | $m_2$ / – | n / AA | p / HD |
| **Type of construction IM B35** | | | | | | | | | | | | | | | | | | |
| 100 | **1PH7101** | 202.5 (7.97) | 250 (9.84) | 160 (6.29) | 180 (7.08) | 11 (0.4) | 215 (8.4) | 196 (7.7) | 4 (0.1) | 100 (3.93) | 80 (3.14) | 411 (16.18) | 434 (17.13) | 52 (2.04) | 64 (2.5) | 27 (1.06) | 39 (1.53) | 220 (8.66) |
| | **1PH7103** | | | | | | | | | | | | | | | | | |
| | **1PH7105** | 297.5 (11.71) | | | | | | | | | | 506 (19.92) | 529 (20.83) | | | | | |
| | **1PH7107** | | | | | | | | | | | | | | | | | |
| 132 | **1PH7131** | 265.5 (10.45) | 350 (13.77) | 216 (8.5) | 250 (9.84) | 14 (0.5) | 300 (11.8) | 260 (10.2) | 5 (0.2) | 132 (5.19) | 110 (4.33) | 538 (21.18) | 561 (22.09) | 63 (2.48) | 75 (2.9) | 33 (1.29) | 52 (2.04) | 275 (10.8) |
| | **1PH7133** | | | | | | | | | | | | | | | | | |
| | **1PH7135** | 350.5 (13.79) | | | | | | | | | | 623 (24.53) | 646 (25.43) | | | | | |
| | **1PH7137** | | | | | | | | | | | | | | | | | |
| 160 | **1PH7163** | 346.5 (13.64) | 400 (15.74) | 254 (10) | 300 (11.8) | 17 (0.6) | 350 (13.7) | 314 (12.3) | 5 (0.2) | 160 (6.29) | 110 (4.33) | 640 (25.2) | 663 (26.1) | 78 (3.07) | 81 (3.1) | 42 (1.65) | 62 (2.44) | 330 (12.9) |
| | **1PH7167** | 406.5 (16) | | | | | | | | | | 700 (27.56) | 723 (28.46) | | | | | |

| (continued) | | D-end of shaft | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | DIN / IEC s / K | $s_2$ / S | $s_3$ / – | $w_1$ / C | **d / D** | $d_6$ / – | l / E | t / GA | u / F |
| **Type of construction IM B35** | | | | | | | | | | |
| 100 | **1PH7101** | 12 (0.47) | 14 (0.55) | Pg 29 | 40 (1.57) | **38 (1.49)** | M12 | 80 (3.14) | 41 (1.61) | 10 (0.39) |
| | **1PH7103** | | | | | | | | | |
| | **1PH7105** | | | | | | | | | |
| | **1PH7107** | | | | | | | | | |
| 132 | **1PH7131** | 12 (0.47) | 18 (0.7) | Pg 36 | 50 (1.96) | **42 (1.65)** | M16 | 110 (4.33) | 45 (1.77) | 12 (0.47) |
| | **1PH7133** | | | | | | | | | |
| | **1PH7135** | | | | | | | | | |
| | **1PH7137** | | | | | | | | | |
| 160 | **1PH7163** | 14 (0.47) | 18 (0.7) | Pg 42 | 64 (2.51) | **55 (2.16)** | M20 | 110 (4.33) | 59 (2.32) | 16 (0.62) |
| | **1PH7167** | | | | | | | | | |

**Fig. 7/52**

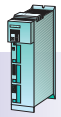


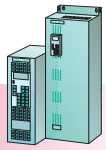



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# Dimension drawings

## 1PH7 asynchronous servomotors

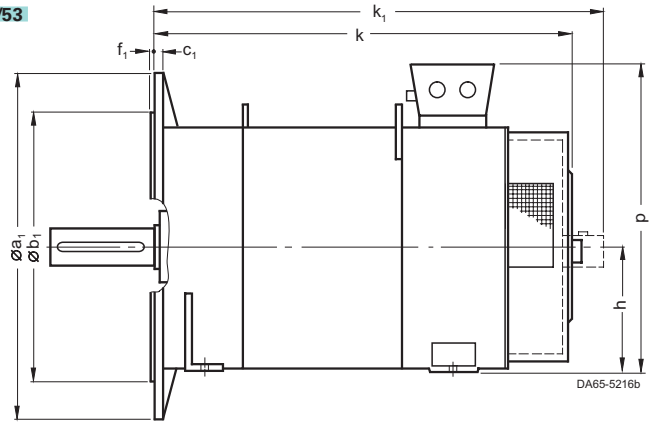

Compact PLUS units

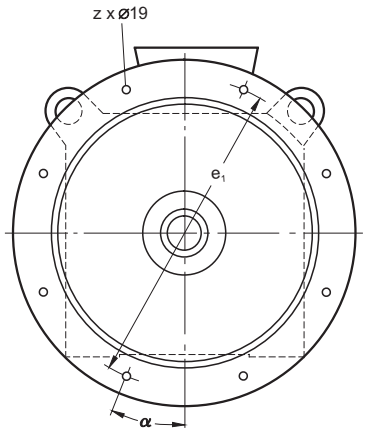

Compact and chassis units

For dimensions for foot mounting, shaft and terminal box, see dimension drawing of 1 PH718. and 1PH722. motors, type of construction IM B3, on page 7/29.

| For motor Size | Type | Dimension in mm (inches) DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | $f_1$ T | h H | k LB | $k_1$ – | p[1] HD | z | $\alpha$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of construction IM B35, air flow from D-end to ND-end** | | | | | | | | | | | | | |
| 180 | **1PH7184**[2] | | 400 (15.75) | 300 (11.8) | 15 (0.59) | 350 (13.77) | 5 (0.19) | 180 (7.08) | 820 (32.28) | – | 500 (19.68) | 4 (0.16) | 45° |
| | **1PH7184**[2] | | 450 (17.71) | 350 (13.77) | 16 (0.62) | 400 (15.74) | | | 820 (32.28) | | 500 (19.68) | 8 (0.31) | 22.5° |
| | **1PH7186** | | | | | | | | 910 (35.83) | | 560 (22.05) | | |
| 225 | **1PH7224** | | 550 (21.65) | 450 (17.71) | 18 (0.7) | 500 (19.68) | 5 (0.19) | 225 (8.85) | – | 1100 (43.31) | 680 (25.59) | 8 (0.31) | 22.5° |
| | **1PH7226** | | | | | | | | | 1200 (47.24) | | | |
| | **1PH7228** | | | | | | | | | 1290 (50.79) | | | |

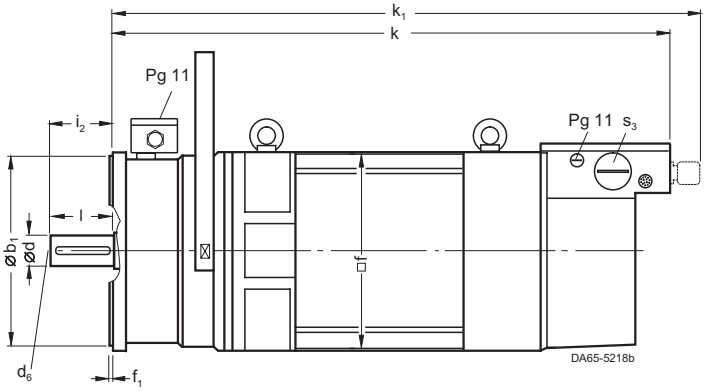
**Fig. 7/53**

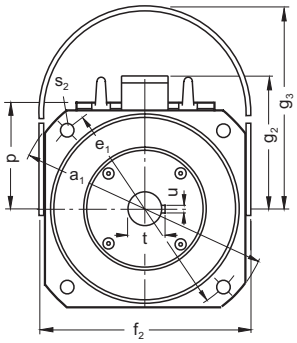



| For motor Size | Type | Dimension in mm (inches) DIN / IEC | $a_1$ P | $b_1$ N | $c_1$ LA | $e_1$ M | f AB | $f_1$ T | $f_2$ – | $g_2$ AB | $g_3$ T | $i_2$ – | k LB | $k_1$ – | p HD | $s_2$ S | $s_3$ S | D-end of shaft d D | $d_6$ – | l E | t GA | u F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of construction IM B5, with brake modul** | | | | | | | | | | | | | | | | | | | | | | |
| 100 | **1PH7101** | | 250 (9.84) | 180 (7.08) | 13 (0.51) | 215 (8.46) | 196 (7.71) | 4 (0.15) | 220 (8.66) | 149 (5.86) | 224 (8.81) | 80 (3.14) | 541 (21.3) | 564 (22.2) | 120 (4.72) | 14 (0.55) | Pg 29 | **38 (1.49)** | M12 | 80 (3.14) | 41 (1.61) | 10 (0.39) |
| | **1PH7103** | | | | | | | | | | | | | | | | | | | | | |
| | **1PH7105** | | | | | | | | | | | | 636 (25.04) | 659 (25.94) | | | | | | | | |
| | **1PH7107** | | | | | | | | | | | | | | | | | | | | | |
| 132 | **1PH7131** | | – | 250 (9.84) | 18 (0.7) | 300 (11.81) | 260 (10.23) | 5 (0.19) | 278 (10.94) | 174 (6.85) | 269 (10.59) | 110 (4.33) | 700 (27.56) | 723 (28.46) | 143 (5.62) | 18 (0.7) | Pg 36 | **42 (1.65)** | M16 | 110 (4.33) | 45 (1.77) | 12 (0.47) |
| | **1PH7133** | | | | | | | | | | | | | | | | | | | | | |
| | **1PH7135** | | | | | | | | | | | | 785 (30.9) | 808 (31.81) | | | | | | | | |
| | **1PH7137** | | | | | | | | | | | | | | | | | | | | | |

**Fig. 7/54**




1) Maximum dimensions. Depending on the electrical design (terminal box type), smaller dimensions are also possible.

2) See Order No. suffix in Chapter 3.



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# Motion Control
# Appendix


A/2 **Certificate for Environment, Resources and Recycling Certificate ISO 9001**

A/3 **Certificate of Adequacy Test/Factory certificate**

A/4 **Index**

A/7 **Siemens Contacts Worldwide**

A/8 **Service & Support**
Information and Ordering via the Internet and on CD-ROM

A/9 Our services for every phase of your project

A/10 **Conversion tables**

A/13 **Conditions of sale and delivery Export regulations**

A/14 **Fax order form for PATH Plus demo version**


A




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## Certificate for Environment, Resources and Recycling, Certificate ISO 9001

Siemens AG has committed itself to protecting the environment and conserving valuable natural resources. This applies to both manufacturing and 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. In doing so, we look beyond existing regulations and legislation.

Below are some of the most important environment-related aspects which are taken into account in the design of SIMOVERT MASTERDRIVES.

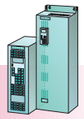
The use of dangerous substances (such as arsenic, asbestos, beryllium, cadmium, CFCs, halogens and many more) is avoided as early as the development phase.

Connections have been designed so that they are easy to service and materials are selected carefully with preference being given to those which can be recycled or disposed of without causing problems.

**Compact PLUS units**



**Compact and chassis units**



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.

Environmentally-compatible packaging materials (pressed board and PE foils) are used for shipping and storage. We also try to keep the amount of packaging material used to a minimum.

If possible we pack our products in reusable packaging.

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).

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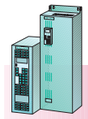
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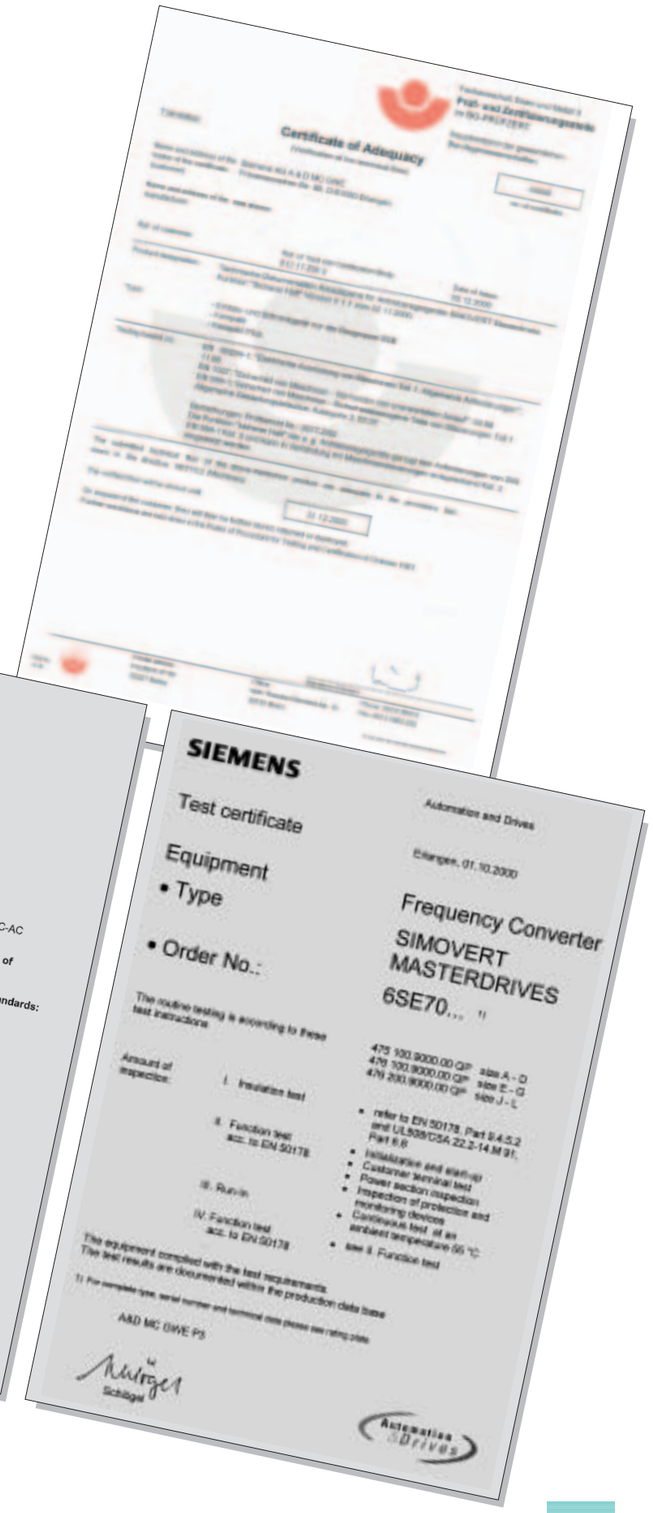

**Compact and chassis units**



**Compact PLUS units**



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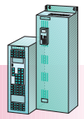
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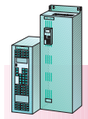
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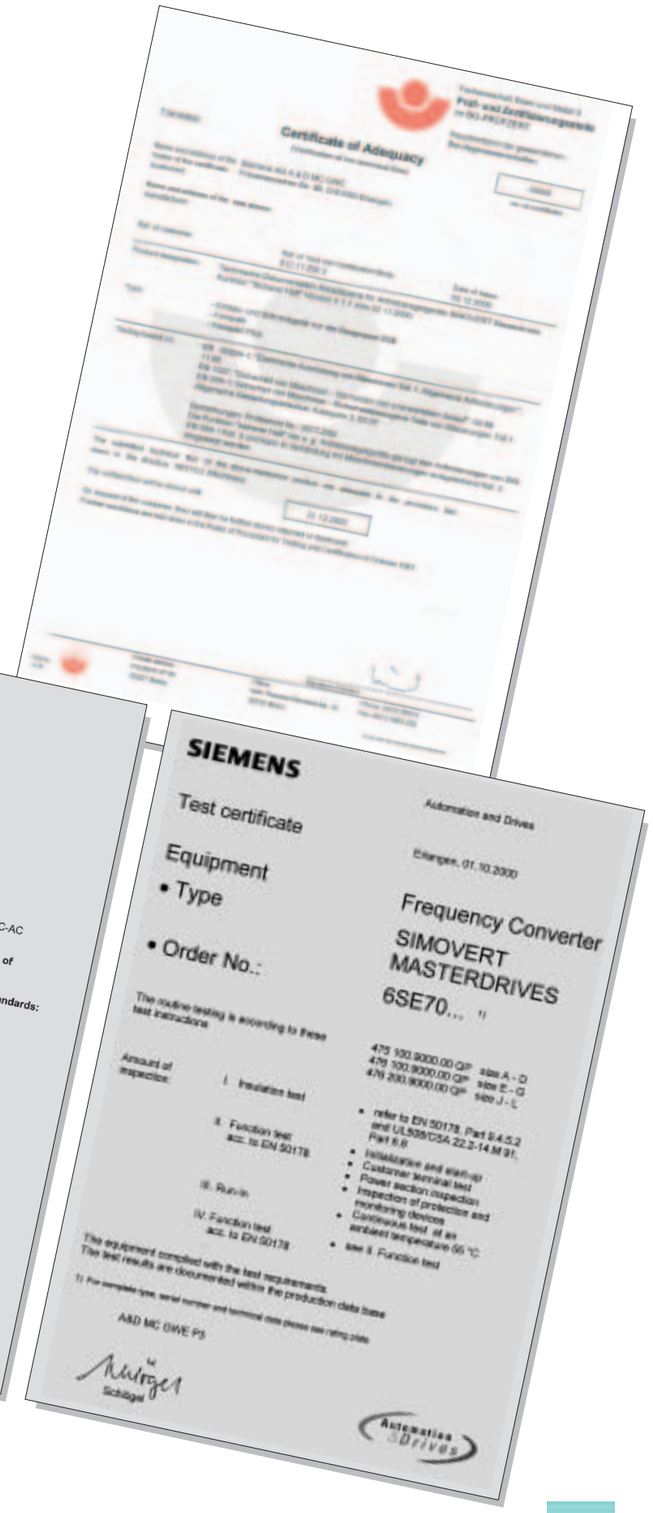

**Compact and chassis units**



**Compact PLUS units**



## Certificate of Adequacy Test/Factory certificate

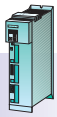




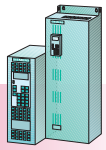

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# Appendix

## Index



Compact PLUS units



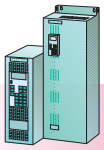
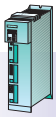
Compact and chassis units


| | Page |
|---|---|
| ***A*** | |
| Absolute-value encoder/incremental-encoder board SBM | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/66, 6/95 |
| AC contactor | |
| for rectifier/regenerative units | 3/25, 3/27 |
| for rectifier units | 3/23 |
| for converters | 3/22 |
| for inverters | 3/30 |
| Adapter board ADB | 3/8 |
| Adapter for cabinet-door mounting AOP1S | 3/39 |
| Adapter for cabinet-door mounting APMU | 3/39 |
| AFE reactor | 3/24, 6/52 |
| AFE rectifier/regenerative unit (Active Front End) | |
| Selection and ordering data | 3/12 |
| Documentation | 5/2 |
| Engineering information | 6/52–6/55 |
| Dimension drawings | 7/3, 7/4 |
| Application | 1/2 |
| Asynchronous servomotors 1PH7 | |
| Limit curves | 6/3 |
| Dimension drawings | 7/22–7/24 |
| Motor selection | 6/3 |
| Motor classification | 4/2, 4/3, 4/12–4/15 |
| Engineering information | 6/2–6/7 |
| Overload capacity | 4/3 |
| Automation | 6/76, 6/77 |
| Autotransformer for rectifier/regenerative units | |
| Selection and ordering data | 3/28 |
| Dimension drawings | 7/10, 7/11 |
| Engineering information | 6/50 |
| ***B*** | |
| Base radio-interference suppression | 3/26 |
| BICO system (see free function blocks) | |
| Brake control | 6/89 |
| Braking resistors | |
| Selection and ordering data | 3/18 |
| Dimension drawings | 7/6, 7/7 |
| Engineering information | 6/2, 6/6, 6/20–6/22, 6/26–6/28, 6/33, 6/48 |
| Technical data | 2/5 |
| Braking units | |
| Selection and ordering data | 3/18 |
| Documentation | 5/4 |
| Dimension drawings | 7/6 |
| Engineering information | 6/20, 6/48, 6/56, 6/57 |
| Technical data | 2/5 |
| Braking units and braking resistors power options | 3/30 |
| Bus adapter LBA | 3/8, 6/60 |
| Bus retaining system | 3/38 |
| ***C*** | |
| Cable design for power and encoder cables | 6/102 |
| Cable-protection fuses | |
| for rectifier/regenerative units | 3/27 |
| for rectifier units | 3/23 |
| for converters | 3/21 |
| Cables (see power cables or encoder cables) | |
| Cam controller | 6/89 |
| CAN | |
| CBC board | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/61, 6/84, 6/85 |
| Capacitor module | |
| Selection and ordering data | 3/19 |
| Power and control terminals | 6/26–6/28 |
| Dimension drawings | 7/2 |
| Engineering information | 6/7, 6/20–6/23, 6/26–6/28, 6/33, 6/35 |
| CBC board for CAN (see CAN) | |
| CBC board for PROFIBUS DP (see PROFIBUS DP) | |
| Central control boards | 6/97 |
| Certificates | A/2 |
| Chassis units | |
| Selection and ordering data | 3/4, 3/10, 3/14, 3/20–3/26, 3/29, 3/30 |
| Unit design | 6/41–6/44 |
| Dimension drawings | 7/4, 7/5 |
| Circuit-breakers for converters | 3/21 |
| Clean Power Filter | 3/26, 6/52, 6/54 |
| Communication | 1/2, 6/78–6/85 |
| Communication board (see CAN/PROFIBUS DP) | |
| Communication packages for SIMATIC S5, S7 (see SIMATIC) | |
| Communication software | 3/40, 3/41, 6/78, 6/83 |
| Commutating reactors | |
| for rectifier/regenerative units | 2/5, 3/28, 6/50 |
| for rectifier units | 2/5, 3/23, 6/50 |
| for converters | 2/5, 3/22, 6/50 |
| Dimension drawings | 7/8, 7/9 |
| Compact PLUS units | |
| Selection and ordering data | 3/3, 3/10, 3/18–3/23 |
| Unit design | 6/26–6/35 |
| Dimension drawings | 7/2 |
| Compact units | |
| Selection and ordering data | 3/4, 3/5, 3/10–3/15, 3/18–3/26 |
| Unit design | 6/36–6/40 |
| Dimension drawings | 7/3 |
| Compendium (documentation) | 3/9, 5/2–5/4 |
| Conditions of Sale and Delivery | A/13 |
| Configuring with PATH Plus | U2, 1/2 |
| Connecting adapter for cable shields | 3/38 |
| Connecting cable PMU-OP1S | 3/39, 6/98, 6/99 |
| Connecting systems | 3/39, 6/98, 6/99 |
| Selection and ordering data | 3/31–3/37 |
| Engineering information | 6/63–6/67, 6/102 |
| Technical data | 2/6 |
| Connection overview | 3/31 |
| Control board CUMC | 3/9, 6/36–6/44 |
| Control board CUPM | 3/9 |
| Control board CUR | 6/46, 6/51 |
| Control board CUSA | 3/24–3/26, 6/47 |
| Control terminals | 6/26–6/46 |
| Converters | |
| Selection and ordering data | 3/3–3/9, 3/20–3/22, 4/8–4/15 |
| Documentation | 5/2, 5/3 |
| Power and control terminals | 6/26–6/30, 6/37, 6/38, 6/41, 6/42 |
| Power options | 3/20–3/22 |
| Dimension drawings | 7/2–7/5 |
| Engineering information | 6/5–6/7, 6/18–6/21 6/26–6/30, 6/35–6/38, 6/41, 6/42, 6/59–6/62, 6/64 |
| Technical data | 2/2, 2/3 |
| Overload characteristic | 2/3 |
| Converters in connection with inverters | 6/5–6/7 |
| Correction factors for installation conditions | 6/19 |
| Coupling relay | 3/17 |
| CUMC control board | 3/9, 6/36–6/44 |
| CUR control board | 6/46, 6/50 |
| CUSA control board | 3/24–3/26, 6/47 |
| ***D*** | |
| DC bus | 6/57–6/59 |
| DC link module | |
| Selection and ordering data | 3/19 |
| Power and control terminals | 6/35 |
| Dimension drawings | 7/2 |
| Engineering information | 6/35, 6/58 |
| DC link power options | 3/29, 3/30 |
| DC link rail | 3/19 |


A



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Compact and chassis units | Compact PLUS units

## Index

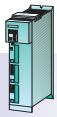

| | Page |
|---|---|
| DC link system components | |
| Selection and ordering data | 3/18 |
| Documentation | 5/3 |
| Dimension drawings | 7/2, 7/6, 7/7 |
| Engineering information | 6/2, 6/6, 6/7, 6/20–6/23, 6/26–6/28, 6/33, 6/35, 6/48, 6/56–6/59 |
| Demonstration case | 5/5–5/7 |
| Derating (see pulse frequency) | |
| Dimensioning of the drive | 6/2–6/19 |
| Dimensioning of the power section | 6/2–6/19 |
| DIN rail to EN 50 022 | 3/38 |
| Documentation overview | 3/16, 5/2 |
| Drive ES | 3/42 |
| DriveMonitor | |
| Selection and ordering data | 3/41 |
| Documentation | 3/16, 5/2 |
| Engineering information | 6/76, 6/79, 6/93, 6/101 |
| ***E*** | |
| EB1/EB2 boards (see expansion boards) | |
| Electromagnetic compatibility | 6/49 |
| Electronics options | |
| Selection and ordering data | 3/6–3/8 |
| Documentation | 5/3 |
| Integration of the electronics options | 6/60 |
| Engineering information | 6/60–6/75 |
| Enclosure IP20 | 3/16, 3/38 |
| Encoder boards | 3/6, 6/61 |
| Encoder cables | |
| Selection and ordering data | 3/34–3/37 |
| Engineering information | 3/31, 6/63, 6/67, 6/102 |
| Technical data | 2/6, 3/34–3/37 |
| Engineering instructions | 6/2–6/7 |
| Engineering package Motion Control | 3/9, 5/4 |
| Expansion boards EB1/EB2 | |
| Selection and ordering data | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/61, 6/68–6/71 |
| ***F*** | |
| Fiber-optic cables for SIMOLINK | 6/79, 6/80 |
| Free function blocks | 6/24, 6/80 |
| Free-wheeling diode for the DC bus | |
| Selection and ordering data | 3/28, 3/30 |
| Engineering information | 6/59 |
| Fuse switch-disconnector | |
| for braking units | 3/30 |
| for rectifier/regenerative units | 3/26, 3/27 |
| for rectifier units | 3/23 |
| for converters | 3/20 |
| for inverters | 3/29 |
| ***G*** | |
| G-rail to EN 50 035 | 3/38 |
| Gear transmission ratio | 6/3 |
| Gears | 6/3 |
| General technical data | 2/2 |
| Guidelines | 1/4 |
| ***I*** | |
| Incremental encoder board SBP | |
| Selection and ordering data | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/20–6/22, 6/64, 6/65, 6/93, 6/95 |
| Installation conditions | 6/19 |
| Integration of the electronics options | 6/60, 6/61 |
| Interface boards SCI1/SCI2 | |
| Selection and ordering data | 3/17 |
| Engineering information | 6/72, 6/74, 6/75 |
| Inverters | |
| Selection and ordering data | 3/3–3/9, 3/29, 3/30, 4/4–4/9 |
| Documentation | 5/2, 5/3 |
| Power and control terminals | 6/31, 6/32, 6/39, 6/40, 6/43, 6/44 |
| Dimension drawings | 7/2–7/5 |
| Engineering information | 6/5, 6/6, 6/7, 6/19, 6/21–6/25, 6/31, 6/32, 6/34, 6/39, 6/40, 6/43, 6/44, 6/50, 6/51, 6/57, 6/59 |
| Technical data | 2/2, 2/3 |
| Overload characteristic | 2/3 |
| Isolation amplifier boards | 3/17 |
| ***L*** | |
| Line filters | 2/5, 6/7, 6/20–6/23 |
| Line fuses | 2/5, 6/23, 6/50 |
| Linear axis | 6/88, 6/90 |
| Line-side components | |
| Selection and ordering data | 3/20–3/28 |
| Dimension drawings | 7/8–7/13 |
| Engineering information | 6/7, 6/50 |
| Technical data | 2/5 |
| Line-side power options | 3/20–3/28 |
| ***M*** | |
| Main circuit-breakers for converters | 3/20 |
| Main contactor | |
| for rectifier/regenerative units | 3/27, 6/51, 6/52 |
| for rectifier units | 3/23, 6/51 |
| for converters | 3/22, 6/20 |
| Main contactor control | 6/100 |
| Mechanical components | 3/38 |
| Multi-axis drives | 1/4, 6/2, 6/5, 6/6, 6/20–6/23 |
| Multiturn encoders | 6/66, 6/95 |
| ***O*** | |
| OP1S (comfort operator control panel) | |
| Selection and ordering data | 3/8 |
| Documentation | 5/3 |
| Engineering information | 6/98, 6/99 |
| Operating instructions | |
| Documentation | 3/9, 5/2–5/4 |
| Reference works | 5/4 |
| Operator control and visualization with OP1S | 3/8, 3/39, 6/98, 6/99 |
| Operator control and visualization package Motion Control | 3/9 |
| Options, with code and description | 3/16 |
| Overload capability of the converter | 6/18 |
| ***P*** | |
| Packages DVA_S5 | 3/40 |
| Planning program Drive ES | 3/42 |
| Peer-to-peer (see SCB1 and SCB2 interface boards) | |
| Performance 2 | 3/3, 6/24 |
| PMU-OP1S | 6/98 |
| Positioning | 6/87, 6/88, 6/92 |
| Power cables 6FX5 and 6FX8 | |
| Selection and ordering data | 3/32, 3/33 |
| Engineering information | 3/31, 6/102 |
| Technical data | 2/6 |
| Power connections | 6/26–6/48 |
| Power supply units | 3/17, 6/21–6/23, 6/98 |
| Precharging | 3/25 |
| Precharging contactor | 3/25 |
| Precharging resistors for inverters | 3/30, 6/58 |
| Print-mark control | 6/94 |
| PROFIBUS DP | |
| CBP board | 3/6, 6/61, 6/82, 6/83 |
| Documentation | 5/3 |
| Bus cable for PROFIBUS DP | 6/82 |
| Pulse frequency | 6/7 |
| ***R*** | |
| Radio-interference suppression filter | |
| for rectifier/regenerative units | 2/5, 3/28, 6/49, 6/50 |
| for rectifier units | 2/5, 3/23, 6/49, 6/50 |
| for converters | 2/5, 3/17, 6/49, 6/50 |

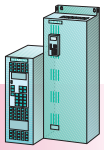

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## Index


Compact PLUS units

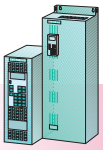

Compact and chassis units


| | Page |
|---|---|
| Documentation | 3/16 |
| Dimension drawings | 7/12, 7/13 |
| Rectifier units | |
| Selection and ordering data | 3/10, 3/12 |
| Documentation | 5/2 |
| Power and control terminals | 6/45, 6/46 |
| Power options | 3/23 |
| Dimension drawings | 7/2–7/4 |
| Engineering information | 6/6, 6/22, 6/23, 6/33–6/34, 6/45, 6/46, 6/50, 6/51 |
| Technical data | 2/4 |
| Rectifier units for supplying 24 V DC | 3/17 |
| Rectifier/regenerative units | |
| Selection and ordering data | 3/12–3/15, 3/27 |
| Documentation | 5/2 |
| Dimension drawings | 7/3, 7/4 |
| Engineering information | 6/51–6/55 |
| Technical data | 2/4 |
| Reference works, operating instructions | 5/4 |
| Regenerative autotransformer for rectifier/regenerative units | 3/28 |
| Resolver | |
| Boards SBR1/SBR2 | 3/6, 6/61 |
| Documentation | 5/3 |
| Engineering information | 6/4, 6/20–6/22, 6/62, 6/63, 6/95 |
| Retaining system for DC bus | |
| Dimension drawings | 7/14 |
| Roll feed | 6/87, 6/88, 6/90, 6/91 |
| Rotary axis | 6/88, 6/90 |
| ***S*** | |
| Safe Stop | 3/3, 3/16, 6/24, 6/25 |
| Safety engineering | 5/4 |
| SBM absolute-value encoder board (see absolute-value encoders/incremental encoders) | |
| SBP incremental encoder board (see incremental encoder board) | |
| SBR1/SBR2 resolver board (see resolver) | |
| SCB1/SCB2 board (see interface boards) | |
| SCI1/SCI2 boards (see interface boards) | |
| Selection guidelines | 1/6, 1/7 |
| Semiconductor-protection fuses | |
| for rectifier/regenerative units | 3/26, 3/27 |
| for rectifier units | 3/23 |
| for converters | 3/21 |
| Servomotors (see induction servomotors) (see synchronous servomotors) | |
| Shield clamps | 3/38 |
| SIMATIC | |
| Communication packages | 3/40, 3/41 |
| Planning package | 3/9 |
| Engineering information | 6/72–6/75, 6/82, 6/83, 6/89, 6/97 |
| Demonstration case | 5/5–5/7 |
| Accessories | 3/8 |
| SIMOLINK | |
| SLB board | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/2, 6/61, 6/79–6/81, 6/88, 6/93, 6/97 |
| Accessories | 3/8 |
| sin/cos incremental encoder 1 $V_{pp}$ | |
| SBM board | 3/6 |
| Documentation | 5/3 |
| Engineering information | 6/4, 6/20–6/22, 6/66, 6/67, 6/90, 6/95 |
| Single-axis drives | 6/5, 6/20 |
| Single-turn encoders | 6/95 |
| SLB board for SIMOLINK (see SIMOLINK) | |
| Software module | 5/3 |
| Software packages for technology functions | 3/40, 5/4 |
| Start/stop function | 6/94 |
| Start-up, parameterization and diagnostics with DriveMonitor | 3/41, 6/101 |
| Start-up box | 5/7 |
| Support | A/9 |
| Switch disconnectors with/without fuse holders | |
| for rectifier/regenerative units | 3/26, 3/27 |
| for rectifier units | 3/23 |
| for converters | 3/20 |
| Synchronous operation | 6/88, 6/93, 6/94 |
| Synchronous servomotors 1FK. and 1FT6 | |
| Limit curves | 6/3 |
| Dimension drawings | |
| 1FK6 | 7/15 |
| 1FK7 | 7/16, 7/17 |
| 1FT6 | 7/18–7/21 |
| Selection of the motor | 6/3 |
| Motor classification | |
| 1FK6 | 4/2–4/4 |
| 1FK7 | 4/2, 4/3, 4/5, 4/6 |
| 1FT6 core types | 4/2, 4/3, 4/7 |
| 1FT6 standard types | 4/2, 4/3, 4/8–4/11 |
| Engineering information | 6/2–6/7 |
| Overload capacity | 4/3 |
| ***T*** | |
| Technology | |
| General functions | 6/87, 6/88, 6/90, 6/91, 6/95 |
| Decentralized operation | 6/87, 6/88, 6/91, 6/92 |
| Centralized operation | 6/87, 6/88, 6/93, 6/94 |
| Technology boards | |
| Selection and ordering data | 3/7 |
| Description | 6/96 |
| Documentation | 5/3 |
| Technology documentation | 5/3 |
| Technology software | |
| Selection and ordering data | 3/9 |
| Engineering information | 6/87, 6/88, 6/91, 6/93 |
| Test certificate | A/3 |
| Torque limit curves for servomotors | 6/3 |
| Training courses | 5/8, 5/9 |
| Transport trolley | 5/7 |
| Travel curve | 6/2 |
| ***U*** | |
| Unit design | 6/26–6/48 |
| USS protocol | |
| Documentation | 5/4 |
| Engineering information | 6/73, 6/76, 6/78, 6/79 |
| ***V*** | |
| Voltage sensing board (VSB) | 3/25, 6/52 |

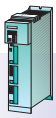

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Compact and chassis units



Compact PLUS units

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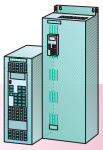
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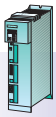
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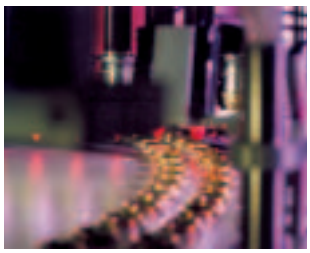
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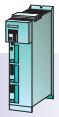
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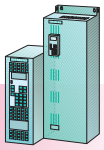
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## Rotary inertia (to convert from A to B, multiply by entry in table)

| A \ B | lb-in$^2$ | lb-ft$^2$ | lb-in-s$^2$ | lb-ft-s$^2$ slug-ft$^2$ | Kg-cm$^2$ | Kg-cm-s$^2$ | gm-cm$^2$ | gm-cm-s$^2$ | oz-in$^2$ | oz-in-s$^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| lb-in$^2$ | 1 | $6.94 \times 10^{-3}$ | $2.59 \times 10^{-3}$ | $2.15 \times 10^{-4}$ | 2.926 | $2.98 \times 10^{-3}$ | $2.92 \times 10^{3}$ | 2.984 | 16 | $4.14 \times 10^{-2}$ |
| lb-ft$^2$ | 144 | 1 | 0.3729 | $3.10 \times 10^{-2}$ | 421.40 | 0.4297 | $4.21 \times 10^{5}$ | 429.71 | 2304 | 5.967 |
| lb-in-s$^2$ | 386.08 | 2.681 | 1 | $8.33 \times 10^{-2}$ | $1.129 \times 10^{3}$ | 1.152 | $1.129 \times 10^{6}$ | $1.152 \times 10^{3}$ | $6.177 \times 10^{3}$ | 16 |
| lb-ft-s$^2$ slug-ft$^2$ | $4.63 \times 10^{3}$ | 32.17 | 12 | 1 | $1.35 \times 10^{-4}$ | 13.825 | $1.355 \times 10^{7}$ | $1.38 \times 10^{4}$ | $7.41 \times 10^{-4}$ | 192 |
| Kg-cm$^2$ | 0.3417 | $2.37 \times 10^{-3}$ | $8.85 \times 10^{-4}$ | $7.37 \times 10^{-5}$ | 1 | $1.019 \times 10^{-3}$ | 1000 | 1.019 | 5.46 | $1.42 \times 10^{-2}$ |
| Kg-cm-s$^2$ | 335.1 | 2.327 | 0.8679 | $7.23 \times 10^{-2}$ | 980.66 | 1 | $9.8 \times 10^{5}$ | 1000 | $5.36 \times 10^{3}$ | 13.887 |
| gm-cm$^2$ | $3.417 \times 10^{-4}$ | $2.37 \times 10^{-6}$ | $8.85 \times 10^{-7}$ | $7.37 \times 10^{-8}$ | $1 \times 10^{-3}$ | $1.01 \times 10^{-6}$ | 1 | $1.01 \times 10^{-3}$ | $5.46 \times 10^{-3}$ | $1.41 \times 10^{-5}$ |
| gm-cm-s$^2$ | 0.335 | $2.32 \times 10^{-3}$ | $8.67 \times 10^{-4}$ | $7.23 \times 10^{-5}$ | 0.9806 | $1 \times 10^{-3}$ | 980.6 | 1 | 5.36 | $1.38 \times 10^{-2}$ |
| oz-in$^2$ | 0.0625 | $4.34 \times 10^{-4}$ | $1.61 \times 10^{-4}$ | $1.34 \times 10^{-5}$ | 0.182 | $1.86 \times 10^{-4}$ | 182.9 | 0.186 | 1 | $2.59 \times 10^{-3}$ |
| oz-in-s$^2$ | 24.13 | 0.1675 | $6.25 \times 10^{-2}$ | $5.20 \times 10^{-3}$ | 70.615 | $7.20 \times 10^{-2}$ | $7.09 \times 10^{4}$ | 72.0 | 386.08 | 1 |

## Torque (to convert from A to B, multiply by entry in table)

| A \ B | lb-in | lb-ft | oz-in | N-m | Kg-cm | Kg-m | gm-cm | dyne-cm |
|---|---|---|---|---|---|---|---|---|
| lb-in | 1 | $8.333 \times 10^{-2}$ | 16 | 0.113 | 1.152 | $1.152 \times 10^{-2}$ | $1.152 \times 10^{3}$ | $1.129 \times 10^{6}$ |
| lb-ft | 12 | 1 | 192 | 1.355 | 13.825 | 0.138 | $1.382 \times 10^{4}$ | $1.355 \times 10^{7}$ |
| oz-in | $6.25 \times 10^{-2}$ | $5.208 \times 10^{-3}$ | 1 | $7.061 \times 10^{-3}$ | $7.200 \times 10^{-2}$ | $7.200 \times 10^{-4}$ | 72.007 | $7.061 \times 10^{7}$ |
| N-m | 8.850 | 0.737 | 141.612 | 1 | 10.197 | 0.102 | $1.019 \times 10^{4}$ | $1 \times 10^{7}$ |
| Kg-cm | 0.8679 | $7.233 \times 10^{-2}$ | 13.877 | $9.806 \times 10^{-2}$ | 1 | $10^{-2}$ | 1000 | $9.806 \times 10^{5}$ |
| Kg-m | 86.796 | 7.233 | $1.388 \times 10^{3}$ | 9.806 | 100 | 1 | $1 \times 10^{5}$ | $9.806 \times 10^{7}$ |
| gm-cm | $8.679 \times 10^{-4}$ | $7.233 \times 10^{-5}$ | $1.388 \times 10^{-2}$ | $9.806 \times 10^{-5}$ | $1 \times 10^{-3}$ | $1 \times 10^{-5}$ | 1 | 980.665 |
| dyne-cm | $8.850 \times 10^{-7}$ | $7.375 \times 10^{-8}$ | $1.416 \times 10^{-5}$ | $10^{-7}$ | $1.0197 \times 10^{-6}$ | $1.019 \times 10^{-8}$ | $1.019 \times 10^{-3}$ | 1 |

## Length (to convert from A to B, multiply by entry in table)

| A \ B | Inches | feet | cm | yd | mm | m |
|---|---|---|---|---|---|---|
| Inches | 1 | 0.0833 | 2.54 | 0.028 | 25.4 | 0.0254 |
| feet | 12 | 1 | 30.48 | 0.333 | 304.8 | 0.3048 |
| cm | 0.3937 | 0.03281 | 1 | $1.09 \times 10^{-2}$ | 10 | 0.01 |
| yd | 36 | 3 | 91.44 | 1 | 914.4 | 0.914 |
| mm | 0.03937 | 0.00328 | 0.1 | $1.09 \times 10^{-3}$ | 1 | 0.001 |
| m | 39.37 | 3.281 | 100 | 1.09 | 1000 | 1 |

## Mass (to convert from A to B, multiply by entry in table)

| A \ B | lb | oz | gm | slug |
|---|---|---|---|---|
| lb | 1 | 16 | 453.6 | 0.0311 |
| oz | $6.25 \times 10^{-2}$ | 1 | 28.35 | $1.93 \times 10^{-3}$ |
| gm | $2.205 \times 10^{-3}$ | $3.527 \times 10^{-3}$ | 1 | $6.852 \times 10^{-5}$ |
| slug | 32.17 | 514.8 | $1.459 \times 10^{4}$ | 1 |

## Power (to convert from A to B, multiply by entry in table)

| A \ B | H.P. | Watts |
|---|---|---|
| H.P. (English) | 1 | 745.7 |
| (lb-in)(deg./sec) | $2.645 \times 10^{-6}$ | $1.972 \times 10^{-3}$ |
| (lb-in)(RPM) | $1.587 \times 10^{-5}$ | $1.183 \times 10^{-2}$ |
| (lb-ft)(deg./sec) | $3.173 \times 10^{-5}$ | $2.366 \times 10^{-2}$ |
| (lb-ft)(RPM) | $1.904 \times 10^{-4}$ | 0.1420 |
| Watts | $1.341 \times 10^{-3}$ | 1 |

## Rotation (to convert from A to B, multiply by entry in table)

| A \ B | RPM | rad/sec. | degrees/sec. |
|---|---|---|---|
| RPM | 1 | 0.105 | 6.0 |
| rad/sec. | 9.55 | 1 | 57.30 |
| degrees/sec. | 0.167 | $1.745 \times 10^{-2}$ | 1 |

## Temperature conversion

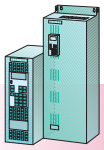
| °F | °C | °C | °F |
|---|---|---|---|
| 0 | –17.8 | –10 | 14 |
| 32 | 0 | 0 | 32 |
| 50 | 10 | 10 | 50 |
| 70 | 21.1 | 20 | 68 |
| 90 | 32.2 | 30 | 86 |
| 98.4 | 37 | 37 | 98.4 |
| 212 | 100 | 100 | 212 |
| subtract 32 and multiply by $^5/_9$ | | multiply by $^9/_5$ and add 32 | |

## Force (to convert from A to B, multiply by entry in table)

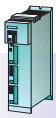
| A \ B | lb | oz | gm | dyne | N |
|---|---|---|---|---|---|
| lb | 1 | 16 | 453.6 | $4.448 \times 10^{-5}$ | 4.4482 |
| oz | 0.0625 | 1 | 28.35 | $2.780 \times 10^{-4}$ | 0.27801 |
| gm | $2.205 \times 10^{-3}$ | 0.03527 | 1 | $1.02 \times 10^{-3}$ | N.A. |
| dyne | $2.248 \times 10^{-6}$ | $3.59 \times 10^{-5}$ | 890.7 | 1 | 0.00001 |
| N | 0.22481 | 3.5967 | N.A. | 100.000 | 1 |



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Compact and chassis units



Compact PLUS units

Conversion tables

## Mechanism Efficiencies

| | |
|---|---|
| Acme-screw with brass nut | ~0.35–0.65 |
| Acme-screw with plastic nut | ~0.50–0.85 |
| Ball-screw | ~0.85–0.95 |
| Chain and Sprocket | ~0.95–0.98 |
| Preloaded Ball-screw | ~0.75–0.85 |
| Spur or Bevel-gears | ~0.90 |
| Timing Belts | ~0.96–0.98 |
| Worm Gears | ~0.45–0.85 |
| Helical Gear (1 reduction) | ~0.92 |

## Friction Coefficients

| Materials | $\mu$ |
|---|---|
| Steel on Steel (greased) | ~0.15 |
| Plastic on Steel | ~0.15–0.25 |
| Copper on Steel | ~0.30 |
| Brass on Steel | ~0.35 |
| Aluminium on Steel | ~0.45 |
| Steel on Steel | ~0.58 |

| Mechanism | $\mu$ |
|---|---|
| Ball Bushings | <0.001 |
| Linear Bearings | <0.001 |
| Dove-tail slides | ~0.2++ |
| Gibb Ways | ~0.5++ |

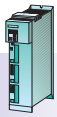
## Material Densities

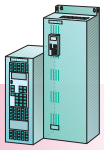
| Material | lb-in$^3$ | gm-cm$^3$ |
|---|---|---|
| Aluminium | 0.096 | 2.66 |
| Brass | 0.299 | 8.30 |
| Bronze | 0.295 | 8.17 |
| Copper | 0.322 | 8.91 |
| Hard Wood | 0.029 | 0.80 |
| Soft Wood | 0.018 | 0.48 |
| Plastic | 0.040 | 1.11 |
| Glass | 0.079–0.090 | 2.2–2.5 |
| Titanium | 0.163 | 4.51 |
| Paper | 0.025–0.043 | 0.7–1.2 |
| Polyvinyl chloride | 0.047–0.050 | 1.3–1.4 |
| Rubber | 0.033–0.036 | 0.92–0.99 |
| Silicone rubber, without filler | 0.043 | 1.2 |
| Cast iron, grey | 0.274 | 7.6 |
| Steel | 0.280 | 7.75 |

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| **Automation & Drives** | *Catalog* |
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| Interactive catalog on CD-ROM | |
| • Components for Automation & Drives | CA 01 |

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

| **Drive Systems** | |
|---|---|
| Variable-Speed Drives | |
| DC Motors | DA 12 |
| DC Drives Preferred Series up to 500 kW | DA 12.1 |
| DC Drives Preferred Series 215 kW to 1500 kW | DA 12.2 |
| SIMOREG DC MASTER 6RA70 Digital Chassis Converters | DA 21.1 |
| SIMOREG K 6RA22 Analog Chassis Converters | DA 21.2 |
| SIMOREG DC MASTER 6RM70 Digital Converter Cabinet Units | DA 22 |
| SIMOVERT PM Modular Converter Systems | DA 45 |
| SIEMOSYN Motors | DA 48 |
| MICROMASTER 410/420/430/440 Inverters | DA 51.2 |
| MICROMASTER 411/COMBIMASTER 411 | DA 51.3 |
| SIMOVERT MV Medium-Voltage Drives | DA 63 |
| SIMOVERT MASTERDRIVES Vector Control | DA 65.10 |
| SIMOVERT MASTERDRIVES Motion Control | DA 65.11 |
| Synchronous and asynchronous servomotors for SIMOVERT MASTERDRIVES | DA 65.3 |
| SIMODRIVE 611 universal and POSMO | DA 65.4 |
| Automation Systems for Machine Tools SIMODRIVE | NC 60 |
| • AC Main Spindle Motors 1PM, 1FE, 1PH | |
| • AC Servomotors 1FT, 1FK | |
| • AC Linear motors 1FN | |
| • Converter System SIMODRIVE 611 | |
| • Converter Systems SIMODRIVE POSMO A/CD/CA/SI | |
| Low-Voltage Three-Phase-Motors | |
| Project Manual | M 10 |
| Squirrel-Cage Motors, Totally Enclosed, Fan-Cooled | M 11 |
| Drive and Control Components for Hoisting Equipment | HE 1 |

| **Electrical Installation Technology** | |
|---|---|
| PDF: *ALPHA Small Distribution Boards and Distribution Boards* | *ET A1* |
| PDF: *ALPHA Side-by-Side Switchgear Cabinets* | *ET A3* |
| PDF: *BETA Modular Installation Devices* | *ET B1* |
| PDF: *DELTA Switches and Outlets* | *ET D1* |
| PDF: *GAMMA Building Management Systems* | *ET G1* |

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

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

| **Low-Voltage Controls and Distribution** | *Catalog* |
|---|---|
| Low-Voltage Controlgear, Switchgear and Systems | NS K |
| Communication-Capable Controlgear, Controlgear with SIRIUS, SIGUARD Safety Systems, Control and Signalling Devices, Switchgear, Transformers and DC Power Supplies, Main- and EMERGENCY-STOP Switches, Control Switches, Terminal Blocks | |
| BERO - Sensors for Automation | NS BERO |
| Products and Systems for Low-Voltage Power Distribution | NS PS |
| SENTRON WL | NS WL |

| **Motion Control System SIMOTION** | PM 10 |
|---|---|

| **Process Instrumentation and Analytics** | |
|---|---|
| Field Instruments for Process Automation Measuring Instruments for Pressure, Differential Pressure, Flow, Level and Temperature, Positioners and Liquid Meters | FI 01 |
| PDF: *Indicators for panel mounting* | *MP 12* |
| Process Recorders and Accessories | MP 20 |
| SIPART, Controllers and Software | MP 31 |
| SIWAREX Weighing Systems | WT 01 |
| Gas Analysis Equipment for the Process Industry | PA 10 |
| PDF: *Process Analytics, Components for Sample Preparation* | *PA 11* |
| SIPAN Liquid Analysis | PA 20 |

| **SIMATIC Industrial Automation Systems** | |
|---|---|
| SIMATIC PCS Process Control System | ST 45 |
| PDF: *SIMATIC S5/PC/505 Automation Systems* | *ST 50* |
| Components for Totally Integrated Automation | ST 70 |
| SIMATIC PCS 7 Process Control System | ST PCS 7 |
| PDF: *Add-ons for the SIMATIC PCS 7 Process Control System* | *ST PCS 7.A* |
| SIMATIC Control Systems | ST DA |

| **SIPOS Electric Actuators** | |
|---|---|
| Electric Rotary, Linear and Part-turn Actuators | MP 35 |
| Electric Rotary Actuators for Nuclear Plants | MP 35.1/.2 |

| **Systems Engineering** | |
|---|---|
| Power supplies SITOP power | KT 10.1 |
| System cabling SIMATIC TOP connect | KT 10.2 |
| MOBY Identification Systems | KT 21 |
| Industrial Microcomputers SICOMP | KT 51 |

| **System Solutions** |
|---|
| Applications and Products for Industry are part of the interactive catalog CA 01 |

| **TELEPERM M Process Control System** | |
|---|---|
| AS 235, AS 235H and AS 235K automation systems | PLT 111 |
| PDF: *AS 488/TM automation systems* | *PLT 112* |
| Operating and monitoring with WinCC/TM | PLT 123 |
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