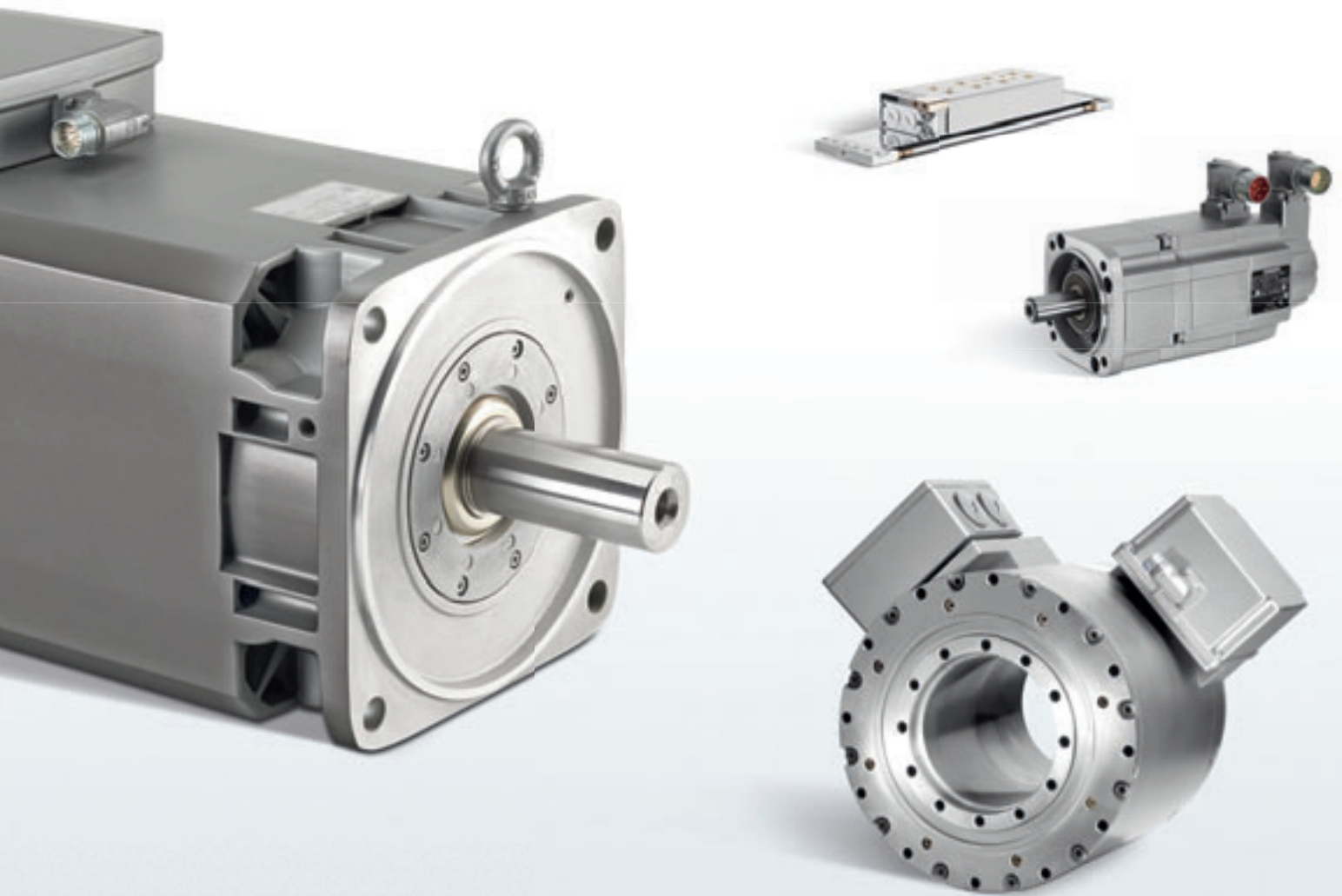


# Are you looking for the optimum motor for your motion control task?

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Motors for motion control: The widest range for every requirement that is second to none.

Answers for industry.

**SIEMENS**



## The ideal motor for every task

Clear trends can be identified for motion control drives: Motors are becoming increasingly more compact with a higher dynamic performance, in the widest range of power ratings and versions – as well as mechanically integrated solutions. Siemens offers the broadest range of servomotors and direct drives motors worldwide as response to all of these demands. No matter what your requirements actually are: We can supply the optimum motor – from 0.05 kW (0.07 HP) up to 1340 kW (1800 HP).



From the left: 1PH8, 1FK7, 1FT7 with planetary gear unit, 1FN3, 1FW3, SINAMICS S120

**Unique worldwide:  
Our extensive portfolio**

Whether synchronous or induction servomotors, geared servo, linear or torque motors – we can offer you the perfect system for all of your requirements from our extensive portfolio:

- For high-speed and precise positioning up to cyclic drives: Synchronous servomotors – also with precision planetary and angled gear heads
- For precise, smooth running operation in rotary axes and main spindles: Induction servomotors
- For gearless direct-driven rotary axis: Torque motors for the lower speed range and built-in motors for spindle applications at higher speeds
- For the highest dynamic performance and precision for linear traversing motion: Linear motors

Our range of motors is rounded-off by special solutions for applications that are somewhat out of the ordinary. These include SIEMOSYN motors for multi-motor drives in the textile sector and mechanically integrated solutions optimized for the particular application – for instance motor spindles.

**Standard solutions based on system components that are optimally harmonized with one another**

Our motors are optimally harmonized to operate with our SINAMICS S120 drive system. Electronic name plates and motor connections established using the DRIVE-CLiQ interface ensure fast commissioning and smooth disturbance-free operation. Pre-fabricated MOTION-CONNECT signal and power cables guarantee that all of the components are connected up simply and faultless.

Together with our control system, you obtain the latest state-of-the-art motion control solutions in all performance classes based on globally available standard components.

**Competent service and support**

Our experts help you when selecting the optimum motor solution. Once the motor type has been defined, the power data can be reliably determined using the SIZER engineering software. The matching power units as well as all of the other required drive components can then be selected. In this way, you can be certain that the drive configuration perfectly matches your specific application. When it comes to designing mechanically integrated motor solutions, our mechatronic experts are there to provide you with professional support.

# High dynamic performance and extremely compact: Synchronous servomotors

Whether for position control in pick and place applications, for cyclic drives in packaging machines or for continuous path operation in handling equipment and machine tools: Our permanent-magnet synchronous motors are always the first choice wherever high-speed and precise motion sequences are demanded. Their high level of dynamic performance, compact design and efficiency guarantees maximum energy-efficiency. With a wide range of integrated encoders, from resolvers up to high-resolution absolute encoders, the matching motor can be precisely selected for each and every application. An optional holding brake ensures reliable standstill without requiring any power input.



## Well proven for motion control applications: 1FK7

Non-ventilated servomotors with degree of protection IP64/65 are completely adequate for many motion control applications. Siemens designed the series of 1FK7 motors specifically for this purpose. We offer these motors in three different versions as demands regarding dynamic performance, precision and the space available can vary significantly.

- 1FK7 CT (Compact): Compact design and high power density
- 1FK7 HD (High Dynamic); Low moment of inertia – for a high accelerating performance
- 1FK7 (high inertia): high intrinsic moment of inertia – for a rugged control behavior under changing load conditions

## High performance in a small space: 1FK7 CT

1FK7 CT motors offer a high power density in the smallest space. Their short length means that they are predestined for applications where space is restricted. Their compact design as well as attractive price-performance ratio makes them the standard motor in the range of rated torques from 0.18 to 48 Nm (0.13 to 35 lb<sub>f</sub>-ft). This results in motion control axes with a high dynamic performance – thanks to their extremely high overload capability.

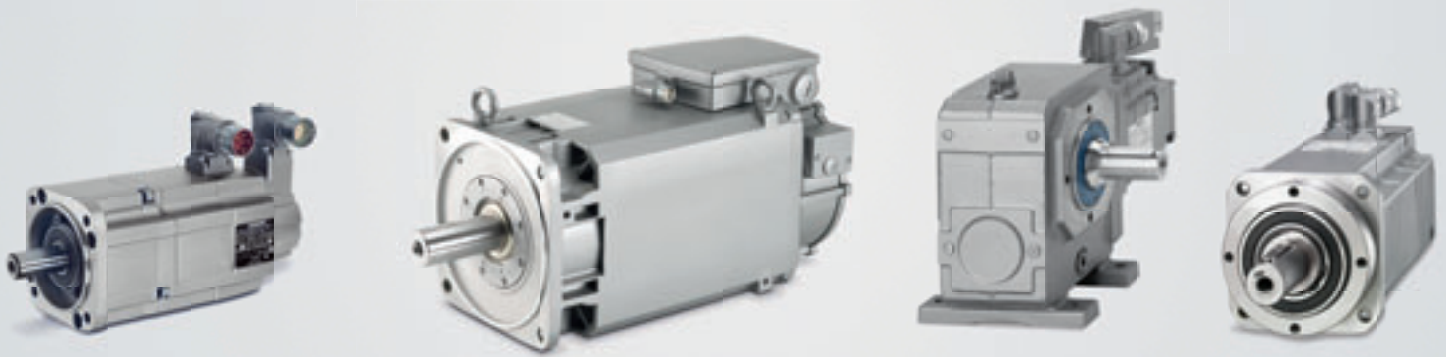
## Top marks for dynamic performance: 1FK7 HD

The small rotor diameter means that the 1FK7 HD high dynamic performance motors have an extremely low moment of inertia. This ensures the highest accelerating performance. As a consequence, they are especially suitable for use in applications demanding extremely short cycle times – for instance, in packaging machines.

## Rugged control behavior through a higher intrinsic moment of inertia: 1FK7-HI

As a result of a higher intrinsic moment of inertia, 1FK7-HI motors have an extremely rugged control behavior. As a consequence, they are especially predestined for applications involving high and variable load moments of inertia – for instance in tool magazines. Drive systems equipped with the SINUMERIK machine tool control system and 1FK7 motors achieve an extremely high contour precision without having to adapt the controller to the machine – a complex and tedious procedure.

1FK7-HI servomotors are extremely rugged when it comes to vibration and shock – and are available with torques extending from 3 up to 20 Nm (2.2 to 14.8 lb<sub>f</sub>-ft).



From the left: 1FK7-HI, 1FT7, 1PH8 with worm gear, 1FK7-DYA with planetary gear

**1FT7 – for use in any environmental conditions**

The 1FT7 series of universal motors are recommended for special requirements. They distinguish themselves as a result of the extended torque range from 1.4 to 125 Nm (1.03 to 92.2 lb<sub>f</sub>-ft) and the highest degree of overload capability. They even master difficult and tough ambient conditions with the optional IP67 degree of protection.

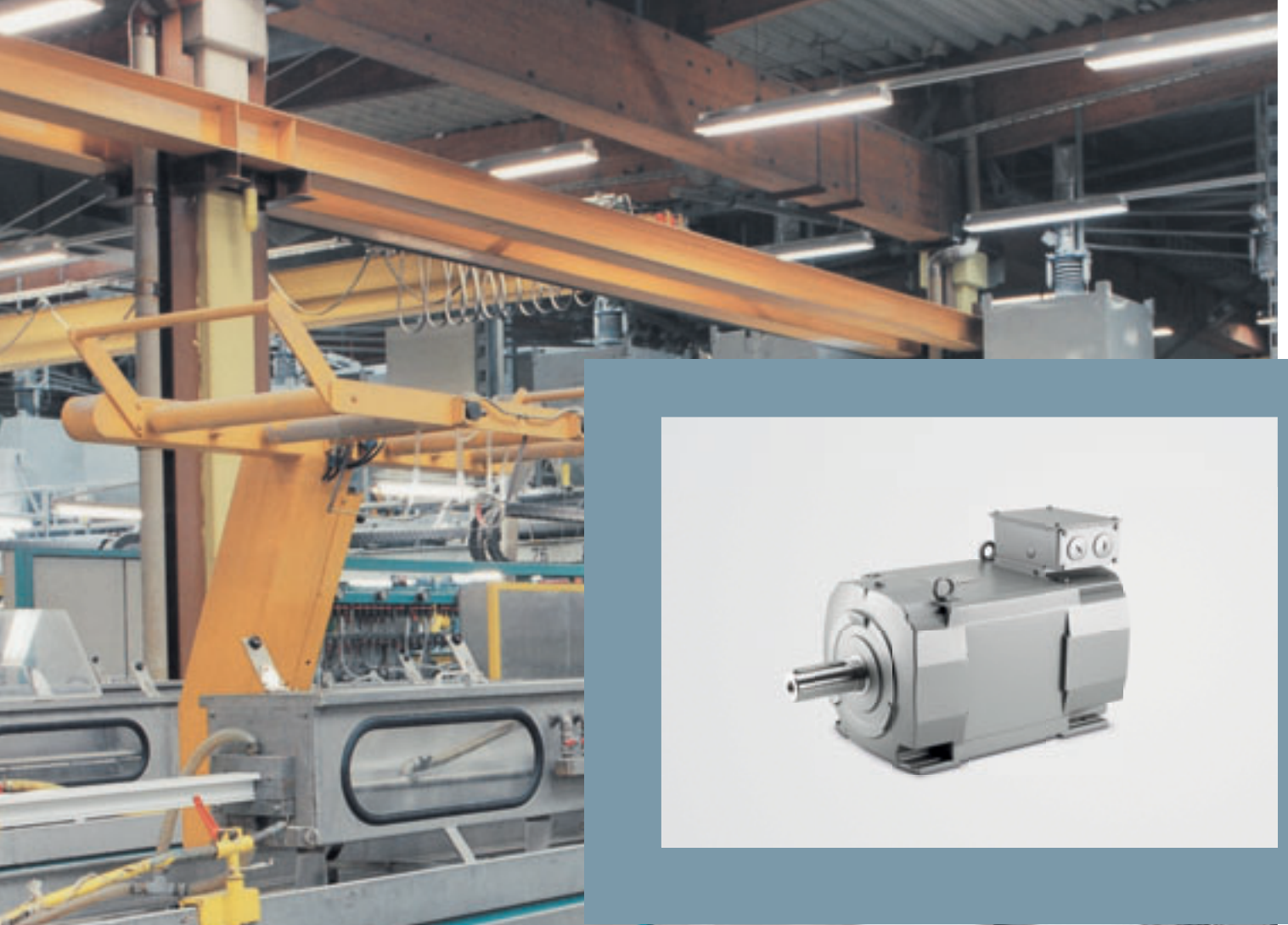
In addition to the standard non-ventilated version, we also offer variants with forced ventilation or water cooling – for a power density that has been increased even further. Efficient thermal dissipation is guaranteed – even under extreme load conditions. The 1FT7 is compact, extremely rugged and thanks to the cross profile it is easy to mount.

**Synchronous servomotors for high rated torques: 1PH8 synchronous**

If an application demands high rated torques, which cannot be addressed using 1FK7 motors, then 1PH8 synchronous motors are the ideal solution. These compact motors with a high balance quality cover a torque range from 83 to 1650 Nm (61.2 to 1217 lb<sub>f</sub>-ft), and can be flexibly adapted to each and every application using the wide range of options. The motors are available with forced ventilation or water cooling.

**Motor and gear unit pre-mounted: Servo geared motors**

When requested, we also offer our 1FT and 1FK synchronous servomotors with a wide range of gear unit types: Helical, offset shaft and angled gear units – or extremely compact and precise planetary gear units. A real highlight: The 1FK7-DYA motor – extremely compact with integrated planetary gear unit.



# Cost-efficient and powerful: Induction servomotors



Our induction servomotors are predestined for applications where the main focus is on continuous, smooth running operation of axes: They are ideal as the main motor for presses, as roll drive in printing and paper machines, in textile and plastics machines, in all kind of winder applications, in machine tool spindles as well as in cranes and hoist applications. They cover a power range from 2.8 to 1340 kW (3.75 to 1800 HP) and can address almost any application.

From the left: 1PH8 – water-cooled, 1PH8 – force-ventilated

## For precise operation of rotary axes

Main drives frequently demand precise smooth running operation and accurate controllability of the drive axes. Further, higher drive power ratings are typically demanded than, for example, for positioning axes. Drives for press cylinders in printing machines represent an impressive example – as a clear print image can only be achieved when they are precisely controlled. Frequently, for cost reasons, induction motors are the preferred choice for main drives instead of synchronous motors. However, it is frequently not possible to use the more favorably priced standard induction motors as the demanded precision or the specified compactness cannot be achieved.

## Our preferred solution for main drives: 1PH8

These are the reasons that make our 1PH8 induction motors the optimum solution for main drives. Available in a wide power range from 2.8 to 1340 kW (3.75... 1800 HP),

they have a compact design and outstanding performance features. They run extremely smoothly as a result of their high balance quality and excellent radial eccentricity. Integrated encoders and a high dynamic performance mean that these motors have an outstanding control behavior. Short acceleration times and maximum speeds of up to 20,000 rpm guarantee a high degree of productivity. 1PH8 motors have a sophisticated modular design. Different encoder types, various cooling types and degrees of protection, versions with solid and hollow shaft, various types of construction and bearing versions as well as flexible connection options allow the optimum 1PH8 motor to be selected that can address the specific application and environmental conditions and installation situation. When required, instead of an induction motor, a 1PH8 synchronous motor can be used. 1PH8 motors are designed for converter operation. Equipped with a DRIVE-CLiQ system interface and integrated rating plate they are optimally harmonized for operation with the SINAMICS S120 converter system.

As a supplement, our well-proven 1PH7 motors can also be selected: with forced ventilation and IP55 degree of protection.

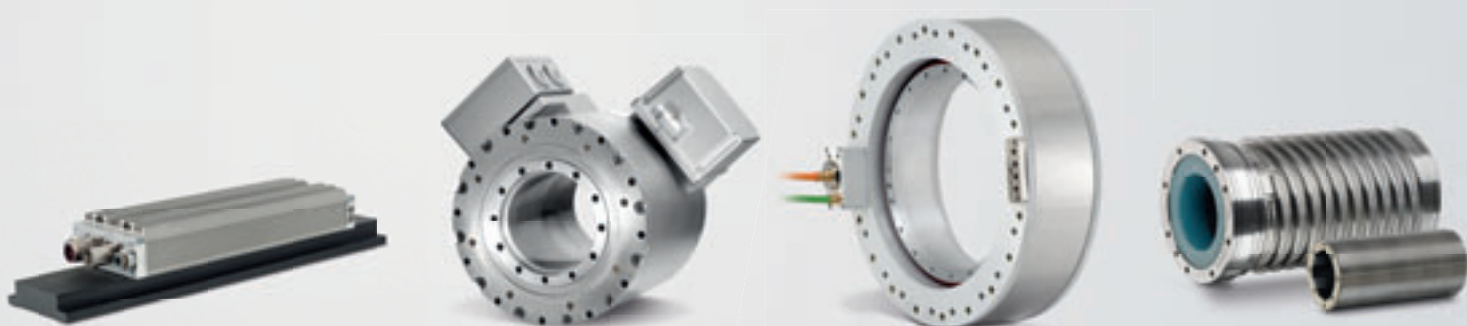
## For drive axes with the highest power ratings: 1PL6 in degree of protection IP23

1PL6 motors are unbeatable when it comes to cost-effectiveness and performance if the environmental conditions allow open motors to be used. The compact three-phase drives in frame sizes 180 to 280 are implemented in conformance with standard IEC 60034-5 in degree of protection IP23 – and the stator as well as the rotor are open-circuit ventilated. This motor cooling allows power ratings of up to 630 kW (845 HP) to be achieved.

# Cost savings over the complete life cycle: Direct-drive motors



Our linear and rotary direct-drive motors distinguish themselves as a result of their innovative design and loss-free power transfer. We offer these both for linear and rotary motion. The complete series of direct-drive motors stands for the highest dynamic performance, precision and cost-efficiency – in all applications. The mounting space required is reduced, the mechanical design of your machine simplified, the machine availability increased and operating costs lowered by eliminating mechanical transmission elements – such as gear units, belts and rack & pinion. As a whole, the mechanical system is subject to less wear, which in turn significantly reduces maintenance costs. All of these features reduce the costs over the complete life cycle.



From the left: 1FN3, 1FN6, 1FW3, 1FW6, 1FE1

**Maximum dynamic performance for linear motion: 1FN3, 1FN6 linear motors**

Linear motors are the ideal solution if linear motion has to be executed with the highest degree of dynamic performance and precision. The reason for this is that the effects of elasticity, play and friction can be avoided to a large extent. The same goes for natural vibration in the mechanical drive train. When linear motors are used mechanical transmission elements such as ballscrews, couplings and belts can be eliminated. This simplifies the machine design and reduces the wear.

Siemens offers two linear motor versions. The 1FN3 linear motor has a magnetic secondary section. It sets itself apart as a result of a maximum force density and dynamic performance. 1FN6 motors are synchronous motors with a favorably-priced secondary section that has no magnets. This makes them predestined for applications with long traversing distances,

which require non-magnetic secondary section tracks.

Our linear motors are available up to rated forces of 10,375 N (2332 lbf) and achieve traversing velocities of more than 1280 m/min (4200 ft/min) – for the highest degree of productivity. Integrated water cooling for the 1FN3 and an enclosure that is optimized for natural cooling for the 1FN6 ensure efficient heat dissipation.

**Highest precision for rotary axes: 1FW6 and 1FW3 torque motors**

Torque motors are optimized for high torque at low rated speeds. Just the same as linear motors, torque motors also have a high degree of precision and dynamic performance – as well as low wear.

Siemens offers two torque motor versions. 1FW6 motors are compact built-in motors for use in rotary cyclic machines, rotary tables, swiveling and rotary axes –

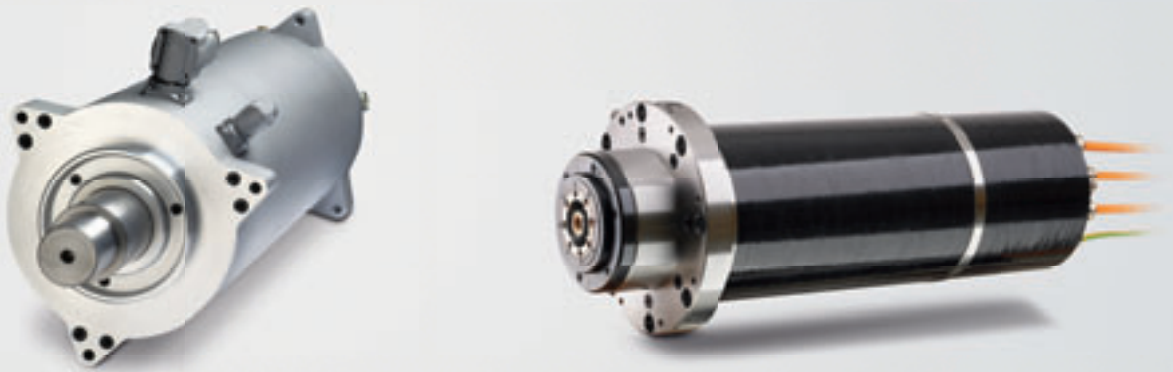
e.g. for machine tools.

The 1FW3 series of torque motors are extremely compact motors in the torque range between 100 Nm and 7,000 Nm (74 lbf-ft and 5163 lbf-ft) that are ready to be installed. They are the ideal alternative for plastic injection molding, extrusion and special-purpose machines. Both of these series are water-cooled and are available in various frame sizes and lengths.

**For spindle operation: 1FE1 built-in motors**

1FE1 built-in motors are designed for operation at high speeds and are therefore used as a direct drive for high-speed rotary axes – for instance to drive machine tool spindles. Their speeds extend up to 40,000 rpm at power ratings up to 104 kW (138 HP).

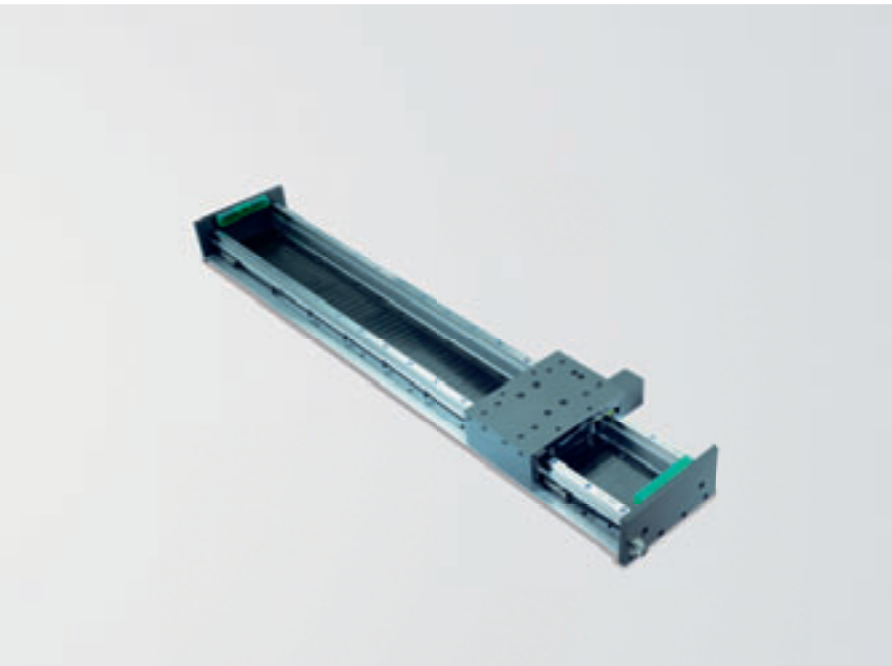
Additional strengths: Shortest accelerating times, highest precision and smooth running operation.



## Motors for special applications and customized solutions

Even if our standard motors address a wide spectrum of applications: Sometimes special solutions are the only way to move forward. A case for our special motor versions. Leveraging our many years of experience, together with our customers we design and implement specific motor solutions – perfectly tailored regarding both design and performance. Further, you also benefit from the high level of integration in our drive converter and control environment. We can also implement application-specific solutions that go beyond the standard motors that have previously been used.

Here is a selection of examples:



From the left: combination motor, 2SP1 motor spindle, LTS profile rail guide slides

### Special motors for combined linear and rotary motion in printing machines

In order that the ink is cleanly and uniformly distributed on the inking rolls, contact rolls for offset printing machines must generate both rotary as well as translatory motion.

Up until now, mechanical solutions were used to achieve this function. They included gear units, couplings, eccentrics etc. – which also proved themselves in the field. However, they could only be realized with fixed relationships between the stroke and speed. As part of a development project with manroland in Augsburg, Siemens Industry developed a completely innovative combination drive. Its axis can perform both rotary as well as linear motion. A permanent-magnet synchronous motor is used for the rotary motion in the combination drive. Its rotor can be moved in an axial direction using a linear drive. In order that both types of motion can be precisely controlled, the rotary axis has a pulse encoder and the linear axis has a linear encoder.

The new leading edge combination drive is convincing in all aspects: stroke height and stroke velocity can be flexibly adjusted – even during operation. The speed can be independently controlled. This high degree of flexibility opens up completely new perspectives for printing companies – and permits a significantly optimized printing process thanks to the more precise setting options.

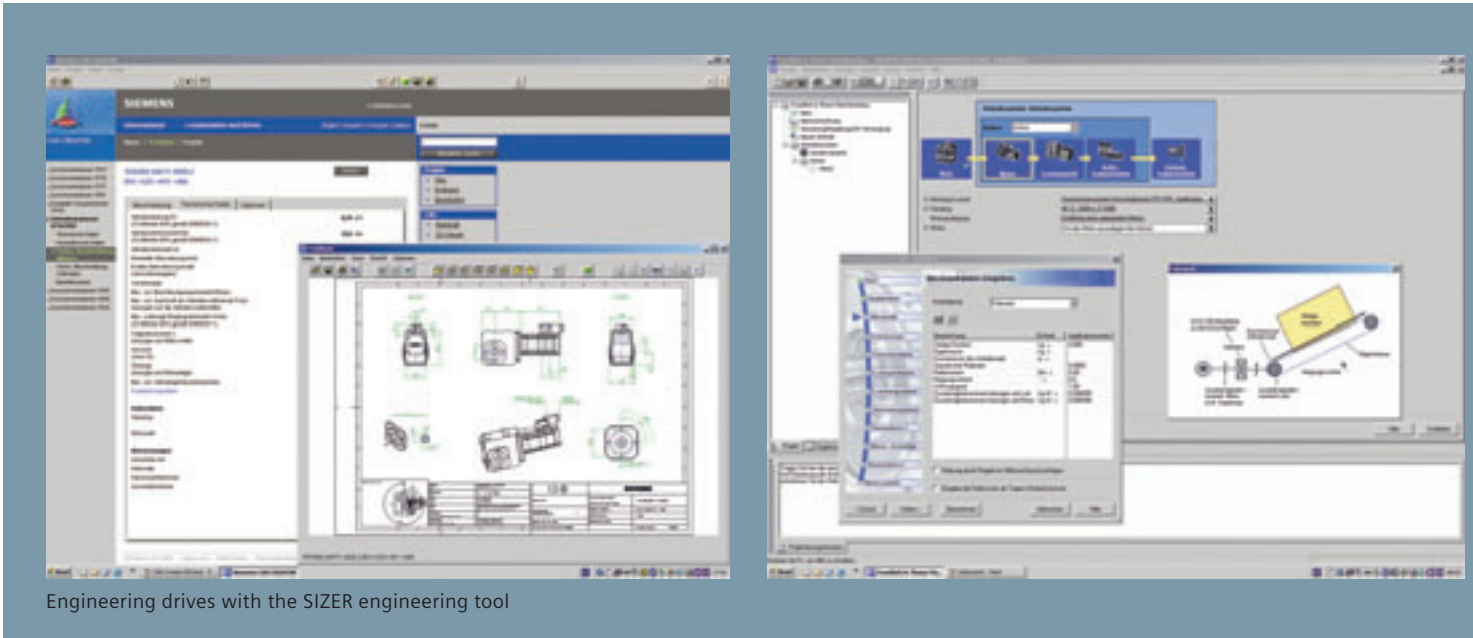
### For highest performance in machine tools: motor spindles

Machine tool spindles also play a decisive role when it comes to the productivity and precision of a machine tool – allowing optimum performance and workpiece quality to be achieved. These mechanically integrated motor solutions are extremely compact and achieve the maximum degree of stiffness – as prerequisites for extremely high speeds and precise smooth running operation.

### Non-ventilated linear motors for use in profile rail guide slides LTS

In cooperation with the SKF Lineartechnologie we have developed a non-ventilated version of the 1FN3 linear motor. This is designed for use in high-speed linear slides. The simple installation of this preconfigured mechanical unit and the fact that it is optimally harmonized to the SINAMICS S120 drive system offer users simple entry into high-precision linear technology having a high dynamic performance.

# Powerful tools and competent support



Siemens supports you when selecting the optimum motor solution – with competent technical support and efficient tools. We have a global competence network and there is always an experienced expert close by to help you – even when it comes to designing mechanically integrated motor solutions.





### **Reliably selecting and dimensioning motors: SIZER engineering software ...**

SIZER supports you when selecting and dimensioning our standard motors and when selecting the necessary drive components. The engineering software has a motor Wizard. This reliably navigates you step-by-step when selecting and dimensioning your motor – starting from the application. As a result, you obtain a list of all of the components with the corresponding ordering data.

### **... with integrated CAD tool, CAD-Creator**




Technical data, dimension drawings and CAD data – generated using the integrated CAD-Creator tool can be easily transferred into the system documentation. It can also be used for the mechanical design.

### **Mechatronic support: Expedited machine development – faster to market**

Using our service “Mechatronic Support” you can significantly optimize the productivity and precision of your machines – already starting in the design phase. This service allows machine ideas and new developments to be tested in the simulation model and subsequently modified:

This means that you don’t have to construct expensive prototypes – and you can rely on the highest level of system security and reliability from the word go.

# Motors for motion control applications

	Induction servomotors for converter operation	Permanent-magnet synchronous servomotors	Servo geared motors
			
<b>Motor types</b>	1PH7, 1PH8, 1PL6	1FK7, 1FT7, 1PH8	1FK7, 1FT7
<b>Cooling types</b>	Force-ventilated, open-circuit cooling, water-cooled	Non-ventilated, force-ventilated, water-cooled	Non-ventilated, force-ventilated, water-cooled
<b>Shaft height</b>	100 ... 355	20 ... 160	28 ... 132 for motors with planetary gear unit
<b>Degree of protection</b>	IP23, IP55, IP65	IP64 to IP68	IP65
<b>Rated voltage</b>	400 ... 480 V, 690 V	230 V, 400 ... 480 V	400 ... 480 V
<b>Rated speed rpm/velocity</b>	400 ... 6000	Up to 6000	34 ... 825
<b>Power rating</b>	2.8 ... 1340 kW (3.75 ... 1800 HP)	0.05 ... 310 kW (0.07 ... 415 HP)	0.3 ... 57 kW (0.4 ... 76 HP)
<b>Torque/force</b>	13 ... 12,415 Nm (9.6 ... 9177 lb <sub>f</sub> -ft)	0.18 ... 1600 Nm (0.13 ... 1217 lb <sub>f</sub> -ft)	2 ... 3400 Nm (1.48 ... 2507 lb <sub>f</sub> -ft)
<b>Encoders</b>	Resolver, incremental encoder (sin/cos, 1V <sub>pp</sub> ), EnDat absolute encoder, HTL pulse encoder	Resolver, incremental encoder (sin/cos, 1V <sub>pp</sub> ), EnDat absolute encoder	Resolver, incremental encoder (sin/cos, 1V <sub>pp</sub> ), EnDat absolute encoder
<b>DRIVE-CLiQ interface</b>	Yes	Yes	Yes
<b>Optional holding brake</b>	Yes	Yes	Yes
<b>Application example</b>	Dynamic performance and compact design, e.g. printing machines, extruders, main spindle drives in machine tools	Applications with high up to extremely high requirements on the dynamic performance and precision, e.g. robots and handling systems, woodworking, glass, ceramic and stone processing, packaging, plastics and textile machines and in the machine tool sector	Positioning tasks and auxiliary drives with servo quality (production machines, high-bay racking units, filling systems, transport belts, robots and handling systems, auxiliary axes)
<b>Drive systems</b>	SINAMICS S110 (1PH7, 1PH8), S120	SINAMICS S110 (1FK7), S120	SINAMICS S110 (1FK7), S120
<b>Catalog *)</b>	PM21, NC61	PM21, PM22, NC61	PM21, NC61

\*) PM21: SIMOTION, SINAMICS S120 and motors for production machines  
 PM22: SINAMICS S110 – The basic positioning drive  
 NC 61: SINUMERIK & SINAMICS – Equipment for machine tools

Permanent-magnet torque motors	High-speed built-in motors	Permanent-magnet linear motors for linear axes
		
1FW3, 1FW6	1FE1	1FN3, 1FN6
Water-cooled, available on request, non-ventilated	Water-cooled	Water-cooled, non-ventilated
150 ... 730 (outer stator diameter dA)	140	
IP23 IP54	IP00	IP65, IP23
400 ... 480 V	400 ... 480 V	400 ... 480 V
Up to 750	Up to 40,000	Max. velocity at rated force (feed force $F_N$ ): up to 1280 m/min
1.7 ... 380 kW (2.3 ... 5163 HP)	4 ... 104 kW (5.36 ... 138 HP)	1.29 ... 81.9 kW (1.75 ... 111 HP) (calculated power)
100 ... 7000 Nm (74 ... 5163 lb <sub>f</sub> -ft)	Up to 820 Nm (up to 605 lb <sub>f</sub> -ft)	Rated force (feed force $F_N$ ) up to 10,375 N (up to 2332 lb <sub>f</sub> )
Resolver, incremental encoder (sin/cos, 1V <sub>pp</sub> ), EnDat absolute encoder (type-dependent), for 1FW6: external encoder required	External encoder required	External encoder required
Yes	Yes	Yes
Applications with high up to very high requirements on the force and precision, e.g. ex- truders, swiveling axes, rotary and rotary cyclic tables, tool magazine, revolver and drum indexing, rotary spindles, roller drives	Motor spindles (e.g. in machine tools)	Linear axes with very high requirements on high dynamic performance and precision, e.g. machining centers, turning, grinding, laser machining, water jet cutter, handling func- tions and in the machine tool sector
SINAMICS S120	SINAMICS S120	SINAMICS S120
PM21, NC61	NC61	PM21, NC61

Note: The technical data listed here refer to the total range of motors specified in the particular column. Generally, different data apply for the individual motor types. The motor data listed in the catalogs are binding.

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