Catalog D 21.2 • April 2004

sinamics

SINAMICS S120
Servo Control Drive System

SIEMENS

Related catalogs

SINAMICS G110 D 11.1
Inverter Chassis Units
0.12 kW (0.16 HP) to 3 kW (4 HP)
Order No.:
E86060-K5511-A111-A1
E86060-K5511-A111-A1-7600

SINAMICS G130/G150 D 11
Drive Converter Chassis Units
Drive Converter Cabinet Units
75 kW (100 HP) to 800 kW (1072 HP)
Order No.:
E86060-K5511-A101-A1
E86060-K5511-A101-A1-7600

SINAMICS S150 D 21.3
Drive Converter Cabinet Units
75 kW (100 HP) to 1200 kW (1609 HP)
Order No.:
E86060-K5521-A131-A1
E86060-K5521-A131-A1-7600

SIMATIC ST 70
Components for Totally Integrated Automation
Order No.:
E86060-K4670-A111-A8
E86060-K4670-A111-A8-7600

SIMOTION PM 10
SIMOTION motion control system
Order No.:
E86060-K4910-A101-A4
E86060-K4910-A101-A4-7600

SITRAIN ITC
Training for Automation and Industrial Solutions
Order No.:
Paper: E86060-K6850-A101-B4 (German)
CD-ROM: E86060-D6850-A100-C1-7400

Components for Automation CA 01

Order No.:
E86060-D4001-A100-C2
E86060-D4001-A110-C2-7600

A&D Mall

Internet:
http://www.siemens.com/automation/mall

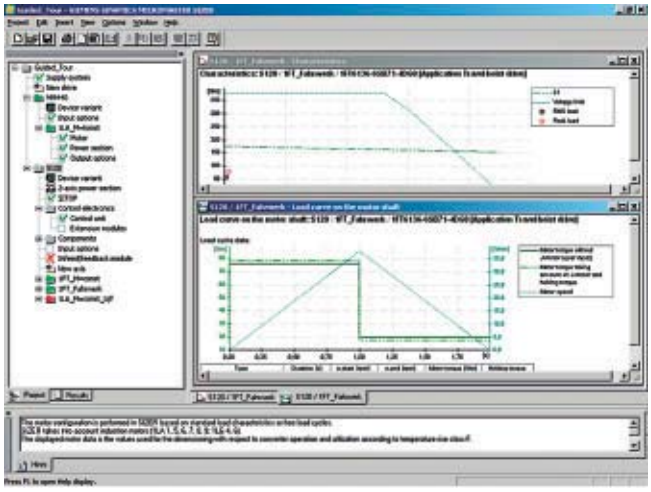
Trademarks

SINAMICS MICROMASTER SIZER configuration tool

SIZER speeds up and simplifies the configuration of **SINAMICS G110, SINAMICS G130, SINAMICS G150, SINAMICS S120, SINAMICS S150** and **MICROMASTER 4** drives.

The tool will support you during the technical configuration of all components required to complete a drive task. SIZER will guide you through all stages of the configuration process, from the line supply through the drive components and beyond to the motors.

Motors are configured by means of standardized load characteristics, cyclic drives or free duty cycles. The drive components required (e.g. power modules, power supplies) are calculated. The configuration completes the drive system by adding the supplementary components (e.g. sensor modules, terminal expansion modules, cables, reactors, filters).



Menu driven configuration makes it easier for beginners to use the tool. Status information keeps you continually informed of the progress of the configuration process. The online help provides support during configuration. In addition to the data calculated, characteristics are also displayed to assist optimization and highlight reserves.

The export function can be used to forward the parts list to the SAP-VSR ordering system where available.

Minimum hardware and software requirements:

PG or PC with Pentium™ II 400 MHz (NT, 2000),
Pentium™ III 500 MHz (XP) 256 MB RAM
At least 600 MB of free hard disk space
An additional 100 MB of free hard disk space on Windows system drive
Monitor resolution 1024x768 pixels
Windows™ NT 4.0 SP5, 2000 SP2, XP SP1
Microsoft Internet Explorer 5.5 SP2

Use

The SINAMICS MICROMASTER SIZER can be used free of charge. A minimal fee is charged for processing CD-delivery.

The user interface is available in English and German.

The SINAMICS MICROMASTER SIZER configuration tool can be ordered from your Siemens representative under Order No. **6SL3070-0AA00-0AG0**.

SINAMICS S120 Servo Control Drive System

Catalog D 21.2
April 2004

The products described in this catalog also appear in
CD-ROM catalog CA 01
Order No.:
E86060-D4001-A110-C2-7600

For details, please contact your Siemens representative.

The products and systems described in this catalog are distributed in accordance with the requirements of a quality management system which has been certified to DIN EN ISO 9001 (Certificate Registration No. 001258 QM) and DIN EN ISO 14001 (Certificate Registration No. 081342 UM). The certificates are recognized in all IQNet countries.

SIEMENS

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Welcome to Automation and Drives

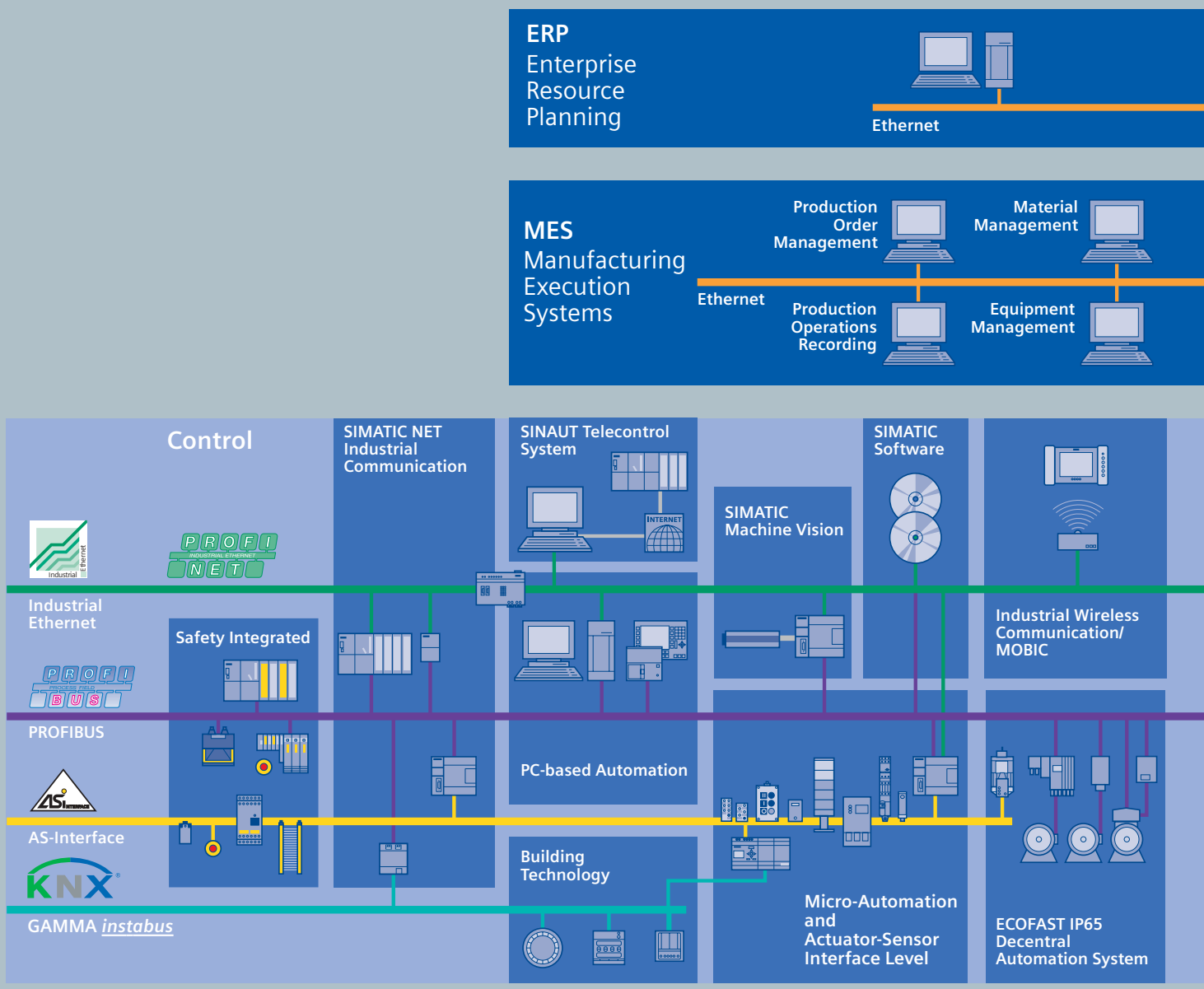
We would like to welcome you to Automation and Drives and our comprehensive range of products, systems, solutions and services for production and process automation and building technology worldwide.

With Totally Integrated Automation and Totally Integrated Power, we deliver solution platforms based on standards that offer you a considerable savings potential.

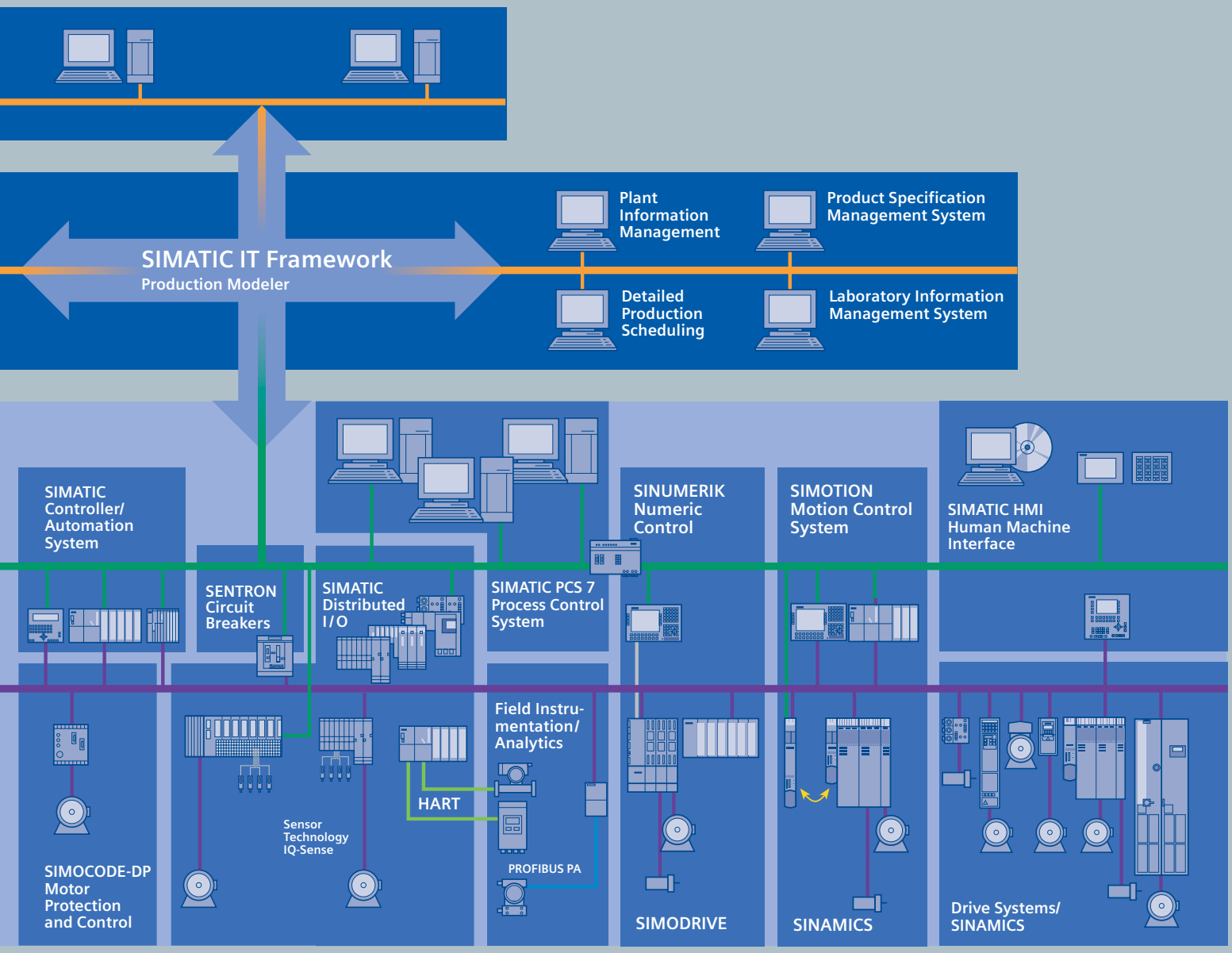
Discover the world of our technology now. If you need more detailed information, please contact one of your regional Siemens partners.
They will be glad to assist you.

Totally Integrated Automation – innovations for more productivity

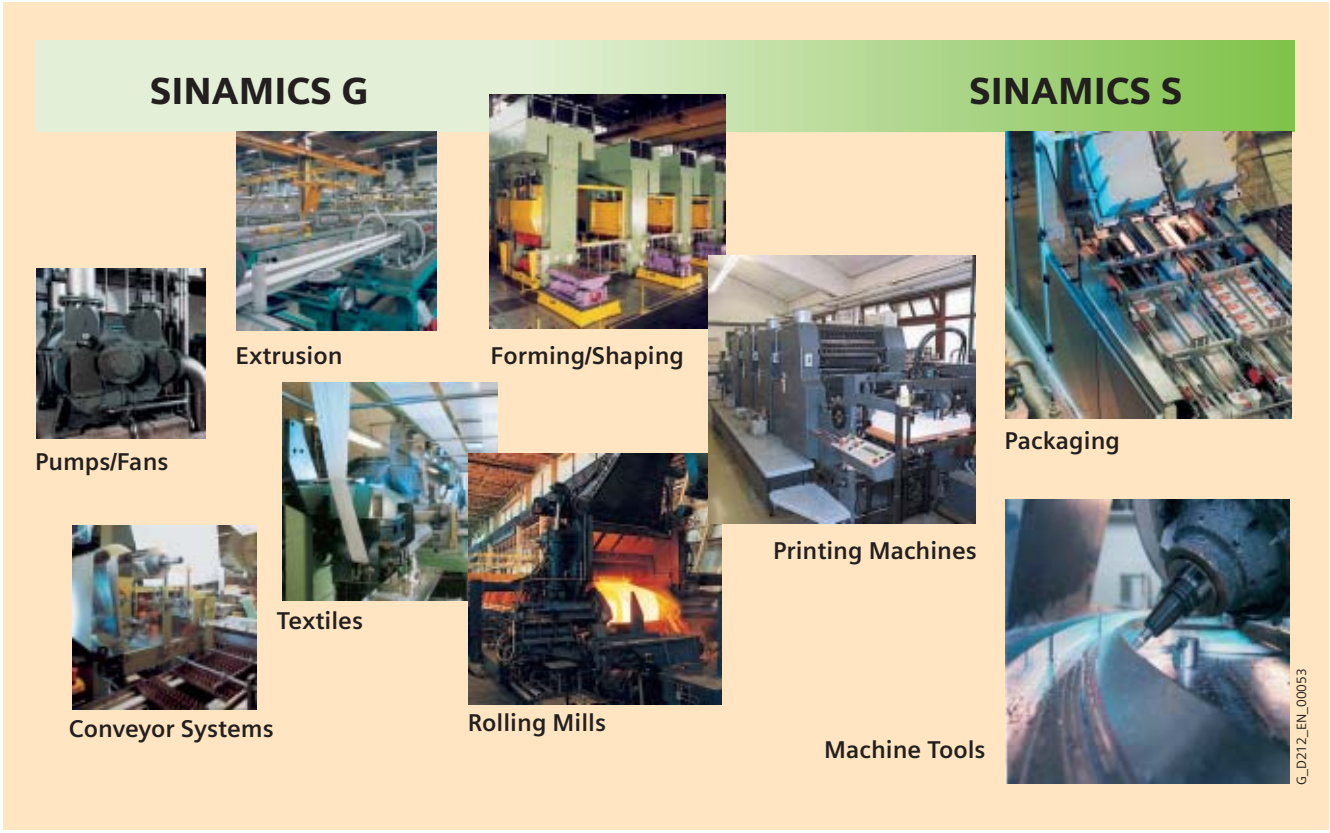
With the launch of Totally Integrated Automation, we were the first ones on the market to consistently implement the trend from equipment to an integrated automation solution, and have continuously improved the system ever since. Whether your industry is process- and production-oriented or a hybrid, Totally Integrated Automation is a unique "common solution" platform that covers all the sectors.
Totally Integrated Automation is an integrated platform for the entire production line - from receiving to technical processing



and production areas to shipping. Thanks to the system-oriented engineering environment, integrated, open communications as well as intelligent diagnostics options, your plant now benefits in every phase of the life cycle.
In fact, to this day we are the only company worldwide that can offer a control system based on an integrated platform for both the production and process industry.



SINAMICS drives family



SINAMICS applications

Applications

SINAMICS is the new drives family from Siemens designed for machine building and plant engineering applications. SINAMICS offers solutions for all drive tasks:

- Simple pump and fan applications in the process industry
- Demanding single drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems
- Drive line-ups in textile, plastic film and paper machines, as well as in rolling mill plants
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines

Product variants

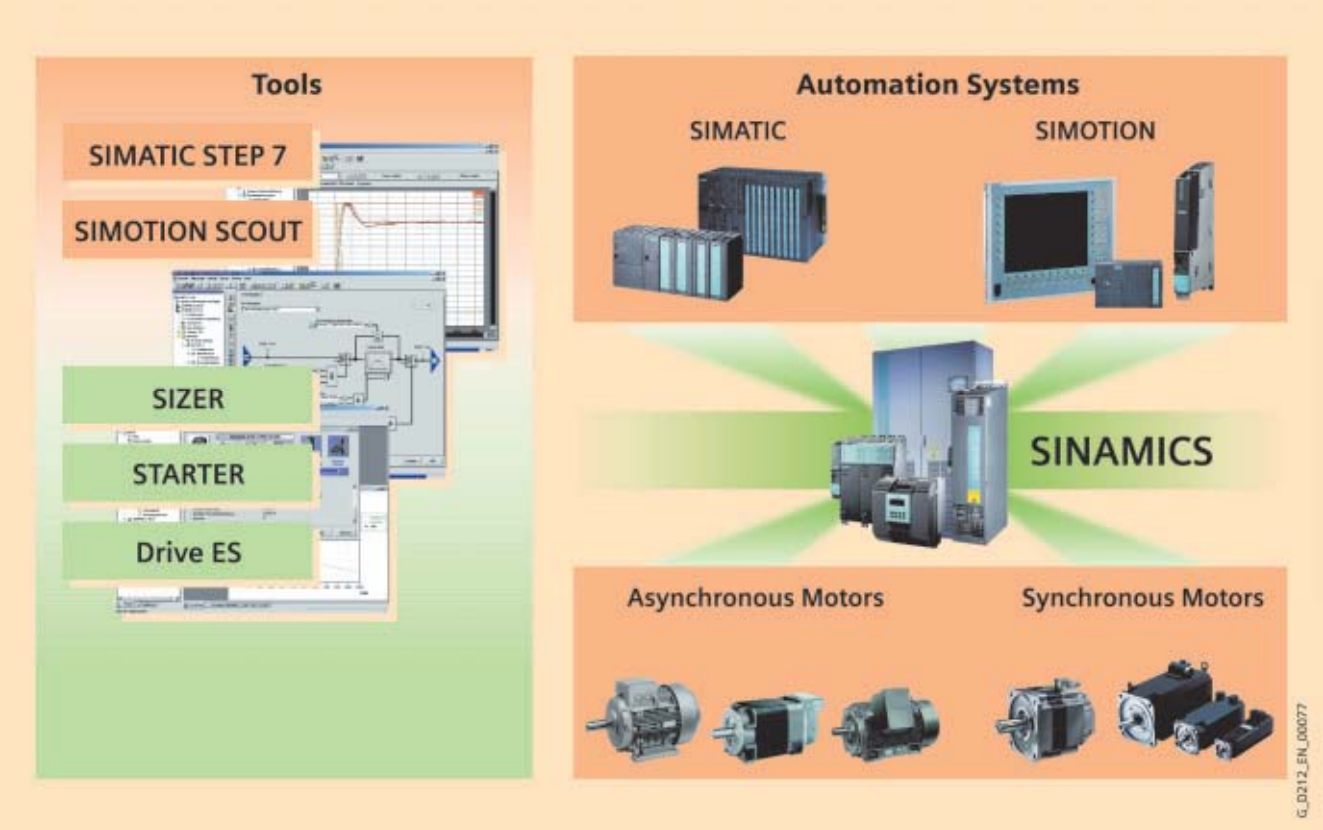
Depending on the application, the SINAMICS range offers the ideal version for any drive task.

- SINAMICS G is designed for standard applications with asynchronous motors. These applications have less stringent requirements regarding the dynamics and accuracy of the motor speed.
- SINAMICS S handles demanding drive tasks with synchronous/asynchronous motors and fulfills stringent requirements regarding:
  - Dynamics and accuracy
  - Integration of extensive technological functions in the drive control system

Platform Concept and Totally Integrated Automation

All SINAMICS variants are based on a platform concept. Common hardware and software components, as well as standardized tools for design, configuration, and commissioning tasks ensure high-level integration across all components. SINAMICS handles a wide variety of drive tasks without system breaks. The different SINAMICS variants can be easily combined with each other.

SINAMICS is a part of the Siemens "Totally Integrated Automation" concept. Integrated SINAMICS systems covering configuration, data management and communication at the automation level ensure low-maintenance solutions with SIMATIC and SIMOTION.



SINAMICS as part of the Siemens modular automation system

Quality to DIN EN ISO 9001

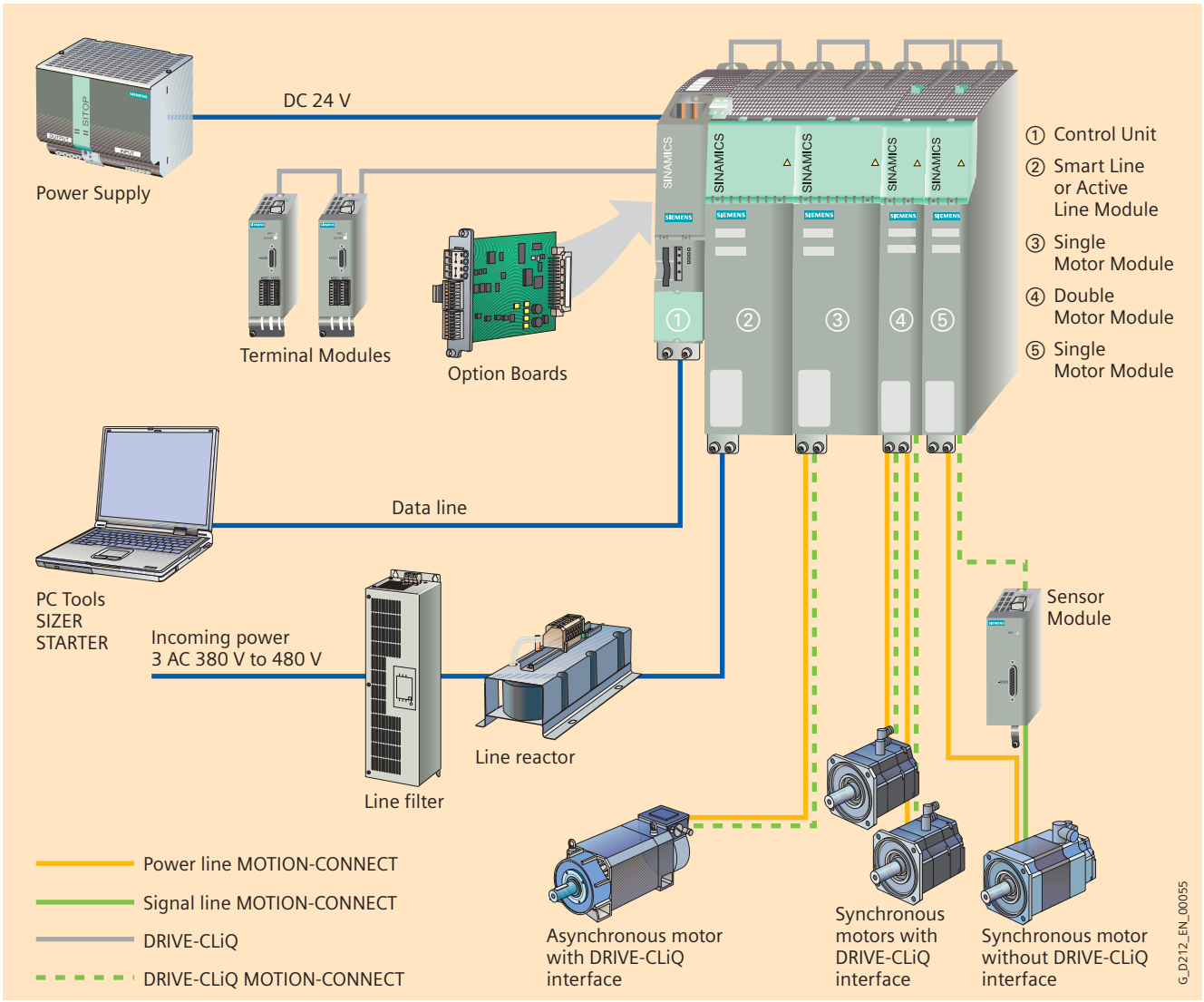
SINAMICS is able to meet the highest requirements in terms of quality. Extensive quality assurance in product design as well as in all development and production processes ensures a constantly high level of quality.

Our quality assurance system has of course been certified by an independent body in accordance with DIN EN ISO 9001.

Suitable for use anywhere in the world

SINAMICS meets the requirements of relevant international standards and regulations –a from the EN European standards through IEC to UL and cULus.

SINAMICS S120 servo control drive system



SINAMICS S120 system overview

Modular system for demanding drive tasks

SINAMICS S120 solves demanding drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Users can choose from many different harmonized components and functions to create a solution that best meets their requirements. SIZER, a high-performance configuration tool, makes it easier to choose and determine the optimum drive configuration.

SINAMICS S120 is enhanced by a wide range of motors. Whether synchronous or asynchronous, all motor types are supported by SINAMICS S120.

Drive for multi-axis applications

The trend towards separate axes in machine building is growing all the time. Where possible, central drives are being replaced by electronically coordinated servo drives. Drives with coupled DC links are required for this purpose, as they support economic energy exchange between braking and driving axes. SINAMICS S120 boasts line supplies and inverter modules covering a wide power range, which, having been designed for seamless integration, pave the way for compact multi-axis drive configurations.

New system architecture with a central control unit

Electronically coordinated individual drives work together to perform your drive tasks. Higher-level controllers operate the drives to achieve the required coordinated movement. This requires cyclic data exchange between the controller and all the drives. This exchange usually took place via a field bus, which required a great deal of time and effort for installation and configuration. SINAMICS S120 takes a different approach. A central control unit controls the drives for all connected axes and also establishes the technological links between the drives and/or axes. Since all the required data is stored in the central control unit, it does not need to be transferred. Inter-axis connections can be established within a control unit and easily configured in the STARTER commissioning tool.

Simple technological tasks can be carried out automatically by the SINAMICS S120 control unit. For complex numerical or motion-control tasks, high-performance SIMOTION D modules are used instead.

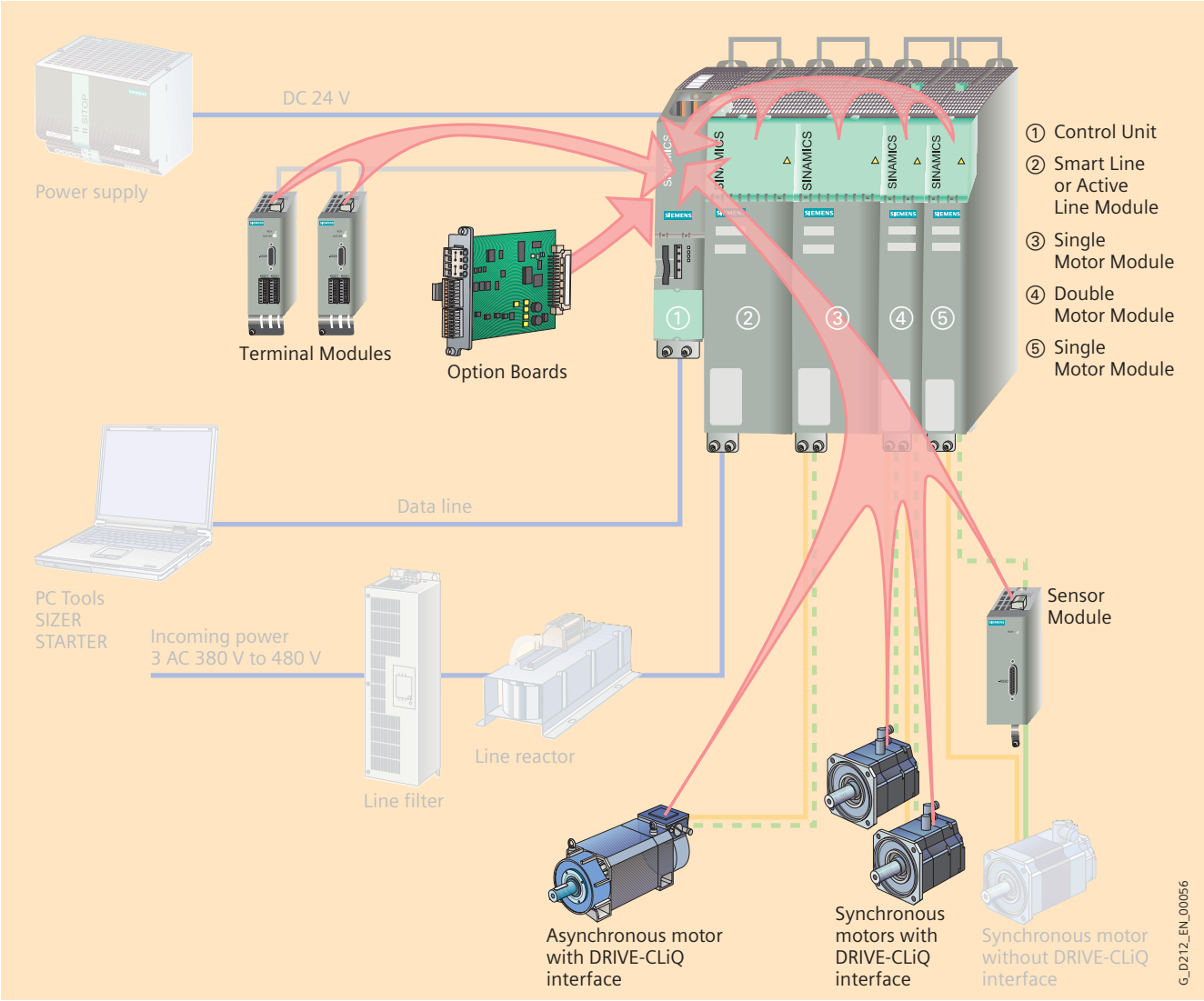
DRIVE-CLiQ – the digital interface between all components

All SINAMICS S120 components, including the motors and encoders, are interconnected via a joint serial interface called DRIVE-CLiQ. The standardized cables and connectors reduce the variety of different parts and cut inventory costs.

Converter boards (sensor modules) for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

SINAMICS S120 servo control drive system

Electronic rating plate in all components



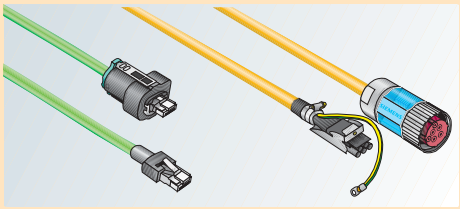
Detection of electronic rating plates via DRIVE-CLiQ with SINAMICS S120

All SINAMICS S120 components have an electronic rating plate that contains all the relevant data about that particular component. In the motors, for example, this data includes the parameters of the electric equivalent circuit diagram and characteristic values for the built-in motor encoder. The control unit records this data automatically via DRIVE-CLiQ so that it does not need to be entered during commissioning or when the equipment is replaced.

In addition to the technical data, the rating plate includes logistical data (manufacturer ID, order number, and globally unique ID). Since this data can be called up electronically on site or remotely, all the components used in a machine can always be individually identified, which helps simplify servicing.

SINAMICS S120 drive system components

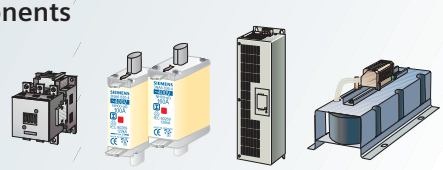
Connectors



3 AC Line

Line-side power components

Line contactors
Line fuses
Line filters
Line reactors



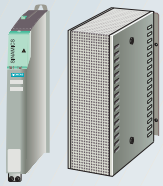
SINAMICS S120 components

Power supplies

Line Modules

Smart Line Modules
Active Line Modules

Control Units

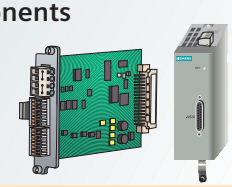


DC link components

Braking Modules
with braking resistors
Capacitor Modules
Control Supply Modules

Additional systems components und Sensor Modules

Option Boards
Terminal Modules
Sensor Modules

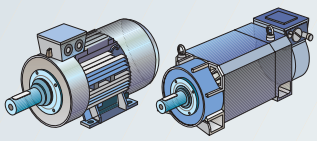


Motor Modules

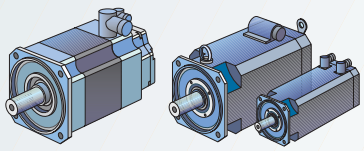
Single Motor Modules
Double Motor Modules

Motors

Asynchron motors



Synchronous motors



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Notes

The overview on page 1/11 features the SINAMICS S120 components that are primarily used for multi-axis drive tasks.

The following power components are available:

- **Line-side power components** such as fuses, contactors, reactors, and filters for switching the power supply and meeting EMC requirements.
- **Line modules**, which supply power centrally to the DC link.
- **DC link components**, which can be used as options to stabilize the DC link voltage and/or to buffer the electronics power supply.
- **Motor modules**, which act as inverters, receive power from the DC link, and buffer the connected motors.

The SINAMICS S120 components have been developed for installation in cabinets. They have the following features and characteristics:

- Easy to handle, simple installation and wiring
- Practical connection system, cable routing in accordance with EMC requirements
- Standardized design, seamless integration
- Internal cooling-fans (other cooling methods available on request)

To carry out the required functions, SINAMICS S120 is equipped with:

- A **control unit** that carries out all drive and technological functions across all axes.
- **Additional system components** that enhance functionality and offer different interfaces for encoders and process signals.

SINAMICS S120 Servo

2

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2/10 Smart Line Modules
2/13 Active Line Modules

2/16 **Motor Modules**
2/16 Single Motor Modules
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2/24 **DC link components**
2/24 Braking Module
2/26 Brake resistors
2/27 Capacitor Module
2/28 Control Supply Module
2/29 DC link power supply adapter

2/30 **Control units**
2/30 CU320 Control Unit
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2/34 CBC10 Communication Board
2/35 TB30 Terminal Board
2/37 TM31 Terminal Module

2/39 **Sensor system connection**
2/40 SMC10 Sensor Module Cabinet-mounted
2/41 SMC20 Sensor Module Cabinet-mounted
2/42 SMC30 Sensor Module Cabinet-mounted

General technical data

Technical data

Unless explicitly specified otherwise, the following technical data are valid for all components of the SINAMICS S120 drive system described here.

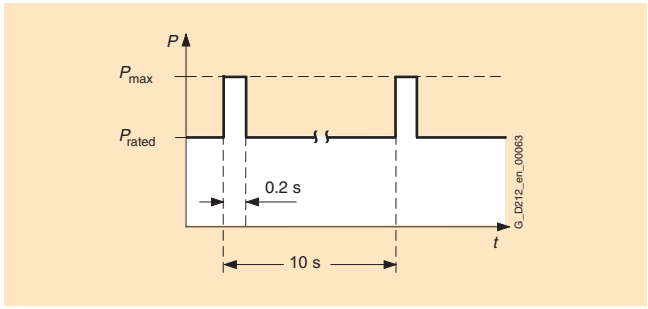
Electrical data	
Line connection voltage	3 AC 380 V to 480 V ±10% (-15% < 1 min)
Line frequency	50/60 Hz, -6/+6%
Electronic power supply	DC 24 V, -15/+20%
Radio interference suppression	
•Standard	No radio interference suppression
•With line filter	Class A1 to EN 55 011 possible
Overvoltage category	Class III to EN 60 664-1
Mechanical data	
Vibration stressing	
•Transport	EN 60 721-3-2, Class 2M3
•Operation	EN 60 721-3-3, Class 3M4
Shock stressing	
•Transport	EN 60 721-3-2, Class 2M3
•Operation	EN 60 721-3-3, Class 3M4
Ambient conditions	
Degree of protection	IP20 to EN 60 529
Protection class	Class I (with protective conductor system) and Class III (PELV) to EN 61 800-5-1
Cooling method	Internal ventilation, power sections with forced air cooling with integrated cooling fan

Ambient conditions	
Permissible ambient and coolant temperature (air) during operation for line-side components, Line Modules and Motor Modules	0 °C (+32 °F) to +40 °C (+104 °F) without derating, > +40 °C (+104 °F) to +55 °C (+131 °F) see derating characteristics
Permissible ambient and coolant temperature (air) during operation for control units, additional system components, DC link components and Sensor Modules	0 °C (+32 °F) to +55 °C (+131 °F)
Climatic ambient conditions	
•Storage	Class 1K3 to EN 60 721-3-1 Temperature -25 °C (-13 °F) to +55 °C (+131 °F)
•Transport	Class 2K4 to EN 60 721-3-2 Temperature -40 °C (-40 °F) to +70 °C (+158 °F) Max. humidity 95% at +40 °C (+104 °F)
•Operation	Class 3K3 to EN 60 721-3-3 Relative humidity 5 to 65% annual average, ≤ 80% max. 2 months per year, condensation, splashwater and ice formation not permitted (EN 60 204, Part 1)
Environmental class/harmful chemical substances	
•Storage	Class 1C2 to EN 60 721-3-1
•Transport	Class 2C2 to EN 60 721-3-2
•Operation	Class 3C2 to EN 60 721-3-3
Organic/biological influences	
•Storage	Class 1B1 to EN 60 721-3-1
•Transport	Class 2B1 to EN 60 721-3-2
•Operation	Class 3B1 to EN 60 721-3-3
Degree of pollution	2 to EN 60 664-1
Installation altitude	Up to 1000 m (3282 ft) above sea level no derating, > 1000 m (3282 ft) to 5000 m (16,408 ft) above sea level see derating characteristics
Approvals	
Certification	CE (low-voltage and EMC Directives), cULus (file nos.: E192450, E164110 and E70122)
Safety Integrated – safe standstill (SH) and safe brake control (SBC)	Safety Integrity Level (SIL) 2 to IEC 61508, control category 3 to EN 954-1
Modules	
Line Modules in Booksize format	
•Rated supply voltage	3 AC 380 V to 480 V
Active Line Modules in Booksize format	
•Rated pulse frequency	8 kHz
Motor Modules in Booksize format	
•DC link connection voltage	DC 510 V to 750 V
•Rated pulse frequency	4 kHz

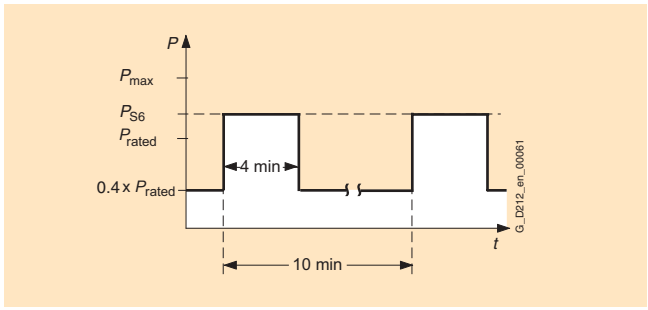
Technical data (continued)

Overload capability

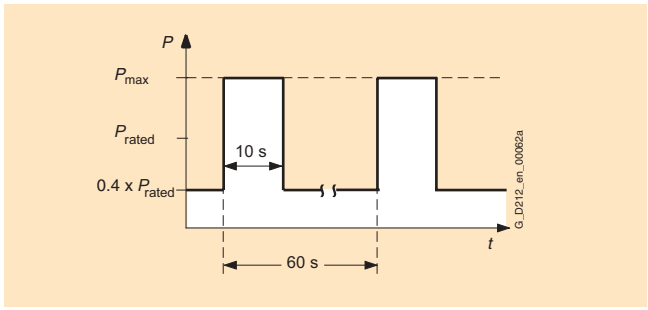
Line Modules in Booksize format



Load cycle with preloading

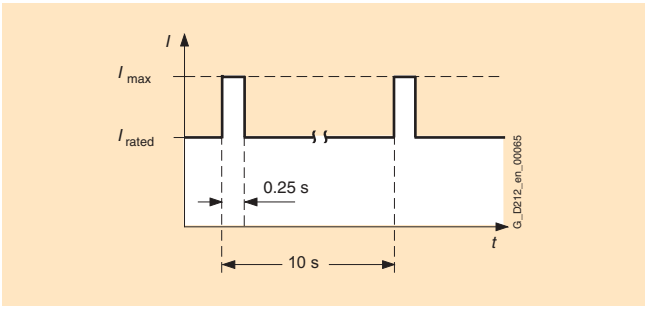


S6 load cycle with preloading

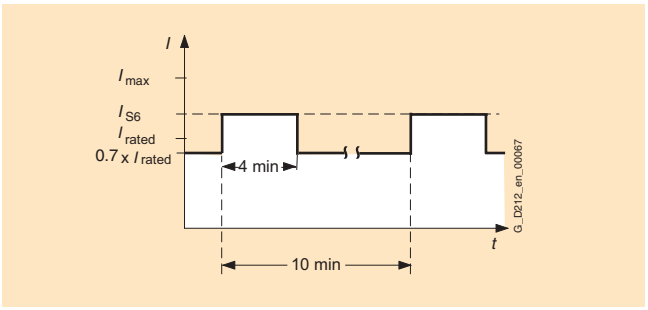


S6 load cycle with preloading

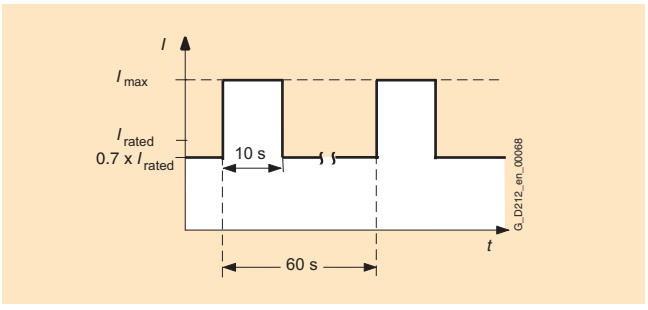
Motor Modules in Booksize format



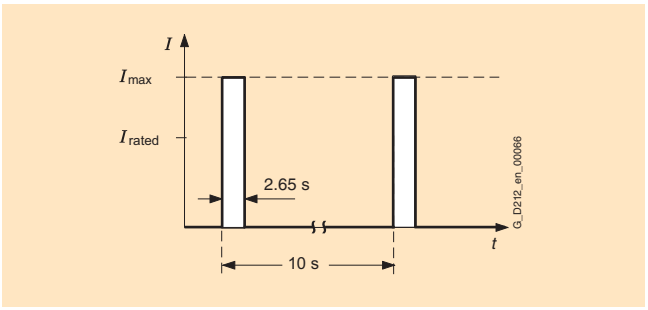
Load cycle with preloading



S6 load cycle with preloading



S6 load cycle with preloading

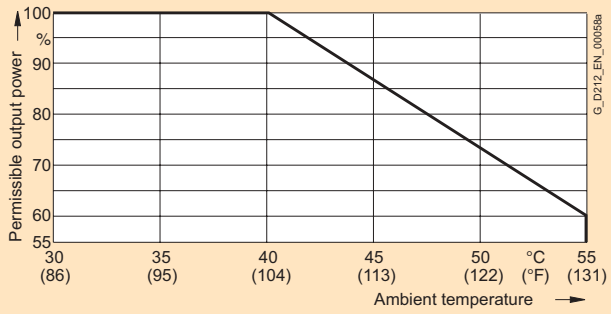


Load cycle without preloading

Derating characteristics

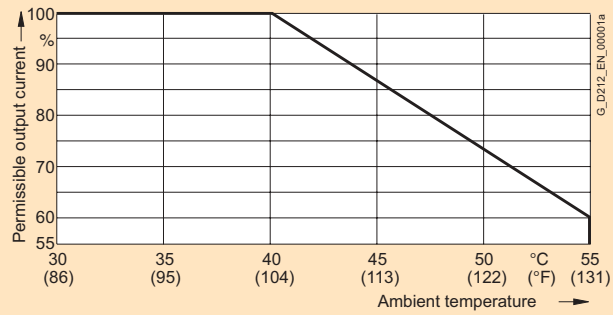
Characteristics

Derating characteristics for Line Modules in Booksize format

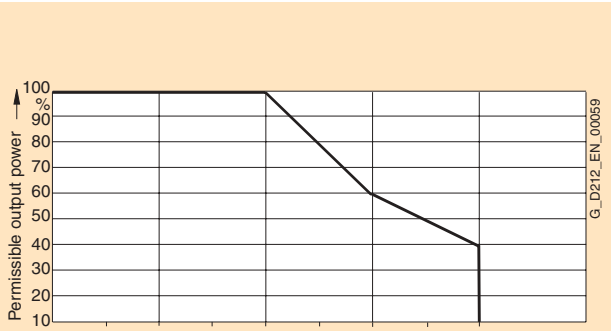


Rated output power as a function of ambient temperature

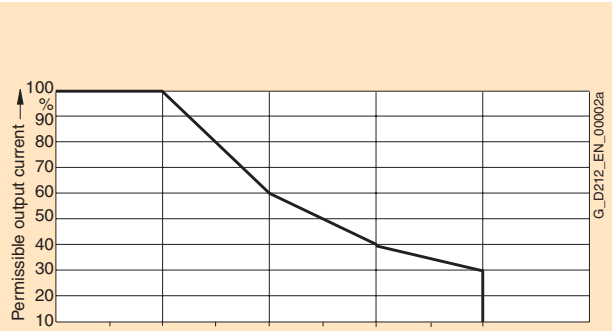
Derating characteristics for Motor Modules in Booksize format



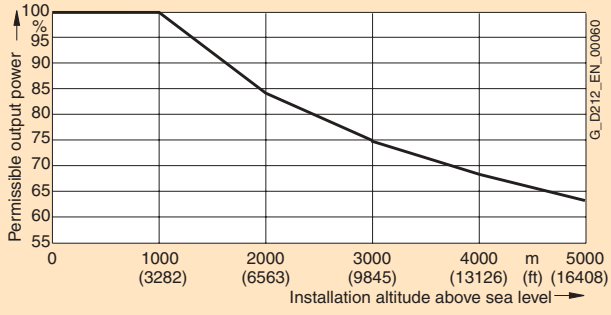
Rated output current as a function of ambient temperature



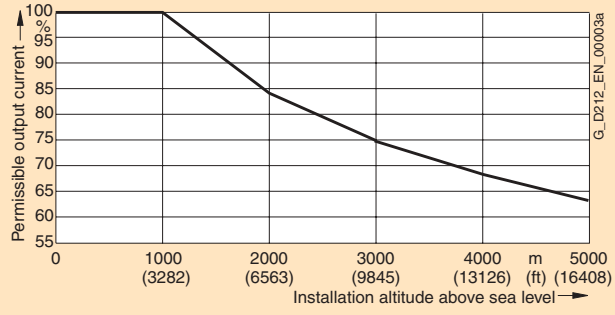
Rated output power as a function of pulse frequency (Active Line Modules only)



Rated output current as a function of pulse frequency



Rated output power as a function of installation altitude



Rated output current as a function of installation altitude

Correction factors for increased ambient temperatures and installation altitudes

If the Line and Motor Modules are operated at ambient temperatures of > 40°C (104°F) and installation altitudes of > 1000 m (3282 ft), both derating characteristics must be taken into account for the permissible output power/output current.

Example:

A motor module is to operate at an ambient temperature of 55°C (131°F) (60% permissible output current) and an installation altitude of 3000 m (9845 ft) (75% permissible output current). The permissible output current in this case is 100 x (0.60 x 0.75) = 45%.

Overview

Line-side power components are used to protect the connected components against transient or continuous overvoltages and ensure that prescribed limit values are adhered to.

When combined with line reactors and a consistent system structure, line filters limit the conducted interference emitted by the power modules to permissible values for industrial supplies (Class A1 to EN 61 800-3) at the installation site. Line filters are only suitable for direct connection to TN systems (grounded).

Selection and ordering data

Line filters can only be ordered together with the appropriate line reactor. The order number comprises the line filter and the line reactor.

Line filters and line reactors	For **Smart** Line Modules	Order No. **Line filters and line reactors**
5 kW (6.5 HP)	6SL3130-6AE15-0AA0	**6SL3000-0GE15-0AA0**
10 kW (13.5 HP)	6SL3130-6AE21-0AA0	**6SL3000-0GE21-0AA0**

Line filters and line reactors	For **Active** Line Modules	Order No. **Line filters and line reactors**
16 kW (21.5 HP)	6SL3130-7TE21-6AA1	**6SL3000-0FE21-6AA0**
36 kW (48 HP)	6SL3130-7TE23-6AA1	**6SL3000-0FE23-6AA0**
55 kW (74 HP)	6SL3130-7TE25-5AA1	**6SL3000-0FE25-5AA0**
80 kW (107 HP)	6SL3130-7TE28-0AA0	**6SL3000-0FE28-0AA0**
120 kW (160 HP)	6SL3130-7TE31-2AA0	**6SL3000-0FE31-2AA1**

Accessories

Adapter sets are available for very compact installation. They enable line filters and line reactors to be installed compactly one above the other in the control cabinet.

Adapter set for line filter and line reactor	**Active** Line Module power output	Order No. **Adapter set**
6SL3000-0FE21-6AA0	16 kW (21.5 HP)	**6SL3060-1FE21-6AA0**
6SL3000-0FE23-6AA0	36 kW (48 HP)	**6SN1162-0GA00-0CA0**

Line filters

Technical data

		Line filters	
For **Smart Line Module**	Type	6SL3130-6AE15-0AA0	6SL3130-6AE21-0AA0
Rated power infeed of the Smart Line Module	kW (HP)	**5 (6.5)**	**10 (13.5)**
Rated current	A	12	24
Power loss	kW	0.005	0.009
Line/power connection L1, L2, L3 / U, V, W		Screw-type terminals 10 mm^2	Screw-type terminals 10 mm^2
PE connection		On housing with M6 bolt	On housing with M6 bolt
Width	mm (inch)	60 (2.36)	60 (2.36)
Height	mm (inch)	285 (11.22)	285 (11.22)
Depth	mm (inch)	122 (4.8)	122 (4.8)
Weight, approx.	kg (lb)	2.0 (4.4)	2.4 (5.3)

		Line filters				
For **Active Line Module**	Type	6SL3130-7TE21-6AA1	6SL3130-7TE23-6AA1	6SL3130-7TE25-5AA1	6SL3130-7TE28-0AA0	6SL3130-7TE31-2AA0
Rated power infeed of the Active Line Module	kW (HP)	**16 (21.5)**	**36 (48)**	**55 (74)**	**80 (107)**	**120 (160)**
Rated current	A	30	67	103	150	225
Power loss	kW	0.17	0.25	0.35	0.45	0.59
Line/power connection L1, L2, L3 / U, V, W		Screw-type terminals 10 mm^2	Screw-type terminals 50 mm^2	Screw-type terminals 50 mm^2	Screw-type terminals 95 mm^2	M10 connecting lugs
PE connection		On housing with M5 bolt	On housing with M8 bolt	On housing with M8 bolt	On housing with M8 bolt	On housing with M8 bolt
Width	mm (inch)	130 (5.12)	130 (5.12)	130 (5.12)	200 (7.87)	300 (11.81)
Height	mm (inch)	480 (18.9)	480 (18.9)	480 (18.9)	480 (18.9)	480 (18.9)
Depth	mm (inch)	150 (5.9)	245 (9.65)	260 (10.24)	260 (10.24)	260 (10.24)
Weight, approx.	kg (lb)	9 (19.8)	16 (35.3)	19 (41.9)	22 (48.5)	32 (70.6)

Overview

Line reactors limit low-frequency line harmonics to permissible values. For this reason, line reactors must always be used.

Selection and ordering data

Line reactor	For **Smart** Line Modules	Order No. **Line reactor**
5 kW (6.5 HP)	6SL3130-6AE15-0AA0	**6SL3000-0CE15-0AA0**
10 kW (13.5 HP)	6SL3130-6AE21-0AA0	**6SL3000-0CE21-0AA0**

Line reactor	For **Active** Line Modules	Order No. **Line reactor**
16 kW (21.5 HP)	6SL3130-7TE21-6AA1	**6SN1111-0AA00-0BA1**
36 kW (48 HP)	6SL3130-7TE23-6AA1	**6SN1111-0AA00-0CA1**
55 kW (74 HP)	6SL3130-7TE25-5AA1	**6SN1111-0AA00-0DA1**
80 kW (107 HP)	6SL3130-7TE28-0AA0	**6SN1111-0AA00-1EA0**
120 kW (160 HP)	6SL3130-7TE31-2AA0	**6SL3000-0DE31-2BA0**

Line reactors

Technical data

		Line reactor	
		6SL3000-0CE15-0AA0	**6SL3000-0CE21-0AA0**
For **Smart Line Module**	Type	6SL3130-6AE15-0AA0	6SL3130-6AE21-0AA0
Rated power infeed supply of the Smart Line Module	kW (HP)	**5 (6.5)**	**10 (13.5)**
Rated current	A	14	28
Power loss	kW	0.062	0.116
Line/power connection 1U1, 1V1, 1W1 / 1U2, 1V2, 1W2		Screw-type terminals 4 mm^2	Screw-type terminals 10 mm^2
PE connection		Screw-type terminals 4 mm^2	Screw-type terminals 10 mm^2
Degree of protection		IP00	IP00
Width	mm (inch)	90 (3.54)	110 (4.33)
Height	mm (inch)	150 (5.91)	180 (7.09)
Depth	mm (inch)	170 (6.69)	197 (7.76)
Weight, approx.	kg (lb)	3.7 (8.2)	7.5 (16.5)

		Line reactor				
		6SN1111-0AA00-0BA1	**6SN1111-0AA00-0CA1**	**6SN1111-0AA00-0DA1**	**6SN1111-0AA00-1EA0**	**6SL3000-0DE31-2BA0**
For **Active Line Module**	Type	6SL3130-7TE21-6AA1	6SL3130-7TE23-6AA1	6SL3130-7TE25-5AA1	6SL3130-7TE28-0AA0	6SL3130-7TE31-2AA0
Rated power infeed supply of the Active Line Module	kW (HP)	**16 (21.5)**	**36 (48)**	**55 (74)**	**80 (107)**	**120 (160)**
Rated current	A	30	67	103	150	225
Power loss	kW	0.17	0.25	0.35	0.45	0.59
Line/power connection 1U1, 1V1, 1W1 / 1U2, 1V2, 1W2		Screw-type terminals 16 mm^2	Screw-type terminals 35 mm^2	Screw-type terminals 70 mm^2	M10 connecting lugs	M10 connecting lugs
PE connection		Screw-type terminals 16 mm^2	Screw-type terminals 35 mm^2	Screw-type terminals 70 mm^2	M10 connecting lugs	M10 connecting lugs
Degree of protection		IP00	IP00	IP00	IP00	IP00
Width	mm (inch)	150 (5.91)	150 (5.91)	150 (5.91)	222 (8.74)	225 (8.86)
Height	mm (inch)	330 (12.99)	330 (12.99)	330 (12.99)	330 (12.99)	330 (12.99)
Depth	mm (inch)	145 (5.71)	230 (9.06)	280 (11.02)	200 (7.87)	300 (11.81)
Weight, approx.	kg (lb)	8.5 (18.7)	13 (28.7)	18 (39.7)	40 (88.2)	50 (110.3)

Overview

Suitable line-side power components are assigned depending on the power rating of the Smart or Active Line Modules.

The circuit-breakers (UL) indicated are available from North American sales offices: 1-800-964-4114 www.sea.siemens.com

Assignment of line-side power components to Smart Line Modules

Rated power infeed	Assignment to **Smart** Line Modules	**Main switch**	**Fuse switch disconnector**	**Switch disconnector with fuse holders**	**NH fuse** (gL/gG)		
kW (HP)	Type 6SL3130-...	Order No.	Order No.	Order No.	Order No.	Rated current	Size
5 (6.5)	6AE15-0AA0	**3LD2003-0TK51**	**3NP4010-0CH01**	**3KL5030-1EB01**	**3NA3805**	16 A	000
10 (13.5)	6AE21-0AA0	**3LD2203-0TK51**	**3NP4010-0CH01**	**3KL5030-1EB01**	**3NA3814**	35 A	000

Rated power infeed	Assignment to **Smart** Line Modules	**Circuit-breaker** (IEC)	**Circuit-breaker** (UL)	**Main contactor**	**Line filter and line reactor**	**Line reactor**
kW (HP)	Type 6SL3130-...	Order No.	Order No.	Order No.	Order No.	Order No.
5 (6.5)	6AE15-0AA0	**3RV1031-4BA10**	**ED43B015**	**3RT1023-1BB40**	**6SL3000-0GE15-0AA0**	**6SL3000-0CE15-0AA0**
10 (13.5)	6AE21-0AA0	**3RV1031-4FA10**	**ED43B035**	**3RT1026-1BB40**	**6SL3000-0GE21-0AA0**	**6SL3000-0CE21-0AA0**

Assignment of line-side power components to Active Line Modules

Rated power infeed	Assignment to **Active** Line Modules	**Main switch**	**Leading auxiliary circuit switch for main switch**	**Fuse switch disconnector**	**Switch disconnector with fuse holders**	**Leading auxiliary switch for switch disconnector with fuse holders**
kW (HP)	Type 6SL3130-...	Order No.	Order No.	Order No.	Order No.	Order No.
16 (21.5)	7TE21-6AA1	**3LD2504-0TK51**	**3LD9250-3B**	**3NP4010-0CH01**	**3KL5030-1EB01**	**3KX3552-3EA01**
36 (48)	7TE23-6AA1	**3LD2704-0TK51**	**3LD9250-3B**	**3NP4010-0CH01**	**3KL5230-1EB01**	**3KX3552-3EA01**
55 (74)	7TE25-5AA1	**3KA5330-1EE01**	**3KX3552-3EA01**	**3NP4270-0CA01**	**3KL5530-1EB01**	**3KX3552-3EA01**
80 (107)	7TE28-0AA0	**3KA5330-1EE01**	**3KX3552-3EA01**	**3NP4270-0CA01**	**3KL5530-1EB01**	**3KX3552-3EA01**
120 (160)	7TE31-2AA0	**3KA5730-1EE01**	**3KX3552-3EA01**	**3NP5360-0CA00**	**3KL5730-1EB01**	**3KX3552-3EA01**

Rated power infeed	Assignment to **Active** Line Modules	**NEOZED fuse** (gL/gG)			**DIAZED fuse** (gL/gG)			**NH fuse** (gL/gG)			**UL/CSA fuse, Class J** Available from: Ferraz Shawmut http://www.ferraz-shawmut.com		
kW (HP)	Type 6SL3130-...	Order No.	Rated current	Size	Order No.	Rated current	Size	Order No.	Rated current	Size	Reference No.	Rated current	Size
16 (21.5)	7TE21-6AA1	**5SE2335**	35 A	D02	**5SB411**	35 A	DIII	**3NA3814**	35 A	000	AJT35	35 A	27×60
36 (48)	7TE23-6AA1				**5SC211**	80 A	DIVH	**3NA3824**	80 A	000	AJT80	80 A	29×117
55 (74)	7TE25-5AA1							**3NA3132**	125 A	1	AJT125	125 A	41×146
80 (107)	7TE28-0AA0							**3NA3136**	160 A	1	AJT175	175 A	41×146
120 (160)	7TE31-2AA0							**3NA3144**	250 A	1	AJT250	250 A	54×181

Rated power infeed	Assignment to **Active** Line Modules	**Circuit-breaker** (IEC)	**Circuit-breaker** (UL)	**Main contactor**	**Output interface for main switch**	**Line filter and line reactor**	**Line reactor**
kW (HP)	Type 6SL3130-...	Order No.	Order No.	Order No.	Order No. **3TX7004-**	Order No. **6SL3000-**	Order No.
16 (21.5)	7TE21-6AA1	**3RV1031-4FA10**	**ED43B035**	**3RT1035-1AC24**	**1LB00**	**0FE21-6AA0**	**6SN1111-0AA00-0BA1**
36 (48)	7TE23-6AA1	**3RV1041-4LA10**	**ED43B080**	**3RT1045-1AP04**	**1LB00**	**0FE23-6AA0**	**6SN1111-0AA00-0CA1**
55 (74)	7TE25-5AA1	**3VF3211-3FU41-0AA0**	**ED43B125**	**3RT1054-1AP36**	**1LB00**	**0FE25-5AA0**	**6SN1111-0AA00-0DA1**
80 (107)	7TE28-0AA0	**3VF3211-3FW41-0AA0**	**FD63T175**	**3RT1056-6AP36**	**1LB00**	**0FE28-0AA0**	**6SN1111-0AA00-1EA0**
120 (160)	7TE31-2AA0	**3VF4211-3DM41-0AA0**	**FD63T250**	**3RT1065-6AP36**	**1LB00**	**0FE31-2AA1**	**6SL3000-0DE31-2BA0**

Line Modules

Overview

The drives group is connected to the power supply network by means of a line module. The Smart Line Module and the Active Line Modules supply power to the DC link.

The line modules are suitable for direct operation on TN, TT (grounded) and IT (ungrounded) systems.

When the Smart and Active Line Modules are in regenerative feedback mode, the power supplied to the DC link from the drives is fed back into the line. On a line which does not support regenerative feedback the regenerative feedback function of the line module must be deactivated.

Smart Line Modules

Overview

Smart Line Modules are non-regulated rectifier/regenerative units (diode bridge for incoming supply; stable, line-commutated feedback via IGBTs) with 100% regenerative feedback power. The regenerative feedback capability of the modules can be deactivated by means of a digital input.

Design

Smart Line Modules feature the following interfaces as standard:

- 1 x line connection via plug-in screw-type terminal with integrated shield connection plate
- 1 x connection for the electronics power supply via the 24 V terminal adapter included in the scope of supply
- 2 x DC link connections via integrated DC link busbars
- 2 x digital inputs
- 1 x digital output
- 2 x PE (protective earth) connections

The status of the Smart Line Modules is indicated via two multi-color LEDs.

The signal line shield can be connected to the line module via a shield connection terminal, e.g. Weidmüller type KLBÜ 3-8 SC. The shield connection terminal must not be used for strain relief.

Selection and ordering data

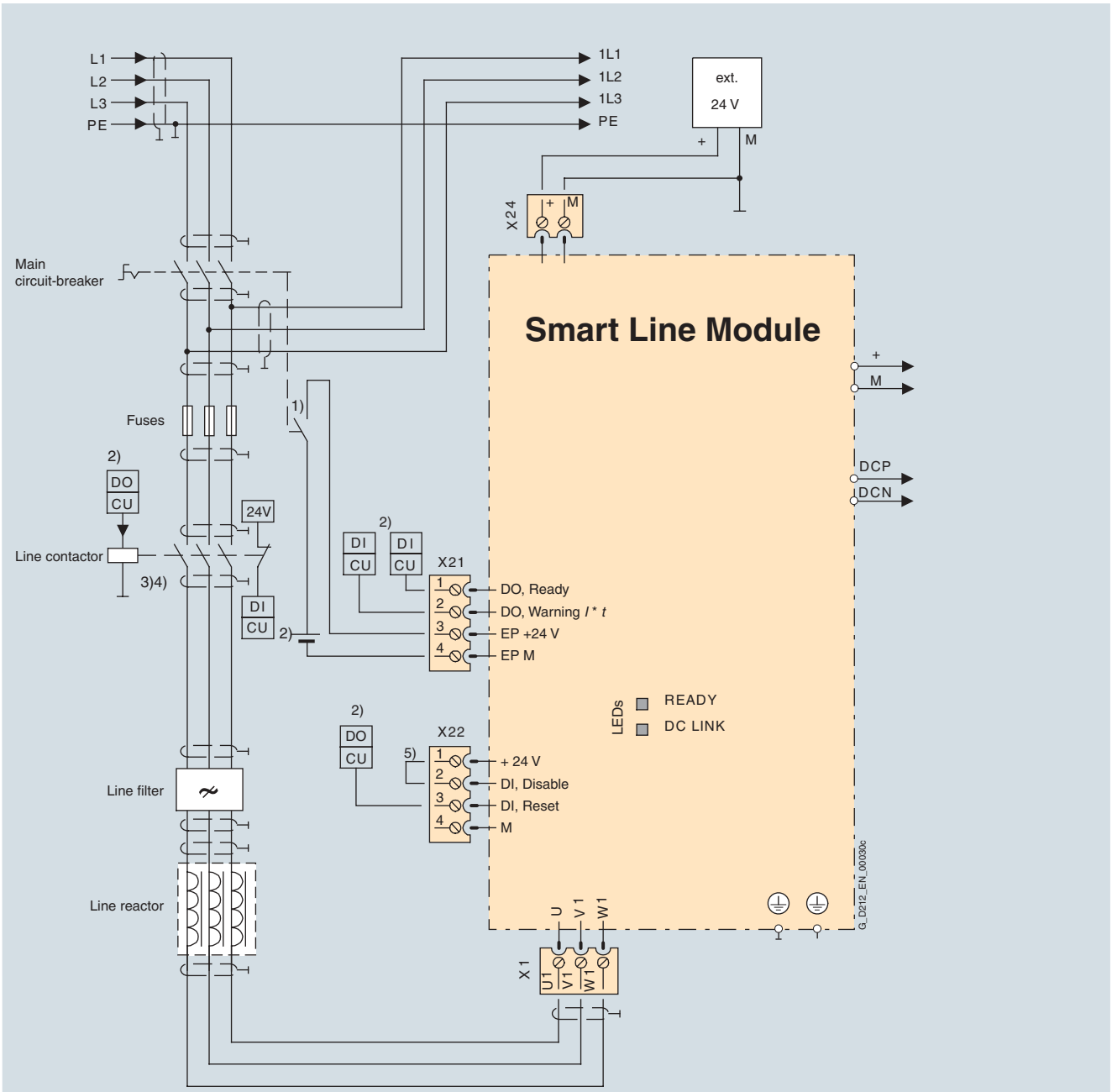
Smart Line Module	Order No.
5 kW (6.5 HP)	**6SL3130-6AE15-0AA0**
10 kW (13.5 HP)	**6SL3130-6AE21-0AA0**

Accessories

Description	Order No.
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**

2

Integration



1) Leading NC contact t >10 ms
2) DI/DO controlled by the Control Unit
3) No additional consumer permitted downstream of the line contactor
4) The current capacity of the DO must be taken into account;
an output interface element may have to be used.
5) Jumper closed, feedback deactivated.

Connection diagram for 5 kW (6.5 HP) and 10 kW (13.5 HP) Smart Line Modules

Smart Line Modules

2

Technical data

Smart Line Module		6SL3130-6AE15-0AA0	6SL3130-6AE21-0AA0
Rated infeed/regenerative power P_{rated}	kW (HP)	**5** **(6.5)**	**10** **(13.5)**
Infeed/regenerative power for S6 duty (40%) P_{S6}	kW (HP)	6.5 (8.5)	13 (17.5)
Max. infeed/regenerative power P_{max}	kW (HP)	10 (13.5)	20 (27)
Rated DC link infeed current	A	8.3	16.6
DC link infeed current for S6 duty (40%)	A	11	22
Max. DC link infeed current	A	16.6	33.2
Rated input current	A	12	24
Input current for S6 duty (40%)	A	on request	on request
Max. input current	A	on request	on request
Max. current requirements (at 24 V DC)	A	1.0	1.3
24 V DC busbar current capacity	A	20	20
DC link capacitance	µF	220	330
Max. DC link capacitance of drive group	µF	6000	6000
DC link busbar current capacity	A	100	100
Efficiency	η	0.95	0.95
Power loss	kW	on request	on request
Cooling air requirement	m^3/s (ft^3/s)	0.008 (0.283)	0.008 (0.283)
Sound pressure level	dB (A)	< 60	< 60
Power connection U1, V1, W1		Screw-type terminals 2.5-6 mm^2 (X1)	Screw-type terminals 2.5-6 mm^2 (X1)
PE connection		On housing with M5 screw	On housing with M5 screw
Max. cable length (total of all motor power cables and DC link)	m (ft)	350 (1150) (shielded) 560 (1840) (unshielded)	350 (1150) (shielded) 560 (1840) (unshielded)
Width	mm (inch)	50 (1.97)	50 (1.97)
Height	mm (inch)	380 (14.96)	380 (14.96)
Depth	mm (inch)	270 (10.63)	270 (10.63)
Weight, approx.	kg (lb)	4.7 (10.4)	4.8 (10.6)

Overview

The self-controlled rectifier/regenerative units (with IGBTs in infeed and regenerative direction) with step-up converters generate an increased, regulated DC link voltage, meaning that the connected motor modules are not dependent on line tolerances.

Design

Active Line Modules feature the following interfaces as standard:

- 1 x power connection via screw terminals with integrated shield connection plate (up to and including 16 kW (21.5 HP) rated power supply)
- 1 x connection for the electronics power supply via the 24 V terminal adapter included in the scope of supply
- 1 x DC link connection via integrated DC link busbars
- 3 x DRIVE-CLiQ sockets
- 2 x PE (protective earth) connections

The status of the Active Line Modules is indicated via two multicolor LEDs.

The shield for the power supply cable can be connected to the integrated shield connection plate of the 100 mm (3.94 in) wide Active Line Module via connection plate via a shield connection terminal or hose-clamp, e.g. Weidmüller type KLBÜ CO 4. The shield connection terminal must not be used for strain relief. A shield connection plate can be supplied for 150 mm (5.91 in), 200 mm (7.87 in) and 300 mm (11.81 in) wide modules.

The signal line shield can be connected to the line module via a shield connection terminal, e.g. Weidmüller type KLBÜ 3-8 SC. The shield connection terminal must not be used for strain relief.

Selection and ordering data

Active Line Module	Order No.
16 kW (21.5 HP)	**6SL3130-7TE21-6AA1**
36 kW (48 HP)	**6SL3130-7TE23-6AA1**
55 kW (74 HP)	**6SL3130-7TE25-5AA1**
80 kW (107 HP)	**6SL3130-7TE28-0AA0**
120 kW (160 HP)	**6SL3130-7TE31-2AA0**

Accessories

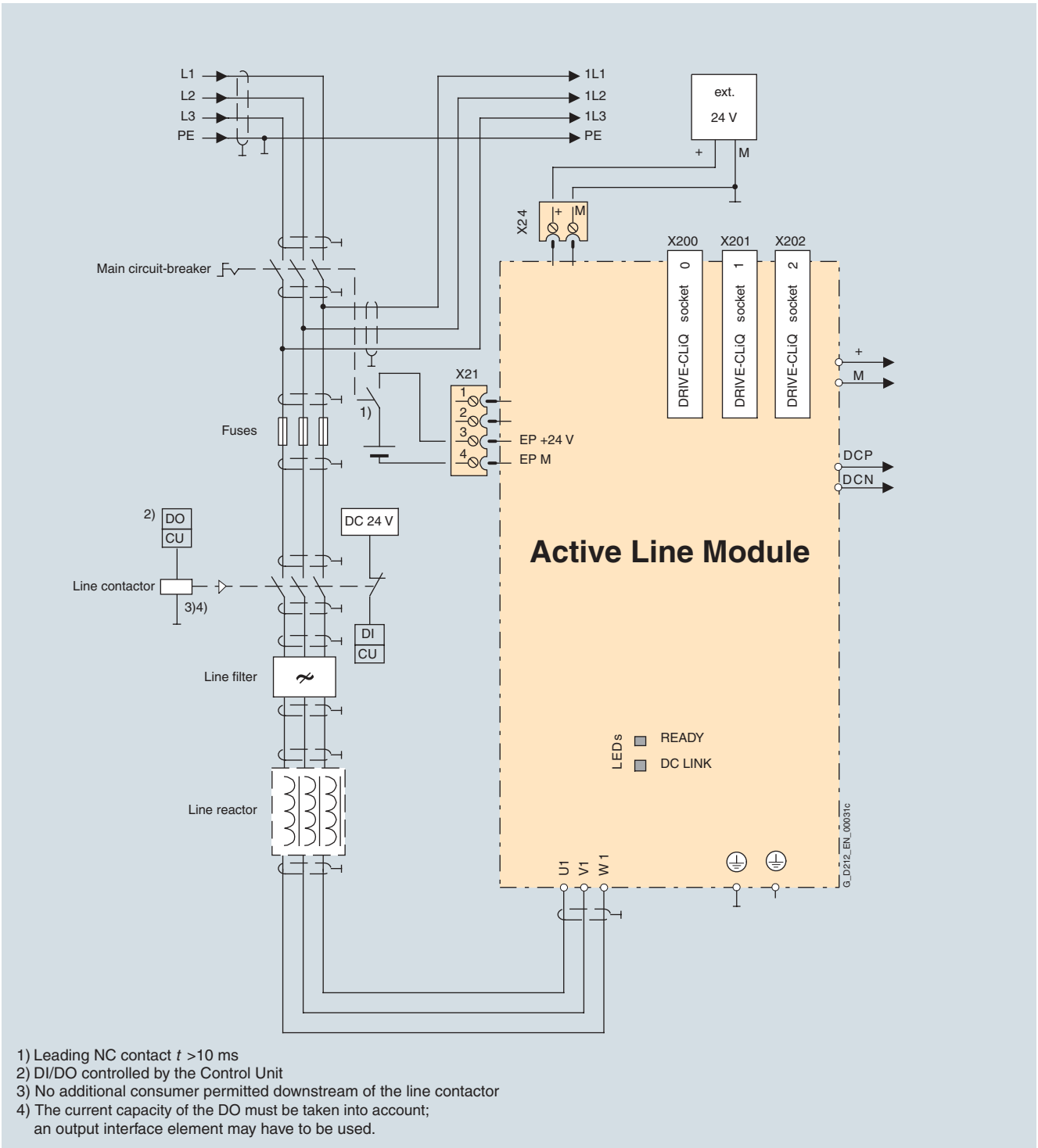
Description	Order No.
Shield connection plate for 150 mm (5.91 in) Line/Motor Modules	**6SL3162-1AF00-0AA0**
Shield connection plate for 200 mm (7.87 in) Line/Motor Modules and 300 mm (11.81 in)	**6SL3162-1AH00-0AA0**
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**

Active Line Modules

Integration

The Active Line Module communicates with the CU320 Control Unit via DRIVE-CLiQ and receives its control information via this route.

The DRIVE-CLiQ cable for communicating with the CU320 control unit is part of the scope of supply of the Active Line Module. The length of this DRIVE-CLiQ cable depends on the module width.



1) Leading NC contact t >10 ms
2) DI/DO controlled by the Control Unit
3) No additional consumer permitted downstream of the line contactor
4) The current capacity of the DO must be taken into account;
an output interface element may have to be used.

Active Line Module connection diagram

Technical data

Active Line Module		6SL3130-7TE21-6AA1	6SL3130-7TE23-6AA1	6SL3130-7TE25-5AA1	6SL3130-7TE28-0AA0	6SL3130-7TE31-2AA0
Rated infeed/regenerative power P_{rated}	kW (HP)	16 (21.5)	36 (48)	55 (74)	80 (107)	120 (160)
Infeed/regenerative power for S6 duty (40%) P_{S6}	kW (HP)	21 (28)	47 (63)	71 (95)	106 (142)	158 (212)
Max. infeed/regenerative power P_{max}	kW (HP)	35 (45)	70 (94)	91 (122)	131 (176)	175 (235)
Rated DC link infeed current	A	27	60	92	134	200
DC link infeed current for S6 duty (40%)	A	35	79	121	176	244
Max. DC link infeed current	A	59	117	152	195	292
Rated input current	A	26	58	88	128	192
Input current for S6 duty (40%)	A	35	79	121	176	244
Max. input current	A	59	117	152	195	292
Max. current requirements (at 24 V DC)	A	1.1	1.5	1.9	2.0	2.5
24 V DC busbar current capacity	A	20	20	20	20	20
DC link capacitance	µF	710	1410	1880	2820	3760
Max. DC link capacitance of drive group	µF	20000	20000	20000	20000	20000
DC link busbar current capacity	A	100	100	200	200	200
Efficiency	η	0.95	0.95	0.95	0.95	0.95
Power loss	kW	0.26	0.63	0.90	1.35	2.20
Cooling air requirement	m^3/s (ft^3/s)	0.016 (0.565)	0.031 (1.095)	0.044 (1.554)	0.144 (5.085)	0.144 (5.085)
Sound pressure level	dB	< 60	< 65	< 60	< 75	< 75
Power connection U1, V1, W1		Screw-type terminals 2.5-10 mm^2 (X1)	Screw studs for ring terminal ends, M6, 2.5-50 mm^2 (X1)	Screw studs for ring terminal ends, M8, 2.5-95 mm^2, 2 x 35 mm^2 (X1)	Screw studs for ring terminal ends, M8, 2.5-120 mm^2, 2 x 50 mm^2(X1)	Screw studs for ring terminal ends, M8, 2.5-120 mm^2, 2 x 50 mm^2(X1)
PE connection		On housing with M5 screw	On housing with M6 screw	On housing with M6 screw	On housing with M8 screw	On housing with M8 screw
Max. cable length (total of all motor power cables and DC link)	m (ft)	350 (1150) (shielded) 560 (1840) (unshielded)	350 (1150) (shielded) 560 (1840) (unshielded)	350 (1150) (shielded) 560 (1840) (unshielded)	350 (1150) (shielded) 560 (1840) (unshielded)	350 (1150) (shielded) 560 (1840) (unshielded)
Width	mm (inch)	100 (3.94)	150 (5.91)	200 (7.87)	300 (11.81)	300 (11.81)
Height	mm (inch)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)
Depth	mm (inch)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)
Weight, approx.	kg (lb)	7 (15.4)	10.3 (22.7)	17 (37.5)	23 (50.7)	23 (50.7)

Motor Modules

Overview

A wide range of single axis and double axis Motor Modules with various current/power ratings are available:

- Single Motor Modules: Single axis module in booksize format with rated output currents of 3 A to 200 A
- Double Motor Modules: Two-axis module in booksize format with rated output currents of 3 A to 18 A

In principle, all Single Motor and Double Motor Modules can be operated on Smart or Active Line Modules.

Single Motor Modules

Design

Single Motor Modules feature the following interfaces as standard:

- 2 x DC link connections via integrated DC link busbars
- 1 x electronics power supply connection via integrated 24 V DC bars
- 3 x DRIVE-CLiQ sockets
- 1 x motor connection, plug-in (not included in scope of supply) or screw-stud depending on rated output current
- 2 x safe standstill input terminals (enable pulses)
- 1 x safe motor brake control
- 1 x temperature sensor input (KTY84-130)
- 2 x PE (protective earth) connections

The status of the Motor Modules is indicated via two multi-color LEDs.

The motor cable shield of the 50 mm (1.97 in) and 100 mm (3.94 in) modules is inside the connector. A shield connection plate can be supplied for the 150 mm (5.91 in), 200 mm (7.87 in) and 300 mm (11.81 in) wide modules. On these modules, the motor cable shield can be connected using a hose-clamp.

The signal line shield can be connected to the line module via a shield connection terminal, e.g. Weidmüller type KLBÜ 3-8 SC. The shield connection terminal must not be used for strain relief.

Selection and ordering data

Single Motor Module		Order No.
Rated output current A	Rated power kW (HP)	
3	1.6 (2)	**6SL3120-1TE13-0AA0**
5	2.7 (3.5)	**6SL3120-1TE15-0AA0**
9	4.8 (6.5)	**6SL3120-1TE21-0AA1**
18	9.7 (13)	**6SL3120-1TE21-8AA1**
30	16 (21.5)	**6SL3120-1TE23-0AA1**
45	24 (32)	**6SL3120-1TE24-5AA1**
60	32 (43)	**6SL3120-1TE26-0AA1**
85	46 (62)	**6SL3120-1TE28-5AA1**
132	71 (95)	**6SL3120-1TE31-3AA0**
200	107 (143)	**6SL3120-1TE32-0AA0**

Accessories

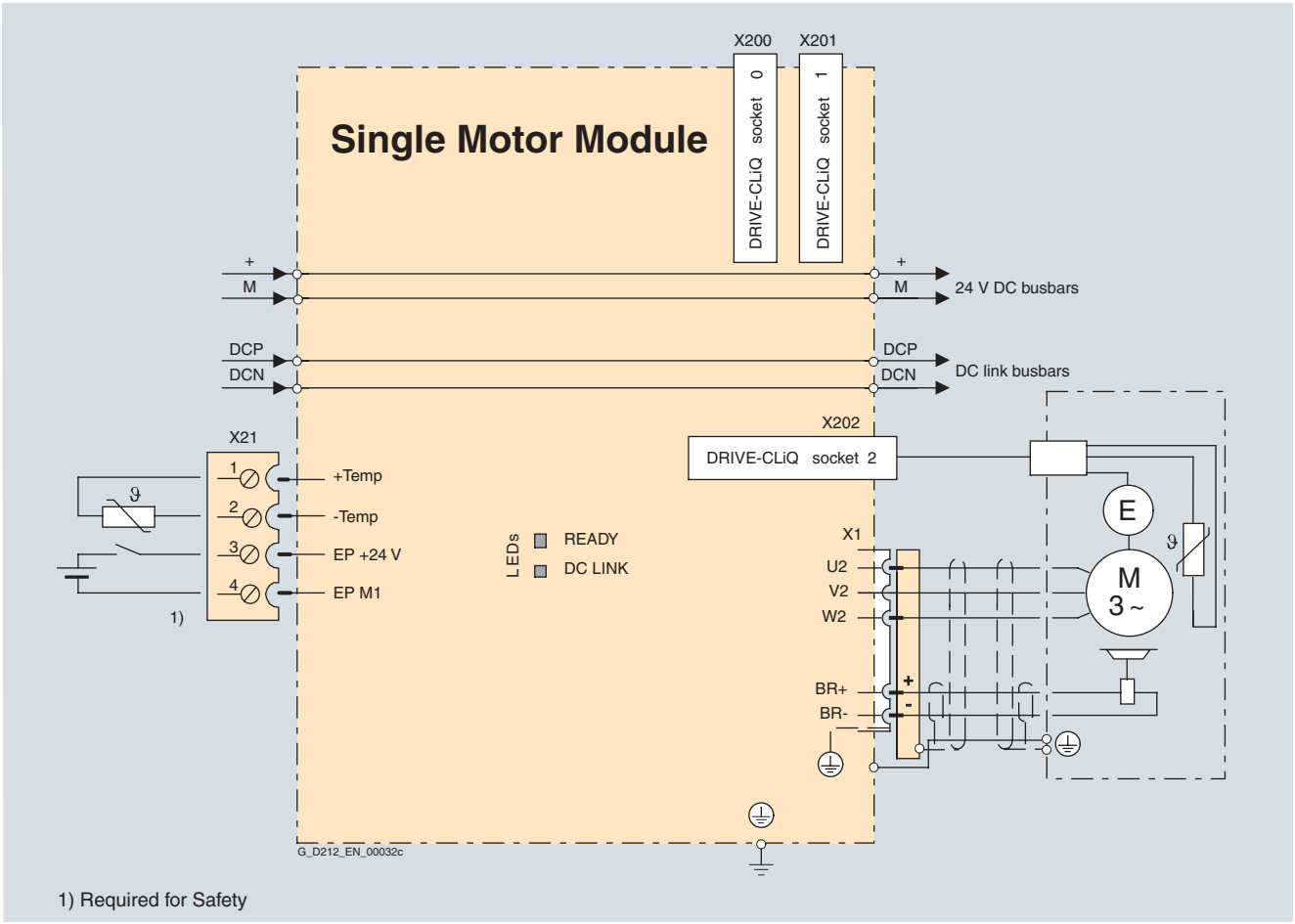
Description	Order No.
Shield connection plate for 150 mm (5.91 in) Line/Motor Modules	**6SL3162-1AF00-0AA0**
Shield connection plate for 200 mm (7.87 in) and 300 mm (11.81 in) Line/Motor Modules	**6SL3162-1AH00-0AA0**
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 0.5-10 mm^2 for 50 mm (1.97 in) and 100 mm (3.94 in) Line/Motor Modules	**6SL3162-2BD00-0AA0**
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 35-95 mm^2 for 150 mm (5.91 in), 200 mm (7.87 in) and 300 mm (11.81 in) Line/Motor Modules	**6SL3162-2BM00-0AA0**

Description	Order No.
DC link adapters (2x) for multi-tier configuration Screw-type terminals 35-95 mm^2 for all Line Modules/Motor Modules in book-size format	**6SL3162-2BM01-0AA0**
24 V terminal adapter	**6SL3162-2AA00-0AA0**
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**
Plug-in motor brake connector for Motor Modules with a rated output current ≥ 45 A Wago http://www.wago.com	Item No.: 231-102/037-000 (Wago)

Integration

The Single Motor Module communicates with the CU320 Control Unit via DRIVE-CLiQ and receives its control information via this route.

The required DRIVE-CLiQ cable for connecting to the next DRIVE-CLiQ device in the axis grouping is included in the scope of supply. The length of this DRIVE-CLiQ cable depends on the module width.

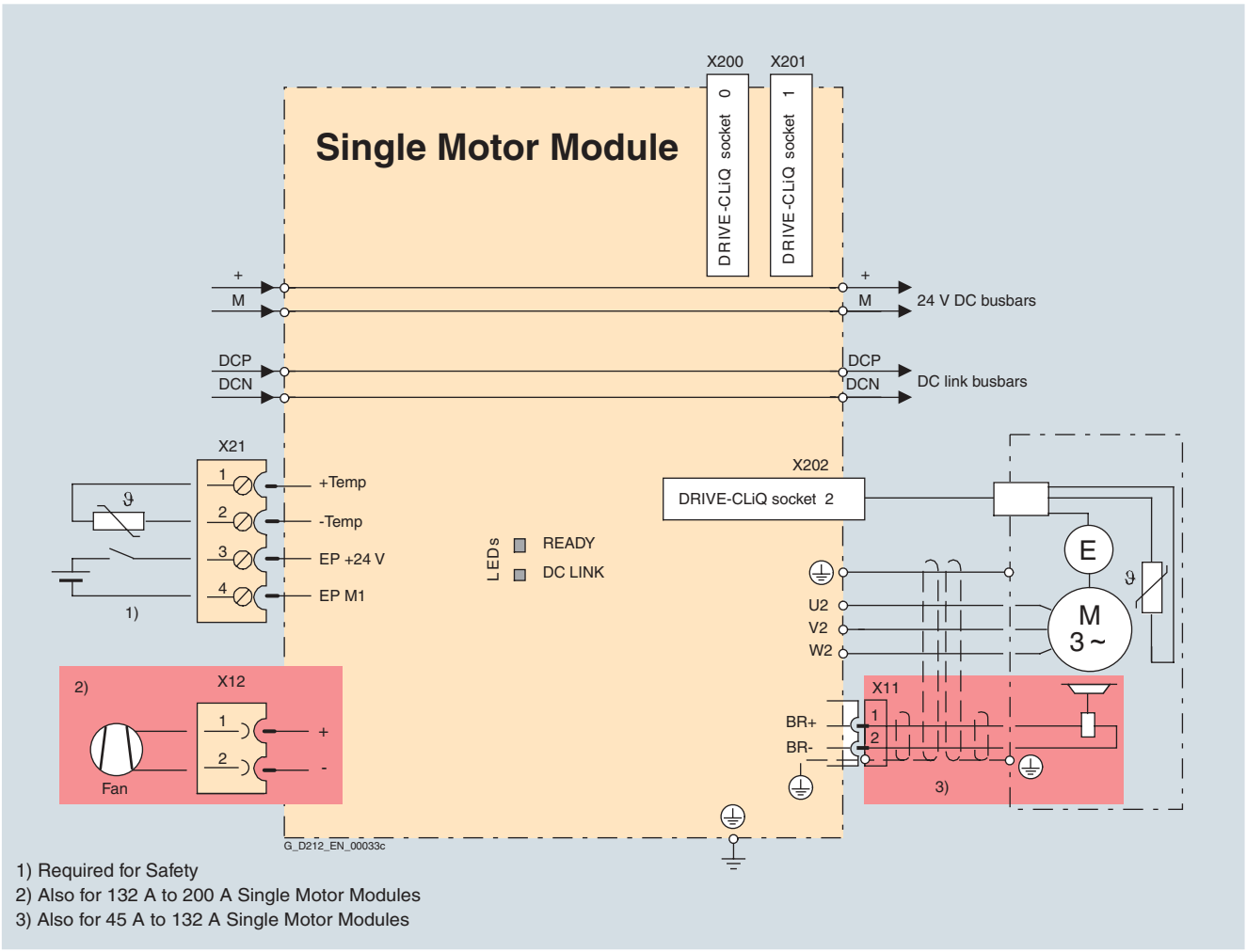


1) Required for Safety

Wiring diagram for the 3 A to 30 A Single Motor Modules

Single Motor Modules

Integration (continued)



Wiring diagram for the 45 A to 200 A Single Motor Modules

Technical data

Single Motor Module		6SL3120-1TE13-0AA0	6SL3120-1TE15-0AA0	6SL3120-1TE21-0AA1	6SL3120-1TE21-8AA1	6SL3120-1TE23-0AA1
Rated output current I_{rated}	A	**3**	**5**	**9**	**18**	**30**
Output current at S6 duty (40%) I_{S6}	A	3.5	6	10	24	40
Max. output current I_{max}	A	6	10	18	36	56
Rated power at 600 V DC DC link voltage	kW (HP)	1.6 (2)	2.7 (3.5)	4.8 (6.5)	9.7 (13)	16.0 (21.5)
DC link voltage range	V	510 to 750	510 to 750	510 to 750	510 to 750	510 to 750
DC link overvoltage trip	V	820 (± 2%)	820 (± 2%)	820 (± 2%)	820 (± 2%)	820 (± 2%)
DC link busbar current capacity	A	100	100	100	100	100
DC link capacitance	µF	110	110	110	220	710
Max. current requirement (at 24 V DC)	A	0.8	0.8	0.85	0.85	0.9
24 V DC busbar current capacity	A	20	20	20	20	20
		If, due to a number of line and motor modules being mounted side-by-side, the current carrying capacity exceeds 20 A, an additional 24 V DC connection using a 24 V terminal adapter is required (max. cross-section 6 mm^2, max. fuse protection 20 A).				
Efficiency	η	0.97	0.97	0.97	0.97	0.97
Power loss	kW	0.035	0.055	0.080	0.165	0.290
Cooling air requirement	m^3/s (ft^3/s)	0.008 (0.283)	0.008 (0.283)	0.008 (0.283)	0.008 (0.283)	0.016 (0.565)
Sound pressure level	dB	< 60	< 60	< 60	< 60	< 60
Motor connection U2, V2, W2		Plug-in connector (X1), max. 30 A	Plug-in connector (X1), max. 30 A	Plug-in connector (X1), max. 30 A	Plug-in connector (X1), max. 30 A	Plug-in connector (X1), max. 30 A
PE connection		On housing with M5 screw	On housing with M5 screw	On housing with M5 screw	On housing with M5 screw	On housing with M5 screw
Motor brake connection		Integrated in the plug-in motor connector (X1), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1), 24 V DC, 2 A
Max. motor power cable length	m (ft)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)
Width	mm (inch)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	100 (3.94)
Height	mm (inch)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)
Depth	mm (inch)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)
Weight, approx.	kg (lb)	5.1 (11.2)	5.1 (11.2)	5 (11)	5 (11)	6.9 (15.2)

2

Technical data (continued)

Single Motor Module		6SL3120-1TE24-5AA1	6SL3120-1TE26-0AA1	6SL3120-1TE28-5AA1	6SL3120-1TE31-3AA0	6SL3120-1TE32-0AA0
Rated output current I_{rated}	A	**45**	**60**	**85**	**132**	**200**
Output current for S6 duty (40%) I_{S6}	A	60	80	110	150	250
Max. output current I_{max}	A	85	113	141	210	282
Rated power at 600 V DC DC link voltage	kW (HP)	24 (32)	32 (43)	46 (62)	71 (95)	107 (143)
DC link voltage range	V	510 to 750	510 to 750	510 to 750	510 to 750	510 to 750
DC link overvoltage tripping	V	820 (± 2%)	820 (± 2%)	820 (± 2%)	820 (± 2%)	820 (± 2%)
DC link busbar current capacity	A	100	100	200	200	200
DC link capacitance	µF	1175	1410	1880	2820	3995
Max. current requirement (at 24 V DC)	A	1.2	1.2	1.5	1.5	1.5
24 V DC busbar current capacity	A	20	20	20	20	20
		If, due to a number of line and motor modules being mounted side-by-side, the current carrying capacity exceeds 20 A, an additional 24 V DC connection using a 24 V terminal adapter is required (max. cross-section 6 mm^2, max. fuse protection 20 A).				
Efficiency	η	0.97	0.97	0.97	0.97	0.97
Power loss	kW	on request	on request	0.75	on request	2.05
Cooling air requirement	m^3/s (ft^3/s)	0.031 (1.095)	0.031 (1.095)	0.044 (1.554)	0.144 (1.554)	0.144 (1.554)
Sound pressure level	dB	< 65	< 65	< 60	< 75	< 75
Motor connection U2, V2, W2		M6 screw studs, 2.5-50 mm^2 (X1)	M6 screw studs, 2.5-50 mm^2 (X1)	M8 screw studs, 2.5-95 mm^2, 2 x 35 mm^2 (X1)	M8 screw studs, 2.5-120 mm^2, 2 x 50 mm^2 (X1)	M8 screw studs, 2.5-120 mm^2, 2 x 50 mm^2 (X1)
PE connection		On housing with M6 screw	On housing with M6 screw	On housing with M6 screw	On housing with M8 screw	On housing with M8 screw
Motor brake connection		Plug-in connector (X11), 24 V DC, 2 A	Plug-in connector (X11), 24 V DC, 2 A	Plug-in connector (X11), 24 V DC, 2 A	Plug-in connector (X11), 24 V DC, 2 A	Plug-in connector (X11), 24 V DC, 2 A
Max. motor power cable length	m (ft)	100 (328) (shielded) 150 (492) (unshielded)	100 (328) (shielded) 150 (492) (unshielded)	100 (328) (shielded) 150 (492) (unshielded)	100 (328) (shielded) 150 (492) (unshielded)	100 (328) (shielded) 150 (492) (unshielded)
Width	mm (inch)	150 (5.91)	150 (5.91)	200 (7.87)	300 (11.81)	300 (11.81)
Height	mm (inch)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)
Depth	mm (inch)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)
Weight, approx.	kg (lb)	9 (19.8)	9 (19.8)	15 (33.1)	21 (46.3)	21 (46.3)

Design

Double Motor Modules feature the following interfaces as standard:

- 2 x DC link connections via integrated DC link busbars
- 2 x electronics power supply connections via integrated 24 V DC bars
- 4 x DRIVE-CLiQ sockets
- 2 x plug-in motor connections (not included in scope of supply)
- 4 x safe standstill input terminals (1 input per axis)
- 2 x safe motor brake control
- 2 x temperature sensor inputs (KTY84-130)
- 3 x PE (protective earth) connections

The status of the Motor Modules is indicated via two multi-color LEDs.

On Double Motor Modules, the motor cable shield can be connected in the connector.

The signal line shield can be connected to the line module via a shield connection terminal, e.g. Weidmüller type KLBÜ 3-8 SC. The shield connection terminal must not be used for strain relief.

Selection and ordering data

Double Motor Module Rated output current A	Rated power kW (HP)	Order No.
3	1.6 (2)	**6SL3120-2TE13-0AA0**
5	2.7 (3.5)	**6SL3120-2TE15-0AA0**
9	4.8 (6.5)	**6SL3120-2TE21-0AA0**
18	9.7 (13)	**6SL3120-2TE21-8AA0**

Accessories

Description	Order No.
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 0.5-10 mm^2 for 50 mm (1.97 in) and 100 mm (3.94 in) Line/Motor Modules	**6SL3162-2BD00-0AA0**
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 35-95 mm^2 for 150 mm (5.91 in), 200 mm (7.87 in) and 300 mm (11.81 in) Line/Motor Modules	**6SL3162-2BM00-0AA0**
DC link adapters (2x) for multi-tier configuration Screw-type terminals 35-95 mm^2 for all Line/Motor Modules in booksize format	**6SL3162-2BM01-0AA0**
24 V terminal adapter	**6SL3162-2AA00-0AA0**
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**
Plug-in motor brake connector Wago http://www.wago.com	Item No.: 231-102/037-000 (Wago)

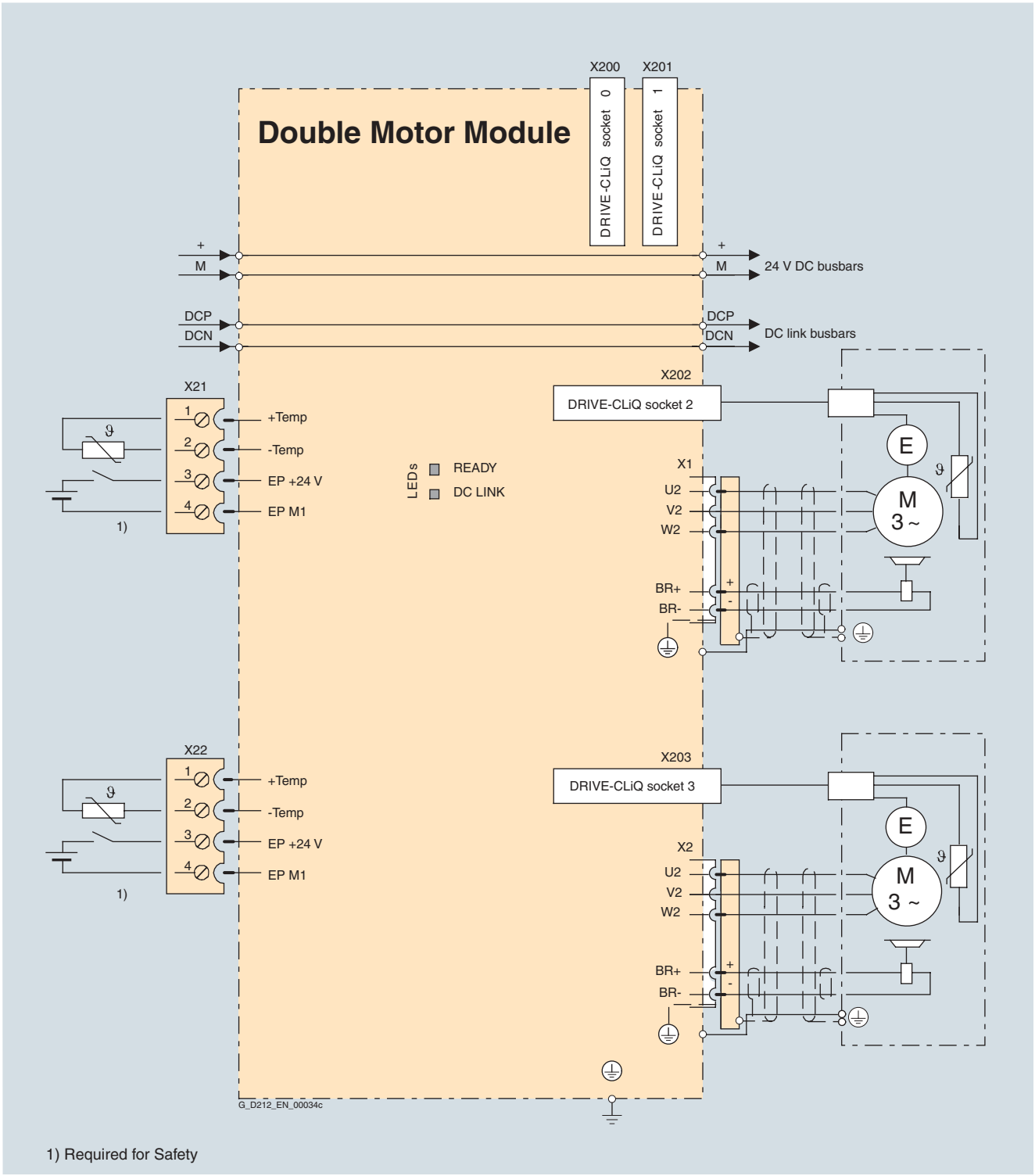
Double Motor Modules

2

Integration

The Double Motor Module communicates with the CU320 Control Unit via DRIVE-CLiQ and receives its control information via this route.

The required DRIVE-CLiQ cable for connecting to the next DRIVE-CLiQ device in the axis grouping is included in the scope of supply. The length of this DRIVE-CLiQ cable depends on the module width.



Wiring diagram for the 2x3 A to 2x18 A Double Motor Modules

Technical data

Double Motor Module		6SL3120-2TE13-0AA0	6SL3120-2TE15-0AA0	6SL3120-2TE21-0AA0	6SL3120-2TE21-8AA0
Rated output current I_{rated}	A	**2×3**	**2×5**	**2×9**	**2×18**
Output current for S6 duty (40%) I_{S6}	A	2×3.5	2×6	2×10	2×24
Max. output current I_{max}	A	2×6	2×10	2×18	2×36
Rated power at 600 V DC DC link voltage	kW (HP)	2×1.6 (2)	2×2.7 (3.5)	2×4.8 (6.5)	2×9.7 (13)
DC link voltage range	V	510 to 750	510 to 750	510 to 750	510 to 750
DC link overvoltage tripping	V	820 (± 2%)	820 (± 2%)	820 (± 2%)	820 (± 2%)
DC link busbar current capacity	A	100	100	100	100
DC link capacitance	µF	110	220	220	710
Max. current requirement (at 24 V DC)	A	0.8	1.0	1.0	1.0
24 V DC busbar current capacity	A	20	20	20	20
		If, due to a number of line and motor modules being mounted side-by-side, the current carrying capacity exceeds 20 A, an additional 24 V DC connection using a 24 V terminal adapter is required (max. cross-section 6 mm^2, max. fuse protection 20 A).			
Efficiency	η	0.97	0.97	0.97	0.97
Power loss	kW	0.06	0.085	0.16	0.32
Cooling air requirement	m^3/s (ft^3/s)	0.008 (0.283)	0.008 (0.283)	0.008 (0.283)	0.016 (0.565)
Sound pressure level	dB	< 70	< 70	< 70	< 70
Motor connection U2, V2, W2		2×plug-in connector (X1, X2), max. 30 A	2×plug-in connector (X1, X2), max. 30 A	2×plug-in connector (X1, X2), max. 30 A	2×plug-in connector (X1, X2), max. 30 A
PE connection		On housing with M5 screw	On housing with M5 screw	On housing with M5 screw	On housing with M5 screw
Motor brake connection		Integrated in the plug-in motor connector (X1, X2), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1, X2), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1, X2), 24 V DC, 2 A	Integrated in the plug-in motor connector (X1, X2), 24 V DC, 2 A
Max. motor power cable length	m (ft)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)	50 (164) (shielded) 75 (246) (unshielded)
Width	mm (inch)	50 (1.97)	50 (1.97)	50 (1.97)	100 (3.94)
Height	mm (inch)	380 (14.96)	380 (14.96)	380 (14.96)	380 (14.96)
Depth	mm (inch)	270 (10.63)	270 (10.63)	270 (10.63)	270 (10.63)
Weight, approx.	kg (lb)	5.1 (11.2)	5.1 (11.2)	5.1 (11.2)	6.6 (14.6)

Braking Module

Overview

A Braking Module (and an external braking resistor) is required to bring drives to a controlled stop in the event of a line failure (e.g. emergency retraction) or to limit the DC link voltage during short-time regeneration if, for example, the regenerative feedback capability of the line module has been deactivated or has not been dimensioned sufficiently. The Braking Module houses the power electronics and the associated control circuit. During operation, the DC link power is converted into heat loss in an external braking resistor located outside the control cabinet. The Braking Module functions autonomously. The Braking Modules can be operated in parallel. Braking Modules can also be used for rapid discharge of the DC link.

Design

The Braking Module features the following interfaces as standard:

- 2 x DC link connections via integrated DC link busbars
- 2 x electronics power supply connections via integrated 24 V DC bars
- 2 x braking resistor connection terminals
- 2 x digital inputs (disable Braking Module/acknowledge faults and rapid discharge of DC link)
- 2 x digital outputs (Braking Module disabled and prewarning – $I \times t$ monitoring)
- 2 x PE (protective earth) connections

The status of the Braking Modules is indicated via two 2-color LEDs.

Technical data

Braking Module	
Rated power	1.5 kW (2 HP)
Peak power	100 kW (134 HP)
Max. current requirement (at 24 V DC)	0.2 A
Digital inputs	
Voltage	-3 V to +30 V
• Low level (an open digital input is interpreted as "low")	-3 V to +5 V
• High level	15 V to 30 V
• Current consumption (typ. at 24 V DC)	10 mA
• Max. connectable cross-section	1.5 mm^2
Digital outputs (continuously-short-circuit-proof)	
• Voltage	24 V DC
• Max. load current per digital output	100 mA
• Max. connectable cross-section	1.5 mm^2
24 V DC busbar current capacity	20 A
DC link busbar current capacity	100 A
PE connection	On housing with M5 screw
Width	50 mm (1.97 in)
Height	380 mm (14.96 in)
Depth, with spacer (included in scope of supply)	270 mm (10.63 in)
Weight, approx.	4.1 kg (9 lb)

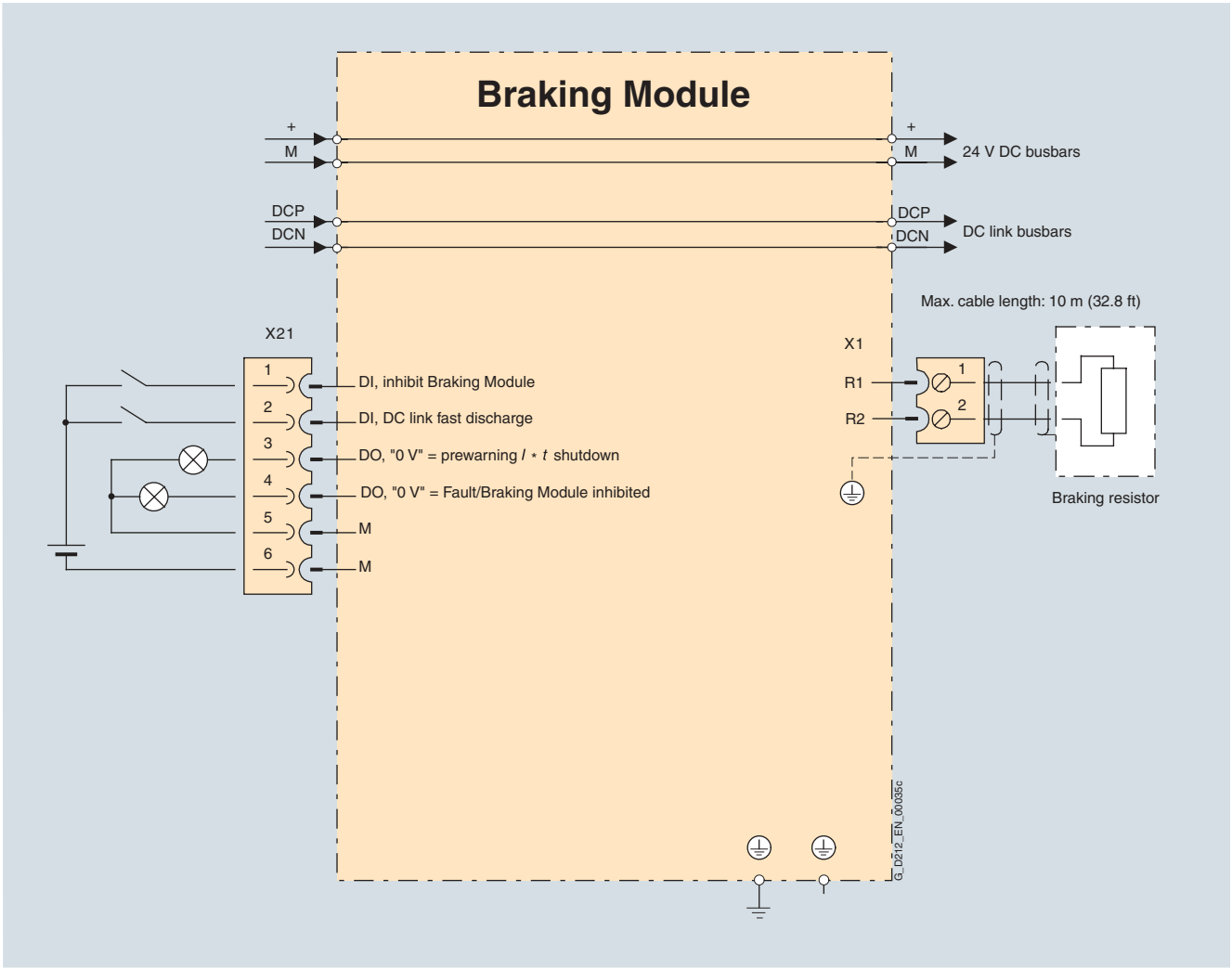
Selection and ordering data

Description	Order No.
Braking Module	**6SL3100-1AE31-0AA0**

Accessories

Description	Order No.
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**

Integration



Connection diagram for the Braking Module

Braking resistors

Overview

Excess power in the DC link is dissipated via the braking resistor.

The braking resistor is connected to a Braking Module. This means that the resulting heat loss can be dissipated outside of the control cabinet.

Two braking resistors with different rated and peak powers are available.

Technical data

		Braking resistor 0.3 kW (0.5 HP)/ 25 kW (33 HP)	Braking resistor 1.5 kW (2 HP)/ 100 kW (134 HP)
Rated power P_{rated}	kW (HP)	0.3 (0.5)	1.5 (2)
Peak power P_{max}	kW (HP)	25 (33)	100 (134)
Switch-on period for peak power	s	0.4	2
Braking duty cycle T duration	s	33	133
Degree of protection		IP54	IP20
Width	mm (inch)	80 (3.15)	193 (7.6)
Height	mm (inch)	210 (8.27)	410 (16.14)
Depth	mm (inch)	53 (2.09)	240 (9.45)
Weight, approx.	kg (lb)	3.4 (7.5)	5.6 (12.3)

Selection and ordering data

Description	Order No.
Braking resistor 0.3 kW (0.5 HP)/ 25 kW (33 HP)	**6SN1113-1AA00-0DA0**
Braking resistor 1.5 kW (2 HP)/ 100 kW (134 HP)	**6SL3100-1BE31-0AA0**

Capacitor Module

Overview

Capacitor Modules are used to increase the DC link capacitance to bridge momentary power supply losses.

Capacitor Modules are connected to the DC link voltage via the integrated DC link busbars. Capacitor Modules function autonomously.

Capacitor Modules can be operated in parallel.

Design

The Capacitor Module features the following interfaces as standard:

- 2 x DC link connections via integrated DC link busbars
- 2 x PE (protective earth) connections

Technical data

Capacitor Module	
Capacitance	4000 µF
24 V DC busbar current capacity	20 A
DC link busbar current capacity	100 A
PE connection	On housing with M5 screw
Width	100 mm (3.94 in)
Height	380 mm (14.96 in)
Depth, with spacer (included in scope of supply)	270 mm (10.63 in)
Weight, approx.	7.2 kg (15.9 lb)

Selection and ordering data

Description	Order No.
Capacitor Module	**6SL3100-1CE14-0AA0**

Accessories

Description	Order No.
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**

Control Supply Module

Overview

The Control Supply Module provides a 24 V DC power supply via the line or DC link. This makes it possible, for example, to make emergency retraction movements in the event of the failure of the line supply, as long as the DC link voltage is available.

Design

The Control Supply Module features the following interfaces as standard:

- 1 x power connection
- 2 x DC link connections via integrated DC link busbars
- 2 x electronics power supply connections via integrated 24 V DC bars
- 1 x connection for the electronics power supply for control units, terminal modules, sensor modules, etc., via the 24 V terminal adapter provided in the scope of supply (max. cross-section 6 mm^2, max. fuse protection 20 A)
- 2 x PE (protective earth) connections

The status of the Control Supply Modules is indicated via two multi-color LEDs.

Technical data

Control Supply Module	
Rated input current	
• at 3 AC 400 V	2.2 A
• at 600 V DC	1.1 A
Radio interference suppression (standard)	Class A1 to EN 55 011
Rated output voltage	26 V DC
Rated output current	20 A
24 V DC busbar current capacity	20 A
DC link busbar current capacity	100 A
Power connection L1, L2, L3 (X1)	Screw-type terminals 0.2 mm^2 to 4.0 mm^2
PE connection	On housing with M5 screw
Width	50 mm (1.97 in)
Height	380 mm (14.96 in)
Depth, with spacer (included in scope of supply)	270 mm (10.63 in)
Weight, approx.	4.8 kg (10.6 lb)

Selection and ordering data

Description	Order No.
Control Supply Module	**6SL3100-1DE22-0AA0**

Accessories

Description	Order No.
Warning labels in foreign languages This set of foreign language warning labels can be placed over the standard German or English signs. One label in each of the following languages is provided in each set: Chinese, Danish, Dutch, Finnish, French, Greek, Italian, Japanese, Korean, Portuguese, Spanish and Swedish.	**6SL3166-3AB00-0AA0**

Overview

If the internal Motor Module DC link bus-baring is not to be used, the DC link voltage can be supplied externally using a DC link power supply adapter. Two versions are available depending on cable cross-section. The DC link power supply adapter is mounted on the DC link busbars of the Motor Module. The DC link cables are routed from above.

If a multi-tier Motor Module configuration is used, a DC link power supply adapter set can be provided for linking the DC links of two drive groups. The DC link power supply adapters are mounted on the DC link busbars of the Motor Modules on the far right of each group. The DC link cables are routed from behind.

Technical data

DC link power supply adapter	6SL3162-2BD00-0AA0	6SL3162-2BM00-0AA0	6SL3162-2BM01-0AA0
Connectable cross-section	0.5 to 10 mm^2	35 to 95 mm^2	35 to 95 mm^2
Weight, approx.	0.06 kg (0.13 lb)	0.48 kg (1.06 lb)	0.76 kg (1.68 lb)

Selection and ordering data

Description	Order No.
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 0.5 mm^2 to 10 mm^2 for 50 mm (1.97 in) and 100 mm (3.94 in) Line and Motor Modules	**6SL3162-2BD00-0AA0**
DC link power supply adapter for direct infeed of DC link voltage Screw-type terminals 35 mm^2 to 95 mm^2 for 150 mm (5.91 in), 200 mm (7.87 in) and 300 mm (11.81 in) Line and Motor Modules	**6SL3162-2BM00-0AA0**
DC link power supply adapter set (2 adapters) for multi-tier configuration Screw-type terminals 35 mm^2 to 95 mm^2 for all Line and Motor Modules in booksize format	**6SL3162-2BM01-0AA0**

CU320 Control Unit

Overview

The communication, control functions for one or more Motor Modules and Active Line Modules run in a CU320 Control Unit. The Control Units are designed as standard for multi-axis operation.

Design

CU320 Control Unit, without cover

The CU320 Control Unit features the following interfaces as standard:

- 4 x DRIVE-CLiQ sockets for communication with other DRIVE-CLiQ devices, e.g. Motor Modules, Active Line Modules, Sensor Modules, Terminal Modules
- 1 x PROFIBUS interface
- 8 x parameterizable digital inputs (floating)
  8 x parameterizable bidirectional digital inputs/digital outputs (non-floating), of which 6 are high-speed digital inputs
- 1 x serial RS232 interface
- 1 x option slot
- 3 x test sockets and one reference ground for start-up support
- 1 x connection for the electronics power supply via the 24 V DC power supply connector
- 1 x PE (protective earth) connection
- 1 x ground connection

A shield connection for the signal cable shield on the option module is located on the CU320 Control Unit.

The available option slot is used to expand the interfaces, for example, to include additional terminals or for communication purposes.

The status of the CU320 Control Unit is indicated via multi-color LEDs.

As the firmware and parameter settings are stored on a plug-in CompactFlash Card, the Control Unit can be changed without the need for additional tools.

The CU320 Control Unit can be mounted on the side of the line module using brackets integrated in a Line Module. The CU320 Control Unit can also be fixed to the back wall of the control cabinet using the integrated fixing lugs. As the CU320 Control Unit is not as deep as the Line Modules, suitable spacers are available to increase the depth of the CU320 Control Unit to 270 mm (10.63 in).

Integration

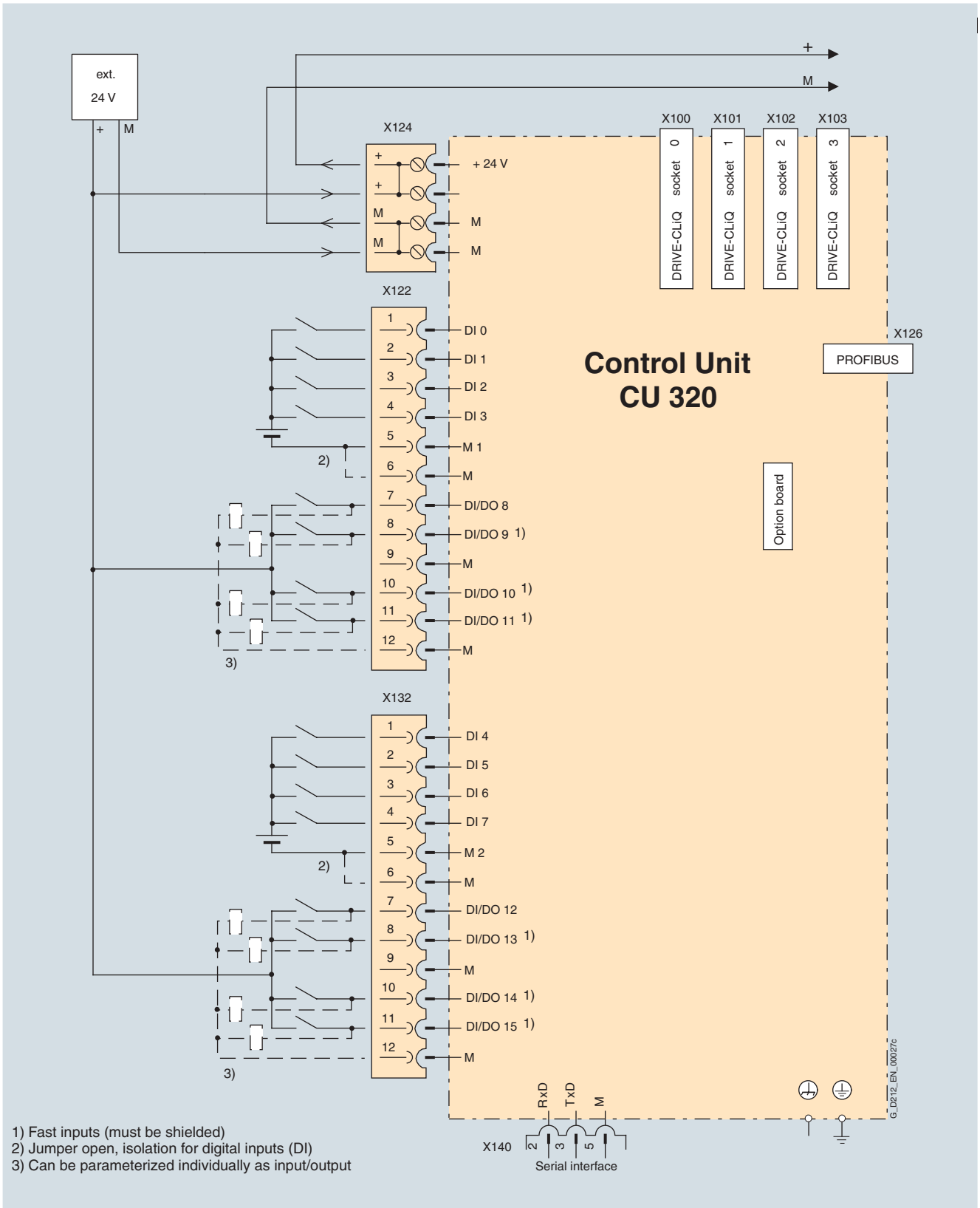
DRIVE-CLiQ components, for example, Motor Modules and Active Line Modules, can be connected to a CU320 Control Unit. The number of modules depends on the performance required, including mode type and additional functions.

Communication between a CU320 Control Unit and the connected components takes place via DRIVE-CLiQ.

If an application requires more than one Control Unit, the number can be increased accordingly. The Control Units are then interconnected, for example, via PROFIBUS on a higher-level controller.

2

Integration (continued)



Connection diagram for the CU320 Control Unit

CU320 Control Unit

2

Technical data

CU320 Control Unit	
Max. current requirement (at 24 V DC) without taking account of digital outputs, option slot expansion	0.8 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Digital inputs	8 x floating digital inputs 8 x bidirectional non-floating digital inputs/digital outputs
• Voltage	-3 V to 30 V
• Low level (an open digital input is interpreted as "low")	-3 V to 5 V
• High level	15 V to 30 V
• Current consumption (typ. at 24 V DC)	10 mA
• Signal propagation delays for digital inputs	L → H: approx. 50 µs H → L: approx. 100 µs
• Signal propagation delays for high-speed digital inputs (high-speed digital inputs can be used for position detection)	L → H: approx. 5 µs H → L: approx. 50 µs
• Max. connectable cross-section	0.5 mm^2
Digital outputs (continuously-short-circuit-proof)	8 x bidirectional non-floating digital outputs/digital inputs
• Voltage	24 V DC
• Max. load current per digital output	500 mA
• Max. connectable cross-section	0.5 mm^2
Power loss	20 W
PE connection	On housing with M5 screw
Ground connection	On housing with M5 screw
Width	50 mm (1.97 in)
Height	270 mm (10.63 in)
Depth	226 mm (8.9 in)
Weight, approx.	1.5 kg (3.3 lb)

Selection and ordering data

Description	Order No.
CU320 Control Unit (excluding CompactFlash Card)	**6SL3040-0MA00-0AA1**

Accessories

Description	Order No.
PROFIBUS connector without PG/PC connection	**6ES7972-0BA41-0XA0**
PROFIBUS connector with PG/PC connection	**6ES7972-0BB41-0XA0**
Spacers (2 x) for increasing the depth of the CU320 Control Unit to 270 mm (10.63 in) (if the brackets on the side are not to be used but the depth still has to be 270 mm (10.63 in)).	**6SL3064-1BB00-0AA0**

Overview

The firmware and parameter settings are stored on the CompactFlash Card, which is plugged into the CU320 Control Unit.

Design

The performance of the firmware on the CompactFlash Card is scalable. The "Performance Extension 1" firmware option can be used to extend the performance of the CompactFlash Card without performance extension.

The use of Performance Extension 1 increases computing power by 100%.

The required performance depends on the number of drives to be used on the Control Unit and their functional scope and dynamics.

The SIZER configuration tool can be used to calculate exact performance requirements. The firmware options are supplied in license form, which are written to the CompactFlash Card in the factory as license codes.

The firmware option can also be enabled on-site, for example, if the performance extension required is not known at the time of placing the order. You will need the serial number of the CompactFlash Card and the order number of the firmware option to be enabled. With this information you can purchase the associated license code from a license database and enable the firmware option. The license code is only valid for the CompactFlash Card declared and cannot be transferred to other CompactFlash Cards.

Selection and ordering data

Description	Order No.
CompactFlash Card with current firmware version including certificate of license **without** performance extension	**6SL3054-0AA00-1AA0**
CompactFlash Card with current firmware version including certificate of license **with** Performance extension 1 firmware option	**6SL3054-0AA01-1AA0**
Firmware license Performance extension 1 firmware option for CompactFlash Card including certificate of license	**6SL3074-0AA01-0AA0**

The current firmware version is always supplied with the above CompactFlash Cards.

The firmware version is encoded in the order number of the CompactFlash Card supplied. This means that the order numbers of the CompactFlash Cards ordered and delivered may not be identical.

Example: A CompactFlash Card is ordered using the order number 6SL3054-0AA00-1AA0 (as specified in the catalog) and a CompactFlash Card with the current firmware version, e.g. order number 6SL3054-0CB00-1AA0 for firmware version 2.1, is confirmed and delivered. This means that in the event of a replacement, a specific firmware version can be ordered.

CBC10 Communication Board

Overview

The CBC10 Communication Board is used to interface the CU320 Control Unit and therefore the drives to the CAN (Controller Area Network) protocol. The corresponding driver software provides the net message content in accordance with the CANopen drive profile and I/O profile.

Design

The CBC10 Communication Board plugs into the option slot on the CU320 Control Unit. The CBC10 features two CAN interfaces.

Technical data

CBC10 Communication Board	
Max. current requirement (at 24 V DC) via CU320 Control Unit	0.05 A
Power loss	< 10 W
Weight, approx.	0.1 kg (0.2 lb)

Selection and ordering data

Description	Order No.
CBC10 Communication Board	**6SL3055-0AA00-2CA0**

Accessories

Description	Order No.
SUB-D connector, 9-pin, female (3 pieces)	**6FC9341-2AE**
SUB-D connector, 9-pin, male (3 pieces)	**6FC9341-2AF**

Overview

The TB30 Terminal Board expands the number of digital inputs/digital outputs and analog inputs/analog outputs of the CU320 Control Unit.

Design

The following interfaces are located on the TB30 Terminal Board:

- Power supply for digital inputs/digital outputs
- 4 x digital inputs
- 4 x digital outputs
- 2 x analog inputs
- 2 x analog outputs

The TB30 Terminal Board plugs into the option slot on the CU320 Control Unit.

A shield connection for the signal cable shield is located on the CU320 Control Unit.

Technical data

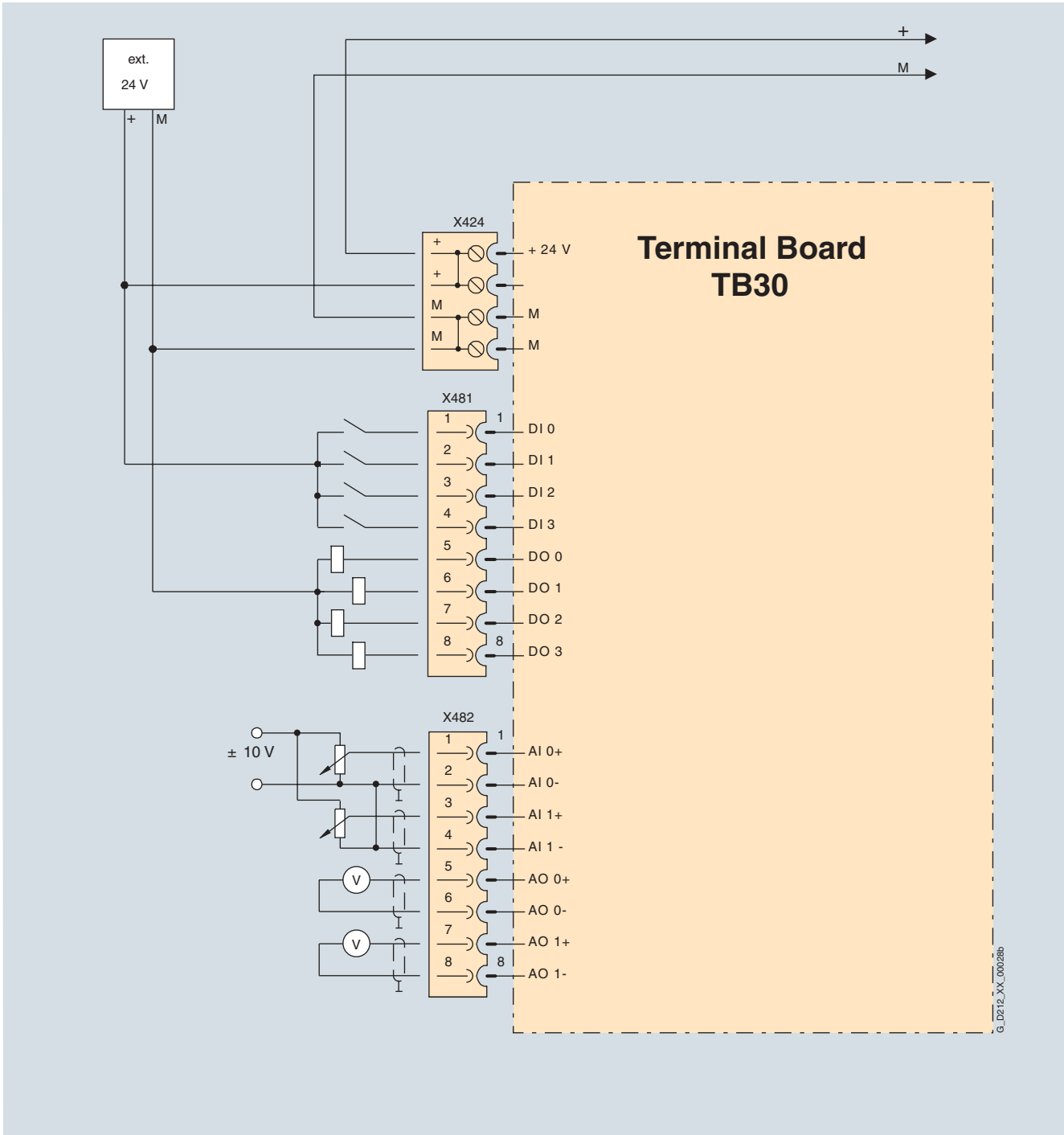
TB30 Terminal Board	
Max. current requirement (at 24 V DC) via CU320 Control Unit without taking account of the digital outputs	0.05 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Digital inputs	
• Voltage	-3 V to +30 V
• Low level (an open digital input is interpreted as "low")	-3 V to +5 V
• High level	15 V to 30 V
• Current consumption (at 24 V DC)	typ. 10 mA
• Signal propagation delays for digital inputs	L → H: approx. 50 µs H → L: approx. 100 µs
• Max. connectable cross-section	0.5 mm^2
Digital outputs (continuously-short-circuit-proof)	
• Voltage	24 V DC
• Max. load current per digital output	500 mA
• Max. connectable cross-section	0.5 mm^2
Analog inputs (differential)	
• Voltage range (an open analog input is interpreted as 0 V)	-10 V to +10 V
• Internal resistance R_i	65 kΩ
• Resolution	13 bit + sign
• Max. connectable cross-section	0.5 mm^2
Analog outputs (continuously-short-circuit-proof)	
• Voltage range	-10 V to +10 V
• Max. load current	-3 mA to +3 mA
• Resolution	11 bit + sign
• Max. connectable cross-section	0.5 mm^2
Power loss	< 3 W
Weight, approx.	0.1 kg (0.2 lb)

Selection and ordering data

Description	Order No.
TB30 Terminal Board	**6SL3055-0AA00-2TA0**

TB30 Terminal Board

Integration



Connection diagram for the TB30 Terminal Board

Overview

With the TM31 Terminal Module, the number of available digital inputs and outputs and the number of analog input and outputs within a drive can be expanded.

Design

The following interfaces are located on the TM31 Terminal Module:

- 8 x digital inputs
- 4 x bidirectional digital inputs/digital outputs
- 2 x relay outputs with change-over contact
- 2 x analog inputs
- 2 x analog outputs
- 1 x temperature sensor input (KTY84-130 or PTC)
- 2 x DRIVE-CLiQ sockets
- 1 x connection for the electronics power supply via the 24 V DC power supply connector
- 1 x PE (protective earth) connection

The TM31 Terminal Module can be snapped onto a 35 x 15/7.5 (1.4 x 0.6/0.3) DIN rail to EN 50 022.

The signal line shield can be connected to the TM31 Terminal Module via a shield connection terminal, e.g. Phoenix Contact type SK8 or Weidmüller type KLBÜ CO 1. The shield connection terminal must not be used for strain relief.

The status of the TM31 Terminal Module is indicated via a multi-color LED.

Technical data

TM31 Terminal Module	
Max. current requirement (at 24 V DC) without taking account of digital outputs	0.5 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Digital inputs	
• Voltage	-3 V to +30 V
• Low level (an open digital input is interpreted as "low")	-3 V to +5 V
• High level	15 V to 30 V
• Current consumption (at 24 V DC)	typ. 10 mA
• Signal propagation delays for digital inputs	L → H: ca. 50 µs H → L: ca. 100 µs
• Max. connectable cross-section	1.5 mm^2
Digital outputs (continuously-short-circuit-proof)	
• Voltage	24 V DC
• Max. load current per digital output	100 mA
• Max. total current of digital outputs	400 mA
• Max. connectable cross-section	1.5 mm^2
Analog inputs (a switch is used to toggle between voltage and current input)	
• As voltage input	
- Voltage range	-10 V to +10 V
- Internal resistance R_i	100 kΩ
• As current input	
- Current range	4 mA to 20 mA/-20 mA to +20 mA/ 0 mA to 20 mA
- Internal resistance R_i	250 Ω
- Resolution	11 bit + sign
• Max. connectable cross-section	1.5 mm^2
Analog outputs (continuously-short-circuit-proof)	
• Voltage range	-10 V to +10 V
• Max. load current	-3 mA to +3 mA
• Current range	4 mA to 20 mA, -20 mA to +20 mA, 0 mA to 20 mA
• Max. load resistance	500 Ω for outputs in the range -20 mA to +20 mA
• Resolution	11 bit + sign
• Max. connectable cross-section	1.5 mm^2
Relay outputs (change-over contacts)	
• Max. load current	8 A
• Max. switching voltage	250 V AC, 30 V DC
• Max. switching power (at 250 V AC)	2000 VA (cos φ = 1) 750 VA (cos φ = 0.4)
• Max. switching power (at 30 V DC)	240 W (ohmic load)
• Required minimum current	100 mA
• Max. connectable cross-section	2.5 mm^2
Power loss	< 10 W
PE connection	On housing with M4 screw
Width	50 mm (1.97 in)
Height	150 mm (5.91 in)
Depth	111 mm (4.37 in)
Weight, approx.	0.87 kg (1.9 lb)

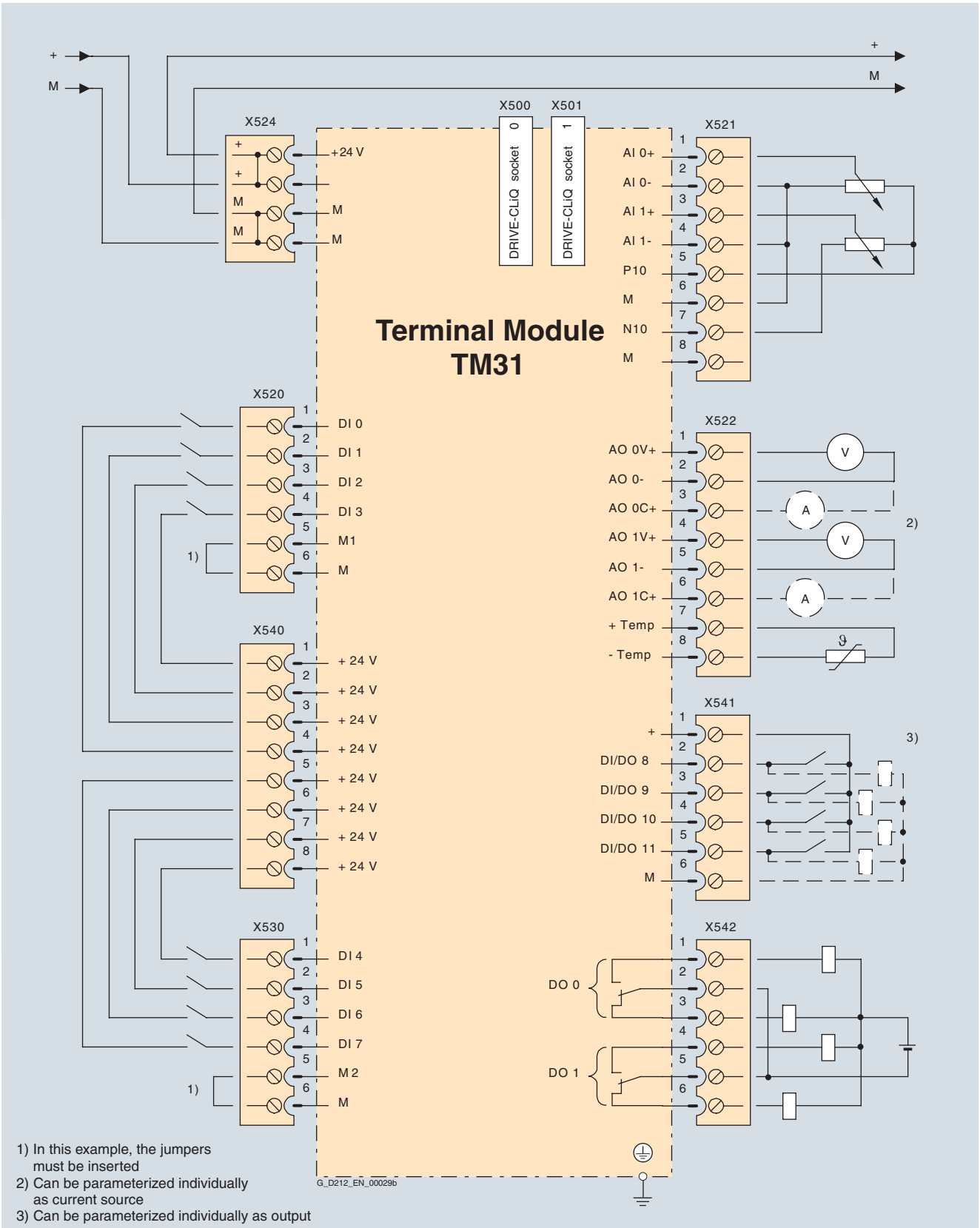
Selection and ordering data

Description	Order No.
TM31 Terminal Module (without DRIVE-CLiQ cable)	**6SL3055-0AA00-3AA0**

TM31 Terminal Module

Integration

The TM31 Terminal Module communicates with the CU320 Control Unit via DRIVE-CLiQ.



1) In this example, the jumpers must be inserted
2) Can be parameterized individually as current source
3) Can be parameterized individually as output

Connection diagram for the TM31 Terminal Module

Overview

Encoder systems can only be connected to SINAMICS S120 via DRIVE-CLiQ.

Motors with DRIVE-CLiQ interfaces can be ordered for this purpose, for example, 1FK7 and 1FT6 synchronous motors and 1PH7 asynchronous motors. Each of these motors can be supplied as standard with one DRIVE-CLiQ interface.

These motors with DRIVE-CLiQ interface can be connected to the corresponding motor module directly via the MOTION-CONNECT DRIVE-CLiQ cables available. This connection route is used to transmit motor encoder and temperature signals as well as electronic rating plate data such as unique ID numbers, rated data (voltage, current, torque) directly to the Control Unit. These motors make start-up and diagnostics much easier, as the motor and encoder type can be identified automatically.

Motors without DRIVE-CLiQ interface

The encoder and temperature signals of motors without DRIVE-CLiQ interfaces, as well as those of external encoders, must be connected via Sensor Modules. Sensor Modules Cabinet-mounted with IP20 degree of protection are currently available for direct installation in control cabinets.

Only one encoder can be connected to each Sensor Module Cabinet-mounted.

Technical data

	Motors with DRIVE-CLiQ interface and resolver (2-pole/multi-pole)	**Motors with DRIVE-CLiQ interface and incremental encoder sin/cos 1 V_{pp}, absolute encoder EnDat (512 S/R, 2048 S/R) or single absolute encoder**
Max. current requirement at 24 V DC (via Motor Module and MOTION-CONNECT DRIVE-CLiQ cable)	500 mA	500 mA
Max. DRIVE-CLiQ cable length between motor and Motor Modules	• 100 m (328 ft) when using MOTION-CONNECT 500 DRIVE-CLiQ cables • 50 m (164 ft) when using MOTION-CONNECT 800 DRIVE-CLiQ cables	

Further information

If possible, motor encoder and temperature signals should be connected to the corresponding Motor Module and external encoders to the Control Unit.

SMC10 Sensor Module Cabinet-mounted

Overview

SMC10 Sensor Modules Cabinet-mounted are required when a motor with a DRIVE-CLiQ interface is not available or when external encoders are required in addition to the motor encoder.

The following encoder signals can be evaluated:

- 2-pole resolver
- Multi-pole resolver

Design

The SMC10 Sensor Module Cabinet-mounted features the following interfaces as standard:

- 1 x DRIVE CLiQ interface
- 1 x encoder connection including motor temperature detection (KTY84-130) via SUB-D connector
- 1 x connection for the electronics power supply via the 24 V DC power supply connector
- 1 x PE (protective earth) connection

The status of the SMC10 Sensor Module Cabinet-mounted is indicated via a multi-color LED.

SMC10 Sensor Modules Cabinet-mounted can be snapped onto a 35 × 15/7.5 (1.4 × 0.6/0.3) DIN rail to EN 50 022.

The maximum encoder cable length between SMC10 Modules and encoders is:

- For 2-pole resolvers: 130 m (427 ft)
- For multi-pole resolvers: 50 m (164 ft)

Integration

The SMC10 Sensor Module Cabinet-mounted communicates with the CU320 Control Unit via DRIVE-CLiQ.

Technical data

SMC10 Sensor Module Cabinet-mounted	
Max. current requirement (at 24 V DC) without taking account of encoder	0.3 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Power loss	< 10 W
PE connection	On housing with M4 screw
Width	50 mm (1.97 in)
Height	150 mm (5.91 in)
Depth	111 mm (4.37 in)
Weight, approx.	0.8 kg (1.9 lb)

Selection and ordering data

Description	Order No.
SMC10 Sensor Module Cabinet-mounted (excluding DRIVE-CLiQ cable)	**6SL3055-0AA00-5AA0**

SMC20 Sensor Module Cabinet-mounted

Overview

SMC20 Sensor Modules Cabinet-mounted are required when a motor with a DRIVE-CLiQ interface is not available or when external sensors are required for direct position measurement in addition to the motor encoder.

The following encoder signals can be evaluated:

- Incremental encoder sin/cos 1 V_{pp}
- Absolute encoder EnDat

The motor temperature can also be detected using a KTY84-130 temperature sensor.

Design

The SMC20 Sensor Module Cabinet-mounted features the following interfaces as standard:

- 1 x DRIVE-CLiQ interface
- 1 x encoder connection including motor temperature detection (KTY84-130) via SUB-D connector
- 1 x connection for the electronics power supply via the 24 V DC power supply connector
- 1 x PE (protective earth) connection

The status of the SMC20 Sensor Module Cabinet-mounted is indicated via a multi-color LED.

SMC20 Sensor Modules Cabinet-mounted can be snapped onto a 35 × 15/7.5 (1.4 × 0.6/0.3) DIN rail to EN 50 022.

The maximum encoder cable length between SMC20 Modules and encoders is 100 m (328 ft).

Integration

The SMC20 Sensor Module Cabinet-mounted communicates with the CU320 Control Unit via DRIVE-CLiQ.

Technical data

SMC20 Sensor Module Cabinet-mounted	
Max. current requirement (at 24 V DC) without taking account of encoder	0.4 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Power loss	< 10 W
PE connection	On housing with M4 screw
Width	50 mm (1.97 in)
Height	150 mm (5.91 in)
Depth	111 mm (4.37 in)
Weight, approx.	0.8 kg (1.9 lb)

Selection and ordering data

Description	Order No.
SMC20 Sensor Module Cabinet-mounted (excluding DRIVE-CLiQ cable)	**6SL3055-0AA00-5BA1**

SMC30 Sensor Module Cabinet-mounted

Overview

SMC30 Sensor Modules Cabinet-mounted are required when a motor with a DRIVE-CLiQ interface is not available or when external sensors are required in addition to the motor encoder.

TTL/HTL incremental encoders with and without cable-break detection are supported.

The motor temperature can also be detected using KTY84-130 temperature sensors.

Design

The SMC30 Sensor Module Cabinet-mounted features the following interfaces as standard:

- 1 x DRIVE-CLiQ interface
- 1 x encoder connection including motor temperature detection (KTY84-130) via SUB-D connector or terminals
- 1 x connection for the electronics power supply via the 24 V DC power supply connector
- 1 x PE (protective earth) connection

The status of the SMC30 Sensor Module Cabinet-mounted is indicated via a multi-color LED.

SMC30 Sensor Modules Cabinet-mounted can be snapped onto a 35 × 15/7.5 (1.4 × 0.6/0.3) DIN rail to EN 50 022.

The maximum encoder cable length between SMC30 Modules and encoders is 100 m (328 ft). For HTL encoders, this length can be increased to 300 m (985 ft) if signals A+/A- and B+/B- are evaluated and the power supply cable has a minimum cross-section of 0.75 mm^2.

The signal line shield can be connected to the SMC30 Sensor Module Cabinet-mounted via a shield connection terminal, e.g. Phoenix Contact type SK8 or Weidmüller type KLBÜ CO 1. The shield connection terminal must not be used for strain relief.

Integration

The SMC30 Sensor Module Cabinet-mounted communicates with the CU320 Control Unit via DRIVE-CLiQ.

Technical data

SMC30 Sensor Module Cabinet-mounted	
Max. current requirement (at 24 V DC) without taking account of encoder	0.6 A
Max. connectable cross-section	2.5 mm^2
Max. fuse protection	20 A
Power loss	< 10 W
PE connection	On housing with M4 screw
Width	50 mm (1.97 in)
Height	150 mm (5.91 in)
Depth	111 mm (4.37 in)
Weight, approx.	0.8 kg (1.9 lb)

Selection and ordering data

Description	Order No.
SMC30 Sensor Module Cabinet-mounted (excluding DRIVE-CLiQ cable)	**6SL3055-0AA00-5CA0**

AC motors

3

3/2	**Synchronous motors**
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	Cooling principle
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3/61	**Gear units**
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3/64	Planetary gear units for 1FT7 motors
3/66	2-speed gearboxes for 1PH7/1PH4 motors
3/68	**Selection guide**
	Type of construction
	Degree of protection

Overview

	1FT6	1FK7 Compact 1FK7 High Dynamic
Rated speed	1500 rpm to 6000 rpm	3000 rpm to 6000 rpm
Static torque M_0	0.4 Nm to 500 Nm (3.5 lb_f-in to 4425 lb_f-in)	0.85 Nm to 36 Nm (1FK7 Compact) (7.5 lb_f-in to 319 lb_f-in) 1.3 Nm to 22 Nm (1FK7 High Dynamic) (11.5 lb_f-in to 195 lb_f-in)
Overload capability up to max.	4 × M_0	3 × M_0
Encoder systems, built-in, for motors with/without DRIVE-CLiQ interface		
	• Incremental encoder sin/cos 1 V_{pp} • Absolute encoder, EnDat • Resolver See the Technical Specifications and the selection and ordering data for the required motor for information regarding compatible encoder systems.	
Sound pressure level L_{pA} (1m) according to EN ISO 1680	55 dB to 70 dB	
Degree of protection EN 60034-5 (IEC 60034-5)	IP64 to IP68	IP64 IP65, additionally IP67 at drive-end flange
Cooling	Natural cooling Forced cooling Water cooling	Natural cooling
Stator winding insulation EN 60034-1 (IEC 60034-1)	Temperature class F for a winding temperature rise of ΔT = 100 K at an ambient temperature of +40 °C (+104 °F)	
	In the case of water cooling, max. inlet temperature +30 °C (+86 °F)	–
Holding brake	Built-on (option)	
Type of motor	Permanent-magnet synchronous motor, 3-phase	
Paint finish	Anthracite gray	None, anthracite gray (option)
Gearbox mounting	Planetary gear i = 4 to i = 10 (single-stage) i = 16 to i = 50 (2-stage)	Planetary gear i = 5, i = 10 (single-stage)

Applications

1FT6/1FK7 synchronous motors can be used in a wide variety of applications. For machine tools, they are called and used as feed motors. For production machines such as printing, packaging and textile machines, they are called synchronous servo motors. In the following description, the motors are generally called synchronous motors on the basis of their operating principle.

Some motor types can be supplied as **core types**. Unlike the standard types, these core types feature the advantage of reduced lead times and faster spare parts delivery. For this reason, it is recommended to include core types in your project-planning.

Overview

1FT6 motors are compact permanent-magnet synchronous motors.
1FT6 motors with built-in encoders can be operated on the SINAMICS S drive system.

The fully digital control system of the SINAMICS S drive system and the encoder technology of the 1FT6 motors fulfill the highest demands in terms of dynamic performance, speed setting range and rotational and positioning accuracy.

The motors are primarily designed for operation without external cooling and the heat is dissipated via the motor surface. The heat generated in the stator winding and stator core is directly dissipated via the good thermal coupling to the motor enclosure. The concept of brushless, permanent-field synchronous motors shows its special merits here.

Benefits

- Optimum workpiece surface quality due to high rotational accuracy (sinusoidal current injection)
- Short non-productive times due to high dynamic performance
- Power and signal connections for use in severely contaminated areas
- Simple installation due to reduced cabling requirements
- High resistance to lateral forces

Applications

- High-performance machine tools
- Production machines with high demands in terms of dynamic performance and precision

Technical data

Type of motor	Permanent-magnet synchronous motor
Magnetic material	Rare-earth magnetic material
Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a winding temperature rise of ΔT = 100 K at an ambient temperature of +40 °C (+104°F) In the case of water cooling, inlet temperature • max. +30 °C (+86 °F)
Type according to EN 60034-7 (IEC 60034-7)	IM B5 (IM V1, IM V3) IM B14 (IM V18, IM V19) IM B35 on 1FT613.
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP64 standard type, IP65 core type
Cooling	Natural air cooling, separate ventilation, water cooling
Temperature monitoring	KTY 84 temperature sensor in stator winding
Paint finish	Anthracite gray
2nd rating plate	Supplied separately packed
Shaft end on the drive end in accordance with DIN 748-3 (IEC 60072-1)	Smooth shaft
Radial eccentricity, concentricity, and axial eccentricity in accordance with DIN 42955 (IEC 60072-1)	Tolerance N (normal)
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Level N (normal)
Max. sound pressure level L_{pA} (1 m) acc. to EN ISO 1680	1FT602: 55 dB 1FT603/1FT604: 55 dB 1FT606: 65 dB 1FT608/1FT610/ 1FT613: 70 dB
Encoder systems, built-in, for motors with/without DRIVE-CLiQ interface	• Incremental encoder sin/cos 1 V_{pp} 2048 S/R • Absolute encoder, multiturn, 2048 S/R on 1FT603 to 1FT613. 512 S/R on 1FT602 and traversing range 4096 revolutions with EnDat interface • Multipole resolver 1) (number of poles corresponds to number of pole pairs of the motor) • 2-pole resolver
Connecting	Connectors for signals and power Terminal box possible on 1FT61.
Options	• Shaft end on the drive end with featherkey and key way (half-key balancing) • Built-in holding brake • Degree of protection IP67, IP68 M5 sealing air connection present (except with forced ventilation) • Planetary gear units, built-on (requirement: smooth shaft end) and vibration severity grade N) • Terminal box for power terminal

1) A max. operating frequency of 470 Hz must be observed with SINAMICS.

Core type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed	Shaft height SH	Rated power	Static torque	Rated torque [1]	Rated current	1FT6 synchronous motors with natural cooling	No. of pole pairs	Rotor moment of inertia (excluding brake)	Weight (excluding brake)
n_{rated}		P_{rated} at ΔT=100 K	M_0 at ΔT=100 K	M_{rated} at ΔT=100 K	I_{rated} at ΔT=100 K	Order No. **Core type**		J	m
rpm		kW (HP)	Nm (lb_f-in)	Nm (lb_f-in)	A			10^{-4} kg m^2 (lb_f-in-s^2)	kg (lb)
2000	100	4.8 (6.43)	27 (239)	23 (203.6)	11	**1FT6 102 - 1AC71 - ■ ■ ■ 1**	4	99 (0.0876)	27.5 (60.6)
		8 (10.72)	50 (442.6)	38 (336.3)	17.6	**1FT6 105 - 1AC71 - ■ ■ ■ 1**	4	168 (0.1487)	39.5 (87.1)
3000	48	1.4 (1.88)	5 (44.3)	4.3 (38.1)	2.9	**1FT6 044 - 1AF71 - ■ ■ ■ 1**	2	5.1 (0.0045)	8.3 (18.3)
	63	1.5 (2.01)	6 (53.1)	4.7 (41.6)	3.4	**1FT6 062 - 1AF71 - ■ ■ ■ 1**	3	8.5 (0.0752)	9.5 (20.9)
		2.2 (2.95)	9.5 (84.1)	7 (62)	4.9	**1FT6 064 - 1AF71 - ■ ■ ■ 1**	3	13 (0.0115)	12.5 (27.6)
	80	3.2 (4.29)	13 (115.1)	10.3 (91.2)	8.7	**1FT6 082 - 1AF71 - ■ ■ ■ 1**	4	30 (0.0266)	15 (33.1)
		4.6 (6.17)	20 (177)	14.7 (130.1)	11	**1FT6 084 - 1AF71 - ■ ■ ■ 1**	4	48 (0.0425)	20.5 (45.2)
		5.8 (7.77)	27 (239)	18.5 (163.7)	13	**1FT6 086 - 1AF71 - ■ ■ ■ 1**	4	66.5 (0.0589)	25.5 (56.2)
4500	63	1.7 (2.28)	6 (53.1)	3.6 (31.9)	3.9	**1FT6 062 - 1AH71 - ■ ■ ■ 1**	3	8.5 (0.0752)	9.5 (20.9)
		2.3 (3.08)	9.5 (84.1)	4.8 (42.5)	5.5	**1FT6 064 - 1AH71 - ■ ■ ■ 1**	3	13 (0.0115)	12.5 (27.6)
	80	4.9 (6.57)	20 (177)	10.5 (92.9)	12.5	**1FT6 084 - 1AH71 - ■ ■ ■ 1**	4	48 (0.0425)	20.5 (45.2)
		5.7 (7.64)	27 (239)	12 (106.2)	12.6	**1FT6 086 - 1AH71 - ■ ■ ■ 1**	4	66.5 (0.0589)	25.5 (56.2)
6000	36	0.88 (1.18)	2 (17.7)	1.4 (12.4)	2.1	**1FT6 034 - 1AK71 - ■ ■ ■ 1**	2	1.1 (0.001)	4.4 (9.7)
	80	4.1 (5.5)	20 (177)	6.5 (57.5)	9.2	**1FT6 084 - 1AK71 - ■ ■ ■ 1**	4	48 (0.0425)	20.5 (45.2)

• Connector outlet direction:	Transverse right (not for 1FT604, 1FT606)	**1**
	Transverse left (not for 1FT604, 1FT606)	**2**
	Axial NDE	**3**
	Axial DE	**4**
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp}, 2048 S/R	**A**
	Absolute encoder EnDat 2048 S/R [1]	**E**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp}, 2048 S/R	**D**
	Absolute encoder EnDat 2048 S/R [1]	**F**
• Smooth shaft/rotational accuracy tolerance N:	Without holding brake	**G**
	With holding brake	**H**

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [2]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 102 - 1AC7...	12.1	5.7 (7.6)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 105 - 1AC7...	21.4	10.5 (14.1)	30	**- 1 TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 044 - 1AF7...	3	1.6 (2.1)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 062 - 1AF7...	4.1	1.9 (2.5)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 064 - 1AF7...	6.1	3 (4)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 082 - 1AF7...	9.6	4.1 (5.5)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 084 - 1AF7...	13.2	6.3 (8.5)	18	**- ■TE21 - 8AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 086 - 1AF7...	16.4	8.5 (11.4)	18	**- ■TE21 - 8AA0**	1.5	4 x 2.5	**- 5■S31 - ■ ■ ■0**
1FT6 062 - 1AH7...	5.7	2.8 (3.8)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 064 - 1AH7...	9	4.5 (6)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 084 - 1AH7...	19.8	9.4 (12.6)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**
1FT6 086 - 1AH7...	23.3	12.7 (22.1)	30	**- 1 TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 034 - 1AK7...	2.6	1.3 (1.7)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 084 - 1AK7...	24.1	12.6 (16.9)	30	**6SL3 120 - 1 TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**		
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**	
• Without brake conductors • With brake conductors			**C** **D**
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.			**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.

2) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed	Shaft height SH	Rated output	Static torque	Rated torque [1]	Rated current	1FT6 synchronous motors with natural cooling	No. of pole pairs	Rotor moment of inertia (excluding brake)	Weight (excluding brake)
n_{rated}		P_{rated} at ΔT=100 K	M_0 at ΔT=100 K	M_{rated} at ΔT=100 K	I_{rated} at ΔT=100 K	Order No. **Standard type**		J	m
rpm		kW (HP)	Nm (lb_f-in)	Nm (lb_f-in)	A			10^{-4} kg m^2 (lb_f-in-s^2)	kg (lb)
1500	100	3.8 (5.1)	27 (239)	24.5 (216.8)	8.4	**1FT6 102 - 8AB7■ - ■ ■ ■ ■**	4	99 (0.0876)	27.5 (60.6)
		6.4 (8.6)	50 (442.6)	41 (362.9)	14.5	**1FT6 105 - 8AB7■ - ■ ■ ■ ■**	4	168 (0.1487)	39.5 (87.1)
		9.6 (12.9)	70 (619.6)	61 (539.9)	20.5	**1FT6 108 - 8AB7■ - ■ ■ ■ ■**	4	260 (0.2301)	55.5 (122.4)
	132	9.7 (13)	75 (663.8)	62 (548.8)	19	**1FT6 132 - 6AB7 1 - ■ ■ ■ ■**	3	430 (0.3806)	85 (187.4)
		11.8 (15.8)	95 (840.8)	75 (663.8)	24	**1FT6 134 - 6AB7 1 - ■ ■ ■ ■**	3	547 (0.4841)	100 (220.5)
		13.8 (18.5)	115 (1017.9)	88 (778.9)	27	**1FT6 136 - 6AB7 1 - ■ ■ ■ ■**	3	664 (0.5876)	117 (258)

• Type of construction:	IM B5 IM B14 [2] (not for 1FT613)	1 2
• Connector outlet direction:	Transverse right Transverse left Axial NDE (not for 1FT613) Axial DE	1 2 3 4
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE	5 6 7 8
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	A E S T
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{PP} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	D F U P

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	A
With featherkey and key way	N	With	B
With featherkey and key way	R	Without	D
With featherkey and key way	R	With	E
Smooth shaft	N	Without	G
Smooth shaft	N	With	H
Smooth shaft	R	Without	K
Smooth shaft	R	With	L

• Vibration severity grade:	• Degree of protection:	
N	IP64	0
N	IP65	1
N	IP67	2
N	IP68	6
R	IP64	3
R	IP65	4
R	IP67	5
R	IP68	7

Selection of degree of protection and type of construction, see "Selection guide".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [4]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 102 - 8AB7...	8.7	4.2 (5.6)	9	**6SL3 120 - ■TE21 - 0AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 105 - 8AB7...	16	7.9 (10.6)	18	**- ■TE21 - 8AA0**	1.5	4 x 2.5	**- 5■S31 - ■ ■ ■0**
1FT6 108 - 8AB7...	22.3	11.0 (14.7)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 132 - 6AB7...	21.6	11.8 (15.8)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**
1FT6 134 - 6AB7...	27	14.9 (20)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 136 - 6AB7...	34	18.1 (24.3)	45	**- 1TE24 - 5AA0**	1.5	4 x 10	**- 5■S64 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**			
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**		
• Without brake conductors • With brake conductors			**C** **D**	
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
4) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque[1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	1FT6 synchronous motors with natural cooling Order No. Standard type	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
2000	63	0.8 (1.07)	4 (35.4)	3.7 (32.7)	1.9	**1FT6 061 - 6AC7■ - ■ ■ ■ ■**	3	6 (0.0053)	8 (17.6)
		1.1 (1.47)	6 (53.1)	5.2 (46)	2.6	**1FT6 062 - 6AC7■ - ■ ■ ■ ■**	3	8.5 (0.0075)	9.5 (20.9)
		1.7 (2.28)	9.5 (84.1)	8 (70.8)	3.8	**1FT6 064 - 6AC7■ - ■ ■ ■ ■**	3	13 (0.0115)	12.5 (27.6)
	80	1.6 (2.14)	8 (70.8)	7.5 (66.4)	4.1	**1FT6 081 - 8AC7■ - ■ ■ ■ ■**	4	21 (0.0186)	12.5 (27.6)
		2.4 (3.22)	13 (115.1)	11.4 (101)	6.6	**1FT6 082 - 8AC7■ - ■ ■ ■ ■**	4	30 (0.0266)	15 (33.1)
		3.5 (4.69)	20 (177)	16.9 (149.6)	8.3	**1FT6 084 - 8AC7■ - ■ ■ ■ ■**	4	48 (0.0425)	20.5 (45.2)
		4.7 (6.3)	27 (239)	22.5 (199)	10.9	**1FT6 086 - 8AC7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	25.5 (56.2)
	100	4.8 (6.43)	27 (239)	23 (203.6)	11	**1FT6 102 - 8AC7■ - ■ ■ ■ ■**	4	99 (0.0876)	27.5 (60.6)
		8 (10.72)	50 (203.6)	38 (336.3)	17.6	**1FT6 105 - 8AC7■ - ■ ■ ■ ■**	4	168 (0.1478)	39.5 (87.1)
		11.5 (15.42)	70 (620)	55 (486.8)	24.5	**1FT6 108 - 8AC7■ - ■ ■ ■ ■**	4	260 (0.2301)	55.5 (122.4)
	132	11.5 (15.42)	75 (663.8)	55 (486.8)	23	**1FT6 132 - 6AC7 1 - ■ ■ ■ ■**	3	430 (0.3806)	85 (187.5)
		13.6 (18.23)	95 (840.8)	65 (575.3)	27	**1FT6 134 - 6AC7 1 - ■ ■ ■ ■**	3	547 (0.4841)	100 (220.5)
		15.5 (20.78)	115 (1018)	74 (655)	30	**1FT6 136 - 6AC7 1 - ■ ■ ■ ■**	3	664 (0.5876)	117 (258)

• Type of construction:	IM B5 IM B14 [2] (not for 1FT613)	**1** **2**	
• Connector outlet direction:	Transverse right (not for 1FT606) Transverse left (not for 1FT606) Axial NDE (not for 1FT613) Axial DE	**1** **2** **3** **4**	
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	**A** **E** **S** **T**	
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	**D** **F** **U** **P**	

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**

• Vibration severity grade:	• Degree of protection:	
N	IP64	**0**
N	IP65	**1**
N	IP67	**2**
N	IP68	**6**
R	IP64	**3**
R	IP65	**4**
R	IP67	**5**
R	IP68	**7**

Selection of degree of protection and type of construction, see "Selection guide".

Selection/Ordering data

Motor type (continued)	Static current I_0 at M_0 ΔT=100 K A	Calculated power P_{calc} = M_0 x n_{rated}/9550 P_{calc} for M_0 ΔT=100 K kW (HP)	SINAMICS Motor Module Rated output current I_{rated} at M_0 ΔT=100 K A	SINAMICS Motor Module Order No.	Power cable with complete shield, Motor connection (and brake connection) via power connector: Power connector Size	Motor cable cross-section 4) mm^2	Order No. Pre-assembled cable
1FT6 061 - 6AC7...	1.9	0.84 (1.13)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 062 - 6AC7...	2.7	1.3 (1.74)	3	**- ■TE13 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 064 - 6AC7...	4.2	2 (2.68)	5	**- ■TE15 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 081 - 8AC7...	3.9	1.7 (2.28)	5	**6SL3 120 - ■TE15 - 0AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 082 - 8AC7...	6.6	2.7 (3.62)	9	**- ■TE21 - 0AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 084 - 8AC7...	8.8	4.2 (5.63)	9	**- ■TE21 - 0AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 086 - 8AC7...	11.3	5.7 (7.64)	18	**- ■TE21 - 8AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 102 - 8AC7...	12.1	5.7 (7.64)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 105 - 8AC7...	21.4	10.5 (14.07)	30	**- 1 TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 108 - 8AC7...	29	14.7 (19.71)	30	**- 1 TE23 - 0AA0**	1.5	4 x 10	**- 5■S61 - ■ ■ ■0**
1FT6 132 - 6AC7...	29	15.7 (21.05)	30	**6SL3 120 - 1 TE23 - 0AA0**	1.5	4 x 10	**6FX■ 002 - 5■S61 - ■ ■ ■0**
1FT6 134 - 6AC7 ...	36	19.9 (26.68)	45	**- 1 TE24 - 5AA0**	1.5	4 x 10	**- 5■S64 - ■ ■ ■0**
1FT6 136 - 6AC7...	42	24.1 (22.31)	45	**- 1 TE24 - 5AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**

Option	Code
• Single Motor Module	**1**
• Double Motor Module	**2**
Type of power cable	
• MOTION-CONNECT 800	**8**
• MOTION-CONNECT 500	**5**
• Without brake conductors	**C**
• With brake conductors	**D**
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.	**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
4) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors with natural cooling** Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
3000	48	0.7 (0.99)	2.6 (23)	2.15 (19)	1.7	**1FT6 041 - 4AF71 -** ■ ■ ■ ■	2	2.9 (0.0025)	6.6 (14.6)
		1.4 (1.88)	5 (44.3)	4.3 (38.1)	2.9	**1FT6 044 - 4AF71 -** ■ ■ ■ ■	2	5.1 (0.0045)	8.3 (18.3)
	63	1.1 (1.47)	4 (35.4)	3.5 (31)	2.6	**1FT6 061 - 6AF7■ -** ■ ■ ■ ■	3	6 (0.0053)	8 (17.6)
		1.5 (2.01)	6 (53.1)	4.7 (41.6)	3.4	**1FT6 062 - 6AF7■ -** ■ ■ ■ ■	3	8.5 (0.0075)	9.5 (20.9)
		2.2 (2.95)	9.5 (84.1)	7 (62)	4.9	**1FT6 064 - 6AF7■ -** ■ ■ ■ ■	3	13 (0.0115)	12.5 (27.6)
	80	2.2 (2.95)	8 (70.8)	6.9 (61.1)	5.6	**1FT6 081 - 8AF7■ -** ■ ■ ■ ■	4	21 (0.0186)	12.5 (27.6)
		3.2 (4.29)	13 (115.1)	10.3 (91.2)	8.7	**1FT6 082 - 8AF7■ -** ■ ■ ■ ■	4	30 (0.0266)	15 (33.1)
		4.6 (6.17)	20 (177)	14.7 (130.1)	11	**1FT6 084 - 8AF7■ -** ■ ■ ■ ■	4	48 (0.0425)	20.5 (45.2)
		5.8 (7.77)	27 (239)	18.5 (163.7)	13	**1FT6 086 - 8AF7■ -** ■ ■ ■ ■	4	66.5 (0.0589)	25.5 (56.2)
	100	6.1 (8.18)	27 (239)	19.5 (172.6)	13.2	**1FT6 102 - 8AF7■ -** ■ ■ ■ ■	4	99 (0.0876)	27.5 (60.6)
		9.7 (13)	50 (442.6)	31 (274.4)	22.5	**1FT6 105 - 8AF7■ -** ■ ■ ■ ■	4	168 (0.1487)	39.5 (87.1)
		11.6 (15.55)	70 (619.6)	37 (327.5)	25	**1FT6 108 - 8AF7■ -** ■ ■ ■ ■	4	260 (0.2301)	55.5 (122.4)
	132	11.3 (15.15)	75 (663.8)	36 (318.6)	23	**1FT6 132 - 6AF71 -** ■ ■ ■ ■	3	430 (0.3806)	85 (187.4)

• Type of construction:	IM B5 IM B14 [2] (not for 1FT604, 1FT613)	**1** **2**
• Connector outlet direction:	Transverse right (not for 1FT604, 1FT606) Transverse left (not for 1FT604, 1FT606) Axial NDE (not for 1FT613) Axial DE	**1** **2** **3** **4**
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	**A** **E** **S** **T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver	**D** **F** **U** **P**

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**

• Vibration severity grade:	• Degree of protection:	
N	IP64	**0**
N	IP65	**1**
N	IP67	**2**
N	IP68	**6**
R	IP64	**3**
R	IP65	**4**
R	IP67	**5**
R	IP68	**7**

Selection of degree of protection and type of construction, see "Selection guide".

Selection/Ordering data

Motor type continued	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [5]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 041 - 4AF7 ...	1.9	0.8 (1.1)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 044 - 4AF7 ...	3	1.6 (2.1)	3	**- ■TE13 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 061 - 6AF7 ...	2.7	1.3 (1.7)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 062 - 6AF7 ...	4.1	1.9 (2.5)	5	**- ■TE15 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 064 - 6AF7 ...	6.1	3 (4)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 081 - 8AF7 ...	5.8	2.5 (3.4)	9	**6SL3 120 - ■TE21 - 0AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 082 - 8AF7 ...	9.6	4.1 (5.5)	18	**- ■TE21 - 8AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 084 - 8AF7 ...	13.2	6.3 (8.5)	18	**- ■TE21 - 8AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 086 - 8AF7 ...	16.4	8.5 (11.4)	18	**- ■TE21 - 8AA0**	1.5	4 x 2.5	**- 5■S31 - ■ ■ ■0**
1FT6 102 - 8AF7 ...	16.9	8.5 (11.4)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 2.5	**6FX■ 002 - 5■S31 - ■ ■ ■0**
1FT6 105 - 8AF7 ...	32	15.7 (21)	30 [4]	**- 1TE23 - 0AA0**	1.5	4 x 10	**- 5■S61 - ■ ■ ■0**
1FT6 108 - 8AF7 ...	41	22 (29.5)	45	**- 1TE24 - 5AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 132 - 6AF7 ...	43	23.6 (31.6)	45	**6SL3 120 - 1TE24 - 5AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**			
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**		
• Without brake conductors • With brake conductors			**C** **D**	
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
4) With the specified motor module, the motor cannot be fully utilized to ΔT = 100 K winding temperature rise. If a motor module with a higher rating is used, you must check whether the specified power cable can be connected to it.
5) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	1FT6 synchronous motors with natural cooling Order No. Standard type	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
4500	63	1.4 (1.88)	4 (35.4)	2.9 (25.7)	3.4	**1FT6 061 - 6AH7■ - ■ ■ ■ ■**	3	6 (0.0053)	8 (17.6)
		1.7 (2.28)	6 (53.1)	3.6 (31.9)	3.9	**1FT6 062 - 6AH7■ - ■ ■ ■ ■**	3	8.5 (0.0075)	9.5 (20.9)
		2.3 (3.08)	9.5 (84.1)	4.8 (42.5)	5.5	**1FT6 064 - 6AH7■ - ■ ■ ■ ■**	3	13 (0.0115)	12.5 (27.6)
	80	2.7 (3.62)	8 (70.8)	5.8 (51.3)	7.3	**1FT6 081 - 8AH7■ - ■ ■ ■ ■**	4	21 (0.0186)	12.5 (27.6)
		4 (5.36)	13 (115.1)	8.5 (75.2)	11	**1FT6 082 - 8AH7■ - ■ ■ ■ ■**	4	30 (0.0266)	15 (33.1)
		4.9 (6.57)	20 (177)	10.5 (92.9)	12.5	**1FT6 084 - 8AH7■ - ■ ■ ■ ■**	4	48 (0.0425)	20.5 (45.2)
		5.7 (7.64)	27 (239)	12 (106.2)	12.6	**1FT6 086 - 8AH7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	25.5 (56.2)
	100	5.7 (7.64)	27 (239)	12 (106.2)	12	**1FT6 102 - 8AH7■ - ■ ■ ■ ■**	4	99 (0.0876)	27.5 (60.6)

• Type of construction:	IM B5 IM B14 [2]	**1** **2**	
• Connector outlet direction:	Transverse right (not for 1FT606) Transverse left (not for 1FT606) Axial NDE Axial DE	**1** **2** **3** **4**	
• Terminal box, cable entry (only on 1FT61):	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver		**A** **E** **S** **T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [3] 2-pole resolver		**D** **F** **U** **P**

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**

• Vibration severity grade:	• Degree of protection:	
N	IP64	**0**
N	IP65	**1**
N	IP67	**2**
N	IP68	**6**
R	IP64	**3**
R	IP65	**4**
R	IP67	**5**
R	IP68	**7**

Selection of degree of protection and type of construction, see "Selection guide".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power P_{calc} = $M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [5]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 061 - 6AH7...	4	1.9 (2.5)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 062 - 6AH7...	5.7	2.8 (3.8)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 064 - 6AH7...	9	4.5 (6)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 081 - 8AH7...	8.6	3.8 (5.1)	9	**6SL3 120 - ■TE21 - 0AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 082 - 8AH7...	14.8	6.1 (8.2)	18	**- ■TE21 - 8AA0**	1.5	4 x 1.5	**- 5■S21 - ■ ■ ■0**
1FT6 084 - 8AH7...	19.8	9.4 (12.6)	18 [4]	**- ■TE21 - 8AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 086 - 8AH7...	23.3	12.7 (17)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 102 - 8AH7...	24.1	12.7 (17)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**			
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**		
• Without brake conductors • With brake conductors			**C** **D**	
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
4) With the specified motor module, the motor cannot be fully utilized to ΔT = 100 K winding temperature rise.
5) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	1FT6 synchronous motors with natural cooling Order No. Standard type	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
6000	28	0.19 (0.25)	0.4 (3.5)	0.3 (2.7)	1.1	**1FT6 021 - 6AK71 -** ■ ■ ■ ■	3	0.21 (0.0002)	1.2 (2.6)
		0.31 (0.42)	0.8 (7.1)	0.5 (4.4)	0.9	**1FT6 024 - 6AK71 -** ■ ■ ■ ■	3	0.34 (0.0003)	2.1 (4.6)
	36	0.47 (0.63)	1 (8.8)	0.75 (6.6)	1.2	**1FT6 031 - 4AK71 -** ■ ■ ■ ■	2	0.65 (0.0006)	3.1 (6.8)
		0.88 (1.18)	2 (17.7)	1.4 (12.4)	2.1	**1FT6 034 - 4AK71 -** ■ ■ ■ ■	2	1.1 (0.0010)	4.4 (9.7)
	48	1.1 (1.47)	2.6 (23)	1.7 (15)	2.4	**1FT6 041 - 4AK71 -** ■ ■ ■ ■	2	2.9 (0.0025)	6.6 (14.6)
		1.9 (2.55)	5 (44.3)	3 (26.6)	4.1	**1FT6 044 - 4AK71 -** ■ ■ ■ ■	2	5.1 (0.0045)	8.3 (18.3)
	63	1.3 (1.74)	4 (35.4)	2.1 (18.6)	3.1	**1FT6 061 - 6AK7**■ **-** ■ ■ ■ ■	3	6 (0.0053)	8 (17.6)
		1.3 (1.74)	6 (53.1)	2.1 (18.6)	3.2	**1FT6 062 - 6AK7**■ **-** ■ ■ ■ ■	3	8.5 (0.0075)	9.5 (20.9)
		1.3 (1.74)	9.5 (84.1)	2.1 (18.6)	3.5	**1FT6 064 - 6AK7**■ **-** ■ ■ ■ ■	3	13 (0.0115)	12.5 (27.6)
	80	2.9 (3.89)	8 (70.8)	4.6 (40.7)	7.7	**1FT6 081 - 8AK7**■ **-** ■ ■ ■ ■	4	21 (0.0186)	12.5 (27.6)
		3.5 (4.69)	13 (115.1)	5.5 (48.7)	9.1	**1FT6 082 - 8AK7**■ **-** ■ ■ ■ ■	4	30 (0.0266)	15 (33.1)
		4.1 (15.55)	20 (177)	6.5 (57.5)	9.2	**1FT6 084 - 8AK7**■ **-** ■ ■ ■ ■	4	48 (0.0425)	20.5 (45.2)

• Type of construction:	IM B5 IM B14 [2] (not for 1FT602, 1FT603, 1FT604)	**1** **2**	
• Connector outlet direction:	Transverse right (not for 1FT603, 1FT604, 1FT606) Transverse left (not for 1FT603, 1FT604, 1FT606) Axial NDE Axial DE	**1** **2** **3** **4**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] (not for 1FT602) Absolute encoder EnDat 512 S/R [1] (not for 1FT602) Multipole resolver [3] 2-pole resolver	**A** **E** **H** **S** **T**	
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] (not for 1FT602) Absolute encoder EnDat 512 S/R [1] (not for 1FT602) Multipole resolver [3] 2-pole resolver	**D** **F** **L** **U** **P**	
• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**
• Vibration severity grade:		• Degree of protection:	
N		IP64	**0**
N (not for 1FT602)		IP65 (not for 1FT602)	**1**
N		IP67	**2**
N (not for 1FT602)		IP68 (not for 1FT602)	**6**
• R		IP64	**3**
R (not for 1FT602)		IP65 (not for 1FT602)	**4**
R		IP67	**5**
R (not for 1FT602)		IP68 (not for 1FT602)	**7**

Selection of degree of protection and type of construction, see "Selection guide".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [4]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 021 - 6AK7 ...	1.25	0.3 (0.4)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 024 - 6AK7 ...	1.25	0.5 (0.7)	3	**- ■TE13 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 031 - 4AK7 ...	1.4	0.6 (0.8)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 034 - 4AK7 ...	2.6	1.3 (1.7)	3	**- ■TE13 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 041 - 4AK7 ...	3	1.6 (2.1)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 044 - 4AK7 ...	5.9	3.1 (4.2)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 061 - 6AK7...	5	2.5 (3.4)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 062 - 6AK7...	7.6	3.8 (5.1)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 064 - 6AK7...	12	4.0 (5.4)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 081 - 8AK7...	11.1	5.0 (6.7)	18	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 1.5	**6FX■ 002 - 5■S21 - ■ ■ ■0**
1FT6 082 - 8AK7...	17.3	8.2 (11)	18	**- ■TE21 - 8AA0**	1.5	4 x 2.5	**- 5■S31 - ■ ■ ■0**
1FT6 084 - 8AK7...	24.1	12.6 (16.9)	30	**- 1 TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**			
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**		
• Without brake conductors • With brake conductors			**C** **D**	
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
4) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with forced ventilation

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors Forced ventilation**[2] Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
1500	100	9.3 (12.47)	65 (575.3)	59 (522.2)	21.7	**1FT6 105 - 8SB7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
		13 (17.43)	90 (796.6)	83 (734.6)	31	**1FT6 108 - 8SB7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)
	132	16 (21.45)	110 (973.6)	102 (902.8)	36	**1FT6 132 - 6SB71 - ■ ■ ■ ■**	3	430 (0.3806)	91 (200.6)
		20.4 (27.35)	140 (1239.1)	130 (1150.6)	45	**1FT6 134 - 6SB71 - ■ ■ ■ ■**	3	547 (0.4810)	106 (233.7)
		25.1 (33.65)	175 (1548.9)	160 (1416.2)	55	**1FT6 136 - 6SB71 - ■ ■ ■ ■**	3	664 (0.5876)	123 (271.2)
2000	100	11.7 (15.68)	65 (575.3)	56 (495.6)	28	**1FT6 105 - 8SC7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
		16.8 (22.52)	90 (796.6)	80 (708.1)	40	**1FT6 108 - 8SC7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)
	132	20.5 (27.48)	110 (973.6)	98 (867.4)	46	**1FT6 132 - 6SC71 - ■ ■ ■ ■**	3	430 (0.3806)	91 (200.6)
		26.2 (35.12)	140 (1239.1)	125 (1106.4)	57	**1FT6 134 - 6SC71 - ■ ■ ■ ■**	3	547 (0.4810)	106 (233.7)
		32.5 (43.56)	175 (1548.9)	155 (1371.9)	72	**1FT6 136 - 6SC71 - ■ ■ ■ ■**	3	664 (0.5876)	123 (271.2)

• Type of construction:	IM B5 IM B14 [3]	**1** **2**
• Connector outlet direction:	Transverse right Transverse left Axial NDE (not for 1FT613) Axial DE	**1** **2** **3** **4**
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [4] 2-pole resolver	**A** **E** **S** **T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [4] 2-pole resolver	**D** **F** **U** **P**

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**

• Vibration severity grade:	• Degree of protection: [5]	
N	IP64	**0**
N	IP65	**1**
R	IP64	**3**
R	IP65	**4**

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [6]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 105 - 8SB7...	21.9	10.2 (13.7)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**
1FT6 108 - 8SB7...	30	14.1 (18.9)	30	**- 1TE23 - 0AA0**	1.5	4 x 10	**- 5■S61 - ■ ■ ■0**
1FT6 132 - 6SB7...	36	17.3 (23.2)	45	**6SL3 120 - 1TE24 - 5AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 134 - 6SB7...	44	22 (29.5)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 136 - 6SB7...	55	27.5 (36.9)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 105 - 8SC7...	30	13.6 (18.2)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 10	**6FX■ 002 - 5■S61 - ■ ■ ■0**
1FT6 108 - 8SC7...	41	18.8 (25.2)	45	**- 1TE24 - 5AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 132 - 6SC7...	47	23 (30.8)	60	**6SL3 120 - 1TE26 - 0AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 134 - 6SC7...	58	29.3 (39.3)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 136 - 6SC7...	77	36.6 (49.1)	85	**- 1TE28 - 5AA0**	3	4 x 25	**- 5DS33 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**								
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500						**8** **5**			
• Without brake conductors • With brake conductors							**C** **D**		
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.								**.**	**.** **.**

Notes for forced-ventilated motors

	Shaft height 80 and 100	Shaft height 132
Direction of air flow	From NDE to DE	From DE to NDE
Connection system	Connector size 1	Terminal box
Type of connecting cable	6FX.002-5CA01-. . . .	6FX.008-1BB11-. . . .
Pin/terminal assignment	Pin 1: L1, pin 2: N	U1/L1: V2/L2: W3/L3
Supply voltage	1 AC 220/260 V, 50/60 Hz	3 AC 400/460 V, 50/60 Hz
Max. fan current	0.3 A	0.4 A
Weight of the fan assembly	Approx. 4.8 kg (10.6 lb)	Approx. 5.6 kg (12.3 lb)
Sound pressure level	SH 80: 69 dB SH 100: 71 dB	74 dB

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Not for use in environments containing electrically-conductive dust. Forced ventilation cannot be used in the presence of flammable, corrosive, electrically-conductive or explosive dust.
3) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
4) A max. operating frequency of 470 Hz must be observed with SINAMICS S.
5) The degree of protection refers to the motor. The built-on fan meets the requirements of degree of protection IP54.
6) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with forced ventilation

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors Forced ventilation**[2] Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
3000	80	6.9 (9.25)	26 (230.1)	22 (194.7)	17	**1FT6 084 - 8SF7■ - ■ ■ ■ ■**	4	48 (0.0425)	25 (55.1)
		9.7 (13)	35 (309.8)	31 (274.4)	24.5	**1FT6 086 - 8SF7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	30 (66.2)
	100	15.7 (21.05)	65 (575.3)	50 (442.6)	35	**1FT6 105 - 8SF7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
		22 (29.49)	90 (796.6)	70 (619.6)	53	**1FT6 108 - 8SF7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)
	132	28.3 (37.94)	110 (973.6)	90 (796.6)	62	**1FT6 132 - 6SF71 - ■ ■ ■ ■**	3	430 (0.3806)	91 (200.6)
		34.6 (46.38)	140 (1239.1)	110 (973.6)	72	**1FT6 134 - 6SF71 - ■ ■ ■ ■**	3	547 (0.4810)	106 (233.7)
		45.5 (60.99)	175 (1548.9)	145 (1283.4)	104	**1FT6 136 - 6SF71 - ■ ■ ■ ■**	3	664 (0.5876)	123 (271.2)
4500	80	9.4 (12.6)	26 (230.1)	20 (177)	24.5	**1FT6 084 - 8SH7■ - ■ ■ ■ ■**	4	48 (0.0425)	25 (55.1)
		12.7 (17.02)	35 (309.8)	27 (239)	31.5	**1FT6 086 - 8SH7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	30 (66.2)
	100	18.8 (25.2)	65 (575.3)	40 (354)	41	**1FT6 105 - 8SH7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
6000	80	10.7 (14.34)	26 (230.1)	17 (150.5)	25.5	**1FT6 084 - 8SK7■ - ■ ■ ■ ■**	4	48 (0.0425)	25 (55.1)
		13.8 (18.5)	35 (309.8)	22 (194.7)	29	**1FT6 086 - 8SK7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	30 (66.2)

• Type of construction:	IM B5 IM B14 [3] (for 1FT613)	**1** **2**	
• Connector outlet direction: (not for 1FT6 136)	Transverse right Transverse left Axial NDE (not for 1FT613) Axial DE	**1** **2** **3** **4**	
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [4] 2-pole resolver		**A** **E** **S** **T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R [1] Multipole resolver [4] 2-pole resolver		**D** **F** **U** **P**

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R	Without	**D**
With featherkey and key way	R	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R	Without	**K**
Smooth shaft	R	With	**L**

• Vibration severity grade:	• Degree of protection: [5]	
N	IP64	**0**
N	IP65	**1**
R	IP64	**3**
R	IP65	**4**

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power P_{calc} = $M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section 7)	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm^2	
1FT6 084 - 8SF7...	18.2	8.2 (11)	18 6)	**6SL3 120 - ■TE21 - 8AA0**	1.5	4 x 2.5	**6FX■ 002 - 5■S31 - ■ ■ ■0**
1FT6 086 - 8SF7...	25	11 (14.7)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FT6 105 - 8SF7...	42	20.4 (27.3)	45	**6SL3 120 - 1TE24 - 5AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 108 - 8SF7...	62	28.3 (37.9)	60 6)	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 132 - 6SF7...	69	34.6 (46.4)	85	**6SL3 120 - 1TE28 - 5AA0**	3	4 x 25	**6FX■ 002 - 5DS33 - ■ ■ ■0**
1FT6 134 - 6SF7...	83	44 (59)	85	**- 1TE28 - 5AA0**	3	4 x 35	**- 5DS43 - ■ ■ ■0**
1FT6 136 - 6SF7...	110	55 (73.7)	132	**- 1TE31 - 5AA0**	Terminal box		
1FT6 084 - 8SH7...	26	12.3 (16.5)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**
1FT6 086 - 8SH7...	38	16.5 (22.2)	45	**- 1TE24 - 5AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 105 - 8SH7...	59	30.6 (41.1)	85	**6SL3 120 - 1TE28 - 5AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 084 - 8SK7...	35	16.3 (21.8)	45	**6SL3 120 - 1TE24 - 5AA0**	1.5	4 x 10	**6FX■ 002 - 5■S64 - ■ ■ ■0**
1FT6 086 - 8SK7...	44	22 (29.5)	45	**- 1TE24 - 5AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**			
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**		
• Without brake conductors • With brake conductors			**C** **D**	
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**. . .**

Notes for forced-ventilated motors

	Shaft height 80 and 100	Shaft height 132
Direction of air flow	From NDE to DE	From DE to NDE
Connection system	Connector size 1	Terminal box
Type of connecting cable	6FX . 002-5CA01-. . . .	6FX . 008-1BB11-. . . .
Pin/terminal assignment	Pin 1: L1, pin 2: N	U1/L1: V2/L2: W3/L3
Supply voltage	1 AC 220/260 V, 50/60 Hz	3 AC 400/460 V, 50/60 Hz
Max. fan current	0.3 A	0.4 A
Weight of the fan assembly	Approx. 4.8 kg (10.6 lb)	Approx. 5.6 kg (12.4 lb)
Sound pressure level	SH 80: 69 dB SH 100: 71 dB	74 dB

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) Not for use in environments containing electrically-conductive dust. Forced ventilation cannot be used in the presence of flammable, corrosive, electrically-conductive or explosive dust.
3) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
4) A max. operating frequency of 470 Hz must be observed with SINAMICS.
5) The degree of protection refers to the motor. The built-on fan meets the requirements of degree of protection IP54.
6) With the specified motor module, the motor cannot be fully utilized to ΔT = 100 K winding temperature rise.
7) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with water cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors with water cooling** Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
1500	100	18.2 (24.4)	119 (1053.3)	116 (1026.7)	43	**1FT6 108 - 8WB7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)
2000	100	17.2 (23.06)	85 (752.3)	82 (752.8)	60	**1FT6 105 - 8WC7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
		24.1 (32.31)	115 (1017.8)	119 (1017.8)	57	**1FT6 108 - 8WC7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)
3000	63	3.2 (4.29)	10.2 (90.3)	10 (88.5)	6.9	**1FT6 062 - 6WF7■ - ■ ■ ■ ■**	3	8.5 (0.0075)	9.5 (20.9)
		5.1 (6.84)	16.2 (143.4)	16 (141.6)	10.3	**1FT6 064 - 6WF7■ - ■ ■ ■ ■**	3	13 (0.0115)	12.5 (27.6)
	80	11 (14.75)	35 (309.8)	35 (309.8)	27	**1FT6 084 - 8WF7■ - ■ ■ ■ ■**	4	48 (0.0425)	21 (46.3)
		14.5 (19.44)	47 (416)	46 (407.1)	37	**1FT6 086 - 8WF7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	26 (57.3)
	100	24.5 (32.84)	85 (752.3)	78 (690.4)	82	**1FT6 105 - 8WF7■ - ■ ■ ■ ■**	4	168 (0.1487)	45.5 (100.3)
		34.2 (45.84)	119 (1053.3)	109 (964.8)	81	**1FT6 108 - 8WF7■ - ■ ■ ■ ■**	4	260 (0.2301)	61.5 (135.6)

• Type of construction:	IM B5 IM B14 [1]	1 2
• Connector outlet direction: (not for 1FT6 108-8WF7)	Transverse right (not for 1FT606) Transverse left (not for 1FT606) Axial NDE (1FT606. with water cooling above) Axial DE (1FT606. with water cooling below)	1 2 3 4
• Terminal box, cable entry (only on 1FT61):	Transverse right Transverse left Axial NDE Axial DE	5 6 7 8
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [2] 2-pole resolver	A E S T
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [2] 2-pole resolver	D F U P

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	A
With featherkey and key way	N	With	B
With featherkey and key way	R (not for 1FT6108)	Without	D
With featherkey and key way	R (not for 1FT6108)	With	E
Smooth shaft	N	Without	G
Smooth shaft	N	With	H
Smooth shaft	R (not for 1FT6108)	Without	K
Smooth shaft	R (not for 1FT6108)	With	L

• Vibration severity grade:	• Degree of protection:	
N	IP64	0
N	IP65	1
N	IP67	2
N	IP68	6
• R	IP64	3
R	IP65	4
R	IP67	5
R	IP68	7

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [4]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 108 - 8WB7...	43	18.7 (25.1)	45	**6SL3 120 - 1TE24 - 5AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 105 - 8WC7...	58	17.8 (23.9)	60	**6SL3 120 - 1TE26 - 0AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 108 - 8WC7...	57	24.9 (33.4)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 062 - 6WF7...	6.9	3.2 (4.3)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 064 - 6WF7...	10.3	5.1 (6.8)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FT6 084 - 8WF7...	24.5	11 (14.7)	30	**6SL3 120 - 1TE23 - 0AA0**	1.5	4 x 4	**6FX■ 002 - 5■S41 - ■ ■ ■0**
1FT6 086 - 8WF7...	34	14.8 (19.8)	45	**- 1TE24 - 5AA0**	1.5	4 x 10	**- 5■S64 - ■ ■ ■0**
1FT6 105 - 8WF7...	83	26.7 (35.8)	85	**6SL3 120 - 1TE28 - 5AA0**	3	4 x 35	**6FX5 002 - 5DS43 - ■ ■ ■0**
1FT6 108 - 8WF7...	86	37.4 (50.1)	85 [3]	**- 1TE28 - 5AA0**	3	4 x 35	**- 5DS43 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**					
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**				
• Without brake conductors • With brake conductors			**C** **D**			
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**.**	**.**	**.**

Notes on water cooling:

- Incoming temperature of cooling water: Max. +30 °C (+86 °F)
- Cooling water throughput: At least 5 l/min (5 l = 1.1 British gallons/1.32 US gallons)
- Pressure upstream of motor: p_{max} = 3 bar
- Cooling water connection: G 3/8"
- Coolant: Water (up to max. 25% corrosion protection, recommendation: Tyfocor)
- Pressure loss between inlet and outlet < 0.1 bar

1) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
2) A max. operating frequency of 470 Hz must be observed with SINAMICS.
3) With the specified motor module, the motor cannot be fully utilized to ΔT = 100 K winding temperature rise. If a motor module with a higher rating is used, it must be checked whether the specified power cable can be connected to it.
4) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with water cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors with water cooling** Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
4500	63	4.7 (6.3)	10.2 (90.3)	10 (88.5)	9.6	**1FT6 062 - 6WH7■ - ■ ■ ■ ■**	3	8.5 (0.0075)	9.5 (20.9)
		7.5 (10.05)	16.2 (143.4)	16 (141.6)	15.2	**1FT6 064 - 6WH7■ - ■ ■ ■ ■**	3	13 (0.0115)	12.5 (27.6)
	80	16.5 (22.12)	35 (309.8)	35 (309.8)	39	**1FT6 084 - 8WH7■ - ■ ■ ■ ■**	4	48 (0.0425)	21 (46.3)
		21.2 (28.42)	47 (416)	45 (398.3)	53	**1FT6 086 - 8WH7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	26 (57.3)
6000	63	6.2 (8.31)	10.2 (90.3)	9.8 (87)	12.7	**1FT6 062 - 6WK7■ - ■ ■ ■ ■**	3	8.5 (0.0075)	9.5 (20.9)
		9.9 (13.27)	16.2 (143.4)	15.8 (139.8)	20	**1FT6 064 - 6WK7■ - ■ ■ ■ ■**	3	13 (0.0115)	12.5 (27.6)
	80	21.4 (28.69)	35 (309.8)	34 (300.9)	51	**1FT6 084 - 8WK7■ - ■ ■ ■ ■**	4	48 (0.0425)	21 (46.3)
		27.7 (37.13)	47 (416)	44 (389.4)	58	**1FT6 086 - 8WK7■ - ■ ■ ■ ■**	4	66.5 (0.0589)	26 (57.3)

• Type of construction:	IM B5 IM B14 [1]	**1** **2**
• Connector outlet direction: (not for 1FT6 108-8WF7)	Transverse right (not for 1FT606) Transverse left (not for 1FT606) Axial NDE (1FT606. with water cooling above) Axial DE (1FT606. with water cooling below)	**1** **2** **3** **4**
• Terminal box, cable entry (only on 1FT61...):	Transverse right Transverse left Axial NDE Axial DE	**5** **6** **7** **8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [2] 2-pole resolver	**A** **E** **S** **T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [2] 2-pole resolver	**D** **F** **U** **P**

• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:	
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
With featherkey and key way	R (not for 1FT6108)	Without	**D**
With featherkey and key way	R (not for 1FT6108)	With	**E**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**
Smooth shaft	R (not for 1FT6108)	Without	**K**
Smooth shaft	R (not for 1FT6108)	With	**L**

• Vibration severity grade:	• Degree of protection:	
N	IP64	**0**
N	IP65	**1**
N	IP67	**2**
N	IP68	**6**
• R	IP64	**3**
R	IP65	**4**
R	IP67	**5**
R	IP68	**7**

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [3]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FT6 062 - 6WH7...	9.7	4.8 (6.43)	18	**6SL3 120 - ■TE21 - 8AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 064 - 6WH7...	15.4	7.6 (10.19)	18	**- ■TE21 - 8AA0**	1	4 x 2.5	**- 5■S11 - ■ ■ ■0**
1FT6 084 - 8WH7...	37	16.5 (22.12)	45	**6SL3 120 - 1TE24 - 5AA0**	1.5	4 x 10	**6FX■ 002 - 5■S64 - ■ ■ ■0**
1FT6 086 - 8WH7...	52	22.1 (29.62)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5■S23 - ■ ■ ■0**
1FT6 062 - 6WK7...	12.9	6.4 (8.6)	18	**6SL3 120 - ■TE21 - 8AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FT6 064 - 6WK7...	20.5	10.2 (13.67)	30	**- 1TE23 - 0AA0**	1	4 x 2.5	**- 5■S11 - ■ ■ ■0**
1FT6 084 - 8WK7...	47	22.0 (29.49)	60	**6SL3 120 - 1TE26 - 0AA0**	3	4 x 16	**6FX■ 002 - 5■S23 - ■ ■ ■0**
1FT6 086 - 8WK7...	59	29.5 (39.54)	60	**- 1TE26 - 0AA0**	3	4 x 16	**- 5DS23 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500	 **8** **5**
• Without brake conductors • With brake conductors	**C** **D**
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.	**. . .**

Notes on water cooling:

- Incoming temperature of cooling water: Max. +30 °C (+86 °F)
- Cooling water throughput: At least 5 l/min (5 l = 1.1 British gallons/1.32 US gallons)
- Pressure upstream of motor: p_{max} = 3 bar
- Cooling water connection: G 3/8"
- Coolant: Water with up to max. 25% corrosion protection (recommendation: Tyfocor)
- Pressure loss between inlet and outlet < 0.1 bar

1) Same flange as type IM B5 but with metric thread inserts in the four mounting holes.
2) A max. operating frequency of 470 Hz must be observed with SINAMICS.
3) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Standard type 1FT6 motors with water cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FT6 synchronous motors with water cooling** Order No. **Standard type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
1500	132	23.6 (31.64)	155 (1371.9)	150 (1327.7)	58	**1FT6 132 - 6WB7■ - ■ ■ ■ ■**	3	430 (0.3805)	90 (198.5)
		29.1 (39.01)	200 (1770.2)	185 (1637.4)	67	**1FT6 134 - 6WB7■ - ■ ■ ■ ■**	3	547 (0.4841)	103 (227.1)
		36.1 (48.39)	240 (2124.2)	230 (2035.7)	90	**1FT6 136 - 6WB7■ - ■ ■ ■ ■**	3	665 (0.5885)	120 (264.6)
		45.5 (60.99)	300 (2655.3)	290 (2566.8)	112	**1FT6 138 - 6WB7■ - ■ ■ ■ ■**	3	845 (0.7478)	137 (302.1)
2500	132	35.3 (47.32)	155 (1371.9)	135 (1194.9)	82	**1FT6 132 - 6WD7■ - ■ ■ ■ ■**	3	430 (0.3806)	90 (198.5)
		48.4 (64.88)	200 (1770.2)	185 (1637.4)	115	**1FT6 134 - 6WD7■ - ■ ■ ■ ■**	3	547 (0.4841)	103 (227.1)
		57.6 (77.21)	240 (2124.2)	220 (1947.2)	149	**1FT6 136 - 6WD7■ - ■ ■ ■ ■**	3	665 (0.5885)	120 (264.6)
		72.0 (96.51)	300 (2655.3)	275 (2434)	162	**1FT6 138 - 6WD7■ - ■ ■ ■ ■**	3	845 (0.7478)	137 (302.1)

• Type of construction:	IM B35		**6**	
• Terminal box, cable entry:	Transverse right Transverse left Axial NDE Axial DE		**5** **6** **7** **8**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [1] 2-pole resolver		**A** **E** **S** **T**	
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 S/R Absolute encoder EnDat 2048 S/R Multipole resolver [1] 2-pole resolver		**D** **F** **U** **P**	
• Shaft end:	• Rotational accuracy tolerance:	• Holding brake:		
With featherkey and key way	N	Without	**A**	
With featherkey and key way	R	Without	**D**	
Smooth shaft	N	Without	**G**	
Smooth shaft	R	Without	**K**	
• Vibration severity grade:		• Degree of protection:		
N		IP64	**1**	
N		IP65	**2**	
R		IP64	**3**	
R		IP65	**4**	

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection via terminal box
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	
	A	kW (HP)	A		
1FT6 132 - 6WB7 ...	58	24.3 (32.6)	60 2)	**6SL3 120 - 1TE 26 - 0AA0**	
1FT6 134 - 6WB7 ...	73	31.4 (42.1)	85	**- 1TE 26 - 0AA0**	
1FT6 136 - 6WB7 ...	92	37.7 (50.5)	132	**- 1TE 28 - 5AA0**	
1FT6 138 - 6WB7 ...	112	47.1 (63.1)	132	**- 1TE 28 - 5AA0**	Motor with terminal box,
1FT6 132 - 6WD7 ...	92	40.6 (54.4)	85 2)	**6SL3 120 - 1TE 28 - 3AA0**	Power and signal cables, see
1FT6 134 - 6WD7 ...	122	52.4 (70.2)	132	**- 1TE 31 - 3AA0**	"MOTION-CONNECT connection system"
1FT6 136 - 6WD7 ...	158	62.8 (84.2)	200	**- 1TE 31 - 0AA0**	
1FT6 138 - 6WD7 ...	167	78.5 (105.2)	200	**- 1TE 32 - 0AA0**	
• Single Motor Module				**1**	

Notes on water cooling:

- Incoming temperature of cooling water: Max. +30 °C (+86 °F)
- Cooling water throughput: At least 8 l/min (8 l = 1.76 British gallons/2.11 US gallons)
- Pressure upstream of motor: p_{max} = 6 bar
- Cooling water connection: G 3/8"
- Coolant: Water with up to max. 25% corrosion protection (recommendation: Tyfocor)
- Pressure loss between inlet and outlet < 0.1 bar

1) A max. operating frequency of 470 Hz must be observed with SINAMICS.
2) With the specified motor module, the motor can only be utilized for a short time after M_0.

Notes

Overview

1FK7 motors are extremely compact permanent-magnet synchronous motors. The available options, gear units and encoders, together with the expanded product range, mean that 1FK7 motors can be optimized to meet the requirements of any application. They therefore also satisfy the permanently increasing demands of state-of-the-art machine generations.
1FK7 motors can be combined with the SINAMICS S drive system to create powerful systems with high functionality. The built-in encoder systems for speed and position control can be selected depending on the application.

The motors are designed for operation without external cooling and the heat is dissipated via the motor surface. 1FK7 motors have a high overload capability.

Benefits

1FK7 Compact motors offer the following benefits:

- Space-saving installation thanks to very high power density
- Can be used universally for numerous applications
- Wide motor spectrum.

1FK7 High Dynamic motors offer the following benefits:

- Extremely high dynamic response due to low moment of inertia of rotor.

Applications

- Machine tools
- Robots and manipulators
- Wood, glass, ceramics and stone working
- Packaging, plastics and textile machines
- Auxiliary axes.

Technical data

Type of motor	Permanent-magnet synchronous motor
Magnetic material	Rare-earth magnetic material
Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a winding temperature rise of ΔT = 100 K at an ambient temperature of +40 °C (+104°F)
Type according to EN 60034-7 (IEC 60034-7)	IM B5 (IM V1, IM V3)
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP64
Cooling	Natural
Temperature monitoring	KTY 84 temperature sensor in stator winding
Paint finish	Unpainted
Shaft end on the drive end in accordance with DIN 748-3 (IEC 60072-1)	Smooth shaft
2nd rating plate 3rd rating plate	Applied to end shield Supplied separately packed
Radial eccentricity, concentricity, and axial eccentricity in accordance with DIN 42955 (IEC 60072-1)	Tolerance N (normal)
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Level N (normal)
Max. sound pressure level L_{pA} (1 m) acc. to EN ISO 1680	1FK702: 55 dB 1FK703: 55 dB 1FK704: 55 dB 1FK706: 65 dB 1FK708: 70 dB 1FK710: 70 dB
Encoder systems, built-in, for motors with/without DRIVE-CLiQ interface	• Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution • Absolute encoder, multiturn, 2048 pulses/revolution on 1FK704 to 1FK710. 512 pulses/revolution on 1FK702 and 1FK703 und traversingrange 4096 revolutions with EnDat interface • Simple absolute encoder, multiturn, 32 pulses/revolution and traversing range 4096 revolutions with EnDat interface • Multipole resolver 1) (number of poles corresponds to number of pole pairs of the motor) • 2-pole resolver
Connecting	Connectors for signals and power can be rotated (270°)
Options	• Shaft end on the drive end with featherkey and featherkey way (half-key balancing) • Built-in holding brake • Degree of protection IP65, additional IP67 drive end flange • Planetary gear unit (requires smooth shaft end) • Anthracite gray paint finish

1) A max. operating frequency of 470 Hz must be observed with SINAMICS.

Core type 1FK7 Compact motors with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW (HP)	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FK7 Compact synchronous motor with natural cooling** Order No. **Core type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
2000	100	7.75 (10.39)	48 (424.8)	37 (327.5)	16	**1FK7 105 - 5AC71 - 1■ ■ ■**	4	156 (0.1381)	39 (85)
3000	48	0.82 (1.1)	3 (26.6)	2.6 (23)	1.95	**1FK7 042 - 5AF71 - 1■ ■ ■**	4	3.01 (0.0027)	4.9 (10.8)
	63	1.48 (1.98)	6 (53.1)	4.7 (41.6)	3.7	**1FK7 060 - 5AF71 - 1■ ■ ■**	4	7.95 (0.0070)	7 (15.4)
		2.29 (3.07)	11 (97.4)	7.3 (64.6)	5.6	**1FK7 063 - 5AF71 - 1■ ■ ■**	4	15.1 (0.0134)	11.5 (25.4)
	80	2.14 (2.87)	8 (70.8)	6.8 (60.2)	4.4	**1FK7 080 - 5AF71 - 1■ ■ ■**	4	15 (0.0133)	10 (22.1)
		3.3 (4.42)	16 (141.6)	10.5 (92.9)	7.4	**1FK7 083 - 5AF71 - 1■ ■ ■**	4	27.3 (0.0242)	14 (30.9)
	100	3.77 (5.05)	18 (159.3)	12 (106.1)	8	**1FK7 100 - 5AF71 - 1■ ■ ■**	4	55.3 (0.0489)	19 (41.9)
		4.87 (6.53)	27 (238)	15.5 (137.2)	11.8	**1FK7 101 - 5AF71 - 1■ ■ ■**	4	79.9 (0.0707)	21 (46.3)
		5.37[2] (7.2)[2]	36 (318.6)	20.5[2] (181.4)[2]	16.5 [2]	**1FK7 103 - 5AF71 - 1■ ■ ■**	4	105 (0.0929)	29 (63.9)
		8.17 (10.95)	48 (424.8)	26 (230.1)	18	**1FK7 105 - 5AF71 - 1■ ■ ■**	4	156 (0.1381)	39 (85)
4500	63	1.74 (2.33)	6 (53.1)	3.7 (32.7)	4.1	**1FK7 060 - 5AH71 - 1■ ■ ■**	4	7.95 (0.0070)	7 (15.4)
		2.09[3] (2.8)[3]	11 (97.4)	5 [3] (44.3)[3]	6.1 [3]	**1FK7 063 - 5AH71 - 1■ ■ ■**	4	15.1 (0.0134)	11.5 (25.4)
	80	2.39 (3.2)	8 (70.8)	5.7 (50.5)	5.6	**1FK7 080 - 5AH71 - 1■ ■ ■**	4	15 (0.0133)	10 (22.1)
		3.04[4] (4.8)[4]	16 (141.6)	8.3[4] (73.5)[4]	9 [4]	**1FK7 083 - 5AH71 - 1■ ■ ■**	4	27.3 (0.0242)	14 (30.9)
6000	28	0.4 (0.54)	0.85 (7.5)	0.6 (5.3)	1.4	**1FK7 022 - 5AK71 - 1■ ■ ■**	3	0.28 (0.0002)	1.8 (4)
	36	0.47 (0.63)	1.1 (9.7)	0.8 (7.1)	1.4	**1FK7 032 - 5AK71 - 1■ ■ ■**	3	0.61 (0.0005)	2.7 (6)
	48	0.69 (0.92)	1.6 (14.2)	1.1 (9.7)	1.7	**1FK7 040 - 5AK71 - 1■ ■ ■**	4	1.69 (0.0015)	3.5 (7.7)
		1.02[5] (1.41)[5]	3 (26.6)	2[5] (17.7)[7]	3.1 [5]	**1FK7 042 - 5AK71 - 1■ ■ ■**	4	3.01 (0.0027)	4.9 (10.8)

• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution	A
	Absolute encoder EnDat 2048 pulses/revolution [1] (not for 1FK702, 1FK703)	E
	Absolute encoder EnDat 512 pulses/revolution [1] (not for 1FK702, 1FK703)	H
	Single absolute encoder EnDat 32 pulses/revolution [1] (not for 1FK702, 1FK703)	G
	Multipole resolver [6]	S
	2-pole resolver	T
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution	D
	Absolute encoder EnDat 2048 S/R [1] (not for 1FK702, 1FK703)	F
	Single absolute encoder EnDat 32 pulses/revolution	K
	Absolute encoder EnDat 512 S/R [1] (not for 1FK702, 1FK703)	L
	Multipole resolver [6]	U
	2-pole resolver	P

	Rotational accuracy tolerance:	Holding brake:	
• Shaft end:			
With featherkey and key way	N	Without	A
With featherkey and key way	N	With	B
Smooth shaft	N	Without	G
Smooth shaft	N	With	H

• Degree of protection:	IP64	0
	IP65 and additional IP67 drive end flange	2
	IP64, anthracite gray paint finish	3
	IP65 and additional IP67 drive end flange, anthracite gray paint finish	5
	IP65 and additional IP67 drive end flange, anthracite gray paint finish and metal rating plate on motor	8

Selection of degree of protection and type of construction, see "Selection guides".

Selection and ordering data

Motor type (continued)	Static current	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$	SINAMICS Motor Module Rated output current		Power cable with complete shield Motor connection (and brake connection) via power connector		
	I_0 at M_0 ΔT=100 K	P_{calc} for M_0 ΔT=100 K	I_{rated} at M_0 ΔT=100 K	Order No.	Power connector	Motor cable cross-section [8]	Order No. Pre-assembled cable
	A	kW (HP)	A		Size	mm²	
1FK7 105 - 5AC71...	20	10 (13.4)	30	**6SL3 120 - ■TE23 - 0AA0**	1.5	4 x 2.5	**6FX■ 002 - 5■S31 - ■ ■ ■0**
1FK7 042 - 5AF71...	2.2	0.9 (1.2)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 060 - 5AF71...	4.5	1.9 (2.5)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 063 - 5AF71...	8	3.5 (4.7)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 080 - 5AF71...	4.8	2.5 (3.4)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 083 - 5AF71...	10.4	5 (6.7)	9 [7]	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 100 - 5AF71...	11.2	5.7 (7.6)	18	**6SL3 120 - ■TE21 - 8AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 101 - 5AF71...	19	8.5 (11.4)	18 [7]	**- ■TE21 - 8AA0**	1.5	4 x 2.5	**- 5■S31 - ■ ■ ■0**
1FK7 103 - 5AF71...	27.5	11.3 (15.1)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FK7 105 - 5AF71...	31	10 (13.4)	30 [7]	**- ■TE23 - 0AA0**	1.5	4 x 10	**- 5■S61 - ■ ■ ■0**
1FK7 060 - 5AH71...	6.2	2.8 (3.8)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 063 - 5AH71...	12	5.2 (7)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 080 - 5AH71...	7.4	3.8 (5.1)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 083 - 5AH71...	15	7.5 (10.1)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 022 - 5AK71...	1.8	0.5 (0.7)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 032 - 5AK71...	1.7	0.7 (0.9)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 040 - 5AK71...	2.25	1 (1.3)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 042 - 5AK71...	4.4	1.9 (2.5)	5	**- ■TE15 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**

• Single Motor Module • Double Motor Module	**1** **2**						
Type of power cable • MOTION-CONNECT 800 • MOTION-CONNECT 500		**8** **5**					
• Without brake conductors • With brake conductors			**C** **D**				
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.				**.**	**.**	**.**	

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) These values refer to n = 2500 rpm.
3) These values refer to n = 4000 rpm.
4) These values refer to n = 3500 rpm.
5) These values refer to n = 5000 rpm.
6) A max. operating frequency of 470 Hz must be observed with SINAMICS.
7) With the specified motor module, the motor cannot be fully to ΔT = 100 K winding temperature rise. If a motor module with a higher rating is used, it must be checked whether the specified power cable can be connected to it.
8) The current carrying capacity of the power cables corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Core type 1FK7 High Dynamic with natural cooling

Selection/Ordering data

Rated speed n_{rated} rpm	Shaft height SH	Rated power P_{rated} at ΔT=100 K kW HP	Static torque M_0 at ΔT=100 K Nm (lb_f-in)	Rated torque [1] M_{rated} at ΔT=100 K Nm (lb_f-in)	Rated current I_{rated} at ΔT=100 K A	**1FK7 High Dynamic synchronous motor with natural cooling** Order No. **Core type**	No. of pole pairs	Rotor moment of inertia (excluding brake) J 10^{-4} kg m^2 (lb_f-in-s^2)	Weight (excluding brake) m kg (lb)
3000	48	1.1 (1.47)	4 (35.4)	3.5 (31)	4	**1FK7 044 - 7AF71 - 1■ ■ ■**	3	1.28 (0.0011)	7.7 (17)
	63	1.7 (2.29)	6.4 (56.6)	5.4 (47.8)	5.3	**1FK7 061 - 7AF71 - 1■ ■ ■**	3	3.4 (0.0030)	10 (22.1)
		2.51 (3.36)	12 (106.2)	8 (70.8)	7.5	**1FK7 064 - 7AF71 - 1■ ■ ■**	3	6.5 (0.0058)	15.5 (34.2)
	80	2.51 (3.36)	14 (123.9)	8 (70.8)	6.7	**1FK7 082 - 7AF71 - 1■ ■ ■**	4	14 (0.0124)	17.2 (37.9)
		3.14[2] (4.21)[2]	22 (194.7)	12[2] (106.2)[2]	12.5[2]	**1FK7 085 - 7AF71 - 1■ ■ ■**	4	23 (0.0204)	23.5 (51.8)
4500	48	1.23 (1.65)	3.1 (27.4)	2.6 (23)	4	**1FK7 043 - 7AH71 - 1■ ■ ■**	3	1 (0.0009)	6.7 (14.8)
		1.41 (1.53)	4 (35.4)	3 (26.6)	4.9	**1FK7 044 - 7AH71 - 1■ ■ ■**	3	1.28 (0.0011)	7.7 (17)
	63	2.03 (2.72)	6.4 (56.6)	4.3 (38.1)	5.9	**1FK7 061 - 7AH71 - 1■ ■ ■**	3	3.4 (0.0030)	10 (22.1)
		2.36 (3.16)	12 (106.2)	5 (44.3)	7	**1FK7 064 - 7AH71 - 1■ ■ ■**	3	6.5 (0.0058)	15.5 (34.2)
6000	36	0.57 (0.76)	1.3 (11.5)	0.9 (8)	1.5	**1FK7 033 - 7AK71 - 1■ ■ ■**	3	0.27 (0.0002)	3.1 (6.8)
	48	1.26 (1.69)	3.1 (27.4)	2 (17.7)	4.4	**1FK7 043 - 7AK71 - 1■ ■ ■**	3	1 (0.0009)	6.3 (13.9)

• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution	**A**
	Absolute encoder EnDat 2048 pulses/revolution [1] (not for 1FK703)	**E**
	Absolute encoder EnDat 512 pulses/revolution [1] (not for 1FK703)	**H**
	Single absolute encoder EnDat 32 pulses/revolution [1] (not for 1FK703)	**G**
	Multipole resolver [6]	**S**
	2-pole resolver	**T**
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution	**D**
	Absolute encoder EnDat 2048 pulses/revolution [1] (not for 1FK703)	**F**
	Absolute encoder EnDat 512 pulses/revolution [1] (not for 1FK703)	**L**
	Multipole resolver [3]	**U**
	2-pole resolver	**P**

	Rotational accuracy tolerance:	Holding brake:	
• Shaft end:			
With featherkey and key way	N	Without	**A**
With featherkey and key way	N	With	**B**
Smooth shaft	N	Without	**G**
Smooth shaft	N	With	**H**

• Degree of protection:	IP64	**0**
	IP65 and additional IP67 drive end flange	**2**
	IP64, anthracite gray paint finish	**3**
	IP65 and additional IP67 drive end flange, anthracite gray paint finish	**5**
	IP65 and additional IP67 drive end flange, anthracite gray paint finish and metal rating plate on motor	**8**

Selection of degree of protection and type of construction, see "Selection guides".

Selection/Ordering data

Motor type (continued)	Standstill current I_0 at M_0 ΔT=100 K A	Calculated power $P_{calc} = M_0 \times n_{rated}/9550$ P_{calc} for M_0 ΔT=100 K kW (HP)	SINAMICS Motor Module Rated output current I_{rated} at M_0 ΔT=100 K A	SINAMICS Motor Module Order No.	Power cable with complete shield Motor connection (and brake connection) via power connector: Power connector Size	Motor cable cross-section [4] mm²	Order No. Pre-assembled cable
1FK7 044 - 7AF71...	4.5	1.3 (1.7)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 061 - 7AF71...	6.1	2.0 (2.7)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 064 - 7AF71...	11	3.8 (5.1)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 082 - 7AF71...	10.6	4.4 (5.9)	18	**6SL3 120 - ■TE21 - 8AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 085 - 7AF71...	22.5	6.9 (9.2)	30	**- 1TE23 - 0AA0**	1.5	4 x 4	**- 5■S41 - ■ ■ ■0**
1FK7 043 - 7AH71...	4.5	1.5 (2)	5	**6SL3 120 - ■TE15 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 044 - 7AH71...	6.3	1.9 (2.5)	9	**- ■TE21 - 0AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 061 - 7AH71...	8	3.0 (4)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 064 - 7AH71...	15	5.7 (7.6)	18	**- ■TE21 - 8AA0**	1	4 x 1.5	**- 5■S01 - ■ ■ ■0**
1FK7 033 - 7AK71...	2.2	0.8 (1.1)	3	**6SL3 120 - ■TE13 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**
1FK7 043 - 7AK71...	6.4	1.9 (2.5)	9	**6SL3 120 - ■TE21 - 0AA0**	1	4 x 1.5	**6FX■ 002 - 5■S01 - ■ ■ ■0**

Option	Code
• Single Motor Module	**1**
• Double Motor Module	**2**
Type of power cable	
• MOTION-CONNECT 800	**8**
• MOTION-CONNECT 500	**5**
• Without brake conductors	**C**
• With brake conductors	**D**
See "MOTION-CONNECT connection system" for length code as well as power and signal cables.	**. . .**

1) If the absolute encoder is used, M_{rated} is reduced by 10%.
2) These values refer to n = 2500 rpm.
3) A max. operating frequency of 470 Hz must be observed with SINAMICS.
4) The current carrying capacity of the motor module corresponds to IEC 60204-1 for type of routing C under continuous operating conditions with an ambient air temperature of +40 °C (+104 °F), designed for I_0 (100 K), PVC/PUR-insulated cable.

Overview

	1PH7 **Asynchronous motors with solid shaft**	1PH4
Type	According to EN 60034-7 (IEC 60034-7): IM B3 (IM V5, IM V6) IM B5 (IM V1, IM V3, only possible with 1PH710 and 1PH713 motors) IM B35 (IM V15, IM V36)	According to EN 60034-7 (IEC 60034-7): IM B35 (IM V15, IM V36)
Type of circuit	Star circuit	
Rated power P_{rated} (S1)	3.7 kW to 100 kW (5 HP to 134 HP)	7.5 kW to 52 kW (10 HP to 70 HP)
Maximum rotational speed	12000 rpm	
Rated torque M_{rated}	23.6 Nm to 750 Nm (17.4 lb_f-ft to 553 lb_f-ft)	48 Nm to 331 Nm (35.4 lb_f-ft to 244 lb_f-ft)
Encoder systems, built-in, for motors with/without DRIVE-CLiQ interface	• Incremental encoder sin/cos 1 V_{pp}, 2048 pulses/revolution • Absolute encoder EnDat • Incremental encoder HTL 1024 pulses/revolution or 2048 pulses/revolution [1] • 2-pole resolver See the Technical Specifications and the selection and ordering data for the required motor for information about a compatible encoder system.	
Sound pressure level L_{pA} (1 m) acc. to EN ISO 1680	70 dB to 76 dB if the external fan unit is operating on a 50 Hz supply system Tolerance +3 dB	69 dB to 71 dB Tolerance +3 dB
Degree of protection EN 60034-5 (IEC 60034-5)	IP55 fan IP54	IP65 IP55 at shaft exit
Cooling	Forced cooling	Water cooling
Insulation of the stator winding EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature (air) of up to +40 °C (+104 °F)	Temperature class F for a coolant inlet temperature of up to +30 °C (+86 °F)
Holding brake	–	Fitted to drive end (option)
Type of motor	Squirrel-cage asynchronous motor	
Paint finish	No paint finish/primed Anthracite gray (option)	Anthracite gray
Gearbox mounting	Prepared (option)	

Applications

1PH/1PM asynchronous motors can be used in a wide variety of applications. On machine tools, they are usually used as main spindle motors. On production machines such as printing, packaging and metalforming machines, they are used as high-power asynchronous servo motors. In the following description, the motors are, on the basis of their operating principle, generally called asynchronous motors.

Some motors can be supplied as **core types**. Unlike standard types, these core types feature the advantage of a reduced lead times and faster spare parts delivery. For this reason it is recommended to include core types in your project-planning.

1) HTL encoders are not suitable for the C-axis of machine tools.
2) Star connection only for water cooling.

Overview

	1PM4	1PM6	1PH2
	Hollow-shaft asynchronous motors		**Built-in asynchronous motors**
Type	According to EN 60034-7 (IEC 60034-7): IM B35 (IM V15, IM V36)	According to EN 60034-7 (IEC 60034-7): IM B5 (IM V1, IM V3)	Supplied in component form, assembled by user
Type of circuit	Star/delta changeover [2]		
Rated power P_{rated} (S1)	3.7 kW to 27 kW (5 HP to 36 HP)	3.7 kW to 22 kW (5 HP to 29 HP)	7.5 kW to 48.1 kW (10 HP to 64 HP)
Maximum rotational speed	12000 rpm		10000 rpm
Rated torque M_{rated}	24 Nm to 170 Nm (17.7 lb_f-ft to 125 lb_f-ft)	24 Nm to 140 Nm (17.7 lb_f-ft to 103 lb_f-ft)	48 Nm to 918 Nm (35.4 lb_f-ft to 677 lb_f-ft)
Encoder system	Hollow-shaft measuring system: • incremental encoder sin/cos 1 V_{pp}, 256 pulses/revolution (built-in)		Hollow-shaft measuring system: • SIMAG H2 with 256 or 512 teeth (option)
Sound pressure level L_{pA} (1 m) acc. to EN ISO 1680	69 dB Tolerance +3 dB	70 dB if the external fan unit is operating on a 50 Hz supply system Tolerance +3 dB	Depending on spindle design
Degree of protection EN 60034-5 (IEC 60034-5)	IP65 IP55 at shaft exit	IP55 Fan IP54	IP00 or as specified by spindle manufacturer
Cooling	Oil/water-cooled	Forced cooling	Water cooling
Insulation of the stator winding EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of up to +30 °C (+86 °F)	Temperature class F for a coolant inlet temperature (air) of up to +40 °C (+104 °F)	Temperature class F for a coolant inlet temperature of up to +25 °C (+77 °F)
Holding brake	–		Using spindle design
Type of motor	Squirrel-cage asynchronous motor		
Paint finish	Anthracite gray		Unpainted
Gearbox mounting	–		

1PH7 motors

1PH7 motors (SH 100 to SH 160 and SH 180/SH 225)

Overview

Air-cooled 1PH7 motors are rugged, low-maintenance 4-pole squirrel-cage asynchronous motors.
A fan for providing separate ventilation is mounted axially on the rear of the motor. The normal direction of air flow is from the drive end to the non-drive end in order to keep the exhaust heat of the motor away from the machine. The reverse air direction can be ordered as an option.
The motors are equipped with a built-in encoder system for sensing the motor speed and indirect position. On machine tools, the encoder system is capable of C-axis operation as standard. An additional encoder is therefore not required for C-axis operation.

Benefits

- Short overall length of motor
- Minimal overall dimension due to the integrated terminal box (SH 100 to SH 160)
- Maximum speeds of up to 9000 rpm (option: 12000 rpm)
- Full rated torque continuously available, even at standstill
- Optimum matching to the power levels SINAMICS S.

Applications

- Small compact machine tools
- Complex machining centers and lathes
- Special machines
- Printing industry:
  - Single drives for printing units
- Rubber, plastic, wire and glass manufacturing:
  - Drives for extruders, calenders, rubber injection molding, film machines, non-woven textile machines,
  - Wire-drawing machines, wire-stranding machines, etc.
- General applications such as coiler and winder drives.

Technical data (general)

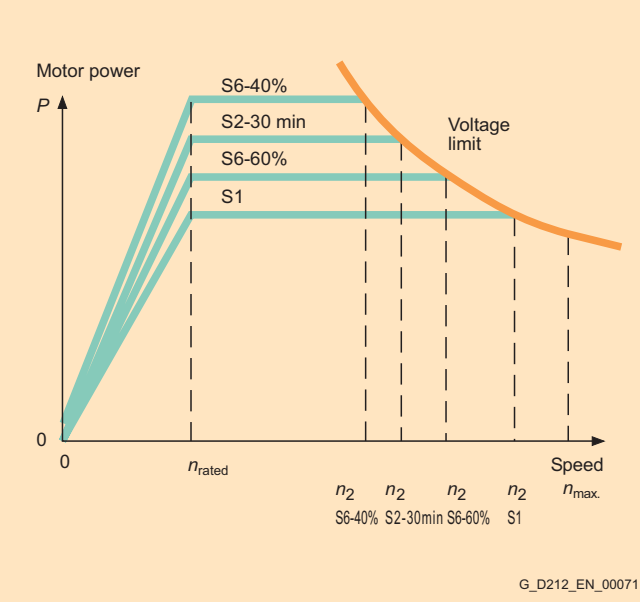
Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of up to +40 °C (+104 °F)
Motor fan ratings	3 AC 400 V ±10%, 50/60 Hz 3 AC 480 V +5% -10%, 66 Hz
Encoder systems, built-in, for motors with/without DRIVE-CLiQ interface	Incremental encoder sin/cos 1 V_{pp}, 2048 pulses/revolution, Absolute encoder EnDat, Incremental encoder HTL [5] 2-pole resolver
Terminal box connection type	
• Motor	Terminals in terminal box
• Fans	Terminals in terminal box
• Motor encoder and PTC thermistor	12/17-pin circular socket (without mating connector)
Type according to EN 60034-7 (IEC 60034-7)	IM B3 IM B35
Rating plates	1 supplied separately packed in terminal box
Permissible coolant temperature	-15 °C to +40 °C (+5 °F to +104 °F)
Temperature monitoring	KTY 84 temperature sensor in stator winding
Sound pressure level L_{pA} (1 m) acc. to EN ISO 1680 (tolerance +3 dB)	From DE to NDE (with the fan operating on a 50 Hz supply system) 1PH710.: 70 dB 1PH713.: 70 dB 1PH716.: 75 dB [1] 1PH718.: 73 dB [2] 1PH722.: 76 dB [2]

Technical data (core type)

Type acc. to EN 60034-7 (IEC 60034-7)	1PH710: IM B5 (IM V1, IM V3) 1PH713: IM B5 (IM V1, IM V3) 1PH716: IM B35 (IM V15, IM V36)
Terminal box location (facing drive end [3])	Top, cable entry from right
Bearing arrangement at drive end [4]	Bearing for belt or coupling output
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Stage S
Shaft and flange accuracy according to DIN 42955 (IEC 60072-1)	Tolerance R (reduced)
Degree of protection according to EN 60034-5 (IEC 60034-5)	Motor IP55, fan IP54
Paint finish	Unpainted

1) The sound pressure level can be reduced if the fan is operated on a 60 Hz supply system with option K44.
2) A sound baffle to reduce the sound pressure level is obtainable for a shaft heights of 225 with option G15.
3) DE is the drive end with shaft.
NDE is the non-drive end.
4) For permissible loads, refer to the 1PH Motors Planning Guide.
5) HTL encoders are not suitable for the C-axis of machine tools.

Characteristics



Typical power-speed diagram for AC motors [1]

The diagram shows the typical ratio between motor speed and drive power for 1PH7 motors in the following duty types (according to IEC 60034-1):

S 1: Continuous duty
S 6: Continuous duty with intermittent loading and a relative ON period of 60% (S6-60%) or 40% (S6-40%) with a maximum duty cycle time of 10 min.
S 2: Short-time operation with an ON period of 30 min (S2-30 min) followed by standstill.

Motor Type	Rated speed n_{rated}	Attainable speed for rated power in duty type (according to IEC 60034-1) n_2 [2]			
		S1	S6-60%	S6-40%	S2-30 min
	rpm	rpm	rpm	rpm	rpm
1PH7 101-..F	1500	8200	7000	6000	6500
1PH7 103-..D	1000	3750	3750	3100	3350
1PH7 103-..F	1500	5000	4600	3900	4500
1PH7 103-..G	2000	9000	7500	6400	6900
1PH7 105-..F	1500	7900	6750	5750	6150
1PH7 107-..D	1000	5800	4800	4100	4650
1PH7 107-..F	1500	6500	6200	5250	5650
1PH7 107-..G	2000	7000	7000	6900	7000
1PH7 131-..F	1500	6700	5500	4500	5000
1PH7 133-..D	1000	4700	3700	2800	3450
1PH7 133-..F	1500	6800	5600	4500	5100
1PH7 133-..G	2000	6500	6500	5900	6450
1PH7 135-..F	1500	7500	6200	5200	5650
1PH7 137-..D	1000	5400	4500	3600	4100
1PH7 137-..F	1500	7000	7000	6200	6800
1PH7 137-..G	2000	6000	6000	5800	6000
1PH7 163-..B	500	2500	1900	1500	1730
1PH7 163-..D	1000	5800	4800	4000	4400
1PH7 163-..F	1500	5500	5500	5500	5500
1PH7 163-..G	2000	3500	3500	3500	3500
1PH7 167-..B	500	2100	1600	1250	1400
1PH7 167-..D	1000	6250	5200	4300	4700
1PH7 167-..F	1500	4500	4500	4500	4500
1PH7 167-..G	2000	3250	3250	3250	3250
1PH7 184-..T	500	4500	3800	3350	3350
1PH7 184-..D	1000	5000	4400	3600	3600
1PH7 184-..E	1250	5000	4680	4190	3600
1PH7 184-..F	1500	5000	5000	5000	5000
1PH7 184-..L	2500	5000	5000	5000	5000
1PH7 186-..T	500	4800	4100	3580	4000
1PH7 186-..D	1000	5000	4650	3850	3850
1PH7 186-..E	1250	5000	4260	3780	3580
1PH7 224-..C	700	3020	2570	2290	2170
1PH7 224-..D	1000	4500	4500	4100	3730
1PH7 224-..F	1500	4500	4330	4000	3890

1) For further planning information refer to the 1PH Motors Planning Guide.
2) Values from the power-speed diagram based on using an Active Line Module on a 3 AC 400 V supply system. If using a Smart Line Module, proceed in accordance with the 1PH Planning Guide.

Core type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed	Max. permanent speed		Max. speed [3]		Rated power for duty type (according to IEC 60034-1)								1PH7 asynchronous motor
	n_{rated}	$n_{S1\ cont.}$ [1]	$n_{S1\ cont.}$ [2]	n_{max}	n_{max} [4]	P_{rated} S1		S6-60%		S6-40%		S2-30 min		Order No. **Core type**
	rpm	rpm	rpm	rpm	rpm	kW (HP)		kW (HP)		kW (HP)		kW (HP)		
100	2000	5500	–	9000	–	7	(9.4)	8.5	(11.4)	10	(13.4)	9.25	(12.4)	**1PH7 103 - ■ ■G02 - 0C■0**
	1500	5500	–	9000	–	9	(12.1)	11	(14.7)	13	(17.4)	12	(16.1)	**1PH7 107 - ■ ■F02 - 0C■0**
132	1000	4500	–	8000	–	12	(16.1)	15	(20.1)	18.5	(24.8)	16	(21.4)	**1PH7 133 - ■ ■D02 - 0C■0**
	2000					20	(26.8)	25	(33.5)	30	(40.2)	27.5	(36.9)	**1PH7 133 - ■ ■G02 - 0C■0**
	1000	4500	–	8000	–	17	(22.8)	20.5	(27.5)	25	(33.5)	22.5	(30.2)	**1PH7 137 - ■ ■D02 - 0C■0**
	2000					28	(37.5)	35	(46.9)	43	(57.6)	39	(52.3)	**1PH7 137 - ■ ■G02 - 0C■0**
160	1000	3700	–	6500	–	22	(29.5)	27	(36.2)	33	(44.2)	30	(40.2)	**1PH7 163 - ■ ■D03 - 0C■0**
	1500					30	(40)	37	(49.6)	45	(60.3)	41	(55)	**1PH7 163 - ■ ■F03 - 0C■0**
	1500	3700	–	6500	–	37	(49.6)	46	(61.7)	56	(75.1)	51	(68.4)	**1PH7 167 - ■ ■F03 - 0C■0**

• Fans:	External fan unit, PG cable entry in terminal box	**2**	
	External fan unit, metric cable entry in terminal box	**7**	
• Encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} (without C or D track)	**N**	
• Encoder systems for motors with DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp} (without C or D track)	**Q**	
• Type of construction: [5]	IM B5 (IM V1, IM V3)		**2**
	IM B35 (IM V15, IM V36)		**3**

• Drive end shaft extension:	• Balancing:	• Direction of air flow (fan):	• Exhaust direction	
Featherkey	Half-key	DE → NDE	Axial	**A**
Smooth shaft	–	DE → NDE	Axial	**J**

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx.	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6- 60%	S6- 40%	S2- 30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 103 - 2NG02 -...	33.4 (24.6)	0.017 (0.15)	40 (88.2)	17.5	20.5	23.5	21.5	18	**6SL3 120 - ■TE21 - 8AA0**
1PH7 107 - 2NF02 -...	57.3 (42.3)	0.029 (0.257)	63 (139)	23.5	27.5	31	29	30	**6SL3 120 - 1TE23 - 0AA0**
1PH7 133 - 2ND02 -...	114.6 (84.5)	0.076 (0.673)	90 (198.5)	30	36	43	37.5	30	**6SL3 120 - 1TE23 - 0AA0**
1PH7 133 - 2NG02 -...	95.5 (70.4)	0.076 (0.673)	90 (198.5)	45	54	63	59	45	**- 1TE24 - 5AA0**
1PH7 137 - 2ND02 -...	162.3 (119.8)	0.109 (0.965)	130 (286.7)	43	50	60	54	45	**6SL3 120 - 1TE24 - 5AA0**
1PH7 137 - 2NG02 -...	133.7 (96.6)	0.109 (0.965)	130 (286.7)	60	73	87	80	60	**- 1TE26 - 0AA0**
1PH7 163 - 2ND03 -...	210.1 (155)	0.19 (1.681)	180 (397)	55	65	77	71	60	**6SL3 120 - 1TE26 - 0AA0**
1PH7 163 - 2NF03 -...	191 (140.9)	0.19 (1.681)	180 (397)	72	86	102	94	85	**- 1TE28 - 5AA0**
1PH7 167 - 2NF03 -...	235.5 (173.7)	0.23 (2.035)	228 (502.7)	82	97	115	104	85	**6SL3 120 - 1TE28 - 5AA0**
Single Motor Module									**1**
Double Motor Module									**2**

1PH7 motor (SH 100 to SH 160)

1) Bearing version for coupling/belt drive.
2) Bearing version for increased maximum speed.
3) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For bearing replacement intervals, refer to the 1PH Motors Planning Guide.
4) Version for increased maximum speed only in conjunction with vibration severity grade SR. The following options are not possible:
   • ZF gearbox mounting prepared
   • Shaft seal
5) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   • Types IM B5 or IM B35
   • Shaft with featherkey and full-key balancing

Standard type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated} rpm	Max. permanent speed $n_{S1\ cont.}$ [1] rpm	$n_{S1\ cont.}$ [2] rpm	Max. speed [3] n_{max} rpm	n_{max} [4] rpm	Rated power for duty type (according to IEC 60034-1) P_{rated} S1 kW (HP)	S6-60% kW (HP)	S6-40% kW (HP)	S2-30 min kW (HP)	1PH7 asynchronous motor Order No. Standard type
100	1500	5500	10000	9000	12000	3.7 (5)	4.5 (6)	5.25 (7.1)	4.9 (6.6)	**1PH7 101 - ■ ■F■ ■ - 0■ ■ ■**
	1000	5500	10000	9000	12000	3.7 (5)	4.5 (6)	5.25 (7.1)	4.7 (6.3)	**1PH7 103 - ■ ■D■ ■ - 0■ ■ ■**
	1500					5.5 (7.4)	6.7 (9)	7.7 (10.3)	7 (9.4)	**1PH7 103 - ■ ■F■ ■ - 0■ ■ ■**
	2000					7 (9.4)	8.5 (11.4)	10 (13.4)	9.25 (12.4)	**1PH7 103 - ■ ■G■ ■ - 0■ ■ ■**
	1500	5500	10000	9000	12000	7 (9.4)	8.5 (11.4)	10 (13.4)	9.25 (12.4)	**1PH7 105 - ■ ■F■ ■ - 0■ ■ ■**
	1000	5500	10000	9000	12000	6.25 (8.4)	7.5 (10.1)	8.8 (11.8)	7.75 (10.4)	**1PH7 107 - ■ ■D■ ■ - 0■ ■ ■**
	1500					9 (12.01)	11 (14.7)	13 (17.4)	12 (16.1)	**1PH7 107 - ■ ■F■ ■ - 0■ ■ ■**
	2000					10.5 (14.1)	12.5 (16.8)	14.5 (19.4)	13.5 (18.1)	**1PH7 107 - ■ ■G■ ■ - 0■ ■ ■**

• Fans:	External fan unit, PG cable entry in terminal box	**2**
	without external fan unit, for pipe connection, PG cable entry in terminal box	**6**
	External fan unit, metric cable entry in terminal box	**7**
	without external fan unit, for pipe connection, metric cable entry in terminal box	**8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Without encoder	**A**
	Absolute encoder EnDat 2048 pulses/revolution	**E**
	Incremental encoder HTL 1024 pulses/revolution [5] (on request)	**H**
	Incremental encoder HTL 2048 pulses/revolution [5] (on request)	**J**
	Incremental encoder sin/cos 1 V_{pp} with C and D track	**M**
	Incremental encoder sin/cos 1 V_{pp} without C and D track	**N**
	2-pole resolver [5] (on request)	**R**
• Encoder systems for motors with DRIVE-CLiQ interface:	Absolute encoder EnDat 2048 pulses/revolution	**F**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track	**D**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	**Q**
• Terminal box/ cable entry:	Top/right	**0**
	Top/NDE	**2**
	Top/left	**3**
• Type of construction: [6]	IM B3 (IM V5, IM V6)	**0**
	IM B5 (IM V1, IM V3)	**2**
	IM B35 (IM V15, IM V36)	**3**

• Bearing version for:	• Vibration severity grade	• Shaft and flange accuracy	
Coupling/belt output	R	R	**B**
Coupling/belt output	S	R	**C**
Coupling/belt output	SR	R	**D**
Increased speed (clutch/belt output) [7]	SR	R	**L**

• Shaft extension [6] (DE):	• Balancing:	• Direction of air flow (fan):	• Exhaust direction	
Featherkey	Half-key	DE → NDE	Axial	**A**
Featherkey	Half-key	NDE→ DE	Axial	**B**
Featherkey	Full-key	DE → NDE	Axial	**C**
Featherkey	Full-key	NDE→ DE	Axial	**D**
Smooth shaft	–	DE → NDE	Axial	**J**
Smooth shaft	–	NDE→ DE	Axial	**K**

• Degree of protection:	• Seal:	• Color:	
IP55, fan IP54	–	No paint finish	**0**
IP55, fan IP54	DE flange with shaft sealing ring [7]	No paint finish	**2**
IP55, fan IP54	–	Anthracite gray	**3**
IP55, fan IP54	DE flange with shaft sealing ring [7]	Anthracite gray	**5**
IP55, fan IP54	–	Anthracite gray, two coats	**6**
IP55, fan IP54	DE flange with shaft sealing ring [7]	Anthracite gray, two coats	**8**

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx.	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6-60%	S6-40%	S2-30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 101 - ..F...	23.6 (17.4)	0.017 (0.150)	40 (88.2)	10	11.5	12.5	12	18	**6SL3 120 - ■TE21 - 8AA0**
1PH7 103 - ..D...	35.3 (26)	0.017 (0.150)	40 (88.2)	10	11.5	13	12	18	**6SL3 120 - ■TE21 - 8AA0**
1PH7 103 - ..F...	35 (25.8)	0.017 (0.150)	40 (88.2)	13	16	18	16.5	18	**- ■TE21 - 8AA0**
1PH7 103 - ..G...	33.4 (24.6)	0.017 (0.150)	40 (88.2)	17.5	20.5	23.5	21.5	18	**- ■TE21 - 8AA0**
1PH7 105 - ..F...	44.6 (32.9)	0.029 (0.257)	63 (139)	17.5	21	23.5	22	18	**6SL3 120 - ■TE21 - 8AA0**
1PH7 107 - ..D...	59.7 (44)	0.029 (0.257)	63 (139)	17.5	20.5	23	21	18	**6SL3 120 - ■TE21 - 8AA0**
1PH7 107 - ..F...	57.3 (42.3)	0.029 (0.257)	63 (139)	23.5	27.5	31	29	30	**- 1TE23 - 0AA0**
1PH7 107 - ..G...	50.1 (37)	0.029 (0.257)	63 (139)	26	28.5	33	31	30	**- 1TE23 - 0AA0**
Single Motor Module									**1**
Double Motor Module									**2**

1PH7 motor (SH 100 to SH 160)

1) Bearing version for coupling/belt output.
2) Bearing version for increased maximum speed.
3) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
4) Version for increased maximum speed only in conjunction with vibration severity grade SR. The following options are not possible:
   • ZF gearbox mounting prepared
   • Shaft sealing ring
5) These encoders are not suitable for machine tools.
6) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   • Types IM B5 or IM B35
   • Shaft with featherkey and full-key balancing
7) Only recommended if oil spray/mist occasionally cames into contact with the sealing ring. A sealing ring is not possible at increased maximum speed.

Standard type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated}	Max. permanent speed $n_{S1\ cont.}$ [1]	$n_{S1\ cont.}$ [2]	Max. speed [3] n_{max}	n_{max} [4]	Rated power for duty type (according to IEC 60034-1) P_{rated} S1	S6-60%	S6-40%	S2-30 min	1PH7 asynchronous motor Order No. Standard type
	rpm	rpm	rpm	rpm	rpm	kW (HP)	kW (HP)	kW (HP)	kW (HP)	
132	1500	4500	8500	8000	10000	11 (14.7)	13.5 (18.1)	16.5 (22.1)	15 (20.1)	1PH7 131 - ■ ■F ■ ■ - 0■ ■ ■
	1000	4500	8500	8000	10000	12 (16.1)	15 (20.1)	18.5 (24.8)	16 (21.4)	1PH7 133 - ■ ■D ■ ■ - 0■ ■ ■
	1500					15 (20.1)	18.5 (24.8)	23 (30.8)	20.5 (27.5)	1PH7 133 - ■ ■F ■ ■ - 0■ ■ ■
	2000					20 (26.8)	25 (33.5)	30 (40.2)	27.5 (36.9)	1PH7 133 - ■ ■G ■ ■ - 0■ ■ ■
	1500	4500	8500	8000	10000	18.5 (24.8)	23 (30.8)	28 (37.5)	25.5 (34.2)	1PH7 135 - ■ ■F ■ ■ - 0■ ■ ■
	1000	4500	8500	8000	10000	17 (22.8)	20.5 (27.5)	25 (33.5)	22.5 (30.2)	1PH7 137 - ■ ■D ■ ■ - 0■ ■ ■
	1500					22 (22.8)	27.5 (36.9)	33 (44.2)	30 (40.2)	1PH7 137 - ■ ■F ■ ■ - 0■ ■ ■
	2000					28 (37.5)	35 (46.9)	43 (57.6)	39 (52.3)	1PH7 137 - ■ ■G ■ ■ - 0■ ■ ■

• Fans:	External fan unit, PG cable entry in terminal box	2
	without external fan unit, for pipe connection, PG cable entry in terminal box	6
	External fan unit, metric cable entry in terminal box	7
	without external fan unit, for pipe connection, metric cable entry in terminal box	8
• Encoder systems for motors without DRIVE-CLiQ interface:	Without encoder	A
	Absolute encoder EnDat 2048 pulses/revolution	E
	Incremental encoder HTL 1024 pulses/revolution [5]	H
	Incremental encoder HTL 2048 pulses/revolution [5]	J
	Incremental encoder sin/cos 1 V_{pp} with C and D track [7]	M
	Incremental encoder sin/cos 1 V_{pp} without C and D track	N
	2-pole resolver [5]	R
• Encoder systems for motors with DRIVE-CLiQ interface:	Absolute encoder EnDat 2048 pulses/revolution	F
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track	D
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	Q
• Terminal box/ cable entry:	Top/right	0
	Top/NDE	2
	Top/left	3
• Type of construction: [6]	IM B3 (IM V5, IM V6)	0
	IM B5 (IM V1, IM V3)	2
	IM B35 (IM V15, IM V36)	3

• Bearing version for:	• Vibration severity grade	• Shaft and flange accuracy	
Coupling/belt output	R	R	B
Coupling/belt output	S	R	C
Coupling/belt output	SR	R	D
Increased speed (clutch/belt output) [7]	SR	R	L

• Shaft extension [6] (DE):	• Balancing:	• Direction of air flow (fan):	• Exhaust direction	
Featherkey	Half-key	DE → NDE	Axial	A
Featherkey	Half-key	NDE→ DE	Axial	B
Featherkey	Full-key	DE → NDE	Axial	C
Featherkey	Full-key	NDE→ DE	Axial	D
Smooth shaft	–	DE → NDE	Axial	J
Smooth shaft	–	NDE→ DE	Axial	K

• Degree of protection:	• Seal:	• Color:	
IP55, fan IP54	–	No paint finish	0
IP55, fan IP54	DE flange with shaft sealing ring [7]	No paint finish	2
IP55, fan IP54	–	Anthracite gray	3
IP55, fan IP54	DE flange with shaft sealing ring [7]	Anthracite gray	5
IP55, fan IP54	–	Anthracite gray, two coats	6
IP55, fan IP54	DE flange with shaft sealing ring [7]	Anthracite gray, two coats	8

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx.	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6-60%	S6-40%	S2-30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 131 - ..F...	70 (51.6)	0.076 (0.673)	90 (198.5)	24	29	34	31.5	30	**6SL3 120 - 1TE23 - 0AA0**
1PH7 133 - ..D...	114.6 (84.5)	0.076 (0.673)	90 (198.5)	30	36	43	37.5	30	**6SL3 120 - 1TE23 - 0AA0**
1PH7 133 - ..F...	95.5 (70.4)	0.076 (0.673)	90 (198.5)	34	41	49	43.5	45	**- 1TE24 - 5AA0**
1PH7 133 - ..G...	95.5 (70.4)	0.076 (0.673)	90 (198.5)	45	54	63	59	45	**- 1TE24 - 5AA0**
1PH7 135 - ..F...	117.8 (86.9)	0.109 (0.965)	130 (286.7)	42	50	58	54	45	**6SL3 120 - 1TE24 - 5AA0**
1PH7 137 - ..D...	162.3 (119.7)	0.109 (0.965)	130 (286.7)	43	50	60	54	45	**6SL3 120 - 1TE24 - 5AA0**
1PH7 137 - ..F...	140.1 (103.3)	0.109 (0.965)	130 (286.7)	57	68	79	73	60	**- 1TE26 - 0AA0**
1PH7 137 - ..G...	133.7 (98.6)	0.109 (0.965)	130 (286.7)	60	73	87	80	60	**- 1TE26 - 0AA0**
Single Motor Module									**1**

1PH7 motor (SH 100 to SH 160)

1) Bearing version for coupling/belt output.
2) Bearing version for increased maximum speed.
3) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
4) Version for increased maximum speed only in conjunction with vibration severity grade SR. The following options are not possible:
   • ZF gearbox mounting prepared
   • Shaft sealing ring
5) These encoders are not suitable for machine tools.
6) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   • Types IM B5 or IM B35
   • Shaft with featherkey and full-key balancing
7) Only recommended if oil spray/mist occasionally gets onto the sealing ring. A sealing ring is not possible at increased maximum speed.

Standard type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated} rpm	Max. permanent speed $n_{S1\ cont.}$ [1] rpm	$n_{S1\ cont.}$ [2] rpm	Max. speed [3] n_{max} rpm	n_{max} [4] rpm	Rated power for duty type (according to IEC 60034-1) P_{rated} S1 kW (HP)	S6-60% kW (HP)	S6-40% kW (HP)	S2-30 min kW (HP)	1PH7 asynchronous motor Order No. Standard type
160	500	3700	7000	6500	8000	12 (16.1)	15 (20.1)	18 (24.1)	16.5 (22.1)	**1PH7 163 -** ■ ■**B**■ ■ **- 0**■ ■ ■
	1000					22 (29.5)	27 (36.2)	33 (44.2)	30 (40.2)	**-** ■ ■**D**■ ■ **- 0**■ ■ ■
	1500					30 (40.2)	37 (49.6)	45 (60.3)	41 (55)	**-** ■ ■**F**■ ■ **- 0**■ ■ ■
	2000					36 (48.3)	44 (59)	52 (69.7)	48 (64.3)	**-** ■ ■**G**■ ■ **- 0**■ ■ ■
	500	3700	7000	6500	8000	16 (21.4)	19.5 (26.1)	24 (32.2)	21.5 (28.8)	**1PH7 167 -** ■ ■**B**■ ■ **- 0**■ ■ ■
	1000					28 (37.5)	34.5 (46.2)	42 (56.3)	38 (51)	**-** ■ ■**D**■ ■ **- 0**■ ■ ■
	1500					37 (49.6)	46 (61.7)	56 (75.1)	51 (68.3)	**-** ■ ■**F**■ ■ **- 0**■ ■ ■
	2000					41 (55)	51 (68.4)	61 (81.8)	56 (75.1)	**-** ■ ■**G**■ ■ **- 0**■ ■ ■

• Fans:	External fan unit, PG cable entry in terminal box	**2**
	without external fan unit, for pipe connection, PC cable entry in terminal box	**6**
	External fan unit, metric cable entry in terminal box	**7**
	without external fan unit, for pipe connection, metric cable entry in terminal box	**8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Without encoder	**A**
	Absolute encoder EnDat 2048 pulses/revolution	**E**
	Incremental encoder HTL 1024 pulses/revolution [5]	**H**
	Incremental encoder HTL 2048 pulses/revolution [5]	**J**
	Incremental encoder sin/cos 1 V_{pp} with C and D track [5]	**M**
	Incremental encoder sin/cos 1 V_{pp} without C and D track	**N**
	2-pole resolver [5]	**R**
• Encoder systems for motors with DRIVE-CLiQ interface:	Absolute encoder EnDat 2048 pulses/revolution	**F**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track	**D**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	**Q**
• Terminal box/ cable entry:	Top/right	**0**
	Top/NDE	**2**
	Top/left	**3**
• Type of construction: [1]	IM B3 (IM V5, IM V6)	**0**
	IM B35 (IM V15, IM V36)	**3**

• Bearing version for:	• Vibration severity grade	• Shaft and flange accuracy	
Coupling/belt output	R	R	**B**
Coupling/belt output	S	R	**C**
Coupling/belt output	SR	R	**D**
Increased speed (clutch/belt output) [7]	SR	R	**L**

• Shaft extension [6] (DE):	• Balancing:	• Direction of air flow (fan):	• Exhaust direction:	
Featherkey	Half-key	DE → NDE	Axial	**A**
Featherkey	Half-key	NDE→ DE	Axial	**B**
Featherkey	Full-key	DE → NDE	Axial	**C**
Featherkey	Full-key	NDE→ DE	Axial	**D**
Smooth shaft	–	DE → NDE	Axial	**J**
Smooth shaft	–	NDE→ DE	Axial	**K**

• Degree of protection:	• Seal:	• Color:	
IP55, fan IP54	–	No paint finish	**0**
IP55, fan IP54	DE flange with shaft seal [7]	No paint finish	**2**
IP55, fan IP54	–	Anthracite gray	**3**
IP55, fan IP54	DE flange with shaft seal [7]	Anthracite gray	**5**
IP55, fan IP54	–	Anthracite gray, two coats	**6**
IP55, fan IP54	DE flange with shaft seal [7]	Anthracite gray, two coats	**8**

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx.	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6- 60%	S6- 40%	S2- 30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 163 - ..B...	229.2 (169.1)	0.19 (1.681)	180 (397)	30	36	42	39	30	**6SL3 120 - 1TE23 - 0AA0**
1PH7 163 - ..D...	210.1 (155)	0.19 (1.681)	180 (397)	55	65	77	71	60	**- 1TE26 - 0AA0**
1PH7 163 - ..F...	191 (140.9)	0.19 (1.681)	180 (397)	72	86	102	94	85	**- 1TE28 - 5AA0**
1PH7 163 - ..G...	171.9 (126.8)	0.19 (1.681)	180 (397)	85	100	114	107	85	**- 1TE28 - 5AA0**
1PH7 167 - ..B...	305.5 (225.3)	0.23 (2.035)	228 (503)	37	44	53	48	45	**6SL3 120 - 1TE24 - 5AA0**
1PH7 167 - ..D...	267.4 (197.2)	0.23 (2.035)	228 (503)	71	85	100	92	85	**- 1TE28 - 5AA0**
1PH7 167 - ..F...	235.5 (173.7)	0.23 (2.035)	228 (503)	82	97	115	104	85	**- 1TE28 - 5AA0**
1PH7 167 - ..G...	195.8 (144.4)	0.23 (2.035)	228 (503)	89	106	124	115	132	**- 1TE31 - 3AA0**
Single Motor Module									**1**

1PH7 motor (SH 100 to SH 160)

1) Bearing version for coupling/belt output.
2) Bearing version for increased maximum speed.
3) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
4) Version for increased maximum speed only in conjunction with vibration severity grade SR. The following options are not possible:
   • ZF gearbox mounting prepared
   • Shaft seal
5) These encoders are not suitable for machine tools.
6) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   • Types IM B5 or IM B35
   • Shaft with featherkey and full-key balancing
7) Only recommended if oil spray/mist occasionally comes into contact with the sealing ring. A sealing ring is not possible at increased maximum speed.

Standard type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated} rpm	Max. permanent speed $n_{S1\ cont.}$ [1] rpm	$n_{S1\ cont.}$ [2] rpm	$n_{S1\ cont.}$ [3] rpm	Max. speed [4] n_{max} rpm	n_{max} [5] rpm	Rated power for duty type (according to IEC 60034-1) P_{rated} S1 kW (HP)	S6-60% kW (HP)	S6-40% kW (HP)	S2-30 min kW (HP)	1PH7 asynchronous motor Order No. Standard type
180	500	3500	3000	4500	5000	7000	21.5 (28.8)	26.5 (35.5)	30.5 (40.9)	30 (40.2)	**1PH7 184 -** ■ ■ **T** ■ ■ **- 0** ■ ■ ■
	1000						39 (52.3)	48 (64.3)	58 (77.7)	58 (77.7)	**-** ■ ■ **D** ■ ■ **- 0** ■ ■ ■
	1250						40 (53.6)	50 (67)	56 (75.1)	66 (88.5)	**-** ■ ■ **E** ■ ■ **- 0** ■ ■ ■
	1500						51 (68.4)	68 (91.2)	81 (108.6)	81 (108.6)	**-** ■ ■ **F** ■ ■ **- 0** ■ ■ ■
	2500						78 (104.6)	97 (130)	115 (154)	115 (154)	**-** ■ ■ **L** ■ ■ **- 0** ■ ■ ■
	500	3500	3000	4500	5000	7000	29.6 (39.7)	36.5 (49)	43 (57.6)	38 (51)	**1PH7 186 -** ■ ■ **T** ■ ■ **- 0** ■ ■ ■
	1000						51 (68.4)	65 (87.1)	77 (103)	77 (103)	**-** ■ ■ **D** ■ ■ **- 0** ■ ■ ■
	1250						60 (80.4)	71 (95.2)	80 (107.2)	84 (112.6)	**-** ■ ■ **E** ■ ■ **- 0** ■ ■ ■

• Fans:	External fan unit, PG cable entry in terminal box	**2**
	without external fan unit, for pipe connection, PG cable entry in terminal box	**6**
	External fan unit, metric cable entry in terminal box	**7**
	without external fan unit, for pipe connection, metric cable entry in terminal box	**8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Without encoder	**A**
	Absolute encoder EnDat 2048 pulses/revolution	**E**
	Incremental encoder HTL 1024 pulses/revolution [6]	**H**
	Incremental encoder HTL 2048 pulses/revolution [6]	**J**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track [6]	**M**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	**N**
	2-pole resolver [6]	**R**
• Encoder systems for motors with DRIVE-CLiQ interface:	Absolute encoder EnDat 2048 pulses/revolution	**F**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track	**D**
	Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	**Q**
• Terminal box/ cable entry:	Top/right	**0**
	Top/DE	**1**
	Top/NDE	**2**
	Top/left	**3**
• Type of construction:	IM B3	**0**
	IM B3 (IM V5, IM V6) (lifting concept for vertical types)	**2**
	IM B35	**3**
	IM B35 (flange D = 450 mm (17.72 in), only for 1PH7184)	**4**
	IM B35 (IM V15, IM V36) (lifting concept for vertical types)	**5**
	IM B35 (IM V15, IM V36) (flange 450 mm (17.72 in), only for 1PH7184)	**6**

• Bearing version for:	• Vibration severity grade:	• Shaft and flange accuracy:	
Coupling output	R	N	**A**
Coupling output	R	R	**B**
Coupling output	S	R	**C**
Coupling output	SR	R	**D**
Belt output	R	N	**E**
Belt output	R	R	**F**
Increased lateral force (belt output)	R	N	**G**
Increased lateral force (belt output)	R	R	**H**
Increased speed (coupling output) [7]	S	R	**J**

• Shaft extension [8] (DE):	• Balancing:	• Direction of air flow (fan):	• Exhaust direction:	
Featherkey	Half-key	DE → NDE	Right	**A**
Featherkey	Half-key	NDE→ DE	Axial	**B**
Featherkey	Full-key	DE → NDE	Right	**C**
Featherkey	Full-key	NDE→ DE	Axial	**D**
Smooth shaft	-	DE → NDE	Right	**J**
Smooth shaft	-	NDE→ DE	Axial	**K**

• Degree of protection:	• Seal:	• Color:	
IP55, fan IP54	–	Primed	**0**
IP55, fan IP54	DE flange with shaft sealing ring [7]	Primed	**2**
IP55, fan IP54	–	Anthracite gray	**3**
IP55, fan IP54	DE flange with shaft sealing ring [9]	Anthracite gray	**5**
IP55, fan IP54	–	Anthracite gray, two coats	**6**
IP55, fan IP54	DE flange with shaft sealing ring [9]	Anthracite gray, two coats	**8**

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx. 2)	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6-60%	S6-40%	S2-30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 184 - ..T...	410 (302)	0.5 (4.424)	390 (860)	76	90	103	102	85	**6SL3 120 - 1TE28 - 5AA0**
1PH7 184 - ..D...	372 (274)	0.5 (4.424)		90	106	126	126	132	**- 1TE31 - 3AA0**
1PH7 184 - ..E...	305 (225)	0.5 (4.424)		85	100	110	128	85	**- 1TE28 - 5AA0**
1PH7 184 - ..F...	325 (240)	0.5 (4.424)		120	149	174	174	132	**- 1TE31 - 3AA0**
1PH7 184 - ..L...	298 (220)	0.5 (4.424)		172	204	237	237	200	**- 1TE32 - 0AA0**
1PH7 186 - ..T...	565 (417)	0.67 (5.929)	460 (1014)	105	126	147	130	132	**6SL3 120 - 1TE31 - 3AA0**
1PH7 186 - ..D...	487 (359)	0.67 (5.929)		118	141	164	164	132	**- 1TE31 - 3AA0**
1PH7 186 - ..E...	458 (338)	0.67 (5.929)		120	135	150	156	132	**- 1TE31 - 3AA0**
Single Motor Module									**1**

1PH7 motor (SH 180 and SH 225)

1) Bearing version for coupling/belt output.
2) Bearing version for increased lateral force.
3) Bearing version for increased maximum speed.
4) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
5) Version for increased maximum speed only in conjunction with vibration severity grade S. The following options are not possible:
   - ZF gearbox mounting prepared
   - Shaft sealing ring.
6) These encoders are not suitable for machine tools.
7) Only recommended if oil spray/mist occasionally comes into contact with the sealing ring. A sealing ring is not possible on type IM B3 (IM V5, IM V6), version with increased lateral force or increased maximum speed.
8) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   - Type IM B35, IM V15 (not IM V36)
   - Shaft with featherkey and full-key balancing
   - Bearing version for coupling output
   - Shaft and flange accuracy R
   - DE flange with shaft sealing ring
9) Applies to type IM B35. For type IM B3 the motor is 20 kg (44 lb) lighter.

Standard type 1PH7 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated}	Max. permanent speed $n_{S1\ cont.}$ [1]	$n_{S1\ cont.}$ [2]	$n_{S1\ cont.}$ [3]	Max. speed [4] n_{max}	n_{max} [5]	Rated power for duty type (according to IEC 60034-1) P_{rated} S1	S6-60%	S6-40%	S2-30 min	1PH7 asynchronous motor Order No. Standard type
	rpm	rpm	rpm	rpm	rpm	rpm	kW (HP)	kW (HP)	kW (HP)	kW (HP)	
225	700	3100	2700	3600	4500	5500	55 (73.7)	66 (88.5)	75 (100.5)	78 (104.6)	**1PH7 224 - ■ ■C■ ■ - 0■ ■ ■**
	1000						71 (95.2)	88 (118)	105 (140.8)	114 (153)	**- ■ ■D■ ■ - 0■ ■ ■**
	1500						100 (134)	126 (169)	136 (182.3)	140 (187.7)	**- ■ ■F■ ■ - 0■ ■ ■**

• Fans:	External fan unit, PG cable entry in terminal box without external fan unit, for pipe connection, PC cable entry in terminal box External fan unit, metric cable entry in terminal box without external fan unit, for pipe connection, metric cable entry in terminal box	**2** **6** **7** **8**
• Encoder systems for motors without DRIVE-CLiQ interface:	Without encoder Absolute encoder EnDat 2048 pulses/revolution Incremental encoder HTL 1024 pulses/revolution [6] Incremental encoder HTL 2048 pulses/revolution [6] Incremental encoder sin/cos 1 V_{pp} with C and D track [6] Incremental encoder sin/cos 1 V_{pp} without C and D track 2-pole resolver [6]	**A** **E** **H** **J** **M** **N** **R**
• Encoder systems for motors with DRIVE-CLiQ interface:	Absolute encoder EnDat 2048 pulses/revolution Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution with C and D track Incremental encoder sin/cos 1 V_{pp} 2048 pulses/revolution without C and D track	**F** **D** **Q**
• Terminal box/ cable entry:	Top/right Top/DE Top/NDE Top/left	**0** **1** **2** **3**
• Type of construction:	IM B3 IM B3 (IM V5, IM V6) (lifting concept for vertical types) IM B35 IM B35 (IM V15, IM V36) (lifting concept for vertical types)	**0** **1** **3** **5**

• Bearing version for:	• Vibration severity grade:	• Shaft and flange accuracy:	
Coupling output	R	N	**A**
Coupling output	R	R	**B**
Coupling output	S	R	**C**
Coupling output	SR	R	**D**
Belt output	R	N	**E**
Belt output	R	R	**F**
Increased lateral force (belt output)	R	N	**G**
Increased lateral force (belt output)	R	R	**H**
Increased speed (coupling output) [7]	S	R	**J**

• Shaft extension [8] (DE):	• Balancing:	• Direction of air flow (fan):	• Exhaust direction:	
Featherkey	Half-key	DE → NDE	Right	**A**
Featherkey	Half-key	NDE→ DE	Axial	**B**
Featherkey	Full-key	DE → NDE	Right	**C**
Featherkey	Full-key	NDE→ DE	Axial	**D**
Smooth shaft	–	DE → NDE	Right	**J**
Smooth shaft	–	NDE→ DE	Axial	**K**

• Degree of protection:	• Seal:	• Color:	
IP55, fan IP54	–	Primed	**0**
IP55, fan IP54	DE flange with shaft sealing ring [7]	Primed	**2**
IP55, fan IP54	–	Anthracite gray	**3**
IP55, fan IP54	DE flange with shaft sealing ring [9]	Anthracite gray	**5**
IP55, fan IP54	–	Anthracite gray, two coats	**6**
IP55, fan IP54	DE flange with shaft sealing ring [9]	Anthracite gray, two coats	**8**

Selection and ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx. 2)	Rated current for duty type (according to IEC 60034-1)				SINAMICS Motor Module Rated output current	
	M_{rated}	J	m	I_{rated}				I_{rated}	Order No.
				S1	S6-60%	S6-40%	S2-30 min	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A	A	A	
1PH7 224 - ..C ...	750 (553)	1.48 (13.098)	650 (1433)	117	135	149	155	132	**6SL3 120 - 1TE31 - 3AA0**
1PH7 224 - ..D ...	678 (500)	1.48 (13.098)	650 (1433)	164	190	222	240	200	**- 1TE32 - 0AA0**
1PH7 224 - ..F ...	636 (469)	1.48 (13.098)	650 (1433)	188	230	248	256	200	**- 1TE32 - 0AA0**
Single Motor Module									**1**

1PH7 motor (SH 180 and SH 225)

1) Bearing version for coupling/belt output.
2) Bearing version for increased lateral force.
3) Bearing version for increased maximum speed.
4) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
5) Version for increased maximum speed only in conjunction with vibration severity grade S. The following options are not possible:
   - ZF gearbox mounting prepared
   - Shaft sealing ring.
6) These encoders are not suitable for machine tools.
7) Only recommended if oil spray/mist occasionally comes into contact with the sealing ring. A sealing ring is not possible on type IM B3 (IM V5, IM V6), version with increased lateral force or increased maximum speed.
8) The following motor versions are required for "ZF gearbox mounting prepared" (see "Gears" for gear selection):
   - Type IM B35, IM V15 (not IM V36)
   - Shaft with featherkey and full-key balancing
   - Bearing version for coupling output
   - Shaft and flange accuracy R
   - DE flange with shaft sealing ring
9) Applies to type IM B35. In type IM B3 the motor is 20 kg (44 lb) lighter.

1PH4 motors

Overview

Given the compact design of modern machines, heat losses from electrical drives can have an adverse effect on machining accuracy. The consequential requirement for cool motors at high power densities led to the development of the water-cooled 1PH4 series motors.

Furthermore, a combination of high torque and small unit volume (low mass inertia) results in short acceleration and braking times and thus in a reduction in non-productive time.

The 1PH4 motors are robust, 4-pole squirrel-cage asynchronous motors. Power loss and noise are minimized. Due to the compact design of the motors, high maximum speeds can be achieved.

The motors are equipped with an encoder system for sensing the motor speed and indirect position. On machine tools, the encoder system is capable of C-axis operation as standard. An additional encoder is therefore not required for C-axis operation.

Benefits

- High power density due to small unit volume
- Maximum speeds of up to 9000 rpm (option: 12000 rpm)
- Full rated torque continuously available, even at standstill
- Cooled flange to prevent thermal stressing of the mechanical power train
- Low noise level
- High degree of protection (IP65, shaft exit IP55)
- High rotational accuracy.

Applications

- Any application in which extreme ambient conditions such as high temperature, dust, dirt or aggressive atmosphere do not permit natural ventilation.
- In processes where no thermal stress may be placed on the environment.
- Fully enclosed milling machines
- High-load milling spindles
- Counterspindles on turning machines
- Special machines where cooling water is available for specific processes

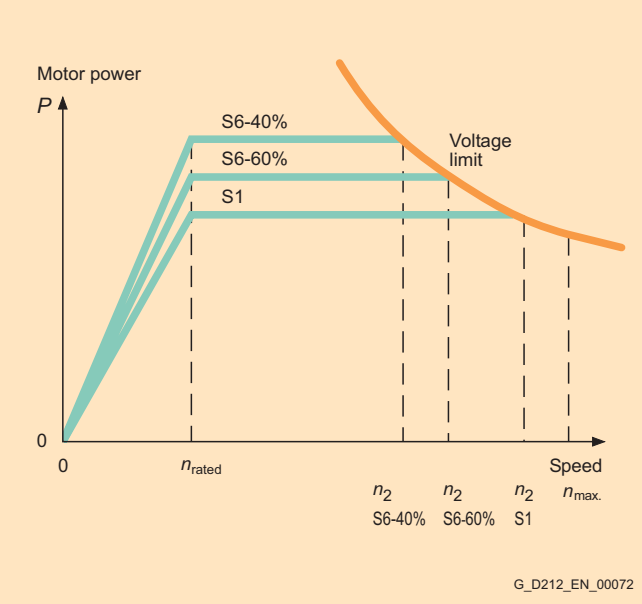
Please refer to "Liquid cooling" for a list of heat exchanger manufacturers.

Technical data

Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of up to +30 °C (+86 °F)
Built-in encoder systems for motors without DRIVE-CLiQ interface:	Incremental encoder sin/cos 1 V_{pp}, 2048 pulses/revolution, absolute encoder EnDat, incremental encoder HTL 1024 pulses/revolution or 2048 pulses/revolution [3]
Type according to EN 60034-7 (IEC 60034-7)	IM B35 (IM V15, IM V36)
Terminal box location (facing drive end) [1]	Top, rotatable 4 x 90°
Terminal box connection type • Motor • Motor encoder and PTC thermistor	Terminals in terminal box 12/17-pin circular socket (without mating connector)
Bearing arrangement at drive end [2]	Bearing for belt or coupling output
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Grade R (reduced)
Shaft and flange accuracy according to DIN 42955 (IEC 60072-1)	Tolerance rated (normal)
Drive end shaft extension according to DIN 748	With featherkey and keyway
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP65, IP55 on shaft exit
Paint finish	Anthracite gray
Permissible coolant temperature	To prevent the formation of condensation, we recommend an inlet temperature of approximately +30 °C (+86 °F) (depending on ambient conditions).
Temperature monitoring	Two KTY 84 temperature sensors in the stator winding, of which one as reserve
Sound pressure level, L_{pA} (1 m) acc. to ISO 1680 (EN 21680) (tolerance +3 dB)	1PH4 10: 69 dB 1PH4 13: 69 dB 1PH4 16: 71 dB

1) DE is the drive end with shaft. NDE is the non-drive end.
2) For permissible loads, refer to the 1PH Motors Planning Guide.
3) HTL encoders are not suitable for the C-axis machine tools.

Characteristics



Typical power-speed diagram for AC motors [1)]

The diagram shows the typical ratio between motor speed and drive power for 1PH4 motors in the following duty types (according to IEC 60034-1):

S 1: Continuous duty
S 6: Continuous duty with intermittent loading and a relative ON period of 60% (S6-60%) or 40% (S6-40%) with a maximum duty cycle time of 10 minutes.

Motor	Rated speed	Attainable speed for rated power in duty type (according to IEC 60034-1)		
Type	n_{rated}	n_2 [2)]		
		S1	S6-60%	S6-40%
	rpm	rpm	rpm	rpm
1PH4 103	1500	8600	7500	6500
1PH4 105	1500	8800	7600	6500
1PH4 107	1500	8600	7400	6400
1PH4 133	1500	8000	7400	6000
1PH4 135	1500	7400	6200	5500
1PH4 137	1500	6800	5800	5000
1PH4 138	1500	7800	6600	5800
1PH4 163	1500	6300	5200	4500
1PH4 167	1500	5200	4400	3800
1PH4 168	1500	6300	5300	4600

1) For additional configuration information, refer to the 1PH Motors Planning Guide.
2) Values from the power-speed diagram based on using an Active Line Module on a 3 AC 400 V supply system. If using a Smart Line Module, proceed in accordance with the 1PH Planning Guide.

Standard type 1PH4 motors

Selection/Ordering data

Shaft height SH	Rated speed n_{rated} rpm	Max. permanent speed $n_{S1\ cont.}$ [1] rpm	$n_{S1\ cont.}$ [2] rpm	$n_{S1\ cont.}$ [3] rpm	Max. speed [4] n_{max} rpm	L37 [4] [5] n_{max} rpm	Motor rated power for duty type (according to IEC 60034-1) P_{rated} S1 kW (HP)	S6-60% kW (HP)	S6-40% kW (HP)	1PH4 asynchronous motor Order No. Standard type
100	1500	5600	6500	10000	9000	12000	7.5 (10.1)	8.75 (11.7)	10 (13.4)	**1PH4 103 - 4■F26**
							11 (14.7)	12.75 (17.1)	14.75 (19.8)	**1PH4 105 - 4■F26**
							14 (18.8)	16.25 (21.8)	18.75 (25.1)	**1PH4 107 - 4■F26**
132	1500	5200	6000	9250	8000	10000	15 (20.1)	18 (24.1)	21 (28.2)	**1PH4 133 - 4■F26**
							22 (29.5)	26.5 (35.5)	31 (41.6)	**1PH4 135 - 4■F26**
							27 (36.2)	32.5 (43.6)	38 (50.9)	**1PH4 137 - 4■F26**
							30 (40.2)	36 (48.3)	42 (56.3)	**1PH4 138 - 4■F26**
160	1500	4000	4500	7000	6500	8000	37 (50)	45 (60.3)	52.5 (70.4)	**1PH4 163 - 4■F26**
							46 (61.7)	55 (73.7)	65 (87.1)	**1PH4 167 - 4■F26**
							52 (69.7)	62.5 (83.8)	73 (97.9)	**1PH4 168 - 4■F26**

• Encoder systems for motors without DRIVE-CLiQ interface:	Absolute encoder EnDat, 2048 pulses/revolution	**E**
	Incremental encoder HTL 1024 pulses/revolution [6] (on request)	**H**
	Incremental encoder HTL 2048 pulses/revolution [6] (on request)	**J**
	Incremental encoder sin/cos 1 V_{pp}, 2048 pulses/revolution with C and D track	**M**
	Incremental encoder sin/cos 1 V_{pp}, 2048 pulses/revolution without C and D track	**N**

Options

When ordering a motor with options, "**-Z**" must be added to the order number and the order code stated for the specific version required.

Order codes must not be repeated in plain text.

Example: **1PH4 135-4NF26-Z**
K04 + K09 +L37

	Code
Bearing version/gearbox mounting • Single bearing facing drive end (standard = twin bearing) - for coupling [7] - for planetary gear units (e.g. ZF gearboxes 2LG43..., types IM B35, IM V15) [7] [8] - for low to moderate lateral forces	**K00**
Vibration severity according to EN 60034-14 (IEC 60034-14) (standard = vibration severity grade R, twin bearing)	
• Grade S with twin bearing	**K05** [9]
• Grade S with single bearing	**K02** [9]
• Grade SR with single bearing	**K03** [9]
Shaft and flange accuracy according to DIN 42955 (IEC 60072-1) (standard = tolerance N) • Tolerance R [10]	**K04**

Shaft extension (drive end) (standard = full-key balancing with keyway)	
• Smooth shaft	**K42**
• Half-key balancing	**L69**
Shaft seal (drive end) [11] • Rotary shaft seal, oil-tight, IP65	**K18**
Brake [7] • With holding brake mounted on drive end	**G46**
Terminal box location (facing drive end) (standard = top)	
• Side right	**K09**
• Side left	**K10**
Rotation of terminal box about its own axis	
• Through 90°, cable entry from drive end	**K83**
• Through 90°, cable entry from non-drive end	**K84**
• Through 180°	**K85**
Speed [12] • With increased maximum speed and half-key balancing	**L37**
Rating plate • Second rating plate, separately packed	**K31**
Encoder system • Without encoder	**H30**

Selection/Ordering data

Motor type (continued)	Rated torque	Moment of inertia	Weight approx.	Motor rated current for duty type (according to IEC 60034-1)			SINAMICS Motor Module Required rated current	
	M_{rated}	J	m	I_{rated}			I_{rated}	Order No.
				S1	S6-60%	S6-40%	S1	
	Nm (lb_f-ft)	kg m^2 (lb_f-in-s^2)	kg (lb)	A	A	A		
1PH4 103 - ...	48 (35.4)	0.017 (0.150)	52 (115)	26	29	32	30	**6SL3 120 - 1TE23 - 0AA0**
1PH4 105 - ...	70 (51.6)	0.024 (0.212)	67 (148)	38	42	47	45	**- 1TE24 - 5AA0**
1PH4 107 - ...	90 (66.4)	0.031 (0.274)	80 (176)	46	52	58	60	**- 1TE26 - 0AA0**
1PH4 133 - ...	95 (70.1)	0.046 (0.407)	90 (198)	55	65	74	60	**6SL3 120 - 1TE26 - 0AA0**
1PH4 135 - ...	140 (103.3)	0.071 (0.628)	112 (247)	73	86	99	85	**- 1TE28 - 5AA0**
1PH4 137 - ...	170 (125.4)	0.085 (0.752)	130 (287)	85	100	114	85	**- 1TE28 - 5AA0**
1PH4 138 - ...	190 (140.1)	0.097 (0.858)	150 (331)	102	119	136	132	**- 1TE31 - 3AA0**
1PH4 163 - ...	235 (173.3)	0.17 (1.504)	175 (386)	107	125	142	132	**6SL3 120 - 1TE31 - 3AA0**
1PH4 167 - ...	293 (216.1)	0.206 (1.823)	210 (463)	120	138	158	132	**- 1TE31 - 3AA0**
1PH4 168 - ...	331 (244.1)	0.22 (1.947)	240 (529)	148	173	197	200	**- 1TE32 - 0AA0**
Single Motor Module								**1**

1) Bearing version for twin bearing.
2) Bearing version for single bearing.
3) Bearing version for increased speed.
4) For continuous duty (with 30% n_{max}, 60% $^2/_3$ n_{max}, 10% standstill) with a duty cycle time of 10 min. For motor and component maintenance intervals, refer to the 1PH Motors Planning Guide.
5) Maximum speed using option **L37** "increased maximum speed".
6) These encoders are not suitable for machine tools.
7) Options are mutually exclusive.
8) Vibration severity grades S, SR not possible for integrated gearbox. Use code **K00 + G97** for old ZF gearbox 2LG42... (see "Gears" for gearbox selection).
9) Automatically includes version **K04**.
10) Increased shaft accuracy.
11) Only recommended if oil spray/mist occasionally comes into contact with the sealing ring.
12) Version for increased maximum speed includes vibration severity grade SR and half-key balancing. The following options are not possible:
- ZF gearbox mounting prepared
- Shaft seal.

1PM4 motors with hollow shaft

1PH7 motor (SH 100 and SH 132, liquid-cooled)

Overview

Liquid-cooled 1PM4 motors have been specially designed for direct mounting on mechanical spindles. The hollow shaft permits the passage of coolant for internally cooled tools.
The shaft is prepared on the non-drive end of the motor for connection of a turning bushing for input of the coolant.

Given the compact design of modern machines, heat losses from electrical drives can have an adverse effect on machining accuracy. The consequential requirement for cool motors at high power densities led to the development of the liquid-cooled 1PM4 motors.

Furthermore, a combination of high torque and small unit volume (low mass inertia) results in short acceleration and braking times and thus in a reduction in non-productive time.

The motors have a built-in hollow shaft measuring system for sensing the motor speed and indirect position.

Benefits

- Hollow shaft for passage of coolant with direct spindle mounting
- Maximum speeds up to 12000 rpm
- Full rated torque continuously available, even at standstill
- Cooled flange to prevent thermal stressing of the mechanical power train
- Low noise level
- High rotational accuracy
- Short ramp-up and braking times.

Applications

- Compact machining centers
- Directly driven tools with internal cooling
- Special machines

Please refer to "Liquid cooling" for a list of heat exchanger manufacturers.

Technical data

Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of up to +30 °C (+86 °F)
Built-in encoder systems for motors without DRIVE-CLiQ interface	Incremental encoder sin/cos 1 V_{pp}, 256 pulses/revolution
Type according to EN 60034-7[1)] (IEC 60034-7)	IM B35 (IM V15, IM V36)
Terminal box location (facing drive end)	Top, rotatable 4 x 90°
Terminal box connection type • Motor • Motor encoder and PTC thermistor	 Terminals in terminal box 17-pin circular socket (without mating connector)
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Stage SR
Shaft and flange accuracy according to DIN 42955 (IEC 60072-1)	Tolerance R (reduced)
Drive end shaft extension	With smooth shaft, without keyway
Hollow ID for shaft	Ø 11.5 mm (0.45 in)
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP65, IP55 on shaft exit
Paint finish	Anthracite gray
Permissible coolant temperature	To prevent the formation of condensation, we recommend a coolant inlet temperature of approximately +30 °C (+86 °F).
Temperature monitoring	Two KTY 84 temperature sensors in the stator winding, of which one as reserve
Sound pressure L_{pA} (1 m) acc. to EN ISO 1680 (tolerance +3 dB)	1PM4 10.: 69 dB 1PM4 13.: 69 dB

1) For types, see "Selection guide".

1PM6 motors with hollow shaft

1PM6 motor (SH 100 and SH 132 with radial and axial fans)

Overview

Air-cooled 1PM6 motors have been specially designed for direct mounting on mechanical spindles. The hollow shaft permits the passage of coolant for internally cooled tools.
The shaft is prepared on the non-drive end of the motor for connection of a turning bushing for input of the coolant.

The 1PM6 motors are rugged and maintenance-free 4-pole squirrel-cage asynchronous motors. They have been designed specifically for use in conjunction with the SINAMICS S drive system.

A fan for providing separate ventilation is mounted either radially or axially on the rear of the motor. The direction of air flow is from the drive end to the non-drive end in order to keep the exhaust heat of the motor away from the machine tool.

The motors have a built-in hollow shaft measuring system for sensing the motor speed and indirect position.

Benefits

- Hollow shaft for passage of coolant with direct spindle mounting
- Maximum speeds up to 12000 rpm
- Full rated torque continuously available, even at standstill
- Axial or radial fans
- High rotational accuracy
- Short ramp-up and braking times.

Applications

- Compact machining centers
- Directly driven tools with internal cooling
- Special machines.

Technical data

Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of up to +40 °C (+104 °F)
Motor fan ratings	3 AC 400 V 50/60 Hz
Built-in encoder systems for motors without DRIVE-CLiQ interface	Incremental encoder sin/cos 1 V_{pp}, 256 pulses/revolution
Type according to EN 60034-7 [1] (IEC 60034-7)	IM B5 (IM V1, IM V3)
Terminal box location (facing drive end)	With axial fan: Top, rotatable 4 x 90° With radial fan: Side right, rotatable 4 x 90°
Terminal box connection type • Motor • Fans • Motor encoder and PTC thermistor	 Terminals in terminal box Terminals in terminal box 17-pin circular socket (without mating connector)
Vibration severity in accordance with EN 60034-14 (IEC 60034-14)	Stage SR
Shaft and flange accuracy according to DIN 42955 (IEC 60072-1)	Tolerance R (reduced)
Drive end shaft extension	With smooth shaft, without keyway
Hollow ID for shaft	Ø 11.5 mm (0.45 in)
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP55, fan IP54
Paint finish	Anthracite gray
Permissible coolant temperature	-15 °C to +40 °C (+5 °F to +104 °F)
Temperature monitoring	Two KTY 84 temperature sensors in the stator winding, of wich one as reserve
Sound pressure L_{pA} (1 m) acc. to EN ISO 1680 (tolerance +3 dB)	From DE to NDE (with the fan operating on a 50 Hz supply system) 1PM6 10.: 70 dB 1PM6 13.: 70 dB

1) For type, see "Selection guide".

Standard type 1PM4/1PM6 motors

Selection/Ordering data

Shaft height SH	Rated speed star	Rated speed delta	Max. permanent speed $n_{S1cont.}$	Max. speed n_{max}	Rated power for **star** n_{NY} = 1500 rpm P_{rated} S1	Rated power for **star** n_{NY} = 1500 rpm P_{rated} S6-40%	Rated power for **delta** $n_{ratedΔ}$ = 4000 rpm P_{rated} S1	Rated power for **delta** $n_{ratedΔ}$ = 4000 rpm P_{rated} S6-40%	**1PM4 asynchronous motor** Order No. **Standard type**	**1PM6 asynchronous motor** Order No. **Standard type**
	rpm	rpm	rpm	rpm	kW (HP)	kW (HP)	kW (HP)	kW (HP)		
									Oil cooling[1]	***Forced cooling***
100	1500	4000	12000	12000	3.7 (5)	5.25 (7)	3.7 (5)	6 (8)	**1PM4 101 - 2LF86 - 1■ S1**	**1PM6 101 - 2LF8■ - 1■ ■1**
	1500	4000			7.5 (10)	11 (14.7)	7.5 (10)	13 (17.4)	**1PM4 105 - 2LF86 - 1■ S1**	**1PM6 105 - 2LF8■ - 1■ ■1**
132	1500	4000	10000	10500	11 (14.7)	16.5 (22.1)	11 (14.7)	19.5 (26.1)	**1PM4 133 - 2LF86 - 1■ S1**	**1PM6 133 - 2LF8■ - 1■ ■1**
	1500	4000			18.5 (24.8)	28 (37.5)	18.5 (24.8)	32 (42.9)	**1PM4 137 - 2LF86 - 1■ S1**	**1PM6 137 - 2LF8■ - 1■ ■1**
	1500	4000			22 (29.5)	33 (44.2)	22 (29.5)	39 (52.3)	**–**	**1PM6 138 - 2LF8■ - 1■ ■1**
									Water cooling [2]	
100	1500		12000	12000	5 (6.7)	6.5 (8.7)	–	–	**1PM4 101 - 2LW26 - 1■ S1**	
	1500				11 (14.7)	14.75 (19.8)			**1PM4 105 - 2LW26 - 1■ S1**	
132	1500		10000	10500	15 (20.1)	21 (28.2)	–	–	**1PM4 133 - 2LW26 - 1■ S1**	
	1500				27 (36.2)	38 (51)			**1PM4 137 - 2LW26 - 1■ S1**	

• Without fan combined with terminal box/metric cable entry	Top/right Top/DE Top/NDE Top/left	**A** **B** **C** **D**		
• Type			IM B5 IM V1 IM V3	**1** **4** **5**
• Axial fan/Bottom-aligned/Direction of air flow DE → NDE combined with terminal box/metric cable entry			Top/right Top/DE Top/NDE Top/left	**A R** **B R** **C R** **D R**
• Radial fan/NDE-aligned/Direction of air flow DE → NDE combined with terminal box/metric cable entry			Side right/bottom Side right/DE Side right/NDE Side right/top	**E D** **F D** **G D** **H D**

1) Star/delta changeover.
2) Only star connection possible.

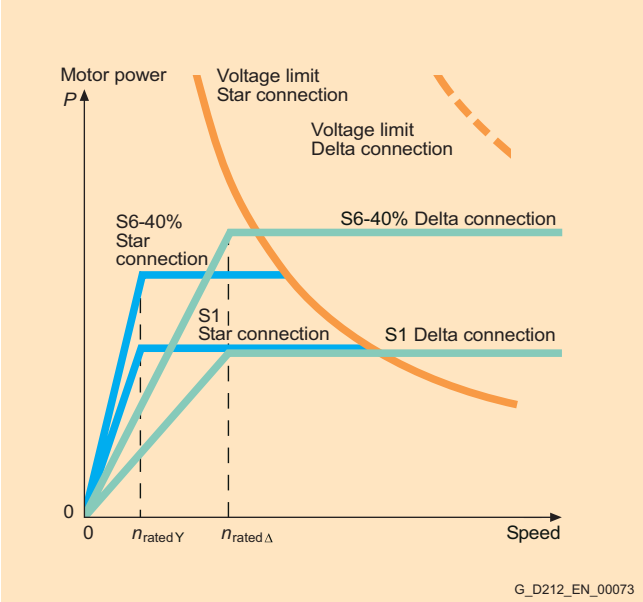
Selection/Ordering data

Motor type (continued)	Rated torque for **star** M_{rated} S1 Nm (lb_f-ft)	Rated torque for **star** M_{rated} S6-40% Nm (lb_f-ft)	Rated torque for **delta** M_{rated} S1 Nm (lb_f-ft)	Rated torque for **delta** M_{rated} S6-40% Nm (lb_f-ft)	Moment of inertia J kg m^2 (lb_f-in-s^2)	Weight 1PM4 kg (lb)	Weight 1PM6 kg (lb)	Rated current for **star** I_{rated} S1 A	Rated current for **star** I_{rated} S6-40% A	**SINAMICS Motor Module** Required rated current I_{rated} S1 A	Order No.
1PM . 101 . . .	24 (17.7)	33 (24.3)	9 (6.6)	14 (10.3)	0.011 (0.0973)	42 (93)	45 (99)	13	17.5	18	**6SL3 120 - ■TE21 - 8AA0**
1PM . 105 . . .	48 (35.4)	70 (51.6)	18 (13.3)	31 (22.9)	0.024 (0.2124)	67 (148)	70 (154)	23	31	30	**- 1TE23-0AA0**
1PM . 133 . . .	70 (51.6)	105 (77.4)	26 (19.2)	47 (34.7)	0.046 (0.4070)	90 (198)	94 (207)	41	58	45	**6SL3 120 - 1TE24 - 5AA0**
1PM . 137 . . .	118 (87)	178 (131.3)	44 (32.5)	76 (56)	0.085 (0.7522)	130 (287)	135 (298)	56	79	60	**- 1TE26 - 0AA0**
1PM . 138 . . .	140 (103.2)	210 (155)	53 (39.1)	93 (68.6)	0.104 (0.9203)	–	156 (344)	58	80	60	**- 1TE26 - 0AA0**
1PM4 101 . . .	32 (23.6)	41 (30.2)	–	–	0.011 (0.0973)	42 (93)	–	18	22.5	18	**6SL3 120 - ■TE21 - 8AA0**
1PM4 105 . . .	70 (51.6)	94 (69.3)	–	–	0.024 (0.2124)	67 (148)	–	38	47	45	**- 1TE24 - 5AA0**
1PM4 133 . . .	95 (70)	134 (99)	–	–	0.046 (0.4070)	90 (198)	–	55	74	60	**6SL3 120 - 1TE26 - 0AA0**
1PM4 137 . . .	172 (126.9)	242 (178.5)	–	–	0.085 (0.7522)	130 (287)	–	85	114	85	**- 1TE28 - 5AA0**
Single Motor Module Double Motor Module											**1** **2**

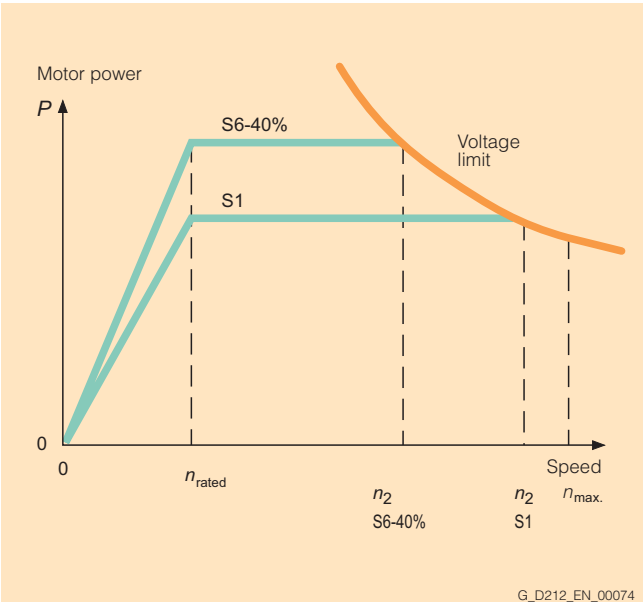
1PM6 (radial fan), 1PM6 (axial fan) and 1PM4 (liquid-cooled) asynchronous motors

1PM4/1PM6 motors

Characteristics



Typical power-speed diagram for 1PM4 star/delta changeover motors [1] oil-cooled and 1PM6 motors [1]



Typical power-speed diagram for 1PM4 motors [1] water-cooled

The diagrams show the typical ratio between motor speed and drive power for 1PM4/1PM6 motors in the following duty types (according to IEC 60034-1):

S1: Continuous duty

S6-40%: Continuous duty with intermittent loading and a relative ON period of 40% (S6-40%) with a maximum duty cycle time of 10 minutes.

Motor type	Rated speed	Attainable speed for rated power in duty type (according to IEC 60034-1)		Rated speed	Attainable speed for rated power in duty type (according to IEC 60034-1)	
	Star circuit			Delta circuit		
	n_{ratedY}	n_2 [2] S1	S6-40%	$n_{ratedΔ}$	n_2 [2] S1	S6-40%
	rpm	rpm	rpm	rpm	rpm	rpm
Forced cooling						
1PM6 101	1500	9710	7170	4000	12000	12000
1PM6 105	1500	9000	6360	4000	12000	12000
1PM6 133	1500	8000	8140	4000	10500	10500
1PM6 137	1500	7000	5920	4000	10500	10500
1PM6 138	1500	4000	4000	4000	6000	6500
Oil cooling						
1PM4 101	1500	9710	7170	4000	12000	12000
1PM4 105	1500	9000	6360	4000	12000	12000
1PM4 133	1500	8000	8140	4000	10500	10500
1PM4 137	1500	7000	5920	4000	10500	10500
Water cooling						
1PM4 101	1500	9670	7590	–	–	–
1PM4 105	1500	9460	7130	–	–	–
1PM4 133	1500	8290	6130			
1PM4 137	1500	6860	4920	–	–	–

1) For additional information, refer to the 1PM Motors Planning Guide.

2) Values from the power-speed diagram based on using an Active Line Module on a 3 AC 400 V supply system. If using the Smart Line Module, proceed in accordance with the 1PM Planning Guide.

Active parts of 1PH2 built-in asynchronous motors

Overview

1PH2 built-in motors for lathes are liquid-cooled squirrel-cage AC asynchronous motors. These built-in motors have been specially developed for variable-speed operation of main spindles on lathes.

Benefits

- Compact design obtained by dispensing with mechanical components such as coupling, belt drive, gearbox and spindle encoder
- High power density as a result of liquid cooling
- The absence of drive transverse forces permits extremely high accuracy on workpiece due to smooth, accurate spindle motion even at very low speeds
- Extremely short ramp-up and braking times
- Full rated torque continuously available, even at standstill
- Simple servicing by replacing complete motor spindles
- Increased rigidity of the spindle drive, achieved by mounting the motor components between the main spindle bearings
- C-axis compatibility due to hollow-shaft measuring system mounted on spindle
- Low noise due to absence of machine elements
- Torque is transmitted to the spindle mechanically without play by means of a cylindrical stepped press fit. The rotor is mounted on the spindle by thermal shrinking. The bond can be released by pressure-oil injection without affecting the joint surfaces.
- The rotor with sleeve is pre-balanced and can be removed and subsequently remounted.
- The rotor with sleeve is finished-machined - that is, the rotor outer diameter need not be finished after mounting.

Applications

1PH2 built-in motors are used for machines requiring an extremely high standard of machining, accuracy and running smoothness.

- Lathes
- Grinders.

Please see "Liquid cooling" for a list of heat exchanger manufacturers.

Technical data

Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature up to +25 °C (+86 °F)
Recommended motor encoder (not included with motor)	SIMAG H2 hollow-shaft measuring system
Type (see ISO)	Individual components: Stator, rotor
Type of motor connection	Free cable ends, length 0.5 m or 1.5 m (19.69 in or 59.06 in)
Balance quality of rotor according to ISO 1940-1	Shaft heights 093 to 256: G 2.5 Reference speed 3600 rpm
Degree of protection according to IEC 60034-5	IP00
Permissible coolant temperature	To prevent the formation of condensation, we recommend an inlet temperature of approximately +25 °C (+86 °F).
Temperature monitoring	Two KTY 84 temperature sensors in the stator winding, of which one as reserve

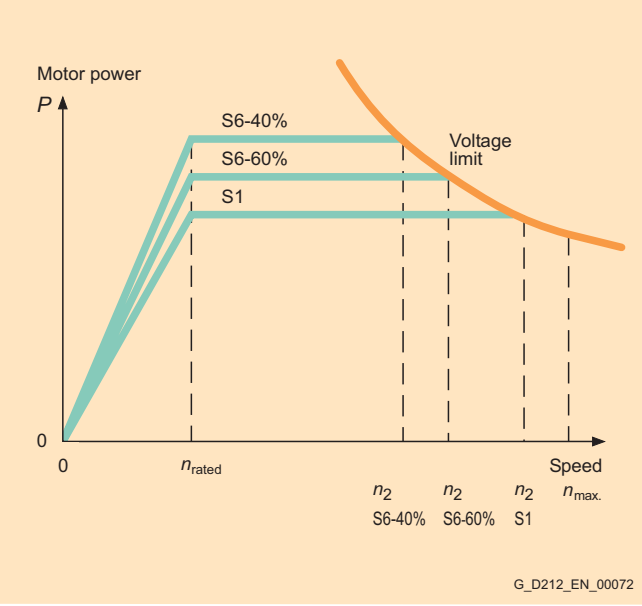
Standard type 1PH2 motors

Selection/Ordering data

Rated speed n_{rated} rpm	Max. speed n_{max} rpm	Motor rated power for duty type (according to IEC 60034-1) [1] P_{rated} S1 kW (HP)	S1 ΔT=105 K kW (HP)	S6-60% kW (HP)	S6-40% kW (HP)	1PH2 asynchronous built-in motor Order No. **Standard type**	Rated torque [1] M_{rated} ΔT= 105 K Nm (lb_f-ft)	
1500	10000	7.5 (10)	9.4 (12.6)	8.2 (11)	9 (12.1)	**1PH2 093 - 6WF4** ■	48 (35.4)	60 (44.2)
		10.1 (13.5)	13 (17.4)	11 (14.7)	12 (16.1)	**1PH2 095 - 6WF4** ■	64 (47.2)	83 (61.2)
1500	10000	15.1 (20.2)	18.5 (24.8)	17 (22.8)	19 (25.5)	**1PH2 113 - 6WF4** ■	95 (70.1)	118 (87)
		16.5 (22.1)	21.5 (28.8)	18.5 (24.8)	21 (28.2)	**1PH2 115 - 6WF4** ■	105 (77.4)	137 (101)
		18.1 (24.3)	23.7 (31.8)	20.5 (27.5)	23 (30.8)	**1PH2 117 - 6WF4** ■	115 (84.8)	151 (111.4)
		23.6 (31.6)	30.9 (41.4)	26.0 (34.9)	29.5 (39.5)	**1PH2 118 - 6WF4** ■	146 (107.7)	197 (145.3)
750	8000	11.8 [2] (15.8)	14.4 (19.3)	14.8 (19.8)	17.7 (23.7)	**1PH2 182 - 6WC4 1**	150 (110.6)	183 (135)
600	8000	14.5 [2] (19.4)	17.7 (23.7)	18.1 (24.3)	22 (29.5)	**1PH2 184 - 6WP4 1**	230 (169.6)	281 (207.3)
500	6000	18.3 (24.5)	22.4 (30)	21.8 (29.2)	25.8 (34.6)	**1PH2 186 - 6WB4 1**	350 (258.2)	428 (315.7)
500	6000	23.6 (31.6)	28.8 (38.6)	29 (38.9)	33 (44.2)	**1PH2 188 - 6WB4 1**	450 (332)	551 (406.4)
500	6000	28.8 [2] (38.6)	35.3 (47.3)	36 (48.3)	40.6 (54.4)	**1PH2 254 - 6WB4 1**	550 (405.7)	673 (496.4)
	4000	39.3 [2] (52.7)	48.1 (64.5)	48.8 (65.4)	55 (73.7)	**1PH2 256 - 6WB4 1**	750 (553)	918 (677.1)

Free cable ends	
• Length: 1.5 m (59.06 in)	**1**
• Length: 0.5 m (19.69 in) (preferred type)	**2**

Characteristics



Typical power-speed diagram for AC motors [3]

Motor Type	Rated speed n_{rated} rpm	Attainable speed for rated power in duty type (according to IEC 60034-1) n_2 [4] S1 rpm	S6-60% rpm	S6-40% rpm
1PH2 093	1500	4700	4200	3900
1PH2 095	1500	4000	3600	3300
1PH2 113	1500	5400	4800	4400
1PH2 115	1500	4500	4100	3700
1PH2 117	1500	4700	4200	3800
1PH2 118	1500	5300	4700	4300
1PH2 182	750	4700	3700	3200
1PH2 184	600	7000	5500	4500
1PH2 186	500	5000	3500	3000
1PH2 188	500	4400	3600	3100
1PH2 254	500	6000	5000	4500
1PH2 256	500	3700	2900	2600

The diagram shows the typical ratio between motor speed and drive power for 1PH2 motors in the following duty types (according to IEC 60034-1):

S 1: Continuous duty
S 6: Continuous duty with intermittent loading and a relative ON period of 60% (S6-60%) or 40% (S6-40%) with a maximum duty cycle time of 10 minutes.

1) Data given for ΔT = 70 K, unless otherwise stated.
2) Version available on request.
3) For additional configuration information, refer to the 1PH Motors Planning Guide.
4) Values from the power-speed diagram based on using an Active Line Module on a 3 AC 400 V supply system.
If using a Smart Line Module, proceed in accordance with the 1PH Planning Guide.

Selection/Ordering data

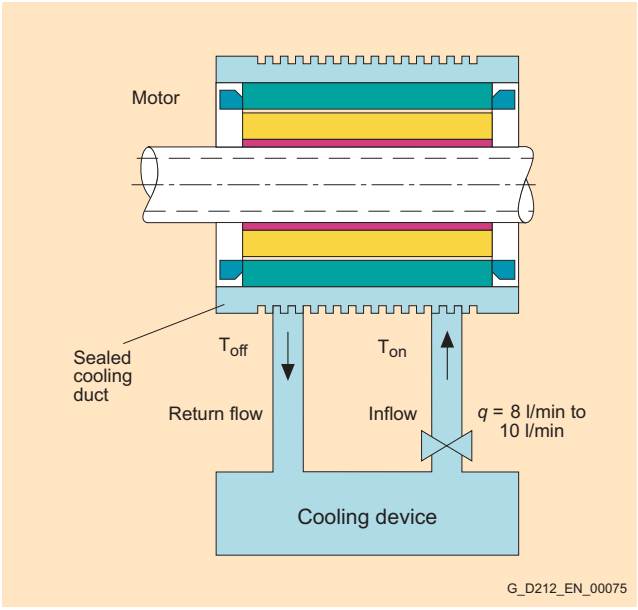
Motor type (continued)	Moment of inertia of rotor	Weight (rotor and stator) approx.	Motor rated power for duty type (according to IEC 60034-1) [1]			SINAMICS Motor Module Required rated current	
	J		I_{rated}			I_{rated}	Order No.
			S1	S6-60%	S6-40%	S1	
	kg m^2 (lb$_f$-in-s^2)	kg (lb)	A	A	A	A	
1PH2 093 - 6W...	0.028 (0.2478)	33 (73)	24	26	28	30	**6SL3 120 - 1TE23 - 0AA0**
1PH2 095 - 6W...	0.036 (0.3186)	42 (93)	30	32	34	30	**- 1TE23 - 0AA0**
1PH2 113 - 6W...	0.066 (0.5841)	51 (112)	56	61	67	60	**6SL3 120 - 1TE26 - 0AA0**
1PH2 115 - 6W...	0.073 (0.6460)	56 (123)	55	60	66	60	**- 1TE26 - 0AA0**
1PH2 117 - 6W...	0.079 (0.6991)	62 (137)	60	67	74	60	**- 1TE26 - 0AA0**
1PH2 118 - 6W...	0.100 (0.8850)	78 (172)	82	90	100	85	**- 1TE28 - 5AA0**
1PH2 182 - 6W...	0.207 (1.8319)	98 (216)	37	44	52	45	**6SL3 120 - 1TE24 - 5AA0**
1PH2 184 - 6W...	0.302 (2.6726)	135 (298)	56	68	80	60	**- 1TE26 - 0AA0**
1PH2 186 - 6W...	0.440 (3.8939)	191 (421)	65	77	87	85	**- 1TE28 - 5AA0**
1PH2 188 - 6W...	0.552 (4.8851)	237 (523)	78	92	103	85	**- 1TE28 - 5AA0**
1PH2 254 - 6W...	1.178 (10.4251)	259 (571)	117	141	161	132	**6SL3 120 -1TE31 - 3AA0**
1PH2 256 - 6W...	1.623 (14.3633)	343 (756)	119	143	158	132	**-1TE31 - 3AA0**
Single Motor Module							**1**

for 1PH4/1PM4/1PH2 asynchronous motors

Overview

Cooling principle

Refer to the Planning Guide for the layout of the heat exchangers.



Heat exchanger manufacturers

These are non-Siemens products which we know to be fundamentally suitable. It goes without saying that similar products from other manufacturers can also be used. You should consider our recommendations as support and not as specification. We do not warrant the composition, nature, state or quality of non-Siemens products.

Please contact the companies below for technical information.

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Hyfra Industriekühlanlagen **www.hyfra.de**

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KKT Kraus Industriekühlung GmbH **www.kkt-kraus.com**

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SP planetary gear units for 1FT6 motors (standard type)

Overview

1FT6 motors can be combined with planetary gear units to form compact coaxial drive units. The gear units are mounted directly to the drive end of the motors.

When selecting the gear units, ensure that the permissible speed of the gear unit is not exceeded by the maximum speed of the motor. In the case of high operating frequencies, allowance must be made for the withstand ratio f_2 (see Planning Guide). The frictional losses of the gear unit must always be taken into account when planning.

The gear units are only available in non-balanced design.

Benefits

- High efficiency (>94% two-stage, >97% single-stage)
- Power transmission from the central sun gear via planetary gears
- No shaft deflections in the planetary gear set due to the symmetrical force distribution
- Very low moment of inertia and hence short acceleration times of the motors
- Output shaft bearings dimensioned for high lateral and axial loads with preloaded tapered-roller bearings
- The enclosed gear units, which are filled with oil before leaving the factory, are attached to the shaft by means of an integral clamping hub. A smooth motor shaft extension and vibration severity degree N in accordance with EN 60034-14 are required for this purpose. Rotational accuracy tolerance N in accordance with DIN 42955 will suffice.
- Operation possible in all mounting positions.
- The gear units are filled with a high quality synthetic gear oil with viscosity class ISO VG 220 before leaving the factory. The oil fill volume is for mounting position IM B5. In the case of single-stage gear units in sizes SP 060 to SP 140, the oil volumes are the same for all mounting positions. In the case of sizes SP 180 to SP 240 and all two-stage gear units, different oil volumes are required for other mounting positions. Please state the mounting position when placing your order.
- Output shaft of gear unit exactly coaxial with the motor
- Oil seal on motor side included in the gear unit
- Small dimensions
- Low weight
- Degree of protection IP64.

1FT6 motor with mounted planetary gear units

Integration

The gear units assigned to the individual motors and gear ratios *i* available for these motor/gear combinations are listed in the selection table. When making a selection, the maximum permissible input speed of the gear unit must be observed (this is the same as the maximum motor speed).

The motor/gear combinations listed in the selection tables are mainly intended for positioning duty (S5). For applications involving continuous operation at high speed, please contact the gear unit manufacturer.

Observe the information in the Planning Guide when assigning gear units to the motor.

Single-stage SP planetary gear units for 1FT6 motors (natural cooling)

Selection/Ordering data

Ordering data: **1FT6■■■-■A■7■-■■■■-Z**
V■■
G 0
H 1
2
6

Order No. of the motor (standard type) with codes **"-Z"** and
Code for mounting the planetary gear assigned to the specific motor
Requirement for mounting planetary gear units:
Smooth motor shaft/rotational accuracy tolerance N and vibration severity

Motor natural cooling	**Planetary gear unit single-stage** Circumferential backlash [1] ≤ 4 arcmin		**Available gear ratio *i* =**				Max. permissible input speed	Max. perm. output torque	Max. perm. drive shaft load [2]	Moment of inertia of gear unit
Type	Type	Gear unit weight approx. kg (lb)	**4**	**5**	**7**	**10**	n_{G1} rpm	M_{G2} Nm (lb_f-ft)	F_r N (lb_f)	J_G at i = 4 10^{-4} kg m² (lb_f-in-s²)
1FT6 024	SP 060-MF1	1.5 (3.3)	✓	✓	✓	✓	6000	40 (29.5) [32 (23.6) for i = 10]	2600 (584.5)	0.17 (0.00015)
1FT6 031			✓	✓	✓	✓				0.17 (0.00015)
1FT6 034			✓	✓	✓					
1FT6 034	SP 075-MF1	2.8 (6.2)				✓	6000	100 (73.8) [80 (59) for i = 10]	3800 (854.3)	0.57 (0.0005)
1FT6 041			✓	✓	✓	✓				0.63 (0.00055)
1FT6 044			✓	✓	✓					
1FT6 044	SP 100-MF1	6.2 (13.7)				✓	4500	250 (184.4) [200 (147.5) for i = 10]	6000 (1348.9)	2 (0.0018)
1FT6 061			✓	✓	✓	✓				2.7 (0.0024)
1FT6 062			✓	✓	✓	✓				
1FT6 064			✓	✓	✓	✓				
1FT6 081	SP 140-MF1	11.5 (25.4)	✓	✓	✓	✓	4000	500 (368.8) [400 (295) for i = 10]	9000 (2023.3)	8.4 (0.0074)
1FT6 082			✓	✓	✓	✓				
1FT6 084			✓	✓	✓	✓				
1FT6 086			✓	✓	✓					
1FT6 086	SP 180-MF1	27 (59.6)				✓	3500	1100 (811.4) [880 (649.1) for i = 10]	14000 (3147.3)	30.6 (0.0271)
1FT6 102			✓	✓	✓	✓				31.7 (0.0281)
1FT6 105			✓	✓	✓					
1FT6 108			✓	✓	✓					
1FT6 105	SP 210-MF1	53 (116.9)				✓	2500	1900 (1401.4) [1520 (1121.2) for i = 10]	18000 (4046.6)	75.8 (0.0671)
1FT6 108						✓				
1FT6 132			✓	✓	✓					
1FT6 134			✓	✓	✓					
1FT6 136			✓	✓	✓					
1FT6 132	SP 240-MF1	80 (176.4)				✓	2200	2720 (2006.3)	27000 (6069.9)	146.3 (0.1295)
1FT6 134						✓				
1FT6 136						✓				

Order codes				
• Gear shaft with featherkey	**V02**	**V03**	**V05**	**V09**
• Gear shaft without featherkey	**V22**	**V23**	**V25**	**V29**

1) For SP 060 and SP 075: ≤ 6 arcmin.

2) Guide values for the maximum permissible load on the midpoint of the drive shaft at speed n_{G2} = 300 rpm. Axial load $F_a = 0.5 \times F_r$ on SP 060 to SP 180. $F_a = F_r$ on SP 210 and SP 240.

Two-stage SP planetary gear units for 1FT6 motors (natural cooling)

Selection/Ordering data

Ordering data **1FT6■■■-■A■7■-■■■■-Z**
V■■

G 0
H 1
2
6

Order No. of the motor (standard type) with codes **"-Z"** and
Code for mounting the planetary gear assigned to the specific motor
Requirement for mounting planetary gear units:
Smooth motor shaft/rotational accuracy tolerance N and vibration severity grade N

Motor natural cooling	**Planetary gear unit two-stage** Circumferential backlash [1] ≤ 6 arcmin		**Available gear ratio *i* =**					Max. permissible input speed	Max. perm. output torque	Max. perm. drive shaft load [2]	Moment of inertia of gear unit
Type	Type	Gear unit weight approx. kg (lb)	16	20	28	40	50	n_{G1} rpm	M_{G2} Nm (lb_f-ft)	F_r N (lb_f)	J_G at i = 16 10^{-4} kg m^2 (lb_f-in-s^2)
1FT6 024	SP 075-MF2	3.1 (6.8)	✓	✓	✓	✓	✓	6000	100 (73.8)	3800 (854.3)	0.52 (0.0005)
1FT6 031			✓	✓	✓	✓	✓				0.52 (0.0005)
1FT6 034			✓	✓							
1FT6 034	SP 100-MF2	7.1 (15.7)			✓	✓	✓	4500	250 (184.4)	6000 (1348.9)	1.7 (0.0015)
1FT6 041			✓	✓	✓	✓					1.8 (0.0016)
1FT6 044			✓	✓							
1FT6 061			✓	✓	✓						2.5 (0.0022)
1FT6 062			✓	✓							
1FT6 041	SP 140-MF2	14.5 (32)					✓	4000	500 (368.8)	9000 (2023.3)	4.4 (0.0039)
1FT6 044					✓	✓	✓				
1FT6 061						✓	✓				5.1 (0.0045)
1FT6 062					✓	✓					
1FT6 064			✓	✓							
1FT6 062	SP 180-MF2	29 (63.9)					✓	4000	1100 (811.4)	14000 (3147.3)	5.5 (0.0049)
1FT6 064					✓	✓	✓				
1FT6 081			✓	✓	✓	✓	✓				8.2 (0.0073)
1FT6 082			✓	✓	✓	✓					
1FT6 084			✓	✓							
1FT6 086			✓	✓							
1FT6 082	SP 210-MF2	48 (105.8)					✓	3500	1900 (1401.4)	18000 (4046.6)	34.5 (0.0305)
1FT6 084					✓	✓					
1FT6 086					✓						
1FT6 102			✓	✓	✓						35.6 (0.0315)
1FT6 105			✓								
1FT6 084	SP 240-MF2	70 (154.3)					✓	3500	3400 (2507.8)	27000 (6069.9)	43.1 (0.0381)
1FT6 086						✓	✓				
1FT6 102						✓	✓				44.2 (0.0391)
1FT6 105				✓	✓						
1FT6 108			✓	✓							

Order codes					
• Gear shaft with featherkey	**V12**	**V13**	**V15**	**V16**	**V17**
• Gear shaft without featherkey	**V32**	**V33**	**V35**	**V36**	**V37**

1) For SP 060 and SP 075: ≤ 8 arcmin.
2) Guide values for the maximum permissible load on the midpoint of the drive shaft at speed n_{G2} = 300 rpm. Axial load $F_a = 0.5 \times F_r$ on SP 075 to SP 180. $F_a = F_r$ on SP 210 and SP 240.

LP planetary gear units for 1FK7 motors

Overview

1FK7 motors can easily be combined with planetary gear units to form compact coaxial drive units. The gear units are flanged directly to the drive end of the motors.

When selecting the gear units, ensure that the permissible speed of the gear unit is not exceeded by the maximum speed of the motor. In the case of high operating frequencies, allowance must be made for the withstand ratio f_2 (see Planning Guide). The frictional losses of the gear unit must always be taken into account when planning.

The gear units are only available in non-balanced design and with featherkey.

Benefits

- High efficiency (> 97%)
- Circumferential backlash: Single-stage ≤ 12 arcmin
- Power transmission from the central sun gear via planetary gears
- No shaft deflections in the planetary gear set due to the symmetrical force distribution
- The enclosed gear units, which are filled with grease before leaving the factory, are attached to the shaft by means of an integral clamping hub. This requires a smooth motor shaft extension with rotational accuracy tolerance N according to DIN 42955. The motor flange is fitted by means of adapter plates.
- Seal on motor side included in the gear unit
- Output shaft of gear unit exactly coaxial with the motor
- The gear units are suitable for all mounting positions.
- The gear units are filled with grease before leaving the factory. They are lubricated and sealed for life (service life 20000 hours).
- Degree of protection IP64
- Small dimensions
- Low weight.

LP planetary gear unit

Integration

The gear units assigned to the individual motors and gear ratios *i* available for these motor/gear combinations are listed in the selection table. When making a selection, the maximum permissible input speed of the gear unit must be observed (this is the same as the maximum motor speed).

The motor/gear combinations listed in the selection table are mainly intended for positioning duty (S5). Continuous operation (S1) is permissible at the rated speed and rated torque of the gear unit. The gear unit temperature must not exceed +90 °C (+194 °F).

Selection/Ordering data

Ordering data: **1FK7 ■■■ - ■A■71 - 1■■■ - Z** Order No. of the motor with codes **"-Z"** and
V■■ Code for mounting the planetary gear assigned to the specific motor
G Requirement: Smooth motor shaft
H

Motor natural cooling	**Planetary gear unit single-stage** Circumferential play ≤ 12 arcmin		**Available gear ratios *i* =**		Maximum permissible input speed [1]	Maximum permissible output torque [1]		Max. perm. radial force on output shaft [2]	Moment of inertia of gear unit
Type	Type	Gear unit weight approx. kg (lb)	**5**	**10**	n_{G1} rpm	M_{G2} at $i = 5$ Nm (lb_f-ft)	M_{G2} at $i = 10$ Nm (lb_f-ft)	F_r N (lb_f)	J_G at $i = 5/10$ 10^{-4} kg m^2 (lb_f-in-s^2)
1FK7 022	LP 050-M01	0.77 (1.7)	✓		8000	11.5 (8.5)	10.5 (7.7)	650 (146.1)	0.059 (0.00005)
1FK7 022	LP 070-M01	1.9 (4.2)		✓	6000	32 (23.6)	29 (21.4)	1450 (326)	0.28 (0.00025)
1FK7 032			✓	✓					
1FK7 033			✓	✓					
1FK7 040	LP 090-M01	4.1 (9)	✓	✓	6000	80 (59)	72 (53.1)	2400 (540)	1.77 (0.0016)
1FK7 042			✓	✓					
1FK7 043			✓	✓					
1FK7 044			✓	✓					
1FK7 060	LP 120-M01	9 (19.8)	✓	✓	4800	200 (147.5)	180 (132.8)	4600 (1034.1)	5.42 (0.0048)
1FK7 061			✓	✓					
1FK7 063			✓	✓					
1FK7 064			✓						
1FK7 080	LP 155-M01	17.5 (38.6)	✓	✓	3600	400 (295)	320 (236)	7500 (1686.1)	25.73 (0.0228)
1FK7 082			✓	✓					
1FK7 083			✓	✓					
1FK7 085			✓						
1FK7 100			✓						
1FK7 101			✓						
1FK7 103			✓						

Code • Gear shaft with featherkey	**V40**	**V42**

Continuous duty S1

Continuous operation is permissible at the rated speed and rated torque of the gear unit. The gear unit temperature must not exceed +90 °C (+194 °F).

Planetary gear unit single-stage Circumferential play ≤ 12 arcmin	Rated input speed	Rated output torque	
Type	n_{rated1} rpm	M_{rated2} at $i = 5$ Nm (lb_f-ft)	M_{rated2} at $i = 10$ Nm (lb_f-ft)
LP 050-M01	4000	5.7 (4.2)	5.2 (3.8)
LP 070-M01	3700	16 (11.8)	15 (11.1)
LP 090-M01	3400	40 (29.5)	35 (25.8)
LP 120-M01	2600	100 (73.8)	90 (66.4)
LP 155-M01	2000	290 (213.9)	170 (125.4)

1) Values for positioning duty S5
2) Referred to the center of the output shaft at 100 rpm

2-speed gearboxes for 1PH7/1PH4 motors

Applications

Multi-speed gearboxes increase the drive torque at low motor speeds and expand the band of constant power output available from the main spindle motor. The full cutting capacity of modern machine tools can therefore be utilized throughout the entire speed range.

Benefits

The performance features of the 2-speed gearboxes for 1PH7/1PH4 motors are as follows:

- Drive power up to 100 kW (134 HP)
- Constant power band at drive shaft up to 1:24
- Bidirectional
- Motor shaft heights SH 100 to SH 225
- Types IM B35 and IM V15 (IM V36 available on request)

Mounting the gearbox outside the headstock of the machine tool has the following advantages:

- Easy adaptation to the machine tool
- Low noise and no temperature fluctuations due to gearing inside the headstock
- Separate lubrication systems for the main spindle (grease) and the gearbox (oil)
- Gear unit efficiency > 95%
- Instead of V-belts, the power output can also be transmitted from the gear drive output shaft by a spur gear pinion (available on request) or coaxially by means of a flexible coupling.

Design

The 2-speed gearboxes are planetary gear units. The central sun gear distributes the power to several planet wheels, which revolve around it. The outstanding advantage of this design is its compactness. The gear-changing device, a splined sleeve that moves axially, is of form-fit design.

Position 1: Gear ratio $i_1 = 4$
Position 2: Gear ratio $i_2 = 1$

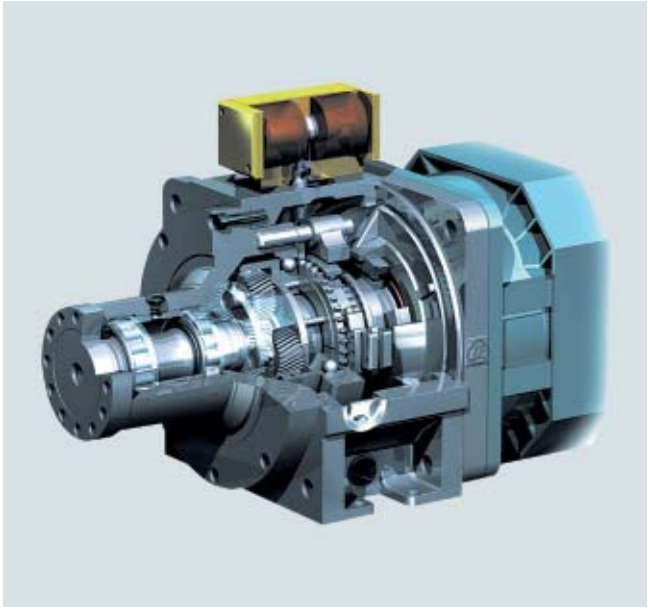
The motor is flanged onto the gearbox via an adapter plate. The AC motor must be suitably prepared for mounting.

For shaft heights of 160 and above, motors of types IM B35 and IM V15 must be supported free from stress on the non-drive end.

Any lateral forces imported into the gear unit have to be borne by the gear unit and transmitted to the machine base.

The motors for all 2K gear units must be full-key balanced with featherkey. Because the 2K 120, 2K 250, 2K 300 gear units are enclosed, the motor flange is adequately sealed in the standard version.
Vertical mounting positions for the IM V15 and IM V36 require circulating-oil lubrication of the gear units.

The standard version of the gearboxes up to and including the 2K 300 has a maximum circumferential backlash of 30 angular minutes (measured at the gear output). Several special versions suitable for milling or machining with cut interruption can be supplied on request:
- Reduced backlash with special features: max. 20'
- Reduced backlash for high performance: max. 15'



Profile of a planetary gear unit

The power unit (i.e. the motor and gear unit) is supplied with vibration severity grade R according to EN 60034-14 (IEC 60034-14). This is also the case when the motor is ordered with grade S.

The belt pulley [1] should be a cup-wheel type pulley. For mounting the pulley, the output shaft on the gear has a flange with an external centering spigot and tapped holes for easy fitting and removal of the pulley.

Motors with mounted planetary gear units

1PH motors can also be supplied with flange-mounted planetary gear units. The motor-gear unit is tested for correct functioning. The complete drive unit - i.e. 1PH7 or 1PH4 motor with mounted ZF gearbox - can be ordered directly from Siemens:

Siemens AG
Industrial Solutions
and Services
Contact: Mr. Britz

Im Schiffelland 10
D-66386 St. Ingbert

Fax: +49 (0) 68 94 - 8 91 - 1 12
E-mail: hans-peter.britz@siemens.com

The following details must be specified with the order:

Ordering example for 1PH4 motor:

Motor complete with gear unit
1PH4 133 - 4NF26 - Z
K00
2LG4 315 - 3FD11

Ordering example for 1PH7 motor:

Motor complete with gear unit
1PH7 186 - 2NE03 - 0BC2
2LG4 260 - 1JC21
1PH7 163 - 2NF03 - 0CC0
2LG4 320 - 3JD11

1) Not included.

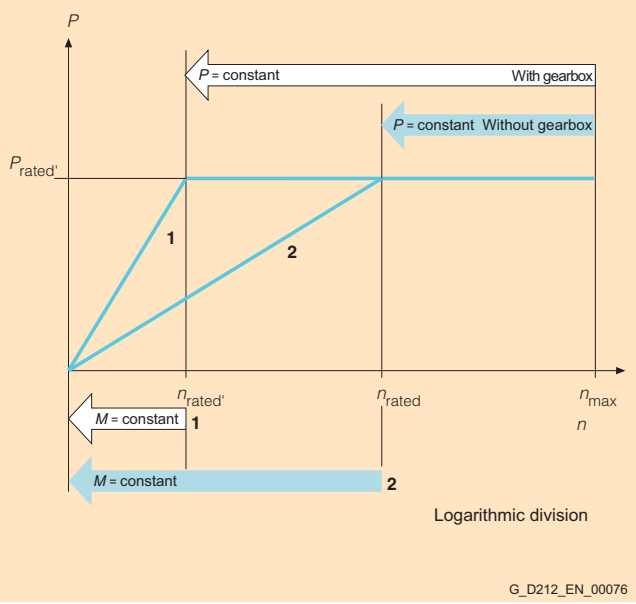
Technical specifications

Motor	Gear unit											
Shaft height SH	ZF type	Type	Max. perm. speed 1)	Permissible rated torque (S1 duty)			Permissible maximum torque (S6-60% duty)			Moment of inertia of gear unit		Gear unit weight approx.
			Drive	Drive	Output $i = 1$	Output $i = 4$	Drive	Output $i = 1$	Output $i = 4$	Output $i = 1$	Output $i = 4$	
			n_{max}	M	M	M	M	M	M	J	J	m
			rpm	Nm (lb_f-ft)	Nm (lb_f-ft)	Nm (lb_f-ft)	Nm (lb_f-ft)	Nm (lb_f-ft)	Nm (lb_f-ft)	kgm^2 (lb_f-in-s^2)	kgm^2 (lb_f-in-s^2)	kg (lb)
100	2K 120	2LG4 312 - . . .	8000	120 (88.5)	120 (88.5)	480 (354)	140 (103.3)	140 (103.3)	560 (413.1)	0.0110 (0.0973)	0.0114 (0.1009)	30 (66.2)
132	2K 250	2LG4 315 - . . .	6300	250 (184.4)	250 (184.4)	1000 (737.6)	400 (295)	400 (103.3)	1600 (1180.2)	0.0270 (0.2389)	0.0570 (0.5044)	62 (136.7)
160	2K 300	2LG4 320 - . . .	6300	300 (221.3)	300 (221.3)	1200 (885.1)	400 (295)	400 (295)	1600 (1180.2)	0.0270 (0.2389)	0.0570 (0.5044)	70 (154.4)
180	2K 800 2K 801	2LG4 250 - . . . 2LG4 260 . - . . .	5000	800 (590.1)	800 (590.1)	3200 (2360.3)	900 (663.8)	900 (663.8)	3600 (2655.4)	0.1956 (1.781)	0.1766 (1.5629)	110 (242.6)
225	2K 802	2LG4 270 . - . . .	On request									

For further binding technical information and planning instructions (e.g. about lubrication, temperature rise and typical applications), please refer to Catalog No. 4161 750 002a available from ZF (Zahnradfabrik Friedrichshafen, www.zf.com). The permissible ratings of the motor and gear unit must be taken into account when dimensioning the overall drive unit (i.e. the motor and gear).

On 1PH4168 or 1PH7167-2NB motors, e.g. the rated torque must be reduced to 300 Nm (2655 lb_f-in). With shaft height 132, please note that the maximum permissible speed of the 2K 250 gear unit for splash lubrication is 6300 rpm.

The use of a gearbox permits the constant power band to be increased significantly.



Power-speed diagram

Type for whole unit	Output flange Dimension D_2	**2-speed gearbox (standard version)** 2) Gear stage $i_1 = 4$	
	mm (in)	Order No.	ZF identifier
For 1PH7 10./1PH4 10. motors			
IM B5, IM B35, IM V1, IM V15	100 (3.94)	**2LG4 312 - 3CC31**	2K 120
For 1PH7 13./1PH4 13. motors			
IM B5, IM B35	118 (4.66)	**2LG4 315 - 3FD11**	2K 250
IM V1, IM V15	118 (4.66)	**2LG4 315 - 3FC11**	2K 250
For 1PH7 16./1PH4 16. motors			
IM B35	130 (5.12)	**2LG4 320 - 3JD11**	2K 300
IM V15	130 (5.12)	**2LG4 320 - 3JC11**	2K 300
For 1PH7 184 motors			
IM B35, IM V15	180 (7.09)	**2LG4 250 - 1JC11**	2K 800
For 1PH7 186 motors			
IM B35, IM V15	180 (7.09)	**2LG4 260 - 1JC21**	2K 801

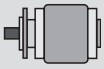
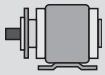
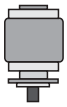
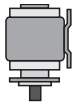
Legend:

n_{rated}	Rated speed
$n_{rated'}$	Rated speed with two-stage gearbox
n_{max}	Max. permissible speed
P_{rated}	Rated power and constant power of the motor in the speed range between n_{rated} and n_{max} or $n_{rated'}$ and n_{max}
M	Torque

1) Higher drive speeds are permitted for gear ratios in some instances with oil-cooled gear units (refer to the ZF Catalog).

2) Special versions, e.g. gear units with different backlash, or other ratios ($i = 3.17$ or $i = 5.5$), are available on request.

Type

Type	Designation	Type	Designation	Type	Designation
	IM B3		IM B5 IM B14		IM B35
	IM V5		IM V1 IM V18		IM V15
	IM V6		IM V3 IM V19		IM V36

Degree of protection

Degree of protection designation according to EN 60034-5 and IEC 60034-5 is made using the letters "IP" and two digits (e.g. IP64). The second digit in the degree of protection designation represents the protection against water, the first digit the protection against penetration of foreign matter.

Since coolants are used for machine tools and transfer machines which contain oil, are able to creep, and may also be corrosive, protection against water alone is insufficient. The designation for the degree of protection should only be considered here as a guideline. Our sealing systems are based on many years of practical experience, exceed the IEC definitions by far, and are appropriate for the requirements of machine tools.

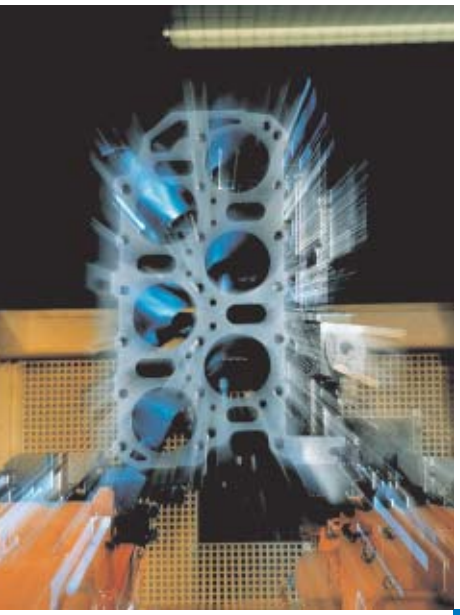
The table can serve as a decision aid for selecting the proper degree of protection for servomotors. With the IM V3/IM V19 designs, permanent liquid on the flange is only permissible with IP67/IP68.

Liquids **Effect**	**General workshop environment**	**Water; gen. coolant** **(95% water, 5% oil); oil**	**Creep oil; petroleum; aggressive coolants**
Dry	IP64	-	
Humid/moist environment	-	IP64	IP67 [1]
Mist		IP65	IP67
Spray	-	IP65	IP68
Jet	-	IP67	IP68
Splash, brief immersion; constant immersion	-	IP67	IP68

1) IP64 with dry run at shaft exit.

Measuring systems
SIMODRIVE sensors

4



4/2 **Built-on optoelectronic rotary encoders**
4/3 Incremental encoders
4/3 Absolute encoders
4/8 Mounting sets

4/9 **SIMAG H2 hollow-shaft measuring system**

Built-on optoelectronic rotary encoders

Overview

SIMODRIVE sensors are built-on optoelectronic encoders for recording paths, angles of rotation, or speeds of machines. They can be used in conjunction with numerical controllers, programmable logic controllers, drives and position displays, e.g. in:

- SINAMICS drive systems
- SIMOTION Motion Control systems
- SINUMERIK CNC controls
- SIMATIC programmable logic controllers
- SIMODRIVE and SIMOVERT MASTERDRIVES drive systems

Applications

A distinction is made between incremental and absolute measuring methods.

- In the case of incremental encoders, the machine must travel to a reference point after each power-off, as the position is not usually stored in the controller, and movements of the machine while the power is off are not recorded.
- Absolute encoders, on the other hand, record these movements while the power is off and return the actual position with power on. Travel to a reference point is not necessary.

Design

All encoders are available in synchronous-flange and flange joint versions. Synchronous-flange encoders can be fixed to the machine with 3 clamp straps or mounted with axial screws. The encoder is driven by means of a plug-in coupling or a spring disk coupling. Alternatively, pulleys can also be used.

The encoder supply voltage is 5 V DC or alternatively 10 V to 30 V DC. The 10 V to 30 V version supports longer cable lengths. The power supply for the measuring systems is provided via the SMC sensor modules.

For rotary encoders with cables, the cable length including the connector is 1 m (3.3 ft).
The following bending radii for the cables at the encoder must be complied with:

- One-time bending: ≥ 20 mm (0.8 in)
- Continuous bending: ≥ 75 mm (3 in)

Built-on optoelectronic rotary encoders
Incremental encoders

Function

Incremental encoders deliver a defined number of electrical pulses per each rotation, which represent the measurement of the traveled distance or angle.

Incremental encoders operate on the principle of optoelectronic scanning of dividing disks using the transmitted light principle. The light source is a light emitting diode (LED). The light-dark modulation generated as the encoder shaft rotates is picked up by photoelectronic elements. With an appropriate arrangement of the line pattern on the dividing disk connected to the shaft and the fixed aperture, the photoelectronic elements provide two trace signals A and B at 90° to one another, as well as a reference signal R. The encoder electronics amplify these signals and convert them into different output levels.

The following output levels are available:

- RS 422 differential signals (TTL)
  In the case of RS 422 encoders (TTL), the resolution can be improved by a factor of four by means of edge evaluation.
- 1 V_{pp} analog signals sin/cos
  Even better resolution can be achieved for encoders with sinusoidal signals by interpolating them in the higher-level controller.
- HTL (High Voltage Transistor Logic)
  Encoders with HTL interfaces are designed for applications with digital inputs with 24 V levels.

Built-on optoelectronic rotary encoders
Absolute encoders

Function

Absolute encoders (absolute shaft encoders) are designed on the same scanning principle as incremental encoders, but have a greater number of tracks. For example, if there are 13 tracks, then 2^{13} = 8192 steps are coded in the case of single-turn encoders. The code used is a one-step code (gray code), which prevents any scanning errors from occurring.

After switching on the machine, the position value is transmitted immediately to the controller. There is no need to travel to a reference point. Data transmission between the encoder and the controller takes place via EnDat or PROFIBUS DP.

SSI and EnDat are of advantage in time-critical applications. In plants with a large number of encoders, PROFIBUS DP is more of an advantage due to the reduced wiring overhead.
Encoders with PROFIBUS DP are programmable and support isochronous mode with internode communication.

Single-turn encoders divide one rotation (360 degrees mechanical) into a specific number of steps, e.g. 8192. A unique code word is assigned to each position. After 360 degrees the position values are repeated.

Multiturn encoders, in addition to the absolute position within one revolution, also record the number of revolutions. To do this, further code discs which are coupled via gear steps with the encoder shaft are scanned. When evaluating 12 additional tracks, 2^{12} = 4096 revolutions can be coded.

Built-on optoelectronic rotary encoders
Incremental encoders

Technical data

	TTL (RS 422) incremental encoder	sin/cos 1 V_{pp} incremental encoder	HTL incremental encoder	TTL (RS 422) double-track incremental encoder
Encoder operating voltage	5 V DC ±10% or 10 V to 30 V DC	5 V DC ±10%	10 V to 30 V DC	5 V DC ±5%
Limit frequency, typ.	–	≥ 180 kHz (-3 dB)	–	–
	–	≥ 450 kHz (-6 dB)	–	–
Sampling frequency (max.)	300 kHz	–	300 kHz	Track 1: 160 kHz Track 2: 1 MHz
No-load current consumption (max.)	150 mA			150 mA per track
Signal level	TTL (RS 422)	sinusoidal 1 V_{pp}	HTL V_H ≥ 21 V at I_H = 20 mA@ 24 V V_L ≤ 2.8 V at I_L = 20 mA@ 24 V	TTL (RS 422)
Outputs protected against short-circuit to 0 V	Yes			
Switching time (10% to 90%) (with 1 m (3.3 ft) cable and recommended input circuit)	Rise/fall time t_+/t_- ≤ 50 ns	–	Rise/fall time t_+/t_- ≤ 200 ns	Rise/fall time t_+/t_- ≤ 100 ns
Phase angle, signal A to B min. edge spacing at:	90	90 ±10°el.	90	90
• 1 MHz		–	–	≥ 0.125 µs (track 2)
• 300 kHz	≥ 0.45 µs	–	≥ 0.45 µs	–
• 160 kHz	–	–	–	≥ 0.8 µs (track 1)
Cable length to electronic circuitry [1], max.	100 m (328 ft)	150 m (492 ft)	100 m (328 ft)	100 m (328 ft) (up to 500 kHz) 50 m (164 ft) (up to 1 MHz)
LED failure monitoring	High-resistance driver	–	High-resistance driver	–
Resolution, max.	5000 S/R	2500 S/R	2500 S/R	Track 1: 1024 S/R Track 2: 9000 S/R
Accuracy (in angular seconds)	±18° mech. × 3600/resolution z			Track 1: ±63 Track 2: ±12
Permissible electr. speed	(18 × 10^6 rpm) / revolution	(27 × 10^6 rpm) / revolution (at -6 dB)	(18 × 10^6 rpm) / revolution	Track 1: 9000 rpm Track 2: 6500 rpm
Max. mech. speed	12000 rpm			
Friction torque	≤ 0.01 Nm (0.08 lb_f-in) (at 20°C (68°F))			
Starting torque	≤ 0.01 Nm (0.08 lb_f-in) (at 20°C (68°F))			
Shaft load capability				
• n > 6000 rpm	Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension			–
• n ≤ 6000 rpm	Axial 40 N (9 lb_f)/radial 60 N (13.5 lb_f) at shaft extension			Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension
Angular acceleration, max.	> 10^5 rad/s^2			
Moment of inertia of rotor	1.45 × 10^{-6} kg m^2 (12.83 x 10^{-6} lb_f-in-s^2)			20 × 10^{-6} kg m^2 (177 x 10^{-6} lb_f-in-s^2)
Vibration (55 Hz to 2000 Hz) to DIN IEC 68-2-6	≤ 300 m/s^2 (984 ft/s^2) for encoder with cable ≤ 150 m/s^2 (492 ft/s^2) for encoder with flange outlet			
Shock (6 ms) to DIN IEC 68-2-27	≤ 2000 m/s^2 (6563 ft/s^2)			
Operating temperature, max.	+100 °C (212 °F) at V_p = 5 V ±10% +70 °C (158 °F) at V_p = 10 V to 30 V	+100 °C (212 °F)	+85 °C (185 °F) +100 °C (212 °F) at V_p < 15 V	+70 °C (158 °F)
Operating temperature, min.	Flange socket or fixed cable: -40 °C (-40 °F) Flexible cable: -10 °C (14 °F)			-10 °C (14 °F)
Degree of protection to DIN EN 60529 (IEC 60529)	IP67 without shaft input IP64 with shaft input			
EMC	Tested in accordance with the electromagnetic compatibility directive 89/336/EEC and the regulations of the EMC guidelines (applicable basic standards)			
Weight, approx.	0.25 kg (0.55 lb)			0.7 kg (1.5 lb)
CE marking	Yes			

1) With recommended cable and input circuitry of the follow-up electronics, observe max. permissible cable length of module to be evaluated.

Selection and ordering data

Designation	Order No.
RS 422 interface (TTL) incremental encoder	
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-2G■■■**
• Radial flange outlet	**6FX2001-2E■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-2C■■■**
Synchronous flange and 10 V to 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-2H■■■**
• Radial flange outlet	**6FX2001-2F■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-2D■■■**
Supported flange joint and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-2R■■■**
• Radial flange outlet	**6FX2001-2P■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-2M■■■**
Supported flange joint and 10 V to 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-2S■■■**
• Radial flange outlet	**6FX2001-2Q■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-2N■■■**
Resolution	
500 S/R	**A 5 0**
1000 S/R	**B 0 0**
1024 S/R	**B 0 2**
1250 S/R	**B 2 5**
1500 S/R	**B 5 0**
2000 S/R	**C 0 0**
2048 S/R	**C 0 4**
2500 S/R	**C 5 0**
3600 S/R	**D 6 0**
5000 S/R	**F 0 0**
sin/cos 1 V_{pp} incremental encoder	
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-3G■■■**
• Radial flange outlet	**6FX2001-3E■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-3C■■■**
Resolution	
1000 S/R	**B 0 0**
1024 S/R	**B 0 2**
2500 S/R	**C 5 0**

Designation	Order No.
HTL interface incremental encoder	
Synchronous flange and 10 V to 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-4H■■■**
• Radial flange outlet	**6FX2001-4F■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-4D■■■**
Supported flange joint and 10 V to 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2001-4S■■■**
• Radial flange outlet	**6FX2001-4Q■■■**
• Cable 1 m (3.3 ft) with connector [1]	**6FX2001-4N■■■**
Resolution	
100 S/R	**A 1 0**
500 S/R	**A 5 0**
1000 S/R	**B 0 0**
2500 S/R	**C 5 0**
RS 422 interface (TTL) double-track incremental encoder	**6FX2001-2UK00**
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Cable 1 m (3.3 ft) with axial connector 2 types of resolution: 9000/1024 S/R	
Replacement connectors with external threads for encoders (3x)	
• 12-pole with 12 contact pins for incremental encoder with RS 422, sin/cos 1 V_{pp} HTL for absolute encoder with SSI	**6FX2003-1CF12**

1) Universal integrated cable outlet for axial and radial outlet direction.
S/R = Signals/Revolution

Built-on optoelectronic rotary encoders
Absolute encoders

Technical data

	EnDat absolute encoder	PROFIBUS DP absolute encoder (EN 50170)
Encoder operating voltage	5 V DC ±10%	10 V to 30 V DC
Power consumption, approx.	250 mA multi-turn, 180 mA single-turn	300 mA to 100 mA (3.5 W)
Clock input	Differential cable receiver according to EIA standard RS 485	Differential cable receiver according to EIA standard RS 485
Data output	Differential cable driver according to EIA standard RS 485	Differential cable driver according to EIA standard RS 485
Short-circuit-proof	Yes	Yes
Data transmission rate	100 kHz to 2 MHz	12 Mbit/s
LED for bus diagnostics	–	yes (green/red)
Permissible electr. speed	5000 rpm at ±1-bit-accuracy 10000 rpm at ±100-bit-accuracy	1500 rpm at ±1-bit accuracy
Max. mech. speed	12000 rpm single-turn 10000 rpm multi-turn	12000 rpm single-turn 6000 rpm multi-turn
Cable length to electronic circuitry [1], max.	Up to 1-MHz-cycle: 50 m (164 ft) Up to 300-kHz-cycle:150 m (492 ft)	Up to 12 Mbit/s 100 m (328 ft) Up to 1.5 Mbit/s 200 m (656 ft) Up to 93.75 kbit/s 1200 m (3938 ft)
Number of nodes, max.	–	99
Connecting	Flange socket, axial/radial	Terminal block with address selector switch and bus terminating resistor in removable cover with 3 radial cable glands
Cable diameter	–	6.5 mm (0.25 in) to 9 mm (0.35 in) Cover can be mounted without interrupting the bus
Resolution	13 bits single-turn (8192 steps) 25 bits multi-turn (8192 × 4096 steps)	13 bits single-turn (8192 steps) 27 bits multi-turn (8192 × 16384 steps)
Telegramme frame length	According to EnDat specification	–
Incremental track	512 S/R, 1 V_{pp}	–
Code type		
• Sampling	Gray	Gray
• Data transfer	Binary	Binary
Parameterization capability		
• Resolution per revolution	–	Between 1 and 8192
• Total resolution	–	Between 1 and 16384
• Preset	–	Yes
• Counting direction	–	Yes
• Speed signal	–	Yes
• Limit switch	–	Yes, 2 pieces
• Isochronous mode and internode communication acc. to DP V2	–	Yes
Online parameterization	–	Yes
Network load, approx.	–	20 µs per encoder at 12 Mbit/s
Cycle time	–	667 µs
Accuracy	±60 angular seconds (incr. track) tested acc. to DIN EN	±½ LSB
EMC	Tested acc. to DIN EN 50081 and EN 50082	Tested acc. to DIN EN 50081 and EN 50082
Friction torque	≤ 0.01 Nm (0.08 lb_f-in) (at 20 °C (68 °F))	≤ 0.01 Nm (0.08 lb_f-in) (at 20 °C (68 °F))
Starting torque	< 0.01 Nm (0.08 lb_f-in) (at 20 °C (68 °F))	< 0.01 Nm (0.08 lb_f-in) (at 20 °C (68 °F))
Shaft load capability		
• n > 6000 rpm	Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension	Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension
• n ≤ 6000 rpm	Axial 40 N (9 lb_f)/radial 60 N (13.5 lb_f) at shaft extension	Axial 40 N (9 lb_f)/radial 60 N (13.5 lb_f) at shaft extension
Angular acceleration, max.	10^5 rad/s^2	10^5 rad/s^2
Moment of inertia of rotor	1.45 × 10^{-6} kg m^2 (12.83 x 10^{-6} lb_f-in-s^2)	1.45 × 10^{-6} kg m^2 (12.83 x 10^{-6} lb_f-in-s^2)

1) Observe the maximum permissible cable length of the connected module.

Technical data (continued)

	EnDat absolute encoder	PROFIBUS DP absolute encoder (EN 50170)
Vibration (55 Hz to 2000 Hz) to DIN IEC 668-2-6	≤ 100 m/s^2 (328 ft/s^2)	≤ 100 m/s^2 (328 ft/s^2)
Shock (6 ms) to DIN IEC 668-2-27	≤ 1000 m/s^2 (3281 ft/s^2)	≤ 1000 m/s^2 (3281 ft/s^2)
Operating temperature, max.	+100 °C (212 °F)	+70 °C (158 °F)
Operating temperature, min.	-40 °C (-40 °F)	-40 °C (-40 °F)
Degree of protection to DIN EN 60529 (IEC 60529)	IP67 without shaft input IP64 with shaft input	IP67 without shaft input IP64 with shaft input
Weight, approx. Single-turn/Multi-turn	0.35 kg (0.8 lb)/0.35 kg (0.8 lb)	0.5 kg (1.1 lb)/0.7 kg (1.5 lb)
CE marking	Yes	Yes
PROFIBUS certificate	–	Yes
Supported profiles	–	Class 1, Class 2

Selection and ordering data

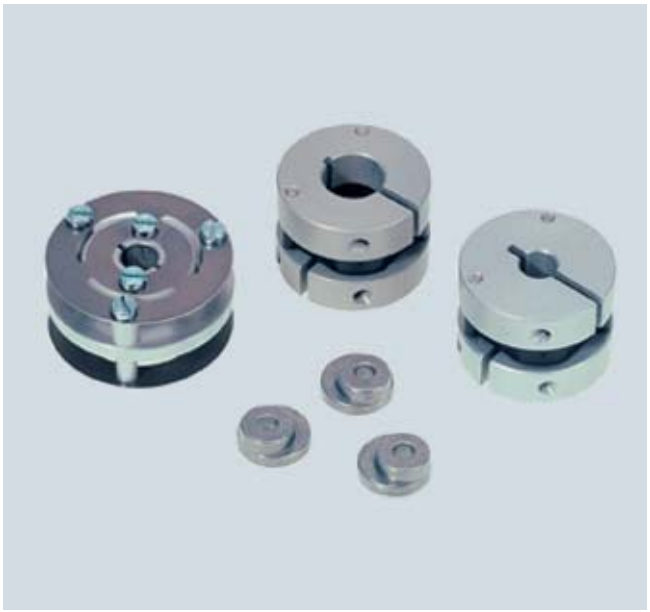
Designation	Order No.
EnDat absolute encoder	
Synchronous flange and 5 V DC supply voltage	
Connection:	
• EnDat with axial flange outlet	**6FX2001-5HE■■**
• EnDat with radial flange outlet	**6FX2001-5FE■■**
Supported flange joint and 5 V DC supply voltage	
Connection:	
• EnDat with axial flange outlet	**6FX2001-5SE■■**
• EnDat with radial flange outlet	**6FX2001-5QE■■**
Resolution	1 3
• Single-turn 8192 steps/revolution (13 bits)	
• Multi-turn 8192 steps/revolution, 4096 revolutions (25 bits)	2 5
• Radial connection	**6FX2001-5QP■■**
Resolution	1 2
• Single-turn 8192 steps/revolution (13 bits)	

Designation	Order No.
PROFIBUS DP absolute encoder	
Synchronous flange and 10 V to 30 V DC supply voltage	
• Radial connection	**6FX2001-5FP■■**
Supported flange joint and 10 V to 30 V DC supply voltage	2 4
• Multi-turn 8192 steps/revolution, 16384 revolutions (27 bits)	
User Manual for start-up and parameterization of PROFIBUS encoders Languages: German/English	**6SN1197-0AB10-0YP3**
Replacement connectors with external threads for encoders (3x)	
• 12-pole with 12 contact pins for incremental encoder with RS 422, sin/cos 1 V_{pp} HTL for absolute encoder with SSI	**6FX2003-1CF12**
• 17-pole with 17 contact pins for absolute encoder with EnDat	**6FX2003-1CF17**

4

Built-on optoelectronic rotary encoders
Mounting accessories

Overview



Clamp straps/couplings

Clamp straps and couplings are available as mounting accessories for the rotary encoders. The clamp straps are used to fix the encoders with a synchronous flange.

Mating connector

A mating connector is available for the encoder with flange socket or with cable and encoder connector for cable diameters 5.5 mm (0.2 in) to 12 mm (0.5 in). Connectors with 12 contact pins are suitable for all incremental encoders. Connectors with 17 contacts are suitable for encoders with EnDat.

Technical data

	Spring disk coupling	Plug-in coupling
Transmission torque, max.	0.8 Nm (7 lb_f-in)	0.7 Nm (6.2 lb_f-in)
Shaft diameter	6 mm (0.2 in) on both sides or d_1 = 6 mm (0.2 in), d_2 = 5 mm (0.2 in)	6 mm (0.2 in) on both sides or 10 mm (0.4 in) on both sides
Center offset of shafts max.	0.4 mm (0.01 in)	0.5 mm (0.02 in)
Axial offset	±0.4 mm (0.01 in)	±0.5 mm (0.02 in)
Angular displacement of shafts, max.	3°	1°
Torsional rigidity	150 Nm/rad (1327.5 lb_f-in/rad)	31 Nm/rad (274.3 lb_f-in/rad)
Lateral spring stiffness	6 N/mm (1.34 lb_f-in)	10 N/mm (2.25 lb_f-in)
Moment of inertia	19 gcm^2 (168 x 10^{-7} lb_f-in-s^2)	20 gcm^2 (177 x 10^{-7} lb_f-in-s^2)
Max. speed	12000 rpm	12000 rpm
Operating temperature		
• Maximum	+150 °C (302 °F)	+80 °C (176 °F)
• Minimum	-40 °C (-40 °F)	-40 °C (-40 °F)
Weight, approx.	16 g (0.03 lb)	20 g (0.04 lb)

Selection and ordering data

Designation	Order No.
Clamp strap for double-track encoder and encoder with synchro flange (3 units are required)	**6FX2001-7KP01**
Spring disk coupling Shaft diameter:	
• 6 mm (0.2 in)/6 mm (0.2 in)	**6FX2001-7KF10**
• 6 mm (0.2 in)/5 mm (0.2 in)	**6FX2001-7KF06**
Plug-in coupling Shaft diameter:	
• 6 mm (0.2 in)/6 mm (0.2 in)	**6FX2001-7KS06**
• 10 mm (0.4 in)/10 mm (0.4 in)	**6FX2001-7KS10**
Mating connector for flange outlet or encoder connector Crimp version, socket contacts for cable diameters 5.5 mm (0.2 in) to 12 mm (0.5 in) (3 units)	
• 12-pin, 12 socket contacts for incremental encoder with TTL, sin/cos 1 V_{pp}, HTL	**6FX2003-0CE12**
• 17-pin, 17 socket contacts for absolute encoder with EnDat	**6FX2003-0CE17**

SIMAG H2 hollow-shaft measuring system

Applications

SIMAG H2 is an incremental system for measuring angles of rotation and rotational speeds. Applications include hollow-shaft applications with direct drives, e.g. 1PH2, as well as applications as an autonomous spindle encoder. SIMAG H2 is intended to replace the SIZAG 2 hollow-shaft measuring system in new applications.

The electrical signals and the flange outlet are compatible with existing motor measuring systems. SIMAG H2 can be operated digitally on SINAMICS S120 converter systems with all available controls as a motor measuring system or as direct measuring system.

Design

The SIMAG H2 measuring system consists of three components:

- Measuring wheel
- Scanning head with connecting lead
- Connection kit

The magnetic division on the measuring wheel is used as unit of measurement. Different internal diameters are available for each outer diameter, whereby the internal diameter can be re-worked. The measuring wheel is attached with the shaft nut; alternatives are screw fitting to a shaft shoulder (not possible with all measurement variants) or shrink fitting.

The non-contact scanning head scans the incremental and reference tracks at the measuring wheel and amplifies the signals.

It is connected via a lead attached to the scanning head. The end of the lead is preassembled with contacts and an insulation insert. For assembly, the insulation insert can be fixed into a straight or angular flange outlet. For confined spaces, the encoder can also be supplied with open core ends.

Technical data

SIMAG H2 hollow-shaft measuring system		
Output signals	2 voltage signals 1 V_{pp} in quadrative; 1 reference signal per encoder revolution	
Operating voltage	5 V DC ±5%	
Current consumption, typ.	30 mA	
Resolution	256 S/R	
Indexing accuracy of measuring wheel	±72 angular seconds at resolution = 256 S/R	
Limiting speed	≤ 25000 rpm at 256 S/R	
Rated distance between measuring wheel and scanning head	200 µm	
Operating temperature range	-20 °C to +120 °C (-4 °F to +248 °F)	
Shock resistance (11 ms)	1000 m/s^2 (3281 ft/s^2)	
Vibration (50 Hz to 2000 Hz)	200 m/s^2 (656 ft/s^2)	
Degree of protection to DIN EN 60529 (IEC 60529)	IP67 when installed	
Bending radius of the cable module lines	One-time bending: ≥ 25 mm (1 in) Multiple bending: ≥ 60 mm (2.4 in)	
Max. length of cable to converter	50 m (164 ft)	
Dimensions (W x H x D), approx. Scanning head (mounted)	37 mm x 18 (+4) mm x 16 mm (1.5 in x 0.7 (+0.1) in x 0.6 in)	
Measuring wheel		
Internal diameter[1)]	45^{H6} mm (1.8^{H6} in)	60^{H6} mm (2.4^{H6} in)
External diameter D_a	81.14 mm (3.2 in)	
Thickness	15 mm (0.6 in)	
Pulse number	256	
Moment of inertia, approx.	4 x 10^{-4} kg m^2 (35.4x10^{-4} lb$_f$-in-s^2)	3 x 10^{-4} kg m^2 (26.5x10^{-4} lb$_f$-in-s^2)
Weight, approx.	0.4 kg (0.9 lb)	0.25 kg (0.5 lb)

1) The internal diameters can be re-worked (hollowed up to max. 65 mm (2.6 in)); see Planning/Installation Guide.

Selection and ordering data

Designation	Order No.
Scanning head, incremental	
1 mm pole pitch, 1 V_{pp}	
• with plug insert with 0.2 m (0.7 ft) cable	**6FX2001-6AA12-1CA0**
• with plug insert with 0.5 m (1.6 ft) cable	**6FX2001-6AA12-1FA0**
• with plug insert with 2 m (6.6 ft) cable	**6FX2001-6AA12-3AA0**
• open core ends with 1 m (3.3 ft) cable	**6FX2001-6AA12-2AA5**
Measuring wheel, D_a 81.14 mm (3.2 in)	
• Internal diameter 45^{H6} mm (1.8^{H6} in)	**6FX2001-6RB12-4EF0**
• Internal diameter 60^{H6} mm (2.4^{H6} in)	**6FX2001-6RB12-4GA0**
Connection kit for insulation insert	
• Straight flange outlet	**6FX2001-6FA12-0GA0**
• Angular flange outlet	**6FX2001-6FA12-0WA0**
Extraction tool for insulation insert of straight or angular flange outlet	**6FX2001-6FK12-0AA0**
Planning/Installation Guide	
• German	**6SN1197-0AB30-0AP2**
• English	**6SN1197-0AB30-0BP2**

SIMAG H2 hollow-shaft measuring system

MOTION-CONNECT connection system

5

5/2 **General information**
5/2 Technical data
5/4 Function

5/5 **Power cables**
5/7 Extensions

5/8 **Signal cables**
5/11 Extensions

5/12 **Length code**

General information

Overview

MOTION-CONNECT cables are suitable for use on all types of machine tools and production machines.

Power, signal and DRIVE-CLiQ cables can be ordered as prefabricated cables.

MOTION-CONNECT comprises the following types of cable:

- **MOTION-CONNECT 500**, the solution for predominantly fixed routing
- **MOTION-CONNECT 800** meets all requirements for use in cable chains on machine tools and production machines.

Benefits

The use of prefabricated MOTION-CONNECT cables will provide you with high quality and system-tested problem-free operation. The cables can be supplied by the meter. Intermediate lengths are also available on request.

Applications

The degree of protection of the prefabricated power and signal cables and their extensions outside the control cabinet when closed and connected is IP67.

Technical data

Cables	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	MOTION-CONNECT 500	MOTION-CONNECT 800
Type	6FX2...-1DC..-....	6FX5...-.DC..-....	6FX500.-.....-....	6FX800.-.....-....
Certification				
Power/signal cables				
• VDE [1]	Yes	Yes	Yes	Yes
• cUL or UL/CSA	UL STYLE 2502/ CSA-N.210.2-M90	UL STYLE 2502/ CSA-N.210.2-M90	UL758-CSA-C22.2-N210.2-M90	UL758-CSA-C22.2-N210.2-M90
• UL-CSA File No. [2]	Yes	Yes	Yes	Yes
Electrical data to DIN VDE 0472				
Rated voltage				
• Power cable V_0/V				
- Supply cores	–	–	600 V/1000 V	600 V/1000 V
- Signal cores	–	–	24 V (VDE) 1000 V (UL/CSA)	24 V (VDE) 1000 V (UL/CSA)
• Signal cable	30 V	30 V	30 V	30 V
Test voltage (rms)				
• Power cable				
- Supply cores	–	–	4 kV	4 kV
- Signal cores	–	–	2 kV	2 kV
• Signal cable	500 V	500 V	500 V	500 V
Operating temperature				
On the surface				
• Fixed installation	-20 °C to +80 °C (-4 °F to +176 °F)	-20 °C to +80 °C (-4 °F to +176 °F)	-20 °C to +80 °C (-4 °F to +176 °F)	-50 °C to +80 °C (-58 °F to -176 °F)
• Flexible installation	–	0 °C to +60 °C (+32 °F to +140 °F)	0 °C to +60 °C (+32 °F to +140 °F)	-20 °C to +60 °C (-4 °F to +140 °F)

1) The respective registration number is printed on the cable sheath (only valid for power cables).

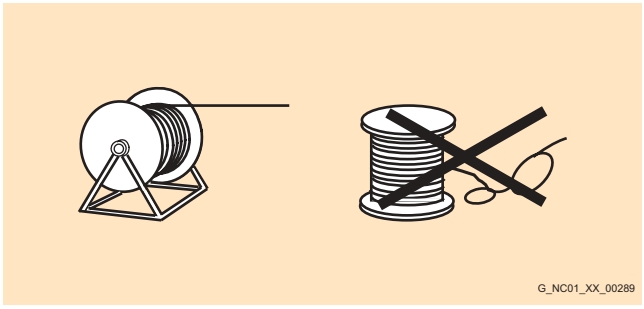
2) The File Number is printed on the cable sheath.

Technical data (continued)

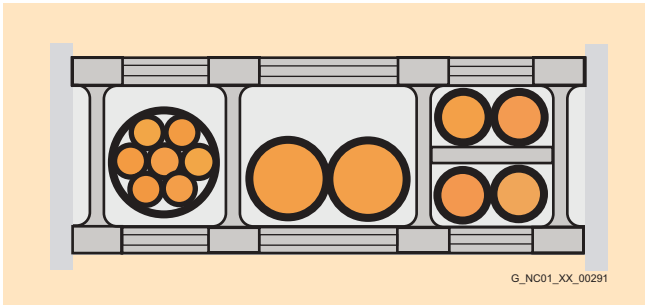
Cables	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	MOTION-CONNECT 500	MOTION-CONNECT 800
Type	6FX2...-1DC..-....	6FX5...-.DC..-....	6FX500.-.....-....	6FX800.-.....-....
Mechanical data				
Max. tensile stress on power/signal cables				
• Fixed installation	45 N/mm^2 (6527 lb$_f$/in^2)	80 N/mm^2 (11603 lb$_f$/in^2)	50 N/mm^2 (7252 lb$_f$/in^2)	50 N/mm^2 (7252 lb$_f$/in^2)
• Flexible installation	–	30 N/mm^2 (4351 lb$_f$/in^2)	20 N/mm^2 (2900 lb$_f$/in^2)	20 N/mm^2 (2900 lb$_f$/in^2)
Minimum permissible bending radius				
• Power cable				
- Fixed installation	–	–	5 × D_{max}	6 × D_{max}
- Flexible installation	–	–	See "Power cables"	See "Power cables"
• Signal cable				
- Fixed installation	50 mm (2 in)	35 mm (1.4 in)	60 mm (2.4 in)	60 mm (2.4 in)
- Flexible installation	–	125 mm (4.9 in)	100 mm (3.9 in)	100 mm (3.9 in)
Torsional stress	–	Absolute 30°/m	Absolute 30°/m	Absolute 30°/m
Bending				
• Power cables				
- 1.5 mm^2 to 6 mm^2	–	–	100,000	10 million
- 10 mm^2 to 185 mm^2	–	–	100,000	3 million
• Signal cables	–	100,000	2 million	10 million
Traversing velocity				
• Power cables				
- 1.5 mm^2 to 6 mm^2	–	–	30 m/min (98 ft/min)	180 m/min (591 ft/min)
- 10 mm^2 to 185 mm^2	–	–	30 m/min (98 ft/min)	100 m/min (328 ft/min)
• Signal cables	–	30 m/min (98 ft/min)	180 m/min (591 ft/min)	180 m/min (591 ft/min)
Acceleration				
• Power cables	–	–	2 m/s^2 (6.6 ft/s^2)	5 m/s^2 (16.4 ft/s^2) (5 m (16.4 ft)); 10 m/s^2 (32.8 ft/s^2) (2.5 m (8.2 ft))
• Signal cables	–	2 m/s^2 (6.6 ft/s^2)	5 m/s^2 (16.4 ft/s^2)	5 m/s^2 (16.4 ft/s^2) (5 m (16.4 ft)); 10 m/s^2 (32.8 ft/s^2) (2.5 m (8.2 ft))
Chemical data				
Insulation material	CFC-free, silicone-free	CFC-free, silicone-free	CFC-free, silicone-free	Halogen-free, CFC-free, silicone-free DIN 472 815/IEC 754-1
Oil resistance	DIN EN 60 811-1-1/2-1	DIN EN 60 811-1-1/2-1	VDE 0472, Part 803 Test mode B (mineral oils only)	VDE 0472, Part 803 Test mode B
Outer sheath	PVC	PVC	PVC	PUR, DIN VDE 0282, Part 10
• Power cable	–	–	DESINA color orange RAL 2003	DESINA color orange RAL 2003
• Signal cable	Gray RAL 7032	DESINA color green RAL 6018	DESINA color green RAL 6018	DESINA color green RAL 6018
Flame-retardant	IEC 60 332.1	IEC 60 332.1	IEC 60 332.1	IEC 60 332.1

General information

Function



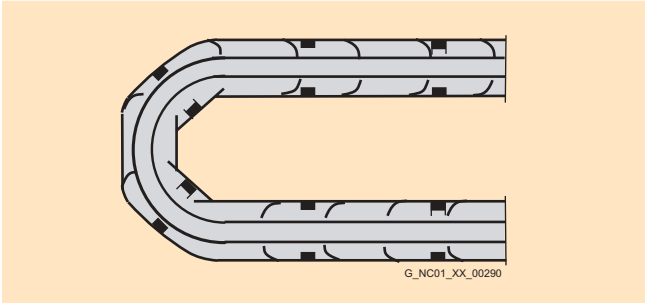
The cables must be removed from the drum without twisting, i.e. the cables must be unwound and must never be lifted over the drum flange while still wound in loops.



To maximize the service life of the cable chain and cables, cables in the chain made from different materials must be installed in the cable chain using spacers. The spacers must be installed uniformly to ensure that the position of the cables does not change during operation. The cables should be distributed as symmetrically as possible on the basis of their weight and dimensions. Cables with very different outer diameters should be separated by spacers.

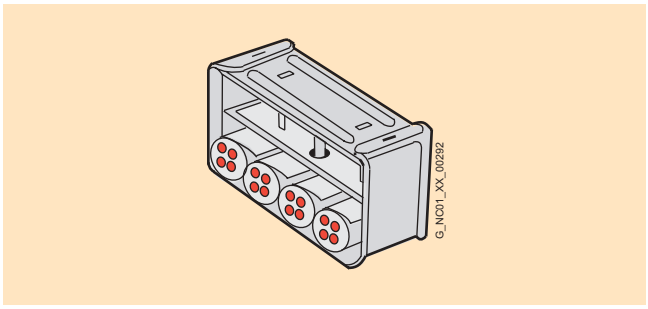
When installing prefabricated cables in the cable chain, do not pull on the connector, as this may damage the strain relief or cable clamping.

The cables must not be fixed in the chain and must have room to move.



The cables must be able to move unrestricted in particular in the radii of curvature of the chain. The prescribed minimum bending radii must not be undershot.

The cable fixings must be attached at both ends at an appropriate distance away from the end points of the moving parts in a "dead" zone.



Siemens cables are tested for use in a cable chain. During testing, a strain-relief assembly is attached to one end of the cable at the moving ends of the cable chain. Strain relief is applied to a wide area of the peripheral surface without crushing the cable assembly.

When installing cables, you must always observe the information in the Installation Guide provided by the cable chain manufacturer as appropriate for the way in which the system has been constructed.

Notes:

If, for example, prefabricated cables are installed in a cable chain in such a way that the connector would inhibit assembly, prefabricated cables without assembled connectors can also be supplied (signal and power cables). On these cables, the contacts are crimped and the connector housing is supplied separately packed. Once the cables have been installed, the customer assembles the connector housing.

When installing cables, you must always observe the information provided by the cable chain manufacturer.

Our cables have been approved for a maximum horizontal traverse path of 5 m (16.4 ft).

In the event of vibrational loads and if horizontal or vertical cable entries are used, we always recommend the use of an additional cable fixing, if part of the cable hangs loose or is not guided in between the strain relief on the cable chain and the connection on the motor. To prevent machine vibrations being transmitted to the connectors, the cable fixing on the moving part should be connected in the same place as the motor.

Overview

MOTION-CONNECT power cables can be used to connect synchronous and asynchronous motors with Motor Modules.

Technical data

Current carrying capacity

The current carrying capacity (I_z) of PVC-insulated cables corresponds to IEC 60 204-1 for type of routing C under continuous operating conditions and is indicated in the table based on an ambient air temperature of +40 °C (104 °F). For other ambient temperatures, the user must calculate the values using the "correction factors" in the table. PUR cables must also meet the requirements of this standard.

Cross-section	**Current carrying capacity in A** to IEC 60 204-1 of 1997 + corrigendum 1998 for type of routing (see standard, Table C1.2)			
mm^2	**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
150	-	-	234	262
185	-	-	267	300
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 °C (°F)	**Correction factor** to IEC 60 364-5-523, Table 52-D1
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

Power cables

Selection and ordering data

MOTION-CONNECT power cables without brake cores

Connection method, motor module side	No. of cores x cross-section mm²	Connector size, motor side	Prefabricated cable for 1FT/1FK motors Order No.	$D_{max.}$ 6FX5 mm (in)	$D_{max.}$ 6FX8 mm (in)	Weight (excluding connector) 6FX5 kg/m (lb/ft)	Weight (excluding connector) 6FX8 kg/m (lb/ft)	Smallest permissible bending radius [1] 6FX5 mm (in)	Smallest permissible bending radius [1] 6FX8 mm (in)
Connector	4×1.5	1	**6FX■002-5CS01-■ ■ ■0**	8.4 (0.3)	10.4 (0.4)	0.18 (0.4)	0.16 (0.4)	155 (6.1)	100 (4)
		1.5	**6FX■002-5CS21-■ ■ ■0**						
		open core ends [2]	**6FX5002-5CS02- ■ ■ ■0**						
Connector	4×2.5	1	**6FX■002-5CS11-■ ■ ■0**	10 (0.4)	12.1 (0.5)	0.24 (0.5)	0.24 (0.5)	180 (7.1)	120 (4.8)
		1.5	**6FX■002-5CS31-■ ■ ■0**						
		open core ends [2]	**6FX5002-5CS12- ■ ■ ■0**						
Connector	4×4	1.5	**6FX■002-5CS41-■ ■ ■0**	11.4 (0.4)	13.2 (0.5)	0.32 (0.7)	0.31 (0.7)	210 (8.3)	130 (5.1)
		open core ends [2]	**6FX5002-5CS42- ■ ■ ■0**						
Connector	4×6	1.5	**6FX■002-5CS51-■ ■ ■0**	13.6 (0.5)	16 (0.6)	0.46 (1)	0.43 (1)	245 (9.6)	170 (6.7)
		open core ends [2]	**6FX5002-5CS52- ■ ■ ■0**						
Connector	4×10	1.5	**6FX■002-5CS61-■ ■ ■0**	20 (0.8)	19.4 (0.8)	0.73 (1.6)	0.63 (1.4)	360 (14.1)	210 (8.3)
		3	**6FX■002-5CS13-■ ■ ■0**						
		open core ends [2]	**6FX5002-5CS62- ■ ■ ■0**						
Ring terminal ends	4×6	1.5	**6FX■002-5CS54-■ ■ ■0**	15.6 (0.6)	16 (0.6)	0.46 (1)	0.43 (1)	285 (11.2)	170 (6.7)
	4×10	1.5	**6FX■002-5CS64-■ ■ ■0**	20 (0.8)	19.4 (0.8)	0.73 (1.6)	0.63 (1.4)	360 (14.1)	210 (8.3)
	4×16	3	**6FX■002-5CS23-■ ■ ■0**	24.2 (1)	23.6 (1)	1.1 (2.4)	0.95 (2.1)	440 (17.3)	260 (10.2)

Type of power cable			
• MOTION-CONNECT 500	**5**		
• MOTION-CONNECT 800	**8**		
Length code		.	. .

MOTION-CONNECT power cables with brake cores

Connection method, motor module side	No. of cores x cross-section mm²	Connector size, motor side	Prefabricated cable for 1FT/1FK motors Order No.	$D_{max.}$ 6FX5 mm (in)	$D_{max.}$ 6FX8 mm (in)	Weight (excluding connector) 6FX5 kg/m (lb/ft)	Weight (excluding connector) 6FX8 kg/m (lb/ft)	Smallest permissible bending radius [1] 6FX5 mm (in)	Smallest permissible bending radius [1] 6FX8 mm (in)
Connector	4×1.5+2×1.5	1	**6FX■002-5DS01-■ ■ ■0**	10.8 (0.4)	12.9 (0.5)	0.22 (0.5)	0.25 (0.6)	195 (7.7)	125 (5)
		1.5	**6FX■002-5DS21-■ ■ ■0**						
Connector	4×2.5+2×1.5	1	**6FX■002-5DS11-■ ■ ■0**	12.4 (0.5)	14.2 (0.5)	0.28 (0.6)	0.31 (0.7)	225 (8.9)	140 (5.5)
		1.5	**6FX■002-5DS31-■ ■ ■0**						
Connector	4×4+2×1.5	1.5	**6FX■002-5DS41-■ ■ ■0**	14 (0.6)	15.3 (0.6)	0.36 (0.8)	0.4 (0.9)	255 (10)	150 (5.9)
Connector	4×6+2×1.5	1.5	**6FX■002-5DS51-■ ■ ■0**	16.1 (0.6)	17.8 (0.7)	0.54 (1.2)	0.53 (1.2)	290 (11.4)	195 (7.7)
Connector	4×10+2×1.5	1.5	**6FX■002-5DS61-■ ■ ■0**	21.7 (0.9)	20.8 (0.9)	0.75 (1.7)	0.74 (1.6)	395 (15.6)	230 (9.1)
		3	**6FX■002-5DS13-■ ■ ■0**						
Ring terminal ends	4×6+2×1.5	1.5	**6FX■002-5DS54-■ ■ ■0**	16.1 (0.6)	17.8 (0.7)	0.54 (1.2)	0.53 (1.2)	290 (11.4)	195 (7.7)
	4×10+2×1.5	1.5	**6FX■002-5DS64-■ ■ ■0**	21.7 (0.9)	20.8 (0.9)	0.75 (1.7)	0.74 (1.6)	395 (15.6)	230 (9.1)
	4×16+2×1.5	3	**6FX5002-5DS23- ■ ■ ■0**	25 (1)	24.7 (1)	1.1 (2.4)	1.1 (2.4)	450 (17.7)	275 (10.8)
	4×25+2×1.5	3	**6FX5002-5DS33- ■ ■ ■0**	29.4 (1.2)	27.9 (1.1)	1.56 (3.4)	1.46 (3.2)	530 (21)	325 (12.8)
	4×35+2×1.5	3	**6FX5002-5DS43- ■ ■ ■0**	32.6 (1.3)	32 (1.3)	2.01 (4.4)	2.1 (4.6)	590 (23.2)	380 (15)
	4×50+2×1.5	3	**6FX5002-5DS53- ■ ■ ■0**	38 (1.5)	35.8 (1.4)	3.30 (7.3)	2.75 (6.1)	685 (27)	420 (16.5)

Type of power cable			
• MOTION-CONNECT 500	**5**		
• MOTION-CONNECT 800	**8**		
Length code		.	. .

1) Valid for installation in cable chain.

Selection and ordering data

Power cable extensions

No. of cores x cross-section	Basic cable for 1FT/1FK motors	Connector size	Extension	Connector size
mm^2	Type		Order No.	
4×1.5	6FX . 002-5 . S01- . . . 0	1	**6FX■002-5■A05-■ ■ ■ 0**	1
4×2.5	6FX . 002-5 . S11- . . . 0	1	**6FX■002-5■A15-■ ■ ■ 0**	1
4×1.5	6FX . 002-5 . S21- . . . 0	1.5	**6FX■002-5■A28-■ ■ ■ 0**	1.5
4×2.5	6FX . 002-5 . S31- . . . 0	1.5	**6FX■002-5■A38-■ ■ ■ 0**	1.5
4×4	6FX . 002-5 . S41- . . . 0	1.5	**6FX■002-5■A48-■ ■ ■ 0**	1.5
4×6	6FX . 002-5 . S51- . . . 0	1.5	**6FX■002-5■A58-■ ■ ■ 0**	1.5
4×10	6FX . 002-5 . S61- . . . 0	1.5	**6FX■002-5■A68-■ ■ ■ 0**	1.5
4×10	6FX . 002-5 . S13- . . . 0	3	**6FX■002-5■X18-■ ■ ■ 0**	3
4×16	6FX . 002-5 . S23- . . . 0	3	**6FX■002-5■X28-■ ■ ■ 0**	3
4×25	6FX . 002-5DS33- . . . 0	3	**6FX■002-5DX38-■ ■ ■ 0**	3

Type of power cable					
• MOTION-CONNECT 500 • MOTION-CONNECT 800	**5** **8**				
• Without brake cores • With brake cores		**C** **D**			
Length code			.	.	.

The power cable extension combinations shown are examples.

Overview

Flange

Flanges are used to route or fix connectors in control cabinets. With the exception of right-angle plugs, a flange can be mounted on site on connectors using union nuts or connectors with external threads.

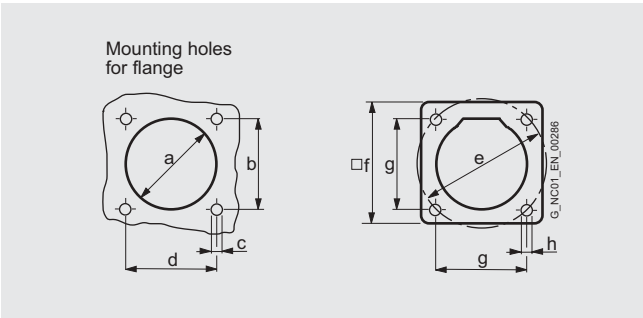
HF (high-frequency) clamp

To guarantee correct grounding on the cable duct or cabinet wall, a ground clamp can be ordered as an accessory together with the flanges for discharging high-frequency interference over a large area.

Selection and ordering data

Designation	Order No.
Flange for	
• Connector size 1	**6FX2003-7BX00**
• Connector size 1.5	**6FX2003-7CX00**
• Connector size 3	**6FX2003-7AX00**
HF clamp for	
• Power connector, Size 1	**6FX2003-7FX00**
• Power connector, Size 1.5	**6FX2003-7GX00**
• Power connector, Size 3	Not required

Dimension drawings



Dimensions in mm (inches)

	Connector size 1	Connector size 1.5	Connector size 3
a	Ø 27.8 (1.1)	Ø 46 (1.8)	Ø 65 (2.6)
b	28.3 (1.1)	42.4 (1.7)	75 (3)
c	M3 (4×)	M4 (4×)	M4 (4×)
d	28.3 (1.1)	42.4 (1.7)	75 (3)
e	Ø 40 (1.6)	Ø 60 (2.4)	Ø 63 (2.5)
f	35 (1.4)	55 (2.2)	85 (3.3)
g	28.3 (1.1)	42.4 (1.7)	75 (3)
h	Ø 3.2 (0.1)	Ø 4.4 (0.2)	Ø 4.5 (0.2)

Signal cables

Overview

Signal cables are prefabricated and are sold by the meter for the connection of a variety of components.

The following different types of cable are available:

- DRIVE-CLiQ cables
- MOTION-CONNECT DRIVE-CLiQ cables
- MOTION-CONNECT prefabricated cables

Applications

DRIVE-CLiQ cables

are used to connect components with DRIVE-CLiQ connections, which have a separate or external 24 V DC power supply.

DRIVE-CLiQ cables for connecting Line/Motor Modules with a control unit are part of the scope of supply of the relevant Line/Motor Modules. These cables are of sufficient length for side-by-side mounting.

MOTION-CONNECT DRIVE-CLiQ cables

are used whenever components with DRIVE-CLiQ connections must meet high requirements such as mechanical stress and oil resistance, e.g. in the event of a connection outside the cabinet between:

- Motor Modules and Sensor Modules
- Motor Modules and motors with DRIVE-CLiQ interface

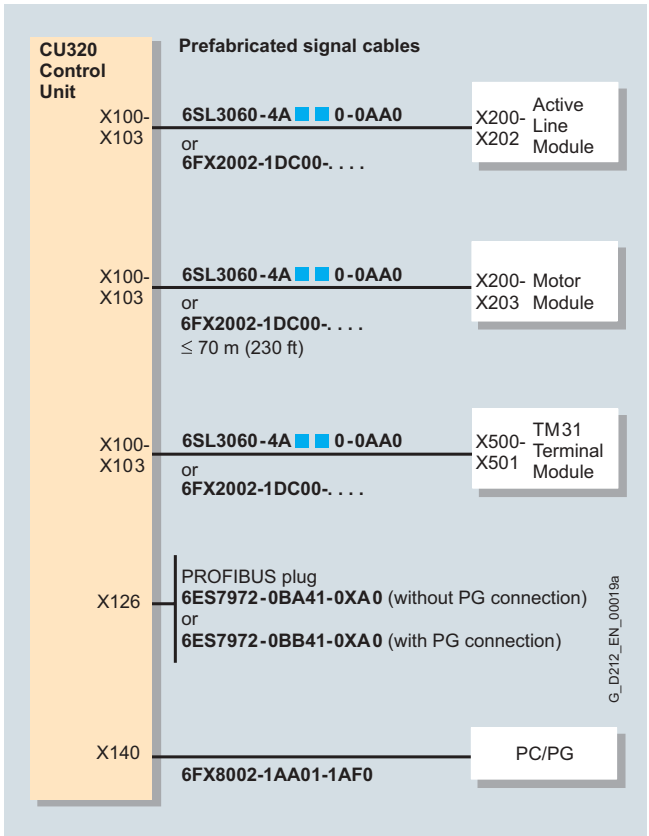
MOTION-CONNECT DRIVE-CLiQ cables feature 24 V DC cores.

MOTION-CONNECT prefabricated cables

are used whenever motor encoders on motors without DRIVE-CLiQ interface are connected to Sensor Modules.

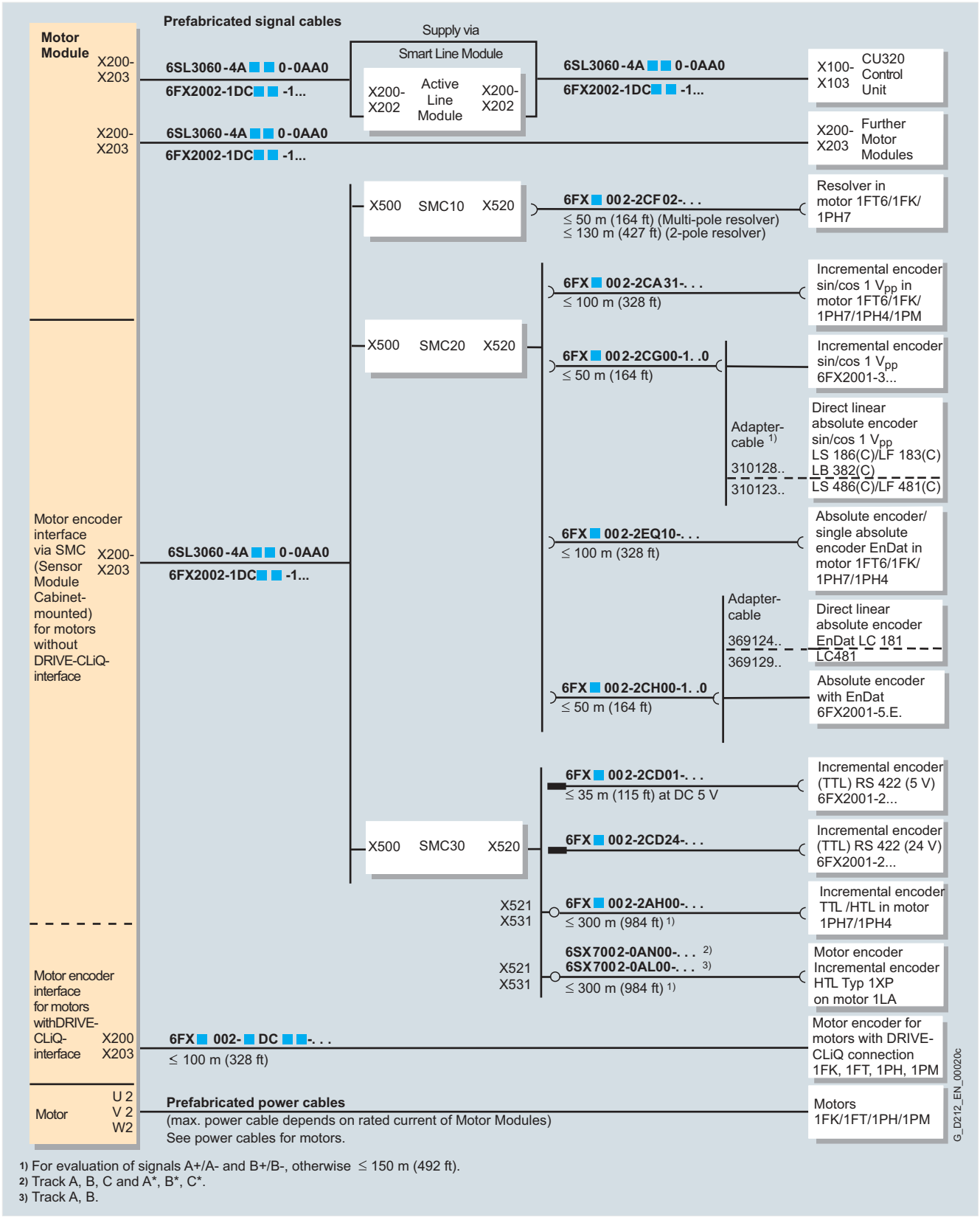
Integration

Overview of connections for the CU320 Control Unit



Overview of connections for line modules and motor modules

The DRIVE-CLiQ cables type 6SL3060-4A■■00-0AA0 required for a standard configuration are part of the scope of supply of the line modules and motor modules. In this case, the modules should be mounted directly adjacent to one another in a single row.



1) For evaluation of signals A+/A- and B+/B-, otherwise ≤ 150 m (492 ft).
2) Track A, B, C and A*, B*, C*.
3) Track A, B.

Signal cables

Selection and ordering data

Signal cable	Length	Degree of protection (connector)	Order No.
DRIVE-CLiQ prefabricated cables (without 24 V DC cores)			
In specific lengths	0.11 m (3.3 ft)	IP20/IP20	**6SL3060-4AB00-0AA0**
	0.16 m (0.5 ft)		**6SL3060-4AD00-0AA0**
	0.21 m (0.7 ft)		**6SL3060-4AF00-0AA0**
	0.26 m (0.9 ft)		**6SL3060-4AH00-0AA0**
	0.31 m (1.1 ft)		**6SL3060-4AK00-0AA0**
	0.36 m (1.2 ft)		**6SL3060-4AM00-0AA0**
	0.60 m (2 ft)		**6SL3060-4AU00-0AA0**
	0.95 m (3.1 ft)		**6SL3060-4AA10-0AA0**
	1.20 m (4 ft)		**6SL3060-4AW00-0AA0**
	1.45 m (4.8 ft)		**6SL3060-4AF10-0AA0**
	2.80 m (9.2 ft)		**6SL3060-4AJ20-0AA0**
	5.00 m (16.4 ft)		**6SL3060-4AA50-0AA0**
By the meter	max. 70 m (229.7 ft)	IP20/IP20	**6FX2002-1DC00-1 ■ ■ 0**
	max. 70 m (229.7 ft)	P67/IP67	**6FX2002-1DC20-1 ■ ■ 0**
MOTION-CONNECT 500 DRIVE-CLiQ cables (with 24 V cores)			
By the meter	max. 100 m (328 ft)	IP20/IP20	**6FX5002-2DC00-■ ■ ■ 0**
	max. 100 m (328 ft)	IP20/IP67	**6FX5002-2DC10-■ ■ ■ 0**
	max. 100 m (328 ft)	IP67/IP67	**6FX5002-2DC20-■ ■ ■ 0**
MOTION-CONNECT 800 DRIVE-CLiQ cables (with 24 V cores)			
By the meter	max. 50 m (164 ft)	IP20/IP67	**6FX8002-2DC10-1 ■ ■ 0**
	max. 50 m (164 ft)	IP67/IP67	**6FX8002-2DC20-1 ■ ■ 0**
MOTION-CONNECT prefabricated cables			
Resolver in 1FT6/1FK/1PH7 motor (for SMC10)		IP20/IP67	**6FX■002-2CF02-■ ■ ■ 0**
• Multi-pole	max. 50 m (164 ft)		
• 2-pole	max. 130 m (427 ft)		
Incremental encoder sin/cos 1 V_{pp} in 1FT6/1FK/1PH/1PM motor (for SMC20)	max. 100 m (328 ft)	IP20/IP67	**6FX■002-2CA31-■ ■ ■ 0**
Incremental encoder sin/cos 1 V_{pp} 6FX2001-3... (for SMC20)	max. 50 m (164 ft)	IP20/IP67	**6FX■002-2CG00-1 ■ ■ 0**
Single/Absolute encoder with EnDat in 1FT6/1FK/1PH motor (for SMC20)	max. 100 m (328 ft)	IP20/IP67	**6FX■002-2EQ10-■ ■ ■ 0**
Absolute encoder with EnDat 6FX2001-5.E. (for SMC20)	max. 100 m (328 ft)	IP20/IP67	**6FX■002-2CH00-1 ■ ■ 0**
Incremental encoder (TTL) RS 422 (5 V) 6FX2001-2... (for SMC30)	max. 35 m (115 ft)	IP20/IP67	**6FX■002-2CD01-■ ■ ■ 0**
Incremental encoder (TTL) RS 422 (24 V) 6FX2001-2... (for SMC30)		IP20/IP67	**6FX■002-2CD24-■ ■ ■ 0**
Incremental encoder in 1PH7/1PH4 motor (for SMC30)		IP20/IP67	**6FX■002-2AH00-■ ■ ■ 0**
• TTL encoder	max. 100 m (328 ft)		
• HTL encoder	max. 300 m (984 ft)		
Incremental encoder HTL type 1XP on 1LA motor (for SMC30)			
• Track A, B	max. 300 m (984 ft)	IP20/IP67	**6SX7002-0AL00-■ ■ ■ 0**
• Track A, B, C and A*, B*, C*	max. 300 m (984 ft)	IP20/IP67	**6FX7002-0AN00-■ ■ ■ 0**

Type of power cable			
• MOTION-CONNECT 500	**5**		
• MOTION-CONNECT 800	**8**		
Length code		**.**	**.** **.**

Selection and ordering data

Signal cable extensions

Basic cable	Extension
Type	Order No.
6FX . 002-2AH00-	**6FX■002-2AH04-■ ■ ■ 0**
6FX . 002-2CA31-	**6FX■002-2CA34-■ ■ ■ 0**
6FX . 002-2CD01-	**6FX■002-2CB54-■ ■ ■ 0**
6FX . 002-2CD24-	**6FX■002-2CB54-■ ■ ■ 0**
6FX . 002-2CF02-	**6FX■002-2CF04-■ ■ ■ 0**
6FX . 002-2CG00-	**6FX■002-2CB54-■ ■ ■ 0**
6FX . 002-2CH00-	**6FX■002-2AD04-■ ■ ■ 0**
6FX . 002-2EQ10-	**6FX■002-2EQ14-■ ■ ■ 0**

Type of power cable	
• MOTION-CONNECT 500	**5**
• MOTION-CONNECT 800	**8**
Length code	. . .

The signal cable extension combinations shown are only examples.

Overview

Flange

Flanges are used to route or fix connectors in control cabinets. With the exception of right-angle plugs, a flange can be mounted post-assembly on connectors with union nuts or connectors with external threads.

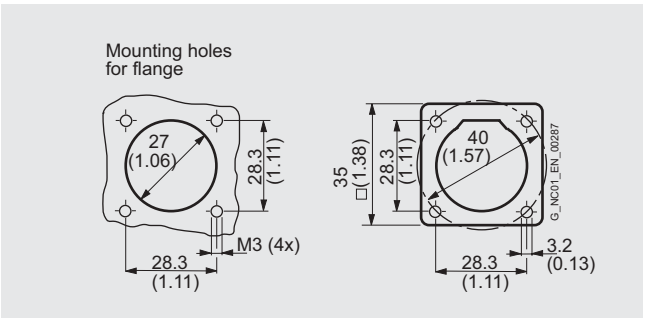
HF (high-frequency) clamp

To guarantee correct grounding on the cable duct or cabinet wall, a ground clamp can be ordered as an accessory together with the flanges for discharging high-frequency interference over a large area.

Selection and ordering data

Designation	Order No.
Flange for all signal connectors	**6FX2003-7DX00**
HF clamp for all signal connectors	**6FX2003-7FX00**

Dimension drawings



Length code

Overview

Length codes for prefabricated cables

Prefabricated cables					
Length code	6FX2002-.....-	■	■	■	**0**
	6FX5002-.....-	■	■	■	**0**
	6FX8002-.....-	■	■	■	**0**
0 m (0 ft)		**1**			
100 m (328 ft)		**2**			
200 m (656 ft)		**3**			
300 m (984 ft)		**4**			
0 m (0 ft)			**A**		
10 m (32.8 ft)			**B**		
20 m (65.6 ft)			**C**		
30 m (98.4 ft)			**D**		
40 m (131 ft)			**E**		
50 m (164 ft)			**F**		
60 m (197 ft)			**G**		
70 m (230 ft)			**H**		
80 m (262 ft)			**J**		
90 m (295 ft)			**K**		
0 m (0 ft)				**A**	
1 m (3.3 ft)				**B**	
2 m (6.6 ft)				**C**	
3 m (9.8 ft)				**D**	
4 m (13.1 ft)				**E**	
5 m (16.4 ft)				**F**	
6 m (19.7 ft)				**G**	
7 m (23 ft)				**H**	
8 m (26.2 ft)				**J**	
9 m (29.5 ft)				**K**	
Examples:	1 m (3.3 ft):	1	A	B	0
	2 m (7.2 ft):	1	A	C	0
	8 m (26.3 ft):	1	A	J	0
	299 m (981 ft):	3	K	K	0

Length definition for prefabricated cables

The cable length specified does not include the connector.

- Tolerance for a cable length of up to 10 m: 2 %
- Tolerance for a cable length of more than 10 m: 1 %

Engineering information

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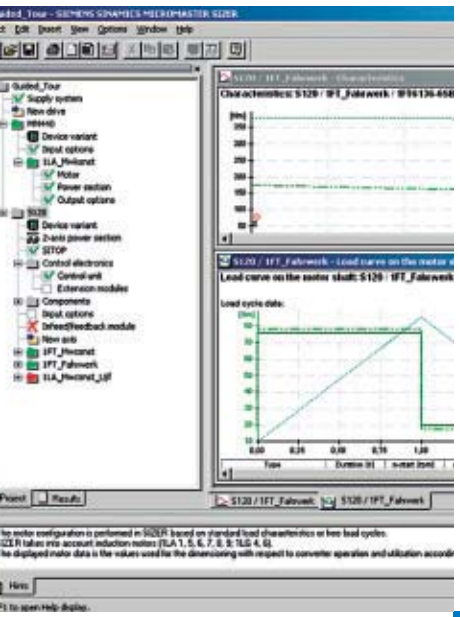
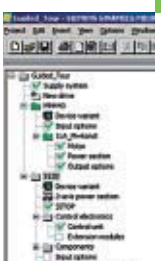




6/2 **Selection guides**
6/2 SIZER configuration tool
6/3 STARTER drive/commissioning software
6/4 Drive ES engineering system

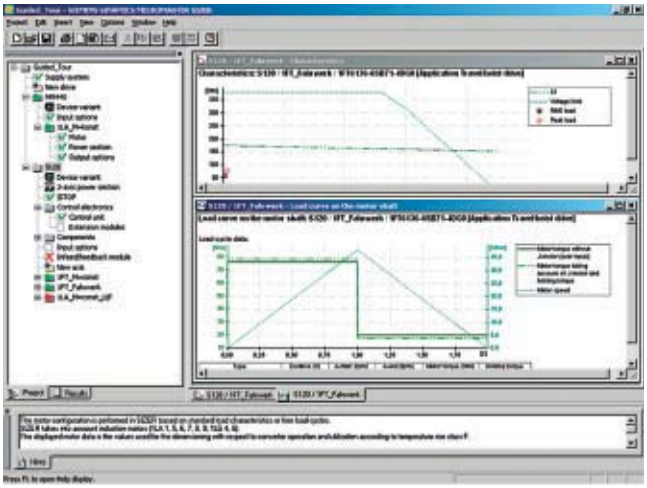
6/5 **Planning**

6/6 **Dimensioning**
6/6 1. Classification of the type of drive
6/6 2. Definition of supplementary conditions and integration into the automation system
6/6 3. Definition of loading cycle, calculation of the max. load torque, definition of motor
6/9 4. Definition of SINAMICS S120 Motor Module
6/9 5. Repetition of Steps 3 and 4 for additional axes
6/9 6. Calculation of the required DC link power and definition of SINAMICS S120 Line Modules
6/13 7. Specification of the line-side power components (main switch, fuses, line filters, etc.)
6/13 8. Specification of the required control performance and selection of SINAMICS S120 Control Unit, definition of component cabling
6/14 9. Definition of additional system components
6/15 10. Calculation of current requirements for the 24 V DC power supply for the components and specification of power supplies (SITOP power supply, Control Supply Modules)
6/16 11. Specification of components for connection system
6/17 12. Configuration of drive group components

6/18 **Ordering example**
6/18 Tubular bag machine

SIZER configuration tool

Overview



The SIZER PC tool provides an easy-to-use means of configuring the SINAMICS and MICROMASTER 4 drive family. It provides technical support when sizing the hardware and firmware components required for a drive task. SIZER supports the complete configuration of the drive system, from simple individual drives to complex multi-axis applications.

SIZER supports all stages of the configuration in the form of a workflow, which comprises the following stages:

- Selection of the line supply
- Dimensioning of the motor(s)
- Calculation of the drive components
- Selecting the required accessories
- Selection of the line-side and motor-side power options.

When SIZER was being developed, particular importance was placed on high usability and a universal, function-based approach to the drive task. The extensive user guidance makes using the tool easy. Status information keeps you continually informed of the progress of the configuration process.

The SIZER user interface is available in German and English.

The drive configuration is saved in a project. In the project, the components and functions used are displayed in a hierarchical tree structure.

The project view supports:

- The configuration of a number of drive devices
- The copying/pasting/editing of existing drives that have already been configured.

The configuration process produces the following results:

- A parts list of the components required
- Technical data
- Characteristics
- Location diagram and dimension drawings

These results are displayed in a results tree and can be printed out for documentation purposes.

User support is provided by the technological online help menu, which provides the following information:

- Detailed technical data
- Information about the drives and their components
- Decision-making criteria for the selection of components

Minimum hardware and software requirements

PG or PC with Pentium™ II 400 MHz (Windows™ NT/2000), Pentium™ III 500 MHz (Windows™ XP)

256 MB RAM

At least 600 MB of free hard disk space

An additional 100 MB of free hard disk space on Windows system drive

Monitor resolution 1024×768 pixels

Windows™ NT 4.0 SP5, 2000 SP2, XP Professional SP1

Microsoft Internet Explorer 5.5 SP2

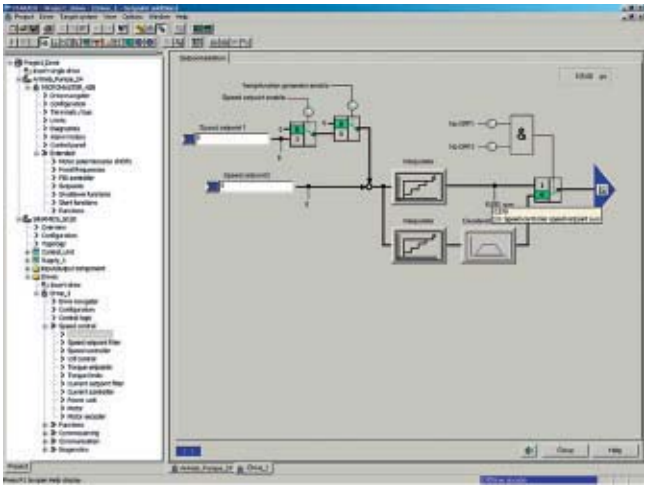
Selection and ordering data

	Order No.
SINAMICS MICROMASTER SIZER configuration tool German/English	**6SL3070-0AA00-0AG0**

6

STARTER drive/commissioning software

Overview



The easy-to-use STARTER drive/commissioning software can be used to:

- start up
- optimize and
- diagnose.

This software can be operated either as a stand-alone PC application or can be integrated into the SCOUT engineering system (SIMOTION). The basic functions and handling are the same in both cases.

In addition to the SINAMICS drives, the current version of STARTER also supports MICROMASTER 4 drives.

The project wizards can be used to create the drives within the structure of the project tree.

First-time users are supported by solution-based dialog menu, with a standard graphics-based display maximizing clarity when setting the drive parameters.

First commissioning is guided by wizards, which make all the basic settings in the drive. This enables a drive to be up and running after only setting a small number of parameters within the drive configuration process.

The individual settings required are made using graphics-based parameterization screenforms, which also display the mode of operation.

Examples of individual settings that can be made include:

- Terminals
- Bus interface
- Setpoint channel (e.g. fixed setpoints)
- Speed control (e.g. ramp-function generator, limits)
- BICO interconnections
- Diagnostics.

Experts can gain rapid access to the individual parameters via the Expert List and do not have to navigate dialogs.

In addition, the following functions are available for optimization purposes:

- Self-optimization
- Trace.

Diagnostics functions provide information about:

- Control/status words
- Parameter status
- Operating conditions
- Communication states.

Performance

- Easy to use: Only a small number of settings need to be made for successful first commissioning: axis turning
- Solution-based dialog-based user guidance simplifies commissioning
- Self-optimization functions reduce manual effort for optimization
- The built-in trace function provides optimum support during commissioning, optimization and troubleshooting.

Minimum hardware and software requirements

PG or PC with Pentium™ II 400 MHz (Windows™ NT/2000), Pentium™ III 500 MHz (Windows™ XP)

256 MB RAM

Monitor resolution 1024×768 pixels

Windows™ NT 4.0 SP6, 2000 SP3, XP Professional SP1

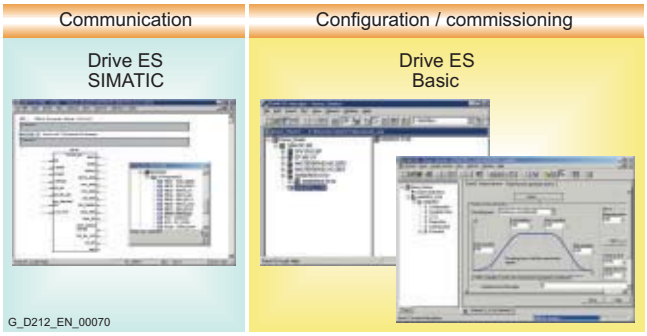
Microsoft Internet Explorer 5.01

Selection and ordering data

	Order No.
STARTER commissioning tool for SINAMICS and MICROMASTER German/English	**6SL3072-0AA00-0AG0**

Drive ES engineering system

Overview



Drive ES is the engineering system used to integrate Siemens drive technology into the SIMATIC automation world easily, efficiently and cost-effectively in terms of communication, configuration and data management. The STEP 7 Manager user interface provides the basis for this procedure.

Various software packages are available for SINAMICS S:

- **Drive ES Basic**
  for first-time users to the world of Totally Integrated Automation and the option for routing beyond network limits and the use of the SIMATIC teleservice.
  Drive ES Basic is the basic software program for setting the parameters of all drives online and offline.
  Drive ES Basic enables both the automation system and the drives to be handled via the SIMATIC Manager user interface.
  Drive ES Basic is the starting point for common data archiving complete projects and for extending the use of the SIMATIC teleservice to drives. Drive ES Basic provides the configuration tools for the new motion control functions slave-to-slave communication, equidistance and isochronous operation with PROFIBUS DP.
- **Drive ES SIMATIC**
  Simply parameterize the STEP 7 communication instead of programming.
  In order to use Drive ES SIMATIC, STEP 7 must be installed. It features a SIMATIC function block library, making the programming of the PROFIBUS interface in the SIMATIC-CPU for the drives easy and secure.
  There is no need for separate, time-consuming programming of the data exchange between the SIMATIC-CPU and the drive.
  All Drive ES users need to remember is:
  Copy – Modify – Download – Ready.
  Customized, fully-developed function blocks are copied from the library into user-specific projects.
  Frequently-used functions are set to run in program format:
  - Read out complete diagnostics buffer automatically from the drive
  - Download complete parameter set automatically from the SIMATIC CPU to the drive, e.g. in the event of a device being replaced
  - Load part parameter sets (e.g. in the event of a recipe or product replacement) automatically from the SIMATIC-CPU
  - Read back, i.e. update, complete parameterization or part parameter sets from the drive to the SIMATIC-CPU
- **Drive ES PCS 7**
  integrates drives with the PROFIBUS interface into the SIMATIC PCS 7 process control system.
  Drive ES PCS 7 can only be used with SIMATIC PCS 7 Version 5.0 and higher. Drive ES PCS 7 provides a function block library with function blocks for the drives and the corresponding faceplates for the operator station, which enables the drives to be operated from the PCS 7 process control system.

For further information please visit us on the Internet at:

http://www.siemens.com/drivesolutions

Selection and ordering data

	Order No.
Drive ES Basic V 5.3 • Configuration software for the integration of drives into Totally Integrated Automation • Requirement: STEP 7 V 5.1 and higher, SP 3 • Supply format: CD-ROM Ger., Eng., Fr., Sp., It. with electronic documentation	
Single license	**6SW1700-5JA00-3AA0**
Multi-user license, 60x	**6SW1700-5JA00-3AA1**
Update service for single-user license	**6SW1700-0JA00-0AB2**
Update service for multi-user license	**6SW1700-0JA00-1AB2**
Upgrade from V 5.x to V 5.3	**6SW1700-5JA00-3AA4**
Drive ES SIMATIC V 5.3 • Function block library for SIMATIC for the parameterization of communication with the drives • Requirement: STEP 7 V 5.1 and higher, SP 3 • Supply format: CD-ROM Ger., Eng., Fr., Sp., It. with electronic documentation	
Single-user license incl. 1 x runtime license	**6SW1700-5JC00-3AA0**
Runtime license	**6SW1700-5JC00-1AC0**
Update service for single-user license	**6SW1700-0JC00-0AB2**
Upgrade from V 5.x to V 5.3	**6SW1700-5JC00-3AA4**
Drive ES PCS 7 V 6.0 • Function block library for PCS 7 for the integration of drives • Requirement: PCS 7 V 6.0 and higher • Supply format: CD-ROM Ger., Eng., Fr., Sp., It. with electronic documentation	
Single-user license incl. 1 x runtime license	**6SW1700-6JD00-0AA0**
Runtime license	**6SW1700-5JD00-1AC0**
Update service for single-user license	**6SW1700-0JD00-0AB2**
Upgrade from V 5.x to V 6.x	**6SW1700-6JD00-0AA4**

Overview

Motion Control

Servo drives are ideal for executing motion control tasks. They execute linear or rotary movements within a defined movement cycle. All movements must be optimized in terms of duration.

In light of these considerations, servo drives must meet the following requirements:

- High dynamic response, i.e. short rise times
- Overload-capable, i.e. high acceleration reserve
- Wide range, i.e. high resolution for precise positioning

The following configuration is valid for synchronous and asynchronous motors.

General configuration sequence

The function description of the machine provides the basis for the configuration. The definition of the components is based on physical dependencies and is usually carried out as follows:

Step	Description of configuration activity
1.	Clarification of type of application
2.	Definition of supplementary conditions and integration into automated system
3.	Definition of load cycle, calculation of max. load torque, definition of motor
4.	Definition of SINAMICS S120 Motor Module
5.	Repeat Steps 3 and 4 for additional axes
6.	Calculation for the required DC link power and definition of the SINAMICS S120 Line Module
7.	Specification of the line-side options (main switch, fuses, line filters, etc.)
8.	Specification of the required control performance and selection of the SINAMICS S120 Control Unit, definition of component cabling
9.	Definition of additional system components
10.	Calculation of the current requirements for the 24 V DC supply for the components and specification of power supplies (SITOP power supply, Control Supply Modules)
11.	Specification of components for connection system
12.	Configuration of drive group components

Dimensioning

Overview

1. Clarification of application

The motor is selected on the basis of the required torque, which is defined by the application, e.g. traveling drive, hoist drive, feed drive or main spindle drive. Gear units for movement conversion or for adapting the motor speed and motor torque to the load conditions must also be considered.

As well as the load torque, which is determined by the applications, the following mechanical data are among those required to calculate the torque to be provided by the motor:

- Masses to be moved
- Diameter of the drive wheel/diameter
- Leadscrew pitch, gear ratios
- Frictional resistance data
- Mechanical efficiency
- Traverse paths
- Maximum velocity
- Maximum acceleration and maximum deceleration
- Cycle time

2. Definition of boundary conditions and integration into automated system

You must decide whether synchronous or asynchronous motors are to be used.

Synchronous motors should be selected for compact construction volume, low rotor moment of inertia and therefore maximum dynamic response.

Asynchronous motors can be used to increase maximum speeds in the field weakening range. Asynchronous motors for higher powers are also available.

Also specify whether the drives are to be operated as single-axis drives or in a group as multi-axis drives.

The following factors are of prime importance during configuration:

- The type of line supply, when using specific types of motor and/or line filters on IT systems (non-grounded systems)
- The utilization of the motor in accordance with rated values for winding temperatures of 60 K or 100 K
- The ambient temperatures and the installation altitude of the motors and drive components

Other boundary conditions apply when integrating the drives into an automation environment such as SIMATIC or SIMOTION.

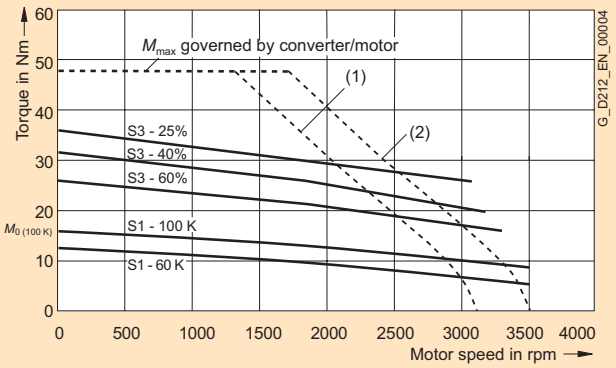
For motion control and technology functions (e.g. positioning), as well as for synchronous functions, the corresponding automation system, e.g. SIMOTION D, is used.

The drives are interfaced with the higher-level automation system via PROFIBUS.

3. Definition of load cycle, calculation of max. load torque, definition of motor

The motor-specific limiting curves provide the basis for defining the motors.

These curves describe the torque characteristic over the speed and take account of the limits of the motor based on the line voltage and function of the power supply (Smart Line Modules or Active Line Modules).



(1) Voltage limit curve for Smart Line Module (governed by DC link voltage)
(2) Voltage limit curve for Active Line Module (governed by DC link voltage)

Limiting curves for synchronous motors (example)

The motor is defined on the basis of the load cycle, which is prescribed by the application. Different characteristics must be used for different load cycles. The following operating scenarios have been defined:

- Duty cycles with constant ON period
- Duty cycles with varying ON period
- Free duty cycle

The aim is to identify characteristic torque and speed operating points, on the basis of which the motor can be defined as appropriate for each load cycle.

Once the operating scenario has been defined and specified, the maximum motor torque is calculated. In general, this takes place during the acceleration phase. The load torque and the torque required to accelerate the motor are added together.

The maximum motor torque is then verified with the limiting curves of the motor.

The following criteria must be taken into account when defining the motor:

- The dynamic limits must be observed, i.e. all speed-torque points of the load cycle must lie below the relevant limiting curve.
- The thermal limits must be observed, i.e. with synchronous motors, the rms motor torque at the average motor speed resulting from the duty cycle must lie below the S1 curve (continuous duty). With asynchronous motors, the rms value of the motor current within a duty cycle must be less than the rated motor current.
- It should be noted that the maximum permissible motor torque on synchronous motors at higher speeds is reduced as a result of the voltage limiting curve. In addition, a clearance of 10% from the voltage limiting curve should be observed to safeguard against voltage fluctuations.
- When using asynchronous motors, the permissible motor torque in the field weakening range is reduced as a result of the stability limit. A clearance of 30% should be observed.
- When using an absolute encoder, the rated torque of the motor is reduced by 10% due to the thermal limits of the encoder.

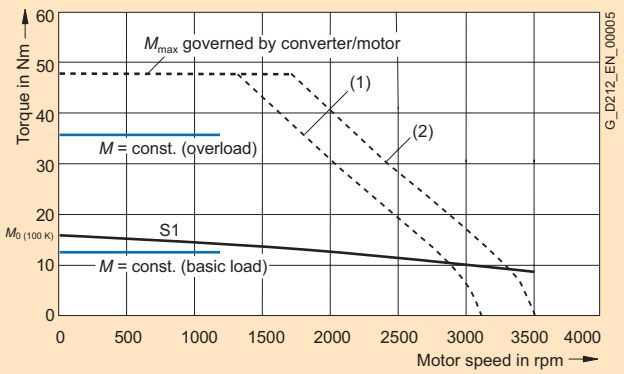
Duty cycles with constant ON period

Duty cycles with constant ON period place specific requirements on the torque characteristic as a function of the speed, e.g. M = constant, $M \sim n^2$, $M \sim n$ or P = constant.

These drives typically work at a stationary operating point. Base load dimensioning is applied. The base load torque must lie below the S1 curve.

In the event of transient overloads (e.g. during start-up), overload dimensioning is applied. The peak torque must lie below the voltage limiting curve on synchronous motors or below the stability limit on asynchronous motors.

In summary, the dimensioning is as follows:

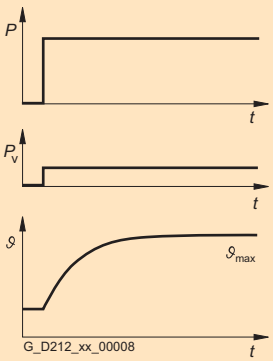


(1) Voltage limit curve for Smart Line Module (governed by DC link voltage)
(2) Voltage limit curve for Active Line Module (governed by DC link voltage)

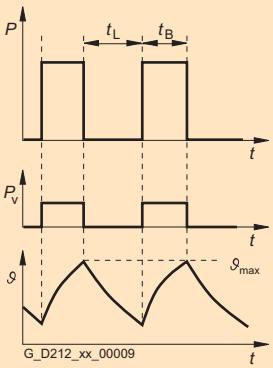
Selection of motors for duty cycles with constant ON period (example)

Duty cycles with varying ON period

As well as continuous duty (S1), standardized periodic duty types (S3) are also defined for duty cycles with varying ON periods. S3 duty is operation which comprises a sequence of similar cycles, each of which comprises a time with constant load and a break.



S1 duty (continuous operation)



$$t_r = \frac{t_B}{t_B + t_L}$$

S3 duty (periodic duty without affecting the start-up procedure)

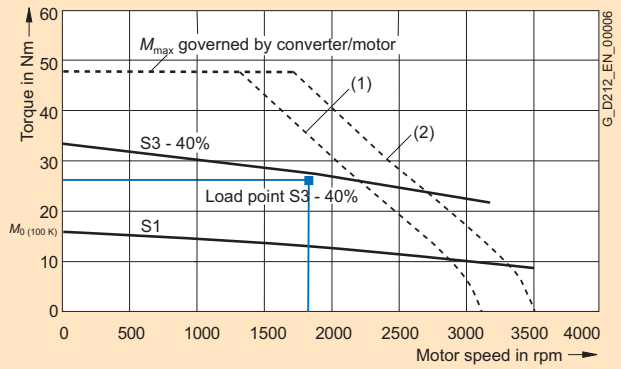
Fixed variables are usually used for the relative ON period:

- S3 – 60%
- S3 – 40%
- S3 – 25%

Corresponding motor characteristics are provided for these specifications. The load torque must lie below the corresponding thermal limiting curve of the motor. Overload dimensioning is taken into account for duty cycles with varying ON periods.

Dimensioning

In summary, the definition of the motor is as follows:

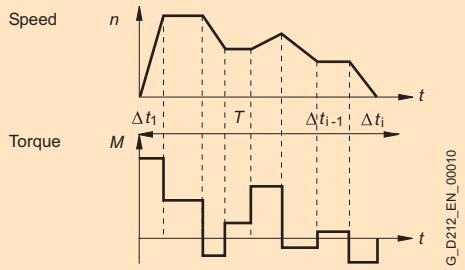


(1) Voltage limit curve for Smart Line Module (governed by DC link voltage)
(2) Voltage limit curve for Active Line Module (governed by DC link voltage)

Selection of motors for duty cycles with varying ON periods using the example of a synchronous motor

Free duty cycle

A free duty cycle defines the progress of the motor speed and torque over time.



A load torque is set for each time period. In addition to the load torque, the average load moment of inertia and motor moment of inertia must be taken into account for acceleration. A friction torque, which works in opposition to the direction of movement, may be required.

The gear ratio and gear efficiency must be taken into account when calculating the load and/or acceleration torque to be provided by the motor. A higher gear ratio increases positioning accuracy in terms of encoder resolution. At the given motor encoder resolution, as the gear ratio increases, so should the resolution of the machine position to be detected.

For more information about the importance of gear units, see the motor descriptions.

The following applies for the motor torque in a time period Δt_k

$$M_{Mot,k} = (J_M + J_G) \times \frac{2\pi}{60} \times \frac{\Delta n_{load,k}}{\Delta t_k} \times i +$$

$$(J_{load} \times \frac{2\pi}{60} \times \frac{\Delta n_{load,k}}{\Delta t_k} + M_{load,k} + M_R) \times \frac{1}{i \times \eta_G}$$

The motor speed is:

$$n_{mot,k} = n_{load,k} \times i$$

The rms torque is as follows:

$$M_{mot,rms} = \sqrt{\frac{\sum M^2_{mot,k} \times \Delta t_k}{T}}$$

The mean motor speed is calculated as follows:

$$n_{mot,mean} = \frac{\sum \frac{n_{mot,k,A} + n_{mot,k,E}}{2} \times \Delta t_k}{t_e}$$

J_M	Motor moment of inertia
J_G	Gear moment of inertia
J_{load}	Load moment of inertia
N_{load}	Load speed
i	Gear ratio
η_G	Gear efficiency
M_{load}	Load moment
M_R	Friction torque
T	Cycle time, clock time
A; E	Initial value, end value in time period Δt_k
t_e	Switch-on duration

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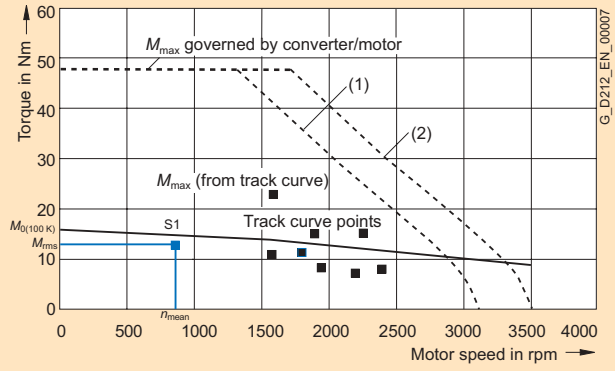
The rms torque M_{rms} must lie below the S1 curve.

The maximum torque M_{max} is reached during the acceleration process and must lie below the voltage limiting curve on synchronous motors and below the stability limit on asynchronous motors.

In summary, the dimensioning is as follows:



(1) Voltage limit curve for Smart Line Module (governed by DC link voltage)
(2) Voltage limit curve for Active Line Module (governed by DC link voltage)

Selection of motors on the basis of a free duty cycle (example)

Motor selection

It is now possible to identify a motor that exactly matches operating conditions.

In a following step, a check is made as to whether the thermal limits are maintained. For this purpose, the motor current at base load must be calculated. For configuration based on duty cycle with constant ON period with overload, the overload current based on the required overload torque must be calculated. The calculation rules for this purpose depend on the type of motor used (synchronous motor, asynchronous motor) and the operating scenario (duty cycles with constant ON period, duty cycles with varying ON period, free duty cycle).

Finally, the other characteristics of the motor must be defined. This is done by configuring the motor options (see motor description).

4. Definition of SINAMICS S120 Motor Module

The Motor Modules can be assigned to the motor on the basis of their rated output and peak current. The Motor Module is assigned on the basis of the static current $I_{0\ 100K}$ (rated current for winding temperature 100 K) for synchronous motors and the rated current I_{rated} for asynchronous motors, and is listed in the motor description.

For an optimum configuration, the motor current calculated is mapped to the Motor Module. The precise calculation is supported by SIZER.

Depending on the ambient conditions (installation altitude, ambient temperature), the output current of the motor modules may need to be reduced (see component description).

The motor current calculated on the basis of the motor type (synchronous motor, asynchronous motor) and the operating scenario (duty cycles with constant ON period, duty cycles with varying ON period, free duty cycle) is used to dimension the Motor Module:

$I_{rated,\ motor\ module} \geq I_{load}$

An increased output current may be requested from the Motor Modules for a specific period of time. In the event of an overload configuration, the following must be true:

$I_{rated,\ Motor\ Module} \times$ *overload factor* $< I_{overload}$

Overload factor = Ratio I_{rated}/I_{max}, taking into account the duty cycles (see component descriptions).

The Motor Modules can be supplied as Single Motor Modules and, in certain current ranges, also as Double Motor Modules.

5. Repeat Steps 3 and 4 for additional axes

The motors and Motor Modules must be calculated for all axes.

6. Calculation for the required DC link power and definition of the SINAMICS S120 Line Module

In multi-axis drive applications, a number of Motor Modules are operated on a common DC link, which is supplied with power by a line module.

Now define whether a Smart Line Module or an Active Line Module is to be used. This depends on the available power ranges of the Line Modules and on whether the DC link voltage needs to be non-regulated and therefore line-voltage-dependent (Smart Line Module) or regulated (Active Line Module) at a constant DC link voltage of 600 V or 625 V (depending on the line voltage, up to 3 AC 415 V → DC 600 V, 3 AC 416 V to 440 V → DC 625 V, above 3 AC 440 V → line-voltage-dependent).

The power required for each axis are taken into account when defining the Line Module.

Dimensioning

The operating scenario and the type of motor must be taken into account when calculating the required DC link power:

- With asynchronous motors, which are dimensioned for duty cycles with varying ON period, the rated power of the motor is equal to the required DC link power.
- With synchronous motors, which are dimensioned for duty cycles with varying ON period, the required DC link power is equal to the calculated power × speed ratio. The required DC link power can be influenced via the speed ratio (ratio of load speed to rated speed). Empirical values for the speed ratio are:

Application	Speed ratio $\tilde{n}/n_{rated}$
Synchronous motors/feed drives for low-speed drives	0.4 to 0.7
Robot drives for high-speed drives	0.9 to 1
Asynchronous/main spindle drives with 1FT and 1PH7 motors	1

- For asynchronous motors and synchronous motors, which are dimensioned on the basis of duty cycles with constant ON period or free duty cycle respectively, the power at the operating point of the motor or the rms power taking into account the efficiency of the motor and Motor Module is applied as the required DC link power.

The total of the P_{calc} ratings for the individual motors, corrected by the coincidence factor and the average speed ratio, provides the basis for the selection of the Line Module type rating.

Calculated power for synchronous motors

$P_{calc\ VSA} = 0.105 \times M_0 \times n_{rated} \times 10^{-3}$

$P_{calc\ VSA}$ = Calculated power for synchronous motors in kW

0.105 = Factor $2 \times \pi/60$

M_0 = Static torque in Nm

n_{rated} = Rated speed in rpm

Calculated power for asynchronous motors

- Motors < 4 kW (5.4 HP)

$P_{calc\ HSA} = 1.45 \times P_{motor\ shaft\ HSA}$

- Motors > 4 kW (5.4 HP)

$P_{calc\ HSA} = 1.25 \times P_{motor\ shaft\ HSA}$

$P_{calc\ HSA}$ = DC link power for constant-power drive in kW

1.45 or 1.25 = Factor taking into account the efficiency of the motor

$P_{motor\ shaft\ HSA}$ = Mechanical power used on the motor shaft in kW

The rated incoming power supply for the line modules is based on a line voltage of 380 V. If the line voltage changes, this may affect the output power of the line modules. However, it cannot exceed the rated power.

Depending on the ambient conditions (installation altitude, ambient temperature), the rated incoming power supply of the line modules may need to be reduced (see component description).

To optimize the dimensioning of the Line Module, the cyclic characteristics of the torque must be taken into account for the individual axes. It is assumed that asynchronous motors are used as main drives/main spindle drives and are therefore in constant long-term operation. Synchronous motors are used for cyclic sequences (e.g. feed axes) – they do not run constantly.

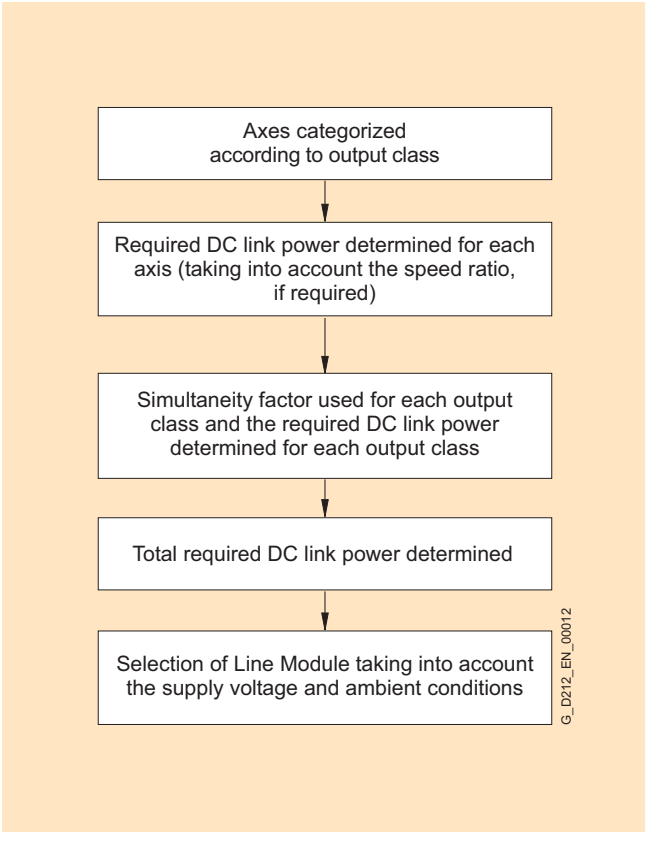
The coincidence factor takes into account the cyclic characteristic of the torque for each individual axis.

Empirical values for the coincidence factor are:

Feed axes per range	Coincidence factor *K* per range
1	1
2	0.63
3	0.5
4	0.38
5	0.33
6	0.28

To prevent misconfigurations on axes with very different power ratings, the axes are categorized in power classes on the basis of their power.

These classes can be used as a basis for dimensioning the Line Module in accordance with the following procedure:



This scheme is reflected in the configuration table below.

Configuration record for the simplified calculation of the DC link power P_Z

Axis	Motor Order No.	n_{rated} rpm	M Nm (lb$_f$-ft)	I_{rated} A	I_O (Motor Module) A	$P_{calcVSA}$ kW (HP)	$\tilde{n}/n_{rated}$	$P_{calcVSA}$ ($\tilde{n}/n_{rated}$) kW (HP)
Range I from 0 kW (0 HP) to 1.8 kW (2.5 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range I		
Range II from 1.8 kW (2.5 HP) to 8.8 kW (12 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range II		
Range III from 8.8 kW (12 HP) to 31 kW (42 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range III		
Range IV from 31 kW (42 HP) to 50 kW (67 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range IV		
Range V from 50 kW (67 HP) to 75 kW (100 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range V		
Range VI from 75 kW (100 HP) to 150 kW (201 HP)								
1								
2								
3								
4								
5								
6								
						Total $P_{calcVSA}$ Range VI		

Dimensioning

Total $P_{calcVSA}$		Coincidence factor				$P_{Z\ VSA}$ kW (HP)
Range I		K_I				
	x		=			
Range II		K_{II}		+		
	x		=			
Range III		K_{III}		+		
	x		=			
Range IV		K_{IV}		+		
	x		=			
Range V		K_V		+		
	x		=			
Range VI		K_{VI}		+		
	x		=			
			Total		x 1.1 =	

The following factors must also be taken into account when dimensioning the DC link:

Braking operation

As device losses are important in motor-driven operation, the dimensioning for motor-driven operation is also relevant for regenerative operation. For the braking operation of the motors, check that the energy regenerated in the DC link does not exceed the permissible peak capacity of the line module:
Peak energy regeneration ≤ 0.9 × (total powers of all axes).

In the event of greater energy regeneration ratings and to master the "line failure" operating scenario, a Braking Module must be provided or the Line Module must be overdimensioned or the energy regeneration reduced by increased braking times.

For the configuration of the "EMERGENCY STOP" operating scenario, the Line Module must either be overdimensioned or an additional Braking Module must be used, in order that the DC link energy can be dissipated as quickly as possible.

Checking DC link capacitance

During power-up, the Line Modules limit the load current to the DC link capacitors. The max. permissible DC link capacitance must not exceed the following max. DC link capacitances in the drive group due to the limits of the pre-charging input circuit: Smart Line Modules 5 kW and 10 kW (6.5 HP and 13.5 HP) max. 6 mF and all other Line Modules 16 kW to 120 kW (21.5 HP and 160 HP) max. 20 mF.

You must ensure that these DC link capacitances in the drive group are not exceeded. The values for the DC link capacitances of the components are specified in the component descriptions for SINAMICS S120.

DC link precharging frequency

The precharging frequency of the DC link via the Line Module is calculated using the following formula:

$$\text{Number of precharges Within 8 min} = \frac{\text{Max. permissible DC link capacitance Infeed module in µF}}{\sum \text{DC link capacitance of configured drive line-up in µF}}$$

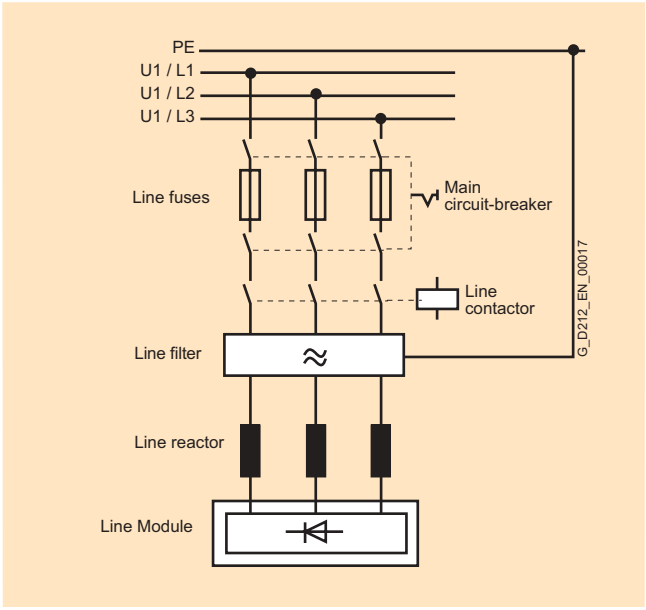
Special considerations for operation on Smart Line Module

Smart Line Modules provide a lower DC link voltage than Active Line Modules. This results in the following supplementary conditions:

- When operating asynchronous motors, a lower maximum motor power is available at high speeds at the same line voltage.
- For synchronous motors, a reduction in the dynamic drive characteristics must be calculated at high speeds.
- For synchronous motors, when overload is required, the rated motor speed is not utilized to as great an extent.

7. Specification of the line-side options (main switch, fuses, line filters, etc.)

The following line-side options are recommended for the drive configuration:



The main switch may take various formats:

- Main and EMERGENCY STOP switch + fuse switch disconnector (with leading signal via auxiliary contact for trip mode)
- Load interruptor with fuses
- Circuit-breaker.

A line contactor can be used, for example, if the drive has to be disconnected from the line supply in the event of a fault or for remote tripping. Follow the instructions in the SINAMICS S120 Planning Guides to interlock the line contactor in the context of safety functions.

A line filter should be used on TN systems to reduce line harmonics.

A line reactor is always required. With Active Line Modules, it is absolutely essential for the operation of the step-up converter. With Smart Line Modules, it must be used to reduce line harmonics and to provide protection against high current overswings.

Note:

Suitable earth leakage devices to provide protection against dangerous shock currents should be fitted to all power converters with three-phase bridge connection (B6). SINAMICS Line Modules are suitable for direct operation on AC/DC-sensitive, selective residual-current circuit breakers. The asymmetric input and output delays caused by the main switch and the associated electric flux and surge current mean that residual-current circuit breakers with selective cut-out characteristics should be used (e.g. 5SZ6468-0KG00, rated current 63 A; rated fault current 300 mA).

Where PWM power converters are in operation, especially in conjunction with EMC measures (such as shielded motor cables), higher leakage currents may be generated. The line filters assigned to 16 kW (21.5 HP) and 36 kW (48 HP) Active Line Modules will restrict the leakage currents to below 150 mA.

As an alternative, an isolating transformer can also be used in conjunction with other protective measures against hazardous leakage currents.

8. Specification of the required control performance and selection of the SINAMICS S120 Control Unit, definition of component cabling

The CU320 Control Unit has been designed to control multiple drives. It provides the control functions for the drives (Motor Modules, Line Module) and system components. The load on the control unit will vary depending on the number of and dynamic performance required from the individual drives. The following data should be used to estimate the load:

Servo	Load
1st Axis	26%
Each additional axis	13%

Each load rating indicated includes the central communication applications.

A 1% load should be applied if a Terminal Module is used.

Total load	Required components (in addition to the control unit)
≤ 55%	CompactFlash Card without performance extension
> 55% to ≤ 100%	CompactFlash Card with performance extension 1
> 100%	Additional CU320 Control Unit and CompactFlash Card required

Component cabling with DRIVE-CLiQ

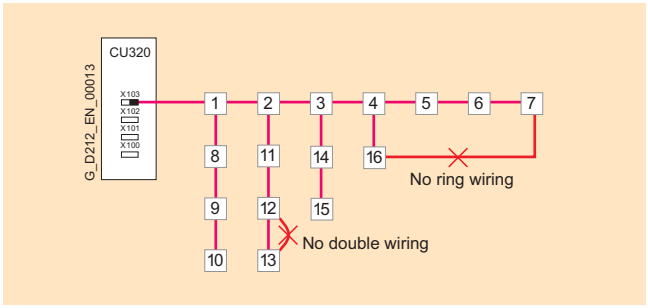
The components communicate with one another via the standard DRIVE-CLiQ interface. This interface connects a Control Unit with the power components, encoders and other system components, e.g. Terminal Modules. Setpoints and actual values, control commands, status messages, and rating plate data for the components are transferred via DRIVE-CLiQ.

The following rules apply to the wiring of components with DRIVE-CLiQ:

- A maximum of 16 nodes can be connected to a DRIVE-CLiQ socket on the CU320 Control Unit.
- A maximum of 7 nodes can be connected in line. A line is always seen from the perspective of the Control Unit.
- Ring wiring is not permitted.
- Components must not be double-wired.

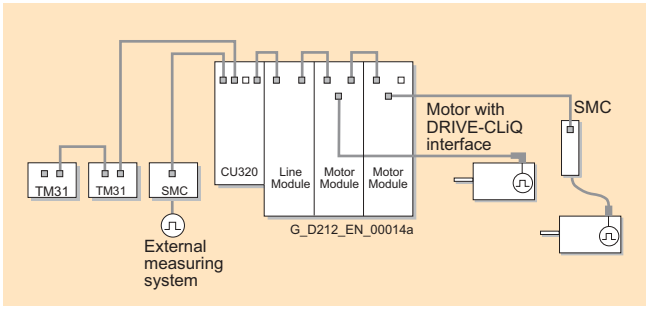
Dimensioning

In addition, the motor encoder should be connected to the associated Motor Module.

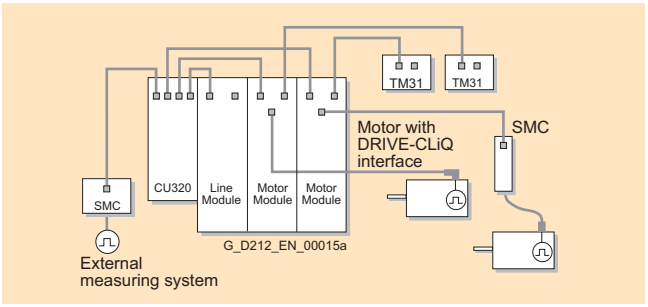


Wiring DRIVE-CLiQ components

The following examples illustrate the flexibility of the DRIVE-CLiQ wiring.



Example of a **line topology** for standard solutions



Example of a **tree topology** for high-performance solutions, e.g. high-dynamic axes in direct motion control group, selective access to individual axes/axis groupings for maintenance operation, etc.

The power components are supplied with the appropriate DRIVE-CLiQ connecting cable for connection to the adjacent drive module in the line-up (line topology). Prefabricated DRIVE-CLiQ cables in various lengths of up to 100 m (328 ft) are available for connecting motor encoders, direct encoders, Terminal Modules, etc.

9. Definition of additional system components

Sensor Modules

Signal connection for the various encoders (incremental encoder sin/cos 1 V_{pp}, absolute encoder, resolver) to the DRIVE-CLiQ interface takes place with Sensor Modules. Depending on the measurement system, SMC10, SMC20 or SMC30 Sensor Modules can be used. The Sensor Modules are suitable for mounting on DIN rails. They are also used for the signal conditioning of external (machine) encoders.

For some motor types, encoder evaluation is integrated as standard in the motors. These motors are wired directly using DRIVE-CLiQ (in addition to the power connection). Conventional signal conditioning is no longer required; neither is a Sensor Module required.

Expansion modules

The CU320 Control Unit features I/O and interfaces for communication. SINAMICS S120 offers the following expansion modules:

- TB30 Terminal Board (terminal expansion for plugging into the option slot on the CU320 Control Unit)
- CBC10 Communication Board (drive CANopen interface for plugging into the option slot on the CU320 Control Unit)
- TM31 Terminal Module (terminal expansion for connection via DRIVE-CLiQ)

The following criteria must be taken into account if you are using the expansion modules:

- Only one option board can be plugged into the option slot on the CU320 Control Unit.
- A maximum of 8 Terminal Modules may be operated in a drive group.

Braking Module

A Braking Module must be used to stop the drives in the event of a line failure or "EMERGENCY STOP", as in these operating scenarios the braking energy can no longer be regenerated into the line or cannot be regenerated quickly enough.

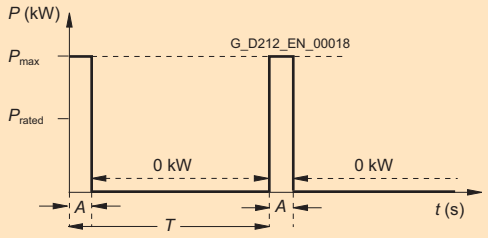
The Braking Modules can be connected in parallel to increase the braking power.

The maximum number of Braking Modules in a drive group depends on the DC link capacitance of the drive configuration in question. One Braking Module can be used for each complete 0.5 mF of DC link capacitance.

If the DC link capacitance is not sufficient for the operation of a number of Braking Modules, Capacitor Modules can be used to increase the DC link capacitance. The max. permissible DC link capacitance of a drive group on a Line Module must be taken into account. The max. DC link capacitance to be taken into account for precharging current limiting on the Line Modules are listed in the technical data for the line modules.

Dimensioning

The braking resistor discharges the excess energy from the DC link:



t Period of braking duty cycle in s
A Load duration in s
P_{rated} Continuous power of braking resistor in kW
P_{max} Peak power of braking resistor in kW

Duty cycle for braking resistors

Capacitor Module

Capacitor Modules are used to increase the DC link capacitance to buffer momentary power losses. If the DC link capacitance is not sufficient for the use of one or a number of Braking Modules, each Capacitor Module used can increase this by 4 mF.

Control Supply Module

The Control Supply Module provides a 24 V DC power supply via the line or DC link, in order to maintain the electronics power supply for the components in the event of a line failure. This makes it possible, for example, to make emergency retraction movements in the event of the failure of the line supply.

10. Calculation of the current requirements for the 24 V DC supply for the components and specification of power supplies (SITOP power supplies, Control Supply Modules)

Line Modules, Motor Modules, option modules and other system components must be provided with a 24 V DC voltage via an electronics power supply made available externally or via Control Supply Modules. Line Modules and Motor Modules have integrated 24 V DC busbars for the 24 V DC voltage, and other components have connection terminals.

SITOP power supplies, which are available as a modular solution for 20 A and 40 A, are to be used to provide the external 24 V DC electronics power supply.

Determining the electronics power supply module to be supplied externally

The current requirements are listed in the table below:

Modules	24 V DC current requirements A
CU320 Control Unit	
• CU320 without load	0.8
• per digital output	max. 0.5 typ. 0.1
• PROFIBUS Teleservice	max. 0.15
Supplementary system components	
• TB30 Terminal Board	< 0.1
- per digital output	max. 0.5 typ. 0.1
• TM31 Terminal Module	typ. 0.2
- per digital output	max. 0.5 typ. 0.1
Smart Line Modules	
• 5 kW (6.5 HP)	1.0
• 10 kW (13.5 HP)	1.3
Active Line Modules	
• 16 kW (21.5 HP)	1.0
• 36 kW (48 HP)	1.4
• 55 kW (74 HP)	1.7
• 80 kW (107 HP)	2.0
• 120 kW (160 HP)	2.5
Single Motor Modules	
• 3 A	0.8
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 1.1
• 5 A	0.8
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 1.1
• 9 A	0.85
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 1.1
• 18 A	0.85
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 1.1
• 30 A	0.9
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 1.1
• 45 A	1.2
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 2.0
• 60 A	1.2
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	typ. 0.4 to 2.0
• 85 A	1.5
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	max. 2.0
• 132 A	1.5
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	max. 2.0
• 200 A	1.5
- for 1×DRIVE-CLiQ	typ. 0.25
- for 1×brake	max. 2.0
Double Motor Modules	
• 2×3 A	1.0
- for 2×DRIVE-CLiQ	typ. 0.5
- for 2×brake	typ. 0.8 to 2.2
• 2×5 A	1.0
- for 2×DRIVE-CLiQ	typ. 0.5
- for 2×brake	typ. 0.8 to 2.2
• 2×9 A	1.0
- for 2×DRIVE-CLiQ	typ. 0.5
- for 2×brake	typ. 0.8 to 2.2
• 2×18 A	1.0
- for 2×DRIVE-CLiQ	typ. 0.5
- for 2×brake	typ. 0.8 to 2.2
Braking Modules	
• Braking module	0.5
Sensor Modules	
• SMC10 Sensor Module	typ. 0.25
• SMC20 Sensor Module	typ. 0.25
• SMC30 Sensor Module	typ. 0.33

Dimensioning

The calculation is made using the following formula:

Σ [CU320 + TB30 + CBC10 + Line Module +
Σ (Motor Modules + SMCxx + motor braking signal)]

The other system components (e.g. line contactor) must also be taken into account.

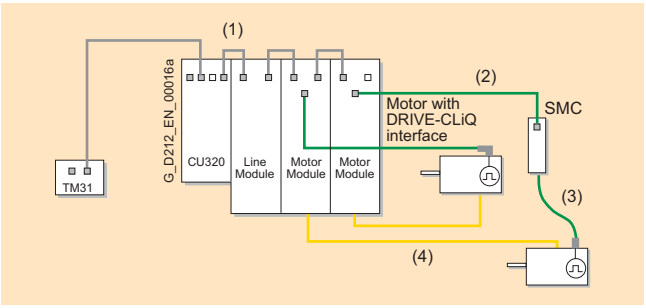
Limit values for the configuration:

- The max. current carrying capacity of the integrated 24 V DC busbars is 20 A.
- In the event of higher current requirements, a number of 24 V DC power supplies must be provided in one drive group. The additional power supplies are provided using 24 V terminal adapters.
- Cable cross-sections of up to 2.5 mm^2 may be connected to the Control Unit, Terminal Boards, Terminal Modules and Sensor Modules.
- Cable cross-sections of up to 6 mm^2 may be connected to the 24 V terminal adapters for the Line Modules and Motor Modules.
- The external 24 V DC power supply should only be used for the SINAMICS components and the direct loads.

11. Specification of components for connection system

To complete the drive system, components such as motors and encoders must be connected via cables.

For motors with DRIVE-CLiQ interface, the 24 V DC power supply is provided via the DRIVE-CLiQ cables. On all other Sensor Modules, a separate 24 V DC power supply must be provided.



Drive system connection system

Legend	Cable	Description
(1)	DRIVE-CLiQ cables	Standard cables for cabinet-internal configuration without 24 V cores
(2)	DRIVE-CLiQ MOTION-CONNECT 500/800 cables	MOTION-CONNECT 500 shielded cables for fixed installation (e.g. in cable ducts), and MOTION-CONNECT 800 for flexible installation (e.g. in cable chains) with 24 V cores
(3)	MOTION-CONNECT 500/800 signal cables	Suitable for the measuring system in question; in versions MOTION-CONNECT 500 shielded cables for fixed installation (e.g. in cable ducts) and MOTION-CONNECT 800 for flexible installation (e.g. in cable chains)
(4)	MOTION-CONNECT 500/800 power cables	MOTION-CONNECT 500 shielded cables for fixed installation (e.g. in cable ducts) and MOTION-CONNECT 800 for flexible installation (e.g. in cable chains)

12. Configuration of drive group components

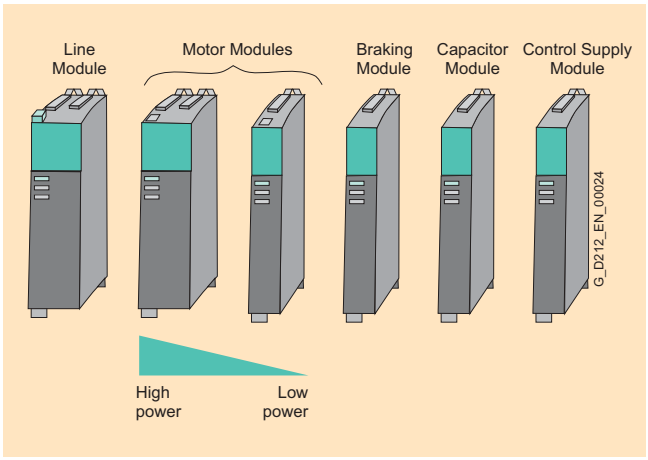
A SINAMICS S drive group comprises a Line Module, Motor modules, DC link components, a Control Unit and the optional expansion modules.

The following criteria must be taken into account when configuring the drive group:

- The Line Module must always be located on the left as the first module.
- Only one Line Module is permitted in each drive group.
- A number of drive groups must be configured for power supplies which cannot be provided by the highest rating.
- The Motor Modules must be located next to the Line Module in descending rated current order from left to right (highest rated current on the left, lowest rated current on the right). Due to the increased currents, Motor Modules with 300 mm (11.8 in) width housings have DC link busbars with increased cross-section. Within the drive group, it must be ensured that the DC link busbars meet the current carrying capacity requirements for the connected Motor Modules.
- DC link adapters can be used for multi-tier drive line-ups.
- The drive groups should be configured so that the total length of all power cables (motor cables and line cables) in each individual group, which should preferably be shielded, is ≤ 350 m (1148 ft).

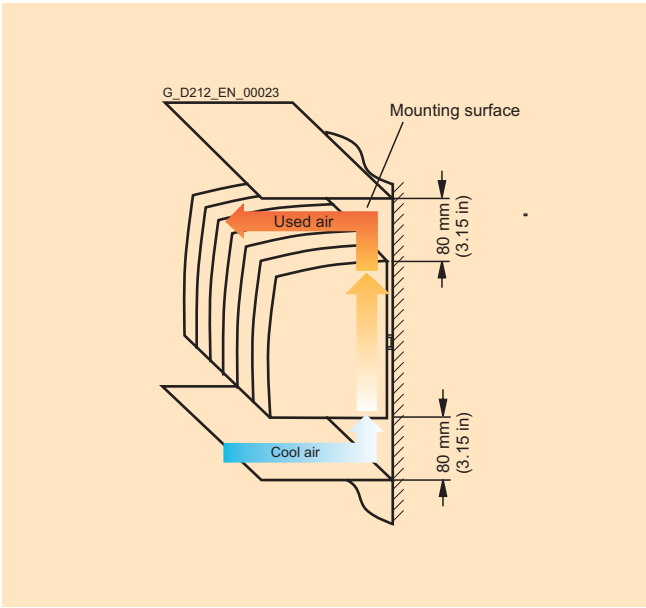
Additional criteria for the use of the Braking Module:

- The Braking Module is usually located on the right, next to the smallest Motor Module. This is particularly important in cases in which the drive group comprises a number of very similar Motor Modules.
- In the event of imbalanced power distribution, e.g. if high-power Motor Modules are being used in conjunction with low-power Motor Modules, the Braking Module must be installed between the Motor Modules whose power ratings differ the most, as the cross-sections of the DC link busbars will vary in terms of dimensions due to the current carrying capacity of the integrated DC link busbars.

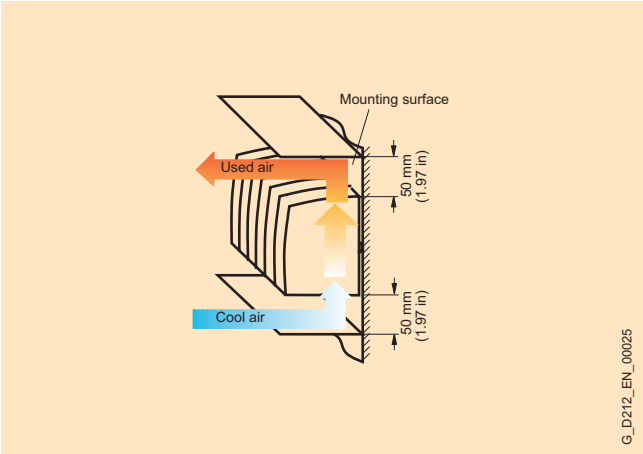


Power-based arrangement of Motor Modules

- The Control Unit mounting position is flexible. The following configuration options are possible:
  - "Docking" on the left-hand side of the Line Module
  - Direct mounting next to the drive group on a mounting plate
  - Mounting in other cabinet areas, taking the permissible DRIVE-CLiQ cable lengths into account.
- The following minimum required ventilation spaces for the components MUST be observed:



Ventilation spaces for booksize format components



Ventilation spaces for Sensor Modules and Terminal Modules

- When mounted on the back panel, line reactors and line filters require a ventilation space of 100 mm (3.9 in) above and below respectively.

Ordering example

Tubular bag machine

Application description - Technical sequence

Film extractor

The packaging film is paid out from the roll by the feed rollers on the fill pipe. The material first passes through a dancer roller. The end positions of the dancer roller are recorded. As soon as the end positions are reached, the machine is stopped. The film adjuster positions the film correctly.

Fill pipe with transport rollers

Next, the film is pulled through the shaping shoulder to create a film tube. This is then transported vertically through the machine via the fill pipe. The transport rollers are responsible for the transportation of the film.
On films with print logos, the position of the print-mark is permanently monitored. Any distortions, such as those caused by stretching of the film, are adjusted by the film feed so that the print logo appears within the appropriate tolerance limits on the package.

Sealing

The tube is sealed by the longitudinal sealer. Heat and pressure are applied during this process. It is important to maintain constant sealing times.
The machine described here is a continuous duty tubular bag machine. Therefore, the transverse sealing bars follow a curve profile (similar to a D form).
Heat and pressure are also applied during transverse sealing. The transverse sealing mechanism is driven by a servomotor, and follows a series of cyclic motions.

Product feed

If the transverse sealing mechanism is closed when the tube reaches it, the product is filled into the bag via a scale, a proportioning screw, or, as in this example, by a proportioning cup. At the same time, the bottom of the tube is sealed and the previously filled tube separated.
The packages produced by the tubular bag machine are then forwarded to other machines, for example, batch packagers.

General machine control

All relevant machine parameters can be changed during operation or when the machine is at standstill:

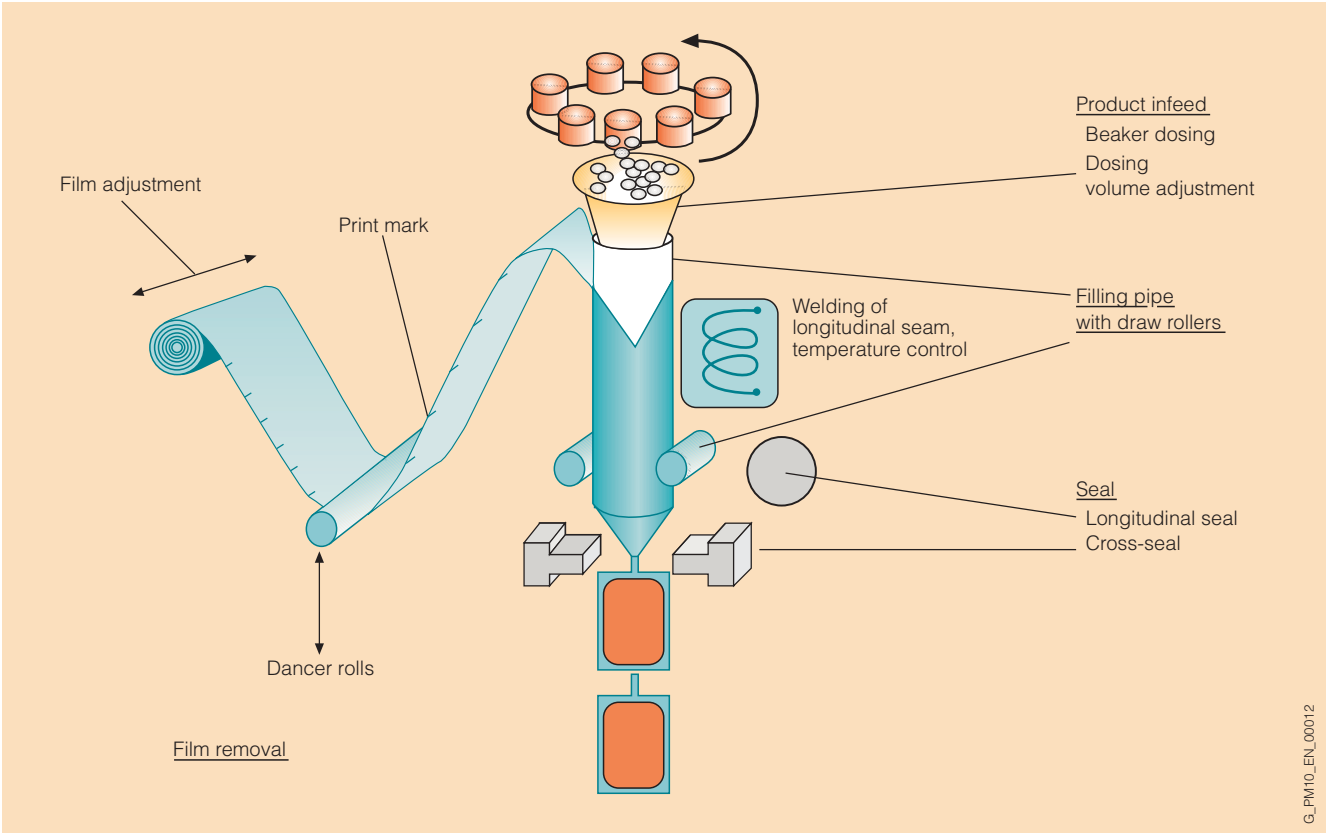
- Sealing temperature
- Switching times for product feed
- Bag length
- Film adjustment

Visualization

The HMI performs the following functions:

- Operation and monitoring
- Program storage and recipe management

Touch-panel operation is required



Schematic representation of a tubular bag machine

Ordering example

The following table, which has been derived from the application description, shows how to set up solutions for the major machine functions.

Note:

A single task can be solved in numerous ways. One possible solution is shown here. For the sake of transparency, a detailed selection of drive systems and connection methods has not been included.

All components must support communication via PROFIBUS DP.

Subsystem	Functions/Requirements	Solution	Order No.
Film extractor	Film adjustment Requires a positioning drive to set the correct position of the film.	**1 x intelligent SIMODRIVE POSMO A positioning motor**	6SN2132-0AA11-1BA0
Fill pipe with transport rollers	Transport rollers The transport rollers, which are driven by a servo motor, pull the film over the fill pipe. Any distortions, such as those caused by stretching of the film, must be corrected by adjusting the film feed.	**1 x synchronous motor with incremental encoder sin/cos (1 V_{pp})** M_0 = 1.1 Nm (0.8 lb_f-in) ΔT = 100 K n_{rated} = 6000 rpm The use of a servo drive enables the film to move precisely and highly dynamically, ensuring the correct positioning of the print logo.	1FK7032-5AK71-1DG2
Sealing	Longitudinal sealing Motion for longitudinal sealing is generated by a drive, which ensures precision and high dynamics.	**1 x synchronous motor with resolver** M_0 = 3.1 Nm (2.3 lb_f-in) ΔT = 100 K n_{rated} = 6000 rpm The use of a servo drive ensures precise and highly dynamic sparkover characteristics.	1FK7043-7AK71-1YG2
	Transverse sealing Motion for transverse sealing is generated by a drive, which ensures precision and high dynamics.	**1 x synchronous motor with resolver** M_0 = 3.1 Nm (2.3 lb_f-in) ΔT = 100 K n_{rated} = 6000 rpm The use of a servo drive ensures precise and highly dynamic sparkover characteristics.	1FK7043-7AK71-1YG2
Product feed	Cup proportioning The product feed requires a precise and highly dynamic drive system.	**1 x synchronous motor with incremental encoder sin/cos (1 V_{pp})** M_0 = 1.1 Nm (0.8 lb_f-in) ΔT = 100 K n_{rated} = 6000 rpm The use of a servo drive enables the film to move precisely and highly dynamically, ensuring the correct positioning of the print logo.	1FK7032-5AK71-1DG2

Ordering example

The following SINAMICS S120 components are used:

Description	Comments	Number of work-pieces	Order No.
CU320 Control Unit (without CompactFlash Card)	Communication between the Motion Control automation system and the drive takes place via the standard PROFIBUS interface. As the module is mounted on the Active line module by means of the brackets built into the side, spacers are not required.	1	6SL3040-0MA00-0AA1
CompactFlash Card with Performance expansion 1 firmware option	The required performance has already been calculated. An alternative would be the CompactFlash Card without firmware options (**6SL3054-0AA00-1AA0**) and the license firmware option Performance Extension 1 (**6SL3074-0AA01-0AA0**)	1	6SL3054-0AA01-1AA0
Line filter for 16 kW Active Line Module	The line filter limits the conducted interference originating from the power modules to the values permissible for industrial environments. There is a one-to-one assignment to the 16 kW (21.5 HP) Active Line Module.	1	6SL3000-0BE21-6AA0
Line reactor for 16 kW Active Line Module	When used in conjunction with the Active Line Module, the reactor stores energy for step-up converter operation (600 V DC link): There is a one-to-one assignment to the 16 kW (21.5 HP) Active Line Module.	1	6SN1111-0AA00-0BA1
16 kW Active Line Module	Power cable shield connection plate integrated into the connector. DRIVE-CLiQ cable included in the scope of supply.	1	6SL3130-7TE21-6AA1
Double Motor Module 3 A	For the 2 motors 1FK7032-5AK71-1AG2 (transport roller and cup proportioning). Shield connection plate integrated into the connector (included in the prefabricated power cable). DRIVE-CLiQ cable included in the scope of supply.	1	6SL3120-2TE13-0AA0
Double Motor Module 9 A	For the 2 motors 1FK7043-7AK71-1TG2 (longitudinal and transverse sealing). Shield connection plate integrated into the connector (included in the prefabricated power cable). DRIVE-CLiQ cable included in the scope of supply.	1	6SL3120-2TE21-0AA0
Braking Module	Brings the machine to a controlled stop in the event of a mains failure. In standard operation, the energy balance is achieved via the Active Line Module.	1	6SL3100-1AE31-0AA0
Braking resistor 0.3/25 kW (0.5/33 HP)	Suitable for Braking Module.	1	6SN1113-1AA00-0DA0
Warning signs in foreign languages	As the machine is to be exported to France, warning labels in French are also required. 1 set is needed for each Line Module, Motor Module and Braking Module.	4	6SL3166-3AB00-0AA0
SMC20 Sensor Module Cabinet-mounted (no DRIVE-CLiQ cable)	For encoder signal evaluation on 1FK7032-5AK71-1AG2 motors	2	6SL3055-0AA00-5BA1
SMC10 Sensor Module Cabinet-mounted (no DRIVE-CLiQ cable)	For encoder signal evaluation on 1FK7043-7AK71-1TG2 motors	2	6SL3055-0AA00-5AA0
MOTION-CONNECT 800 prefabricated power cable	No brake cores, 4 × 1.5 mm^2, connector size 1 (motor-side), 10 m (32.8 ft)	2	6FX8002-5CS01-1BA0
MOTION-CONNECT 800 prefabricated signal cable	For SMC20 with incremental encoder sin/cos (1 V_{pp}), 10 m (32.8 ft)	2	6FX8002-2CA31-1BA0
MOTION-CONNECT 500 prefabricated power cable	No brake cores, 4 × 1.5 mm^2, connector size 1 (motor-side), 5 m (16.4 ft)	2	6FX5002-5CS01-1AF0
MOTION-CONNECT 500 prefabricated signal cable	For SMC10 with resolver, 5 m (16.4 ft)	2	6FX5002-2CF02-1AF0
SITOP modular 24 V DC, 20 A power supply unit	The total current requirements (24 V DC) of the SINAMICS components, including the motor encoders, are 6.3 A: CU320: 0.8 A 16 kW (21.5 HP) Active Line Module: 1.3 A Double Motor Module 3 A: 0.8 A Double Motor Module 9 A: 0.8 A Braking Module: 0.2 A SMC20 Sensor Module Cabinet-mounted (no DRIVE-CLiQ cable) 2x: 2 × 0.6 A SMC10 Sensor Module Cabinet-mounted (no DRIVE-CLiQ cable) 2x: 2 × 0.6 A The power supply is connected to the 24 V terminal adapter on the Active Line Module (included in the scope of supply of the Line Module) and distributed via the integrated 24 V busbar. The CU320 and Sensor Modules must be connected separately via their own 24 V DC power supply connectors (included in the scope of supply of each module).	1	6EP1436-3BA00

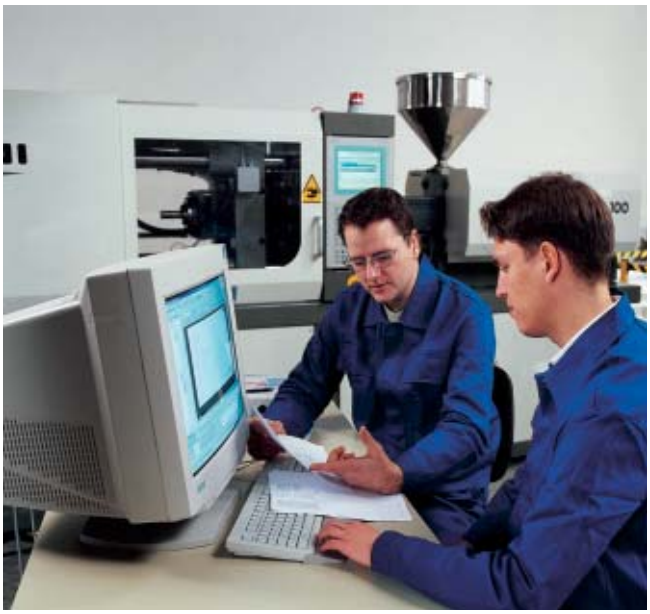
Services and documentation

7

7/2	**Applications**
7/2	Application centers
7/2	**Training**
7/3	Training package for the SINAMICS S120 drive system
7/6	SINAMICS S120 training case
7/7	SIMOTION D435 upgrade kit
7/8	SIMOTION D435 training case
7/9	**Service & Support**
7/10	**Documentation**

Applications

Overview



Our understanding of an application is the customer-specific solution of a motion control task based on standard hardware and software components. In this respect, our industry knowledge and technological expertise are just as important as expert knowledge about how our products and systems work. We are setting ourselves this challenge with more than 100 application engineers at 11 locations in 5 countries in various parts of the world.

Application centers

We currently have application centers in:

- Germany: Chemnitz, Erlangen, Cologne, Mannheim, Stuttgart
- Italy: Bologna, Milan
- France: Paris
- USA: Atlanta, Cincinnati
- China: Beijing

Further application centers are coming soon.

These application centers specialize in the use of SINAMICS. They can provide skilled motion control specialists to help you set up successful concepts. By involving your personnel at an early stage in the process, we can provide a solid basis for rapid knowledge transfer, maintenance and further development of your motion control solution.

From an idea to successful installation and commissioning: We can provide complete support for SINAMICS! Contact your Siemens representative for additional details.

Training

Overview

Because training is the key to your success

SITRAIN ® – Siemens training for automation and industrial solutions – will be constantly by your side to help you find solutions for your tasks.

With training provided by the market leader in automation, plant installation and support, you can have complete confidence in any decisions you make, in particular concerning the optimum use of products and the efficient running of systems. You can rectify deficits in existing systems and rule out expensive planning errors right from the start.

All in all, this is a massive plus for your company, as you will benefit in terms of shorter start-up times, optimized plant sections, faster troubleshooting and reduced downtimes. The result? Profits go up and costs come down.

Top trainers

Our trainers are skilled specialists with extensive experience of training provision. The designers of our courses are directly involved in product development and forward their knowledge directly to our trainers.

A firm basis in practice

As our trainers have direct experience of practical applications, they are able to render their theoretical knowledge with real plausibility. However, as we all know that any theory has its gray areas, we prioritize practical exercises, and allocate up to half of the course program to them. This means that you can apply what you have learned immediately in everyday activities. We use state-of-the-art customized training equipment. Once you have completed your training with us, you will feel ready for anything.

Training variety

With a total of some 300 participant-based courses, we can provide training for the entire range of products and a large number of system solutions. Remote learning services, self-teach software and moderated online seminars complement our traditional training offer.

Customer proximity

We are never very far away. We have approximately 60 locations in Germany and a presence in 62 countries all over the world. Would you prefer individual training to taking part in one of our 300 courses? Our solution: We can customize our program to meet your personal requirements. Training takes place in our training centers or on your site.

Overview (continued)

The ideal combination: Blended learning

Blended learning combines a variety of teaching media and sequences. For example, a participant-based course in a training center can be ideally combined with self-teach programs prior to or following completion. SITRAIN also uses moderated online learning to provide training live on the Internet at agreed times.

The combination is key, because blended learning is able to communicate complex subjects and transfer knowledge on a networked basis. Additional benefit: Travel expenses and downtimes are reduced as training is no longer restricted to a specific time and place.

The international learning portal

For further information please visit us on the Internet at:

http://www.siemens.com/sitrain

All your learning options at a glance! Take your time to browse our international training package, call up all course dates online, use the available places indicator (updated daily) - and apply directly.

Alternatively, contact us directly for personal advice:

Training Office, Infoline Germany
Phone: +49 (0) 18 05 23- 56 11
Fax: +49 (0) 18 05 23 - 56 12

... and request a copy of our latest training catalog:

	Language	Order No.
ITC Catalog (paper version)	German	**E86060-K6850-A101-B4**
List of dates and prices including CD-ROM	German	**E86060-P6850-A101-C8**
Interactive training information system SITRAIN on CD on CD-ROM	German/ English	**E86060-D6850-A100-C1-7400**
Overview of training worldwide	German/ English	**E86060-K6899-A101-B4-7400**

Structure

Training package for the SINAMICS S120 drive system

This provides an overview of the training available for the SINAMICS S120 drive system.

The courses are modular in design and are intended for a variety of target groups as well as individual customer requirements.

The system overview will acquaint decision-makers and sales personnel with the system very quickly.

The planning course provides all the information you need to set up the drive system.

The basic and follow-up courses are sure to provide all the technical knowledge service engineers will need for servicing/starting up motion control applications, communication and cabinet-mounted units.

All modules contain as many practical exercises as possible, in order to enable intensive and direct training on the drive system.

Title	Target group						Duration	Course code
	Decision-makers, sales personnel	Project managers, members of project teams	Engineers, programmers	Start-up engineers, configuring engineers	Service engineers	Maintenance personnel		
Basic courses								
SINAMICS system overview	X	X					2 days	DR-SN-UEB
SINAMICS S120 configuration and planning	X	X	X	X			5 days	DR-SNS-PRJ
SINAMICS S120 service and commissioning			X	X	X	X	5 days	DR-SNS-SI
SINAMICS S120 motion control			X	X	X	X	3 days	DR-SNS-MC
Follow-up course								
SINAMICS communication			X	X	X		3 days	DR-SN-COM

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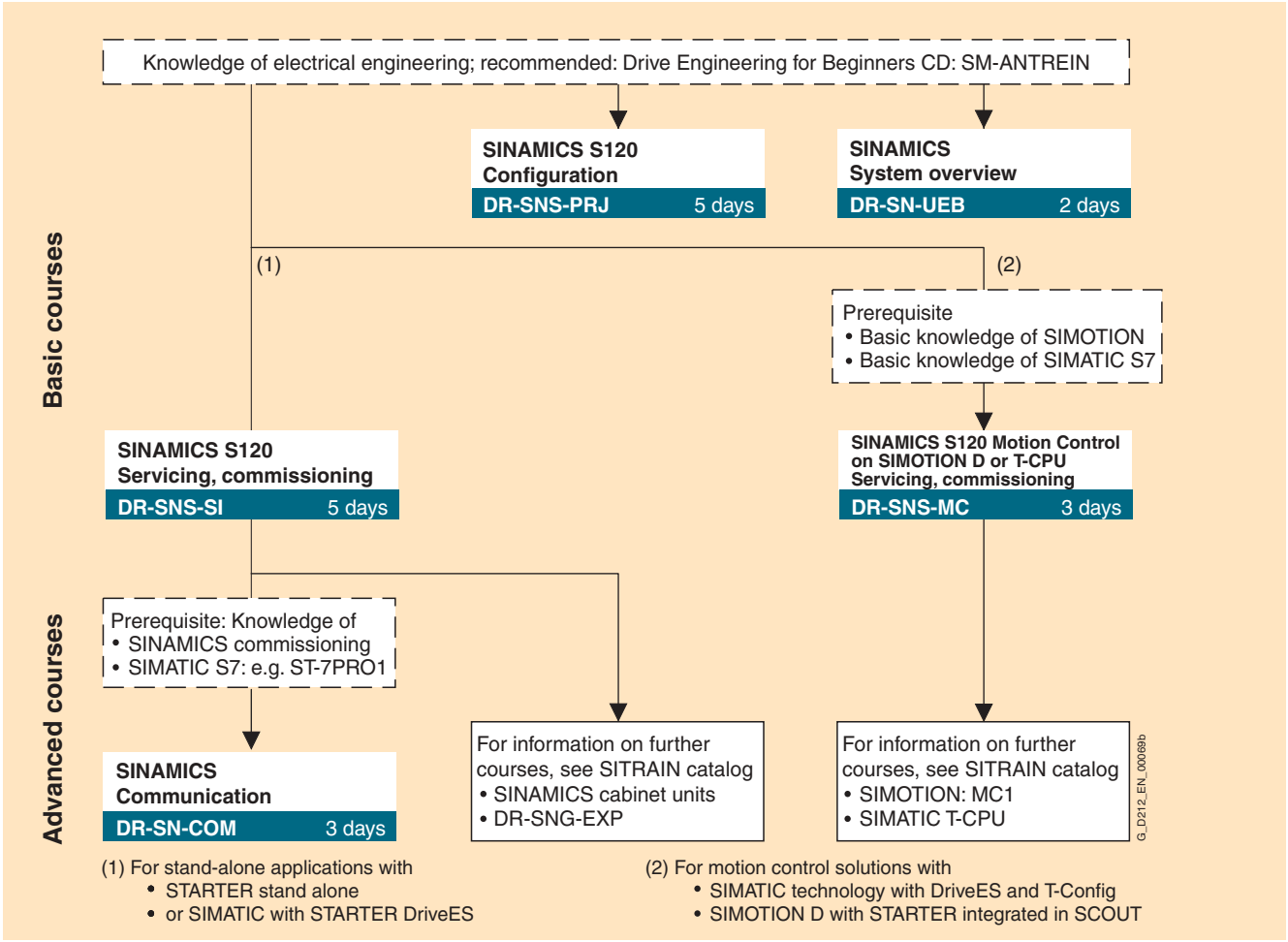
Training

Structure (continued)

SINAMICS S120 training



Function

SINAMICS system overview (2 days)
DR-SN-UEB

Description/Training objective

This course has been designed specifically for sales personnel and decision-makers, who wish to obtain a streamlined overview of the SINAMICS drive concept as well as find out how it fits into the existing Siemens drive structure.

The system overview is supplemented by basic information about the motor and converter technology.

The SIZER configuration tool and the STARTER commissioning tool are presented and demonstrated using brief exercises.

Target group

Decision-makers and sales personnel

Content

- SINAMICS system overview
- Integration into existing drive systems
- Fundamentals of converter technology and motors
- SIZER dimensioning tool
- STARTER commissioning tool
- Simple commissioning of a drive
- Practical exercises on the training case

Function (continued)

SINAMICS S120 configuration and planning course (5 days) DR-SNS-PRJ

Description/Training objective

The course is designed for design engineers, planning engineers and sales personnel responsible for the configuration and planning of drive systems with SINAMICS S120.

Building on the SINAMICS system overview, the fundamental interrelationships for setting up a drive system are outlined. The self-explanatory SIZER configuration tool is used to calculate various applications of SINAMICS S120 and demonstrate them in more detail by means of PC-based exercises. The technical documentation provides an overview of the parameter structure and essential software functions.

The STARTER commissioning tool is used to demonstrate a simple commissioning application on the SINAMICS S120 training case.

Target group

Configuring engineers, design engineers

Content

- SINAMICS system overview
- Range of motors for SINAMICS S120
- Configuration of the SINAMICS S120 drive system and fundamentals
- SIZER configuration tool with example layouts
- Technical documentation: Catalogs, Planning Guides, Operating Instructions
- Overview of functions and parameters
- Simple commissioning with the STARTER commissioning tool

SINAMICS S120 service/commissioning course (5 days) DR-SNS-SI

Description/Training objective

This course provides basic training for the SINAMICS S120 drive system.

It provides the technical knowledge required for commissioning, parameterization and troubleshooting.

Starting with an overview of the drive system in terms of hardware and documentation, the course progresses with extensive information about the software functions, parameter structure and function charts for servo and vector control applications.

Even more detailed information is provided in the form of practical exercises on the training cases and the STARTER commissioning tool.

Target group

Start-up engineers and service engineers for general applications

Content

- Structure of the drive system with brief basics
- Overview of documentation
- HW structure, cabling, user interfaces, EMC
- Commissioning and parameterization with the STARTER commissioning tool
- Open-loop and closed-loop control methods, as well as software functions
- Parameter structure and function charts
- Diagnostics and troubleshooting
- Practical exercises on the training case

SINAMICS S120 motion control (3 days) DR-SNS-MC

Description/Training objective

The course is designed for users of SINAMICS S120 drives in conjunction with SIMOTION and/or SIMATIC T-CPU motion control systems.

The course starts with an introduction to the SIMOTION and SIMATIC T-CPU controllers and an overview of the SINAMICS S120 drive system in terms of hardware and documentation before describing the software functions, parameter structure and function charts for motion control applications. It provides the technical knowledge required for commissioning, parameterization and troubleshooting.

Even more detailed information is provided in the form of practical exercises on the training cases and the SCOUT, T-Config and "STARTER integrated" commissioning tools.

Target group

Start-up engineers and service engineers for motion control applications

Content

- Brief introduction to SIMOTION und SIMATIC T-CPU motion control controllers using two examples
- Overview of the SINAMICS S120 drive system
- Starting up and parameterizing SINAMICS drives with the SCOUT and T-Config tools
- Description of the SINAMICS control structure for motion control applications with DSC (dynamic servo control)
- Parameterization, optimization and diagnostics with the integrated STARTER functions
- Practical exercises on the SIMOTION D, SINAMICS S120 and SIMATIC training cases with T-CPU

SINAMICS communication (3 days) DR-SN-COM

Description/Training objective

The course is designed for programmers and service engineers who, having completed course DR-SNS-SI, required more extensive knowledge about the PROFIBUS, RS232 for STARTER and AOP30 communication interfaces as well as I/O terminals.

The focal point of the course is PROFIBUS in the PROFIDrive V3 profile with routing, teleservice and the functions for equidistant bus cycle, isochronous operation in servo applications and OP direct access. The DriveES SIMATIC libraries for cyclic and acyclic data exchange are also described.

Even more detailed information is provided by means of practical exercises on the SINAMICS and SIMATIC S7 training cases with CPU 315-2 DP.

Target group

Programmers, start-up engineers and service engineers

Content

- Overview of the PROFIBUS DP, RS232-PPI, CAN interfaces und I/O terminals: function, topology, parameterization
- Fundamentals of PROFIBUS in the PROFIDrive V3 profile
- Basic functions on PROFIBUS: routing, teleservice and direct access
- PROFIBUS for motion control with: equidistant bus cycle and isochronous operation for servo control
- Cyclic and acyclic data exchange with Drive ES SIMATIC modules
- Fault diagnostics of the drive via the bus system
- Practical exercises on the SINAMICS S120 and SIMATIC S7 training cases with CPU 315-2 DP

SINAMICS S120 training case

Applications

The training case is used for training and familiarization with the SINAMICS S120 drive system.

It can also be used for test purposes in the laboratory and as a drive for the SIMOTION motion control system. The SIMOTION D435 upgrade kit can be used to convert the SINAMICS S120 training case to a SIMOTION D training case.

Structure

- Case optimized in terms of weight and volume
- Set up complete with transport wheels and ready for connection
- Supply voltage 1 AC 230 V or via line adapter 1 AC 115 V (USA)
- Regenerative feedback not possible
- Drive system comprising:
  - CU320 Control Unit with TB30 Terminal Board
  - Smart Line Module 5 kW (6.5 HP)
  - Single/Double Motor Module 3 A
  - 1 x synchronous motor 1FK7022-5AK71-1DG3 with incremental encoder sin/cos 1 V_{pp} 2048 S/R and DRIVE-CLiQ interface
  - 1 x synchronous motor 1FK7022-5AK71-1LG3 with absolute encoder 2048 S/R and DRIVE-CLiQ interface: Absolute encoder EnDat 512 S/R
  - Reference loops for position monitoring
- Control box for setpoint/actual-value linkage via terminals
- Prefabricated connection option for an external motor, e.g. asynchronous motor

The training case is supplied ready-to-use with a demo project on the CompactFlash Card and documentation.

Technical data

SINAMICS S120 training case	
Input voltage	1 AC 230 V
Degree of protection to DIN VDE 0470 Part 1/EN 60529/IEC 529	IP00
Weight, approx.	30 kg (66 lb)
Dimensions (W × H × D)	320 × 650 × 330 mm (12.6 × 25.6 × 13 in)

Selection and ordering data

	Order No.
SINAMICS S120 training case TK-SIN-CU320 with CU320, demo project on CompactFlash Card and control box	
• Single-axis version with 1FK7 motor	**6ZB2480-0AA00**
• Double-axis version with 1FK7 motors	**6ZB2480-0BA00**
Line adapter 1 AC 115 V/1 AC 230 V	**6AG1064-1AA02-0AA0**
Control box SINAMICS (if ordered separately)	**6AG1064-1AA01-0AA0**

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SIMOTION D435 upgrade kit

Applications

The SIMOTION D435 upgrade kit is used for the problem-free upgrade of the SINAMICS S120 training case for training and familiarization with the SIMOTION D motion control system. It is also suitable for use for test purposes in the laboratory.

An HMI operator control and monitoring training case is available for SIMOTION D, comprising a panel and a remote ET 200M I/O module, to which a simulation module is connected. Alternatively, the HMI can be simulated via a PC/PG.

Structure

The upgrade kit comprises:

- SIMOTION D435 Control Unit
- CompactFlash Card with demo project and license for technology package
- Documentation

The HMI training case comprises:

- An operator panel
- An ET 200M remote I/O module with simulation module

Selection and ordering data

	Order No.
SIMOTION D435 upgrade kit for TK-SIN-CU320 with demo project on CompactFlash Card	**6ZB2470-0AH00**
HMI case for SIMOTION D435 with ET 200 and OP	**6ZB2470-0AG00**

SIMOTION D435 training case

Applications

For pure SIMOTION D applications, the SINAMICS S120 case is supplied with the D435 Control Unit.

The training case is used for training and familiarization with the SIMOTION D motion control system. It is also suitable for use for test purposes in the laboratory.

Structure

- Case optimized in terms of weight and volume
- Set up complete with transport wheels and ready for connection
- Supply voltage 1 AC 230 V or via line adapter 1 AC 115 V (USA)
- Regenerative feedback not possible
- Drive system comprising:
  - SIMOTION D435 with TB30 Terminal Board
  - Smart Line Module 5 kW (6.5 HP)
  - Double Motor Module 3 A
  - 1 x synchronous motor 1FK7022-5AK71-1DG3 with incremental encoder sin/cos 1 V_{pp} 2048 S/R and DRIVE-CLiQ interface
  - 1 x synchronous motor 1FK7022-5AK71-1LG3 with absolute encoder 2048 S/R and DRIVE-CLiQ interface: Absolute encoder EnDat 512 S/R
  - Reference loops for position monitoring
- Control box for setpoint/actual-value linkage via terminals
- Prefabricated connection option for an external motor, e.g. asynchronous motor

The training case is supplied ready-to-use with a demo project and technology package license on the CompactFlash Card including documentation.

Technical data

SIMOTION D training case	
Input voltage	1 AC 230 V
Degree of protection to DIN VDE 0470 Part 1/EN 60529/IEC 529	IP00
Weight, approx.	34 kg (75 lb)
Dimensions (W × H × D)	320 × 650 × 330 mm (12.6 x 25.6 x 13 in)

Selection and ordering data

	Order No.
SIMOTION D435 training case TK-SIM-D435 with control box, demo project on CompactFlash Card and license for technology package	**6ZB2470-0AE00**

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In the face of harsh competition you need optimum conditions to keep ahead all the time:
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Fax: +1 423 262 2200
E-Mail: solutions.support@sea.siemens.com

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E-Mail: cic@siemens.ca

In Asia:
Tel.: +86 10 6475 7575,
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Configuration and Software Engineering

Support in configuring and developing with customer-oriented services from actual configuration to implementation of the automation project. [1])

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With Service On Site we offer services for startup and maintenance, essential for ensuring system availability.

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In the operating phase of a machine or automation system we provide a comprehensive repair and spare parts service ensuring the highest degree of operating safety and reliability.

In Germany
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Tel.: +1 800 241 4453

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To enhance productivity and save costs in your project we offer high-quality services in optimization and upgrading. [1])

1) For country-specific telephone numbers go to our Internet site at: http://www.siemens.com/automation/service&support

Documentation

Overview

The documentation is clearly divided into a number of manuals. The manuals must be ordered separately (in the required language and quantities).

Information is available in the following formats:

- **Paper version**, printed copy
- **PDF file** on the Internet as DOConWEB – application with search option covering all documents
  http://www.siemens.com/automation/doconweb

The following manuals are available:

- *Equipment Manual/Planning Guide*
  containing all necessary information about the intended use of the components of a system, e.g. technical data, interfaces, dimension drawings, characteristics and possible applications. The Equipment Manual/Planning Guide is intended for use during the following phases: Cabinet configuration/setup, circuit diagram configuration/drawing.
- *Commissioning Manual*
  containing all information relevant to commissioning after installation and wiring. It also contains all safety and warning notices relevant to commissioning in addition to overview drawings.
  The Commissioning Manual is intended for use during the following phases: commissioning of components that have already been connected, configuration of system functions.
- *List Manual*
  containing all parameters, function charts, and faults/warnings for the product/system as well as their meanings and setting options. It contains parameter data, descriptions of faults/warnings and how they affect functions.
  The List Manual is intended for use during the following phases: commissioning of components that have already been connected, configuration of system functions, fault cause/diagnosis.
- *Getting Started*
  providing information about getting started for the first-time user as well as references to additional information. It contains information about the basic steps to be taken during commissioning. For more advanced operations, see the information in other documentation.
  Getting Started is intended for use during the following phases: commissioning of components that have already been connected.
- *DOConCD*
  DOConCD is a CD-ROM containing manufacturer and service documentation for the SINAMICS motors and drive systems.

For more information, visit
http://www.siemens.com/motioncontrol
→ Support → Technical documentation → Overview of publications.

Selection/Ordering data

Ordering data	Order No.	
	German edition	**English edition**
SINAMICS S120		
Equipment Manual for Control Units and Additional System Components	**6SL3097-2AH00-0AP0**	**6SL3097-2AH00-0BP0**
Equipment Manual for Booksize Power Sections	**6SL3097-2AC00-0AP0**	**6SL3097-2AC00-0BP0**
Booksize Commissioning Manual	**6SL3097-2AF00-0AP0**	**6SL3097-2AF00-0BP0**
Commissioning Manual for CANopen	**6SL3097-2AA00-0AP0**	**6SL3097-2AA00-0BP0**
SINAMICS S List Manual	**6SL3097-2AP00-0AP1**	**6SL3097-2AP00-0BP1**
Getting Started	**6SL3097-2AG00-0AP0**	**6SL3097-2AG00-0BP0**
DOConCD, the SINAMICS System	**6SL3097-2CA00-0AG0**	**6SL3097-2CA00-0BG0**
Motors		
Planning Guide for 1FT6 Motors	**6SN1197-0AD02-0AP0**	**6SN1197-0AD02-0BP0**
Planning Guide for 1FK7 Motors	**6SN1197-0AD06-0AP0**	**6SN1197-0AD06-0BP0**
Planning Guide for 1PH7 Motors	**6SN1197-0AC65-0AP0**	**6SN1197-0AC65-0BP0**
Planning Guide for 1PH4 Motors	**6SN1197-0AC64-0AP0**	**6SN1197-0AC64-0BP0**
Planning Guide for 1PH2 Motors	**6SN1197-0AC63-0AP0**	**6SN1197-0AC63-0BP0**

The Planning Guides are also available in the following languages:
French: ...-0DP0
Italian: ...-0CP0
Spanish: ...-0EP0
Replace the third-last letter in the order number with the corresponding letter.

Appendix

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Glossary

Absolute encoder

Position encoder, which makes the position of the drive available immediately as an absolute value when it is connected to the power supply. On single-turn encoders, the detection range is one revolution and on multi-turn encoders a number of revolutions (typically e.g. 4096 revolutions).
When using an absolute encoder as a position encoder, reference point approach is not necessary following power-up, and the reference switch, which would otherwise be needed for this purpose (e.g. BERO) can be omitted. Rotary and linear absolute value encoders are available.

Example for an absolute encoder:
1FK and 1FT6 motors can be supplied with built-in multi-turn absolute encoders with 2048 sinusoidal/cosinusoidal signals per revolution through 4096 revolutions (absolute) and → "EnDat protocol".

Active Line Module

Regulated, self-commutating rectifier/regenerative unit (with IGBTs in rectifier/regenerative unit), which supplies the DC link voltage for the → "Motor Modules".

Asynchronous motor

The asynchronous motor is an AC motor, which runs at a speed "lagging behind" the synchronous speed. Asynchronous motors can be connected to the AC line both directly in a star or delta circuit and via a frequency converter. When combined with a frequency converter, asynchronous motors form a "variable-speed drive system".
Other designations currently in use: squirrel-cage motor, cage motor.

Booksize

Booksize configuration of the components of a drive suitable for mounting side-by-side. Designed primarily for multi-motor (→ "motors") operation.

Brake control

A software function, which defines when an available mechanical holding brake or service brake should be applied, either as part of a duty cycle for momentary standstill or in the event of a fault.

Braking Module

Electronic switch or chopper (brake chopper), which connects a → "braking resistor" with a specific pulse-no-pulse ratio to the DC link voltage in order to convert regenerative (braking) energy into heat energy and ultimately limit the DC link voltage to permissible values. In the SINAMICS system, the Braking Module does not have a built-in braking resistor. The braking resistor must be installed outside the Braking Module.

Braking resistor

A resistor via which excess power in the DC link is dissipated. The resistor is connected to a → "Braking Module". It provides a means of discharging the resulting heat loss outside the control cabinet.

CAN bus

The acronym CAN stands for "Controller Area Network". CAN is a serial bus system in accordance with ISO 11898. CAN was originally developed for applications in automotive engineering (ISO 11519-1) but has established itself in other fields, e.g. in applications on textile and film machinery. A range of device profiles was defined in → "CANopen" for CAN applications in industrial automation, in order to standardize communication at application level.

CANopen

CANopen is an expansion of the → "CAN bus" for standardized communication for various types of automation devices at application level.

Control Unit

Central control module, in which the closed-loop and open-loop control functions for one or more SINAMICS → "Line Modules" and/or → "Motor Modules" are implemented.

The following are examples of types of Control Units:

- SINAMICS CU320 Control Unit
- SIMOTION D435 Control Unit

Command data set

The parameters belonging to a motor data set define the configuration of a → "motor". There are a number of data sets. Control commands can be used to toggle between them. This toggle function can be used to switch over all → "parameters", which define the motor configuration, at once. A typical application is the operation of a number of motors on the same → "Motor Module". Example: The traveling motor and hoisting-gear motor on a hoist are linked to the same Motor Module and are connected to it alternately via contactors.

CompactFlash Card

Memory card for non-volatile storage of the drive software and corresponding parameters. The memory card can be plugged into the → "Control Unit" from the outside.

Direct measuring system

Position encoder, which is connected directly to the moving machine part (→ "external encoder") as well as to the associated decoding electronics. On linear axes, linear position encoders can also be used for this purpose. In many cases, a direct measuring system must be used, because the → "motor encoder" for position detection and control is not suitable. This might be due to excessive elasticities and backlash in the drive train.

Double Motor Module

Two motors can be connected to and operated with a Double Motor Module.

See → "Motor Module" → "Single Motor Module".

DRIVE-CLiQ

Abbreviation for Drive Component Link with IQ.

Communication system for connecting the various components of a SINAMICS drive system, e.g., → "Control Unit", → "Line Modules", → "Motor Modules", → "motors" and speed/position encoders.
In terms of hardware, DRIVE-CLiQ is based on Standard Industrial Ethernet with twisted-pair cables. The DRIVE-CLiQ cable provides the transmit and receive signals, as well as the +24 V power supply.

Drive group

A drive group comprises a → "Control Unit" and the → "Motor Modules" and → "Line Modules" connected to it via → "DRIVE-CLiQ".

Droop

The speed controller is artificially "weakened" by droop, whereby a configurable (negative) percentage of the speed controller output signal is applied to the speed controller input. In the event of high load torque, this will cause the speed to dip. Droop is applied to take the edge off the response to load impulses and for certain types of load compensation control on drives, which are interconnected via a continuous web. The integral component or the summary output signal can be used as the speed output signal. Droop can be activated and deactivated via a control command.

Dynamic servo control (DSC)

Dynamic servo control (DSC) enables the position actual value to be evaluated during the fast speed control cycle directly on the drive. The position setpoint is set in the position control cycle by the higher-level controller using the isochronous PROFIBUS with PROFIdrive telegrams.
DSC is able to use fine signal filtering and feedforward control to optimize the dynamic response in the position control loop without overloading the bus bandwidth.
DSC supports increased controller gain and therefore high rigidity, i.e. load-conditioned path deviations can be compensated quickly.

EnDat protocol

Serial transmission protocol for transmitting position/angular actual values from an → "absolute encoder" to the drive control or position controller. The EnDat protocol can also be used to set the parameters of and diagnose the encoder.

External encoder

Position encoder that is not built into or mounted on the → "motor", but is built on externally via a mechanical transmission element or a mechanical intermediate element. The external encoder is used for direct position detection.

Fault buffer

Faults that have occurred are recorded in a fault buffer by the drive. The fault buffer can be read out via parameters.

Field weakening

Field weakening describes the reducing of the magnetizing current of an electric motor in order that the speed can be increased further when the rated voltage is reached. Above the threshold speed for field weakening (the synchronous speed on asynchronous motors), the voltage is kept constant and the speed is controlled by varying the magnetizing current. The available torque drops in field weakening mode with the speed in accordance with the speed/torque characteristic.

Flying measurement

When a hardware signal is received, the current position actual value is stored and - e.g. via PROFIBUS - made available for further processing. The hardware signal can, for example, originate from a probe or a print-mark detection sensor (mechanical switch, BERO or optical sensor). The active edge of the hardware signal can be parameterized (rising, falling or both).

Flying restart

Following power-up, the "flying restart" function automatically switches a converter into any motor connected downstream. When the converter switches into the running motor, the current speed setpoint in the ramp-function generator is set to the current speed actual value. Ramp-up to the definitive speed setpoint starts out at this value. The "flying restart" function can help to shorten the ramp-up procedure following power-up (if the load is still running down) (see → "automatic restart").

Incremental encoder

Incremental distance and speed encoder, which, unlike → "absolute encoder", does not output a position actual value signal corresponding to the absolute distance, but incremental "differential distance or angular signals". Incremental encoders can be → "incremental encoders TTL/HTL", → "incremental encoders sin/cos 1 V_{pp}" or → "resolvers".

Incremental encoder sin/cos 1 V_{pp}

This is a high-resolution optical sine/cosine encoder, which, for example, can be integrated into 1FK motors as a → "motor encoder". The following signals are typically output:

- Two 90-degree signals each with 2048 sinusoidal signals per revolution as differential signals with an amplitude of 1 V_{pp} (A/B fine tracks).
- A reference signal (reset pulse) for each revolution as a differential signal with an amplitude of 0.5 V_{pp}.
- On some types, also two 90-degree sinusoidal signals as differential signals with an amplitude of 1 V_{pp} (C/D track).
  The position/angular actual value is calculated by first evaluating the zero crossovers of the fine tracks (approximate evaluation, e.g. a total of 4×2048 = 8192 zero crossovers per revolution).
  Precise evaluation can then be carried out by means of analog detection of the amplitude. The combination of approximate and precise evaluation makes possible resolutions of more than 1,000,000 increments per encoder revolution.
  Typical sin/cos encoders include: ERN1387, ERN1381.

Incremental encoders TTL/HTL

Incremental distance and speed encoder (→ "incremental encoder"), which usually produces two 90-degree pulse trains (tracks) with square-wave output signals and generally also one reset pulse per revolution. The output signals are TTL-level (usually +5 V RS422 differential signals; TTL = Transistor-Transistor Logic) or HTL-level (+15 or +24 V logic level; HTL = High Level Transistor Logic) signals.

Glossary

Kinetic buffering

Kinetic buffering is a software function, which can be used to bridge transient line failures (up to approx. 1 s or as long as the drive continues to turn). Kinetic buffering can usually only be used on drives that are primarily motor-driven. It requires a sufficiently large centrifugal mass, i.e. sufficient kinetic energy, on the part of the mechanical transmission element. During the line failure, the kinetic buffering switches the machine to no-load operation or light regeneration (in order to cover the minor losses from the motor and inverter). Once the line supply has been restored, the machine switches back to standard motor-driven operation. In order to use the kinetic buffering, the technological conditions must be in place to allow the motor to coast for the duration of the line failure. In some applications with multi-motor drives, the speed ratios between the individual drives have to be maintained during kinetic buffering, in order to prevent the web from tearing or damage. In such cases, kinetic buffering may only be activated on one of the drives (usually the main drive). The reduced speed setpoint values must then be fed into the overall setpoint cascade.

Line filters

Line filters are filters in the converter input that are designed to protect the network from harmonic loads and/or interference voltages created in the converter. Line filters can be passive or active filters, for the lower-frequency harmonics (line feedback) with 5, 7, 11, 13, etc. times the line frequency, and for high-frequency interference voltages 10 kHz and above (RFI suppression filters). In relation to SINAMICS, line filters refer only to passive radio interference suppression filters.

Line Module

A Line Module is a power component that generates the DC link voltage for one or more → "Motor Modules" from a 3-phase line voltage. In SINAMICS, there are two types of Line Module: → "Smart Line Modules" and → "Active Line Modules".

Line-side power components

Power components arranged between the line and converter unit (e.g. line reactors, line filters, line contactors, etc.).

Motor

For the electric motors that can be driven by SINAMICS, a basic distinction is made between rotary and linear motors with regard to their direction of motion, and between synchronous and asynchronous motors with regard to their electromagnetic operating principle. In SINAMICS, the motors are connected to a → "Motor Module". See → "synchronous motor" → "asynchronous motor" → "motor encoder" → "external encoder"

Motor encoder

An → "encoder", e.g. → "resolver", → "pulse encoder", → "incremental encoder TTL/HTL" or → "incremental encoder sin/cos 1 V_{pp}", built into or onto the motor. The encoder detects the motor speed and, in the case of synchronous motors, also the rotor position angle (of the commutation angle for the motor currents).

Motor Module

A Motor Module is a power unit (DC-AC inverter) that provides the power supply for the connected motor(s). Power is supplied through the → "DC link" of the → "drive unit". A "Motor Module" must be connected with a → "Control Unit" housing the open-loop and closed-loop control functions for the Motor Module via → "DRIVE-CLiQ".
There are → "Single Motor Modules" and → "Double Motor Modules".

Motor potentiometer

This function is used to simulate an electromechanical motor potentiometer for setpoint input. The setpoint is adjusted via one control command for "higher" and one for "lower".

Optimized pulse patterns

Complex modulation procedure carried out by a converter gating unit, whereby the voltage pulses are arranged so that the output current is as sinusoidal as possible. This is essential if high firing angles are to be maximized and torque ripple minimized.

PROFIBUS

Fieldbus standardized to IEC 61 158 Part 2 to 6.

PROFIdrive

PROFIBUS profile specified for speed and position-controlled drives by the PROFIBUS user organization (German: PNO). The latest version is the PROFIdrive V3 profile.

Pulse-edge modulation

Modulation method used by a converter gating unit, whereby the pulses "cut out" of the DC link voltage do not appear in a fixed time frame. The edges of the output voltage generated are formed by a small number of short pulses, while a wide pulse (around zero crossover) is generated in the middle of each half-wave. This provides the conditions for a high output voltage in the order of 100% of the supply voltage and consequently efficient motor performance.

Resolver

A very robust and cost effective (in mechanical and electrical terms) → "motor encoder", which does not require any built-in electronics and operates entirely in accordance with the electromagnetic principle: One sinusoidal and one cosinusoidal signal is induced in each of two 90-degree tracks. The resolver supplies all the signals required for the speed-controlled operation of the converter and/or for position control. The number of sinusoidal and cosinusoidal signals supplied per resolution is equal to the number of pole pairs of the resolver. On a two-pole resolver, the decoding electronics can output an additional reset pulse for each encoder revolution, which enables the position information to be uniquely assigned to a specific encoder resolution. A 2-pole resolver can be used as a single-turn encoder. 2-pole resolvers can be used for motors with any number of pairs of poles. On multi-pole resolvers, the number of pole pairs of the motor and resolver are always the same. On multi-pole resolvers, the resolution is correspondingly higher than on 2-pole resolvers.

Safe brake control (SBC)

A → "Safety Integrated" function. On SINAMICS → "booksize modules" the motor holding brake is controlled on a two-channel basis by one electronic switch in the 24 V channel and one in the ground channel. Both channels are monitored. The failure of one of the two channels is detected and reported. On booksize modules, the brake line is integrated into the power cable.

Safe standstill (SH)

A → "Safety Integrated" function. The function is used in the event of a fault or in conjunction with a machine function to safely isolate the torque-generating power supply to the motor. This process takes place on a drive-specific and contactless basis.

Safety Integrated

Safety functions integrated into products for the effective protection of personnel and machinery in accordance with EC Machinery Directive 98/37/EG.

The integrated safety functions provide a simple and cost-effective means of meeting the requirements of Safety Category 3 to EN 954-1.

The Safety Integrated functions are:

- → "Safe brake control" (SBC)
- → "Safe standstill" (SH)

SBC and SH are implemented autonomously in the drive.

Sensor Module

Hardware module for evaluating speed/position encoder signals and providing detected actual values as numerical values on a → DRIVE-CLiQ socket.

SMCxx = Sensor Module Cabinet-mounted = Sensor Module for snap-on mounting in the control cabinet.

Single Motor Module

A Single Motor Module is a → "Motor Module" to which just one motor can be connected and operated. See → "Double Motor Module".

SIZER

SIZER is a tool for configuring the SINAMICS and MICROMASTER drive systems. SIZER assists with the correct technical specifications for the drive systems and selection of the drive components required for the system.

Smart Line Modules

Non-regulated rectifier/regenerative unit with a diode bridge for the infeed and stall-protected, line-commutated feedback via IGBTs. Smart Line Modules provide the DC link voltage for the → "Motor Modules".

STARTER

STARTER assists with the startup and parameterization of drive units. This tool can also be used to execute the diagnostic functions required during servicing (e.g. PROFIBUS diagnostics, function generator, trace).

Suppression band

A suppression band is an illegal range of the speed or frequency setpoint. An upper and a lower limit parameter can be set for the suppression band. If an external or internal setpoint source sets a signal value within the suppression band, it is overwritten with one of the suppression band limits. This provides a means of suppressing undesirable sympathetic oscillations, whereby speeds which may induce such oscillations are suppressed.

Synchronous servo motor

Synchronous motors run at the same frequency with which they are operated: They do not have a slip (like → "asynchronous motors"). Synchronous motors are built in different ways. They require different feedforward and feedback control concepts depending on their design to ensure that they can be operated with converters. A distinction is made between permanent-field and separate-field synchronous motors, with/without a damping cage, and with/without a position encoder.

Terminal Board

Terminal extension module for plugging into a → "Control Unit". In SINAMICS, for example, Terminal Board 30 (TB30) is available with analog and digital I/O terminals.

Terminal Module

Terminal extension module for snapping onto the installation rail, for installation in the control cabinet. In SINAMICS, for example, Terminal Module 31 (TM31) is available with analog and digital I/O terminals.

Travel to fixed stop

This function can be used to move a motor to a fixed stop at a specified torque without a fault being signaled. When the stop is reached, the torque specified via parameters is built up and remains applied.

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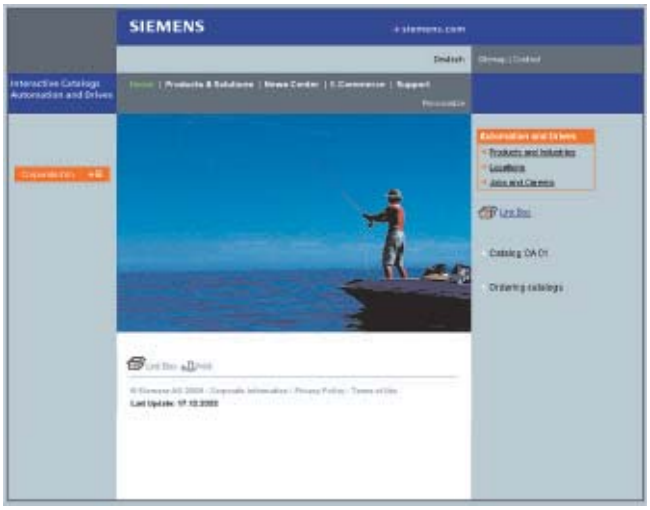

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Conversion tables

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	6.94×10^{-3}	2.59×10^{-3}	2.15×10^{-4}	2.926	2.98×10^{-3}	2.92×10^{3}	2.984	16	4.14×10^{-2}
lb-ft^2	144	1	0.3729	3.10×10^{-2}	421.40	0.4297	4.21×10^{5}	429.71	2304	5.967
lb-in-s^2	386.08	2.681	1	8.33×10^{-2}	1.129×10^{3}	1.152	1.129×10^{6}	1.152×10^{3}	6.177×10^{3}	16
lb-ft-s^2 slug-ft^2	4.63×10^{3}	32.17	12	1	1.35×10^{-4}	13.825	1.355×10^{7}	1.38×10^{4}	7.41×10^{-4}	192
kg-cm^2	0.3417	2.37×10^{-3}	8.85×10^{-4}	7.37×10^{-5}	1	1.019×10^{-3}	1000	1.019	5.46	1.42×10^{-2}
kg-cm-s^2	335.1	2.327	0.8679	7.23×10^{-2}	980.66	1	9.8×10^{5}	1000	5.36×10^{3}	13.887
gm-cm^2	3.417×10^{-4}	2.37×10^{-6}	8.85×10^{-7}	7.37×10^{-8}	1×10^{-3}	1.01×10^{-6}	1	1.01×10^{-3}	5.46×10^{-3}	1.41×10^{-5}
gm-cm-s^2	0.335	2.32×10^{-3}	8.67×10^{-4}	7.23×10^{-5}	0.9806	1×10^{-3}	980.6	1	5.36	1.38×10^{-2}
oz-in^2	0.0625	4.34×10^{-4}	1.61×10^{-4}	1.34×10^{-5}	0.182	1.86×10^{-4}	182.9	0.186	1	2.59×10^{-3}
oz-in-s^2	24.13	0.1675	6.25×10^{-2}	5.20×10^{-3}	70.615	7.20×10^{-2}	7.09×10^{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	8.333×10^{-2}	16	0.113	1.152	1.152×10^{-2}	1.152×10^{3}	1.129×10^{6}
lb-ft	12	1	192	1.355	13.825	0.138	1.382×10^{4}	1.355×10^{7}
oz-in	6.25×10^{-2}	5.208×10^{-3}	1	7.061×10^{-3}	7.200×10^{-2}	7.200×10^{-4}	72.007	7.061×10^{7}
N-m	8.850	0.737	141.612	1	10.197	0.102	1.019×10^{4}	1×10^{7}
kg-cm	0.8679	7.233×10^{-2}	13.877	9.806×10^{-2}	1	10^{-2}	1000	9.806×10^{5}
kg-m	86.796	7.233	1.388×10^{3}	9.806	100	1	1×10^{5}	9.806×10^{7}
gm-cm	8.679×10^{-4}	7.233×10^{-5}	1.388×10^{-2}	9.806×10^{-5}	1×10^{-3}	1×10^{-5}	1	980.665
dyne-cm	8.850×10^{-7}	7.375×10^{-8}	1.416×10^{-5}	10^{-7}	1.0197×10^{-6}	1.019×10^{-8}	1.019×10^{-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	1.09×10^{-2}	10	0.01
yd	36	3	91.44	1	914.4	0.914
mm	0.03937	0.00328	0.1	1.09×10^{-3}	1	0.001
m	39.37	3.281	100	1.09	1000	1

Power (to convert from A to B, multiply by entry in table)

A \ B	HP	Watts
HP (English)	1	745.7
(lb-in)(deg./sec)	2.645×10^{-6}	1.972×10^{-3}
(lb-in)(rpm)	1.587×10^{-5}	1.183×10^{-2}
(lb-ft)(deg./sec)	3.173×10^{-5}	2.366×10^{-2}
(lb-ft)(rpm)	1.904×10^{-4}	0.1420
Watts	1.341×10^{-3}	1

Force (to convert from A to B, multiply by entry in table)

A \ B	lb	oz	gm	dyne	N
lb	1	16	453.6	4.448×10^{-5}	4.4482
oz	0.0625	1	28.35	2.780×10^{-4}	0.27801
gm	2.205×10^{-3}	0.03527	1	1.02×10^{-3}	N.A.
dyne	2.248×10^{-6}	3.59×10^{-5}	890.7	1	0.00001
N	0.22481	3.5967	N.A.	100.000	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	6.25×10^{-2}	1	28.35	1.93×10^{-3}
gm	2.205×10^{-3}	3.527×10^{-3}	1	6.852×10^{-5}
slug	32.17	514.8	1.459×10^{4}	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	1.745×10^{-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	

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	μ
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	μ
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

Wire Gauges [1])

Cross-Section mm^2	Standard Wire Gauge (SWG)	American Wire Gauge (AWG)
0.2	25	24
0.3	23	22
0.5	21	20
0.75	20	19
1.0	19	18
1.5	17	16
2.5	15	13
4	13	11
6	12	9
10	9	7
16	7	6
25	5	3
35	3	2
50	0	1/0
70	000	2/0
95	00000	3/0
120	0000000	4/0
150	–	6/0
185	–	7/0

1) Table shows approximate SWG/AWG sizes nearest to standard metric sizes; the cross-sections do not match exactly.

Notes

Notes

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SIMOREG K 6RA22 Analog Chassis Converters	DA 21.2
SIMOREG DC MASTER 6RM70 Digital Converter Cabinet Units	DA 22
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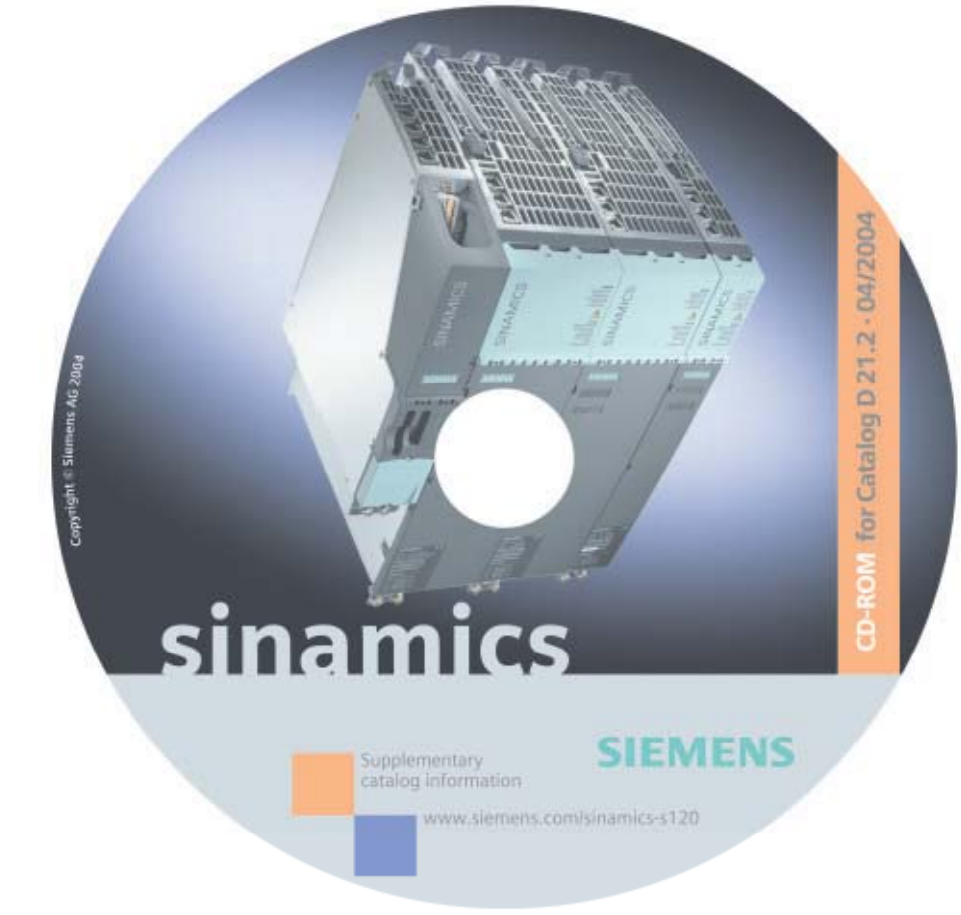
www.siemens.com/sinamics-s120

Order No.: E86060-K5521-A121-A1-7600

CD-ROM for catalog D 21.2

The enclosed CD-ROM for catalog D 21.2 · April 2004 contains:

- Information on planning/configuration based on the technical documentation; further technical documentation can be found at: http://www.siemens.com/automation/doconweb
- Dimension drawings of our motors (PDF/DXF format)
- Catalog D 21.2, in electronic form (PDF format)



Hardware and software requirements

- Intel Pentium 333 MHz or higher
- At least 128 MB RAM
- Screen resolution 1024 x 768 pixels
- 4x CD-ROM drive
- Windows 9x/NT 4.x/2000/XP
- Acrobat Reader
- MS Internet Explorer version 5.5

Start

Insert the CD into the CD-ROM drive. The program starts automatically.
If the AutoRun function is not activated in your system, please start the "start.hta" file from the CD-ROM in Windows Explorer.

Note

No programs have to be installed to view the information on this CD-ROM.
The use of dimensions drawings in DXF format is an exception.

Hotline

Please send any queries and suggestions to: motioncontrol.docu@erlf. siemens.de