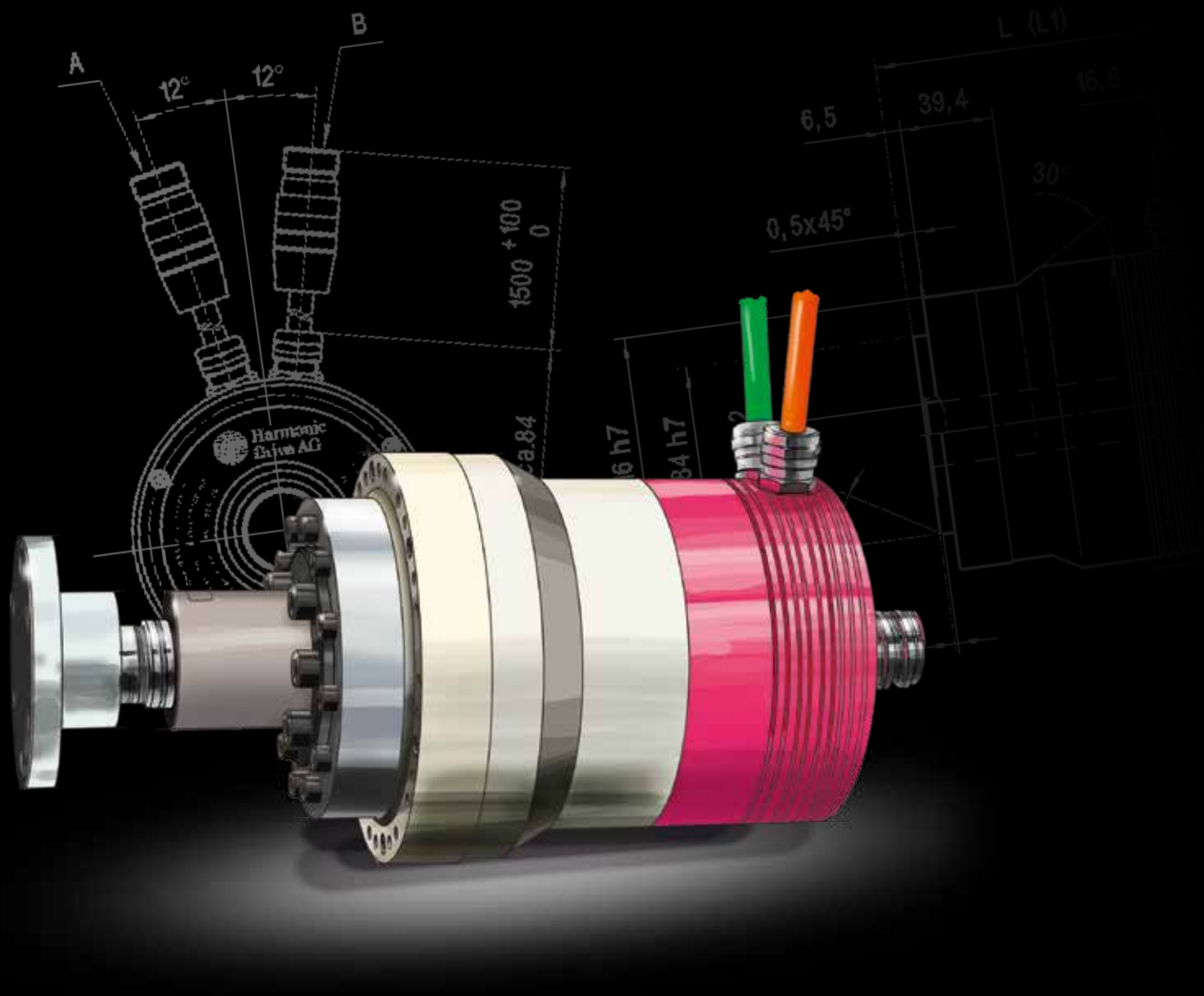
Solutions for additive manufacturing

Harmonic Drive AG



Content

Our inspiration

Your business drives us. For every individual set of requirements, we have an equally diverse range of solutions: four out of every five products that leave our company are special versions, developed, designed, and produced to customer specifications – from space saving component sets to customised special drives. Harmonic Drive® Precision Drive Technology based on the strain wave gear principle can be found in machine tools, and of course also in robotics, the aerospace industry, and numerous other key industries.

Our headquarters are in Limburg an der Lahn, Germany, but our marketplace is the entire world. Since the company was founded in 1970, Harmonic Drive AG has grown from a small distribution company to a leading international solution provider with production capability for drive technology – with a parent company in Japan and a sister company in the USA, employees in more than 20 locations worldwide, and a product range of over 23,000 items.

Each product reflects our extensive expertise – and also the conviction that successful innovations are not made for the market, but are created by the market. We are your reliable partner when it comes to developing solutions together that ideally meet your needs – as a result Harmonic Drive AG has been creating pioneering products for nearly half a century.

Find out for yourself: share your next challenge with us and find out how your business can become a driving force for innovation.

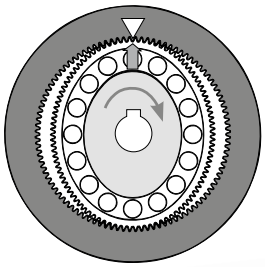
Principle of operation

The Harmonic Drive® Gear belongs to the group of the strain wave gears.
The Flexspline is slightly smaller in diameter than the Circular Spline resulting in it having two fewer teeth on its outer circumference. It is held in an elliptical shape by the Wave Generator and its teeth engage with the teeth of the Circular Spline across the major axis of the ellipse.

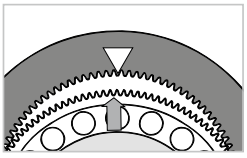
As soon as the Wave Generator starts to rotate clockwise, the zone of tooth engagement travels with the major elliptical axis.

When the Wave Generator has turned through 180 degrees clockwise, the Flexspline has regressed by one tooth relative to the Circular Spline.

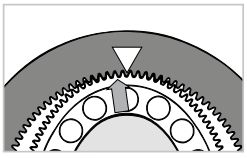
Each turn of the Wave Generator moves the Flexspline two teeth anti-clockwise relative to the Circular Spline.



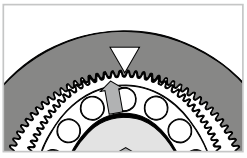
1. *Start*



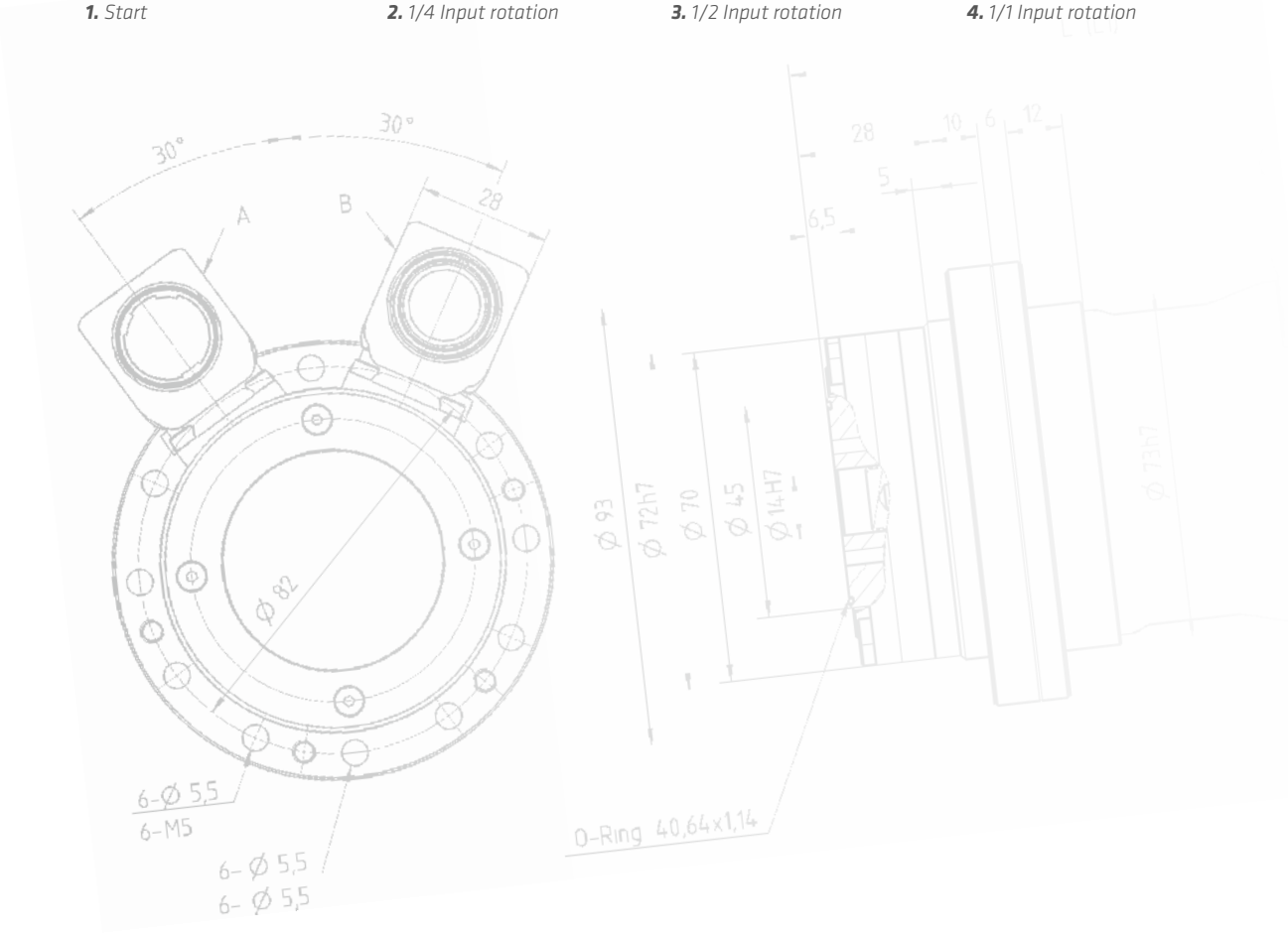
2. *1/4 Input rotation*



3. *1/2 Input rotation*



4. *1/1 Input rotation*



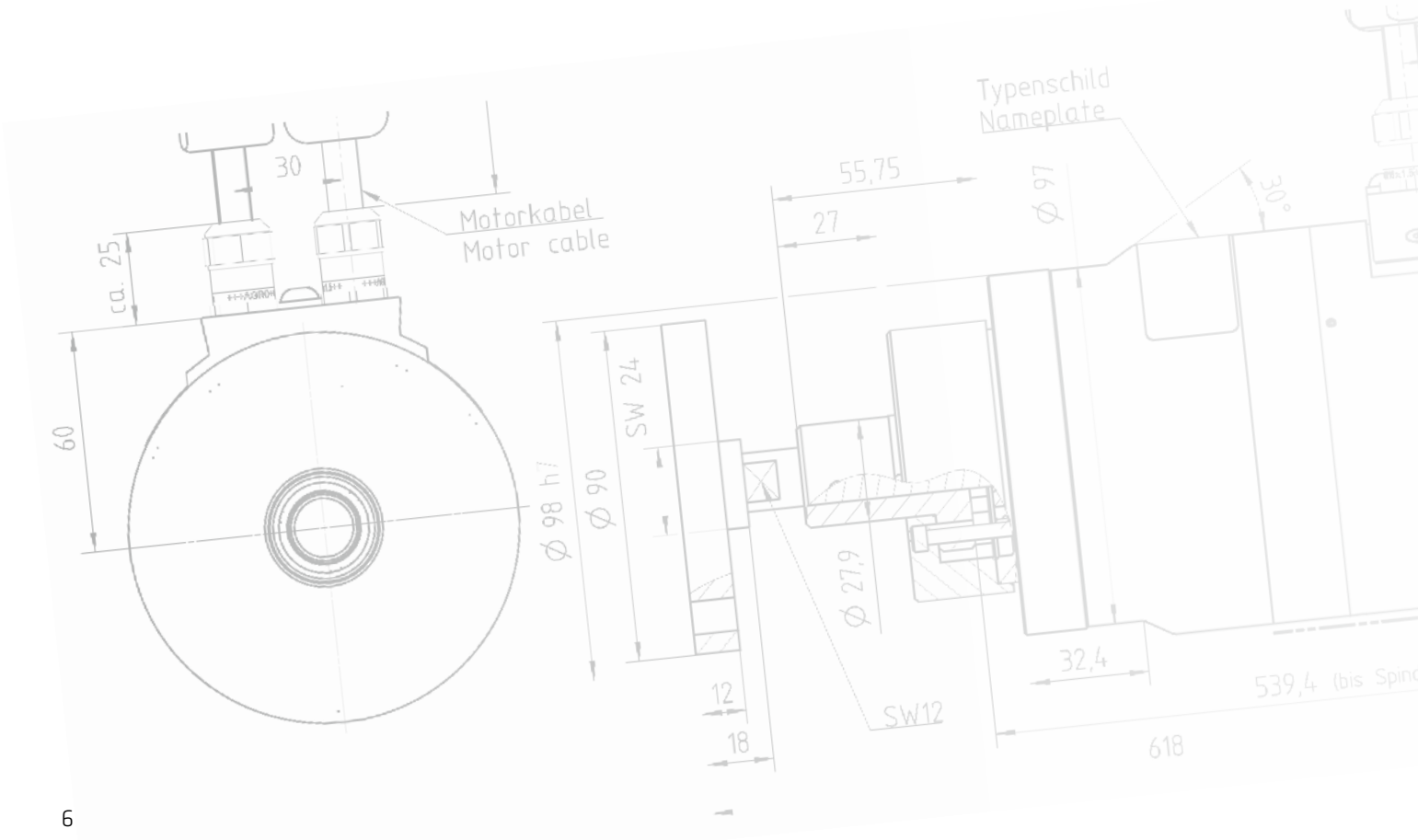
Actuator solutions for additive manufacturing

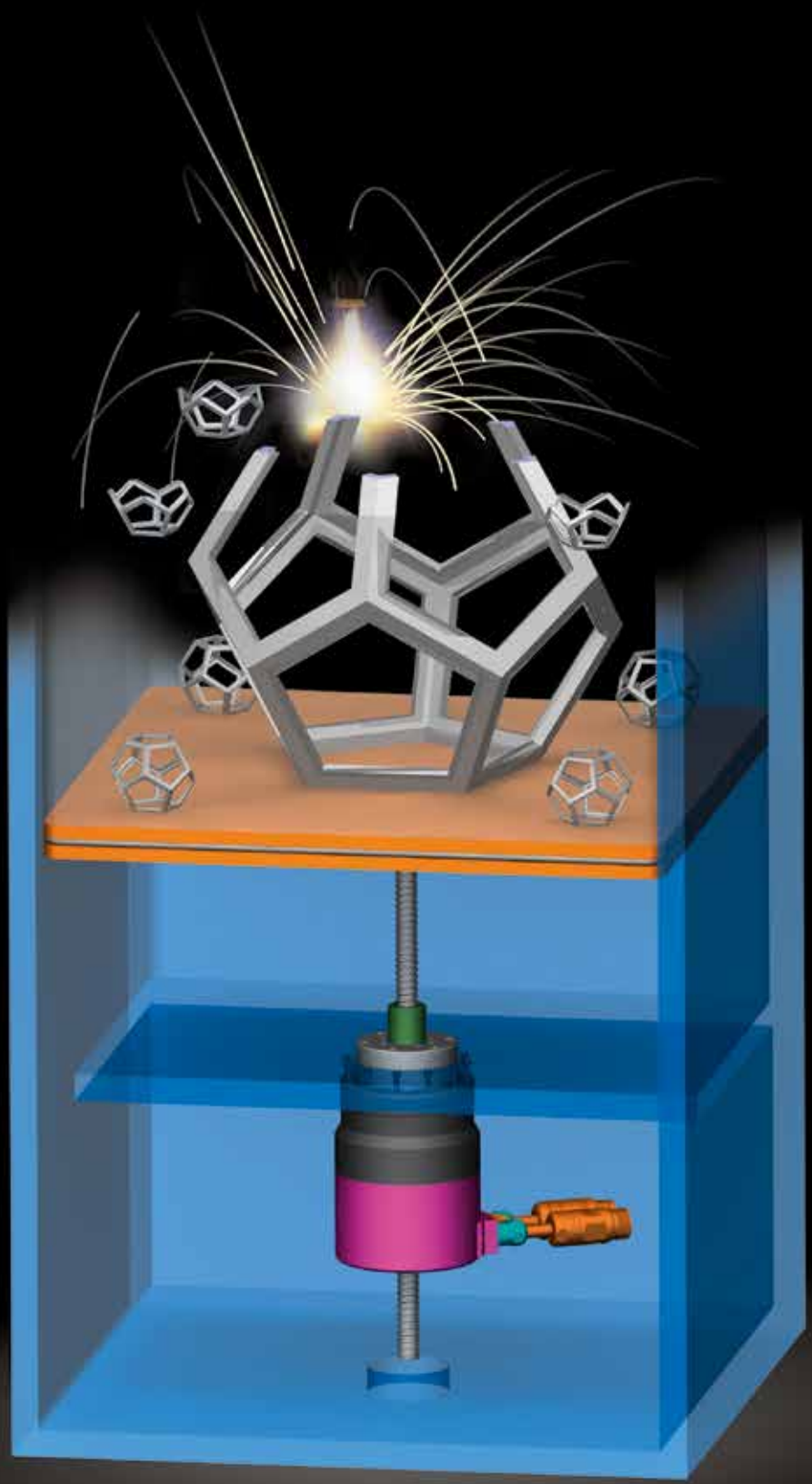
3D printing systems in industrial applications are highly developed, high precision machines. In particular, powder based metal manufacturing processes require precise movement of the individual axes with high positioning accuracy.

In contrast to conventional machine tools, the focus is not on dynamics, but on precision. Harmonic Drive AG offers rotary and linear drive systems which provide ideal solutions.

Zero backlash and high precision gears can be combined with precise bearings to create compact rotary axes.

For linear movements, such as the Z axis of powder bed based systems, the gears and servo actuators are combined with ball screw spindles. This enables the creation of linear axes with maximum positioning accuracy in small increments.





3 innovative versions: for direct motor mounting, with hollow shaft or with stainless steel input shaft

The CPU Series is available in three versions: the CPU-M Unit for direct mounting of any servo motor, the CPU-H Unit with hollow shaft to feed through supply lines for further drive systems and the CPU-S Unit with stainless steel input shaft enabling flexible integration into your design.

Harmonic Drive® Units combine the precision Harmonic Drive® Component Sets consisting of three components – Circular Spline, Flexspline and Wave Generator – and integral high load capacity, tilt resistant output bearings.

The combination of a CPU-H Unit® with a ball screw spindle creates high precision linear axes. The integrated high capacity output bearing supports high axial loads without an additional external bearing.

If required, the units are available as specific configurations tailored to your application, or with particularly high corrosion protection. The high capacity output bearing with maximum tilting rigidity and precision allows that the units can quickly and easily absorb high payloads and feature long service life. The units are fully sealed and thus ideally suited for use in harsh ambient conditions.
The units accurate positioning guarantees stable machine characteristics with short cycle times guaranteed.

Table 8.1

	Symbol [Unit]	**Unit CPU-M/H/S**								
Size		14	17	20	25	32	40	45	50	58
Ratio	i [ ]	**30-100**	**30-120**	**30-160**	**30-160**	**30-160**	**50-160**	**50-160**	**50-160**	**50-160**
Repeatable peak torque	T_R [Nm]	9-28	16-54	27-92	50-176	100-372	402-647	500-882	715-1180	1020-1840
Average torque	[Nm]	6,8-11	12-39	20-49	38-108	75-216	196-451	265-630	122-843	177-1210
Maximum input speed	$n_{in\ (max)}$ [rpm]	8500	7300	6500	5600	4800	4000	3800	3500	3000
Hollow shaft diameter (only Version H)	d_H [mm]	14	19	21	29	36	46	52	60	70
Outer diameter	D [mm]	78	88	98	116	148	180	206	222	255
Dynamic axial load	F_a [N]	2880	4600	15800	19200	22300	42000	52300	56100	57700

CPU-M/H/S

Maximum power density and lifetime precision

A large hollow shaft, low weight, small volume and a combination of outstanding torque density, service life and reliability were the key requirements for the development of the new CanisDrive® series.

Central hollow shaft and output bearing with high tilting capacity

Harmonic Drive® Servo Actuators are the perfect combination of highly dynamic compact servo motors, precision Harmonic Drive® Component Sets and integral high load capacity, tilt resistant output bearings.

In addition to all these features, the large central hollow shaft is the highlight of this design. This basic feature simplifies the design of numerous applications considerably, offering a time-saving and cost-effective solution. The servo actuators comprise a synchronous servo motor and a zero backlash gear unit. They are available in eight sizes and five gear ratios between 50:1 and 160:1 at a maximum torque of between 23 and 1840 Nm. The output bearing with high tilting capacity enables the direct attachment of heavy payloads without the need for further support, ensuring a simple and space-saving design. With its high protection ratings and excellent corrosion resistance, the series is ideal for use in harsh environmental conditions.

Numerous possible combinations

For adaptation to your concrete application, the CanisDrive® series offers numerous possible combinations when it comes to selecting the motor winding, motor feedback system, brake and various sensor, cable and connector options. The flexible configuration ensures compatibility with almost all servo controllers on the market. YukonDrive® servo controllers, which are specially tailored to the needs of Harmonic Drive® servo actuators, provide a preconfigured drive system from a single source – which is, of course, in a specific customised version for your application.

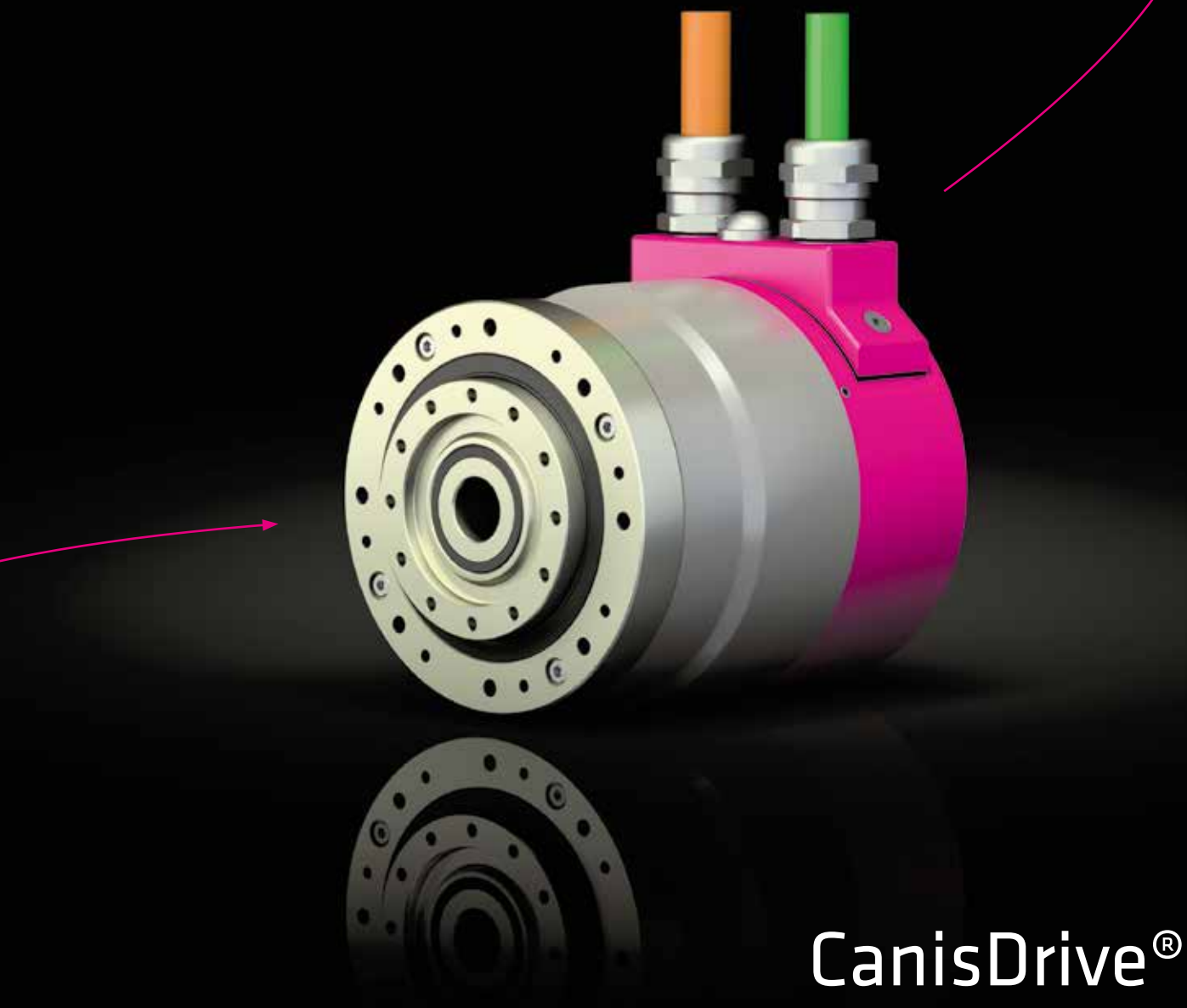
Features

- Excellent lifetime precision
- Large hollow shaft
- Increased power density
- Improved operating life
- Integrated high capacity output bearing
- Corrosion protection

Optimised for your applications:

- Higher product quality
- Optimal design solution
- Longer machine life
- Reduced maintenance costs
- Reduced set up time
- Increased operating reliability

Customer Benefits



CanisDrive®

Optimised for use in machine tools

CanisDrive® Servo Actuators are ideally suited to the requirements of modern machine tools in terms of torque density, service life and reliability. The trend towards higher component quality at increased speed is leading to similar requirements for industrial applications in the field of additive manufacturing.

Harmonic Drive® Servo Actuators are the perfect combination of highly dynamic compact servo motors, precision Harmonic Drive® Component Sets and integral high load capacity, tilt resistant output bearings.

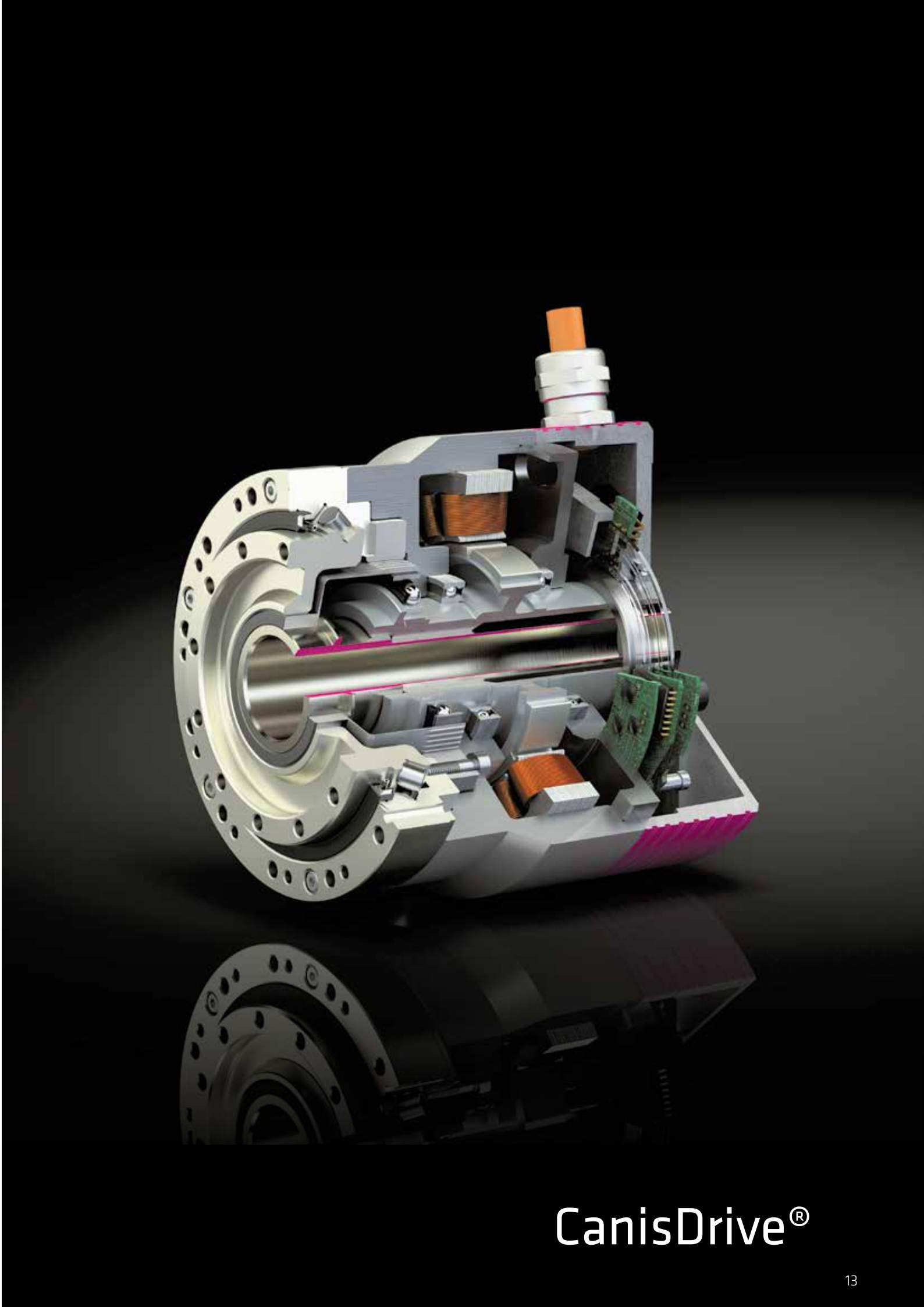
Increased corrosion protection together with IP65 protection enables use even in areas where contamination may occur. The ingress of foreign particles such as metal or plastic powder can therefore be prevented, this protection can be further increased by selecting the optional positive pressure connection.

The extremely precise gear with ratios greater than 50:1 together with excellent transmission accuracy, enable extremely small movements with highly repeatable accuracy.

The hollow shaft is ideal for use in combination with a ball screw spindle. The nut is attached directly to the output and the spindle runs through the hollow shaft, creating compact linear drives with extremely high positioning accuracy without additional external measurement systems.

Table 12.1

	Symbol [Unit]	**CanisDrive®**					
Size		14	17	20	25	32	40
Ratio	i [ ]	**50-100**	**50-120**	**50-160**	**50-160**	**50-160**	**50-160**
Repeatable peak torque	T_{max} [Nm]	23-36	44-70	73-120	127-229	281-484	523-841
Average torque	T_0 [Nm]	9-14	33-51	33-64	72-140	79-247	134-446
Maximum input speed	n_{max} [rpm]	85-170	61-146	41-130	35-112	30-96	25-80
Hollow shaft diameter	d_H [mm]	12	16	18	27	32	39
Outer diameter	D [mm]	81	92	106	128	148	180
Dynamic axial load	F_a [N]	2880	4600	15800	19200	22300	42000



CanisDrive®

Customer specific linear actuators from the modular system

The technologies for gears, motors, encoder systems, output bearings and other components are designed as a modular system where they can be used in different combinations. The SolutionKit® from Harmonic Drive AG provides a very quick way of creating customer specific solutions with a high level of customisation.

The SolutionKit® combines the advantages of the latest optimised designs with those of reliable drive solutions based on many years of experience. It is based on proven technologies and components that can be combined individually.

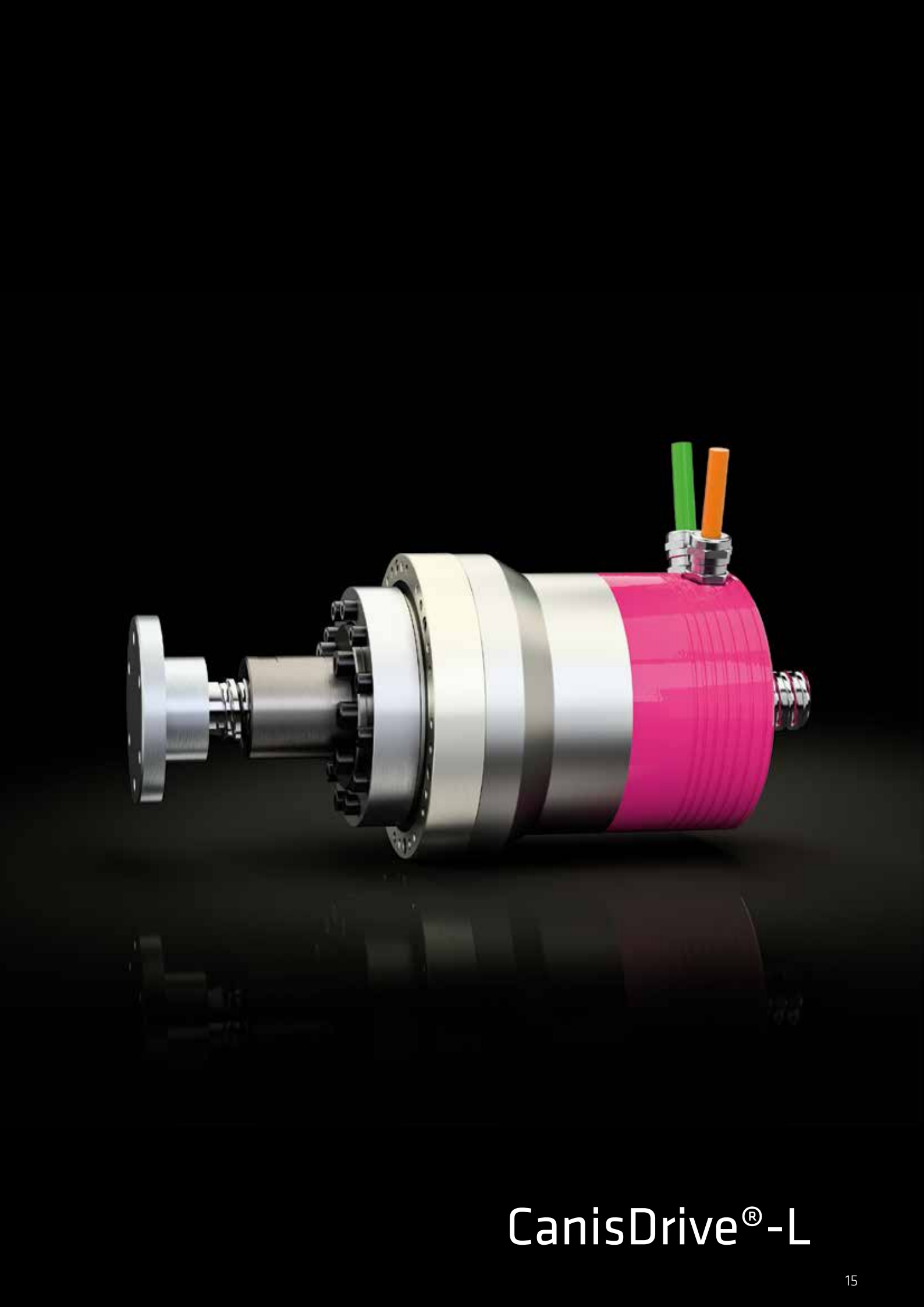
Based on the CanisDrive® Series, CanisDrive®-L is a modular system for customer specific linear actuators. The modular system includes specially adapted CanisDrive® Hollow Shaft Servo Actuators and customised ball screw spindles in tolerance class T5 (or T3 as an option).

Within the specified spindle lengths, the spindles are adapted exactly to meet customer requirements and supplied as a ready to install linear actuator. For adaptation to a specific application, there are numerous possible combinations of components. With motor windings, motor feedback systems, brakes and various sensor, cable and connector options, customer applications can be created quickly and flexibly.

Table 14.1

	Symbol [Unit]	CanisDrive®-L				
Size		14	17	20	25	32
Ratio	i [ ]	**50, 80, 100**		**50, 80, 100, 120, 160**		
Spindle diameter	d_0 [mm]	12	16	16	25	32
Maximum spindle length	$L_{max\ Sp}$ [mm]	500	700	700	900	1200
Spindle pitch	P [mm]	5	5	5	5	5, 10
Spindle class	[ ]	T5	T5 (T3 optional)			
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	2880	4600	15800	19200	22300
Static axial load	$F_{0\ (max)}$ [N]	xxx	xxx	xxx	xxx	xxx
Motor feedback		Resolver Multi-turn absolute (SSI) Incremental		Multi-turn absolute (SSI) Singleturn absolute (Endat®) Multi-turn absolute (Endat®)		
Brake		●	●	●	●	●

● available



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